IRVING FISHER COMMITTEE
ON CENTRAL-BANK STATISTICS

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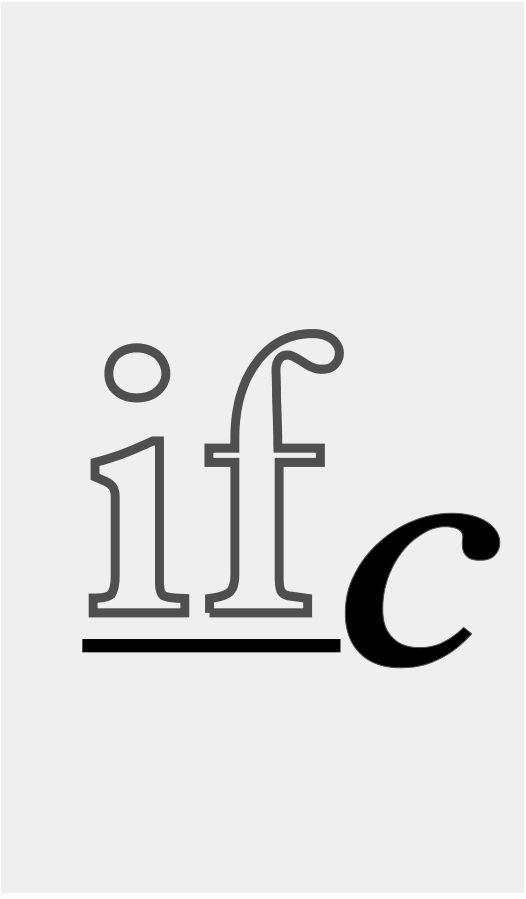

The Irving Fisher Committee is part
of the International Statistical Institute

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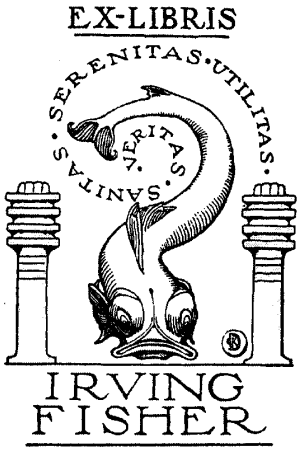

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ifc Bulletin

No 13 – December 2002

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What is the IFC?

The Irving Fisher Committee (IFC) is a forum for discussion on statistical issues that are of interest to central banks. The Committee, which derives its name from the great American economist and statistician Irving Fisher, is part of the International Statistical Institute (ISI).

Objectives

By providing a forum for discussion, the IFC aims at:

- participating in the discussion on adapting statistical systems to changing requirements;
- promoting the adoption of international statistical standards and methodologies;
- sharing experience on the development of new statistics and the implementation of new methods of collecting, compiling and disseminating statistical information;
- exchanging views between central bankers and academics on statistical methods and techniques;
- facilitating personal contacts between central-bank statisticians.

Strategy

To achieve its objectives, the IFC organizes conferences, which take place both inside and outside the framework of the ISI's biennial Sessions. The first "outside" conference – on the challenges to central bank statistical activities – is scheduled for summer 2002 at the Bank for International Settlements in Basle.

The conferences are supported by the publication of the IFC Bulletin, which contains the conference papers and other articles.

The IFC has a Web site (http://www.ifcommittee.org), on which an electronic version of the IFC Bulletin can be found.

What kind of topics are discussed?

Any kind of theoretical or practical statistical subject that has a relationship with the activities of central banks can be considered for discussion. The subjects will mostly be in the area of monetary, financial and balance of payments statistics.

Membership and Structure

In principle, the IFC has no personal members. Central banks and other institutions interested in statistical systems and statistical techniques that have a bearing on the collection, compilation and distribution of central-bank statistics can become members by simple application. So far, more than 60 central banks and a number of other institutions have applied for membership. Members are entitled to appoint delegates to participate in the IFC's activities and to contribute to its conferences by presenting papers.

The prime decision-taking body is the assembly of members' delegates at the "administrative meetings" that are organized during the conferences. Here the IFC's strategy is determined. At these meetings an Executive Body is elected, which is charged with the committee's day-to-day business and with the preparation of the "administrative meetings". Likewise, at the "administrative meetings" topics are proposed for future conferences, and a Programme Committee is elected to choose from these topics and to organize the conferences.

A Short History

The Irving Fisher Committee (IFC) was established on the initiative of a number of central banks statisticians who were attending the ISI Corporate Members Meeting at the 1995 ISI Session in Beijing.

In 1997, during the 51st ISI Sessions in Istanbul, the IFC held its inaugural meeting. At the "administrative meeting" held during that Session an Executive Body was established and it was decided to start publishing the IFC Bulletin devoted to the activities of the IFC. Two years later, at the 52nd ISI Session in Helsinki, the IFC's presence was further strengthened. In 2001, at the 53rd ISI Session in Seoul, the IFC presented a programme comprising an invited papers meeting on "Financial Stability Statistics" and several contributed papers meetings.

In 2002, a conference on "Challenges to Central Bank Statistical Activities" was organised in co-operation with the Bank for International Settlements, which hosted it at its premises in Basle. 160 statisticians representing 73 countries participated. Some 50 papers were presented.

IFC Bulletin

The IFC Bulletin is the official periodical of the Irving Fisher Committee. The Bulletin contains articles and the text of papers presented within the framework of the ISI Conferences. It also sees as its task the recording of interesting events concerning Fisher's life. Institutions and individuals active in the field of central-bank statistics can subscribe to the Bulletin free of charge.

54th ISI Session, Berlin, 2003

The contribution of the IFC to the 54th ISI Session, to be held in Berlin in 2003, will basically be structured along the same lines as in Istanbul (1997), Helsinki (1999) and Seoul (2001), which means that a number of meetings will be organized by persons representing our Committee. Some preliminary information on these meetings is presented on the next page.

Since September, the web site of the ISI Session *(http://www.isi-2003.de)* contains practical information and offers the possibility to register interest in participation or in presenting a paper.

Any person, wanting to submit a paper at one of the contributed papers meetings organized on behalf of the IFC are requested to observe not only the procedures and deadlines laid down by the ISI on its web site, but also to heed the following **recommendations**, which should allow the IFC to properly prepare the meetings and enable publication of the conference documents in the IFC Bulletin and on the IFC Web site:

- Inform the IFC Secretary *(rudi.acx@nbb.be)* as soon as possible about your intention to present a paper at a contributed papers meeting.

- Submit the final version of your invited or contributed paper as soon as possible, but **not later than 14 April 2003** to both the IFC Secretary *(rudi.acx@nbb.be)* and the Editor of the IFC Bulletin *(wucwo@wxs.nl)*.

While, according to the ISI rules, papers should not exceed 4 pages (invited papers) or 2 pages (contributed papers), the IFC encourages authors to submit a more **comprehensive version** of their papers for publication in the IFC Bulletin and on the IFC Web site. Extended versions should be made available to the Editor of the IFC Bulletin immediately after the conference at the latest.

Moreover, the IFC would be pleased to receive **abstracts** of papers – containing 150-300 words – at an early stage, but ultimately on 14 April 2003. These abstracts will be published in the IFC Bulletin and on the IFC Web site before the conference.

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To facilitate reproduction in the IFC Bulletin any documents should be made available as Microsoft Word files, with tables and graphs in the Excel format; use of colours, particularly in graphs, should be avoided.

Tthe latest developments concerning the CPM's in Berlin

Since the October edition of the IFC Bulletin No 12 some more information is available on the content of the Contributed Paper Meetings which are organised by IFC-members.

CPM No 79 "The Sectoral and Geographical Allocation of Negotiable Instruments Holdership", organised by Günter Kleinjung (Deutsche Bundesbank), will deal in part 1 with contributions of central banks and in part 2 with contributions from the ECB. For part one papers have been notified from the Bank of England, the Banco de España and the Deutsche Bundesbank. Two more papers are not yet confirmed. From ECB side so far two papers will be presented.

CPM No 91 "International Trade in Services – a Challenge for Statisticians", organised by Almut Steger (Deutsche Bundesbank), will contain up to three different parts. In addition to the results of direct contacts with possible contributors, there was a number of reactions to the call for pa-

Meetings of the IFC at the 54th ISI Session, Berlin, 13-20 August 2003

The IFC has been scheduled to organize two Invited Papers Meetings (IPMs) and three Contributed Papers Meetings (CPMs).

- IPM52: *"The Use of Hedonic Methods for Quality-adjusted Prices "*,
  organized by Bart Meganck
  Papers:
  (1) Mick Silver (Professor, Cardiff University, UK)
  (2) David Fenwich (Head of price statistics, ONS, UK)
  (3) Geoff Kenny (Principal economist, ECB)
  (4) Brian Newson (Head of unit, Eurostat)

- IPM85: *"Use of Statistics in Developing Monetary Policy"*,
  organized by Armida San José
  Papers:
  (1) The Role of Statistics in the Conduct of Monetary Policy in Albania
  by Governor Shelquim Cam and Gramos Kolasi, Bank of Albania)
  (2) Use of Statistics in the Monetary Policy of the Czech National Bank:
  The Case of a Country in Transition
  by Ivan Matalik (Czech National Bank) and Josef Arlt (Czech National Bank, University of Economics, Prague)
  (3) Labour Market Indicators and Macroeconomic Modeling in the UK
  by Craig Lindsay (UK Office for National Statistics)
  (4) The use of statistics in Monetary Policy in Cambodia
  by Phousnith Khay (Central Bank of Cambodia)
  (5) The new Interest Rate Survey in the Euro-zone : the case of Germany
  by Stefan Brunken, (Deutsche Bundesbank)

Regarding the CPMs, the following topics have been accepted by the ISI:

- CPM79: *"The Sectoral and Geographical Allocation of Holdership of Negotiable Instruments",*
  organized by Gunter Kleinjung (Deutsche Bundesbank)

- CPM91: *"Trade in Services – a Challenge to Statisticians"*,
  organized by Almut Steger (Deutsche Bundesbank)

- CPM98: *"The Use of Surveys in Financial Statistics"*,
  organized by Jorma Hilpinen (Bank of Finland).

pers. The intention is to make a split into "Part I: The GATS-agreement and the four modes of supply", "Part II: The Manual on Statistics of International Trade in Services and its Implementation", and "Part III: Methodological Aspects of Trade in Services". The contributions will be to some degree made by representatives of international organisations, and to some degree by representatives of central banks and statistical institutes.

For CPM No 98 "The Use of Surveys in Financial Statistics" the organisation has been taken over by Jorma Hilpinen (Bank of Finland). For this session six potential contributors (ECB, Bank of England, National Bank of Austria, Reserve Bank of India, ISTAT, Statistics Netherlands) are available so far.

The time schedule for Berlin foresees a first preliminary registration (Form A) up to January 13, 2003. In addition, participants who want to present a contributed paper have to fill in Form B. Both forms are to be returned to the Congress Center, preferably via the website of the Session (http://www.isi-2003.de).

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This issue of the IFC Bulletin

This issue contains the second part of the Proceedings of the IFC Conference "Challenges to Central Bank Statistical Activities" (20-22 August 2002, Basle). The conference was organised in co-operation with the Bank for International Settlements, which hosted it at its premises. The first part of the conference documents was published in IFC Bulletin No. 12 (October 2002). The final part will appear in IFC Bulletin No 14, to be published early in 2003.

Irving Fisher's "Short Stories on Wealth" will be continued in IFC Bulletin No 15.

New members of the IFC

In recent months, central banks of several countries have joined the Irving Fisher Committee: Albania, Croatia, Greece, India, the Netherlands Antilles, New Zealand, Sri Lanka,and the USA (Board of Governors of the Federal Reserve System, Federal Reserve Bank of New York). Total membership has risen to 79 (see updated list below).

Members of the Irvin4g Fisher Committee

Central banks and monetary authorities of:

Albania
Aruba
Austria
Bangladesh
Barbados
Belgium
Bolivia
Botswana
Bulgaria
Burundi
Canada
Colombia
Costa Rica
Croatia
Cyprus
Czech Republic
Denmark
Eastern Caribbean
Ethiopia
Finland
France
Germany
Ghana
Greece
Guatemala
Guinéa
Guyana
India
Indonesia
Iran
Italy
Jamaica
Japan
Jordan
Kyrgyz Republic
Latvia
Lithuania
Former Yugoslav Republic of Macedonia
Malawi
Malta
Mauritius
Mongolia
Netherlands
Netherlands Antilles
New Zealand
Nigeria
Norway
Oman
Pakistan
Peru
Philippines
Poland
Portugal
Russian Federation
Rwanda
Saudi Arabia
Slovakia
Slovenia
South Africa
Spain
Sri Lanka
Sudan
Switzerland
Taiwan, China
Turkey
Ukraine
United Arab Emirates
United Kingdom
Uruguay
USA –- Fed. Reserve Bank of New York
USA –- Federal Reserve Board
West African States
Zambia
Zimbabwe
European Central Bank

Other institutions:

Bank for International Settlements
Eurostat
International Monetary Fund
Ufficio Italiano dei Cambi

Proceedings[1] of the Conference on "Challenges to Central Bank Statistical Activities" Basle, 20-22 August 2002

Keynote presentation

Session 1:
Central bank statistics and monetary stability

Session 2:
Central bank statistics and financial stability

Workshop A:
Constraints on central bank statistical activities

Workshop B:
Co-operation with national statistical offices

Session 3:
Improving the use(-fulness) of central bank statistics

Session 4:
Developments with respect to statistical analysis at central banks

Session 5:
Central bank co-operation on statistical issues

Workshop C:
Issues relating to balance of payments compiling

Workshop D:
Monetary and financial statistics and international accounting standards

Workshop E:
Deriving information from financial market data

1 The Keynote presentation and the documents concerning Sessions 1 and 2 were reprinted in the previous issue of the IFC Bulletin. Documents presented at Sessions 3, 4 and 5 and in Workshops A and B have been reprinted in the present issue, while documents of the Workshops C, D and E will be reprinted in the forthcoming issue. All documents are available at the IFC Web site *(http://www.ifcommittee.org)*.

SESSION 3

Improving the use(-fulness) of central bank statistics

Panel Discussion

Chair: Carol Carson, *Director, Statistics Department, IMF*

Secretary: Karsten von Kleist, *BIS*

Presentations: "The Economist's experience of central bank statistics – A user's view"
Marianne Comparet, *The Economist*

"A shroud of secrecy"
Steve Hanke, *John Hopkins University*

"High Frequency Data – an essential resource"
Richard Olsen, *Olsen Ltd and OANDA Corp.*

Session 3: Improving the use(-fulness) of central bank statistics

Issues Note

Carol Carson (IMF)

The topic of use and usefulness of central bank statistics clearly hints that the point of view to be taken for this session is that of the user of statistics. Central banks have a long tradition of compiling statistics for users inside the bank, but the landscape is different if one think of the outside users of statistics. In a few cases, there is a provision in the central bank law that calls for the compilation and dissemination of statistics to the public, often related to exchange rates, interest rates, or money supply. Usually though, a central bank gives as it reason for, and authority for, disseminating statistics the provision of a public service. However, one can see that this landscape is changing. For example, one can see that inflation targeting has brought with it a trend of central bank communication with the public, and one aspect of that is dissemination of statistics.

The obvious question, if one is taking the view point of the user of statistics, is to ask what users care about. I have put together a list of attributes, or characteristics, of statistics that users care about. To be sure, not all users care about all of the attributes, and to be sure users would not all put the same weights on the characteristics.

1. Central bankers have been challenged (e.g., by Steve Hanke) to present statistics, especially central bank balance sheets, on their websites in a more uniform way.
- Does this make sense, at least for analytical presentations of balance sheets?
- Is it realistic?
- If it makes sense, how could it be made happen?

2. Central banks are generally recognized as having become more transparent (e.g., Peter Kenen's recent article). Among the signs of their transparency, they are seen as providing more information to the public, including statistics, of the sort they employ in making decisions.
- Where is this trend taking us?
- What are the potholes that may be encountered?
- What do the trend and the potholes mean for the compilation and presentation of statisticvs?
- Would it be useful (possible) to present more information about monetary policy formulation to make easier for the public to put statistics into context?

3. Internet has been a major force in changing the way central bank statisticians do their work and disseminate statistics to the public. Some emerging technologies – XML, to name just one – may well present new opportunities to statisticians as they try to improve the usefulness of their statistics.
- What are the prospects for improved dissemination using the emerging technologies?
- If individual central banks are to harness the emerging technologies, what role could international organizations play in moving forward?

4. Central banks, especially perhaps in developing countries, have important roles to play especially given the likelihood that they are relatively more well endowed than some other institutions. Some central bankers (including Venner of the ECCB) mention the role of raising the level of economic literacy in their countries.
- What would this mean for statistics?
- What are some of the steps along the way – e.g., making available contact information for a person who is able to answer questions about statistics?

The Economist's experience of central bank statistics – A user's view

Marianne Comparet (The Economist)

Thank you very much for including The Economist in your conference. I am Marianne Comparet, and I work as a statistician in The Economist's research department I would like to present you with:

- an overview of the way The Economist uses statistics and more specifically, central bank statistics and, by drawing upon this,
- the attributes of data which are most important to us.

I hope that this will add some colour to this conference and will serve as an illustration of how things are at the other end of statistics dissemination.

Introducing The Economist and use of statistics

In essence, our department works closely with editors and journalists and on occasion other parts of The Economist Group. We provide anything from background information on a topic, specific figures related to an article, collect forecasts…

Figures permeate The Economist even in the non-business affairs pages. The newspaper aims to provide the reader with specific figures rather than vague statements. Also printed in chart or table format.

Therefore, we refer to statistics concerning numerous countries and topics.

As a statistician, however, our pride and joy are the indicators pages. Most people who come across these pages for the first time experience anything from utter panic to total rapture. Here, in the print edition, we update data weekly on the real economy and financial markets for 15 advanced economies and the Euro area and 25 emerging economies on 3 pages. We also track an additional 10 economies on our website. We compile in-house a weekly commodities price index, forecast polls and produce three foci – boxes to illustrate newly released data on topics as wide ranging as interest rate forecasts to world music sales or refugees worldwide. Big Mac index.

Need to draw from numerous sources. More specifically, we use central bank statistics to update our figures on

- interest rates; reserves; money supply; house prices; BOP & trade ...;
- A lot for non-Western countries, whether directly or through our sister company the EIU.

Internet: An important aspect of our work is that we mainly use the internet to collect statistics and therefore come into regular contact with websites, whether of central banks, national stats offices or international organisations.

> *Our tables, charts and figures are carefully updated until Thursday morning shortly before the paper is sent to the printing presses around the world. Because we work to very defined deadlines, even slight delays can generate problems in the publishing process or result in data being updated a week later.*
> *Ensure a smooth publishing and editing process.*

1. The data release is announced and on time

We considerably rely on release calendars and appreciate greatly dates & times of release. We like to obtain such data directly from the source since, even though we do rely on news agencies stories which are instantaneous, we like to check with the source to avoid typos, errors or taking the wrong series & include revisions.

- *timeliness:* regular, punctual releases. In fact, by the end of this conference, we hope to convince everyone to release their data by our weds night deadlines;
- *frequency:* related to timeliness, frequency. The more breakouts, the better. More frequent reporting, even daily for things like credit or intra-day for interest rates, would be good.

Unfortunately, it does happen that series' updates are considerably delayed or even discontinued. Although such things happen for many reasons, it is always extremely useful for us to know what is happening.
That's why the next important thing for our work is that:

2. Further information is easily available and enquiries dealt with rapidly

It has happened on occasion that there is no evident person or press office that we can contact to obtain further information or explanations from.

Also, we have found from experience that e-mails sent to general enquiries addresses can take a while to be addressed or even remain unanswered.

As a result, we have found it very useful:
- *clear contact details* (including contact person, direct line to press office...)
- *prompt reply to e-mails*, especially when time differences and language can be a barrier to phoning;
- *use of website* to post information concerning data – like train times or road conditions.

However, even when there are no problems on the release side, it can be a small challenge finding or downloading the data. There fore, we greatly appreciate when:

3. The data is clearly presented and easily accessible

These are more practical considerations:

- *presentation:* the simpler the better. Clear tables whose contents are not too often changes. Keeping one standard summary table for all central banks would be very helpful – drawing on or extending the SDDS tables;
- in the same vein, *language* is sometimes a problem and without redoing a whole website, a simple caption in English under table headings is very useful. Also, efforts towards using less jargon;
- because our main access method is electronic, it is important to keep *computer formats* as simple as possible. Certainly, we probably have shortcomings in our computer proficiency but something easily downloadable, Excel or text without zip files.
- greater understanding of the data by adding extra *colour* sometimes with something as simple as a short summary of why figures change – one or two drivers.

If the data is available and complete, it is always helpful to know that we are getting a comprehensive and exhaustive view. For example, in the context of our house price index, it happened several times that I would come across different house price indices which yielded rather different results. Therefore, it is very helpful for central banks to co-ordinate their output with national statistics offices, international organisations or private institutions.

4. Different series are well co-ordinated and centralised

- Series should tie in with each other, or if not, there should be clear explanations as to why not (differences in methodology, scope etc...).
- Often the case that series are available sooner and more quickly via the private sector.
- Greatly appreciate feedback on our series, work undertaken. We would be grateful for greater feedback and discussion about our series & methodologies (example house prices survey).

Finally, we are always keen to extend the scope of our reporting and look forward to the development of reliable and regular statistics.

5. The amount of reliable data is increased through improved reliability

We are always keen to extend the coverage of our pages to new series or new economies. However, we need to be confident that the data is reliable and accurate and will be updated regularly.

Marianne Comparet
Statistician, Research Department, The Economist
mariannecomparet@economist.com

A shroud of secrecy

Steve Hanke (John Hopkins University)[1]

Central bank watchers observe that monetary authorities continue to drape a shroud of secrecy over their actions. However, it may be noted that international institutions, like the IMF and the BIS, support central bank transparency.

The central banks' balance sheet and the monetary base

The balance sheet is the foundation upon which any diagnosis of a central bank's activities rests. As a currency rise uses to be preceded by a pattern of rapidly shrinking foreign reserves that are offset by increases in net domestic assets, the monetary base, contained in the balance sheet, should be decomposed into foreign and domestic components.

Beyond the balance sheet

A central bank should also disclose its off-balance sheet assets and liabilities. Off-balance sheet items include claims on reserves related to financial derivatives. In 1997, the central bank of Thailand swapped US$ 23 billion for bath in the forward market, which was, however, not disclosed. So, it remained hidden that the foreign reserves of Thailand were almost fully committed.

Publication of legislation

Central banks should also publish their enabling laws and the regulations pertaining to the banking sector. By providing definitions, these documents are often indispensable to understand and interpret the balance sheet. To give an example, some central banks have the habit to use the term "reserve money" to refer to currency in circulation, while others use the same term to denote foreign currency held in reserve. Furthermore, accounts on the central bank's balance sheet which correspond to assets used in the banking sector liquidity management can be confusing if definitions are not available. Such assets may or may not be collateralised, and when they are collateralised, the securities and financial instruments which are acceptable as collateral may be diverse and subject to frequent change.

Four transparency tests

To judge the central banks' transparency, four simple tests, based on the availability of information on central banks' web sites, have been executed:
- the timely and frequent publication of balance sheets;
- the publication of off-balance sheet information;
- the publication of central banks' enabling laws;
- publication in English, the language of international markets and institutions.

1 *On the request of Professor Steve H. Hanke, who was unable to attend the conference, this presentation was given by Karsten von Klaist (BIS), on the basis of an artcle prepared by Steve Hanke and Matt Sekerke for "Central Banking".*

Web site
Of 174 central banks worldwide, 30 did not have a web site.

Balance sheets
Of the remaining 144 central banks, 118 displayed some form of balance sheet, but not nece3ssarily useful or relevant. While 101 out of these 118 institutions published their balance sheets with at least a monthly frequency, very few did so with appropriate timeliness: only 48 central banks displayed data that were one month old or less. It is clear that the data of the other central banks are of little use for market participants and others who must make decisions quickly.

Off-balance sheet items
A number of central banks publish their off-balance sheet assets and liabilities using the IMF's data template on international reserves and foreign currency liquidity (IRFCL), introduced in March 1999. This template, a part of the SDDS program, includes information on contingent drains on reserves and derivative positions of the monetary authority and the central government. By the end of 2001, there were 49 subscribers to the SDDS program, of which 43 published the IRFCL template on the IMF web site.

Legal information
Only 90 central banks published their legal mandate, and only 76 published any sort of laws and/or regulations pertaining to the banking sector. 17 central banks had legislation on both central banks and the banking sector published in English.

Table – Summary of transparency tests

Central banks with web sites	144 *(124 in English)*
Balance sheet frequency: monthly or more often	102
Balance sheet timeliness: less than two months elapsed	48
Off-balance sheet information published	43
Central banking law published	90 *(67 in English)*
Banking law and/of regulations published	76 *(46 in English)*
Central banking law and banking sector law and/or regulations both published in English	17
All criteria met (balance sheet available with appropriate frequency and timeliness, off.balance sheet information, and enabling laws: all published in English	16

Conclusion

On the basis of the tests, the world's central banks must be given very poor marks. These marks become even worse when one considers the low thresholds applied to the tests. Any kind of a balance sheet was accepted, whether it was clear or not. Unfortunately, no standard format exists. To correct this, central bank balance sheets should include detailed explanatory notes (on the conventions used in valuing assets and liabilities, recognition of gains and losses, aggregation of accounts and off-balance sheet transactions which cannot be precisely valued, potential operations that may impact liquidity and solvency, potential unrecognised losses, and an explanation of large changes in the accounts).

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High Frequency Data – an essential resource

Richard Olsen (Olsen Ltd and OANDA Corp.)

Analysis of economic trends and research of economic processes requires access to quality data. Big investments have gone into building extensive databases of macroeconomic data. So far, high frequency or tick by tick market data has not been included in these efforts. People have been of the opinion that short-term price fluctuations are irrelevant noise and not worthwhile to collect. Recent discoveries in finance have changed this assessment.[1] High frequency data has a high information content and is indicative of long-term trends. This is a plea to expand data collection to high frequency market data as an invaluable source of information.

During the course of the past 20 years, there has been a growing interest in the study of high frequency market data. A rich structure of statistical properties was discovered. Unlike long-term macroeconomic data, which is known to have Gaussian distribution properties, high frequency market data is non-stationary and increasingly fat-tailed over shorter intervals. It has also fractal properties. It is subject to a scaling law, where the average absolute price change increases by the same percentage from a ten to a twenty minutes interval, as from a one to two hour, or a one to two days or one to two month interval. Absolute price changes exhibit long-term autocorrelation properties, where a price shock lasting for only twenty minutes for example has an impact for six or more weeks. There are other properties as well, such as a 24 hour volatility pattern, which is the result of the three time zones of trading in Asia, Europe and America.

Classical economics assumes that financial markets are homogeneous and that short-term price movements follow a Gaussian random walk. The complex structure of statistical properties discovered with high frequency data is the result of the heterogeneity of financial markets.[2] Market participants trade with different time horizons, some take positions for only minutes, others for hours, days, weeks or months. Depending on their trading horizon, they react differently to the same news events. The heterogeneity has the effect of creating a strong temporal interdependence of price moves.

With modern mathematical tools it is possible to analyze high frequency data and extract information of long-term trends and trend changes. We propose to expand data collection and create a global tick by tick market data repository. This repository would also include "synthetic data" for data that is not directly observable, such as yield curves and volatility surfaces. Today, there exists no commercial database that fulfills this task. It has been estimated that such a project would cost anywhere between 10 and 50 Mio USD.

Its usage would be manifold. First of all, it would provide us with a detailed record of how events unfolded. For historians, economists and finance specialists, it would be an invaluable resource to understand the history of events and get a deeper understanding of the diversity of phenomena that occur. Research of market liquidity would play a prominent role. Transparent and liquid capital markets constitute a "public good", which can only safeguarded, if we have a deeper understanding of how the markets function.

The repository could be used to feed a global early warning system that would operate similarly to a weather forecasting system providing predictive information of financial markets and the economy as a whole. Unlike existing market analysis which is fed by macroeconomic data that has a time delay due to the sparse underlying data, the global early warning system would be online and up to date. At the same time, the data repository could fulfill straight forward tasks – it would allow financial institutions to validate the transaction prices of their complex derivatives transactions by an independent third party resource and prevent losses, such as occurred with Allied Irish Bank.

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1 *An Introduction to High-Frequency Finance Michael M. Dacorogna, Ramazan Gençay, Ulrich Müller, Richard B. Olsen, and Olivier V. Pictet. San Diego, CA: Academic Press, 2001. 383 pp., ISBN: 0-12-279671-3.*

2 *Olsen, R. (2000). The Fallacy of the Invisible Hand, in Visions of Risk, edited by Carol Alexander, Pearson Education.*

Recapitulation

Carol Carson (IMF)

Mrs Carson recapitulated the ensuing discussion, which has not been recorded, briefly along the following lines:

- Participants understood and were in general sympathy with the five attributes of data that Ms. Comparet described.
- There were pros and cons expressed about Mr. Hanke's call for standardized formats, including a point that "interpretability" must be a consideration when there are different users.
- Most in the audience were yet to be convinced by Mr. Olsen's arguments about the need for keeping very high frequency data.

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SESSION 4

Developments with respect to statistical analysis at central banks

Chair: Richard D. Porter, *Deputy Associate Director, Division of Monetary Affairs, Board of Governors of the Federal Reserve System*

Secretary: Karsten von Kleist, *BIS*

Papers:

"A tool for quality control of time series data: Program TERROR"
Augustin Maravall and Gianluca Caporello, *Bank of Spain*

"Cassandra and the Sirens:economic forecasting in emerging economies"
John Hawkins, *BIS*

"Forecasting Swiss inflation with a structural macromodel: the role of technical progress and the 'Mortgage rate – Housing rent' link"
Peter Stalder, *Swiss National Bank*

"The NAIRU in Israel: an unobserved components approach"
Tanya Suchoy and Amit Friedman, *Central Bank of Israel*

"Forecasts of economic indicators for monetary policy in India: An assessment"
R.B. Barman, *Reserve Bank of India*

"Efficiency of banks in Croatia: a DEA approach"
Igor Jemrić and Boris Vujčić, *Croatian National Bank*

Discussants: Richard D. Porter, *Board of Governors of the Federal Reserve System*
John Hawkins, *BIS*
Igor Jemrić, *Croatian National Bank*

Session 4: Developments with respect to statistical analysis at central banks

Issues Paper

Richard D. Porter (Board of Governors of the Federal Reserve System)

The papers in the fourth session represent a varied set of methodological and empirical contributions to the art and science of analyzing and processing data, modeling the economy, and conducting policy at a central bank. The comments here constitute both an overview of the session, as well specific comments on selected papers.

- Methodological papers: (1), (2), and (3);
- Papers on inflation: (4) and (5);
- Papers on miscellaneous subjects: (6) and (7).

Methodological papers

Each of these three papers provides a useful methodological contribution.

(1) Augustin Maravall[1]

Augustin Maravall develops a powerful procedure for empirically determining outliers or process errors in large batches of data reported to a central bank or other statistical agency, that is, reported data that has been contaminated by some kind of "reporting error". This is a common problem, but one that has been likened to finding a needle in a haystack. Experienced data analysts who have a well developed practitioner's sense of what constitutes accurate data can spot errors much like knowledgeable banknote handlers can detect a single counterfeit among a large batch of genuine notes. But detecting errors by direct observation amidst hundreds or thousands of observations, especially for those processed at a high frequency is both time-consuming and daunting. Thus, having a powerful aid like Terror should let such experts work more productively and focus on those "outlier" problems that fall outside the statistical realm, such as making sure entries in deposit reports of banks are properly classified as to deposit type or unearthing changes in bank behavior that represent new forms of avoidance of reserve requirements. [2]

(2) Jon Faust, Eric Swanson, and Jonathan H. Wright [3]

In a provocative paper Brunner [2000] questioned whether standard monetary policy vector autoregressions, VARS, made much sense since their implied predictions for interest rates as a result of change in a policy rate were at odds with comparable information gleaned from futures market quotes. The paper by Faust and co-authors addresses Brunner's challenge by creating a new method for identifying such monetary VAR systems, one that matches futures markets quotes by

1 *Richard Porter discussed the Maravall paper at the conferencer.*

2 *There is one technical difficulty that needs to be considered in practical applications. Real-time series are a mixture of unrevised data for more recent observations and revised data, for more distant, earlier observations. The revisions arise from various sources, benchmarks, tax information and other information that is compiled with a long lag, and the like. This feature of the data generation process often implies that there is a higher noise to signal ratio for the recent observations. Presumably, the intervention parameters can be chosen so "good" recent observations are not removed for being falsely to be thought in "error".*

3 *This paper, "Identifying VARs based on high frequency futures data," was not explicitly discussed at the conference.*

construction at various horizons, one-month ahead, two months ahead, … or combinations of these. Evaluating the resulting model properties, they find highly plausible estimates of the effect of monetary policy surprises on output. Moreover, the estimated model does not exhibit a price puzzle, so that a monetary tightening does not perversely raise the aggregate price level. Finally, they reject the standard recursive (Cholesky) identification scheme, which assumes that prices and output do not respond within the month to changes in interest rates. To estimate their model they employ a generalized method of moments (GMM) procedure.[4]

(3) John Hawkins [5]

Hawkins reviews the forecasting accuracy of inflation and real growth for various private sector forecasters and one official institution (the IMF). His evaluation period extends over the recent short and turbulent period, 1996-2001. He spotlights results for emerging countries, which he groups into four "regions", East Asia, Central Europe, Latin America, and an "other" category (Turkey, Israel, and South Africa).

The remaining papers in session four illustrate more applied empirical efforts directed to important policy concerns of central banks

Papers on inflation

These two papers present contrasting views of the supply side of the process generating inflation in small, open economies, Switzerland and Israel, respectively.

(4) Peter Stalder[6]

Peter Stalder develops a small-scale macro model for the Swiss National Bank that embodies a putty-clay technology and aggregate disequilibrium effects in the labor market as a means of tracing out the relationship between the policy rate and inflation at various horizons.[7] To explore the robustness of the model, he evaluates the forecasting properties of the model for two types of "interventions," a productivity shock and a change in the way that housing rents enter into the model. I am not sure how important the putty clay effects are to his results as the results also hold in some run in a putty-putty model.

A central point of Stalder's analysis is that a jump in productivity growth has a favorable effect on price inflation as long as aggregate demand is sufficiently price insensitive, specifically as long as actual demand does not jump by as much as potential demand. In the Federal Board's model of the United States economy, FRB/US, actual demand does jump by more than potential demand if nominal rates are held constant because agents are expected to "understand" the new regime. They see the increase in productivity growth and it affects their consumption through a kind of permanent income or "wealth channel". Forward-looking households capitalize the future income streams associated with the higher productivity and raise their spending accordingly. In this case, Say's law effects appear to usher forth very powerful demand-side effects, which are absent in the Swiss model, which does not have posit such consumption possibilities, though it could also be a consequence of the smaller role that equities play in Swiss household portfolios than in the United States.

One thing I did not understand is the estimation strategy followed by Stalder. Some elaboration of that would be helpful. Did Stalder consider such supply side consumption possibilities for his consumption sector?

(5) Tanya Suchoy and Amit Friedman [8]

Suchoy and Friedman address some of the same linkages that Stalder does but with a more standard supply side, at least one that is more familiar in American modeling terms. They construct a joint state space representation of an inflation-augmented Phillips curve, potential output, and the

4 *This is the problem that a tightening of policy causes the price level to rise in the short run. Chris Sims has ascribed the phenomena to inside information that central banks posses but which is not part of the model.*

5 *Both Richard Porter and Igor Jemric discussed the Hawkins paper at the conference.*

6 *John Hawkins discussed this paper at the conference.*

7 *While a putty-clay model was a prominent feature in the original Board macroeconomic model, the MPS model of Modigliani, Ando, and various Board staff members, it is not a feature of the current model.*

8 *Richard Porter discussed this paper at the conference.*

NAIRU, the unemployment rate that is consistent with no change in inflation, or the "non-accelerating rate of inflation." for the Israeli economy. In a period in which unemployment fluctuated substantially, they find relatively little movement in their time-varying estimate of the NAIRU, though an estimate that generally lies above the unemployment rate itself. As the authors recognize, their state-space estimates have fairly wide confidence bands so that the capacity to pin statements down is limited in the relatively limited sample that they are able to employ.

Papers on miscellaneous subjects

(6) R.B. Barman [9]

The final macro paper in the session – "Forecasts of economic indicators for monetary policy in India: An assessment," R.B. Barman, Reserve Bank of India – examines of the quantitative determination of monetary policy in India against the backdrop of developing financial markets and arrangements in this large economy. The author presents an overview of the various approaches that have been considered, which appear to involve an eclectic approach given the difficulties inherent in the enterprise.

(7) Igor Jemric and Boris Vujcic [10]

The final paper in this session – "Efficiency of Banks in Croatia: A DEA Approach," Igor Jemrić and Boris Vujčić, Croatian National Bank – present a micro economic analysis of the efficiency of various sized banks in Croatia. It uses the Data Envelope Analysis method developed by Charnes, Cooper, and Rhodes (1978). The virtue of this approach, which the author's stress, is that the form of a banks production function does not need to be assumed a priori but can be estimated non-parametrically. Their findings overall appear quite intuitive and plausible.

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9 *John Hawkins discussed this paper at the conference.*
10 *This paper had no explicit discussant at the conference.*

A tool for quality control of time series data: Program TERROR

Agustín Maravall and Gianluca Caporello [1] *(Bank of Spain)*

1. Introduction

Parallel to the increase in size and information of statistical data bases, there has been a growing concern with the control of the data quality. I center on data bases of time series and consider the following basic quality control problem: *When for the present period the data becomes available, which of the new observations are likely to be erroneous?* What we have in mind are relatively large errors, such as mistaking Belgium for Belize, apples for apricots, not using the correct period, misplacing a decimal, etc. Although not much is known, there is some evidence that the frequency of errors in large statistical data bases can be relatively large (3%, for example, may not be unusual.)

Some economic data bases (at statistical and economic agencies, or big companies) can be very large, and may contain several hundreds of thousands of series that are periodically updated. Quality control of newly reported data relies heavily on "manual" inspection, with the help of some simple measures, such as comparing the last two period-to-period growth, or the annual differences, checking if the new observation is an overall maximum or minimum, etc. These measures do not consider the full information contained in the series, but just a few values. Moreover, they can be strongly affected by seasonality, noise, or special events. Finally, manual (non-automatic) control limits strongly the number of series that can be checked, and hence the control has to be made at a relatively high level of aggregation.

Although "a priori" information can be of help (for example, some change in regulation, or a big bank merger) it would be convenient to dispose of an automatic method, reliable and efficient in large scale applications, that would consider the full information in the time series, and permit control at a more disaggregate level.

Such an automatic method needs to use a sensible and well-defined criterion for judging when a new observation is likely to be an error. An obvious criterion is the following. A new observation is judged suspicious when it is very far from what could have been expected from looking at its past history.

The idea of detecting errors by means of simple time-series models has been around for some time (see, for example, Alwan and Roberts (1988), Lucas and Saccuci (1990), and Montgomery and Mastrangelo (1991)), but the few available applications use very simple models (for example, an AR model with one or two parameters) or ad-hoc simple formulas (such as an Exponentially Weighted Moving Average scheme). Use of properly identified ARIMA models (Box and Jenkins, 1970) was judged too slow and complex, and much too demanding in terms of time-series analysts. Adding the fact that many series are contaminated by outliers (reflecting sometimes past errors that were not corrected; see Barnett and Lewis (1998)), and may contain holes due to missing observations, the problem of properly modeling large sets of series is further complicated.

Gómez and Maravall (1992-2001) developed a methodology (and an associated program) for automatic (or manual) identification of ARIMA models, when observations may be missing and the series may be contaminated by outliers and by special effects (in particular, calendar effects). The automatic performance of program TRAMO ("Time Series Regression with ARIMA noise, Missing values, and Outliers") has been intensively tested and it has proved fast and reliable; see, for example, the large scale study in Fischer and Planas (2000). TRAMO's automatic model identification procedure is in fact being adapted and incorporated to the official X12 ARIMA US-Bureau of the Census program (see, for example, Monsell (2002)).

1 *Thanks are due to the research and secretarial help of Jorge Carrillo and Nieves Morales.*

Program TERROR is simply an application of TRAMO, executed in an automatic manner to the problem of quality control in time series (with several possible options). The program identifies a REG-ARIMA model for each series (perhaps with missing values, outliers, and some deterministic effects) and obtains the standarized forecast error for the period associated with the new data (which is not considered in the process of model identification and forecasting). TERROR is designed to handle large sets of time series with a monthly or lower frequency of observation.

This paper contains a brief description and an application of TERROR. Needless to say, TERROR is meant to be a useful tool, that can be complemented with whatever additional criterion judged relevant. Program TERROR (and TRAMO) can be freely downloaded from the Bank of Spain web site *(www.bde.es)*.

2. The methodology

For each series, the program automatically identifies an ARIMA model, detects and corrects for several types of outliers, and, if appropriate, estimates calendar effects. It also interpolates missing observations if there are any. Next, the one-period-ahead out-of-sample forecast of the series is computed and compared with the new observation. In brief, when the forecast error is, in absolute value, larger than some a priori specified limit, the new observation is identified as a possible error. Summary results for all series and for the aggregate set are also provided. The program runs in a fully automatic manner, though several options are nevertheless available. The next paragraphs adapt the description of TRAMO in Gómez and Maravall (1996) to the case of the TERROR application.

Let z_t denote one of the series in the set subject to quality control. Given the vector of observations:

$$z = (z_{t_1}, \ldots, z_{t_M})' \tag{1}$$

where $0 < t_1 < \ldots < t_M$, the program fits the regression model

$$z_t = y'_t \beta + x_t \tag{2}$$

where $\beta = (\beta_1, \ldots, \beta_n)'$ is a vector of regression coefficients,
$y'_t = (y_{1t}, \ldots, y_{nt})$ denotes n regression variables, and
x_t follows the general ARIMA process

$$\phi(B)\delta(B)x_t = \theta(B)a_t \tag{3}$$

where B is the backshift (or "lag") operator; $\phi(B)$, $\delta(B)$ and $\theta(B)$ are finite polynomials in B, and a_t is assumed a n.i.i.d $(0, \sigma_a^2)$ variable, i.e., a white-noise innovation.

It should be noted that t_1 and t_M may differ for different series in the set. The series may have very different numbers of observations and start or finish at different periods.

The polynomial $\delta(B)$ contains the unit roots associated with differencing (regular and seasonal), $\phi(B)$ is the polynomial with the stationary autoregressive roots, and $\theta(B)$ denotes the (invertible) moving average polynomial. These polynomials take, in general, the following multiplicative form:

$$\delta(B) = (1-B)^d (1-B^s)^D$$
$$\phi(B) = (1+\phi_1 B+\ldots+\phi_p B^p)(1+\Phi_1 B^s+\ldots+\Phi_P B^{s\times P})$$
$$\theta(B) = (1+\theta_1 B+\ldots+\theta_q B^q)(1+\Theta_1 B^s+\ldots+\Theta_Q B^{s\times Q})$$

where s denotes the number of observations per year. The model may contain a constant T_i, equal to the mean of the differenced series $\delta(B)z_t$. In practice, this parameter is estimated as one of the regression parameters in (2).

Outliers that have been automatically identified by the program are also treated as regression variables. Thus, if there are J outliers, occurring at periods $T_1,\ldots,T_J$, the outlier regression term can be expressed as

$$y'_t \omega = \sum_{i=1}^{J} \omega_i \lambda_i(B) I_t^{(T_i)}$$

where $I_t^{(T_i)}$ is a dummy variable equal to 1 when $t=T_i$, and zero otherwise. The polynomial $\lambda_i(B)$ specifies the type of outlier detected. Three types are considered:

- Additive outlier: $\lambda(B) = 1$
- Level shift: $\lambda(B) = 1/\Delta$
- Transitory change: $\lambda(B) = 1/(1-\delta B)$

where $\Delta = 1-B$, $0 < \delta < 1$, and, by default, $\delta = 0.7$. The additive outlier represents a one-period spike, the level shift represents a step function, and the transitory change is as an additive outlier that gradually disappears over several periods. If appropriate for the group of series under consideration, the program can also handle automatic treatment (pre-testing and estimation) of Calendar effects such as Trading Day, Easter, Leap Year, and Holiday effects. Several specifications are available for the Trading Day variable. Calendar effects are also modeled as regression variables.

The program automatically,

1) identifies model (2) - (3), and estimates by exact maximum likelihood (or unconditional least squares) its parameters;
2) detects and corrects for several types of outliers and, perhaps, special effects;
3) yields optimal interpolators of the missing observations with their associated MSE;
4) computes optimal forecasts for the series, together with their MSE.

The basic methodology followed in TRAMO is described in Gómez and Maravall (1992, 1994, 1996, 2001), and Gómez, Maravall and Peña (1999). The program is aimed at monthly or lower frequency data, the maximum number of observations is 600 and the minimum depends on the periodicity of the data (in particular, 16 for quarterly and 36 for monthly data).

Estimation of the regression parameters (including calendar variables, outliers, and the missing observations among the initial values of the series) and of the ARIMA model parameters, is made by concentrating the former out of the likelihood (default). Several algorithms are available for computing the likelihood (i.e., the nonlinear sum of squares to be minimized). When the differenced series can be used, the algorithm of Morf, Sidhu and Kailath (1974) is employed, with a simplification similar to that of Mélard (1984), but also extended to multiplicative seasonal moving average models. For the nondifferenced series, the Kalman filter is used (see Anderson and Moore, 1979). By default, the exact maximum likelihood method is employed (see Gómez and Maravall, 1994, and Gómez, Maravall and Peña, 1999). Nonlinear maximization of the likelihood function and computation of the parameter estimates standard errors is made using Marquardt's method and first numerical derivatives.

Estimation of regression parameters is made by using first the Cholesky decomposition of the inverse error covariance matrix to transform the regression equation (the Kalman filter provides an efficient algorithm to compute the variables in this transformed regression). Then, the resulting least squares problem is solved by applying the QR algorithm, where the Householder orthogonal transformation is used. This procedure yields an efficient and numerically stable method to compute GLS estimators of the regression parameters. Forecasting is made with the Kalman filter applied to the original series; for the problem of building initial conditions on a nonstationary situation, see Gómez and Maravall (1993).

Missing observations can be handled in two equivalent ways. The first one is an extension to nonstationary models of the skipping approach of Jones (1980), and is described in Gómez and Maravall (1994). In this case, interpolation of missing values is made by a simplified Fixed Point Smoother, and yields identical results to Kohn and Ansley (1986). The second one consists of assigning an arbitrary value and specifying an additive outlier for each missing observation. The interpolator is the difference between the tentative value and the estimated regression parameter and coincides with the interpolator obtained with the skipping approach (the likelihood is corrected so that it becomes that of the skipping approach; see Gómez, Maravall and Peña (1999) for more details). Mean squared errors of the forecasts and interpolations are obtained following the approach of Kohn and Ansley (1985).

The program has a facility for detecting outliers and for removing their effect; the outliers can be entered by the user or they can be automatically detected by the program, using an approach based on those of Tsay (1986) and Chen and Liu (1993). The outliers are detected one by one, as proposed by Tsay (1986), and eventually multiple regressions are used, as in Chen and Liu (1993), to detect the ones that may be spurious. The procedure used to incorporate or reject outliers is similar to the stepwise regression procedure for selecting the "best" regression equation.

In brief, regression parameters are initialized by OLS and the ARIMA model parameters are first estimated with two regressions, as in Hannan and Risannen (1982). Next, the Kalman filter and the QR algorithm provide new regression parameter estimates and regression residuals. For each observation, t-tests are computed for several types of outliers. If there are outliers whose absolute t-values are greater than a pre-selected critical level VA, the one with the greatest absolute t-value is selected. Otherwise, the series is free from outlier effects and the algorithm stops.

If some outlier has been detected, the series is corrected by its effect and the ARMA model parameters are re-estimated. Finally, a multiple regression is performed using the Kalman filter and the QR algorithm. If there are some outliers whose absolute t-values are below the critical level VA, the one with the lowest absolute t-value is removed from the regression and the multiple regression reestimated. Next, using the regression residuals provided by the last multiple regression, t-tests are computed for the types of outlier considered and for each observation. If there are now outliers whose absolute t-values are greater than the critical level VA, the one with the greatest absolute t-value is selected and the algorithm goes on to the estimation of the ARMA model parameters to iterate. Otherwise, the algorithm stops. A notable feature of this algorithm is that all calculations are based on linear regression techniques, which reduces computational time. By default, three types of outliers are considered: additive outlier, level shift, and transitory change.

The program also contains a facility to pretest for the log-level specification (based on a comparision of the BIC using both specifications) and, if appropriate, for the possible presence of Calendar effects, such as Trading Day and Easter effects (the pretests are made with regressions using the default model for the noise and, if the model is subsequently changed, the test is redone). The program further performs an automatic identification of the ARIMA model. This is done in two steps. The first one yields the nonstationary polynomial $\delta(B)$ of model (3). This is done by iterating on a sequence of AR and ARMA(1,1) models (with mean), which have a multiplicative structure when the data is seasonal. The procedure is based on results of Tiao and Tsay (1983), and Tsay (1984). Regular and seasonal differences are obtained, up to a maximum order of $\Delta^2\Delta_s$ where $\Delta = 1-B$ and $\Delta_s = 1-B^s$.

The second step identifies an ARMA model for the stationary series (corrected for outliers and regression-type effects) following the Hannan-Rissanen procedure, with an improvement which consists of using the Kalman filter instead of zeros to calculate the first residuals in the computation of the estimator of the variance of the innovations of model (3). For the general multiplicative model

$$\phi_p(B)\Phi_P(B^s)x_t = \theta_q(B)\Theta_Q(B^s)a_t \ ,$$

the search is made over the range $0 \le (p,q) \le 3$, $0 \le (P,Q) \le 2$. This is done sequentially (for fixed regular polynomials, the seasonal ones are obtained, and viceversa,) and the final orders of the polynomials are chosen according to the BIC criterion, with some possible constraints aimed at increasing parsimony and favouring "balanced" models (similar AR and MA orders).

Finally, the program combines the facilities for automatic detection and correction of outliers and automatic ARIMA model identification just described in an efficient way, so that it can perform automatic model identification of a non-stationary series in the presence of outliers and missing observations (perhaps with some regression effects added).

The default model in TERROR is the so-called Airline Model, popularized by Box and Jenkins (1970). The model is given by the equation

$$\Delta\Delta_s x_t = (1+\theta_1 B)(1+\theta_s B^s)a_t \tag{4}$$

with $-1 \le (\theta_1, \theta_s) \le 1$. It is often found appropriate for many series (see the large-scale study in Fischer and Planas (2000)), and displays many convenient features (see, for example, Maravall (1998)); in particular it encompasses many other models, including models with close to deterministic trend or seasonality, or models without seasonality. For very short series, for which the automatic model identification is unreliable, TERROR relies heavily on the Airline Model specification.

3. Program TERROR: input parameters

3.1. Fixed configuration

TERROR can be executed in the DOS version of TRAMO by setting the input parameter TERROR = 1, or in the Windows program TSW by selecting in the main window the TERROR option. For large scale applications the program should be run as a batch file, as can be done with the DOS version. The Windows environment increases inefficiency and slows the program down. When the input parameter TERROR is set equal to 1 (or the TERROR option chosen) a particular configuration of TRAMO, mostly based on the automatic model identification and outlier detection and cor-

rection procedures, is specified. This input configuration will be applied to each time series and includes the following features.

Automatic ARIMA Model Identification

a) Automatic identification of the unit roots. The program searches for regular differences up to order 2 and for seasonal differences up to order 1. Then, it continues with the identification of an ARMA model for the differenced series. (Equivalent parameter in TRAMO: IDIF = 3).
b) Automatic identification of the stationary ARMA model. The program searches for regular polynomials up to order 3, and for seasonal polynomials up to order 2. (Equivalent parameter in TRAMO: INIC = 3).

Automatic detection and correction of outliers

Automatic detection and correction of Additive Outliers, Transitory Changes, and Level Shifts is performed. After correcting for the outliers found in the first round, the program performs a new automatic model identification, and a new search for outliers if the model has been changed. In this second round, the critical value VA is reduced. If the second round does not provide a satisfactory model, a third round is carried out. (Equivalent parameters in TRAMO: AIO = 2, IATIP = 1).

Pre-test for log/level specification

The program tests for the log-level specification by comparing the Bayesian Information Criteria (BIC) of the default model using both specifications. (Equivalent parameter in TRAMO: LAM = -1).

Interpolation

Interpolates missing values (if any). (Equivalent parameter in TRAMO: INTERP = 1).

Computation of the Forecasts and Forecast errors

The last observation is omitted from the end of the series. The model is estimated for the shorter series and the one-period-ahead forecast and forecast error are computed for the last period (without reestimation of the model) as well as the t-value associated to the error. (Equivalent parameter in TRAMO: NBACK = -1).

Finally, the same input namelist applies to all series in the file. (Equivalent parameter in TRAMO: ITER = 2).

3.2. Other input parameters from TRAMO

Parameters that are not part of the fixed input configuration can be entered if one wishes to modify their default value. The most relevant ones are the following:

MQ = Number of observations per year (12 for monthly, 6 for bimonthly, 4 for quarterly,1 for annual, and so on). Default = 12.

VA = Used to set the critical value for outlier detection. The default values are as follows:

$$\begin{aligned} NZ \leq 50, &\quad VA = 3 \\ 50 < NZ \leq 450, &\quad VA = 3 + .0025(NZ–50) \\ 450 < NZ, &\quad VA = 4 \end{aligned}$$

INT2 = Two parameters, INT1 and INT2, can be used to define the interval (INT1, INT2) over which outliers have to be searched. Further, a facility has been introduced to avoid outlier correction in the last observations of the series, which may cause instability in the series forecasts. In particular:

When INT2 = -k < 0, outliers are automatically detected and corrected in the interval (INT1, NZ - k). The detection procedure is also applied to the last k observations and, if some outlier is detected, a warning is printed, but no correction is made. Example: if NZ = 47 and INT2 = -3, outliers are detected and corrected for the interval (1, 44). For the last 3 observations they are only detected. In TERROR, since NBACK = -1, observation 47 is deleted from the sample estimation period, and hence in this case INT2 = -3 implies that outliers, if detected, will not be corrected for the last two observations of the estimation period (observations 45 and 46). Default value (in TERROR) INT2 = -3.

In automatic outlier identification and correction and automatic model identification, the sequence of actions is as follows. After obtaining the degrees of differencing automatically, the program finds a model using the BIC criterion, and then performs the automatic identification and correction of outliers with this model. There are two iteration rounds: first, the program finds a model and corrects the series for the outlier effects. Then, it returns to model identification and further outlier identification and correction, using the model obtained in the second round. If the model is not found satisfactory, a third round is carried out with a slightly reduced critical level.

INCON = 0 Exact maximum likelihood estimation. (Default).
= 1 Unconditional least squares.

IMVX = 0 The fast method of Hannan-Rissanen is used for parameter estimation in the automatic detection and correction of outliers. (Default).
= 1 Maximum likelihood estimation is used for parameter estimation in the automatic detection and correction of outliers.

3.3. Easter and trading day effects

If the group of series to be treated by TERROR is suspicious of being possibly affected by Easter or Trading Day effects, automatic pre-testing and eventual estimation of the effect, can be incorporated to TERROR. As in TRAMO, this is controlled by the following input parameters.

IEAST = 0 No Easter effect. (Default).
= 1 Easter effect adjustment.
= -1 The program pretests for Easter effect and, if detected, adjusts for it.

IDUR = k Duration of Easter affected period (in days). (Default = 6).

ITRAD = 0 No Trading Day effect is estimated. (Default).
= 1 # of (M, T, W, Th, F) - # (Sat, Sun) x (5/2). [One-variable specification].
= 6 # M - # Sun. # T - # Sun, ..., # Sat - # Sun. [Six-variable specification]
= 7 As the previous case, but with Leap-Year correction. [Seven-variable specification]
= -1 As ITRAD = 1, but a pretest is made
= -6 As ITRAD = 6, but a pretest is made.
= -7 As ITRAD = 7, but a pretest is made.

For very short series the value ITRAD = -1 is recommended.

3.4. New input parameters

TERROR is mostly controlled by the parameter SENS, which determines how sensitive the detection of errors should be, according to the following values.

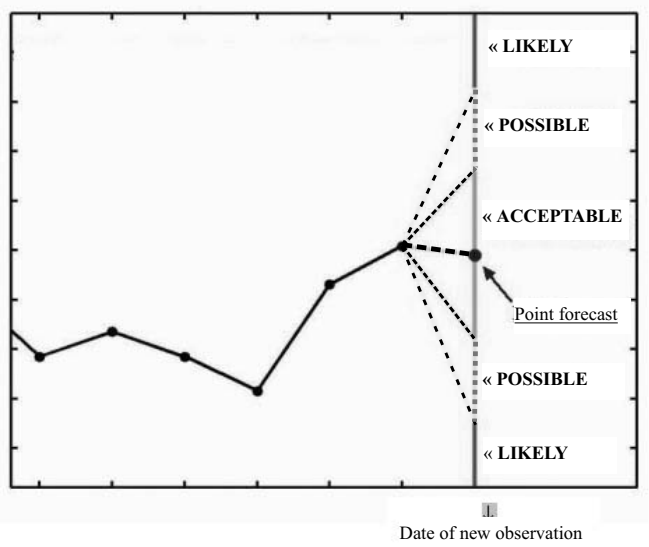
SENS = 0 Low sensitivity;
= 1 Medium sensitivity; (default)
= 2 High sensitivity.

The parameter SENS sets two parameters, k_1 and k_2.
Let t = forecast error/standard deviation of residuals. Then:
If, for a particular series, $|t| > k_2$, the new observation in the series is classified as "likely" to contain an error.
If $k_1 < |t| \leq k_2$, the new observation is classified as containing a "possible" error.
If $|t| \leq k_1$, the new observation is accepted as without error.

The values of k_1 and k_2 for the different levels of sensitivity are as follows:

SENS = 0	$k_1 = 5$	$k_2 = 6$
SENS = 1	$k_1 = 4$	$k_2 = 5$
SENS = 2	$k_1 = 3$	$k_2 = 4$

igure 1 – Likely and possible errors



These values can be changed. By setting

SENS ≥ 3,

one can enter the new values of k_1 and/or k_2.

For a given data set,

- Larger values of the k's imply that less elements will appear in the set of likely or possible errors.
- The values of the k's should be large enough to avoid serious "size" problems that would yield too many spurious errors. For example, if $k_2 = 2$, in 100 000 series, 5 000 would be expected to be spuriously detected as errors, clearly an unacceptable number.
- The k-values should depend on the type of series treated. For example, series with unstable models and large forecast errors will require larger values of the k's.
- Series that have not been subject to careful control of errors in the past are likely to require higher k's than series that have been looked at with more care, and whose quality is higher.

Avoiding overdetection of irrelevant series.

By looking at the standardized forecast errors, all series in the set are treated as equally important. Yet one series can be in the order of 10, while other can be in the order of 10^9. Often, it is desirable to "ignore" very small components (series of little interest) that can show nevertheless very large standardized forecast. The following parameter allows the program to ignore these irrelevant series.

MINABS = 0 parameter is inactive (all series will be considered). Default.
= k (real # > 0). If, for a particular series, the absolute value of the forecast error (in original units) is $< k$, the series is not considered in the test for possible or likely errors.

4. Output files

4.1. Main output file

When TERROR is executed, the results of the quality control check are contained in the file ***list.out*** (located in the subdirectory TRAMO\OUTPUT.) The file lists, first, the parameters used in the application. Then, the series that have been found suspicious. Each line contains the name of the series, the date of the observation for which the test has been made, the new reported value and what would have been its forecast one period ago, the forecast error, its standard deviation, the associated t-value, and the classification of the new observation as a "Likely" or "Possible" error.

To illustrate the output files and figures produced by the program, 200 real monthly time series were arbitrarily selected. The series have different lengths (from 42 to 522 observations), belong to different countries and different periods, and represent different types of economic variables (monetary and financial variables, foreign trade variables, production and price indices, a variety

of short-term indicators, etc.) They were moved in time so that the last observation was always June 2002. Then, this last observation was considered a newly reported value, and TERROR was applied to detect possible or likely errors in the 200 new data. (A detailed discussion of an application can be found in Luna and Maravall (1999)).

Results of the test (file "list.out")

DATE : 2002-09-26 14:51:20
Inp ut Parameters :
int2= -3 terror = 1 k1 = 4.000 k2 = 5.000

Series title	Date	New Value	Forecast	Diff.	StdDev.	T-value	Results
Series 25	06-2002	13.90000	32.47640	-18.57640	3.474482	-5.346524	Likely
Series 28	06-2002	-5.700000	11.87520	-17.57520	2.215275	-7.933642	Likely
Series 36	06-2002	5.162784	5.223978	-.0611942	0.0152308	-4.017802	Possible
Series 76	06-2002	17.8388	14.55002	3.288818	0.7272889	4.522024	Possible
Series 90	06-2002	23.69046	26.96759	-3.277133	0.6237600	-5.253837	Likely
Series 110	06-2002	4.739614	4.807734	-.0681206	0.0157679	-4.320194	Possible
Series 140	06-2002	94.81960	3.959579	90.86002	3.657171	24.84434	Likely
Series 153	06-2002	67.93730	-21.27136	89.20866	5.209442	17.12442	Likely
Series 162	06-2002	665.0469	834.5731	-169.5262	37.98918	-4.462487	Possible
Series 167	06-2002	129.2012	46.15271	83.04849	4.026240	20.62681	Likely
Series 168	06-2002	-752.6359	-601.7935	-150.8424	15.91433	-9.478405	Likely
Series 169	06-2002	6.614892	6.685780	-.0708876	0.0062549	-11.33313	Likely
Series 171	06-2002	-807.7597	-833.2131	25.45344	6.323477	4.025228	Possible
Series 176	06-2002	880.9004	887.3626	-6.462161	1.530289	- 4.222837	Possible

Summary Statistics
200 Series were tested.
6 Releases were suspicious (possibly wrong).
8 Releases were very suspicious (likely wrong).
0 Series produced a Run-Time EXCEPTION.
0 Series did not match TERROR memory constraints.
186 Series passed the plausibility tests.

4.2. Summary of the results for the individual series

When the parameter

NMATRIX = 1 (default value) summary results for the individual series are produced in the form of several matrices.
= 0 no summary results for the individual series are produced.

The summary results consist of 5 matrices. For each matrix, each row refers to a particular series. The columns of the matrices are the following:

Fitted Model (file "tfit")

Nz:	Number of observations in series.
Lam:	0 if logs have been taken; 1 if levels.
Mean:	0 if model has no mean; 1 if it has a mean.
p,d,q,bp,bd,bq:	orders (P, D, Q) (BP, BD, $BQ)_s$ of the fitted ARIMA model.
SE(res):	Standard Error of Residuals.
Q-val:	Ljüng-Box-Pierce Q statistics for residual autocorrelation. (1)
N-test:	Bowman-Shenton test for Normality of the residuals. (2)
SK(t):	t-value for Ho: Skewness of residuals = 0
Kur(t):	t-value for Ho: Kurtosis of residuals = 3
QS:	Pierce Qs-test for seasonal autocorrelation in residuals. (2), (3)
Q2:	Q-statistics for autocorrelation in squared residuals. (1)
Runs:	t-test for runs (randomness) in signs of residuals.

(1) χ^2_k where k = degrees of freedom. For Q, k = number of AC included in the test (default = 24 for monthly data, 16 for quarterly, …) minus the number of ARIMA model parameter estimates. For QZ, the latter parameter estimates are ignored.
(2) χ^2_2
(3) when the lag-12 autocorrelation is negative, QS is unrelated to seasonality and no number is printed.

ARMA Parameters (file "tarmapar")

The order is the following:

Estimate of the regular AR polynomial.
Estimate of the seasonal AR polynomial.
Estimate of the regular MA polynomial.
Estimate of the seasonal MA polynomial.
The associated t-values are also given.

Deterministic Effect (total) (file "tdeterm")

TD: Number of Trading Day variables.
EE: Presence / absence of Easter effect.
OUT: Total number of Outliers
AO: Number of Additive Outliers
TC: Number of Transitory Change outliers.
LS: Number of Level Shift outliers.
REG: Number of (additional) regression variables.
MO: Number of missing observations

Calendar Effect (file "tcalend")

TD1, …. , TD6: Estimators of Trading Day variable effects.
LY: Estimator of Leap-Year effect.
EE: Estimator of Easter effect.
The associated t-values are also provided.

Outliers (file "toutlier")

Detected and corrected outliers are listed; first Additive Outliers, then, Transitory Changes, and finally, Level Shifts. For each outlier, the date and associated t-value are given.

4.3. Summary results for the set of series

When the input file contains a very large number of series, inspection of the results for each one of the series may be of little interest or unfeasible. It is possible however to obtain aggregate results for the full set of series though the parameter MODELSUMM.
When
MODELSUMM = 1 an aggregate summary is produced. (Default)
= 0 no aggregate summary is produced.

The summary consists of several tables and figures.

Tables

Table 1 presents, for the full set of series, the number of series (and the % this number implies)
- for which logs or levels are chosen,
- that need regular differencing,

- that need seasonal differencing,
- that are stationary or nonstationary,
- that are purely regular (no seasonal polynominals in model),
- that follow the default (Airline) model.

General	*# of series*	*%*
Levels	153	76.5
Logs	47	23.5
Regular diff	162	81
Seasonal diff	116	58
Stationary	22	11
Non stationary	178	89
Purely regular	56	28
Default (Airline model)	63	31.5

Table 2: For all possible combinations of regular and seasonal differences that the program considers, namely,
no differencing, ∇, ∇^2, ∇_s, $\nabla\nabla_s$, $\nabla^2\nabla_s$,
the number of series falling into each combination is given.

Differences	*D=0*	*D=1*	*D=2*	*Total*
BD=0	22	58	4	84
BD=1	16	81	19	116
Total	38	139	23	200

Table 3 gives information on the orders of the stationary ARMA model (the orders of the AR and MA, regular and seasonal, polynomials).

ARMA parameter	*P*	*Q*	*BP*	*BQ*	
% of series with 0	64.5	26.5	93	34.5	
% of series with 1	15	67.5	7	65.5	
% of series with 2	7.5	4.5	0	0	
% of series with 3	13	1.5	0	0	
Total > 0	35.5	73.5	7	65.5	
Average # of param. per series	0.7	0.8	0.1	0.7	2.2

Table 4 gives information on Missing Observations, Outliers (for the 3 types), Calendar effects (Trading Day and Easter) and possible additional regression variables.

MO & Regression	*MO*	*AO*	*TC*	*LS*	*Tot. Outlier*	*TD*	*EE*	*Tot. Calendar*
% of series with	0	49	38.5	32.5	57.5	0	0	0
Average # per series	—	3.2	1.1	0.9	5.2	—	—	—
Maximum #	—	28	17	9	29	—	—	—
Minimum #	—	0	0	0	0	—	—	—

Table 5 presents some summary statistics (mean, standard deviation, maximum and minimum values) for the length of the series, the number of parameters and the number of outliers per model, and a sequence of diagnostics (residual autocorrelation; skewness, kurtosis, and normality of the residuals; residual seasonality; possible nonlinearity; randomness of signs in residuals.)

For all the diagnostics, the number of cases for which the statistics falls in the 5% rejection region is also given, as well as the percent of series that pass the tests.

Summary	*Mean*	ST	*Max*	*Min*	*Beyond 5% CV*	*% of series that pass the test (95%)*
Length	184	125.8	522	42	—	—
# of ARMA param. per series	2.3	1.2	6	1	—	—
# of outliers per series	5.2	7.7	29	0	—	—
Q-Val	25.2	7.9	46.68	—	14	86
N-Test	6.3	13.6	85.8	—	19	81
Skewness	0.1	1.5	6.25	-2.79	13.5	86.5
Kurtosis	0.5	1.9	7.94	-1.97	16	84
Qs	—	—	—	—	4.5	95.5
Q2	21.8	29.6	237.9	—	13	87
Runs	0.2	1.2	4.32	-2.75	13	87

Figures

The ***figures*** are, in essence, histograms. They show the histograms for several of the descriptive and diagnostics statistics in the previous tables. Figure 2 shows the distribution of the length of the series; Figure 3, the distribution of the ARMA parameters; Figure 4, the distribution of the outliers (classified by type). Figures 5, 6, 7, 8, 9, and 10 compare the histograms of the diagnostic statistics with their asymptotic distributions.

Figure 2 – Distribution of series length

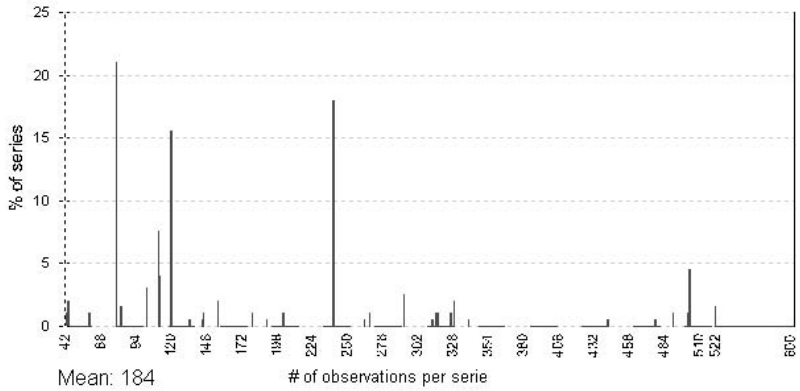


Figure 3 – ARMA parameters per model

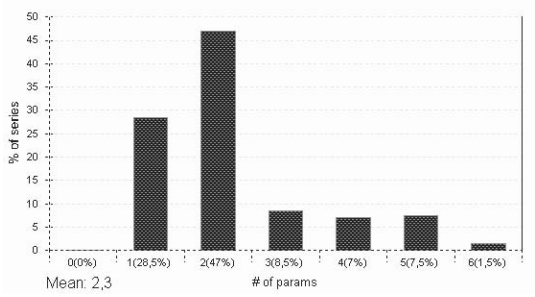


Figure 4 – Distribution of outliers

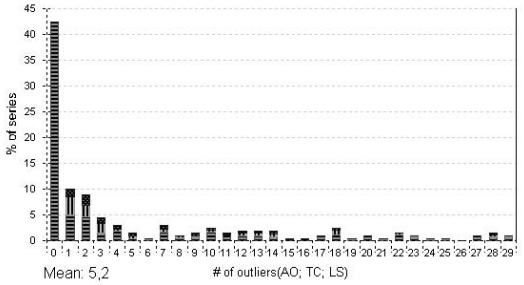


Figure 5 – Residual autocorrection (Q)

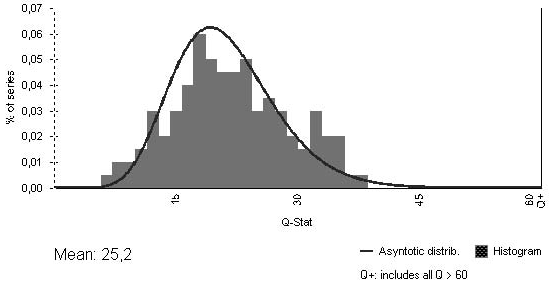


Figure 6 – Normality of residuals (N)

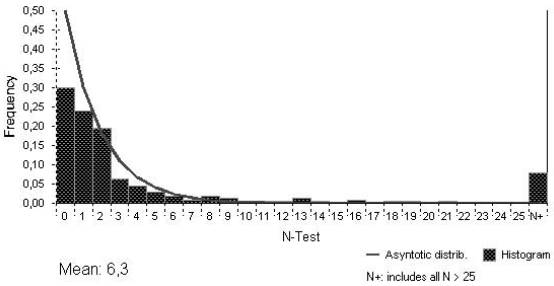


Figure 7 – Skewness of residuals (Sk)

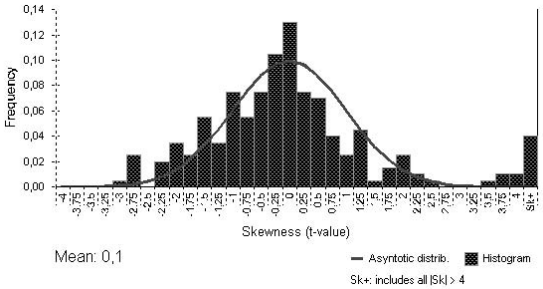


Figure 8 – Kurtosis of residuals (Kur)

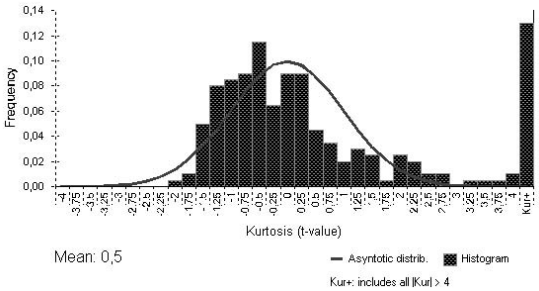


Figure 9 – Linearity of residuals (Q2)

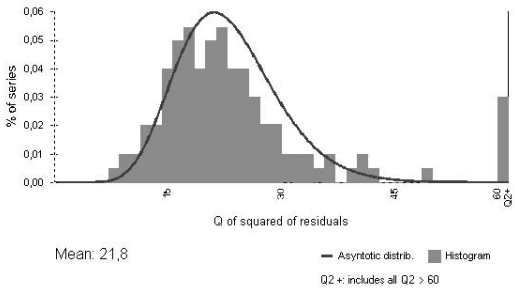
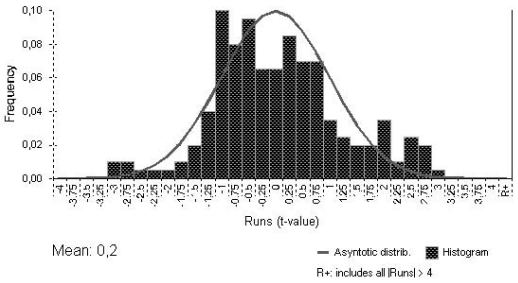


Figure 10 – Randomness of signs in residuals (Runs)



5. Input file

1 The input file for DOS is a multiple-series TRAMO input file. It should be named *serie*, and placed in the directory TRAMO. It consists of a sequence of series. Each series should be entered as follows:

First line: J TITLE (no more than 72 characters)
Second line: NZ NYEAR NPER MQ (free format)

Third and next lines: Z(I) : I = 1,..., NZ (free format),

where J refers to the order of the series in the file (J = 10 denotes the tenth series), NZ is the number of observations, NYEAR is the starting year, NPER is the starting period of the year (if the series is monthly, 1 for January, 2 for February, and so on), and MQ is the number of observations per year (12 if monthly, 4 if quarterly, …). Z(.) is the array (or matrix) of observations.
For each missing observation, the code -99999. must be entered.
The first series (and only the first series) is followed by the INPUT namelist, entered as follows:
$INPUT TERROR = 1, (if desired) other parameter = parameter value, ... $,
where only non-fixed, non-default parameter values need to be entered. Executing TRAMO, the TERROR application is obtained.

2 TERROR can also be executed in TSW, directly from the main window; see Caporello, Maravall and Sánchez (2001).

3 An Excel macro (Xlsts) is also available at the Bank of Spain web address that transforms arbitrary-format Excel files into Excel or Text files ready for TSW or TRAMO-SEATS.

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Cassandra and the Sirens: Economic forecasting in emerging economies

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Economic forecasts in emerging economies share many of the characteristics of those for advanced economies. There is little sign of consistent biases but turning points are almost invariably missed (or at least greatly underestimated), individual forecasts tend to converge with each other and become more accurate as the forecasting horizon reduces, the consensus forecasts for GDP and inflation are significantly better than simple alternative forecasting rules, it is rare for individual forecasters to consistently outperform the consensus, and the IMF and private sector forecasts tend to be of similar quality.

However, a key difference is that average forecasting errors are larger in emerging economies. This is because the task is inherently harder in emerging economies, given their greater exposure to external shocks and poorer data. This has policy implications for central banks; in particular those setting inflation targets should be less ambitious than central banks in advanced economies.

1. Introduction and a brief history

Cassandra was a Trojan princess with the 'gift' of prophecy. She was cursed by Apollo to be always right but never believed. Many would say our modern day forecasters are the opposite: often believed but never right! And the curse is on those that rely on them! Modern forecasters may be more like the Sirens, luring users to their doom with their songs.

Economic forecasting in a sense goes back to the times of Cassandra. The ancient Egyptians foretold harvests (which made up the majority of their GDP) from the level reached by the Nile in flood season. The Oracles of Delphi and Nostradamus are early examples of often ambiguous forecasters. In the 17th century Sir William Petty discerned a seven-year business cycle, suggesting a basis for systematic economic forecasts. In the United States, a forecasting industry developed around 1910-1930, with a prominent participant being the Irving Fisher after whom this conference is named. Much of this forecasting industry was wiped out by the Great Depression - which it failed to foresee!

The Keynesian revolution led to an interest in macroeconomic forecasts as a guide to policy-making. Official forecasts were produced regularly soon after World War II in the Scandinavian countries and the practice spread to the United Kingdom in the early 1950s and many other economies in the 1960s. The OECD began compiling forecasts in 1960 and commenced publishing them in 1966. However, even in 1969, Cairncross, writing in the *Economic Journal*, referred to macroeconomic forecasting as "this new activity".

The 1970s saw a great increase in forecasting activity as econometric models were increasingly applied. The move towards floating exchange rates and less controlled interest rates around this time provided a further stimulus. The early 1970s was probably the period when hopes were highest for forecasting: see Diebold (1998). Subsequently cynicism increased, with some critics dismissing forecasting as insufficiently rigorous and others as too mechanical.

As forecasting developed, so did the study of it. Probably the first evaluation of forecasters was Cox (1929). Zarnowitz (1967) wrote one of the first studies comparing forecasts from different forecasters and he went on to write many papers on this area over the next three decades. Since then there has been a plethora of such studies, particularly in the United States. As Stevens (1999) notes, there tends to be an upsurge in such discussions after (unpredicted) recessions. There has also been an increase in studies of forecasting techniques. Palm and Zellner (1992) claim there were over 200 articles published in the 1970s and 1980s just on the best method of combining forecasts (without resolving the issue!).

1 *Senior economist, Bank for International Settlements. All views expressed are those of the author and not necessarily shared by the BIS.* *Thanks to Marc Klau for helpful comments and preparing Graph 1.*

Most of these studies focus on advanced economies.[2] This study examines the record of economic forecasting in emerging economies. It also concentrates on the implications for central banks.

2. The performance of economic forecasts of emerging economies

The record of private sector macroeconomic forecasting for emerging economies is summarised in Table 1. Like many tables in this paper, it is based on the surveys of private sector forecasters conducted by Consensus Economics. Of course, such a table only summarises the "numbers" produced by forecasters and is mute about the accompanying "narrative". It also leaves aside the question of whether forecast errors are due to misunderstandings of the nature of the economy or to incorrect assumptions about policy settings or "exogenous" variables. For more on these points, see Siviero and Terlizzese (2001).

It is clear that forecasters have much to be modest about; even when the year being forecast has been underway for a couple of months there are still sizeable forecast errors.[3] The errors tend to be particularly large at turning points.[4] Indeed at these times, it is not unusual for the outcomes to be above (or below) all the forecasts. This suggests firms conducting sensitivity analyses should not restrict their scope to the range of published forecasts.

Table 1 – Accuracy of consensus forecasts for 1996-2001
Average absolute percentage error

	Real GDP		Consumer prices	
	Forecast in March	Forecast made in March of previous year	Forecast in March	Forecast made in March of previous year
Emerging economies				
East Asia[1]	2.8	4.1	2.1	3.9
Central Europe[2]	1.3	1.6	0.8	2.3
Latin America[3]	2.2	3.2	n.a.	n.a.
Other[4]	1.8	3.1	3.2	7.8
Recession years[5]	3.5	5.2	1.2[9]	2.7[9]
Crisis years[6]	5.8	10.8	1.2[9]	4.8[9]
Recovery years[7]	3.4	2.5	2.2[9]	4.4[9]
Advanced economies[8]	0.9	1.1	0.5	0.9

[1] Simple average of China, Hong Kong, Indonesia, Korea, Malaysia, the Philippines, Singapore and Thailand. [2] Simple average of Czech Republic, Hungary and Poland. [3] Simple average of Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela. [4] Simple average of Israel, South Africa and Turkey. [5] Years when real GDP fell less than 2%; Argentina in 2000, Chile in 1999, Mexico in 2001, Peru in 1998, Venezuela in 1996, the Philippines and Singapore in 1998, Thailand in 1997, Israel in 2001 and the Czech Republic in 1997-99. [6] Years when real GDP fell more than 2%; Argentina in 1999 and 2001, Colombia and Venezuela in 1999, Hong Kong, Indonesia, Korea, Malaysia and Thailand in 1998 and Turkey in 1999 and 2001. [7] The first year of positive real GDP growth after a recession or crisis. [8] Simple average of Australia, Austria, Belgium, Canada, Denmark, Finland, France, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and the United States. [9] Excludes Latin America.

2 *Loungani (2000) is an exception. But as his sample ends in 1998, he cannot discuss post-crisis forecasting in emerging economies. Also, his study is restricted to forecasts of real GDP.*

3 *The errors are calculated with reference to the latest data. Some authors prefer to use the initial published estimates; for example Loungani (2000) was "pursuaded by the argument that subsequent releases of the data often incorporate information (such as revisions of weights, changes in methods of construction, etc) that forecasters simply could not have been aware of at the time of the forecast". By contrast, McNees (1981) argues "the main objective of forecasting is to anticipate what will actually happen in the economy rather than what the data source agencies, on the basis of incomplete information, initially estimated had happened". In practice, Macfarlane and Hawkins (1983) report that it tends to make little difference to the results of exercises such as these as the revisions are effectively random.*

4 *In Loungani's (2000) sample there are 60 years in which real GDP fell but in only two of these was a fall predicted early in the previous year.*

There is a general tendency for forecasters to be "conservative"; the forecasts tend to be too close to current trends and underestimate changes. Keynes (1936, p 148) remarked that in forecasting;

> "it is reasonable to be guided to a considerable degree by the facts about which we feel somewhat confident, even though they may be less decisively relevant to the issue than other facts about which our knowledge is vague and scanty. For this reason the facts of the existing situation enter, in a sense disproportionately, into the formation of our long-term expectations; our usual practice being to take the existing situation and project it into the future, modified only to the extent that we have more or less definite reasons for expecting a change."

Quantitative studies confirm Keynes' intuition. As far back as Theil (1958), it was noted "the most important systematic error ... is the underestimation of changes". More recently, Andersen (1997) reports that OECD forecasts generally underpredict changes. Macfarlane and Hawkins (1983) note that this conservatism becomes more marked with forecasts over longer horizons, which almost invariably contain a "return to normality" for the out-years.

To some extent this smaller variation in forecasts than outcomes might be rationalised by arguing that forecasters should not be expected to forecast random shocks. But more than this, they seem to engage in "forecast smoothing"; which leads to a succession of revisions in the same direction over subsequent months. Loungani (2000) cites two conjectures by Nordhaus to explain this; "the first is that forecasters are fearful that "jumpy" or "jagged" forecasts will be treated as inconsistency by their bosses or customers. Second, studies from behavioural psychology suggest that people tend to hold on to prior views too long."

Table 1 also shows that forecasts do get better as more data accumulate; by March of the year being forecast the typical size of the forecast error for inflation is about half that of forecasts prepared a year earlier; see also Graph 1. There is also a consistent but smaller improvement in output forecasts.

A notable point is that forecast errors in emerging economies are much larger than in advanced economies.[5] There are two main reasons for this. The first is that the coverage, periodicity and timeliness of data in emerging economies is not as extensive as in advanced economies. While 85% of upper-income economies (with populations over 1 million) meet the Special Data Dissemination Standard, only 36% of middle-income economies do. Even if data are currently produced, there may not be sufficiently long time series available to estimate models for forecasting. Secondly, especially in the transition economies, even if there are long series, only the most recent years' data may be useful because of structural changes that have altered behavioural relationships. Furthermore, for real GDP, the forecasters' task is made more challenging by the extent of revisions to the data.[6]

The size of forecast errors is placed in more context in Table 2. It compares the private sector forecasts with those of the IMF, published in its *World Economic Outlook*. This is published in April but prepared in March so based on similar information to that available to the private sector forecasters. Table 2 suggests the forecasting performance by the IMF is generally comparable to that of the private sector forecasters.[7] The IMF forecasts are also much less accurate for emerging economies than for advanced economies. This suggests that forecasting emerging economies is inherently harder; the problem is not that their forecasters are less proficient.

A commonly asked question is whether the forecasts outperform some simple "naive" rule. Given the conservatism noted above, one such naive rule is saying "this year will be the same as last year". The performance of such an approach is compared to the March forecasts (this is a reasonable alternative as generally last year's outcomes will become known around March) in Table 2. The forecasters are not "worse than useless"[8]; they generally do quite a bit better than this simple rule.

5 *Loungani (2000) reaches similar conclusions.*

6 *In distilling the lessons from his experience with macroeconomic forecasts, former UK Chancellor of the Exchequer (Finance minister) Nigel Lawson (1992) comments "the efforts and skills of the economists and statisticians should be concentrated on establishing what in fact has been happening in the recent past. Unlike the future, the past is as at least in principle knowable: yet the greatest source of error in assessing the economic situation has in practice been a misperception of the recent past."*

7 *Loungani (2000) also finds this and reports it is also true for the OECD's forecasts.*

8 *A description of them attributed to their critics in The Economist (1992). Of course, there have been even more strongly worded critiques. Napoleon is cited as saying "all predictions are impostures, the result of fraud, folly or fanaticism" by Siviero and Terlizzese (2001).*

Table 2 – Comparison of accuracy of forecasts for 1996-2001
Aaverage absolute percentage error of forecasts

	Real GDP			Consumer prices		
	Consensus forecast in March	IMF forecast from WEO	"Naive forecast"	Consensus forecast in March	IMF forecast from WEO	"Naive forecast"
Emerging economies						
East Asia[1]	2.8	2.9	5.2	2.1	1.6	4.3
Central Europe[1]	1.3	1.2	1.3	0.8	1.1	3.4
Latin America[1]	2.2	2.1	3.9	n.a.	1.8	5.4
Other[1]	1.8	2.0	3.5	3.2	3.5	3.6
Recession years[1]	3.5		5.5	1.2[2]		2.2[2]
Crisis years[1]	5.8		7.8	1.4[2]		3.0[2]
Recovery years[1]	3.4		10.4	2.2[2]		6.8[2]
Advanced economies[1]	0.9	0.9	1.2	0.5	0.5	0.7

1 For definitions, see Table 1. [2] Excludes Latin America.

Are forecasts systematically biased? Table 3 compares the average forecasts and outcomes (both private sector and IMF although it makes very little difference). There is no sign of bias in the forecasts for the advanced economies. There is a consistent pattern of (on average) over-optimism about economic growth in the emerging economies. In East Asia this was accompanied by overpredictions of inflation, even during the unpredicted recessions, but not in central Europe or Latin America.

Table 3 – Average percentage errors of forecasts for 1996-2001

	Real GDP		Consumer prices	
	Consensus forecast in March	IMF forecast from WEO	Consensus forecast in March	IMF forecast from WEO
Emerging economies				
East Asia[1]	0.6	0.6	0.7	0.7
Central Europe[1]	0.6	0.4	0.0	-0.4
Latin America[1]	0.9	0.9	n.a.	-0.7
Advanced economies[1]	-0.3	-0.2	0.1	0.1

1 for definitions, see Table 1. [2] excludes Latin America.

The second factor is that emerging economies tend to be inherently more volatile. The industrial composition make output fluctuate more. The agricultural sector, whose production is dependent on almost unpredictable climatic fluctuations, typically accounts for a much larger proportion of output. Emerging economies are more likely to have exports concentrated on a small number of commodities (such as rural produce, mining or computer chips). Similarly, inflation is more volatile as fresh food makes up a larger proportion of CPI baskets (an unduly large proportion in many cases as baskets have not kept pace with changes in consumption patterns in fast-growing economies). Table 4 compares advanced economies with emerging economies on some of these criteria. It also includes data for some of today's advanced economies for the pre-WWI period, when they were at a more comparable stage of development to today's emerging economies.

Table 4 – Underlying economic factors

	Volatility of real GDP[1]	Volatility of CPI inflation[1]	Share of agriculture in GDP (2000)
Emerging economies			
East Asia[2]	3.8	3.2	11
Central Europe[2]	1.8	8.8	5
Latin America[2]	7.7	127.6	8
Other[2]	2.7	8.3	n.a.
Former "emerging" economies[8]	3.9	4.1	
Advanced economies[2]	1.5	1.1	3

[1] Standard deviations of annual percentage changes, 1992-2002. [2] See Table 1 for definitions. [8] Simple average of Australia, Canada, Finland, Norway, Sweden and the United States; 1891-1913 for real GDP, 1871-1913 for CPI.

Forecasts can be wrong for two reasons. The first is that the forecaster has an incomplete knowledge of the economy and the nature of the transmission process. Forecast based on models will err if there are incorrect coefficients or lag structures, or important variables omitted from the model. The second cause of errors is incorrect assumptions about exogenous variables, including policy instruments. In the case of emerging economies, one of the most important exogenous factors is the outlook for the advanced economies. Table 5 presents correlations between forecast errors for the advanced economies and emerging economies. They are uniformly positive, with the largest being that between Japan and east Asia (although this may be overstated as the slump in Japanese output in 1998 was only a small part of the reason for the collapse in many Asian economies that year).[9]

Andersen (1997) notes that in general in the 1970s forecast errors for real growth and inflation tended to be offsetting (so that nominal GDP was "better" forecast than real GDP) as supply shocks, which affect output and inflation in opposite directions, dominated (notably oil shocks). By contrast in the 1980s and 1990s, demand shocks were more important and so forecast errors for output and inflation have been positively correlated.

Table 5 – Correlation with forecast errors in consensus forecasts of real GDP made in March (1996-2001)

	Western Europe[2]	United States	Japan	G-7[3]
Emerging economies				
East Asia[1]	0.05	0.00	0.85	0.52
Central Europe[1]	0.14	0.13	0.22	0.23
Latin America[1]	0.14	0.21	0.45	0.41
Other[1]	0.35	0.41	0.68	0.70

1 For definitions, see Table 1. [2] Simple average of France, Germany, Italy and United Kingdom. [3] Simple average of Western Europe, US and Japan.

3. Uncertainty and variation of forecasts

The greater difficulty of forecasting in emerging economies is reflected in more uncertainty. There are two aspects of this. Firstly, there is the degree of confidence with which individual forecasters hold their views. When asked to give probability distributions around their point estimates, the de-

9 *Andersen (1997) examines OECD forecasts, which he argues are largely representative of official national forecasts, and finds forecast errors are positively correlated across countries.*

gree of confidence in inflation forecasts is less in emerging economies, but there is no pattern in GDP forecasts, at least in the 2002 observations summarised in Table 6.

Table 6 – Uncertainty about forecasts

Forecast probability that outcome will lie within 1% of point forecast[1]

	Real GDP	CPI
Emerging economies		
China	95	77
Hong Kong	63	86
Indonesia	69	49
Korea	80	90
Czech Republic	96	86
Hungary	98	75
Poland	65	86
Advanced economies		
Germany	87	94
Japan	61	98
United States	58	86

1 2002 forecast made in January 2002.

Secondly, there is a greater variety of views between forecasters. The variation in opinion about economic growth is almost twice as high as in advanced economies. There is an even wider range of views about inflationary prospects (Table 7). Loungani (2000) reports that higher forecaster discord is associated with larger errors in the consensus forecast.

Table 7 – Variation among forecasters

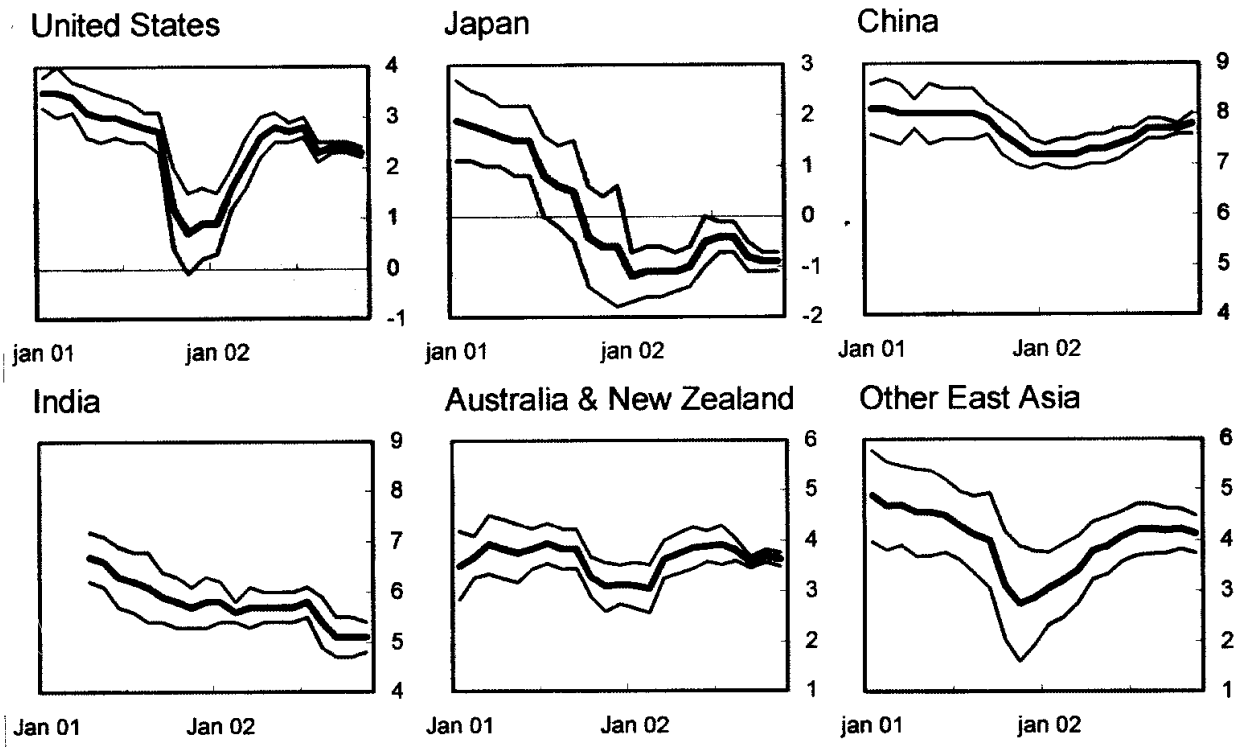
Average of standard deviations of consensus forecasts made in March of previous year, 1997-2003

	Real GDP	Consumer prices
Emerging economies		
East Asia[1]	0.9	1.3
Central Europe[1]	0.6	0.7
Latin America[1]	0.7	1.5[2]
Advanced economies[1]	0.4	0.3

1 For definitions, see Table 1. [2] *Excludes Brazil.*

It seems plausible that these two measures of uncertainty would be related, that is that when there is more difference of opinion between forecasters, each is less sure of their own view. Zarnowitz and Lambros (1987) find this is the case in the US. Over time the range of forecasts narrows (Graph 1), unless there is some large shock that greatly increases uncertainty such as the 1997 Asian crisis or the September 2001 terrorist attacks (top left-hand panel of Graph 1). There are two reasons for this. The first is that with the passage of time there is more information that leads to all forecasters converging on the final actual outcome (as shown by Table 1). The second is a tendency for forecasters to want to avoid being outliers. Forecasters will observe the published consensus and are likely to adjust their forecasts towards it.

GDP forecasts for 2002 made in successive months *



** Percentage changes over previous year. Forecasts published in the month shown by Consensus Economics. The observations are positioned at the middle of the month in which the forecast was made. The thin lines represent ±1 standard deviation around the Consensus forecast.*
Source: Consensus Economics.

4. The search for a "best" forecaster

One motivation for comparisons of forecasters is to see if a superior forecaster can be identified. An example of this is shown in Table 8. For Hong Kong, six forecasters have been included consistently in the survey by Consensus Economics over six years.[10] They are evaluated in the table on their forecasts made in March of the year forecast, giving six independent observations.

Table 8 – Hong Kong: forecasts for 1996-2001
Aaverage absolute percentage error of forecasts made in March

	Real GDP	Consumer prices
"Best" forecaster for a variable	3.5	1.7
"2nd best" forecaster for a variable	3.6	2.0
"Worst" forecaster for a variable	4.0	2.5
Consensus forecast	3.7	2.1

10 *The six forecasters are Bank of East Asia, HSBC group, JP Morgan, Jardine Fleming, SG group and Standard Chartered. Of course, this does not mean the same individuals were doing the forecasting within these companies over the six years.*

As mentioned above, forecasters tend to bunch. As Keynes (1936) put it, "worldly wisdom teaches it is better for reputation to fail conventionally than to succeed unconventionally". How much worse then to fail unconventionally! This bunching shows up in the correlation between the forecasts of an individual forecaster and the consensus forecast being much higher than the correlation between that individual's forecasts and the actual outcomes. As a result of this bunching, the difference between the performance of the "best" and "worst" forecaster tends to be relatively small. Another consequence is that performance rankings tend not to be very robust. A forecaster who has done well one year will not necessarily do well in another. One reason is that some forecasters tend to be optimists (and so do well in booms) and others pessimists (and so do well in recessions); see Batchelor and Dua (1990). And the best forecaster for inflation is not necessarily the best forecaster for real GDP.

The implication for users is that they are probably better off using the consensus forecast than just that of one forecaster. Nor is there much point in trying to construct a weighted average forecast giving weights inverse to past forecasting errors.

5. Policy implications for central banks

The general view is that the lag from a change in monetary policy to its peak effect on inflation is one to two years. This means monetary policy must be based on macroeconomic forecasts. The "inflation-targeting" central banks are really targeting inflation forecasts, or at least these are an intermediate objective. The properties of economic forecasts are therefore relevant to monetary policy setting.

The Economist (1992) argues that "since economists tend to overpredict growth in downturns and underpredict it during booms, their forecasts are more likely to smooth the cycle than amplify it". This is true in terms of the impact of their forecasts on private agents. But conservatism in forecasts provided to policy-makers risks leading to policy responses that are 'too little, too late'.

It has been noted above that forecasting errors for inflation are larger for emerging economies and this is due to inherent features of these economies rather than policy regimes. This suggests that to maintain credibility by hitting their inflation targets reasonably frequently, emerging economies would be well-advised to choose a wider range than is common in advanced economies. An alternative would be to keep a relatively narrow target range but promise to meet the target on average over a period of years rather than at all times; essentially the approach adopted by the Reserve Bank of Australia.

A counter-argument sometimes put is that if inflation targeting anchors the mean rate of inflation it will reduce the variance of it as well. One way of testing this is to turn to the data shown in Table 9, inflation in various economies during the classical gold standard era. The black cells are years in which inflation was within 0-2% and the black and grey cells represent years when it was within 0-3%. At this time, these economies had structures more comparable to those in emerging economies now. The table illustrates that even though these countries had very low average rates of inflation, they had quite volatile inflation such that they did not stay within narrow ranges.

Moreover, emerging economies targeting inflation should probably do more than just widen their targets from, for example, the ECB's 0 to 2% to a range of -1 to 3%. Periods of deflation are generally regarded as very costly for economies, so it would be better to aim for 0 to 4% or 1 to 5%.[11]

11 *There are other arguments for most emerging economies targeting a higher rate than advanced economies. Given their generally poorer history at controlling inflation, a somewhat higher (and wider) target may be more believable. Furthermore, published inflation rates are generally thought to be overstatements. Given that the pace of restructuring and extent of quality improvements are likely to be higher in fast-growing emerging economies, the degree of understatement is likely to be greater. See Hawkins and Kee (1996) for further discussion.*

Table 9 – Inflation in various economies 1871-1913: 0-2, 0-3%

	Den	UK	Neth	Fran	Aus	Swd	Aut	Can	Ger	Italy	Nor	Fin	Chil
1871													
1872													
1873													
1874													
1875													
1876													
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1905													
1906													
1907													
1908													
1909													
1910													
1911													
1912													
1913													
average	-0.2	-0.1	0.1	0.2	0.3	0.5	0.5	0.7	0.7	0.7	0.7	0.8	4.1

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Forecasting Swiss inflation with a structural macromodel: The role of technical progress and the "Mortgage rate – Housing rent" link

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1. Introduction

At the beginning of the year 2000, the Swiss National Bank (SNB) has adapted its monetary policy strategy. Instead of using a medium-term target path for the monetary base, an *inflation forecast* now serves as the main indicator for monetary policy decisions. At the operational level, the SNB has adopted the *3M-Libor* (three-month London Interbank Offered Rate) as its new reference interest rate, and the intended stance of monetary policy is communicated to the public in terms of a target range for this interest rate with a width of 1 percentage point.

In view of this adapted concept, a sound foundation of monetary decisions requires deeper insights into the *process generating future inflation* in general and the *transmission mechanism* from short-term interest rates to long-term interest rates, exchange rates, real economic activity and inflation in particular. Ideally, an econometric model should be available that produces reliable conditional inflation forecasts, thus showing how the 3M-Libor has to be adjusted in order to keep inflation in conformity with the *definition of price stability* (CPI inflation below 2%).

The SNB inflation forecast is based on different models and indicators. Among the forecasting models, three approaches may be distinguished. A *first* approach follows the *VAR methodology* and identifies the variables that are most relevant for future inflation in Switzerland (Jordan, 1999). A *second* approach is a small structural model of the Swiss economy, centered on a Phillips-curve and an IS-relationship (Zurlinden/Lüscher, 1999). The *third* approach is a medium-size structural model of the Swiss economy with a relatively detailed representation of aggregate demand, a supply block (wage-price dynamics, capacity output, labor market) and a monetary block (interest rates and exchange rates). This latter model forms the basis for the analysis of this paper.

In the framework of the adapted concept, the appropriateness of monetary policy is in a straightforward manner connected to the reliability of the inflation forecast. Erroneous inflation forecasts give rise to wrong policy decisions, and wrong policy decisions can in principal be traced back to erroneous inflation forecasts, although performing this task may not be quite easy in practice due to the overlapping character of updated inflation forecasts and monetary decisions. In this context, the paper investigates two issues that are related to (i) *uncertainties* in the process of forecasting inflation and (ii) *institutional changes* in the Swiss economy that may affect the monetary transmission mechanism.

Specifically, a first model simulation deals with the question to what extent the inflation forecast is affected by alternative assumptions with respect to the *rate of technical progress*. This experiment is motivated by the recent discussion about potential, but so far insecure productivity gains resulting from the "New Economy" in connection with liberalized markets and intensified competition. A second simulation addresses the question to what extent the *link of housing rents to mortgage rates*, as established by Swiss legislation on tenancy rights, hampers the monetary transmission mechanism. This is done by carrying out a counterfactual simulation in which the housing rent equation of the model, reflecting current legislation, is replaced an alternative link of housing rents to the CPI. In fact, proposals that go in such a direction are currently discussed in Swiss parliament.

The second simulation is somewhat different in character from the productivity experiment since it addresses the implications of an institutional change that would be known to the monetary authorities some time in advance. In both cases, however, the change in the economic structure affects inflation and thus – if not taken into account properly in the forecasting model – will give rise

to wrong signals for monetary policy. Alternatively, the second simulation can also be viewed as an exercise that sheds some light on the question of whether the current legislation should be changed or not.

All simulations and forecasts presented in this paper refer to a situation comparable to the one faced by the SNB in August 2000. It should be noted, however, that they are made for the purpose of this study only and do not necessarily coincide with the actual SNB forecast. Moreover, although the SNB does not actually pursue a policy of explicit inflation targeting, a strict inflation target of 1.7% is assumed for didactic reasons.

The remainder of the paper is organized as follows. *Section 2* outlines the *basic structure* of the model, with emphasis on those parts that matter most in the following simulation experiments. The sequence of simulations starts – as in the actual monetary decision process – with an inflation forecast based on the assumption of an unchanged 3M-Libor *(Section 3)*. This *Baseline Forecast* is intentionally made somewhat more inflationary than the actual SNB forecast of August 2000 in order to bring it into clear contrast to price stability and to motivate – in *Section 4* – the simulation of a more restrictive monetary policy. The role of productivity growth is analyzed in *Section 5*. This simulation is implemented in such a way that, given higher productivity growth, the inflation target is attained without monetary tightening. On this basis, the consequences of *two possible errors* in the stance of monetary policy can be discussed: (i) tightening because actually higher productivity growth is not taken into account in the inflation forecast, (ii) not tightening because expecting higher productivity growth when in fact it remains unchanged). *Section 6* deals with the role of the "mortgage rate-housing rent" link and analyzes to what extent this link affects the monetary transmission mechanism. *Section 7* summarizes the paper and draws some conclusions.

2. Structure of the model

The model used for the following simulations is a quarterly structural model of the Swiss economy recently developed at SNB. In its present version, it contains 29 stochastic equations, which may be assigned to an *aggregate demand block*, a *supply block* (production function, labor market, wage-price dynamics) and a *monetary block* (interest and exchange rates).[1] Although the model is rather conventional in many respects, it involves some *distinguishing features* that should be pointed out. The emphasis in this section is on those aspects of the model that are particularly relevant for the simulations presented in the sequel of this paper.

2.1.. Supply block

2.1.1. Capacity output, factor proportions, investment and scrapping

A rather non-standard approach is taken in the specification of the supply block of the model.[2] The equations for firms' decisions on investment, production capacity and prices are based on a vintage *production function*, i.e., the assumption that 'machines' can be designed to combine with an optimal input of labor prior to their installation but that the factor proportions remain fixed thereafter. Further assuming monopolistic *competition in the product market*, the problem of the firm is to choose on each investment vintage the cost-minimizing factor mix, to pursue an optimal policy of replacing old investment vintages by new equipment and to adjust production capacities, output and prices in response to changes in goods demand and factor costs. In this framework, the evolution of capacity output YC_t and capacity labor demand LC_t (i.e., labor demand corresponding to full utilization of available equipment) can be described by the following two equations:

$$YC_t = S_t YC_{t-1} + B_t I_t \tag{1}$$

$$LC_t = S_t LC_{t-1} + C_t I_t \tag{2}$$

In (1) and (2), S_t is the share of surviving equipment from the previous period ($1\text{-}S_t$ is the scrapping rate). B_t is capital productivity and C_t is labor intensity of the new vintage, and I_t. is gross investment of the period. Hence B_tI_t is capacity added by the vintage installed at time t and C_tI_t is the cor-

1 *The author of the model has previously been responsible for the development of the macroeconometric model at KOF/ETH. Several insights into the mechanism of the Swiss Economy gained during this work at KOF/ETH are reflected in the model of this paper.*

2 *A more detailed description is given in Stalder (1994).*

responding labor requirement. Assuming a Cobb-Douglas production function with labor-augmenting technical progress θ and labor share α, one obtains B_t and C_t as

$$B_t = B_0 q_t^{-\alpha} e^{\theta\alpha t} \quad \text{and} \tag{3}$$

$$C_t = C_0 q_t^{-1} \qquad \text{where} \qquad q_t = w_t / v_t \tag{4}$$

is the ratio of wages to capital cost at the time of investment.

The expected long-term growth rate of q_t theoretically also plays a role in (3) and (4) and at the same time affects the *prospective lifetime* of vintage t for the following reasons. The replacement of existing by new equipment is determined by a comparison of production costs. On existing vintages the factor input proportions are fixed and capital costs are "sunk". Existing vintages get thus replaced as soon as the associated unit labor costs exceed total unit costs on new equipment (scrapping rule). Hence, if wages are expected to increase strongly in relation to capital costs, the prospective lifetime of new equipment shortens and firms shift to a more capital-intensive expansion path, i.e., they choose lower B_t and C_t. Without such a shift, the prospective lifetime would obviously shorten more. In specifications (3) and (4), these considerations are neglected or, put differently, it is assumed that the expected long-term growth rate of q_t is constant. This can be justified by noting that the logarithm of q_t can be represented empirically as a random walk with drift, implying that the innovations of the process affect the actual growth rate of the factor price ratio but leave its expected long-term growth rate unchanged.

With respect to the scrapping decision of each period, it is however not the *expected* long-term growth rate but the known *actual* growth rate of q_t that matters (denoted by $\dot{q}_t$). Old equipment is typically more labor intensive than new equipment and capital costs on old equipment are "sunk". Therefore, if wages increase strongly in relation to capital costs in a certain period, a larger share of existing equipment will loose its competitiveness and get scrapped. Hence, the share of surviving equipment is a negative function of $\dot{q}_t$:

$$S_t = S(\dot{q}_t) \tag{5}$$

Investment behavior can be specified on basis of the same theoretical considerations. If S_t and B_t are low (because of high $\dot{q}_t$ and q_t respectively), a larger volume of new investment I_t will be needed to adjust production capacity from YC_{t-1} to YC_t. In fact, the investment equation can be derived from (1) by replacing YC_t by some concept of desired capacity, solving for I_t and allowing for adjustment lags (see below).

2.1.2. Price setting and regimes of the firm

On the assumption of monopolistic competition in the goods market, firms set the price as a profit-maximizing markup over marginal costs *MC*. These can be defined either as total unit costs on new equipment or as unit labor costs on marginal (oldest) equipment. The two concepts are equivalent in equilibrium due to the scrapping rule (old vintages get replaced as soon as the associated unit labor costs exceed total unit costs on the most recent vintage). The *normal markup price* of a firm can thus be written as[3]

$$\bar{p}_t = \left(\frac{\eta}{\eta - 1}\right) MC_t \quad , \tag{6.1}$$

where η is the price elasticity of the firm's demand curve and marginal costs are defined, on basis of the Cobb-Douglas vintage production function, as

$$MC_t = w_t^{\alpha} v_t^{1-\alpha} e^{-\theta\alpha t} \tag{6.2}$$

where α is the labor share and θ is the rate of labor-augmenting technical progress.

Desired production capacity is given by expected demand at $\bar{p}$, $YD(\bar{p})$,

In the short run, however, the available set of vintages places an upper bound on output, giving rise to two possible *regimes* of the firm:[4]

1 If a firm faces a demand curve which, at the normal markup price $\bar{p}$, exceeds capacity output *YC*, it will produce at full capacity ($Y = YC < YD(\bar{p})$) and raise the price ($p > \bar{p}$) in order to

3 *The term "normal" is maybe somewhat misleading. More precisely,*

4 *In the following equations, the time subscripts are omitted.*

choke off excess demand. Moreover, effective labor demand *LD* corresponds to capacity labor demand *LC*.

2 If demand at $\bar{p}$ falls short of capacity output *YC*, the firm's output level is constrained by demand ($Y = YD(\bar{p}) < YC$) and the optimal price p is equal to $\bar{p}$. In this case, effective labor demand *LD* falls short of capacity labor demand *LC*.

This theoretical framework, which is somewhat in the spirit of the "disequilibrium" approach of Malinvaud (1980), Benassy (1986) or Sneessens (1990), establishes a straightforward link to *business survey data*: A firm that reports capacities as being "too small" (too large) indicates to be in regime 1 (regime 2). Of course, individual firms will generally be in different regimes, and this creates an aggregation problem. Moreover, $YD(\bar{p})$ and *YC* are not directly observable.

2.1.3. Aggregation and the use of business survey data

A convenient way to deal with both problems at one go has been proposed by Lambert (1988). Assuming that the ratio $YD(\bar{p})/YC$ is *lognormally distributed* in the population of firms and that the output level of each firm *i* is given by the minimum of the two possible constraints, i.e. $Y_i = \min(YC_i, YD(\bar{p}))_i$, the aggregate relationships can be approximated by

$$Y(1-\pi_G)^{-\kappa} = YD(\bar{p}) \tag{7.1}$$

$$Y\pi_G{}^{-\kappa} = YC \tag{7.2}$$

where π_G is the proportion of firms reporting capacities as being "too small" (capacity-constrained firms in regime 1). Equations (7.1) and (7.2) define a one-to-one mapping from the two latent variables $YD(\bar{p})$ and *YC* to the two observables *Y* and π_G. In order to see how this mapping works, it is instructive to divide (7.1) by (7.2), yielding a logit-type equation for π_G:

$$\left(\frac{\pi_G}{1-\pi_G}\right)^{\kappa} = \frac{YD(\bar{p})}{YC} \tag{7.3}$$

According to (7.3), the regime mix $(\pi_G\ , 1-\pi_G)$ is endogenously determined in the model by the aggregate demand/capacity ratio, and the "curvature" of this relationship is shaped by parameter κ. If we let $YD(\bar{p})$ increase in relation to *YC*, π_G converges to its upper bound 1 ("all" firms are capacity-constrained). In such a limiting situation, *Y* according to (7.2) tends from below to *YC*, i.e., aggregate output corresponds to aggregate capacity. If we let $YD(\bar{p})$ decrease in relation to *YC*, then π_G converges to its lower bound 0 ("all" firms are demand-constrained) so that in the limit – according to (7.1) – *Y* gets bounded from above by $YD(\bar{p})$. Aside from these limiting situations, actual output *Y* is smaller than *YC* and $YD(\bar{p})$, increasingly so for large values of κ. Parameter κ can be viewed as a measure of *mismatch* between the micro structures of aggregate demand and capacity. More precisely, it measures the dispersion of $YD(\bar{p})/YC$ in the population of firms.

Firms for which $Y = YC < YD(\bar{p})$ have an incentive to raise the price p above $\bar{p}$ in order to bring demand into line with available capacity. At the aggregate level, this can be formalized as follows:

$$p_t = \bar{p}_t(1-\pi_{G_t})^{-\tau} \tag{8}$$

The aggregate price level p is an increasing function of π_G. The specification implies that p tends from above to its lower bound $\bar{p}$ if π_G converges to 0, which – according to (7.3) – happens if aggregate demand gets sufficiently low in relation to capacity output ("all" firms demand-constrained). Provided that firms facing excess demand at $\bar{p}$ raise the price enough to eliminate excess demand, one may assume that $Y = YD(p)$. Note however that it is always $YD(\bar{p})$ – and not $YD(p)$ – that determines desired capacity and thus *investment behavior*.

Substituting (6.1) and (6.2) into (8), one obtains the following aggregate price equation:

$$p_t = \left(\frac{\eta}{\eta-1}\right) w_t^{\alpha}\ v_t^{1-\alpha}\ e^{-\theta\alpha t}\ (1-\pi_{G_t})^{-\tau} \tag{9}$$

In the empirical model, (9) is dynamically extended into an error correction equation and applied to the GDP-deflator (excluding housing rents).

2.1.4. Investment behavior

By investing in new equipment firms tend to bring production capacities into line with the development of demand. Demand at the normal markup price determines *desired* production capacity, i.e., $YC_t^* = YD_t(\bar{p}_t)$. After substituting this into (1) one may solve for the *desired investment rate*:

$$IR_t^* \equiv I_t^* / YC_{t-1} = \left(\frac{YD_t(\bar{p}_t)}{YC_{t-1}} - S_t \right) \Big/ B_t \tag{10}$$

This equation defines the investment rate that would just close the gap between demand at $\bar{p}_t$ and the surviving capacity from the previous period. To allow for adjustment cost and other factors that may cause inertia in investment behavior, a simple partial adjustment scheme is introduced:

$$IR_t = \lambda\, IR_t^* + (1-\lambda) IR_{t-1}\ , \quad \text{where} \quad IR_t = I_t / YC_{t-1} \tag{11}$$

The *role of capacity output in the mode*l differs from the more commonly used concept of *potential output* in two respects. First, capacity output acts as a strict *upper bound* for actual output ($Y \le YC$), i.e., the output gap is never positive, whereas potential output is usually defined as output at a normal utilization rate so that actual output may exceed potential output in boom periods. Second – and also in contrast to the usual concept of potential output –, capacity output refers to *technical capacities* only. The tension situation on the labor market is taken into account separately, as shown next.

2.1.5. Labor market and wage formation

On the labor market, the aggregate relationships can be formalized in a similar way. As outlined above, in capacity-constrained firms (regime 1, proportion π_G) we have $LD = LC$ while in demand-constrained firms (regime 2, proportion 1- π_G) we have $LD < LC$. At the aggregate level, this spillover from insufficient goods demand to effective labor demand can be represented by

$$LD = LC\, \pi_G^{\kappa}\ , \tag{12}$$

where LC is given by (2). Apart from the limiting situation where π_G tends to 1 (i.e., as soon as some firms are demand constrained in the goods market), effective labor demand LD falls short of capacity labor demand LC. To allow for labor hoarding, π_G is expanded into a lag structure in the empirical model. Employment L is determined in connection with aggregate labor supply LS as

$$L(1-\pi_L)^{-\upsilon} = LD = LC\, \pi_G^{\kappa} \tag{13.1}$$

$$L\, \pi_L^{-\upsilon} = LS\ , \tag{13.2}$$

where π_G, endogenously determined by LD/LS, is the proportion micro labor markets in excess demand (measured by the share of firms reporting labor shortages). The implied unemployment rate is

$$URATE = 1 - L/LS = 1 - \pi_L^{\upsilon} \tag{14}$$

If $LD = LS$, we have $\pi_L = 0.5$. This can be regarded as an aggregate equilibrium. The associated unemployment rate *(structural rate of unemployment at equilibrium)* is

$$SURE = 1 - 0.5^{\upsilon} \tag{15}$$

SURE is an increasing function of parameter υ, which can be viewed as a measure of demand/supply "mismatch" (dispersion of the demand/supply ratio across micro labor markets).[5]

In the empirical application, econometric equations are substituted on the right-hand side of (7) and (13), and the parameters of these equations are estimated jointly with the parameters υ and κ, which shape the transformation from the latent variables YD, YC, LC and LS to the observable variables Y, L, π_G and π_L.

The equation substituted for *labor supply* makes LS dependent on the exogenous potential labor force and involves a partial adjustment scheme with respect to actual employment. This can be seen as kind of a "discouraged worker"-mechanism in the sense that low (high) employment entails a retreat from (re-entry into) the labor market. In addition, it may also reflect a cyclical buffer role of seasonal and frontier workers, which are not included in the potential labor force.

The proportion π_L enters the wage equation of the model in the following way:

5 *With regard to the SURE-concept and some other aspects the model of this paper is quite similar to the various country models presented in Drèze and Bean (1990).*

$$w_t = p_t^{k_1}\ pc_t^{(1-k_1)}\left(\frac{Y_t}{L_t}\right)^{k_2}\left(\frac{\pi_{L_t}}{1-\pi_{L_t}}\right)^{k_3} \tag{16}$$

The development of the nominal wage thus depends on a weighted average of the GDP-deflator *p* and consumer prices *pc*, labor productivity *Y/L* and π_L, reflecting tension in the labor market. In the empirical model, equation (16) is brought into an error correction form as well.

Equation (16) says that wages increase in relation to prices if the labor market gets tight (high π_L). Equation (9) says that firms raise prices in relation to wages if capacity utilization increases (high π_G). Hence, if both the goods and the labor market are tight, the formation of wages and prices may become incompatible in the sense that the income claims of workers and firms add up to more than what is actually available for distribution. The result is accelerating inflation that must go to the point where real activity is dampened enough to make income claims compatible by lowering π_L and π_G.[6]

Consumer prices *pc*, which enter (16) with a weight of about 0.5, depend on the GDP-deflator *p*, import prices *pim* (excluding oil), the price of imported oil *poil* and housing rents *phr*:

$$pc_t = pc(p_t, pim_t, poil_t, phr_t) \tag{17}$$

According to this equation, increasing import prices or housing rents may drive a "wedge" between the GDP-deflator and consumer prices (or between the real producer wage and the real consumer wage) and thereby – since nominal wages are partly adjusted to consumer prices –- also set in motion a wage-price spiral. This aspect to the model will become relevant in Section 6, where the impact of the formation of housing rents on the monetary transmission process is discussed.

2.1.6. Impact of higher productivity growth – theoretical considerations

Section 5 of this paper presents a model simulation addressing the question to what extent the inflation forecast is affected by higher technical progress. Given the above specifications, it is quite straightforward to carry out this exercise. All what has to be done is raising the technical progress parameter θ in equations (3) and (9). In accordance with the adopted vintage framework, this amounts to the assumption that higher technical progress falls exclusively on new equipment:

- In equation (3), a higher θ entails a stronger increase of capital productivity *B* and thus labor productivity on new equipment, which is given as[7]

$$A_t = B_t/C_t = (B_0/C_0)\,q_t^{1-\alpha}\ e^{\theta\alpha t} \tag{18}$$

- In equation (9), a higher θ lowers the output price in relation to factor prices.

Of course, these are just initial effects. Eventually, all variables of the supply block are affected by higher productivity growth in a rather complex way. The responses also depend on various reaction parameters in the aggregate demand block and the monetary block of the model. A crucial issue is to what extent the higher growth potential of the economy is actually absorbed by a steeper increase of aggregate demand. If the positive effect of lower prices on aggregate demand is weak, investment and employment will decline as a result of higher capital productivity and labor productivity, respectively. The corresponding under-utilization of resources enhances the direct price dampening effect of productivity growth. If aggregate demand is stimulated strongly by lower prices, negative reactions of investment and employment may be prevented. But then, the price-dampening effect of higher productivity growth will also be smaller.

More technically, consider an increase of θ by an amount of $\Delta\theta$. Initially, this raises the growth rate of both capital productivity and labor productivity by $\Delta\theta\alpha$ but leaves the labor intensity of new equipment unaffected, as can be seen from equations (3), (4) and (18). In the sequel, however, since higher technical progress pushes prices down in relation to wages, there will be an increase in the factor price ratio $q = w/v$, shifting the factor input ratio in favor of capital (lower *C*). This process of capital deepening on the one hand raises the growth rate of labor productivity still further. On the other hand, it dampens the growth rate of capital productivity. An illustrative benchmark case obtains if we assume that the growth rate of *q* just rises by $\Delta\theta$ (wages increase in relation to capital costs exactly by the amount of additional labor-augmenting technical progress, thus keep-

6 *This is in the spirit of the NAIRU model of Layard, Nickel and Jackman (1991).*

7 *B is output per unit of new capital, C is labor per unit of new capital, hence B/C is output/labor, i.e., labor productivity.*

ing the factor price ratio in terms of *efficiency units* constant). In this case, the growth rate of labor productivity A rises by $\Delta\theta$ (instead of $\Delta\theta\alpha$), while capital productivity B remains constant (instead of rising by $\Delta\theta\alpha$). Empirically, it turns out that the growth rate of q increases, but by less than $\Delta\theta$. Nevertheless, the induced process of capital deepening reduces the negative impact of faster technical progress on investment while the negative impact on employment is enhanced. Both negative effects are mitigated or even reversed if aggregate demand shows a large positive reaction to lower prices (which can be expected in the longer run).

The model distinguishes between three concepts of *labor productivity*, namely *technical* labor productivity on *new equipment (A = B/C)*, *technical* labor productivity on the *entire productions apparatus (YC/LC)* and measured labor productivity *(Y/L)*. The increase in YC/LC resulting from a higher value of θ hinges on the speed by which old equipment is replaced by new equipment, i.e., scrapping and investment. Measured labor productivity Y/L additionally depends on cyclical factors like capacity utilization Y/YC and labor hoarding.

Empirically, all three productivity measures show a positive reaction to a higher value of q. The effect on output Y is positive as well, but smaller than the increase in labor productivity. As a result, employment L declines and unemployment rises, lowering the tension measure π_L. In the wage equation (16), one thus has two opposing effects, a positive productivity effect and a negative tension effect. Empirically, the productivity effect dominates so that wages decline by less than the GDP-deflator and consumer prices. Accordingly, both the real producer wage *(w/p)* and the real consumer wage *(w/pc)* increase. The price of new capital goods, v, also declines substantially in relation to the nominal wage so that the factor price ratio $q = w/v$ increases. The fall in v is partly due to the functioning of the monetary block, where lower domestic prices lead to an appreciation of the Swiss Franc, which in turn has a dampening effect on the prices of imported investment goods.

Investment behavior is influenced by higher technical progress in different ways. First, the stronger increase in the factor price ratio $q = w/v$ lowers S, i.e., speeds up scrapping and thus stimulates investment. Second, the stronger growth of capital productivity B exerts an opposing negative effect on investment since less investment is needed to attain a certain production capacity. Third, the response of investment depends on the extent by which aggregate demand is stimulated by lower prices. Empirically, it turns out that the response of investment to a higher rate of technical progress is negative in the *short run* (the effect of higher capital productivity dominates) but positive in the longer run (as the aggregate demand effect gains strength).

In the following, we describe the specification of the aggregate demand part of the model, which is rather conventional.

2.2. Aggregate demand, income determination and sector prices

On the demand side of the *goods market*, we have the equations for the various components of aggregate demand:

- *Private consumption* depends on real disposable household income, the real long-term interest rate, the share of the non-active population and the unemployment rate.
- *Investment in machinery and equipment* is determined in close connection with the specification of capacity output as a function of tension in the goods market and the level and growth rate of relative factor costs, as described in section 2.1 above.
- *Business construction* reacts with some delay on investment in machinery and equipment and relative construction prices.
- *Housing investment* responds to the level and the growth rate of GDP, a specific profitability measure (involving long-term interest rates, housing rents and construction prices) and population growth.
- *Inventory investment* is specified according to a buffer-stock stock-adjustment model. The impact of purely short-term demand shocks on GDP is thus buffered by inventory changes, whereas more persistent demand movements are reinforced by the stock-adjustment process.
- *Exports* depend on a weighted composite of GDP in Europe, the USA and Japan on the one hand and the Swiss supply price in relation to the prices of competing producers in the world economy (converted into Swiss francs by the trade-weighted external value of the Swiss franc) on the other hand.
- *Imports* react to all components of aggregate demand with component-specific elasticities (reflecting different import intensities) on the one hand and import prices (excluding oil) in relation to the GDP-deflator on the other hand.
- *Public construction* and *government consumption* are treated as exogenous or – as an alternative in model simulations – linked in fixed proportions to GDP.

Together, these components define GDP *(Y)* from the demand side. However, *Y* is constrained in the supply block of the model by capacity output *YC*. In a situation where *Y* tends to its upper bound *YC*, prices increase, which dampens aggregate demand, in particular via foreign trade (lower exports, higher imports), while investment and capacity growth are stimulated. This mechanism works towards equilibrium in the goods market in the long run.

The *goods market* and the *labor market* interact via the production function and wage-price dynamics, as described above. In addition, income generated in the labor market is the most important component of *primary household income* and thus the central determinant of private consumption. The other component of primary household income, *business and property income*, is linked to *non-wage value-added*, defined as nominal GDP minus total labor costs. The *net-tax rate* that enters in the definition of *disposable household income* is treated as exogenous.

The aggregate demand part of the model also collects the equations for those sector prices that are not part of the supply block:

- *Construction prices* depend on the GDP-deflator and the share of construction investment in total GDP as a rough indicator for the relative position of the construction sector in the overall business cycle.
- *Housing rents* are determined by construction prices and interest rates, reflecting Swiss legislation that allows house owners to pass changes in the mortgage rate to tenants. An increase in interest rates by 1 percentage point pushes housing rents up by 4.5% (with a lag), which is less than what is legally allowed but nevertheless hampers the efficiency of monetary policy to a significant degree, as shown in Section 6.
- *Import prices* are linked to world market prices converted into Swiss francs by the trade-weighted external value of the Swiss franc.
- *Export prices* depend on the GDP-deflator and import prices as a proxy for the input prices of imported raw materials and intermediate products.

Finally, one should note that equation (9), the central price equation of the model, refers to the GDP-deflator excluding housing rents, *p*. The overall GDP-deflator is then obtained by a definition equation involving *p* and housing rents *phr*. This distinction is motivated by the following consideration. As noted above, the speed by which tighter monetary policy dampens CPI-inflation is hampered by the fact that higher interest rates are passed onto housing rents. However, increasing housing rents do not only raise consumer prices and thus depress real wages but also raise non-wage incomes, which mitigates the negative effect on overall real household incomes. This is taken into account by the explicit appearance housing rents in the equation for the GDP-deflator, since it is the difference between nominal GDP and labor costs that determines non-wage household incomes. When simulating a more restrictive monetary policy (Section 4) or when suppressing the impact of interest rates on housing rents (Section 6), taking these income effects properly into account is important.

2.3. Monetary block

The *monetary block* determines *short-term interest rates* (3M-Libor), *long-term interest rates* (government bond rate) and the *exchange rate of the Swiss franc*, defined as trade-weighted external value. The specification of this part of the model is based on the following assumptions:

- The orientation of *monetary policy* is reflected in the development of the *short-term interest rate* (3M-Libor), and it is assumed that this interest rate is a "sufficient statistic" for the stance of monetary policy. Put differently, monetary policy affects the economy only through short-term interest rates and there is no additional role for the quantity of money in the model.
- Swiss *long-term interest rates* depend on Swiss short-term interest rates and foreign long-term interest rates.
- The *exchange rate of the Swiss franc* reacts to interest rate differentials and the balance on the external account.

Furthermore, taking into account the orientation of Swiss exports as well as the origin of Swiss imports, it seems likely that monetary policy pays special attention to the exchange rate of the Swiss franc against the Euro (historically the DM or the currencies of the "DM block"). Therefore, the model is focused on the Swiss franc/Euro (DM) exchange rate and the corresponding interest rate and inflation differentials. The overall trade-weighted external value of the Swiss franc is then determined by the endogenous Swiss franc/Euro (DM) exchange rate and the exogenous external value of the Euro (DM) against other currencies.

Based on these considerations, monetary policy is assumed to be conducted in such a way that Swiss short-term interest rates *(srate)* go up if real GDP growth ($\dot{y}$) and inflation ($\dot{p}$) rise, whereas an appreciation of the Swiss franc ($\dot{e}$) and increasing unemployment *(URATE)* are counteracted by lowering short-term interest rates. These reactions of srate take place in relation to the Euro (German) short-term interest rate *(srate*)* as a point of reference in the following form:

$$\Delta srate_t = S_s \Delta srate_t^* + S_e \log(e_t / e_{t-4}) + S_\gamma \log(Y_t / Y_{t-1}) + S_u URATE_t$$
$$- S_\gamma (srate_{t-1} - S_0 - srate_{t-1}^*) \qquad (19)$$

In the actual process of inflation forecasting, equation (19) is typically removed from the model and the 3M-Libor is treated as an exogenous instrument. Equation (19) should also not be viewed as the "official SNB policy rule". For certain simulation exercises it is necessary, however, to endogenize the 3M-Libor. Historically, the behavior of the 3M-Libor is captured quite well by (19). Attempts to include the current inflation rate were empirically unsuccessful. This result is not really surprising: On the one hand, in case of a cost-induced inflation, the appropriate policy response is rather to accommodate higher money demand to some extent than to tighten monetary reins. On the other hand, in case of a demand-pull inflation, high GDP growth precedes inflation, so that monetary tightening is advisable already when GDP growth rises. Moreover, *URATE* is the driving force in the wage-price block of the model. Hence, low values of *URATE* can be viewed as a leading indicator of rising inflation as well.

The dependence of *srate* on *srate** in (19) is of an *error correction* form and involves the assumption that *srate* is cointegrated with *srate**. If *srate** changes, *srate* moves by the same amount in the long run, while the short-term adjustment of *srate* is governed by parameters S_γ and S_s. The dependence of *srate* on the relative change in the external value of the Swiss franc, GDP growth and the unemployment rate is of a simple *partial adjustment* type. This can be made more apparent be rewriting (19) as:

$$srate_t = S_0 S_\gamma + (1 - S_\gamma) srate_{t-1} + S_e \log(e_t / e_{t-4}) + S_\gamma \log(Y_t / Y_{t-1}) + S_u URATE_t$$
$$+ S_s srate_t^* + (S_\gamma - S_s) srate_{t-1}^* \qquad (19')$$

In case of *URATE*, e.g., the short-run impact on *srate* is given by parameter S_u (< 0) and the long-run impact by S_u/S_γ. The exchange rate *e* is defined as Euro (DM) per Swiss franc (external value), so that an increase in *e* reflects an appreciation.

The *long-term interest rate* depends on the foreign (German) long-term interest rate and – in a specific form – on Swiss and foreign short-term interest rates:

$$\Delta lrate_t = L_l \Delta lrate_t^* + L_s \left[\Delta srate_t - S_s \Delta srate_t^* + S_\gamma (srate_{t-1} - S_0 - srate \right]$$
$$- L_\gamma (lrate_{t-1} - L_0 - lrate_{t-1}^*) \qquad (20)$$

The dependence of *lrate* on *lrate** is of an *error correction* form, involving the assumption of a full pass-through in the long run, while the short-run adjustment of *lrate* to *lrate** is characterized by parameters L_γ and L_s. The response of *lrate* to *srate* is of a *partial adjustment* type. Note that the term in brackets in (20) is derived from (19). This specification amounts to a distinction between changes in *srate* that result from changes in *e*, *Y* and *URATE* on the one hand and changes in *srate* that reflect changes in *srate** on the other hand. Only the former have an impact on *lrate* (in relation to *lrate**). Consider for instance a situation where *srate** increases while *lrate** remains unchanged. In this case, *srate* according to (19) adjusts to the higher *srate**, but – as the term in brackets in (20) does not change – *lrate* remains unaffected. The spread of Swiss interest rates (*srate*-*lrate*) thus fully adjusts to the change in the foreign spread (*srate**-*lrate**), although with a certain lag. This can be seen as a *delayed tightening* of Swiss monetary policy in response to more restrictive course abroad. On the other hand, consider an increase in *srate* that is induced in (19) by an overheating of the Swiss economy. This will be reflected in (20) by a higher value of the term in brackets and hence transmit to *lrate*, but only partly (as $L_s + L_\gamma < 1$ empirically). Such a *relative tightening* of Swiss monetary entails an increase of the spread (*srate*-*lrate*) in relation to the foreign spread (*srate**-*lrate**).

The equation for the *external value of the Swiss Franc* vis-à-vis the Euro (DM) is specified as

$$\log(e_t / e_{t-1}) = E_0 + E_\rho \log(e_{t-1} / e_{t-2}) + E_s \left((srate_t - lrate_t) - (srate_t^* - lrate_t^*) \right)$$
$$+ E_b BAL_t + E_\gamma \log(er_{t-1}) \qquad (21)$$

where *BAL* is the balance on the external account including commodities, services and tourism in relation to nominal GDP and *er* is the real external value, defined as

$$er_t = e\left(\frac{p_t}{p_t^*}\right) \tag{22}$$

According to this specification, the relative change in the external value of the Swiss franc depends on the difference in interest rate spreads (indicating relative tightness of monetary policy) and the external account. In addition, there is kind of an error correction "feedback" from the real external value *er* on the change in *e* ($E_\gamma < 0$), ensuring that persistent inflation differentials, giving rise to a trendlike behavior of *p/p**, must be accompanied by a compensating trend in *e*. Hence, if the other explanatory variables in (22) were stationary (which is not the case for *BAL* though), *er* would be stationary as well.

Obviously, this specification of the monetary block has a strong *ad hoc* flavor. Theoretical considerations like the *uncovered interest rate parity* condition and the *term structure of interest rates* are not taken into account explicitly, although the equations involve some rough approximations to these concepts. Empirically, however, the specification works quite well in terms of historical fit, parameter stability and accuracy of ex post forecasts (Stalder, 2000).

3. Baseline forecast (unchanged 3M-Libor)

In the *Baseline Forecast,* the Swiss short-term interest rate (3M-Libor) is held constant at 3.5% (level prevailing in August 2000). Together with the assumptions for the world economy, the model predicts a strong expansion of the Swiss economy in the year 2000 and a moderate slowdown in the following years. After an increase of 3.3% in 2000, GDP growth falls to 2.2% in 2001. The growth rate is further reduced to 1.8% in 2002/2003 and picks up slightly to 1.9% in 2004. Despite this slowdown, the expansion of GDP exceeds productivity growth throughout the forecast period. Accordingly, employment increases – on average by somewhat more than labor supply – so that the unemployment rate falls from 2% in 2000 to 1.7% in 2004.

CPI-inflation increases from 0.8% in 1999 to 1.7% in 2000 and reaches 2.5% in the next two years. In 2003/2004 the inflation rate goes back somewhat but remains above 2% until the end of the forecast period.[8]

The rise in CPI-inflation is caused by:

(i) a sizeable increase in ***housing rents***, due to the delayed adjustment to higher interest rates,
(ii) increasing ***import prices***, caused by the weakness of the Swiss franc against the Dollar and higher oil prices,
(iii) higher ***wage growth*** and a stronger increase in the ***GDP-deflator*** resulting from tighter conditions in the labor and product markets (lower unemployment, narrowed output gap).

Factor (i) becomes weaker towards the end of the forecasting horizon. Factor (ii) dies out quickly in 2001 and is even reversed later on. In contrast, factor (iii) remains relevant during the whole forecast period. In other words, the external factors responsible for the current rise of inflation are replaced in the course of the forecast period by higher internal market tension.

The *Baseline Forecast* is presented in some more detail in Table 1 of the Appendix[9].

4. The effects of tighter monetary policy (Alternative 1)

The SNB defines price stability as a CPI-inflation rate below 2%. This definition is violated in the *Baseline Forecast*, implying that monetary policy should become more restrictive. However, one should note in this respect that SNB officials have indicated on several occasions that inflation rates in excess of 2% may temporarily be tolerated, in particular if caused by factors that are beyond the reach of monetary policy. Moreover, one should also recognize that a sizable amount of inflationary pressure is already in the pipeline for the year 2001 and could be counteracted only by a radical monetary tightening at excessive costs in terms of real output loss. What monetary policy may reasonably try to control is inflation at longer forecasting horizons. Although the SNB does not pursue a policy of explicit inflation targeting, it is assumed in this paper that the *Baseline Fore-*

8 *What is referred to here as Baseline Forecast has been designed for the purpose of this paper and does not fully correspond to the actual assessment of SNB. In particular, the Baseline Forecast is intentionally made somewhat more expansionary and inflationary than the official SNB-forecast of August 2000.*

9 *The Appendixx to this paper is available on the IFC Web site (http://www.ifcommittee.org/S4stalder.pdf).*

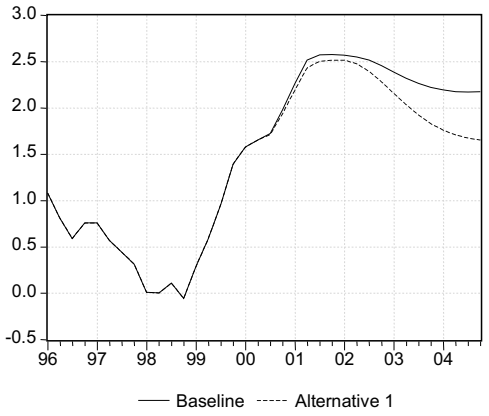
cast is considered too inflationary and that monetary policy is tightened such as to bring CPI-inflation down to a target value of 1.7% in 2004 (instead of 2.2% as in the *Baseline Forecast*).

According to the model, this target can be attained by raising the 3M-Libor from 3.5% to 4.5% at the start of the simulation period (2000Q3). Of course, other paths of the 3M-Libor that would produce the same inflation outcome in 2004 are conceivable as well. However, as GDP growth is stronger now than later in the forecast period, an immediate tightening of monetary policy seems preferable with regard to a smooth development of aggregate output.

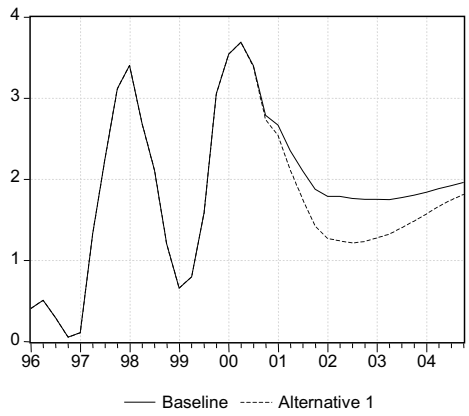
The forecast with higher short-term interest rates (3M-Libor = 4.5%), referred to as *Alternative 1*, is documented in Table 2a. Table 2b shows the effects of monetary tightening in form of differences between *Alternative 1* (Table 2a) and the *Baseline Forecast* (Table 1). The effects are expressed as differences in growth rates except for the long-term interest rate and the unemployment rate where differences in levels are displayed. Figures 1 and 2 show the dynamic responses of some important endogenous variables of the model on a quarterly basis. Figure 1 compares the two scenarios with respect to CPI-inflation and GDP growth in form of percentage rates of change over the same quarter in the previous year. Figure 2 shows the deviations of *Alternative 1* from the baseline path as level effects for interest rates and the unemployment rate and as differences in annualized quarterly growth rates for all other variables.

Figure 1 – Effects of tighter monetary policy (Baseline and Alternative 1)

a) CPI inflation



b) GDP growth



The mechanisms in the model by which monetary tightening dampens CPI-inflation can be assigned to an *exchange rate channel* and an *aggregate demand channel*. A temporary counter effect originates from the *response of housing rents* to higher interest rates. The rise in the 3M-Libor entails a quick appreciation of the Swiss Franc (Figure 2c). This has a dampening impact on CPI-inflation via declining import prices (Figure 2b) and reduces aggregate demand via lower export growth. Second, there is a partial pass-through of short-term to long-term interest rates, and this reduces aggregate demand via investment and private consumption (Figure 2d). Both initial effects set in motion a multiplier-accelerator process, by which all income-dependent components of aggregate demand are further reduced. Of course, import growth also declines, which partly offsets the negative impact of lower aggregate demand on GDP. GDP growth falls by a maximum of about 0.6 percentage points 6 quarters after the rise of the 3M-Libor. The response of export growth is relatively quick with a maximum loss of about 1 percentage point. The reaction of construction and investment in machinery and equipment is stronger but somewhat delayed. In case of investment in machinery and equipment, there is a positive response later in the simulation period. This is caused by the dampening effect of the appreciation on (imported) investment goods. As shown in Figure 2f, the price of investment goods (machinery and equipment) falls markedly in relation to wage costs, changing the factor price ratio in favor of capital. The response of private consumption turns out to be relatively weak and slow.

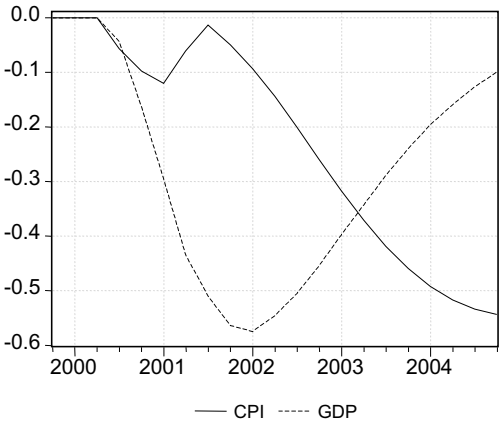
CPI-inflation is reduced in two waves (Figures 2a and b). There is a quick downward move already in the first few quarters of the forecast period. This is mainly brought about by the exchange rate channel. In the second year of the simulation, there is a sizable counter-effect coming from increasing housing rents. Due to this mechanism, the inflation-dampening record of tighter monetary policy looks quite disappointing one year after action has been taken. CPI-inflation is almost back to the baseline path whereas there is a considerable loss in GDP growth of about 0.6 percent-

age points. Thereafter, however, the dampening effects of lower aggregate demand and higher unemployment (Figure 2e) begin to work, reducing CPI-inflation by slightly more than half a percentage point by the end of the forecast period, while GDP growth rates tend back to the baseline values.

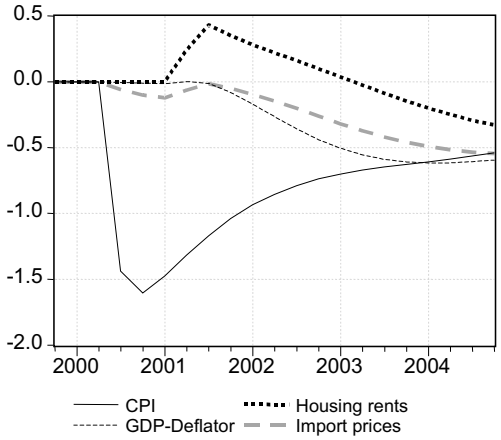
Figure 2 – Effects of tighter monetary policy

Alternative 1, deviations from baseline growth rates or levels (interest rates and unemployment rate)

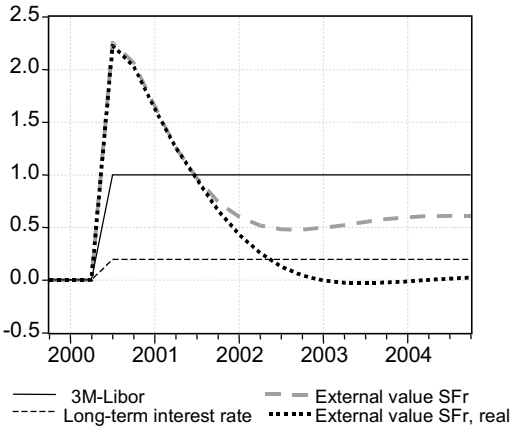
a) GDP growth and CPI inflation



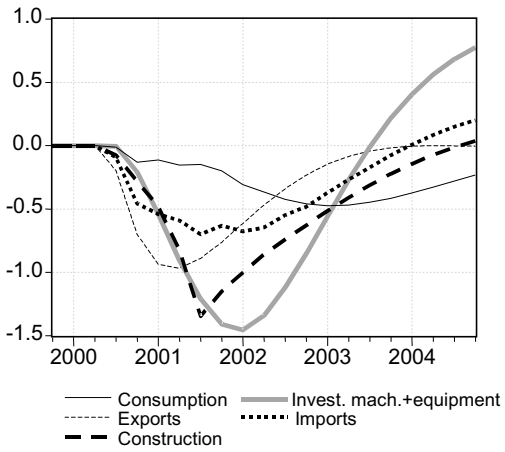
b) Various inflation rates



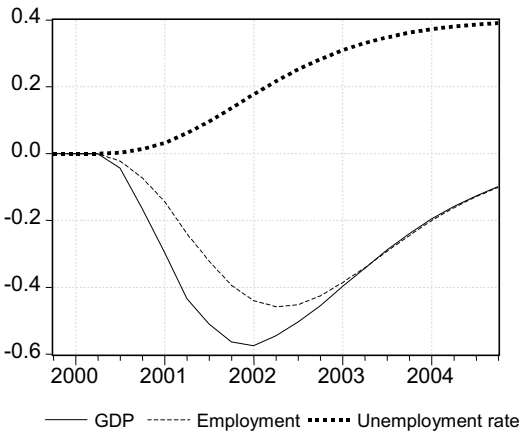
c) Interest rates and external value SFr



d) Components of GDP



e) GDP and employment



f) Nominal wage and price of IME

5. The role of productivity growth

5.1. The effects of higher productivity growth (Alternative 2)

Productivity growth is captured in the supply block of the model by the rate of labor-augmenting technical progress on new equipment, θ (see Section 2.1). The historical estimate of θ is 0.003 or 1.2% on an annual basis. The forecasts described in the preceding sections are based on this estimate. Motivated by the outstanding recent development of the US economy (high growth and low unemployment without much indication of rising inflation), many observers have argued that the fast diffusion of *new technologies* has given rise to productivity growth which is much faster than what historical estimates suggest. In this paper, we do not try to make an assessment as to the relevance and magnitude of such a "New Economy"-effect.[10] The purpose of the following simulation is merely to show the *sensitivity of the inflation forecast* with respect to alternative assumptions about productivity growth.

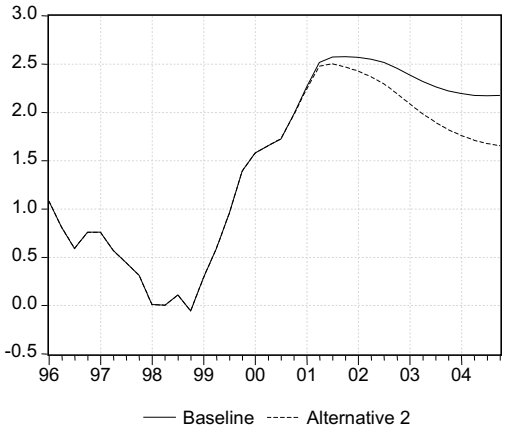
In the *Baseline Forecast*, on the assumption of a continuing historical productivity trend and an unchanged 3M-Libor of 3.5%, the CPI-inflation rate is 2.2% in 2004. In Section 4, it was shown that a 1 percentage point increase in the 3M-Libor to 4.5% is required to bring inflation down to 1.7% in 2004. In the following scenario, the *technical progress parameter* θ is raised to such an extent that the inflation target of 1.7% is attained without any monetary tightening (3M-Libor = 3.5%). According to the model, θ has to be raised from 0.003 to 0.0045, lifting the annual rate of labor-augmenting technical progress from 1.2% to 1.8%. This scenario, denoted as *Alternative 2*, is documented in Table 3a (Appendix). Table 3b shows the effects of higher productivity growth in the form of deviations of *Alternative 2* from the *Baseline Forecast*.

The implications of faster technical progress in the adopted vintage framework have already been discussed from a theoretical perspective in Section 2.1.6. The initial effect of a higher θ is a stronger increase in capital productivity and labor productivity on new equipment and a decline in the output price in relation to factor prices. What happens in the sequel is the result of an interaction of various responses in the labor market, on the demand side of the goods market and in the foreign exchange market. The extent to which the higher growth potential of the economy is actually absorbed by a stronger increase of aggregate demand is decisive for the outcome. The larger the stimulation of aggregate demand by lower output prices, the smaller is the inflation dampening effect of higher productivity growth.

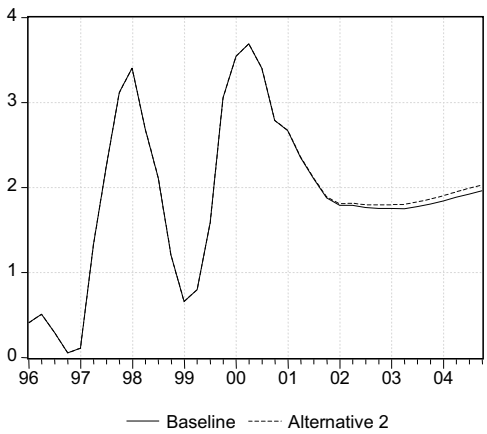
As shown in Figures 3 and 4a, higher productivity growth has a sizable negative effect on the *inflation rate* of about half a percentage point towards the end of the forecast period while *GDP growth* is stimulated only weakly. Accordingly, *employment* growth decreases in relation to the baseline path and unemployment rises (Figure 4c). In *wage formation*, we thus have two opposing forces, namely a stimulating effect of stronger productivity growth and a dampening effect of higher unemployment. The productivity effect dominates. To be sure, the growth rate of nominal wages declines, but by less than both CPI-inflation and inflation measured by the GDP-deflator (Figure 4d). Hence, real wage growth is higher than in the *Baseline Forecast*. The price of investment goods (machinery and equipment, largely imported) is dampened strongly. This is due to the

Figure 3 – Effects of higher productivity growth (Baseline and Alternative 2)

a) CPI inflation



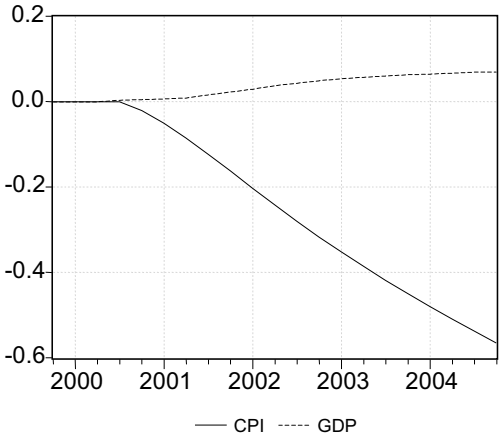
b) GDP growth



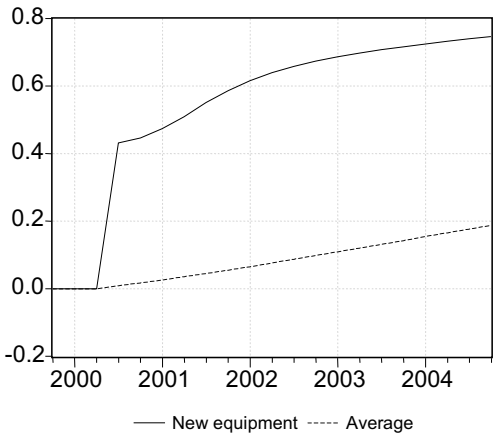
10 *A rather sceptical view is advocated for instance by Gordon (2000).*

Figure 4 – Effects of higher productivity growth
Alternative 2, deviations from baseline growth rates or levels (interest rates and unemployment rate)

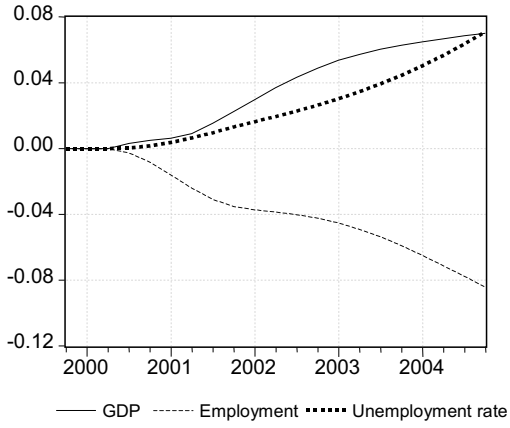
a) GDP growth and CPI inflation



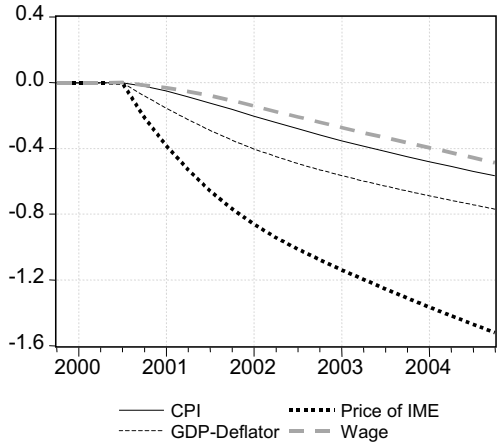
b) Labor productivity



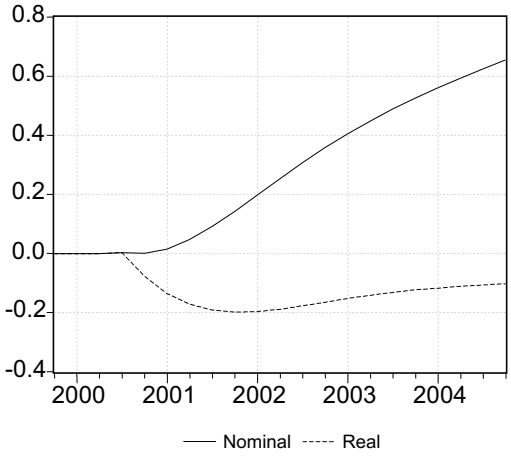
c) GDP and employment



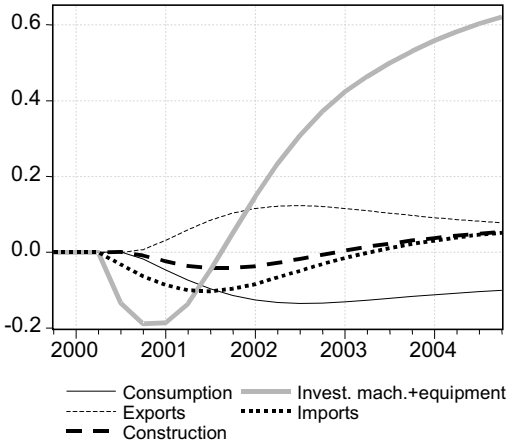
d) Wage and various prices



e) External value SFr



f) Components of GDP



functioning of the monetary block, where lower inflation reduces the real external value of the Swiss franc but leads to a nominal appreciation in the longer run (Figure 4e).

The decline of investment prices in relation to wages induces a change in the factor price ratio in favor of capital. The resulting process of *capital deepening* raises the growth rate of *labor productivity* above the initial effect of higher technical progress (Figure 4b). The initial effect is 0.42 percentage points, corresponding to the increase in θ of 0.6 percentage points (annualized) times α

= 0.7 (output elasticity with respect to labor). Together with the effect of capital deepening, the growth rate of labor productivity on new equipment is raised by the end of the forecast period by somewhat more than 0.7 percentage points. The effect on technical labor productivity on the whole production apparatus is of course smaller because the higher rate of technical progress is exclusively embodied in new equipment and thus materializes only to the extent by which old equipment is replaced by new equipment. In fact, due to the faster increase of relative wage costs, replacement speeds up, but the share of new equipment in the whole production apparatus nevertheless remains small within a time horizon of four years. The growth rate of overall technical labor productivity is raised by about 0.2 percentage points by the end of the simulation period. The effect on measured labor productivity is even somewhat smaller (0.16 percentage points) since employment is reduced by slightly less than what would be technically feasible. The 0.16 percentage point productivity gain is split in roughly equal parts between higher GDP growth and a lower employment growth (Figure 4c).

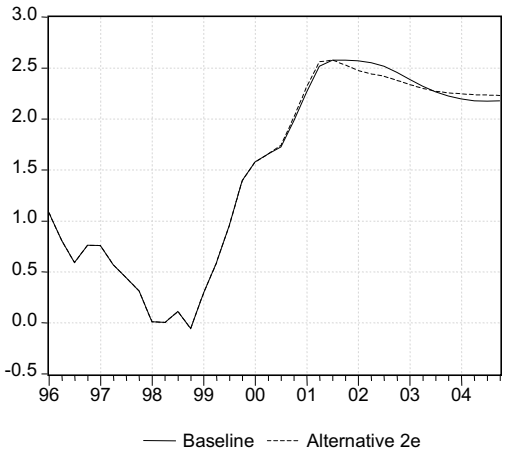
The reactions of the various components of GDP are shown in Figure 4f. *Investment in machinery and equipment* is first negatively affected by the stronger growth of capital productivity (less investment is needed for a certain expansion of production capacity). In the second year of the simulation, the response turns positive as GDP growth increases and the factor price ratio shifts in favor of capital. At the end of the forecast period, the growth rate of investment in machinery and equipment exceeds the baseline values by 0.6 percentage points. *Private consumption* shows a delayed and weak but long-lasting negative response. The increase in the real consumer wage is smaller than the decrease in employment, so that real household income is negatively affected. In addition, there is a negative impact of higher unemployment on consumption. *Construction investment* remains practically unaffected. Lower Swiss inflation improves international competitiveness and thus stimulates *export growth*. This effect however weakens in the course of the forecast period as the Swiss franc appreciates (Figure 4e). The reaction of *import* growth is negative in the first half of the simulation period but becomes positive in the second half. This reflects the changes in the various components of aggregate demand on the one hand and improved competitiveness of domestic producers on the other hand.

To *summarize*, one can say that the assumption of a higher rate of technical progress dampens future inflation significantly while it stimulates GDP growth only weakly. The two results are connected to each other. The fact that the higher growth potential of the economy is only partly matched by higher growth of actual GDP reinforces the price dampening effect of stronger productivity growth through increased slack in the goods and labor market. The stronger growth of capital productivity temporarily reduces investment in machinery and equipment, and the stronger increase of labor productivity has a long-lasting negative effect on employment.

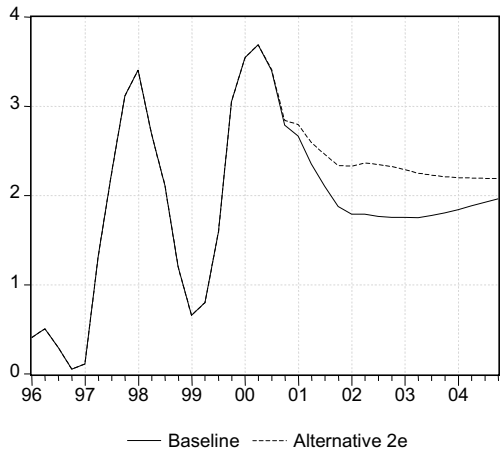
Of course, the *split* of the productivity effect on lower inflation and higher GDP growth can be influenced by monetary policy. For instance, by cutting the 3M-Libor from 3.5% to 2.5%, monetary policy would stimulate aggregate demand and thus give more room for actual output to increase. On this assumption, as shown in Figure 5 (to be compared with Figure 3), one obtains an inflation forecast that practically coincides with the *Baseline Forecast* whereas GDP growth is nota-

Figure 5 – Effects of higher productivity growth
Baseline and Alternative 2e (Monetary policy relaxed: 3M-Libor = 2.5%)

a) CPI inflation



b) GDP growth



bly higher. In other words, given a certain inflation target, the appropriate level of short-term interest rates is lower the more productivity rises. The recent development in the US can be taken as an illustration for this relationship. Counting on faster technical progress, the FED has tightened monetary conditions only gradually although the US economy was expanding for several years at a pace that would have had to be judged as highly inflationary on basis of historical estimates of productivity growth.

In other respects, the recent US experience shows that the above simulation exercise captures potential "New Economy" effects only in a very limited sense. In particular, in the US economy higher productivity growth was not accompanied by a decline in investment activity and employment. To some extent, this may be due to a lucky coincidence with other factors that *independently* stimulated the economy from the demand side. However, it is probably more appropriate to think of the "New Economy" as a phenomenon that *simultaneously* boosts productivity *and* spurs aggregate demand through the creation of new market opportunities. A related point is made by Gordon (2000). He finds that the productivity effect of the "New Economy" is confined to durable manufacturing. The other sectors of the economy invest in new technologies as well, but without much impact on productivity. For instance, firms may be forced by competition to engage in the internet activities, to maintain web sites and to offer e-commerce services. In many cases, such investments are only duplicating traditional sales promotion activities rather than replacing them by something more productive.

Obviously, such *direct* demand effects are not taken into account in the scenario of *Alternative 2*. To be sure, higher productivity growth influences aggregate demand, but only through the adjustment of relative prices like an increase in the real wage, a relative decline in capital costs and a fall in the real exchange rate. Eventually, these adjustments bring about an increase in aggregate demand. The process is however slow and moreover delayed by the initial decline in investment and employment. Against this background, labeling Alternative 2 as a "New Economy" scenario would seem rather problematic.

5.2. Implications for monetary policy (Alternative 3)

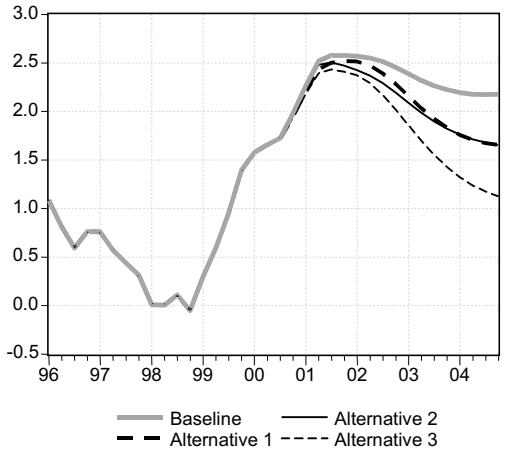
In this section, we want to illustrate how monetary policy may be misled by wrong assessments of future productivity growth. In order to get a clear basis of comparison, monetary authorities are again assumed to aim at an inflation target of 1.7% in 2004. Accordingly, *Alternative 1* (historical productivity growth, 3M-Libor = 4.5%) portrays an appropriate stance of monetary policy. This is also the case for *Alternative 2* (higher productivity growth, 3M-Libor = 3.5%). In both scenarios, the 3M-Libor is set on basis of correct assumptions with respect to productivity growth and the inflation target is therefore attained (Figure 6a). Of course, as shown in Figure 6b, GDP growth is higher in *Alternative 2* since the reduction in the inflation rate is brought about by stronger productivity growth instead of monetary tightening. In contrast, two other scenarios are conceivable in which monetary authorities either underestimate or overestimate future productivity growth:

- The inflation forecast is based on the assumption of an unchanged productivity trend (q = 1.2%) and the 3M-Libor is therefore raised to 4.5%. In fact, however, productivity growth accelerates (θ = 1.8%). In this scenario, referred to as *Alternative 3* (Table 4, Appendix), monetary policy turns out to be too restrictive. The inflation rate falls to 1.2% (0.5 percentage points below the target), at the cost of an unnecessary depression of GDP growth as compared to *Alternative 2*, where the acceleration of productivity growth is correctly anticipated and the 3M-Libor is therefore left unchanged at 3.5% (Figure 6). The cumulative loss in GDP growth associated with the excessive tightness of monetary policy is 1.5 percentage points.
- Monetary authorities may expect an increase in productivity growth but in fact productivity proceeds on the historical trend. Simulating such a scenario is not really necessary since the *Baseline Forecast* (Table 1) can be interpreted this way. It combines an unchanged productivity growth (θ = 1.2%) with a 3M-Libor of 3.5%, which would be appropriate with regard to the inflation target in case of increased productivity growth (θ = 1.8%). However, as productivity growth actually remains unchanged, monetary policy turns out to be too lax. The inflation rate in 2004 is 2.2% (0.5 percentage points above the target), as shown in Figure 6.

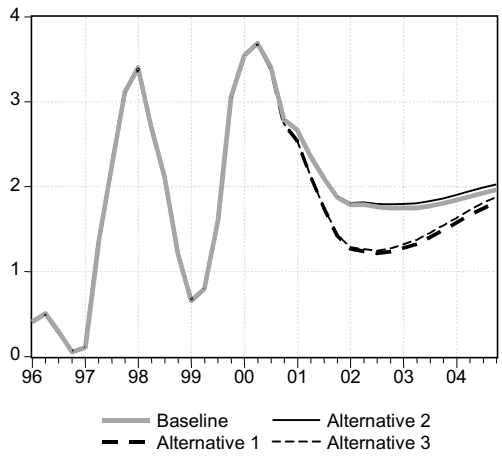
In this latter case, there is a cumulative gain in GDP growth of 1.7 percentage points as compared to *Alternative 1*, where the 3M-Libor is raised to 4.5%. However, one should refrain from weighing this GDP gain against the deviation from the inflation target because, by doing so, one would call the target itself in question. Moreover, as can be seen from figure 6, the loss in GDP growth associated with monetary tightening in *Alternative 1* is largely temporary whereas not tightening in case of unchanged productivity growth has inflationary consequences of a longer-term nature.

Figure 6 – Baseline (3M-Libor = 3.5%), Alternative 1 (3M-Libor = 4.5%)
Alternative 2 (higher productivity growth, 3M-Libor = 3.5%)
Alternative 3 (higher productivity growth, 3M-Libor = 4.5%)

a) CPI inflation



b) GDP growth



6. The role of the "mortgage rate-housing rent" link

As already noted in Section 4, monetary tightening reduces inflation via the exchange rate channel and the aggregate demand channel, but there is a sizable temporary *counter-effect* resulting from the dependence of *housing rents* on *mortgage rates*. In this section, we want to quantify the importance of this counter-effect by means of a model simulation in which housing rents are alternatively linked to the overall CPI.

6.1. The effects of linking housing rents to CPI (Alternative 4)

The equation for housing rents in the model does not explicitly include the mortgage rate as an argument but takes the long-term interest rate as a proxy. Using the mortgage rate would require an additional equation in the model, linking mortgage rates with a certain lag to market interest rates. However, a simple error-correction equation for housing rents (*phr*) with a three-quarter lag on the long-term interest rate (*lrate*) and construction prices (*picnstr*) actually works better than the alternative approach. The equation reads as

$$\Delta \log(phr_t) = b_0 + b_1 \Delta lrate_{t-3} + b_2 \Delta \log(picnstr_{t-3}) - \gamma \left[\log(phr_{t-1}) - \beta_1 lrate_{t-4} - \beta_2 picnstr_{t-4}\right] \quad (21a)$$

Estimation of (21a) shows that the pass-through of interest rates to housing rents is significant. However, as an analysis of parameter stability reveals, the pass-through has become somewhat weaker over time (decreasing values of b_1 and β_1). Taking this into account, the equation used in the above simulations implies that a 1 percentage point increase in long-term interest rates pushes housing rents up by about 4.5% (β_1), although with a substantial degree of inertia ($\gamma = 0.15$). This is less than what would be allowed according to Swiss legislation on tenant protection, permitting a 3% rise of housing rents per one quarter of a percentage point rise in mortgage rates. A plausible explanation of the reduced impact is that an increasing share of apartments is nowadays rented at market prices and no longer at cost-determined rents below market prices. Nevertheless, the impact of interest rates on housing rents is still strong enough to hamper the efficacy of monetary policy to a considerable degree.

In the following simulation, (21a) is replaced by an alternative "rule" that links housing rents (*phr*) to the overall CPI (*pci*). Proposals for such a change in the legislation are currently discussed in Swiss parliament. From an economic point of view, linking housing rents to the CPI is rather problematical since it amounts to fixing the relative price of a sector that probably differs from the rest of the economy with respect to the development of production costs and demand. In fact, in the period 1980-1999 housing rents have increased more than the CPI, on average by 0.23 percentage

point per quarter. Accordingly, when a *CPI-rule* for housing rents is fitted to the data, one needs to include a constant term, which assumes a significant positive value of 0.0023:

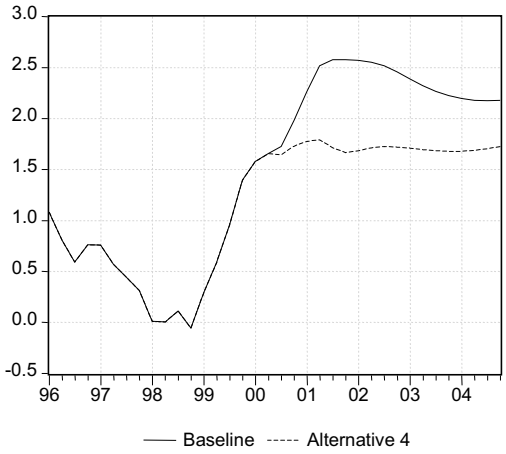
$$\Delta \log(phr) = 0.0023 + \Delta \log(pci)\,. \qquad (21b)$$

Longer-run simulations with the model without such a constant term would entail a continuous decline of *housing investment*. This outcome is due to the fact that the equation for *housing investment* involves a measure of profitability, and this measure deteriorates if *phr* is prevented from increasing in relation to *pci*. In the following simulation, the *interest rate rule* for housing rents, (21a), is therefore replaced by a *CPI rule* in the form of (21b). The constant term in (21b) ensures that the long-term development of housing rents is the same on average as for (21a). In periods of increasing interest rates, (21b) will, however, produce smaller increases in housing rents than (21a).

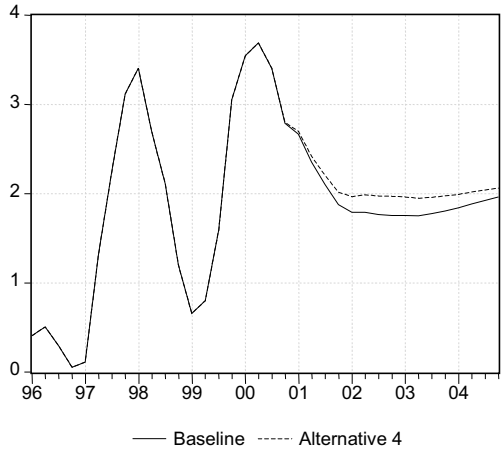
This forecast scenario, referred to as *Alternative 4*, is presented in Table 5a. Table 5b displays the differences in comparison to the *Baseline Forecast*, where everything is identical except that housing rents are determined by (21a). Figures 7 and 8 show to what extent the forecasts for important endogenous variables of the model are affected by the change in the housing rent equation. Figure 7 compares the two scenarios with respect to CPI-inflation and GDP growth. Figure 8 shows the deviations of *Alternative 4* from the baseline path as level effects for interest rates, the output gap and the unemployment rate, and as differences in annualized quarterly growth rates for all other variables of the model.

Figure 7 – Effects of linking housing rents to CPI (Baseline and Alternative 4)

a) CPI inflation



b) GDP growth



c) Long-term interest rate

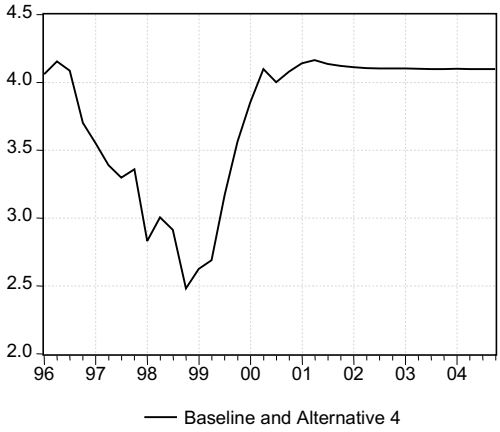
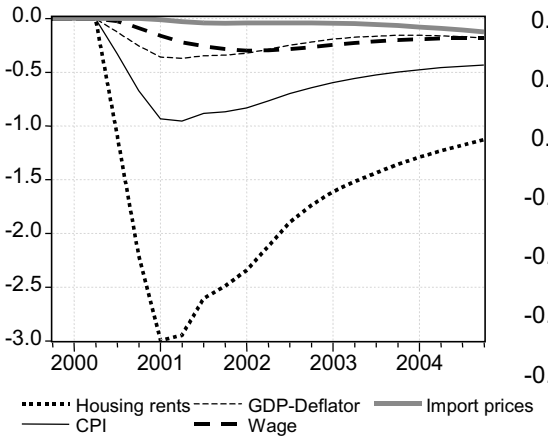


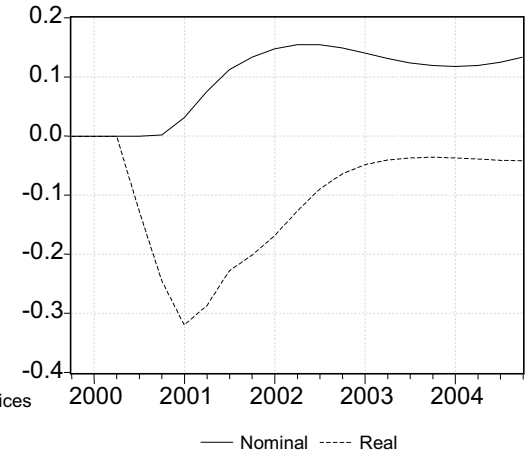
Figure 8 – Effects of linking housing rents to CPI

Alternative 2, deviations from baseline growth rates or levels (interest rates and unemployment rate)

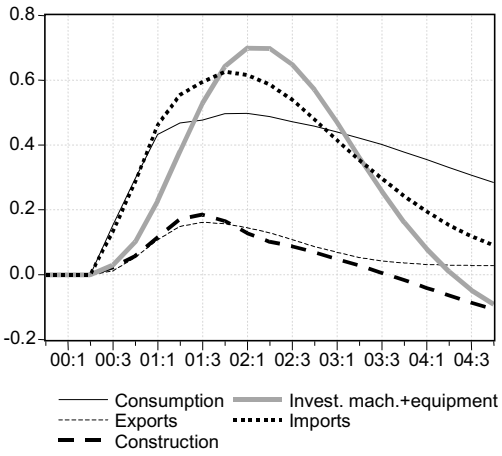
a) Various inflation rates



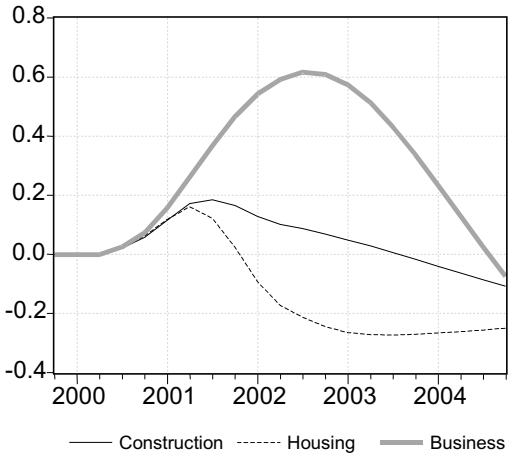
b) External value Swiss Franc



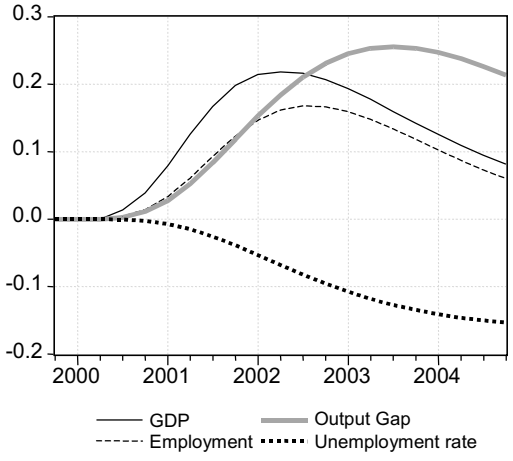
c) Components of GDP



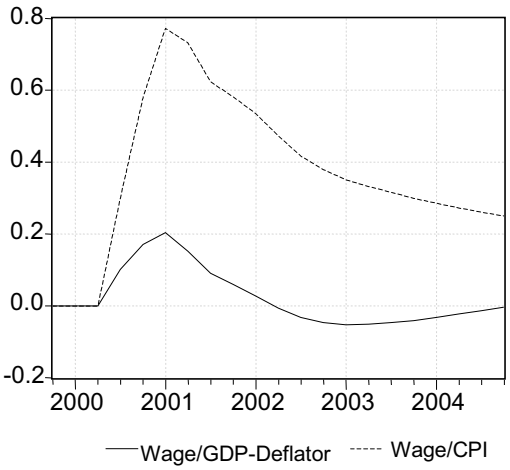
d) Components of construction



e) Tension on the goods and labor market



f) Real producer and consumer wage



Suppressing the impact of interest rates on housing rents by linking them to the CPI has a considerable effect on the inflation forecast. Whereas *CPI inflation* is temporarily pushed as high as 2.5% in the *Baseline Forecast*, CPI inflation hovers closely around 1.7% throughout the forecast period in *Alternative 4* (Figures 7a and c). At the same time, there is a small positive effect on *GDP growth* (Figure 7b). In terms of differences in annualized quarterly growth rates, housing rent inflation is reduced by a maximum of 3 percentage points in 2001Q1 (Figure 8a). This is reflected in a reduction of overall CPI inflation of almost 1 percentage point. Due to *second-round effects*, the reaction of CPI inflation exceeds the direct impact of housing rents to some extent. Inflation measured by the GDP deflator is dampened by about 0.4 percentage points. Nominal wage growth is also reduced, but by less than CPI inflation, so that real wages, in particular real consumer wages, are positively affected by the *CPI rule* (Figure 8f).

The *second-round effects* on inflation have to be seen in the context of the wage equation of the model that links wages to a weighted average of the CPI and the GDP-deflator, and the "wedge" driven by increasing housing rents between the CPI and the GDP-deflator. This wedge, reflecting the income claims of house owners, is reduced in *Alternative 4* as compared to the *Baseline Forecast*. Hence, the inflationary pressure resulting from conflicting income claims becomes smaller, and this lets the economy move towards a new equilibrium with lower unemployment, increased capacity utilization and higher income shares of workers and firms. For a more detailed explanation of these mechanisms on basis of a stylized version of the model's wage-price dynamics, see the Box on the next page.

Lower inflation raises real disposable household incomes, although non-wage incomes are depressed somewhat by the smaller increase in housing rents. As a result, the growth rate of private consumption shows a positive reaction (Figure 8c). Lower inflation also leads to a real depreciation of the Swiss franc (always in relation to the *Baseline Forecast*), which stimulates export growth. This effect is however mitigated in the course of the forecast period by a nominal appreciation (Figure 8b). The higher growth of consumption and exports sets in motion a multiplier/accelerator process by which employment, capacity utilization, investment in machinery and equipment and construction investment are all positively affected (Figure 8c). The stronger growth of aggregate demand is, however, partly absorbed by higher imports, so that the GDP effect turns out to be rather small. Nevertheless, the output gap narrows (higher capacity utilization) and unemployment decreases (Figure 8e). Towards the end of the forecast period, the growth rate of construction shows a negative reaction. This is due to the fact that the smaller increase of housing rents depresses the profitability of housing investment. Accordingly, as can be seen from Figure 8d, the growth rate of housing investment is negatively affected, whereas business construction shows a positive response, in close connection to the behavior of investment in machinery and equipment.

6.2. Implications for monetary policy

In the simulations of Section 5, it was shown that the inflation forecast depends quite strongly on alternative assumptions as to future productivity growth, even if these assumptions remain within the bounds of possibility. This was an illustration for one of the various types of uncertainty surrounding monetary policy (parameter uncertainty, model uncertainty, uncertainty with respect to the exogenous variables in the forecast period, future shocks). The simulation in this section with a changed equation for housing rents is different in character. The current legislation on rent control is known and a potential new rule would be introduced only after a lengthy political process. The simulation is therefore rather to be viewed as a *counterfactual experiment*, shedding light on the question of whether the current legislation should be changed.

Due to the constant term in the *CPI rule* (21b), the development of housing rents is the same on average as for the *interest rate rule* (21a) in a long-term simulation. In the concrete forecasting situation under consideration, however, using the *CPI rule* instead of the *interest rate rule* makes quite some difference because it prevents higher interest rates from being passed onto housing rents. Supposing again an inflation target of 1.7% for the year 2004, the forecast of *Alternative 4* implies that monetary policy may remain unchanged (3M-Libor = 3.5%) since the inflation target is just met.[11] In contrast, the *Baseline Forecast* has inflation at 2.2% in 2004 and therefore signals that monetary conditions must be tightened, as is done in *Alternative 1* (3M-Libor = 4.5%). In other words, it is the *interest rate rule* for housing rents that necessitates a move to a more restrictive stance of monetary policy – and at the same time it hampers the effectiveness of monetary tightening in reducing inflation.

11 *To be precise, one should mention that the constant term in (21b) has been set to a slightly larger value of 0.00247 in order to obtain this result. With the estimated value of 0.0023, inflation would even fall somewhat below 1.7% in 2004.*

Box: The role of housing rents in a stylized version of the wage-price block *

Wages *w* react to a weighted average of the GDP-deflator *p* and consumer prices *pci* and in addition depend on labor market tension (π_L):

$w = w(p, pci, \pi_L)$ (This equation represents the income claims of workers.)

The GDP-deflator (to be viewed as the aggregate price of domestic production) depends in a flexible mark-up equation on wages *w* and tension in the goods market (π_G):

$p = p(w, \pi_G)$ (This equation represents the income claims of firms.)

Consumer prices depend on the GDP-deflator *p*, housing rents *phr* and import prices *pimp*:

$pcp = pci(p, phr, pimp)$

Now, a rise in *phr* entails an increase of *pci* in relation to *p* and – since *w* partly depends on *pci* – also an increase of *w* in relation to *p* (for given labor market tension). Thus, a rise in *phr* produces a lower real consumer wage *w/pci* (since *w* is *only partly* adjusted to *pci*) but a higher real producer wage *w/p* (since *w is partly* adjusted to *pci*). However, the higher real producer wage *w/p* is in conflict with the *p*-equation, which – for given tension in the goods market – implies a fixed mark-up of *p* over *w*. In other words, for given market tension, the income claims of worker and firms become incompatible as a result of the higher income claims of house owners, exceeding what is actually available for distribution. This conflict sets in motion an inflationary process, which must go to the point where reduced market tension has re-established compatibility of the income claims. In the *w*-equation, a lower value of π_L (higher unemployment) dampens *w* in relation to *p*. In the *p*-equation, a lower value of π_G (lower capacity utilization) reduces the mark-up of *p* over *w*.

A conceivable new equilibrium (taking the increase in *phr* as exogenous) has π_G and thus the mark-up of *p* over *w* back to the starting point, whereas π_L and *w/pci* are lower. So firms are eventually unaffected by the higher *phr*, while workers carry the full burden in form of a reduced real consumer wage. This is brought about in the *w*-equation by lower π_L (higher unemployment), which completely counteracts the response of *w* to the higher *pci* (weaker bargaining position of workers). Of course, alternative equilibrium positions in which firm also carry part of the burden in form of a lower π_G and thus a lower mark-up of *p* over *w* are conceivable as well. But what happens in the model is closer to the first solution for the following reason. Investment and thus production capacity react fairly quickly to reduced capacity utilization so that π_G has a rather strong tendency to return to the initial equilibrium. In contrast, the supply side of the labor market is much more rigid. Accordingly, compatibility of the income claims is re-established primarily through higher unemployment and a lower real consumer wage *w/pci* – and not through reduced capacity utilization and a higher real producer wage *w/p* (smaller mark-up of *p* over *w*).

Exactly the same "wedge"-mechanism comes into play if import prices (*pimp*) increase. In both cases, the inflationary pressure and the increase in unemployment depend crucially on the weights of *p* and *pci* in the *w*-equation. If *w* depended only on *p*, then workers would "voluntarily" accept a lower real consumer wage *w/pci*. In this case, an increase in *phr* or *pimp* would not set in motion an inflationary spiral of wages and prices. The stronger the impact of *pci* in the *w*-equation, the more have workers to be forced to accept a lower real consumer wage *w/pci* by higher unemployment. Until this point is reached, the incompatibility of income claims gives rise to an inflationary process with wages pushing up prices and prices pushing up wages.

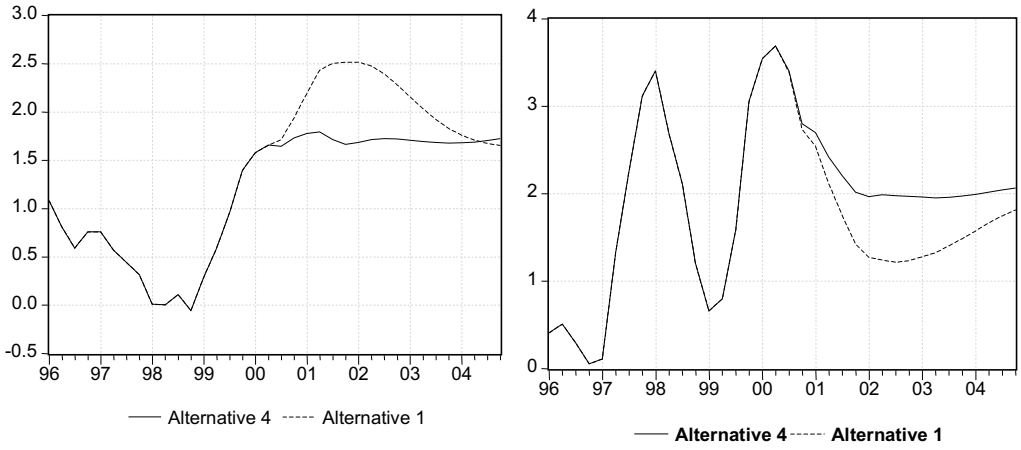
** The specification is in the spirit of Layard, Nickel and Jackman (1991); see also Section 2.1.*

Considering the entire forecasting horizon and taking GDP growth also into account, the advantage of the *CPI rule* becomes even more evident (Figure 9). *Alternative 1* (*interest rate rule*, 3M-Libor = 4.5%) and *Alternative 4* (*CPI rule*, 3M-Libor = 3.5%) both produce an inflation rate of 1.7% in 2004. However, whereas the inflation dampening effect of tighter monetary policy is subject to a long lag, the replacement of the *interest rate rule* by the *CPI rule* reduces inflation to 1.7% right from the beginning of the forecast period. Moreover, there is a sizeable real side effect of monetary tightening that reduces GDP growth temporarily to 1.2%, while GDP growth remains at about 2% throughout the forecast period in the scenario with the *CPI rule*.

The beneficial impact of a switch to the *CPI rule* should however be interpreted with care. In particular, it must be recognized that it is not a general result but applies to the concrete forecasting situation with rising interest rates. To be sure, interest rates do not rise much *during* the forecast period, but they have been rising by 1.5 percentage in the 7 quarters *preceding* the forecast period. This increase, given the delay in the adjustment of housing rents to interest rates, is thus in the pipeline under the *interest rate rule*. What the switch to the *CPI rule* then does is just to block up this pipeline at a time when it matters much. Hence, the strong inflation dampening effect of the switch to the *CPI rule* is conditional on the concrete forecasting situation.

Figure 9 – Housing rents linked to CPI (Alternative 4) versus tighter monetary policy under the "mortgage rate-housing rent" link (Alternative 1)

a) CPI inflation b) GDP growth

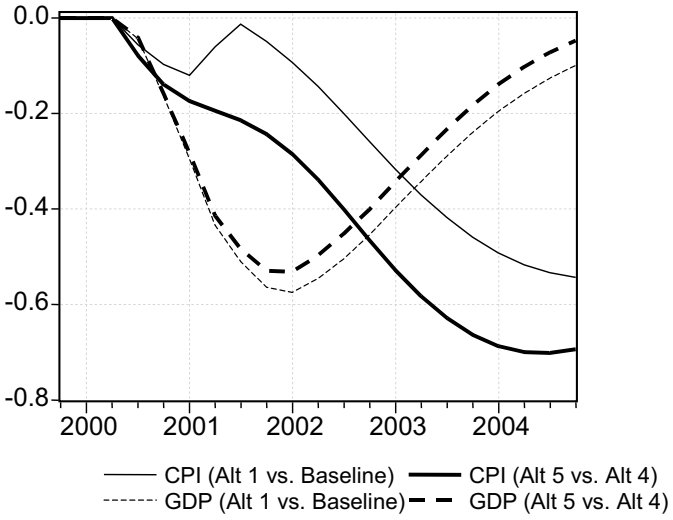


A possibility to assess the difference between the two rules for housing rents from a more general perspective is to analyze the monetary transmission mechanism under the two regimes. This requires a further simulation in which the 3M-Libor is raised to 4.5% under the *CPI rule* as well – as was done under the *interest rate rule* in *Alternative 1*. This forecast, referred to as *Alternative 5*, is documented in Table 6a and compared to *Alternative 4* (3M-Libor = 3.5%) in Table 6b. Table 6b thus shows the effects of raising the 3M-Libor by 1 percentage point under the *CPI rule*. Table 2b, comparing *Alternative 1* with the *Baseline Forecast*, does the same for the model with the *interest rate rule*. These effects are not conditional on the concrete forecasting situation since the *past* interest rate increases that are in the pipeline under the *interest rate rule* are cancelled out by the comparison of the scenarios. What Tables 6b and 2b thus show is only the effect of the *additional* increase in interest rates that takes place *within* the forecast period.

Figure 10 shows the effects of monetary tightening on inflation and GDP growth under the two regimes. The thin (bold) lines refer to the model with the *interest rate rule* (*CPI rule*). The solid (dashed) lines show the reaction of CPI inflation (GDP growth rates). The *CPI rule* makes the monetary transmission mechanism more efficient in two respects. *First*, while the interest rate rule pushes CPI inflation almost back to the baseline path by the 5th quarter of the simulation, monetary tightening under the CPI rule entails a smoother and overall stronger reduction in CPI inflation. At the end of the forecasting horizon, the reduction is 0.54 percentage points in case of the interest rate rule and 0.69 percentage points in case of the CPI rule. *Second*, the negative side effect of monetary tightening on GDP growth is somewhat less pronounced under the CPI rule.

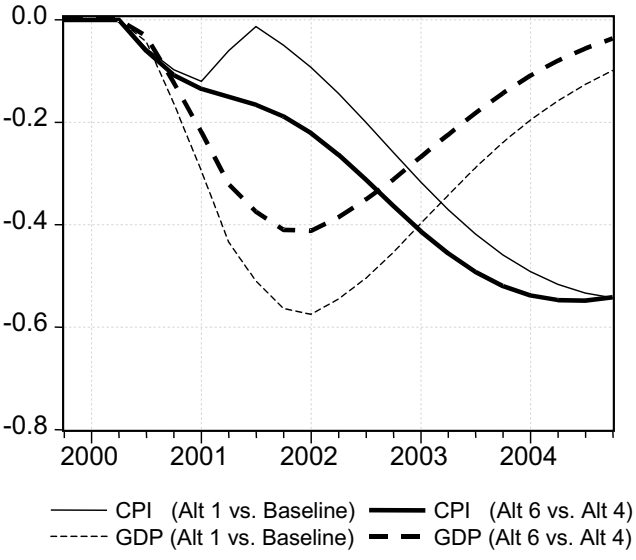
A more detailed account of the differences between the two regimes is given by a comparison of Table 6b with Table 2b. Monetary tightening reduces the growth rate of private consumption to a lesser extent under the *CPI rule*. The mirror image is a somewhat stronger negative effect on housing investment. The more favorable development of private consumption under the CPI rule is partly absorbed by higher import growth. Moreover, lower inflation initially results in a somewhat smaller real appreciation of the Swiss franc. This is however compensated later in the forecast period by a stronger nominal appreciation. The growth rate of exports thus differs only very little between the two regimes. Taken together, the reactions of the various demand components amount to a somewhat smaller reduction of overall GDP growth under the CPI rule.

Figure 10: Effects of tighter monetary policy (3M-Libor raised from 3.5% to 4.5%)
Housing rents linked to interest rates: Alternative 1 vs. Baseline
Housing rents linked to CPI: Alternative 5 vs. Alternative 4



Of course, one should not expect big differences in overall GDP growth between the two regimes in the first place. The only way for monetary policy to bring down inflation is through a depressing impact on the real economy. What differs to some extent between the two regimes is the distribution of the effects on the different sectors of the economy. However, the main difference between the two regimes pertains to inflation. Given a *certain degree of monetary tightening* (3M-Libor = 4.5% instead of 3.5%), the inflation dampening effect is more pronounced under the CPI rule. Of course, turning the argument around, one may also say that for a *certain reduction in the inflation rate* a less resolute monetary tightening is required under the CPI rule. This point can be made more concrete by solving the model for the 3M-Libor that produces the same inflation dampening effect as the increase in the 3M-Libor from 3.5% to 4.5% under the interest rate rule. It turns out that the 3M-Libor must be raised to 4.27% only, and this is associated with a smaller adverse GDP effect. As shown in Figure 11, the maximum loss in GDP growth is only about 0.4 percentage points instead of nearly 0.6 percentage points in case of the interest rate rule.

Figure 11 – Effects of tighter monetary policy
Housing rents linked to interest rates: Alternative 1 (3M-Libor = 4.5%) vs. Baseline
Housing rents linked to CPI: Alternative 6 (3M-Libor = 4.27%) vs. Alternative 4



Overall, the simulations of this section show that the link of housing rents to interest rates, as established by Swiss legislation on tenancy rights, hampers the efficacy of monetary policy in two dimensions. First, the inflation dampening effect of monetary tightening is reduced. Second, the adverse side effects on the real economy are larger. Under an alternative CPI rule, the same reduction in the inflation rate is attained with a less restrictive course of monetary policy and thus a smaller loss in real GDP. In other words, Swiss legislation on tenant protection forces monetary policy to become more restrictive if a certain reduction in the inflation rate is to be achieved, since the counter-effect of increasing housing rents has to be compensated.

7. Summary and Conclusions

At the beginning of the year 2000, the Swiss National Bank (SNB) has replaced its traditional monetary targeting approach by a concept that focuses on inflation forecasts. The *key elements* of this concept are (i) an explicit *definition of price stability* (CPI inflation below 2%), (ii) regularly updated conditional *inflation forecasts* with a horizon of three years and (iii) the announcement of a target range for *short-term interest rates* (3M-Libor). For instance, an inflation forecast – obtained on the provisional assumption of an unchanged 3M-Libor – exceeding 2% gives a signal for monetary tightening. The simulations presented in this paper have to be seen in the context of this adapted concept of monetary policy.

It is a commonplace to say that monetary policy, irrespective of the concrete concept, has always been a difficult task. One of the advantages of the modified concept is that it makes these difficulties more transparent and therefore offers a better chance to learn from past errors. From a methodological point of view, things are in fact quite simple: The appropriateness of monetary policy hinges directly on the reliability of the inflation forecast. If the stance of monetary policy in a certain period turns out to be inappropriate, the error can be traced back to an erroneous inflation forecast for that period, although the overlapping character of updated inflation forecasts and monetary reactions would complicate this task in practice.

Forecasting errors may arise for several reasons. *First*, the economy may be affected by shocks in the forecast period, as was the case in the past. However, while past shocks are captured by the stochastic error terms of the model, these error terms are set to zero in the forecast period since future shocks are – by definition – unpredictable. *Second*, the parameters of the model are estimated on basis of a limited sample and therefore are subject to sampling error. *Third*, the forecast may be misled by wrong assumptions with respect to the exogenous variables of the model. It should be recognized that all these types of errors will occur even if the model gives an adequate description of the data-generating process. However, the assumption to dispose of such an ideal, correctly specified model is unwarranted, as documented by the simple fact that different researchers typically advocate different types of models. Hence, forecast errors of a *forth* type must be expected in practice, arising from the *uncertainty* with respect to the *adequate specification* of the model.

Against this background, this paper presents two specific examples of structural/institutional changes that affect the inflation forecast and thus – if not taken into account properly in the forecasting model – would give wrong signals for monetary policy. The first simulation experiment deals with the impact of productivity growth on inflation. This experiment may be regarded as an example of model uncertainty. Can the historical estimate of technical progress be carried over to the forecast period, or is it more realistic to assume a faster rate of *technical progress* in the era of the "New Economy", liberalized and globalized markets and tougher competition? If such considerations seem relevant, to what extent do they affect technical progress in the forecast period? The second simulation deals with a potential change in the Swiss legislation on tenancy rights, replacing the traditional link of housing rents to *mortgage rates* by an alternative link to the *CPI*. This simulation is somewhat different in character since it addresses the implications of an institutional change that, in principal, would be known to the monetary authorities some time in advance, although the practical working of the new rule might be less obvious.

These simulation experiments are carried out with a medium-size structural macromodel and are imbedded in a forecasting situation similar to the one faced by the SNB in August 2000. As in the actual monetary decision process, the first step thus is to compute a *Baseline Forecast* conditional on the assumption of an unchanged 3M-Libor. The *Baseline Forecast* is intentionally made somewhat more inflationary than the actual SNB forecast of August 2000. The inflation rate increases from 1.7% in the current year to 2.5% in 2001/2002 and falls slightly back to 2.3% and 2.2% in 2003/2004. Hypothetically assuming an inflation target of 1.7%, the *Baseline Forecast* thus gives a signal for monetary tightening. According to the model, as shown in a second simulation (*Alternative 1*), the 3M-Libor has to be raised from currently 3.5% to 4.5% in order to attain the inflation target.

In the model used so far, *productivity growth* proceeds on its *historical trend.* A next simulation (*Alternative 2*) then addresses the implications of higher productivity growth. The simulation is implemented by raising the technical progress parameter of the model by 50%, implying an annual rate of labor-augmenting technical progress of 1.8% instead of 1.2% as in the *Baseline Forecast*. Since the production function of the model is of a vintage type, faster technical progress falls exclusively on new equipment. The productivity gain on the whole production apparatus is endogenous, depending on the replacement of old equipment by new equipment (scrapping and investment). Although this process is sped up by a higher rate of technical progress on new equipment (old equipment looses its competitiveness more quickly), the share of new equipment in the production apparatus remains relatively small in the time horizon under consideration. Hence, overall productivity increases by less than productivity on new equipment. Nevertheless, the productivity gain in *Alternative 2* is sufficient to bring inflation down to 1.7% in 2004. As this is just the assumed target value, no monetary tightening is indicated – in contrast to the *Baseline Forecast,* where the inflation target is missed by 0.5 percentage points.

Evidence for a sustained boost to productivity growth in Switzerland is, at least for the time being, far from being conclusive. Monetary policy can thus be misled in two directions. First, future productivity growth may be *overestimated*. In this case, monetary policy is based on a too optimistic inflation forecast and thus turns out to be too lax. The cost of the forecast error shows up in form of an inflation rate that exceeds the target value. Second, productivity growth may be *underestimate*d. In this case, monetary policy is based on a too pessimistic inflation forecast and thus turns out to be too restrictive. In this case, the inflation rate falls below the target value at the cost of an unnecessary depression of real GDP growth. This is an illustration for the many uncertainties surrounding monetary policy. Changes in parameter values, even if they remain within the bounds of possibility, can have sizable effects on the inflation forecast and hence on monetary policy decisions.

As a second issue, the paper tries to assess the implications of a potential change in the *formation of housing rents*. The equation for housing rents reflects current legislation on tenant protection, which permits house owners to pass higher mortgage rates in certain proportions to housing rents.[12] If monetary policy is tightened, mortgage rates and thus housing rents increase. Housing rents being an important component of the CPI, one may suspect that this mechanism hampers the efficiency of monetary policy. In order to see to what extent, the housing rent equation of the model is replaced by an alternative rule that links housing rents to the CPI. On basis of this model, two further simulations are performed. The first refers to the concrete forecasting situation of August 2000. The second compares the monetary transmission mechanism between the two regimes from a more general perspective.

In the forecasting situation of August 2000, the alternative *CPI rule* lowers the inflation forecast significantly (*Alternative 4*). Supposing again an inflation target of 1.7%, the forecast implies that monetary policy may remain unchanged. In contrast, the *Baseline Forecast* has inflation at 2.2% in 2004 and therefore signals that monetary policy should be tightened. Moreover, while monetary tightening lowers inflation only slowly and in company with a substantial negative GDP effect under the *interest rate rule*, the switch to the *CPI rule* reduces inflation to 1.7% right from the beginning of the forecast period and has a small positive impact on GDP growth.

These beneficial effects may be traced back to the formation of wages, which depend on a weighted average of the CPI and the GDP-deflator, and the "wedge" driven by increasing housing rents between the CPI and the GDP-deflator. The existence of this wedge, reflecting the income claims of house owners, requires higher unemployment and lower capacity utilization in order to confine the income claims of workers and firms. The switch to the *CPI rule* lowers the wedge, so that the economy moves towards a new equilibrium with lower inflation, higher employment and higher GDP.

It should be stressed, however, that these results are not general but apply to the specific forecasting situation, which was preceded by a considerable increase in interest rates. Due to adjustment lags, a strong increase of housing rents is therefore already in the pipeline under the *interest rate rule*. What the switch to the *CPI rule* then does is to cut this pipeline at a time when it matters much. Hence, the rather strong inflation dampening effect is conditional on the concrete forecasting situation.

In order to assess the differences in the monetary transmission mechanism between the two regimes from a more general perspective, a final simulation is carried out that tightens monetary pol-

12 *The term tenant protection and the right for house owners to pass higher mortgage rates to tenants may seem somewhat contradictory at first sight. However, one should recognize that rents of older apartments are often below potential market prices. Therefore, the principle of cost-determined housing rents "protects" tenants from market-determined rent increases. Moreover, the mechanism should also go into the other direction, i.e., lower mortgage rates should be passed to tenants as well. To what extent this actually happens in reality is however less clear.*

icy under the CPI rule as well (although this is not necessary with regard to the inflation target). It turns out that the *CPI rule* makes the monetary transmission mechanism more efficient in two respects. *First*, the inflation dampening effect is quicker and stronger, since the adverse counter-effect of rising housing rents is suppressed. *Second*, the negative side effects on GDP growth are less pronounced. Put differently, Swiss legislation on tenant protection forces monetary policy to become more restrictive if a certain reduction in the inflation rate is to be achieved, and this additional tightening is reflected in a stronger loss of real GDP growth.

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An appendixx to this paper is available on the IFC Web site (http://www.ifcommittee.org/S4stalder.pdf).

The NAIRU in Israel: an unobserved components approach

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1. Introduction

Unemployment in Israel varied substantially during the 1990s. This was the result of both the business cycle and a huge immigration influx during the first years of the decade, as well as other structural changes. During that era, the Bank of Israel followed a descending inflation target regime. These changes suggest that some of the basic properties of the economy have changed as well.

The perception that some fundamentals of the economy lie underneath the business cycle "veil" is one of the major concepts of economic thought. While some of these fundamentals are backed up and well defined by theoretical models, empirical work that aims to "recover" these forces has encountered substantial obstacles.

The major source for these obstacles is that some of them are unobserved: they are blurred due to numerous shocks that cause deviations from long run equilibria. Hence the economy is constantly moving in the neighborhood of these fundamentals, but the complexity of the economy and the realization of new shocks does not allow for exact identification.

Among these "obscured" fundamentals, the natural rate of unemployment has played a key role for decades. The interest in this variable is twofold: first, to investigate the factors that are responsible for its changes (e.g. labour market structure, demography). Second, to derive policy implications, especially in the context of the unemployment– inflation trade-off. When using the terminology "natural rate" it is essential to define in what sense this rate is "natural": economic theory nowadays generates more than one definition (see Rogerson (1997)). One of these definitions, and the focus for this work, is the Non Accelerating Inflation Rate of Unemployment (we use its acronym NAIRU, hereafter). As its name suggests, the NAIRU is the unemployment rate that is consistent with a stable inflationary process, in the absence of supply shocks, or simply the rate of unemployment that does not press the price level. A comprehensive theoretical and empirical review of the NAIRU framework was presented in a special issue of the Journal of Economic Perspectives (1997).

Knowledge about the NAIRU may have important policy implications, since it provides a better understanding of inflationary pressure, especially the influence of real factors such as the unemployment gap on inflation. The simple, not to say simplistic, way of thinking about the NAIRU is to assume it has a fixed rate over time: on that account, the "textbook NAIRU" in the US was long quoted to be 6% (see Blanchard (1997)). Recent business cycle episodes in some OECD markets disprove the fixed NAIRU assumption. For instance, unemployment went to historically low levels both in the UK and US during 2000, without any visible inflationary pressure, which may be interpreted as a decline in the NAIRU. In the US, where 6% NAIRU was commonly held, unemployment went down to 4% with only minor signs of pressure on wage or price inflation. As for Israel, evidence for changing NAIRU during the post-stabilization era has been found by Yotav-Solberg (1997), and Sussman and Lavi (1999), who suggested that an 1(1) process is reasonable.

There are several possible estimation strategies for identifying the NAIRU. The classic way is to construct a price-price equation where the level of unemployment affects inflation. Using some restrictions on the inflation process that ensure that it is stable, it is possible to use the estimated coefficients in order to generate the NAIRU. This framework was used by Yotav-Solberg (1997), who found that even when restrictions on the inflationary process are imposed, the generated NAIRU tends to move much more than one would think of as reasonable. The solution to this problem usually used in these models is to smooth the estimated NAIRU till a "reasonable" NAIRU volatility is achieved. In countries with stable inflation rates, this framework seems to work better (see Tulip (2001)).

1 *We thank R.D. Porter, Z. Hercowitzs, and R. Melnick for discussion, Y. Rubinstein for constructive comments, and R. Alsheikh for helping us with the SAS programming.*

The present study uses the unobserved components (UC) approach. The essence of this approach is to treat the fundamentals, namely the NAIRU, the unemployment gap, and potential output as latent variables. Assumptions regarding the stochastic processes that describe the evolution of these latent variables over time, enable their exact identification. This approach reflects the fact that not much is known about the factors that determine them (Apel and Jansson (1999), AJ hereafter). Since the determinants are unknown, they are treated as random. The unobserved variables are "recovered" through a set of identifying equations that define the relation between these variables and observed variables. The identifying equations may be structural in the sense that they have some theoretic grounds or, alternatively, identities that generate statistical decompositions of actual data to these variables.

In order to estimate the NAIRU one has to have a well specified inflation process. Following Gordon (1997) this study uses a variant of the "triangle" version of the Phillips curve, where the inflation process depends on three factors: inertia, demand and supply. The basic framework is extended by specifying the unemployment gap as an AR process: this fits Friedman's concept that deviations from the natural rate can not be permanent (see Laubach (2001)). This framework is extended further in order to simultaneously estimate the NAIRU and potential output (see AJ (1999)).

The UC approach has been used extensively in recent years. Statistical decompositions of GDP were presented in Harvey (1989). Phillips curve based estimates for the NAIRU were presented by Gordon (1997), and recently by Laubach (2001) A joint system for NAIRU/Output gap estimation was first introduced by AJ (1999). This system serves nowadays as the IMF "workhorse" , and was also estimated for Israel (Bal-Giindiiz (2001)).

This study uses different State Space Models in order to estimate the NAIRU. An iterative procedure was adopted, involving at each step Kalman filter and SUR equation routines, that sequentially improve the model parameters and expected values of latent (state) variables according to Maximum Likelihood criteria.

The results indicate that the NAIRU is surprisingly stable. Changes in the actual unemployment rate have only a minor effect on the level of the NAIRU. The estimated potential output varies significantly, suggesting that the immigration influx had an important role. In order to build confidence interval for the NAIRU we applied the jackknife technique. As in Laubach (2001) the uncertainty around the NAIRU and potential output estimates is substantial. During the investigated period, however, the unemployment rate differed significantly from the NAIRU in three episodes – as for example during the business boom of 1995-96.

2. The model

2.1. NAIRU as unobserved component

We follow previous works that were quoted before, and use a Phillips curve specification in order to define the NAIRU. We use a variant of the expectations augmented Phillips curve presented by Friedman and Phelps, which emphasized that the inflation-unemployment trade-off does not exist in the long run.

$$\pi_t - \pi_t^e = \rho(L)(u_t - u_t^n) + \beta x_t + \varepsilon_\tau^\pi \qquad \varepsilon_t^\pi \sim N(0, \sigma_\pi^2) \tag{1}$$

where π_t is the inflation rate, π_t^e is the expected rate, u_t is the unemployment rate and u_t^n is the NAIRU. Since expected inflation is in Israel is highly adaptive, i.e. $\pi_t^e = \pi_{\tau-1}$ [2], we estimate this relation using the first difference of inflation.

Note that the causality in this specification is somewhat counter-intuitive. Usually, we think of the unemployment–inflation trade-off as the ability to boost real activity by an unexpected price shock. This specification ignores this feedback channel. Instead, the unemployment gap is used as an explanatory variable – a proxy for excess demand. As explained by Gordon (1997) one can justify this handling by empirical findings that suggest that unemployment Granger-cause inflation (see King and Watson (1994)).

Specifically, we use the so-called "Gordon's triangle" equation. The general structure of the triangle is:

$$\pi_t = \alpha(L)\pi_t + \rho(L)(u_t - u_t^n) + \beta x_t + \varepsilon_t^\pi \tag{2}$$

2 *Note that under rational expectations this specification is reduced to a contemporaneous relation between the unemployment gap and unexpected inflation, as expected inflation incorporates all the information up to time t. Thus, lagged unemplomentgaps can not explain unexpected inflation.*

where inflation is a function of three factors: inertia, demand and supply. The excess demand is captured by the unemployment gap, while the *x*'s capture supply shocks. This equation implies that when unemployment persists under a certain "natural" level, other things equal, the inflation rate will rise. This "natural" level is the NAIRU. The NAIRU is well defined in this context if and only if the sum of the lagged inflation coefficients equals 1.

This formulation assumes that in the absence of supply shocks, and if actual unemployment equals the NAIRU, the inflation rate converges to a constant, long-run equilibrium level. This assumption does not match the inflation trend during the estimated period (1990s), due to the descending inflation target regime that was implemented (successfully) at that time. Hence, we estimated the model in first differences of inflation.

$$\Delta\pi_t = \alpha(L)\Delta\pi_t + \rho(L)(u_t - u_t^n) + \beta x_t + \varepsilon_t^{\Delta\pi} \tag{3}$$

This specification does not assume an implicit long-run equilibrium (Bal-Giindiiz (2001)), and therefore is more appropriate in the case of Israel, and still, defines a meaningful NAIRU (see AJ (1999)). An alternative specification may use the unexpected inflation, namely the difference between actual and expected inflation. In the case of adaptive expectations, the two different specifications resemble each other.

The first term in the triangle is the inertia term that is captured by lags of the dependent variable. An alternative specification that we use is a moving average specification:

$$\Delta\pi_t = \rho(L)(u_t - u_t^n) + \beta x_t + (1-\omega(L))\,\varepsilon_t \tag{4}$$

The justification for this specification is empirical: the equations are not equivalent, even if the AR process is invertible, since other components remain unchanged. However, the residuals that are generated by the different models suggest that this specification captures inertia as well.

The atheoretical part of the model specifies the stochastic process of the NAIRU and the unemployment gap. We now turn to complete the system with some assumptions about the dynamics of the unobserved components. Equation (6) specifies the NAIRU process as a random walk. Although in the long run one would not expect the NAIRU to follow a random walk process since it is bounded[3], this process seems to be a good approximation for short-run movements. As cited in the introduction, evidence for an 1(1) specification was found by Sussman and Lavi (2001).

Together, the system is composed of equations (5)-(7)[4]. The theoretical part of the model is captured by a triangle relationship (the measurement eq. (5)), whilst the atheoretical part of the model specifies the stochastic process of the NAIRU and the unemployment gap (transition eq, (6)- (7)).

$$\Delta\pi_t = \alpha(L)\Delta\pi_t + \rho(L)(u_t - u_t^n) + \beta x_t + \varepsilon_t^{\Delta\pi} \tag{5}$$

$$u_t^n = u_{t-1}^n + \varepsilon_t^n \tag{6}$$

$$(u_t - u_t^n) = \delta_1(u_{t-1} - u_{t-1}^n) + \delta_2(u_{t-2} - u_{t-2}^n) + \varepsilon_t^{gap} \tag{7}$$

A parsimonious version, composed of equations (5) – (6) only, is the specification used by Gordon (1997). As we describe later, this specification tends to generate a volatile NAIRU, unless a restriction is imposed on ε_t^n. In the extreme case the volatility is restricted to zero and the NAIRU is fixed: in other cases, an assumption of the smoothness of the NAIRU is required. As a result, the smoothness of the NAIRU achieved by this specification is an assumption rather than a result. In order to avoid this difficulty, an augmented system with eq. (7) was constructed. This specification requires that the unemployment gap follows an auto-regressive process. Note that the AR parameters are estimated simultaneously without restrictions. Hence, the process is not restricted to be stationary. The augmented system generates a relatively stable NAIRU as a result, without any further direct restrictions. Moreover, the estimated δ's suggest that the unemployment gap is stationary, although the results of an ADF test applied on the estimated series are inconclusive.

This equation has some economic reasoning since "sticky" labor markets cause inertia in the unemployment gap. It also imposes an indirect restriction on the NAIRU process, thus, no additional direct assumptions on the NAIRU volatility are required in order to get a relatively smooth NAIRU path.

3 *Note that in a symmetric random walk process the probability that the random variable will sooner or later (and therefore, infinitely many times), return to its initial position, is one (for univariate and bivariate variables, see Feller (1957)).*

4 *Actually, the system is closed by an additional equation, an identity that restricts the sum of unobserved components to be equal to actual unemployment, imposing the decomposition to be consistent (see appendix B).*

2.2. Potential output as unobserved component

The system below generates a pure statistical decomposition of actual output. The measurement equation is an identity (with no error term) that defines actual output as a sum of two components: potential output and the output gap. The transition block that is composed of equations (9) and (10) defines the stochastic properties of the unobservables. Potential output is assumed to follow a random walk plus drift process (9) , while the output gap is assumed to be an AR(2) process (10). This captures the persistence of the business cycle. This system was also estimated by de Brouwer (1998). Likewise, an AR(2) process was estimated, with no further restrictions on the residuals.

$$y_t = y_t^p + y_t^{og} \tag{8}$$

$$y_t^p = y_{t-1}^p + d + \varepsilon_t^p \tag{9}$$

$$u_t^{og} = \varphi_1 y_{t-1}^{og} + \varphi_2 y_{t-2}^{og} + \varepsilon_t^{og} \tag{10}$$

The estimated parameters ($\varphi_1 = 0.59, \varphi_2 = 0.19$) indicate that the output gap is stationary. Hence, the system decomposes actual output into a stationary and a non-stationary process[5]. This means that the shocks to potential output are permanent, while the shocks to the gap process are transitory (see Yachin and Menashe (2001)).

2.3. Simultaneous system for NAIRU and Potential Output

As first introduced by AJ (1999), it is possible to simultaneously estimate the NAIRU (and therefore the unemployment gap) and potential output (and the derived output gap). This section describes this augmented model.

The term "potential output" is in a way indefinite, and mirrors the equivocal nature of the term "natural rate". A thorough review of this issue has been presented recently by Yachin and Menashe (2001). As for the output gap estimated here, it is simply a "NAIRU output gap", meaning that potential output in this study is the level of output that does not cause inflationary pressure.

The system ties the NAIRU and potential output by augmenting the measurement block using Okun's law (eq. 12) , that relates cyclical unemployment to cyclical output. Since a new unobserved variable is added, an additional assumption about its dynamics is required. Consequently, the system is completed by augmenting the state block with an equation that describes potential output dynamics as a random walk plus drift (eq. 15). The drift captures the growth of the labor force as well as improvements in productivity.

$$\Delta\pi_\tau = \alpha(L)\Delta\pi_t + \rho(L)(u_t - u_t^n) + \beta x_t + \varepsilon_t^{\Delta\pi} \tag{11}$$

$$y_t = y_t^p + \gamma_1(u_t - u_t^n) + \gamma_2(u_{t-1} - u_{t-1}^n) + \varepsilon_t^y \tag{12}$$

$$u_t^n = u_{t-1}^n + \varepsilon_t^n \tag{13}$$

$$(u_t - u_t^n) = \delta_1(u_{t-1} - u_{t-1}^n) + \delta_2(u_{t-2} - u_{t-2}^n) + \varepsilon_t^{gap} \tag{14}$$

$$y_t^p = y_{t-1}^p + d_t + \varepsilon_t^p \tag{15}$$

3. Estimation technique

In order to estimate the system parameters we first cast it in a State-Space Form (SSF). The essence of this representation is to express a dynamic system with two equations (or, in the multivariate case, by two blocks of equations written in a matrix form):

The measurement equation describes the dependence of observed components (such as inflation and output) on a set of variables, some of which may be unobserved (state variables), and others observed "regular" (exogenous) variables. This block may be based on theoretical grounds (hence, "structural"), or on identities (this will be clarified in the next sections).

$$\underset{n\times 1}{Y_t} = \underset{n\times m}{H}\ \underset{m\times 1}{Z_t} + \underset{n\times k}{B}\ \underset{k\times 1}{X_t} + \underset{n\times 1}{\xi_t} \tag{16}$$

where Y_t is a vector of n response (dependent) observed variables at (and up to) time i,

5 *This decomposition is not unique, though. It is possible to decompose output into two non-stationary processes: this depends on the initial values of the ρ's.*

Z_t – vector of m unobserved (state) components at time t,
H – measurement matrix, assumed to be time invariant,
X_t – vector of k exogenous or lagged dependent variables with coefficient matrix B,
ξ_t – vector of serially uncorrelated disturbances with $E(\xi_t) = 0$ and $Var(\xi_t) = R$.

The transition equation, describes the evolution of the unobserved components over time, i.e. the transmission from observation $t-1$ to t. The transition equation is based on a set of atheoretical assumptions, reflecting the fact that our knowledge about the factors that determine their evolution is limited (AJ, (1999)). These assumptions are based on some economic grounds, or may be justified empirically, such as the evaluation of potential output as a random walk plus drift.

The transition equation describes the dynamic process of the unobserved components Z_t, and takes the form of a first order Markov process:

$$\underset{m\times 1}{Z_t} = \underset{m\times m}{F}\ \underset{m\times 1}{Z_{t-1}} + \underset{m\times 1}{\eta_t} \tag{17}$$

where F is an $m \times m$ transition matrix, assumed to be time-invariant,
η_t – vector of serially uncorrelated disturbances with $E(\eta_t) = 0$ and $Var(\eta_t) = V$.

For example, the SSF for the system of equations (11-16) is given below (a full set of SSF's for the different models used throughout this work is given in the appendix B)

$$Y_t = \begin{bmatrix} y_t \\ u_t \\ \Delta\pi_\tau \end{bmatrix}, \qquad Z_t = \begin{bmatrix} y_t^p \\ u_t^p \\ u_t - u_t^n \\ u_{t-1} - u_{t-1}^n \\ d_t \end{bmatrix}$$

$$H = \begin{bmatrix} 1 & 0 & \gamma_1 & \gamma_2 & 0 \\ 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & \rho_1 & \rho_2 & 0 \end{bmatrix}, \qquad F = \begin{bmatrix} 1 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & \delta_1 & \delta_2 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix},$$

$$X_t = \begin{bmatrix} \Delta\pi_{t-1} \\ \Delta\pi_{t-2} \\ \cdots \\ x_t^1 \\ x_t^2 \\ \cdots \end{bmatrix}, \qquad B = \begin{bmatrix} 0 & 0 & 0..0 & 0 & 0 & 0..0 \\ 0 & 0 & 0..0 & 0 & 0 & 0..0 \\ \alpha_1 & \alpha_2 & \ldots & \beta_1 & \beta_2 & \ldots \end{bmatrix},$$

$$\xi_t = \begin{bmatrix} \varepsilon_t^y \\ 0 \\ \varepsilon_t^{\Delta\pi} \end{bmatrix}, \qquad \eta_t = \begin{bmatrix} \varepsilon_t^p \\ \varepsilon_t^n \\ \varepsilon_t^{gap} \\ 0 \\ 0 \end{bmatrix}$$

The aim is to obtain expected values of the state components $Z_t^1, .. Z_t^m$ (t = 1, .. T) and of their variances, as well as measurement and transition coefficients. Note that had $Z^1, .. Z^m$ been observed, the matrices H and F would have been immediately evaluated by straightforward regression estimates. On the other hand, if the system matrices H, F, R and V were known, the unobserved components $Z_t^1, .. Z_t^m$ would be calculated by one pass of the Kalman filter (a full description of the Kalman filter and smoother is given in appendix C).

In order to solve this dual estimation problem, we apply the Estimation Maximisation (EM) algorithm of Watson and Engle (1983). This is a derivative free, iterative algorithm that consists of a Kalman filter pass and SUR estimation. The idea of this method is to maximise the expected likelihood function, by improving the set of unknown parameters and state variables, using information only on their first two moments. This means that the likelihood function maximisation is achieved not through its derivatives but step by step, indirectly.

The likelihood function L of the unknown parameters in (16) and (17) depends on the innovations $Y_t - E(Y_t | Y_{t-1}, \ldots, Y_1, X_t, \ldots, X_1)$ and their variance C_t :

$$L(\theta) = \frac{1}{2}\sum_{t=1}^{T} \log|C_t| - \frac{1}{2}\sum (Y_t - HZ_{t|t-1} - BX_t) C_t^{-1} (Y_t - HZ_{t|t-1} - BX_t)'$$

where θ is the vector of unknown parameters.

The innovations and their variances are calculated previously by a Kalman filter pass.

When the best parameter values are obtained, a new pass of Kalman filter is run, generating an "improved" set of state variables $Z^1, ..Z^m$ and their variances. This is the " estimation" step of the algorithm, while the first step was "maximisation".

More precisely, the estimation starts with the initial matrices *H, F, R, V* and initial values for the mean and variance of the state variables. It allows the first pass of the Kalman filter, generating Z^1, $..Z^m$, by one-step prediction, i.e. $Z_{t|t-1}$. While the system (16)-(17) holds for conditional expected values of Z_t , the last can be evaluated using the smoothing procedure that recursively calculates $Z_{t|T} = E(Z_t | Y_T, Y_{T-1}, \ldots, Y_1, X_T, X_{T-1}, \ldots, X_1)$ and their mean square error matrices $P_{t|T} = \mathrm{var}(Z_t | Y_T, Y_{T-1}, \ldots, Y_1, X_T, X_{T-1}, \ldots, X_1)$. The values $Z_{t|T}$ are the best estimates for expected values of Z_t given the information available till *T,* and the parameter set θ. The smoother runs backward from the last to the first observation of each *Z* variable.

Once the *Z's* are generated, they may be considered as "regular", observed variables. Next, the maximisation step can be carried out. When the system is unrestricted, ordinary least square estimates are sufficient, that is :

$H = (Z'Z)^{-1}(Z'Y) + (Z'X)(X'Y)$,

$B = (X'X)(X'Y) + (X'Z)(Z'Y)$

and

$F = (Z'_{-1}Z_{-1})^{-1}(Z'_{-1}Z)$

where *Z* consists of smoothed state variables $Z^1_{t|T}, \ldots, Z^m_{t|T}$ $(t = 1, \ldots, T)$ and Z_{-1} of their lagged values.

In our case the system contains parameter restrictions, such as zeros and ones in *H* and *F* matrices. Some equations of our system are fully restricted, having no degrees of freedom, so OLS estimates for these equations cannot be obtained.

Assuming that residuals among partially restricted and not restricted equations may be correlated, at each iteration we solve a reduced SUR system, which includes only full rank equations.

In other words, having $n + m$ equations of which l are fully restricted, we compose at each iteration a SUR system of $n + m - l$ equations and obtain "reduced" matrices *H*, F** and *B*.* To complete this step, we need only to enlarge the system, by resubstituting the O's and 1's at their original positions.

When the parameters of *H, F* and *B* are updated and a new series of residuals ξ_t and η_t are available, together with their variance matrices *R* and *V* , we can switch to the next pass of the Kalman filter, constructing an "improved" set of *Z*'s.

'Therefore, one iteration of the EM algorithm involves solving SUR equations (maximisation step), one pass of the Kalman filter which calculates one-step predictions of state variables and one pass of the Kalman smoother that evaluates their conditional expected values (estimation step).

The process converges when the relative changes of parameters, likelihood function, and state variables become negligible.

Our experience shows that this method is sensitive to some initial values, while to some of them it is rather indifferent. For instance, we found that even when the guesses about mean *Z* values are very poor (even zero vector was tried) we reached convergence near the same region. The sensitivity to initial values of the transition matrix *F* and measurement matrix *H* (that were based on ad-hoc considerations) is low, too.

Residual variances *(R* and *V* initial matrices) depend also on the initial assumptions about *B* coefficients, the influence of the exogenous variables on the response. They were approximated by OLS, assuming the NAIRU was fixed over time and equal to the sample average.

The algorithm tends to be quite sensitive to the initial *Z*'s variance, however, the solution to this problem was to use a diffuse prior (see Harvey, 1989): this method calculates the initial variances under lack of stationarity, assuming the variance to be infinite. The results support this treatment, as some of the eigenvalues of *F* are near unity. Alternatively, we tried to enlarge the variances till convergence was reached: this method was inferior to the previous one in terms of convergence speed. The reason for this difference is that we do not have a good guess for the relative variance of the state variables.

4. Empirical results

Three main models were used: the first version (V1, hereafter) is the basic form, composed of eq. (5) and (6), without unemployment gap as a state variable. The second model specifies the unemployment gap as an AR process (eq. (5)-(7)) and the third model is the AJ model (V2 and V3 respectively). This order is not random: each model is in fact a nested parsimonious form of the next model. In addition, statistical decompositions of output are presented.

Table 1 – System estimation results

Parameters		Version			
		V1	V2(AR)	V2(MA)	V3
Measurement equation (H)	γ^1	-	-	-	-0.000509
	γ_2	-	-	-	-0.011246
	ρ_1	-0.187071	-0.334002	-0.201102	-0.295034
	ρ_2	-	0.1609596	0.111102	0.1846966
Transition equation (F)	δ_1	-	1.1217391	1.1395334	1.1930171
	δ_2	-	-0.202972	-0.224058	-0.275905
	ω_1	-	-	-0.211654	-0.47757
	ω_2	-	-	-0.2794	-0.477553
Error term variances	$\sigma^2(\varepsilon_t^y)$	-	-	-	0.000099
	$\sigma^2(\varepsilon_t^{\Delta\pi})$	1.23439	1.24033	0.44071	1.44365
	$\sigma^2(\varepsilon_t^p)$	-	-	-	0.000127
	$\sigma^2(\varepsilon_t^n)$	0.01	0.01769	0.02049	0.0452
	$\sigma^2(\varepsilon_t^{gap})$	1.74649	0.21398	0.20492	0.17764
	$\sigma^2(\varepsilon_t)$	-	-	1.35459	1.04236
Average and st.dev. of unobserved variables	y_p	-	-	-	11.02 (0.20)
	d	-	-	-	0.01194 (0)
	u_n	8.49 (0.29)	8.44 (0.14)	8.66 (0.19)	8.70 (0.36)
	$(u-u_n)$	-0.1 (1.37)	-0.04 (1.50)	-0.27 (1.51)	-0.31 (1.40)
	ε	-	-	-0.06 (1.18)	-0.005 (0.05)
Average SE	y_p	-	-	-	0.000139
	d	-	-	-	0
	$u_n,(u-u_n)$	0.064978	0.261481	0.54929	0.651889
	ε	-	-	0.33331	1.516338
Likelihood		174.688	53.150	58.520	-322.976
Convergence (iterations)		5	6	13	44

This section describes the estimation results of the models, and is organized as follows. First we give a short description of the data. Then, we discuss the results for two partial models for the NAIRU, and then switch to the joint NAIRU/Output model results. We also compare the model parameters obtained from the different versions.

The data are composed of quarterly data between 1987:1 till 2001:1. Since the model assumes that inflation process is at least partially dominated by real factors, the sample period includes only the post stabilization period. Before that, it is clear that the process was almost completely dominated by nominal factors [6] $\Delta\pi$ is the second difference of seasonally adjusted log CPI.[7] The unemployment rate is seasonally adjusted chained unemployment rate. Supply side shocks are captured by the relative price of imports excluding oil and diamonds, the relative price of oil, deviations of labor productivity from its trend and the relative contribution of new immigrants to population growth. Other variables that have been checked include the IMF's Real Exchange Rate[8] (RER), and the interest rate. A complete description of the data is given in the data appendix (A).

Table 1 presents the results obtained by the different models. Our model selection strategy was to choose a specification for which the state space model performance was best in terms of stability, and to eliminate the effect of the unemployment gap on inflation. Thus, we "over-controlled"

6 *Although Sussman and Lavi (1999) have found that even during the high inflation period (1975-1985) real factors had significant influence on inflation.*

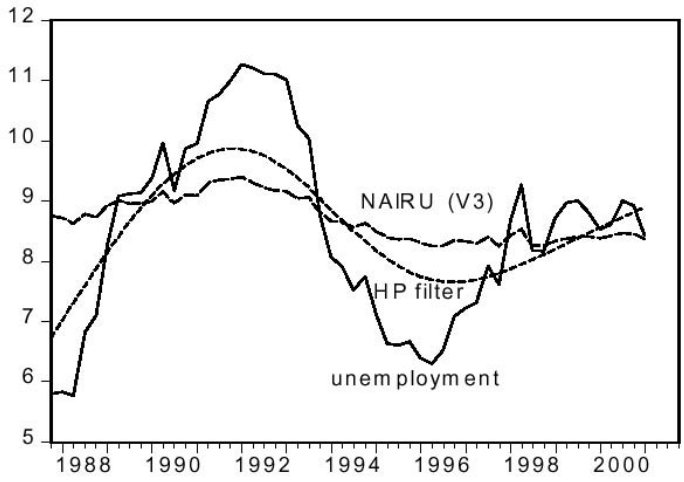
7 *Both X12 and SABL procedures were applied. Major differences between the seasonal adjusted series appeared during the first two years of the sample. After 1989 the differences are negligible.*

8 *Although this variable was used as a supply shock in several previous works, the Real Exchange Rate may be confounded by demand shocks.*

for this variable, and even insignificant lags of the unemployment gap are included, clearing also possible level effects, and not only change effects (see AJ (1999)). We, nevertheless, applied the "parsimony principle" when selecting the exogenous variables[9]. The models were estimated using two alternative specifications: an AR specification, where inertia is captured by four lags of $\Delta\pi$, and a specification where inertia is captured by two moving average terms. When using lagged variables of the dependent variable, they were treated as "regular" exogenous variables[10].

The estimates, as presented in Table 1, are in accordance with economic theory. The sums of the coefficients of the unemployment gap in the Phillips curve equation (ρ_1 and ρ_2) are negative for all specifications, as is the sum of the coefficient in Okun's law equation (in V3). The transition matrix coefficients imply that the unemployment gap process is stationary. There is a clear trade-off between augmenting the system and the average standard errors of the unobserved components as calculated by the Kalman smoother[11]. The estimated error term variance of the NAIRU varies between 0.017 and 0.045. This interval, although shifted downward, overlaps with some of the restricted values in Gordon (1997), where a SD of 0.2 was used. Since the models were not selected on the basis of the levels of significance of the explanatory variables, we present later single equations estimates that were constructed using standard considerations with the relevant *t*-statistics.

Figure 1 – Actual unemployment and the NAIRU



4.1. The NAIRU

The most noticeable result is the stable pattern of the NAIRU during the sample period. Although unemployment rate has varied from a peak of 11.3 % to a low of 5.8 %, the NAIRU during this period changed by no more than one percentage point, as shown in Figure 1 [12]. Note that this result holds for the models that were generated without any direct restrictions on the NAIRU variance (V2 and V3 below), confirming the variance constraint in the first model.

The second result is that the level of the NAIRU is quite high: in fact, in all the specifications, the average level of the NAIRU is higher, by 0.1 to 0.3 percentage points, than the average level of unemployment (8.39%). This result may reflect the fact that during the first years of the sample period, nominal factors still dominated the inflation process [13].

The results from the different systems are given below. As presented in Figure 2, the NAIRU generated by the different systems resemble each other, though some differences emerge. As claimed before, the smoothness of V1 is more an assumption than a result. The variance of the NAIRU in V1 was restricted so that its amplitude resembles that of the unrestricted V2. Although the pattern is similar, V1 generates smoother a NAIRU. The "edgy" pattern of V2 is the result of the decomposition of the unemployment rate into two different components, where the second component (the unemployment gap) is generated by an AR(2) process.

9 *An alternative strategy was used by AJ (1999), and by Bal Gunduz (2001) where the system includes 5 lags of all exogenous variables. Our treatment of inertia and the unemployment gap is identical, however.*

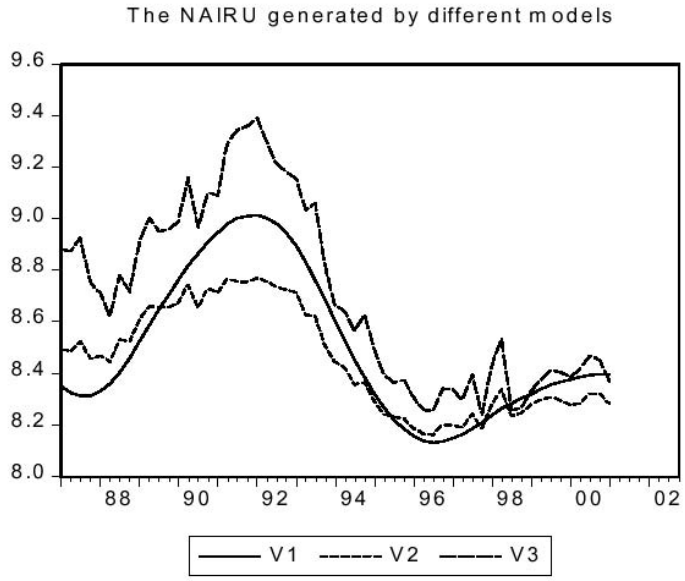
10 *For a justification of this treatment see Hamilton (1994) or Harvey (1989). Alternatively, the lagged variables may be treated as state variables.*

11 *The average SB's are calculated by averaging the diagonal elements of the $P_{t/T}$'s for t = 1..T (see appendix C).*

12 *VI was generated by the assumption that the NAIRU follows a random walk only. V2 is a model where an additional assumption was made on the process of the gap (AR(2)). V3 is the augmented AJ model that includes output.*

13 *As shown by Sussman and Lavi (2001), money growth (or alternatively, monetary policy as reflected by the real interest rate) dominated the inflation process during the first years of the sample.*

Figure 2 – NAIRU comparison



"Digging Deeper". At first sight, the NAIRU estimates, especially V1, look as if they could have been generated by a univariate filter such as the HP filter. A closer look at the results shows that these series differ substantially. The first obvious difference is the series average: while the HP filtered series has the same average as the original series, the generated NAIRU series is above average. As presented also by Yachin and Menashe (2001), it is interesting to check the correlations between the computed series and an HP filtered series. Table 2 shows that the HP series is highly correlated with the original unemployment series while the state space NAIRU estimates are less correlated. Not surprisingly, the correlation coefficient drops as the system includes a larger information set. Hence when the NAIRU is constructed using inflation and unemployment only, the correlation coefficient is still high (but still below the univariate HP filter). When using the assumption that the unemployment gap follows an AR process the coefficient drops to 0.66; and when introducing output the coefficient drops further to 0.64.

Table 2 – Correlations between state space NAIRU
Estimates and HP filtered unemployment

	U hp	U	V1	V2 MA	V3	V2 AR
U hp	1.00					
U	0.90	1.00				
V1	0.82	0.83	1.00			
V2 MA	0.58	0.66	0.92	1.00		
V3	0.55	0.64	0.91	0.98	1.00	
V2 AR	0.66	0.74	0.95	0.99	0.97	1.00

Although V2 and V3 are highly correlated, their levels differ, especially during the 10 first years of the sample. Adding output to the system (V3) increases the NAIRU volatility and changes its reaction to shocks: for instance, during the early 1990s, when unemployment went above 11% (the immigration influx from former Soviet Union countries was at its peak then), the augmented form (V3) reacts much more to changes in the actual rate (an 0.5 percentage point increase) while the reduced form (V2) indicates that the NAIRU hardly changed: this leads to a difference of 0.8 percentage points between the two estimates during 1992. The reason may be that when taking information on output into account, the model "interprets" the output rise in 1991 as a permanent shock, i.e., as a rise in potential output. As a result, the NAIRU increases more dramatically (during this episode unemployment rose as well, without any downward pressure on prices, after controlling directly for immigration). The immigration shock caused a simultaneous rise in output and unemployment. It seems that the augmented model handles better the immigration shock, as the new im-

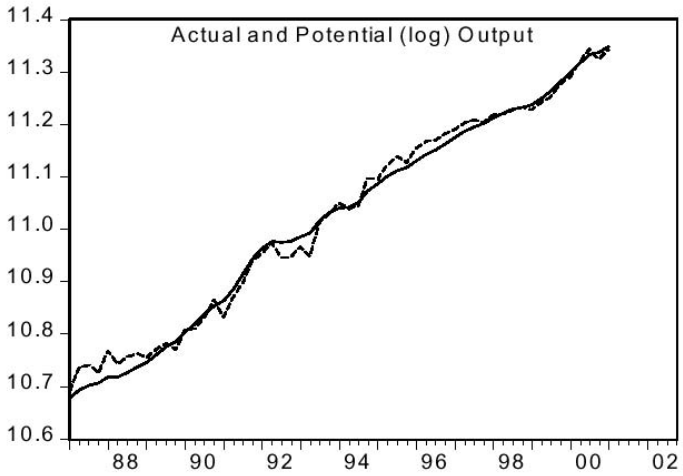
migrants increases permanently the labor force; It is reasonable to believe that this shock caused the NAIRU to increase for the short run.

Minor differences between the versions are apparent after immigration has slowed down.

4.2. The unemployment gap

The derived unemployment gap reflects the business cycle state. As such, the gap should follow some regularities, namely the persistence and stationary nature of the business cycle. The parameters of the transition matrix *F* of all estimated models point out that the unemployment gap follows a stationary-process, although the parameters show that this is a borderline-case.[14] Note that the unemployment gap is modelled as an unrestricted AR(2) process. When checking the gap itself the results are inconclusive, however. An ADF test shows that the unit root hypothesis may be rejected based on high critical values only (i.e. the ADF test statistic is near the 5% critical value).

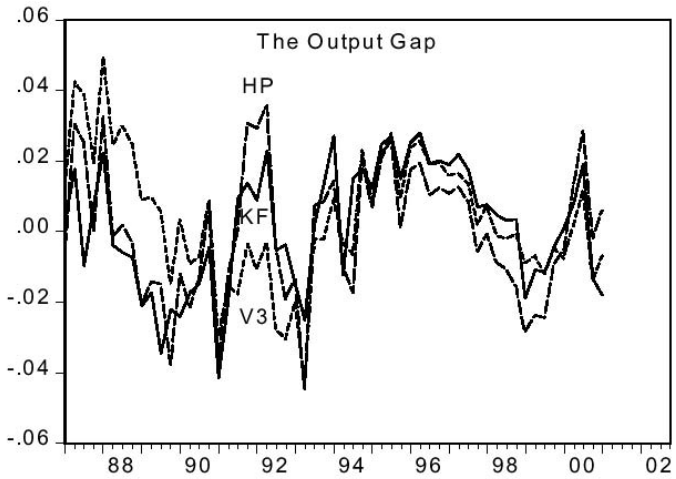
Figure 3 – Potential output



4.3. Potential output and the Output Gap

This section presents the potential output and imputed output gap derived from the 3rd version (AJ model). The estimated drift is 1.19, reflecting a 4.76 annual growth rate. The system output is compared with both HP filtered series and a Kalman filter series generated by the non-structural system of section 2.2.

Figure 4 – Output gap



14 *Some of the eigenvalues of the transition matrix F equal one.*

The estimated output gap is highly correlated with the unemployment gap: this result is not surprising, as the output gap, by construction, is related to the unemployment gap only. Yet, the augmented system specifies the potential output's stochastic process, and this leads to changes in the estimated NAIRU (V3 in figure 2).

Figure 4 presents the different output gaps derived from the augmented system (V3), the output gap derived from a pure statistical decomposition (KF), and the output gap as a difference between actual and HP filtered output (HP). The main difference that meets the eye is the "interpretation" of each method of the 1992 mass immigration period. The HP filter gap indicates that this period was a business boom, while the State Space Model shows that potential output rose significantly during this period, leading to the conclusion that this movement of output was not cyclical. The statistical decomposition (KF) lies in between: the interpretation is that this model better captures permanent shocks than a simple HP estimate. A closer look at the gaps reveals the following results: the correlation between HP and KF is 0.77, and the correlation between HP and V3 is 0.54; the ACF of HP gap indicates that only the first two terms are significant, while the ACF of the other methods contain 6-7 significant terms. This implies that these methods comply with our perception of the "business cycle", while a simple HP gap does not exhibit a cycle at all.

Table 3 – Single equation Phillips curve estimates

	V1	V1	V2(AR)	V2(AR)	V2(MA)	V3
U_gap_{t}	-0.30		-0.27		-0.10	-0.09
	(-2.02)		(-2.1)		(-2.07)	(-2.23)
U_gap_{t-1}		-0.24		-0.22		
		(-1.60)		(-1.65)		
$\Delta\pi_{t-1}$	-0.48	-0.41	-0.48	-0.41		
	(-3.39)	(-2.82)	(-3.40)	(-2.82)		
$\Delta\pi_{t-2}$	-0.53	-0.49	-0.53	-0.49		
	(-3.20)	(-2.83)	(-3.22)	(-2.83)		
$\Delta\pi_{t-3}$	-0.25	-0.26	-0.24	-0.26		
	(-1.67)	(-1.77)	(-1.68)	(-1.77)		
$\Delta\pi_{t-4}$	-0.28	-0.25	-0.28	-0.25		
	(-2.18)	(-1.91)	(-2.20)	(-1.90)		
MA(1)					-0.67	-0.63
					(-4.37)	(-4.55)
MA(2)					-0.13	-0.33
					(-0.85)	(-2.39)
$immigration_{t-1}$	2.24	2.79	2.45	2.83		
	(2.14)	(2.47)	(2.31)	(2.53)		
$imports_{t}$		20.81		21.06		
		(2.79)		(2.83)		
oil_{t-3}	3.91	3.88	4.03	3.89	3.04	2.44
	(2.63)	(2.63)	(2.73)	(2.64)	(2.34)	(1.90)
$productivity_{t-1}$	-14.15	-12.66	-13.55	-12.61		-3.41
	(-2.00)	(-1.81)	(-1.95)	(-1.81)		(-2.40)
RER_{t}	-17.8		-18.77		-19.14	-15.82
	(-2.80)		(-2.97)		(-3.23)	(-2.50)
R^2_{adj}	0.45	0.44	0.46	0.44	0.43	0.41
DW					(1.91)	(2.05)
LM_test	9.01	9.07	8.90	9.56		
(probability)	(0.34)	(0.33)	(0.35)	(0.20)		

4.4. Confidence intervals

Being conditional expectations, estimated state variables have two sources of uncertainty. The first, due to "parameter uncertainty", reflects the uncertainty around the estimated parameters in *H* and *F* matrices. This type of uncertainty would remain even if the state variables were observed and model was estimated using standard regression methods. The second type of uncertainty is the

"filter uncertainty" and reflects the fact that the estimated Z-values represent conditional expectations of true unobserved values. This uncertainty is due to Kalman filter estimation and would be present even if the true values of the matrices H and F were known. A decomposition of mean squared error $P_{t|t}$ into these components is shown in Hamilton (1994, pp.397-399).

The question is what is the pivotal statistic that enables us to build the confidence interval around the estimated state variables, taking into account both sources of uncertainty. Obviously, the use of a prediction interval in this case will overestimate the uncertainty since it relates to out-of-saniple error terms.

In order to roughly estimate the confidence interval around the unobserved NAIRU we applied the jackknife technique [15]. The idea of jackknifing is to modify the sample by randomly deleting one or a group of observations and to measure the generated bias in the statistic of interest. The bias measured by repeating this procedure, and normalized in a special way (see appendix D), should have an approximate t distribution, and constitutes a pivotal statistic for robust interval estimation (Miller (1974)).

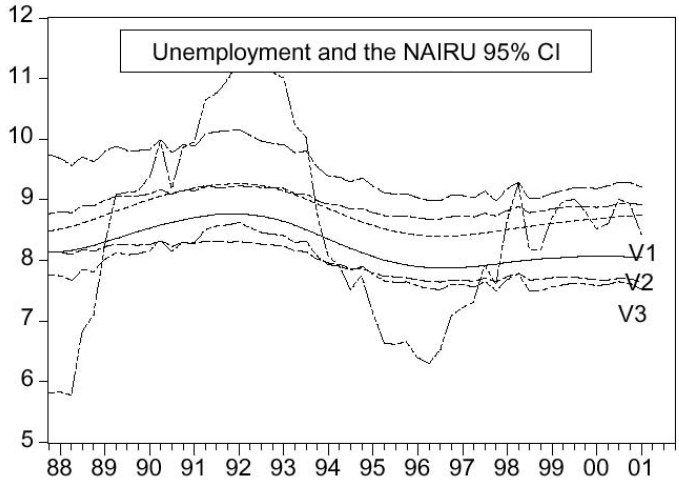
This simulation enables us to get an idea of the aggregate uncertainty around the unobserved components directly, that is, without estimating each source separately.

During the last two decades the resampling techniques (rather bootstrapping than jackknife) were applied in a time-series domain for model selection [Veall (1992)], as well as parameters and standard error checks (see, for example, Li (1994), Staffer and Wall (1991), Brownstone (1990)).

Since our observations are serially correlated, instead of deleting the row of observations, we replaced it by the average of its neighbours. Such " interpolation" resembles row deleting because the modified observation is not independent and does not contain any new information. The deleted rows were chosen by a random counter. After this treatment, we re-estimated the model. Thus, new estimates of the state variables were obtained, together with the new system matrices H and F. Repeated 22 times, this simulation created 22 versions of each state-variable for each date. The details about the data processing are given in appendix D. The outcome of this experiment is that the confidence bands, computed by jackknifing, are much narrower than the prediction intervals by the Kalman filter. Yet, the confidence bands, obtained by jackknifing, contain both sources of uncertainty, as discussed before.

The figures below show the standard 95% confidence band for the NAIRU for the three different models(Vl, V2, V3). Model V3 was used to estimate the confidence bands for Potential Output. As presented in the figure below, the uncertainty around the NAIRU estimates depends on the model that was used. Augmenting the model by new state variables increases the uncertainty around the NAIRU estimates.

Figure 5 – NAIRU confidence bands



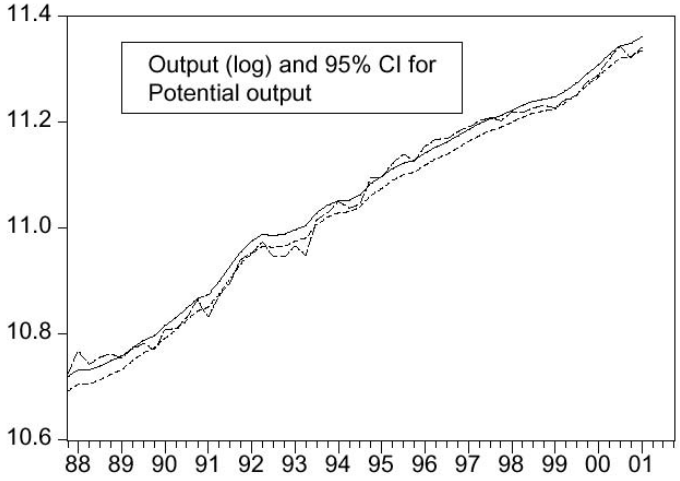
The conclusion from model V3 is that in the standard confidence band, actual unemployment was significantly different from the NAIRU only during three episodes. This reflects the limited power of the unobserved components approach. Similar results were reported by Laubach (2001), where for most countries that were checked, the unemployment rate from 1970 to 1998 varied within the

15 *We thank I.Muchnik for suggesting this strategy.*

95% confidence band. [16]This led Laubach to the conclusion that "The question whether at any point in time the actual unemployment rate is above or below the NAIRU can rarely be answered at conventional confidence levels" . Note that the parsimonious models V2 and V1 generate lower uncertainty around the estimated NAIRU. This result is straightforward, as augmenting the State Space representation by new unobserved components increases uncertainty.

The limited uncertainty regarding the NAIRU estimates are mirrored in the uncertainty around Potential Output estimates. Again, using the standard confidence bands, actual output was significantly different from potential output only during three episodes. The high growth rate during 2000 for example, is still in the confidence band for potential output.

Figure 6 – Potential output confidence bands



4.5. Sample effects

Although the sample period that we used for estimation is relatively short, still, one could question our assumption that the links between the variables are constant, or technically, that the system matrices H and F are not time-varying.

The problem with this approach is that it is clear that during this period (1987-2001), some structural changes, especially in the labor market, took place. Since wage determination is one of the channels that the Phillips curve works through, these changes pose the question whether the effect of the unemployment gap on prices has changed.

On one hand, major changes in the labor market took place due to the mass immigration wave. This supply side shock reduced the bargaining power of workers both directly and indirectly, as the new workers, most of them unorganized, reduced the bargaining power of labor unions. On the other hand, the transfer payments policy became more generous, offsetting the immigration wave effect on the reservation wage, and leaving the total effect on the NAIRU unknown.

In addition to these effects, the number of foreign workers increased dramatically during the 90s. Note that all these factors may affect the participation in labor force as well.

In order to answer these questions we also estimated the NAIRU for a sub sample starting on 1995 – a post mass immigration period. The results imply that the total effect of unemployment gap on prices is similar, but the lag structure is different: changes in inflation are much more sensitive to contemporaneous unemployment gap, rather than to lagged gap as for the whole sample. This may be the result of a less rigid labor market.

The estimation results of the augmented system (V3) implies that the same holds for the Okun's law equation (12) , where the link between unemployment and output gap becomes contemporaneous rather than lagged. Again, this may reflect a more flexible labor market in which changes in output are mirrored immediately in the unemployment rate.

16 *This referes to the Bivariate model with 1(2) NAIRU, that seems to better capture the upward unemployment trend in the inspected countries. This model implies that the NAIRU was within the band throughout the period in Canada, Prance, Italy and Australia; while in Germany, the US and the UK it was significantly different, at least once.*

Figure 7 – The NAIRU: sample effect

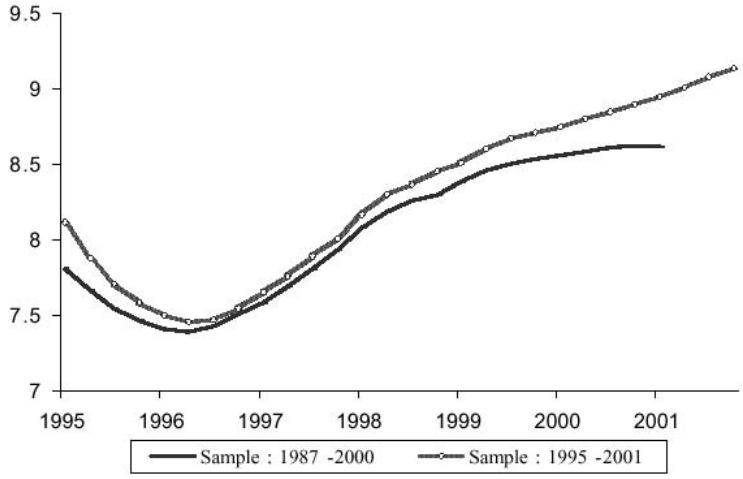
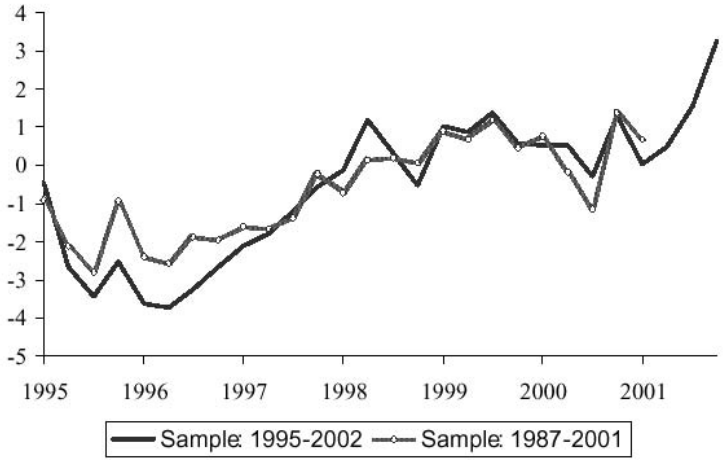


Figure 7 compares the NAIRU generated using the whole sample to the NAIRU as generated by the new, reduced, 1995-2001 sample. The results show that the NAIRU is stable with respect to sample effects. Note that the new sample is enlarged to end-2001 (three more observations compared to the full sample), this enables us to check the end-sample effect, therefore we check simultaneously for two different sample effects. The end sample effect can be seen clearly after 1996, when the NAIRUs were almost identical. During 2001 the actual rate of unemployment increased steeply from 8.6 % at the first quarter to 10.3 % at the last quarter. Since this process was not followed by acceleration downwards in the rate of inflation, the model interprets this as a rise in the NAIRU. Since we use smoothed Kalman estimates, which use the full information set, pre–2001 NAIRUs are updated upwards (the "stickiness " of the NAIRU does note allow for dramatic jumps). This explains the growing difference between the estimates after 1996. Still, the difference between the estimates at the first quarter of 2001 is less than 0.5 percentage points.

Figure 8 – The output gap: sample effect



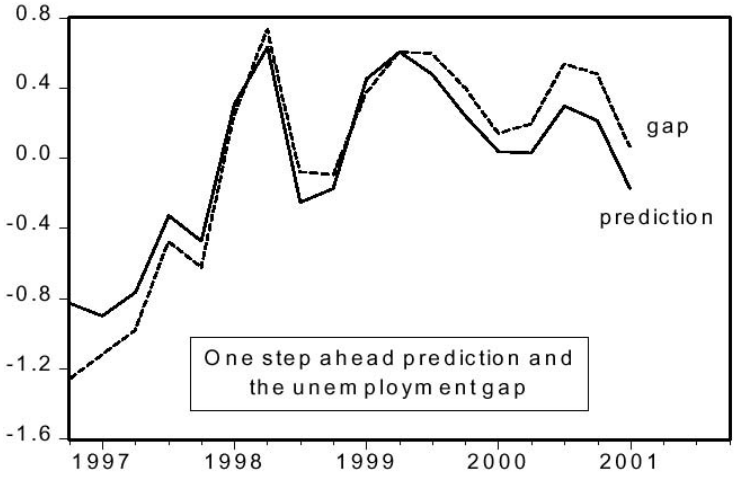
The sample effect on the output gap is more substantial. This is partly because the output gap is not smooth as the NAIRU. Note that the differences in the NAIRU (and hence in the unemployment gap) are not reflected in the output gap. For example, the output gap according to the different samples was identical during the third quarter in 2000, while the NAIRU was different. This is the result of the changing coefficients in the Okun's law equation *(H* matrix). Yet, the differences between the estimates are not large: the largest difference is between the gaps is near one percentage points (during 1996 peak).

4.6. Prediction

This section describes one-step-ahead predictions of the unobserved components. In order to generate these predictions, we used the whole sample to compute the system matrices (assuming that they are time-invariant), and then applied the prediction equation of the Kalman filter (see appendix C) for each observation, starting from 1997:3. When comparing the predicted sub-series with previously computed expected (smoothed) values of state variables we found a very good fit. The correlation between the predicted NAIRU and its smoothed "realization" is 0.8.

Figure 9 presents the predicted values of the unemployment gap and its "realisations" for the last four years of the sample. These results point out that the system is very stable, suggesting that it may be used for short-term prediction. Note that these results were achieved by using the same system matrices for the whole sample: obviously, updating the matrices at each step will improve the prediction power.

Figure 9 – Prediction



5. Conclusions

The substantial changes of unemployment rates, inflation rates, and the labour market structure during the last decade, raise the question as to what extent these changes are reflected in the NAIRU. In order to answer this we constructed State Space Models in which the NAIRU and potential output are latent variables. These variables are identified by both economic relations such as the Phillips curve and Okun's law, and by non-theoretical assumptions about their evolution over time. Following the state-of-the-art literature in this field, we start by estimating the NAIRU only with the simple univariate model (V1) suggested by Gordon (1997), and a bivariate specification (V2) as used by Laubach (2001). Next, we estimate a variant of the AJ model (1999), an augmented SSM for simultaneous estimation of the NAIRU and potential output (V3).

We use the Kalman filter, combined with a quasi -maximum likelihood algorithm for restricted SSM estimation (EM) of Watson and Engle (1983), in order to estimate the model parameters (the system matrices), the unobserved components. In addition, we use the jackknife technique to quantify the uncertainty around these estimates – namely, the uncertainty around the NAIRU and potential output – due to the fact that these variables are unobserved, and that the system matrices are estimated and hence are not known without uncertainty. The fact that each model is completely nested in the next specification allows us to shed some light on the trade-off between the goodness-of-fit of the model and the uncertainty around the estimated unobserved components.

The estimation results suggest that the NAIRU path is relatively stable, with no clear evidence for hysteresis after the unemployment peak of 1991.[17] Note that this conclusion is based on models where the volatility of the NAIRU is not restricted; that is, this outcome is not a result of any direct restrictions on the NAIRU path, while the simple model (V1) required this restriction in order to reach convergence (as in Gordon (1997)). The estimated NAIRU during the sample period varied

17 *At least as reflected in the unemployment rate. The estimates show that the disinflation process during the 1990s did not cause an increase in the NAIRU. Nevertheless, it is possible that hysteresis affected the participation-in -labor-force rates.*

within approximately a one percentage point band, while the unemployment rate varied between 5.8 and 11.8 percent. The derived unemployment gap had a significant negative effect on the price process, as presented in the single equation estimates of the Phillips curve. This in turn justifies the use of such an equation as an identifying equation, as it contains significant information about the unobserved components. As always, using the state-space methodology does not come without a cost: the uncertainty around the unobserved components is substantial, and therefore, usually, it is hard to judge the state of the economy using the conventional confidence levels, as for example holds for the period 1997-2001. This leads to the conclusion that one should use caution when deriving direct policy implications based on the NAIRU estimates.

Appendices

A. Data

This section describes variables used to estimate the quarterly model for Israel from 1987:1 to 2001:4.

Endogenous observed variables:
- (y) – Gross Domestic Product, at fixed 1995 prices, reported quarterly by CBS, seasonally adjusted by XI2 procedure, levels at natural logarithms.
- (Δpai) – consumer price index, reported monthly by CBS, seasonally adjusted and log differenced at quarterly level. This variable is called pai. The variable used in the model is Apai, that is first difference of pai multiplied by 100.
- (u) – chained unemployment rate (%), reported quarterly by CBS, seasonally adjusted.

Exogenous variables:
- (rer) – Real Exchange Rate of Israel, reported quarterly by IPS statistics (IMF), log difference.
- (mp) – import $ price index, excluding fuel and diamonds, PASH formula, reported quarterly by CBS on 1991 base, seasonally adjusted and log differenced.
- (productivity) – labor productivity, measured as the relation of GDP to the number of employees (natural logarithm of this relation is used). Employees include Israelis, Palestinians and foreign workers. Israeli employees data, based on Labour Force surveys, have been chained through their multiple samples. GDP and employees time-series are seasonally adjusted.
- (oil) – fuel import price index, PASH formula, reported quarterly by CBS on 1991 base, log differenced. No seasonality was found.
- (rel_mp) – relative import price (excluding fuel and diamonds), computed as import NIS price index relatively to CPI. To convert $ price index into NIS, representative exchange rate is used. CPI and import price indices are seasonally adjusted. The log differences of their relations are used.
- (rel_delek) – relative fuel import price computed as import NIS fuel price index relatively to CPI. To convert $ fuel price index into NIS, the average exchange rate is used. The CPI quarterly index is seasonally adjusted. Log difference of this index is used.
- (immigration) – the share of new immigrants in population growth. Measured as quarterly new immigrant arrivals relative to total population growth. The first difference of this relation is used.

All quarterly time-series are supported and currently updated by the Bank of Israel Research Department Database.

B. Systems

This section describes all the State Space systems that were estimated.

All the Moving Average systems take the same set of exogenous variables. The Auto Regressive systems take the same set plus four lags of att. All exogenous variables are normalised to zero.

B.I. Version 1

Measurement

$$\begin{bmatrix} u_t \\ \Delta\pi_t \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ 0 & \rho_1 \end{bmatrix} \begin{bmatrix} u_t^n \\ u_t - u_t^n \end{bmatrix} + \begin{bmatrix} 0 & 0 & 0 & 0 \\ \alpha_1 & \alpha_2 & \alpha_3 & \alpha_4 \end{bmatrix} \begin{bmatrix} \Delta\pi_{t-1} \\ \Delta\pi_{t-2} \\ \Delta\pi_{t-3} \\ \Delta\pi_{t-4} \end{bmatrix} + \\ + \begin{bmatrix} 0 & 0 & 0 & 0 \\ \beta_1 & \beta_2 & \beta_3 & \beta_4 \end{bmatrix} \begin{bmatrix} x_t^1 \\ x_t^2 \\ x_t^3 \\ x_t^4 \end{bmatrix} + \begin{bmatrix} 0 \\ \varepsilon_t^{\Delta\pi} \end{bmatrix}$$

State

$$\begin{bmatrix} u_t \\ u_t - u_t^n \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} u_{t-1}^n \\ u_{t-1} - u_{t-1}^n \\ u_{t-2} - u_{t-2}^n \end{bmatrix} + \begin{bmatrix} \varepsilon_t^n \\ \varepsilon_t^{gap} \\ 0 \end{bmatrix}$$

In this system, ε_t^n must be restricted.

B.2. Version 2 (AR)

Measurement

$$\begin{bmatrix} u_t \\ \Delta\pi_t \end{bmatrix} = \begin{bmatrix} 1 & 1 & 0 \\ 0 & \rho_1 & \rho_2 \end{bmatrix} \begin{bmatrix} u_t^n \\ u_t - u_t^n \\ u_{t-1} - u_{t-1}^n \end{bmatrix} + \begin{bmatrix} 0 & 0 & 0 & 0 \\ \alpha_1 & \alpha_2 & \alpha_3 & \alpha_4 \end{bmatrix} \begin{bmatrix} \Delta\pi_{t-1} \\ \Delta\pi_{t-2} \\ \Delta\pi_{t-3} \\ \Delta\pi_{t-4} \end{bmatrix} + \\ + \begin{bmatrix} 0 & 0 & 0 & 0 \\ \beta_1 & \beta_2 & \beta_3 & \beta_4 \end{bmatrix} \begin{bmatrix} x_t^1 \\ x_t^2 \\ x_t^3 \\ x_t^4 \end{bmatrix} + \begin{bmatrix} 0 \\ \varepsilon_t^{\Delta\pi} \end{bmatrix}$$

State

$$\begin{bmatrix} u_t^n \\ u_t - u_t^n \\ u_{t-1} - u_{t-1}^n \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \delta_1 & \delta_2 \\ 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} u_{t-1}^n \\ u_{t-1} - u_{t-1}^n \\ u_{t-2} - u_{t-2}^n \end{bmatrix} + \begin{bmatrix} \varepsilon_t^n \\ \varepsilon_t^{gap} \\ 0 \end{bmatrix}$$

B.3. Version 2 (MA)

Measurement

$$\begin{bmatrix} u_t \\ \Delta\pi_t \end{bmatrix} = \begin{bmatrix} 0 & 1 & 1 & 0 & 0 \\ 0 & \rho_1 & \rho_2 & 1 & 0 \end{bmatrix} \begin{bmatrix} u_t^n \\ u_t - u_t^n \\ u_{t-1} - u_{t-1}^n \\ \varepsilon_t \\ \varepsilon_{t-1} \end{bmatrix} + \\ + \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ \beta_1 & \beta_2 & \beta_3 & \beta_4 & \beta_5 & \beta_6 \end{bmatrix} \begin{bmatrix} x_t^1 \\ x_t^2 \\ x_t^3 \\ x_t^4 \\ x_t^5 \\ x_t^6 \end{bmatrix} + \begin{bmatrix} 0 \\ \varepsilon_t^{\Delta\pi} \end{bmatrix}$$

State

$$\begin{bmatrix} u_t^n \\ u_t - u_t^n \\ u_{t-1} - u_{t-1}^n \\ \varepsilon_t \\ \varepsilon_{t-1} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & \rho_1 & \rho_2 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & \omega_1 & \omega_2 \\ 0 & 0 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} u_{t-1}^n \\ u_{t-1} - u_{t-1}^n \\ u_{t-2} - u_{t-2}^n \\ \varepsilon_{t-1} \\ \varepsilon_{t-2} \end{bmatrix} + \begin{bmatrix} \varepsilon_t^n \\ \varepsilon_t^{gap} \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

Note that there is no explicit error term in the measurement equation. The implicit error term ε_t is a state variable.

B.4. Version 3

Measurement

$$\begin{bmatrix} y_t \\ u_t \\ \Delta\pi_t \end{bmatrix} = \begin{bmatrix} 1 & 0 & \gamma_1 & \gamma_2 & 0 & 0 & 0 \\ 0 & 1 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & \rho_1 & \rho_2 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} y_t^p \\ u_t^n \\ u_t - u_t^n \\ u_{t-1} - u_{t-1}^n \\ d_t \\ \varepsilon_t \\ \varepsilon_{t-1} \end{bmatrix} +$$

$$+ \begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ \beta_1 & \beta_2 & \beta_3 & \beta_4 & \beta_5 \end{bmatrix} \begin{bmatrix} x_t^1 \\ x_t^2 \\ x_t^3 \\ x_t^4 \\ x_t^5 \end{bmatrix} + \begin{bmatrix} \varepsilon_t^y \\ 0 \\ \varepsilon_t^{\Delta\pi} \end{bmatrix}$$

State

$$\begin{bmatrix} y_t^p \\ u_t^n \\ u_t - u_t^n \\ u_{t-1} - u_{t-1}^n \\ d_t \\ \varepsilon_t \\ \varepsilon_{t-1} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \delta_1 & \delta_2 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & \omega_1 & \omega_2 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} y_{t-1}^p \\ u_{t-1}^n \\ u_{t-1} - u_{t-1}^n \\ u_{t-2} - u_{t-2}n \\ d_{t-1} \\ \varepsilon_{t-1} \\ \varepsilon_{t-2} \end{bmatrix} + \begin{bmatrix} \varepsilon_t^p \\ \varepsilon_t^n \\ \varepsilon_t^{gap} \\ 0 \\ 0 \\ \xi_t \\ 0 \end{bmatrix}$$

Note that there is no explicit error term in the Phillips curve equation, implicit error term ε_t is a state variable.

C. The Kalman filter and Smoother

The SSM (or SSF – State Space Form) allows us to distinguish between two blocks of equations: the measurement/signal block describes the dependence of observed components (such as inflation and output) in a set of variables, of which some may be unobserved, and others observed exogenous variables. This block may be based on theoretical grounds (hence, "structural"), or on identities (see appendix B). The second block, the transition/state block describes the stochastic process of the unobserved components. This block contains atheoretical assumptions describing the way the unobservables evolve over time. Though some of these assumptions may be justified empirically, such as the evolution of potential output that is proxied by a random walk plus drift process, these assumptions reflect the fact that our knowledge about these unobservables is limited (AJ, (1999)).

The SSF is composed of two equations. The measurement (or observation) equation relates $n \times 1$ *vector of observable variables* y_t, to α_t, an $m \times 1$ *vector of unobservable variables (the state vector).*

$$y_t = Hz_t + BX_t + \varepsilon_t \tag{18}$$

where H is an $n \times m$ matrix, and ε_t is an $n \times 1$*vector of serially uncorrelated disturbances, satisfying* $E(\varepsilon_t) = 0$ and $Var(\varepsilon_t) = Q_t$. The elements of α are unobserved. X is a matrix of observed exogenous variables.

The transition (or state) equation specifies the stochastic process generating the unobservable α's as a first order Markov process

$$z_t = Fz_{t-1} + R\eta_t \tag{19}$$

where F is an $m \times m$ transition matrix. $E(\eta_t) = 0$ and $Var(\eta_t) = Qt$. The matrices H, X, Q, F, R will be referred to as the system matrices. The models that are estimated in this study assume that the system matrices do not change over time. Hence, the system is time-invariant, and the time subscripts may be omitted from the system matrices.

The assumptions below complete the specification of the state space system:

$E(\alpha_0) = a_0 \quad Var(\alpha_0) = P_0$ where α_0 is the initial state vector, and P_0 is the initial state variance.

The disturbances of the measurement and transition equations are assumed to be uncorrelated with each other in all time periods, and uncorrelated with the initial state α_0.

Once rewritten in a state space form, the system may be estimated, including the unknown parameters, using the Kalman Filter and smoother. The Kalman Filter is a recursive procedure for computing the optimal estimator (thus, minimising the Mean Square Error) at time *t* based on the information available at that time. This information consists of the observations up to and including y_t. The filter consists of two sets of equations: the first set is the prediction equations that generate optimal predictors for the state vector z_t, based on the information set at $t-1$. Let a_{t-1} be an MSE of the state vector α_{t-1}, and P_{t-1} be the $m \times m$ covariance matrix, $P_{t-1} = E(a_{t-1} - \alpha_{t-1})(a_{t-1} - \alpha_{t-1})'$, based on the information at $t-1$, thus based on y_{t-1}. Then the prediction equations are simply given by $a_{t/t-1} = Fa_{t-1}$ and $P_{t/t-1} = FP_{t-1}F' + RQR'$. Once a new observation y_t is available, it is possible to update the estimated state vector $a_{t/t-1}$ and its covariance matrix $P_{t/t-1}$ using the information embodied in the prediction error: $e_t = y_t - Ha_{t/t-1} - SX_t$. This is done by the updating equations $a_t = a_{t/t-1} + P_{t/t-1}HF^{-1}e_t$ and $P_t = P_{t/t-1} - P_{t/t-1}HF^{-1}HP_{t/t-1}$ where $F = HP_{t/t-1}H' + Q$. The estimators for a_t and P_t that are generated using the updating equations are called filtered estimates. Note that these estimates are based on the information set up to and including y_t only, thus, the filtered estimates were generated using a one-side filter (unlike moving average filters, for example). As pointed out by Harvey (1989) and Hamilton (1994), when the state variable of interest has some economic meaning, it is better to use a full information set: thus, in order to estimate the NAIRU at time t, where $t = 1..T$ it is better to use the information up to $T - NAIRU_{t/T}$, than using the truncated information set $NAIRU_{t/t}$. Thus, after the filtered estimates for the whole sample are computed, we use the Kalman smoother to generate full information set estimates. The smoothed estimates are generated using the backward recursion: $a_{t/T} = a_t + P_t^*(a_{t+1/T} - Fa_t)$, and $P_t^* = P_t F P_{t+1/t}^{-1}$.

D. Jackknife technique

Let $\hat{Z}_{k\tau}$ be the τ-th observation of the *k*-th state variable (i.e. NAIRU), obtained as result of the estimation procedure on the whole sample of size *T* (in our case *T*=57 quarters). This value constitutes a conditional expectation of the true value $Z_{k\tau}$.

Let $\tilde{Z}_{k\tau}^{(-i)}$ be the corresponding observation, estimated on the "spoiled" sample, when the *i*-th original row of data (dependent and independent variables relating to the *i*-ih date) was deleted and substituted by averaging the neighbours around it. Suppose this procedure was repeated *g* times.

Consider all multiple realisations of the *k*-th state variable at date τ and define:

$$\tilde{Z}_{k\tau}^{(i)} = g\hat{Z}_{k\tau} - (g-1)\tilde{Z}_{k\tau}^{(-i)}$$

and

$$\tilde{Z}_{k\tau} = \frac{1}{g}\sum_{i=1}^{g}\tilde{Z}_{k\tau}^{(i)}$$

The length of the confidence interval $\left|\tilde{Z}_{k\tau} - Z_{k\tau}\right|$ for the $\{\tau, k\}$ observation may be found as:

$$t_{\alpha,g-1}\sqrt{\frac{\sum_{i=1}^{g}(\tilde{Z}_{k\tau}^{(i)} - \tilde{Z}_{k\tau})^2}{g(g-1)}}$$

where $t_{\alpha,g-1}$ is taken from the Student distribution with α and (g-1) degrees of freedom (see Miller, (1974)).

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Abstract

The Non Accelerating Inflation Rate of Unemployment (NAIRU) is estimated for the post-stabilization period, as an unobserved stochastic variable, using state-of-the-art State Space Models. The NAIRU is identified by a Phillips curve equation, and is assumed to follow a random walk. The basic model is augmented by an equation that captures the persistence of the unemployment gap. We also use the joint system that was first introduced by Apel and Jansson (1999) in order to estimate potential output and the NAIRU simultaneously. Confidence intervals around the NAIRU were computed by jackknife technique. The results indicate that the actual variation of unemployment has only a minor effect on the NAIRU, which remained relatively stable throughout the sample period. The state variables have sufficiently stable characteristics to be successfully predicted, at least one step ahead. However, policy implications that may be derived are sometimes limited, as the uncertainty around the estimated NAIRU is substantial. No evidence for hysteresis were found. The estimates show that the disinflation process during the 1990s did not cause an increase in the NAIRU.

Key words: NAIRU, Phillips curve, output gap, Kalman filter, SUR equations, jackknife technique.

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Forecasts of economic indicators for monetary policy in India: an assessment

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" ...when schools evolve and paradigms are born and die, it is forced upon you that what ultimately shapes the verdicts of the scientist juries is an empirical reality out there."
Paul Samuelson

1. Introduction

The monetary policy operates within the overall objectives of the economic policy of the country. The projection of average annual growth in GDP with broad sectoral targets for the five year plan period as a whole is set in the plan document as part of national strategy for economic development. The policies of the Government find their expression in the broad objectives of the plan. The Tenth Five Year Plan (2002 to 2007) is now on the anvil. As a part of the plan exercise an assessment is made about the likely savings of the different sectors of the economy. The investment requirement is estimated consistent with the projected growth rate. This gives the projected need for foreign saving for realisation of targeted growth. Public sector's need for private savings is also estimated as a part of this exercise. The plan projections thus arrived at provide the broad contours for pursuing economic policy in India.

The monetary policy stance has to respond to the evolving developments during a year and, therefore, the actual conduct of policy cannot be defined *a priori* at any point of time. The overall approach, however, is generally pronounced annually in the third week of April after Central Government Budget, with mid-year reviews prepared in October. The budget provides certain important inputs for monetary policy such as fiscal deficit as percentage of GDP, market borrowing requirement of the government and interest rate in small saving instruments. The budget papers thus contain implicit assumptions about GDP growth and inflation for the ensuing year, two important parameters of monetary policy, apart from providing a broad indication of expected movement of interest rate. However, the determination of Bank Rate, the key policy rate that anchors the interest rate structure, is the domain of the Reserve Bank of India (RBI).

The operations of the RBI in the money market and the foreign exchange market by way of purchases and sales are part of liquidity management exercise aimed at maintaining adequate liquidity in the market to support genuine demand while keeping excessive volatility under check. These short-term operations are subsumed in the monetary policy objective of non-inflationary economic growth.

The paper starts with a description of the framework for monetary policy to indicate the requirement for forecasting. This is followed by consideration of methods for forecasting of liquidity for short term liquidity management. Next, we go into structural modelling, time series modelling, neural network approach, considerations on judgmental projection, initiative on business cycle analysis and industrial outlook survey to explain the whole gamut of approaches followed in RBI for forecasting of important economic indicators for monetary policy. The advantages and disadvantages of different methods have been examined mainly from practitioners' point of view. The assessment of forecast performance is broadly impressionistic in nature.

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2. The framework for monetary policy and forecasting requirement

The forecasting requirements for the conduct of monetary policy in India have changed considerably during the 1990s with: (a) the switchover from monetary targeting to a multiple indicator approach in April 1998, and (b) the gradual shift in emphasis in favour of indirect instruments of monetary policy in the face of significant deregulation of interest rates and growing emphasis on liquidity adjustment to strengthen the interest rate channel of monetary policy.

Till the introduction of the multiple indicator approach, the "monetary targeting with feedback" rule was operationalised on the basis of empirical validation of the stability of the money demand function. In this framework, given the need to set a money supply target consistent with the expected output growth and the tolerable rate of inflation, forecasts of GDP and inflation represented the key inputs to the conduct of policy. Rangarajan (1997) had justified the role of monetary targeting in India on two grounds: (a) the money demand function for India was reasonably stable and it continued to be helpful in predicting price movements with reasonable accuracy over 3 to 5 years, and (b) the money supply target was relatively well understood by the public at large. The key role assigned to feedback in the monetary targeting framework, however, symbolized the absence of "mindless monetarism" in the conduct of policy. The flexibility in the approach allowing the actual money growth to deviate from the target was necessary to account for the supply shocks, supply rigidities in the system, and external sector developments. The Chakaravarty Committee Report (1985) that recommended the adoption of monetary targeting in India had cautioned that "In a developing country like India, where significant structural changes are sought to be achieved to facilitate the growth process, the mechanical application of a constant money supply growth rule can have *no* place". Formulation of monetary policy in terms of money stock as the target also required (a) stable and predictable relationships between money, output and prices, (b) stable and predictable money multiplier, and (c) significant control of the monetary authority over the monetary base or the reserve money. When the recommendations of the Chakravarty Committee Report were made, the growth of high-powered money in India was largely the result of increase in RBI credit to Government on which RBI had little control. The Report observed in this regard that "The inability of the Reserve Bank to deny or regulate credit to government, due to both legal and practical considerations, has been interpreted as an important factor contributing to Reserve Bank's lack of control over reserve money and hence on money supply. The conclusion is, therefore, drawn that monetary policy has *no* effective role to play in the control of inflation in the Indian context".

A major constraint to the monetary targeting in India was addressed by de-linking the fiscal deficit from automatic monetisation through the agreement between the Government of India and the RBI on September 9, 1994. As per the agreement, the automatic monetisation of the fiscal deficit through the issue of *ad hoc* Treasury Bills was phased out over a period of three years and from 1997-98 the instrument of *ad hoc* Treasury Bills was completely abolished. The desired impact in terms of making the base money completely exogenous, however, was not realised due to continued fiscal dominance and surges in capital flows in several years in the face of a managed flexible exchange rate regime. Nevertheless, due to the progress in developing the secondary market for government securities, open market operations (OMOs) have ensured somewhat better control over the base money.

Besides the issue of controllability of the base money, possible instability of the money demand function also warranted a change in the framework for monetary policy. The Working Group on Money Supply (1998) observed in this regard that monetary policy exclusively based on monetary targets set by estimates of money demand could lack precision because while the money demand function exhibited parametric stability, predictive stability was less certain. The Monetary Policy statement of April 1998 discussed about the possible instability in the money demand function arising from the growing financial innovations and also recognized the role of interest rates in influencing the money demand. Developing a monetary condition index using the rate variables – including the interest rate – to assess the monetary dis-equilibrium through the behaviour of rate variables was, however, viewed to be premature because of the uncertainty about the interest rate channel for the transmission of monetary policy. Market orientation of the interest rate structure and their growing sensitivity to financial developments and real activity, however, suggested that rate variables can be used along with the quantity variables in the conduct of policy. The rate variables cannot substitute the monetary targeting framework as long as the rate channel for monetary transmission does not become robust and reliable. Till such time, the rate variables can supplement the quantity variables and the monetary authority can implement its monetary strategies using a multiple indicators approach. Recognising this aspect, the Policy Statement of April 1998 observed that "it is necessary to adopt a multiple indicator approach wherein interest rates or rates of return in different markets (money, capital and government securities markets) along with such

data as on currency, credit extended by banks and financial institutions, fiscal position, trade, capital flows, inflation rate, exchange rate, refinancing and transactions in foreign exchange available on high frequency basis are juxtaposed with output data for drawing policy perspective". Given that monetary policy has to be operated in a forward looking manner, need for generating appropriate forecasts for each of the multiple indicators has widened the scope of forecasting exercise in RBI.

The pursuit of multiple indicator approach to some extent reflects the multiple objectives assigned to the monetary authority. The Annual Report of the Bank for 1994-95 highlighted that "Monetary policy must be seen as an arm of economic policy. All the objectives of economic policy would as a result become the objectives of monetary policy" (also refer to Jalan (2000)). The Annual Report for 1998-99 noted that "monetary policy has had to facilitate the process of growth and inflation control without losing sight of the need to develop financial markets and to promote financial stability". The Chakravarty Committee Report (1985) underscored in this context that the functioning of the monetary system must necessarily be in consonance with the national development strategy as articulated in the successive Five Year Plans. The monetary system should therefore aim at (a) mobilizing the savings of the country while enlarging the financial savings pool, (b) promoting efficiency in the allocation of the savings of the community to relatively more productive purposes in accordance with national economic goals, (c) enabling the resource needs of the major entrepreneur in the country – the government – to be met adequately, (d) promoting price stability, and (e) promoting an efficient payments system. As the manager of the debt issues by the government, making market-borrowing possible at the lowest possible cost also becomes an implicit objective, which often conflicts with the monetary management objective. In the managed flexible exchange rate regime, ensuring orderly market condition has also emerged as an explicit objective and monetary measures are often assigned to the exchange rate objective during disorderly market conditions. Given the multiple objectives assigned to the Bank, a multiple indicator approach serves the economy better even if that amounts to avoiding clearer assignment of instruments based on any intermediate target to any specific policy goals. In such a framework, it has become imperative to use a macro-economic model that explains the dynamic interactions among multiple objectives, indicators and instruments to generate alternative scenarios representing optimum combinations of instruments and targets which would help in the actual designing of policies over time depending on the actual evolution of the key indicators and objectives.

It needs to be noted that despite the multiple objectives assigned to it, the RBI has generally assigned priority to low and stable inflation objective, with all other objectives often remaining subservient to the inflation objective. In other words, monetary instruments have been assigned to other objectives only when that is viewed as not very much detrimental to the inflation objective. Keeping in view the need to deal with the recent slowdown in economic activity as also to strengthen the interest rate channel of monetary policy, the statement on the monetary and credit policy for 2002-03 outlined the stance of monetary policy as: (a) provision of adequate liquidity to meet credit growth and support investment demand in the economy while continuing a vigil on the movements in the price level, (b) a preference for soft interest rates, and (c) to impart greater interest rate flexibility to the interest rate structure in the medium-term. In a benign inflation environment, adequate provision of liquidity at soft interest rates suggests the assignment of monetary policy to the growth objective. Pursuit of this objective, however, does not jeopardize the inflation objective. Imparting flexibility to the interest rate structure assumes particular importance in the context of the segmentation that continues to persist in the Indian financial system. The money market rates, which can be directly influenced by the RBI through its liquidity management operations, do not strongly influence the other interest rates across the term structure, particularly in the credit market. Given the deposit rates, the lending rates remain inflexible due to the problem of NPA and operational costs. The deposit rates, which should compensate the depositors for the inflation while providing appropriate real return, also remains inflexible due to rigidities in the contractual small savings. Large annual borrowing programmes of the government also impart downward rigidity to the interest rates. Like the requirement of a stable and predictable relationship between money, output and prices in a monetary targeting framework, use of interest rate as an operating target requires clear transmission of the policy rates to the objective by influencing the entire term structure. Segmented financial markets where the risk-adjusted returns do not exhibit strong sensitivity to the policy rate may constrain the conduct of monetary policy. The extent to which this constraint operates at present in India gets fully reflected in the objectives stated in the monetary policy statements. With ample liquidity in the system, a deregulated interest rate environment should ensure that the interest rate structure on its own remains soft. Due to the presence of rigidities in the system, however, when the policy rates are reduced (whether Bank Rate or Repo Rate) to deal with an economic slowdown, interest rates in the credit market fail to respond adequately. Similarly, when liquidity is injected to the banking system (by reducing the CRR), the excess liquidity in the

banking system does not always translate into lower lending rates. At times, overshooting of the borrowing programme of the government may completely offset the favourable impact of extra liquidity injected to the system by reducing the CRR. Similarly, as a part of the liquidity management operations when the short-term money market rate is kept soft as a matter of policy to signal the stance of monetary policy, other interest rates do not fully adjust to the soft short-term rate. As a result, despite soft policy rates, making available adequate liquidity to meet the credit demand and to support investment demand finds a separate mention in the policy statement. With a view to improving the integration of markets while also ensuring a strong and resilient financial system that would strengthen the interest rate channel, the monetary policy statements of RBI since April 1998 have rightly placed particular emphasis on structural issues relating to the financial sector.

The multiple indicator approach, thus, makes use of both the quantum channel (based on annual growth of money supply and credit) and the interest rate channel (based on the growing – though still imperfect – integration of markets and the rising sensitivity of different components of aggregate demand to interest rate changes). As the Annual Report for 1998-99 noted, "the emerging evidences on transmission channel (in India) suggest that the rate channels are gradually gaining importance over the quantum channel". The Annual Report for 1999-2000, however, emphasized that the rate channel cannot completely substitute quantum channel based on monetary targeting until the rate channel is fully evolved into a robust and reliable one. "Such an outcome requires that certain conditions are satisfied, *viz.* the elimination of fiscal dominance in macroeconomic process and of the connect between monetary and internal debt management, and the full integration of financial markets." Recognising the growing importance of the rate channel within the multiple indicator approach, the operating procedure of monetary policy has laid considerable emphasis on liquidity management in the recent period.

The Liquidity Adjustment Facility (LAF) which was introduced effective June 05, 2000 has gradually emerged as an effective mechanism for absorbing and/or injecting liquidity on a day-to-day basis in a flexible manner while providing an informal corridor for the call money rate and signalling the stance of policy. Prior to the introduction of LAF, the RBI used to provide liquidity to the banks through its standing liquidity facilities, particularly general and export refinance at rates linked to the Bank Rate which was reactivated in April 1997 as a reference rate for signalling the stance of monetary policy. With the introduction of the Interim Liquidity Adjustment Facility (ILAF) in April 1999, the general refinancing was replaced by Collateralised Lending Facility (CLF) and Additional Collateralised Lending Facility (ACLF) at rates linked to the Bank Rate whereas liquidity absorption was done through fixed rate repos announced on a day to day basis, supplemented by OMO in government dated securities and treasury bills depending on the liquidity conditions. Under ILAF, thus, liquidity was injected at different rates and absorbed at a fixed repo rate. As a result, an informal corridor for the call rate emerged with the refinance rate operating as the ceiling and the repo rate setting the floor. The LAF is being implemented in three stages to facilitate a smooth transition so that LAF emerges ultimately as the primary instrument of liquidity adjustment and the other forms of liquidity support, *viz.,* the collateralized lending facility and export credit refinancing to banks, and liquidity support to Primary Dealers (PDs) are completely phased out. The intention is also to move towards a pure inter-bank call money market by restricting participation of non-banks (like AFI, mutual funds and insurance companies) to repo market. In the final stage, LAF would operate at different timings of the same day with flexible quantum and rates depending on the immediate needs of the system. By influencing the short-term rate, as the different segments of the financial market get further integrated, the interest rate channel would be primarily relied upon in the conduct of monetary policy. The forecasting requirements to support this new framework would be much more demanding as the expected liquidity mismatch would be the key factor guiding the conduct of liquidity adjustment operations every day and at different time intervals during the same day. Liquidity forecasting, however, continues to be a challenging task for every central bank and in India, the forecasting ability of an internally developed model is being validated at present against the actual realizations in the market.

The entire monetary policy transmission could be conceptually analysed in terms of stages. At the first stage, central bank action affects "quantify" variables like bank reserves (or base money) or "price" variables like short-term money market rates. At the second stage, the changes in reserves or the short-term rates begin to affect "quantity" variables like narrow or broad money and "price" variables like the long-term interest rates. At the third stage, the changes in the monetary and financial variables begin to affect aggregate demand, while at the fourth and the final stage the interaction of aggregate demand and supply leads to a change in the prices and output. At every stage, the process of monetary transmission mechanism is extremely complex and the channels through which monetary policy begin to affect the real sector is one of the most widely debated areas in eco-

nomics. To complicate the matter further, the relative strengths of different channels may very sharply across countries and over time.

In the Indian context, an intensive examination of the transmission mechanism is difficult because the nature of economic relationships appears to be changing as a consequence of continuous economic reforms in the financial sector. Yet tremendous efforts have been made by Indian modellers to understand the implications of these changes.

Following the reforms in the financial sector, the Bank Rate has emerged as an important indicator for signalling the stance of policy for the market and guiding the interest rates to the desired trajectory. So far as the first stage of monetary policy transmission is concerned, creation of informal corridors has helped to stabilize the short-term rates in the money market. RBI's current task is to monitor the excess reserves and assess the liquidity needs of the banking sector continuously to guide the course of short-term rates within the corridor. With the impending reforms in the money market, the stability of the money market rates is likely to improve further.

Results from models reveal that in the second stage the policy impulses from short-term rates still appear to suffer from considerable stickiness. Although reforms have led to the emergence of a yield curve in the debt market, the lack of volumes in the debt market has somewhat blurred its full development. The debt market in India is, however, evolving at a fast pace. The credit market, on the other hand, suffers from a few structural rigidities which needs to be addressed through future policies.

So far as the third and the fourth stages of monetary policy transmission in India are concerned, there have been a plethora of macroeconomic models. Implications of monetary growth or changes in official interest rates on prices and output – as per the estimates obtained from these models – form important inputs for policy. Results confirm the importance of CRR and Bank Rate as policy tools. Results also confirm the importance of agricultural sector – not only in influencing aggregate supply, but also in stimulating demands from the other sectors.

3. Liquidity Forecasting

In recent years, monetary policy operations have become market-orientated, leading to increasing importance of markets as against financial intermediation. Profound changes are taking place in the financial environment, making certain static monetary policy perceptions gradually out of order. For example, viewing the monetary base as the key concept in the determination of interest rates; use of reserve requirements for monetary control; treating the marginal demand for bank reserves as a function of the volume of deposits; or that the central bank's administered interest rates mechanism by mechanically supplying a certain volume of funds to meet a generally well-behaved demand for monetary base or bank reserves. As the old order changes has given way to new operating procedures for monetary operations, majority of central banks have put in place a flexible framework of liquidity management, which operates as the main fulcrum for influencing monetary conditions.

Liquidity forecasting with a reasonable degree of accuracy helps a central bank to know how much of liquidity to provide or withdraw from the money market on a day-to-day basis. The objective is to smooth undesirable market fluctuations and contain excessive overall financial market volatility.

The system of liquidity forecasting sits in the confluence of central bank's balance sheet flows; government's debt and cash balance position and central bank's interactions with market participants. Liquidity assessment thus requires timely synthesizing of wide range of information on financial transactions that affect central bank's balance sheet. The available liquidity forecasting methodologies vary from an intensive data based approach to adaptive adjustment procedures applied on outputs obtained from a plurality of models expressed in the form of functional equations and identities.

Broad structure and the related issues underlying the liquidity analysis and projections undertaken under the directions of Financial Market Committee (FMC) of RBI are described below.

Liquidity analysis and projection

The term liquidity has different connotations. To a central bank, liquidity in the money market implies a comfortable level of reserves maintained by the banking sector over and above the stipulated limit.

The rationale and analytical foundations of liquidity management in India are based on recommendations of three Working Groups on Money Supply Measures in 1961, 1977 and 1998. The last Working Group was constituted under the Chairmanship of Reddy, then Deputy Governor of RBI.

In the Indian context, the short-term liquidity conditions of the banking system is monitored by the Bank on a daily as well as monthly basis with projections generated for two fortnights. The Framework of liquidity analysis was set out in the recommendations of the *Working Group on Liquidity Analysis and Forecasting (Y. S. R. Sarma Group).*

Daily Assessment of Liquidity

(i) Daily position on liquidity is prepared giving cumulative injection/absorption of liquidity during the year, during the latest two fortnights and next two working days.
(ii) Monthly in-flow and outflow in respect of the banking system is monitored by taking into account coupon payment on central and state government securities, issues and maturity of treasury bills and dated securities during the month that is known in advance.
(iii) Cash Reserve maintenance of Scheduled Commercial Banks on daily basis is monitored after taking cumulative Deposits Accounts Department (DAD) current account balances of all the centers. After getting latest position, the CRR requirement for remaining period of the fortnight is derived.

Monthly Forecast of Liquidity

A short-term forecast of liquidity is carried out on a monthly basis in the format suggested by the Working Group on Liquidity Analysis and Forecasting.

Short-term Liquidity Forecasting Model

The need for better understanding of the implications of liquidity management through systematic methods of analysis based on models can hardly be over emphasized. However, such an endeavour is circumscribed by the availability of information and the extent of market developments. Needless to mention, while models can throw useful light on mechanisms of market behaviour, the inherent uncertainty requires that modelling efforts are undertaken with humility and a great degree of caution. A modelled view on liquidity conditions is to an extant logical structure estimated statistically based on the past data which requires to be graduated periodically based on new informational flow and new phases of market developments. In this sense, like any dynamic forecasting system, liquidity assessment tools and techniques, have to draw down heavily upon extensive flow of financial information on a timely basis, multiple simulation schemes and adaptive empirical adjustments based on early judgements of dominant market participants and policy makers.

To aid monetary policy operations, in 1998, an Advisory Group of eminent economists was constituted by the Reserve Bank to guide the development of an operational model. While unveiling the initiatives towards model building for liquidity forecasting, it was posited that the "fundamental issue in the conduct of the monetary policy operations relates to strike a balance between the quantum of liquidity required to support economic activities and the interest rates reckoned in the investment decisions". In a dynamic system, as the underlying linkages are in a constant process of evolution, the empirical relationships also tend to change over time. This is more so in emerging markets like India, which is in a transitional phase. Based on these perspectives a short-term liquidity forecasting model based on daily data on liquidity operation conducted at the behest of the FMC has recently been developed. The model attempts to study the interaction of the RBI policy measures – both liquidity and interest rate measures – and the short-term money market rates. The generic form of the model has been made public for wider debate and suggestions for possible modifications to be made in the future.

Methodological issues in Short-term liquidity forecasting

Due to unstable, heteroscedastic and volatile nature of the financial data series used in liquidity assessment, it is very difficult to use conventional forecasting methods adopted in time series and structural model analysis. The methods adopted for the short-term liquidity forecasting are, there-

fore, purely based on data based approaches that are based on current data on each variable and the previous period comparable trends.

(a) For example, currency in circulation is projected using the latest available week-end data and the weekly growth rate observed in the corresponding periods last year. Forecasts generated using time series analysis are also compared.
(b) Similarly, past trend in Government of India's receipts and expenditures is used in projecting the current data over a short-term time horizon by adjusting with known figures on redemption and coupon payments in respect of the outstanding dated securities. In case of estimating daily changes in Wage and Means Advance (WMA) a myopic estimation rule is followed under normal conditions of rising/declining phases by considering the daily change observed in the last two working days.
(c) As regards Forex transactions operation by the RBI, continuance of past trend in the immediate preceding fortnights are assumed.

4. Forecasting of economic indicators for monetary policy

Structural Model for Forecasting

Macro-models have been widely used in the design and implementation of stabilization policies world-wise, especially when the stabilisation programme has to be pursued with multiple (and sometime conflicting) objectives. The major ingredients for policy formulation must involve a judicious blending of economic theory, informed judgments and thorough knowledge of the principal structural and institutional characteristics of the economy in question, and a macro-model in this context has a pivotal role.

Macro econometric model building for the Indian economy has a long history (Jadhav (1990)). The first model by Narsimham was published in 1956. The model of the Indian economy built by P.K.Pani (1984) was an early attempt from within the Reserve Bank explaining inter-sectoral transmission mechanisms and looking for policy options. This was basically a structuralist model. Pani's model contained 79 equations, of which 17 related to monetary sector comprising components of money supply, other monetary variables, fiscal feedbacks and price formation.

Bhattacharya, Barman and Nag (1994) model went into examining the stabilisation policy options based on an eclectic approach. The model has four blocks of equations: output and investment; money and prices; government revenue and expenditure; and external trade, debt and balance of payments. In this model, agricultural prices are assumed to be more sensitive to agricultural supply, whereas non-agricultural prices are influenced more by cost-push factors than pure supply and demand factors. The output is explained by capital and rainfall beside other dummy variables.

Manohar Rao and Balwant Singh (1995) designed a macro-model titled "Analytical Foundations of Financial Programming and Growth Oriented Adjustment" under the Development Research Group of RBI. This involved preparing a consistent framework for the major macro identities, in a financial programming framework, and thereby estimating relationships for certain variables. Parameters were obtained using time varying parameters, i.e. Kalman filter. Certain policy options and forecasts were obtained using control theory methods in a consistent and compatible policy framework.

Rangarajan and Mohanty (1997) model, also an important attempt from within the Bank, focussed on various macroeconomic impacts of fiscal deficit with special emphasis on the nature of relationship between deficit, external balance and monetary growth. This model reflected the thinking on analytical relationships among fiscal deficits, prices, output and current account balance for formulation of alternative policy options for maintaining stable internal and external balance in the economy.

The latest on macro-model from RBI is a four blocks model i.e. real, monetary, fiscal and external sectors published in the Report on Currency and Finance, 2001-02. The model has been developed with an objective of assessing the implications of autonomous demand shocks and monetary and fiscal policy impulses on growth and inflation. A novel aspect of the model structure is an explicit treatment of output demand and supply schedules with output gap acting as a key component in the evolution of inflationary process. Also perhaps, for the first time in India such a model has considered adoption of a monetary reaction function, which is anchored to lending and deposit rates in the economy- thereby providing a role for central bank's monetary policy actions in the management of aggregate demand and inflation.

Many early macroeconometric modellers in India including those in RBI were trained by Klien. Klien has continued with his interest on modelling of Indian economy. Recently, Palanivel

and Klien (1999) visited trade-off between inflation and output for the Indian economy once again and attempted to trace the impact of change in trade, fiscal and monetary policies especially during the 1990s. The policy simulation based on this model has been of use for analysis of monetary policy options. One may refer to Krishnamurty (2002) for a most recent and authoritative review of macroeconometric models for India.

The research on macro-models in RBI have been oriented primarily in the policy simulation framework – wherein a detailed structure consistent with the economy is prepared and which is put through different policy shocks. A further development in the methodological research took place with the application of control methods, which provided a direct linkage between policy objectives and policy instruments and revealed trade-off between different policy options.

In terms of monetary policy, the focus of the macro-models in RBI has been on (a) analysis of transmission mechanism of the monetary policy; (b) deriving a feedback rule in order to attain desired objectives, say maximisation of output and minimisation of inflation rate, using different policy instruments, like cash reserve ratio and bank rate, etc. and finally for the forecasting purposes. Models relating to the transmission mechanism are broad based covering linkages of the economy and having a detailed coverage of the monetary sector. Broad mechanism of these models involves evaluating the performance of the macro-system under different hypotheses. Models relating to the derivation of feedback rule, framed in the control theoretic framework, are small in size. Similarly, macro-models, used for forecasting purposes are small and focused on the performance of a few select macro variables – real output and inflation rate being the main ones. It may be mentioned that much of the empirical research in RBI relating to macro-models is attributed to individual efforts of the researchers in the research departments.

The approach of the models before the liberalization of the economy used to be based on the stability of money demand function. With the change in the policy framework, there is also a shift in the paradigm of modeling efforts in RBI. At present modeling exercises are focused on the 'market clearing mechanism' and as such many of the variables, which were earlier exogenously given are determined endogenously. As mentioned in the previous section, the Bank Rate has emerged as an important policy variable for modeling exercise.

In the pursuit of macroeconomic modeling in India a number of difficulties have been encountered. To begin with, the data were available generally on annual basis, especially in respect of many of the important real sector variables. Data on investment, which is a key to determine the linkages between interest rate and aggregate demand is still available on annual basis. Another difficulty is that, in the wake of reforms process, relationships are undergoing a major shift and this in turn causes a degree of freedom problem, if one uses post reform data. To a certain extent, this problem has been tackled by making use of Kalman Filter, etc. Another difficulty, which is more relevant for the forecasting purposes, is that macro-econometric models typically involve quantitative analysis involving a large number of parameters. Often, the data pertaining to the latest period used in such models are provisional and undergoes substantial revision at later stages. As a result, macro-econometric models – especially, the large ones have been perceived as having limitations for forecasting purposes and specifically prediction of turning points often become undependable. Similarly, for forecasting purposes, information on exogenous variables become available with much delay. In the light of these limitations and the emergence of cointegration approach researches have shown preference for theoretically and empirically consistent models of small sizes.

Limitations of structural model for forecasting

Besides evaluating different policy options, macro-econometric models have also been used for forecasting purposes, though with a limited success. There are numerous difficulties in obtaining reliable and accurate forecasts using structural model. Since structural models represent a comprehensive structure of the economic system, it involves relatively larger data space as compared to other forecasting procedures. Many a times, parameters are estimated based on the provisional data, and with revision of data these estimates undergo a substantial change which makes forecasting difficult. Secondly, while obtaining any forecast using macro-econometric model, one has to make a judgment about the exogenous variables. Any error in the exogenous variables is likely to affect the forecasting of the overall macro-model. For example, in India, rainfall which has a vital role on the overall economy, is an exogenous variable in the macro-model. Any error in the judgment of rainfall is likely to affect the forecast of all the important variables. Finally, since macro-models take into account feedback effects of all the sectors into account, error in any one sector or any one equation, in terms of its specification, estimation, etc. affects the performance of forecasts of other variables also.

Simultaneous nature and direction of causality are issues which create serious problems in macroeconomic modeling. As Ramsey and Kmenta (1980) said "An important distinction between the classical econometric approach and the time series approach to modeling is that the econometric approach typically begins with a strong parametric formulation of the model which provides the basis for the empirical analysis. Potentially blatant contradictions of the assumptions of the model are investigated but diagnostic checking is not pursued vigorously. Time series models, on the other hand, typically begin with a relatively weak, nonparametric formulation of the model. Much more emphasis is placed on data analysis to suggest the types of simplifications that may be appropriate." Diebold (1998), while expressing similar view, concluded that "The hallmark of macroeconomic forecasting over the next 20 years will be a marriage of the best of the nonstructural and structural approaches, facilitated by advances in numerical and simulation techniques that will help macroeconomists to solve, estimate, simulate, and yes, *forecast* with rich models.

Time Series Models

A number of alternative methodologies exist for the purpose of forecasting. Experience shows that no single technique or approach can give accurate forecast uniformly for all economic variables. Even in case of a given variable, it may so happen that a different model/technique performs well for generating forecast at different time horizons depending on the peculiarity of its evolving economic structure. In such a situation a simple model which is easy to build and operate is often preferred.

Time series models have been found to be very useful for short term forecasting. A class of models known as univariate time series models has certain advantages for carrying out forecasting exercise as these models are easy to identify and estimate and do not require any data other than the series itself. Being based on the generating process of its own past, these models do not explicitly incorporate the cause and effect relationship as done in structural models. Inspite of this, these models often produce forecasts which surpass the forecasting performance of large models.

Depending on the mathematical formulation, univariate time series models could be of two types – linear and non-linear. The linear models, such as ARIMA, are simple to understand and its identification is supported by good diagnostics. The non-linear models, viz., Bilinear, Threshold Auto Regression, Random Coefficient Auto-regression, State Dependent, SETAR, ARCH/GARCH, etc. are powerful alternative forecasting tools which help in approximating the generating process better and thereby improving forecast performance.

As univariate time series models cannot capture inter-linkages of related variables, multivariate time series models, (i) Vector Auto-Regression (VAR) and its modified versions, like, Structural-VAR and Near-VAR models (Sims, 1980; 1986; Bernanke, 1986; Blanchard and Watson, 1986; Filardo, 1997), (ii) Error-Correction Models (ECM)/Vector Error-Correction Models (VECM), (Engle and Granger, 1987; Johansen, 1988) etc., are used to strike a compromise between univariate time series and structural models.

VAR models are useful for both policy analysis and forecasting. As pointed out by Sims (1980), macroeconometric models are 'incredible' in the sense that economic theory is weak in specification of reduced form and exclusion restrictions imposed on variables and lags. The assumption of erogeneity is often considered by default rather than economic or statistical arguments. The outcome is also subjective reflecting on the judgment of the modeler. However, VAR approach has also come under criticism as 'atheoretical'. The identification of lag structure is also problematic. The ordering of variables, method of trend removal, the selection of variables also effect the results. Canova (1995) has presented a review of developments and critiques of the VAR methodology.

The multivariate time series framework can be compared with reduced form model and may explain interaction of economic variables in terms of economic theories if so designed. To the extent that *a priori* knowledge of economic theory guides the specification of multivariate time series models, some elements of structural modeling may be found in these models as well.

In RBI, concerted efforts are made for generating forecasts of several economic and financial variables, primarily for internal usage. The list includes Wholesale and Consumer Price Index based inflation, Index of Industrial production, Quarterly GDP, monetary aggregates, foodgrains production, currency demand/requirement, foreign exchange reserves, exports and imports, money multiplier and so on. The choice of a model for forecasting a variable depends on many factors like data availability, data frequency and of course the nature of the series. Instead of relying on any single model, a number of alternatives are tried under different assumptions and the one

found to have best predictive performance is chosen for forecasting exercise. The construction exercise is revisited when the forecasts start showing high errors.

Several univariate time series models have been tried for forecasting of inflation (Barman, Madhusoodanan and Samanta (1994)). In the case of monthly series, it appears that linear model (such as ARIMA) is quite good in generating one-to-three step-ahead forecasts even though Bilinear and State Dependent models often perform better. 'Self-Exciting Threshold Auto-Regression' (SETAR) model performs well for most of the series for lead periods above 3 months. For higher time horizon, some forms of non-linear models outperform their linear counterparts. As the forecasting performance depends on the nature of volatility and non-linearity in each series it is advisable to try a number of models and select the one which performs best for a series.

The possible impact of a monetary policy shock on output and inflation was examined in a VAR framework by Srimany and Samanta (1998). Their study demonstrates divergences that occur in results based on ordinary and structural VAR models, thus highlighting the need for appropriate specifications. A number of other studies have also focused on impulses of monetary policy on output under different frameworks.

The performance of forecasts of inflation and output based on VAR models have been comparable to univariate time series model. In some cases, multivariate error-correction models (in cointegration framework) are found to outperform univariate models. In general, multivariate time series models have not as yet emerged as superior alternative to univariate models.

Leading Indicator Approach

Though the 'leading indicator' (LI) approach is widely used primarily in business cycle literature for tracking real GDP and pattern of movement in related aggregates, research in this vital area in India is only now gaining in importance. Of late, a number of individual efforts have been made in adopting this framework and now it is a part of RBI's own research agenda. The available literature indicates its success in predicting upward and downward movements in IIP and inflation rate (please refer to the Report of the Expert Group set up by RBI).

An expert group was constituted by RBI with the author of this paper as the Convenor to suggest methodology for studying business cycles in the Indian context with a view to working out composite leading, coincident and lagging indicator, among others. The group felt that the data on quarterly real GDP, major activity sectors and other related national accounts aggregates on a quarterly basis, at least since 1970-71, would be needed to facilitate studies in these areas. The group suggested formation of a Standing Committee to go into the issues of dating of reference peaks and troughs, development of methodologies for construction of composite leading indicators, suggest further action for strengthening data base for research on business cycle and take a view on state of the economy.

Neural Network Techniques for high frequency data

For forecasting high frequency time series (say, daily return in stock/forex market), the main limitation in using macro-model or multivariate technique lie in lack of information on related variables with same frequency. The results of time series models for the purpose are also not very impressive. Actually, these series are dominated by peculiar (but unknown) types of non-linearity, which are difficult to model by traditional time series analysis. To tackle such complexity and to extract pattern from such volatile and noisy data, attempt was made to use certain techniques used in the area of artificial intelligence (such as fuzzy logic, neural networks and genetic algorithm), which are generally believed to be global approximator of unknown non-linearity and are widely used in forecasting literature. We experimented with (i) neural networks for forecasting daily returns in stock/forex markets and also for predicting currency crisis; and (ii) fuzzy logic-based techniques for forecasting weekly series on annual inflation rate.

Nag and Mitra (2002) employed hybrid artificial intelligence methodology of genetically optimized neural network to model stock indices, index of industrial production, and inflation in India. In an earlier paper they attempted to forecast daily foreign exchange rates. The results are very encouraging even though each of these series is volatile and difficult to approximate by time series models.

Combination of Forecasts

The use of multiple-techniques for forecasting may give rise to conflicting results in the sense that the predictions of a variable generated through different techniques may vary considerably. This is partly because of the fact that behaviour of all variables is not similar and partly because the basic assumptions made by different techniques are not always fulfilled. In such a case, selection of a final forecast for policy formulation and decision making purposes becomes difficult. As pointed out by many researchers, different individual forecasts may reflect different assumptions, data and expertise, etc., and therefore, one may not prefer to simply choose forecast from one model. Rather, one would combine all individual forecasts to get a final forecast. In this context, the strategy of combination of individual forecasts assumes importance in recent literature. Our empirical research in this direction, particularly for forecasting inflation rate, affirms that suitable combination of individual forecasts leads to substantial improvement in forecast accuracy.

Industrial Outlook Survey

A quarterly survey was launched by RBI in January 1998 to elicit information on industrial outlook as a leading indicator of the industrial economy. The survey is designed to gain insight into the performance of the industrial sector on a quarterly basis. The survey has undergone several changes during the last four years in terms of content and coverage. The main elements of information collected at present cover size class of companies, technology constraints, availability of inputs, industrial relation, financing requirement, domestic and export demand, competitive environment, order book, inventory, capacity utilization, employment and profit margin. The data collected are qualitative in nature; mainly of 'increase', 'no change' and 'decrease' types. The schedule is canvassed with non-government non-financial public limited companies.

The survey results are analysed using all seventeen elements for which data are now collected and the data are combined to get a composite index, which measures the performance in the current quarter and the outlook for the next quarter. The results are useful to assess the prospect for the next quarter, though average response seems to be optimistic on many elements and thus often need subjective downward adjustment.

Two other agencies also undertake similar surveys. The National Council of Applied Economic Research cover about five to six hundred companies for their quarterly survey. The Confederation of Indian Industries cover about the same number of companies registered with them. It is interesting to note that though the sample of companies differ for the three agencies the results appear to converge in terms of broad direction of change, giving added confidence in the results.

Judgmental Forecasts

The expert opinion is also important in forecasting. The experts develop a feel for the economy based on many years of experience, partly based on model building and assessment of model performance. The economic news papers report these espert forecasts. For example, P. R. Brahmananda, with experience of over half a century in the thick of economics teaching and research, has been making projection of GDP growth mainly using contextual data, for the past few years. His latest projection relates to the current year i.e. 2002-03 published in the daily economic news paper the Hindu Business Line on 20 July, 2002. As monsoon is a key element in agriculture production accounting for one quarter of GDP, the drought this year is assumed to result in drop in agricultural output by 10 per cent and a minimum of 10 per cent drop in output in the non-agriculture sector. Various sectoral drops on supply and demand by way of raw material for industry, decline in surplus for exports, lower movement of goods transport, price rise and consequent effect on wage bill, lower income from other tertiary sectors were considered on notional basis. The growth in GDP fearing worst is placed at 2.12 per cent and highly optimistic estimate is placed at 5.39 per cent. The mean rate of GDP growth is projected just about 4.8 per cent.

Judgmental forecast serves an useful purpose for RBI as expert opinion has its value. It may not be out of place to quote from Wright, Lawrence and Collopy (1996) about the role and validity of judgment in forecasting:

"Even the most die-hard quantitative forecaster may resort to judgmental adjustment of the time series history to remove extreme events caused by strikes or special promotional events. And even the most die-hard judgmental forecaster may utilize quantitative methods to process the time series history before estimating a forecast."

Performance of Forecast of GDP and Inflation made by RBI

In RBI, the first projection of GDP is made in April based on assessment of available model based forecasts, budget projections, discussion with experts and bankers and the overall assessment of movements in financial and real sector indicators. These forecasts are revised in October at the time of mid term review of monetary and credit policy. The projections of RBI and the actual from 1998-99 to 2001-02 are as below:

Projections of growth in GDP and Inflation made in Monetary and Credit Policy

		April	October	Actual
1998-99	GDP	6.5 – 7.0%	6.0%	6.6%
	Inflation	5.0 – 6.0%		5.9%
1999-00	GDP	6.0 – 7.0%	6.0 – 6.5%	6.0%
	Inflation			3.3%
2000-01	GDP	6.5 – 7.0%	6.0 – 6.5%	4.0%
	Inflation	around 4.5%		7.2%
2001-02	GDP	6.0 – 6.5%	5.0 – 6.0%	5.4%
	Inflation	within 5,0%		3.6%

It may be observed that these projections were fairly accurate except for 2000-01. It may be said that the informed judgment of RBI through judicious combination of quantitative and expert forecasts has been generally close to the mark.

5. Conclusion

Forecasting is not an easy task; it is a continuous process of re-building models and re-examining their performance – a process which undergoes changes with the development of new theories/tools and the better knowledge gained through experience. It is hardly surprising, therefore, that a model/strategy, which is the best for forecasting a series today, may no longer be so tomorrow.

The success in forecasting is also a relative concept. Improvement in the forecast accuracy by adopting a new model/strategy, no doubt, gives a degree of satisfaction to the forecaster. But the challenge of doing better and hitting the bull's eye again and again remains. There are many problems over which forecaster has no control. One of them, and quite often, is the reliability of data used in the model. For example, the initial estimate of growth in GDP of India for 2000-01 was 6 per cent, which was revised to 5.4 per cent and finally placed at 4 per cent. This has upset various forecasts for reasons beyond control of modeler.

Forecasting error has a cost. The targets go wrong, policy becomes erroneous and mis-allocations take place. At times they turn into blunders and the costs become heavy. The crises encountered by different economies in the recent period bear testimony of glaring failures. These are lessons for doing better next time and the challenge continues. One can definitely do a better job if the information available is reliable and timely, markets are efficient and transmission mechanisms are well developed. Even then past can not be relied fully as the evolution has certain surprises or policy induced elements and also influence of expectations based on both internal and external environments which cannot be fully captured in a model is a reality.

Forecasting is also an art. One hones this art with experience and uses different tricks to incorporate his subjectivity into the model. The choice of sample period, lag structure, variables, specifications, method of estimation of parameters are but some of the arts forecasters make use of from a large repository of alternatives. This art distinguishes a good forecaster from not so good. However, it is difficult to be uniformly good all the time. Thus the job of forecasting is both stimulating and challenging.

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Abstract

The overall stance of monetary and credit policy in India is to provide adequate liquidity to meet credit requirement and support investment demand in the economy while continuing a vigil on movements in the price level to keep inflation within limit. The policy for stability and efficiency of the financial system are considered important for improving the health of the financial sector. The Reserve Bank of India presently operates with a broad-based multi-indicator approach for assessing the environment and conducting its policy. The approach is different from any intermediate targeting (like broad money or exchange rate targeting) or any targeting of final policy objective (like inflation targeting), but it essentially takes into consideration the important elements of both forms of targeting while operating with its multiple indicator approach. The growth in money supply, GDP, deposits, credit, market borrowing requirement of the Government, money market interest rates, exchange rate, foreign exchange reserves and the overall liquidity condition are the main indicators which are generally watched and assessed for building alternative scenarios for the year ahead. Model estimated forecasts of output, inflation and liquidity comprise important elements of the information set used by the policy makers in the conduct of monetary policy. These forecasts are generated by structural models, time series models and industrial outlook surveys. The short-term liquidity forecast is a more complex area and the appropriate approach and method for generating liquidity forecasts is being explored in India. The paper discusses these issues and highlights the problems that often warrant methodological refinements.

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Efficiency of banks in Croatia: a DEA approach

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1. Introduction

Bank efficiency has been an important issue in transition. All transition countries have been faced with at least one banking crisis, and many with more. In most of the transition countries the question of relative comparison of banks by size, type of ownership or date of appearance has at some point been an issue: how good it is to let new banks enter the market; should the domestic banking sector be sold to the foreigners; do small banks have a future in the era of globalization and banking market consolidation? These, and others, are all questions which continue to dominate discussions in many transition countries. Therefore, an understanding of a bank's relative performance compared to the market, or over a period of time, is important for analysts, practitioners and policymakers alike.

In this paper we analyze bank efficiency in Croatia using the Data Envelopment Analysis (DEA). Data Envelopment Analysis is a methodology for analyzing the relative efficiency and managerial performance of productive (or response) units, having the same multiple inputs and multiple outputs. It allows us to compare relative efficiency of banks by determining the efficient banks which span the frontier. Most important advantage of the DEA over the traditional econometric frontier studies is that it is a non-parametric, deterministic method and, therefore, does not require a priori assumptions about the analytical form of the production function. Therefore, the probability of a misspecification of the production technology is zero. Disadvantage is that, being a non-parametric method, it is more sensitive to possible mismeasurement problems.

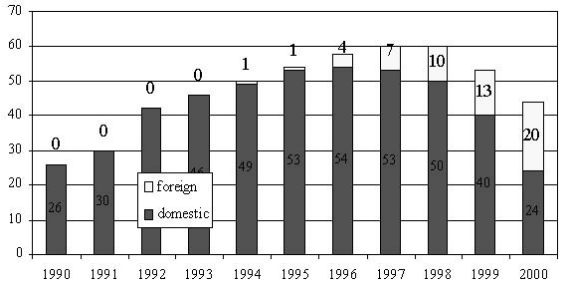
We measure the relative efficiency of banks in the Croatian market according to size, ownership structure, date of the establishment and quality of assets in the period from 1995 until 2000. We find that foreign owned banks are on average most efficient, that new banks are more efficient than the old ones and that smaller banks are globally efficient, but large banks appear to be locally efficient. We also find that strong equalization in terms of average efficiency has happened in the Croatian banking market, both between the peer groups as well as within the peer groups of banks. Regarding particular inputs, the most significant cause of inefficiency among state owned and old banks vs. foreign and new ones is the number of employees and fixed assets. In terms of size, the most efficient in various specifications are either smallest or largest banks, and technically more efficient banks are also banks that have, on average, less non-performing loans, but this conclusion becomes more obvious only with the gradual consolidation in the banking sector.

2. Banking industry development

After gaining independence in 1990, Croatia already had a two-tier banking system from ex-Yugoslavia. However, it had to rebuild its banking system establishing new standards of market based banking practice. During the process many new commercial banks were established. In Croatia banks represent by far the most important segment of financial intermediation. Their share in the estimated total balance sheet of financial institutions is almost 90 per cent. The number of banks in Croatia has been rising until 1997 (Figure 1). Barriers to entry were low, as the minimum equity capital to found a bank was about HRK 55 million for a full international license (this has been raised with the introduction of the new Banking Law at the end of 1998). That has helped the entry of a substantial number of new small banks.

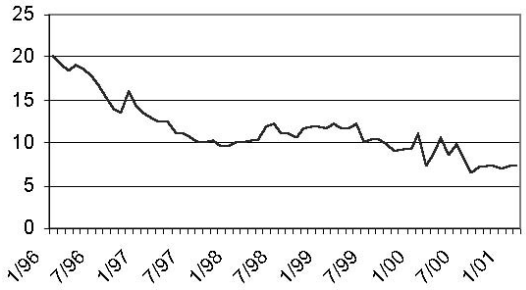
1 *We would like to thank Paul Wachtel for his comments on an earlier draft of this paper. Views expressed in this paper are those of the authors, and do not necessarily reflect views of the Croatian National Bank.*

Figure 1 – Number of banks



However, the main reason for the successful growth of smaller banks was the high interest rate spread, a situation in which many small new banking institutions without the burden of old debts could do business with large profit. It was only after the rehabilitation process of large state-owned banks had started that the spread came down from 20 percentage points level, to below 10 percentage points (Figure 2).

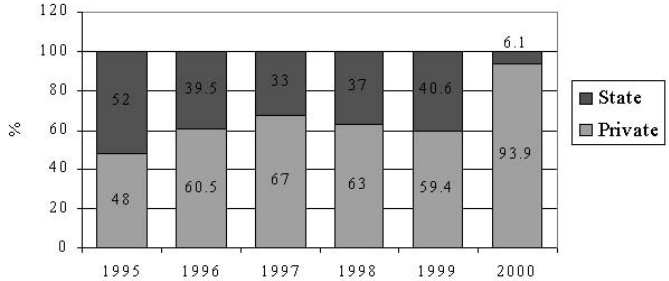
Figure 2 – Interest rate spread



In 1990 there were 26 banks in Croatia, but by the end of 1997, The Croatian banking sector already comprised 61 universal banks[2], of which nine were foreign owned. Foreign banks started entry relatively late, only after the Dayton peace agreement in 1995, which has put an end to the hostilities in Croatia and Bosnia and Herzegovina. Entry of foreign banks, coupled with the exit from the market of some badly managed/undercapitalized banks (since 1998), has gradually increased competition in the domestic market. As the high interest rate spreads started to come down, a number of banks have experienced difficulties in adjusting to the new conditions and increased competition. During the 1998-2000 period, 13 small and medium sized banks failed. Eleven of them exited from the market, and two were rehabilitated. After those failures, and some mergers and acquisitions, the number of banks fell rapidly. This rapid process of consolidation will continue. Two small banks failed in 2001 and a number of M&As are currently under way.

Since 1995, the ownership structure of the banking industry has substantially changed (Figure 3).

Figure 3 – Share in total assets

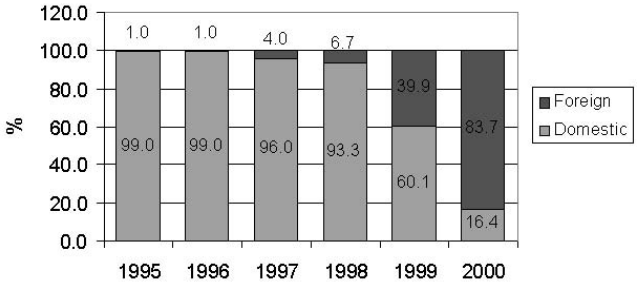


Previously predominant state ownership, when measured by assets, is down to only 6.1 per cent at the end of 2000, when only three banks remained majority state-owned. In 1999, however, before a sale of three large rehabilitated banks to foreign strategic owners, the share of state owned banks was still high – 40.6 per cent. Equally dramatic change has happened when we look at the domestic/foreign structure of ownership. By 2000, although only 20 banks out of 44 were foreign owned,

2 *There were also 33 saving banks, whose combined assets were less than 1 per cent of total assets of the banking system.*

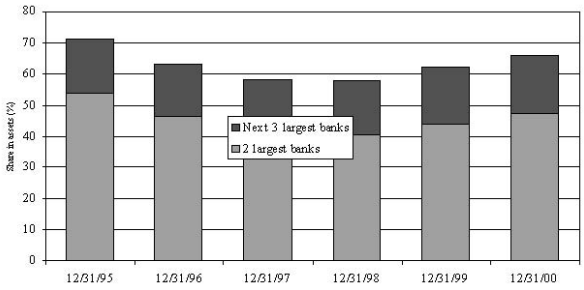
84 per cent of the banking system assetwise was already in hands of foreign owned banks (Figure 4). This was up from only 7 per cent in 1998. Such a rapid change was a consequence of a sale of the largest state owned banks to foreign owners.

Figure 4 – Share in total assets



The concentration in the banking sector is high, as is the case in other transition countries of Central and Eastern Europe. Market structure is oligopoly-like. Almost one-half of total banking deposits, and 47 per cent of assets belong to the two largest banks. The five largest banks control 65 percent of total assets.

Figure 5 – Share of largest banks in total assets



A number of new private banks, unburdened by dubious operations from socialist times have been established in the nineties. However, these banks were financially quite insignificant and did not influence much main aggregate indicators, including the concentration ratio. Although the loan and deposits growth was faster among those banks, the concentration was only slowly changing. The share of two largest banks fell primarily because one of them was downsized in the rehabilitation process. Since 1998, however, their market share is on the rise again, in part due to the exit from the market of a number of small and medium sized banks.

The only efficiency analysis of the Croatian banking system so far is Kraft, Tirtiroglu (1998), where the stochastic-cost frontier analysis is used on the data for 1994 and 1995. In the paper both operating and scale efficiency are estimated for old vs. new and state vs. private banks. The results show that old state-owned banks were more (both operating and scale) efficient than the new ones, although new banks were highly profitable. The authors ascribe that "abnormality" to free-riding oportunities created by distressed borrowers, limited competition, and start-up difficulties at the new banks.

3. Data Envelopment Analysis

DEA is a methodology for analyzing the relative efficiency and managerial performance of productive (or response) units, having the same multiple inputs and multiple outputs. It allows us to compare relative efficiency of banks by determining the efficient banks as benchmarks and by measuring the inefficiencies in input combinations (slack variables) in other banks relative to the benchmark. Since the mid-eighties, DEA has become increasingly popular in measuring efficiency in different national banking industries, as for example in Sherman and Gold (1985), Rangan et al. (1988), Ferrier and Lovell (1990), Aly et al.(1990), Elyasiani and Medhian (1990), Berg et al. (1993), Brockett et al. (1997), and in many other papers. Leibenstein and Maital (1992) argue that DEA is the superior method for measuring overall technical inefficiency.

Data Envelopment Analysis is a non-parametric, deterministic methodology for determining relatively efficient production frontier, based on the empirical data on chosen inputs and outputs of

a number of entities, called Decision Making Units (DMUs). From the set of available data DEA identify reference points (relatively efficient DMUs) that define the efficient frontier (as the best practice production technology) and evaluate the inefficiency of other, interior points (relatively inefficient DMUs) that are below that frontier.

Compared to the regression analysis, data envelopment analysis provides an alternative approach. While regression analysis relies on central tendencies, the DEA is based on extremal observations; while in the regression approach a single estimated regression equation is assumed to apply to each observation vector, DEA analyze each vector (DMU) separately, producing individual efficiency measures relative to the entire set under evaluation.

The main advantage of DEA is that, unlike the regression analysis, it does not require an a priori assumption about the analytical form of the production function. Instead, it constructs the best practice production function solely on the basis of observed data and therefore the possibility of misspecification of the production technology is zero. On the other hand, the main disadvantage of DEA is that the frontier is sensitive to extreme observations and measurement errors (the basic assumption is that random errors do not exist and that all deviations from the frontier indicate inefficiency).

Among a number of DEA models, we use two most frequently used ones: CCR-model (after Charnes, Cooper, Rhodes, 1978) and BCC-model (after Banker, Charnes and Cooper, 1984). The main difference between the two models is the treatement of returns to scale: while the latter allows for variable returns to scale, the former one assumes that each DMU operates with constant returns to scale.

3.1. CCR-model

Charnes, Cooper and Rhodes introduced a measure of efficiency for each DMU that is obtained as a maximum of a ratio of weighted outputs to weighted inputs. The weights for the ratio are determined by a restriction that the similar ratios for every DMU have to be less than or equal to unity, thus reducing multiple inputs and outputs to single "virtual" input and single "virtual" output without requiring preassigned weights. The efficiency measure is then a function of weights of the "virtual" input-output combination. Formally the efficiency measure for the DMU_0 can be calculated by solving the following mathematical programming problem:

$$\max_{u,v} h_0(u,v) = \frac{\sum_{r=1}^{s} u_r y_{r0}}{\sum_{i=1}^{m} v_i x_{i0}} \tag{3.1}$$

subject to

$$\frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \le 1, \quad j = 1,2,\ldots,j_0,\ldots,n \tag{3.2}$$

$$u_r \ge 0, \quad r = 1,2,\ldots,s \tag{3.3}$$

$$v_i \ge 0, \quad i = 1,2,\ldots,m, \tag{3.4}$$

where x_{ij} = the observed amount of input of the ith type of the jth DMU ($x_{ij} > 0$, $i = 1,2,...,n$, $j = 1,2,...,n$) and y_{rj} = the observed amount of output of the rth type for the jth DMU ($y_{rj} > 0$, $r = 1,2,...,s$, $j = 1,2,...,n$).

The variables u_r and v_i are the weights to be determined by the above programming problem[3]. However, this problem has infinite number of solutions since if (u*,v*) is optimal then for each positive scalar α ($\alpha u^*, \alpha v^*$) is also optimal. Following the Charnes-Cooper transformation (1962), one can select a representative solution (u,v) for which

$$\sum_{i=1}^{m} v_i x_{i0} = 1 \tag{3.5}$$

3 *In the original model, those variables are restricted to be strictly positive. However, their strict positive sign can be guaranteed by using the infinitesimal to generate the Non-Archimedean ordered extension field, in which its usage guarantees that optimal solutions of the transformed linear program are at finite non-zero extremal points.*

to obtain a linear programming problem that is equivalent to the linear fractional programming problem (3.1) - (3.4). Thus, denominator in the above efficiency measure h_0 is set to equal one and the transformed linear problem for DMU_0 can be written:

$$\max_u z_0 = \sum_{r=i}^{s} u_r y_{r0} \tag{3.6}$$

subject to

$$\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \le 0, \quad j = 1,2,\ldots,n \tag{3.7}$$

$$\sum_{i=1}^{m} v_i x_{i0} = 1 \tag{3.8}$$

$$u_r \ge 0, \quad r = 1,2\ldots,s \tag{3.9}$$

$$v_i \ge 0, \quad i = 1,2,\ldots,m. \tag{3.10}$$

For the above linear programming problem[4], the dual can be written (for the given DMU_0) as:

$$\min_\lambda z_0 = \Theta_0 \tag{3.11}$$

subject to

$$\sum_{j=1}^{n} \lambda_j y_{rj} \ge y_{r0}, \quad r = 1,2,\ldots,s \tag{3.12}$$

$$\Theta_0 x_{i0} - \sum_{j=1}^{n} \lambda_j x_{ij} \ge 0, \quad i = 1,2,\ldots,m \tag{3.13}$$

$$\lambda_j \ge 0, \quad j = 1,2,\ldots,n \tag{3.14}$$

Both above linear problems yield the optimal solution Θ^*, which is the efficiency score (so-called technical efficiency or CCR-efficiency) for the particular DMU_0, and repeating them for each DMU_j, j=1,2,....,n efficiency scores for all of them are obtained. The value of Θ is always less then or equal unity (since when tested, each particular DMU_0 is constrained by its own virtual input-output combination too). DMUs for which $\Theta^* < 1$ are relatively inefficient and those for which $\Theta^* = 1$ are relatively efficient, having their virtual input-output combination points laying on the frontier. The frontier itself consists of linear facets spanned by efficient units of the data, and the resulting frontier production function (obtained with the implicit constant returns-to-scale assumption) has no unknown parameters.

3.2. BCC-model

Since there are no constraints for the weights λ_j, other than the positivity conditions in the problem (3.11) - (3.14), it implies constant returns-to-scale. For allowing variable returns to scale, it is necessary to add the convexity condition for the weights λ_j, i.e. to include in the model (3.11) - (3.14) the constraint:

$$\sum_{j=1}^{n} \lambda_j = 1. \tag{3.15}$$

The resulting DEA model that exhibits variable returns to scale is called BCC-model, after Banker, Charnes and Cooper (1984). The input-oriented BCC-model for the DMU_0 can be written formally as:

$$\min_\lambda z_0 = \Theta_0 \tag{3.16}$$

subject to

4 *The problem (3.6) - (3.10) is so-called "input-oriented CCR model", in which the maximization is oriented toward the choice of "virtual multipliers" (i.e. weights) u and v which produces the greatest rate of "virtual output" per unit of "virtual input" The analogous "output-oriented CCR model" can be obtained by output (instead of input) normalization used in the Charnes-Cooper linearization.*

$$\sum_{j=1}^{n} \lambda_j y_{rj} \geq y_{r0}, \quad r = 1,2,\ldots,s \tag{3.17}$$

$$\Theta_0 x_{i0} - \sum_{j=1}^{n} \lambda_j x_{ij} \geq 0, \quad i = 1,2,\ldots,m \tag{3.18}$$

$$\sum_{j=1}^{n} \lambda_j = 1 \tag{3.19}$$

$$\lambda_j \geq 0, \quad j = 1,2,\ldots,n \tag{3.20}$$

Running the above model for each DMU, the BCC-efficiency scores are obtained (with similar interpretation of its values as in the CCR model). These scores are also called "pure technical efficiency scores", since they are obtained from the model that allows variable returns to scale and hence eliminate the "scale part" of the efficiency from the analysis. Generally, for each DMU the CCR-efficiency score will not exceed the BCC-efficiency score, what is intuitively clear since in the BCC-model each DMU is analyzed "locally" (i.e. compared to the subset of DMUs that operate in the same region of returns-to-scale) rather than "globally".

4. Relative efficiency of the Croatian commercial banks

Using both the CCR and BCC models, the relative efficiency of the Croatian commercial banks is measured for the period 1995-2000 (separately for each year). Both DEA models are used under two different approaches in estimating relative efficiency of the banks: 1) operating approach, and 2) intermediation approach. Two approaches that we use reflect two different ways in which efficiency of banks can be evaluated. One from the perspective of cost/revenues management, and the other, more mechanical one which takes banks as entities which use labor and capital to transform deposits into loans and securities.

4.1. Specification of the data

As a statistical basis for input and output data, both end-of-year balance sheets and financial statements of Croatian commercial banks are used, as well as survey data on number of employees. Different sets of input and output data are used for the two approaches in estimating efficiency. For the operating approach all data are taken from banks' financial statements:

for each (j^{th}) Decision Making Unit (i.e. for each bank) the input data (x_{ij}) are:
- Input1 (x_{1j}) - interest and related costs;
- Input2 (x_{2j}) - commissions for services and related costs;
- Input3 (x_{3j}) - labor related administrative costs (gross wages);
- Input4 (x_{4j}) - capital related administrative costs (amortization, office maintenance, office supplies etc.);

while the output data (y_{ij}) are:
- Output1 (y_{1j}) - Interest and related revenues; and
- Output2 (y_{2j}) - non-interest revenues (commissions for provisions of services and related revenues)..

For the intermediation approach, for each (j-th) bank three inputs are chosen:
- Input1 (x_{1j}) - fixed assets and software (balance sheet item);
- Input2 (x_{2j}) - number of employees (survey data);
- Input3 (x_{3j}) - total deposits received (balance sheet item);

and two outputs (both being balance sheet items);
- Output1 (y_{1j}) - total loans extended; and
- Output2 (y_{2j}) - short-term securities issued by official sectors - CNB bills and MoF treasury bills. .

We exclude from our sample banks that went bankrupt during the analyzed period. It has been found that those banks had misreported data to the central bank. Given the fact that DEA is a non-stohastic method, it is particularly sensitive to the problems of mismeasurement. Therefore, inclusion of those banks into the sample could seriously undermine the quality of the results.

4.2. Relative efficiency - operating approach

4.2.1. Summary results

The summary results for the analysis via operating approach (for both CCR and BCC models) are presented in Table 1. In the table, average efficiency M stands for the average of all optimal values $\Theta_0^?$ obtained by running separate programs (3.11)-(3.14) (for CCR model) or (3.16)-(3.20) (for BCC model) for each commercial bank.

Table 1 – Summary results – operating approach

Summary results (CCR model)

	1995	1996	1997	1998	1999	2000
Number of DMUs:	39	42	45	48	47	43
No. of efficient DMUs:	4	6	12	10	11	8
Average efficiency (M):	0.445	0.658	0.734	0.736	0.793	0.745
Average inefficiency ((1-M)/M):	1.246	0.520	0.362	0.358	0.261	0.343
Standard deviation (sigma)	0.261	0.218	0.195	0.182	0.174	0.180
Interval I = [M-sigma; M+sigma]	(0.18;0.71)	(0.44;0.88)	(0.54;0.93)	(0.55;0.92)	(0.65;0.97)	(0.57;0.93)
Percentage of DMUs in I	74.36%	54.76%	57.78%	60.42%	46.81%	53.49%

Summary results (BCC model)

	1995	1996	1997	1998	1999	2000
Number of DMUs:	39	42	45	48	47	43
No. of efficient DMUs:	18	16	20	20	17	17
Average efficiency (M):	0.777	0.791	0.844	0.849	0.868	0.852
Average inefficiency ((1-M)/M):	0.287	0.264	0.184	0.178	0.153	0.173
Standard deviation (sigma)	0.252	0.217	0.168	0.166	0.166	0.152
Interval I = [M-sigma; M+sigma]	(0.53;1.03)	(0.57;1.08)	(0.68;1.01)	(0.68;1.02)	(0.70;1.03)	(0.70;1.00)
Percentage of DMUs in I	82.05%	76.19%	80.00%	81.25%	74.47%	86.05%

Under the constant returns to scale assumption in 1995 the Croatian financial system was characterized with large asymmetry between banks regarding their technical efficiency. Only four (out of 39) banks were efficient in that year, and the average efficiency of the banks was only 0.445. That means that the average bank, if producing its outputs on the efficiency frontier instead of at its current (virtual) location, would have needed only 44,5 % of the inputs currently being used (or, in terms of average inefficiency, it would have needed 124,6 % more inputs to produce the same outputs as an efficient bank). Such a figure can be, without doubts, treated as not relatively but absolutely low, since it is among ten lowest average efficiencies out of 124 obtained from 36 different DEA studies of banks' efficiency that were conducted for 11 different countries (see Berger and Humphrey, 1997). For the comparison, the mean value of average efficiencies obtained from 78 separate measurements of US banks' efficiencies by using nonparametric techniques (either Data Envelopment Analysis or Free Disposal Hull approach) was 0.72 (ibid.).

Those two facts (the efficiency frontier being spanned by only four entities and relatively low average efficiency) indicate that in 1995 being relatively efficient in the Croatian financial system implied an unusual, extreme behavior. Indeed, those four efficient banks were relatively small, newly established private banks.

However, as Table 1 shows, in subsequent years the situation has changed. The number of efficient banks rose rapidly, and there was a rapid catch-up towards the "normal" levels of efficiency, resulting in a much higher average efficiency of 0.793, and 0.745 in 1999 and 2000 respectively. The only statistical indicator that has moved in the opposite direction is the percentage of banks whose efficiency falls within the interval of one standard deviation around the mean. This is, however, mainly a simple mathematical consequence of the fact that efficient units never fall within

that interval (and in later years there were more of such units then in 1995) and that the interval itself narrowed to 68 % of its initial size.

If we allow for variable returns to scale (BCC model), we find much less of a change during the analyzed period. Allowing for variable returns to scale always results in a higher average efficiency because DMUs that were efficient under the constant returns to scale are accompanied by new efficient DMUs that might operate under the increasing or decreasing returns to scale. Allowing for variable returns to scale reveals the impact of only few relatively small banks that were spanning the production posibillities frontier under the CCR model.

However, under both assumptions (of either constant or variable returns to scale) one can conclude that in the six-year transition period the Croatian financial system has moved towards the equalization of the banks regarding their technical efficiency. This convergence in the banking market was spurred by increasing competition, and helped by exit of a number of bad banks from the market after 1998.

4.2.2. Structural Insight

Here we clasify Croatian commercial banks into peer groups present the results separately for each group.

Table 2 – Average efficiency of the banks grouped by their size (CCR model)

Peer Group		1995	1996	1997	1998	1999	2000
1	over 5 bln HRK	0.24	0.65	0.72	0.66	0.70	0.77
2	1 - 5 bln HRK	0.30	0.63	0.69	0.67	0.78	0.71
3	0.5 - 1 bln HRK	0.29	0.64	0.69	0.76	0.73	0.82
4	less than 0.5 bln	0.54	0.67	0.77	0.79	0.83	0.73

Table 3 – Average efficiency of the banks grouped by their size (BCC model)

Peer Group		1995	1996	1997	1998	1999	2000
1	over 5 bln HRK	0.92	1.00	0.95	1.00	0.99	0.98
2	1 - 5 bln HRK	0.89	0.82	0.86	0.83	0.84	0.85
3	0.5 - 1 bln HRK	0.69	0.70	0.83	0.84	0.75	0.91
4	less than 0.5 bln	0.74	0.77	0.82	0.84	0.89	0.79

When interpreting the data, it is important to have in mind that composition of peer groups has changed over time. Banks were moving from one group to the other, and the number of banks changed over the analyzed period. That, together with the nature of the DEA method make comparisons of changes in relative efficiency over time sensitive to the changing structure of the banking market.

The results show that, until 1999, smaller banks were technically most efficient. Average efficiency of peer groups 1and 3, has reached its maximum at the end of the period, largest banks being more efficient than smallest ones for the first time. At the beginning of the period largest banks were overstaffed and burdened with non-performing assets inherited from the previous system. On the other hand, as previously noted, the main reason for the successful growth of smaller banks was a high interest rate spread (as shown in Figure 2), a situation in which many small new banking institutions without the burden of old debts could do business with exceptional profit. There were two main reasons for high spreads: 1) lending was risky owing to inadequate financial discipline and the lack of an institutional framework to protect the creditors, and 2) substantial structural problems in banks regarding the operating efficiency and staff efficiency existed. Once spreads started to come down, after three out of four large banks were rehabilitated and then sold to foreign owners, the situation changed. Thus, the "catch up" of large banks from the position in which they were in 1995, is related to the successfully conducted process of rehabilitation of four banks and their subsequent privatization.

Under the pure technical efficiency, i.e. allowing for variable returns to scale, the situation looks quite different. Throughout the period most efficient banks are the largest ones. Interestingly,

inverse results that we have obtained by using two different models (constant and variable returns to scale) is the common finding for many studies of the banking industry. In the constant returns to scale case smaller banks dominate the frontier (see, for example, Berg et al. 1993), while in the variable returns to scale case frontier banks are on average much larger. Although it appears that the variable returns to scale is a more plausible model for an analysis of the banking industry, one has to take into account that peer group 1 consists of only the 3-5 largest banks, which might appear efficient simply because there is no good reference bank (or a group of banks) for them. In that sense, with a relatively small sample of large banks, the concept of local efficiency might be misleading.

Table 4 – Coefficients of variations of the banks grouped by their size (CCR)

Peer Group		1995	1996	1997	1998	1999	2000
1	over 5 bln HRK	1.176	2.803	3.176	3.100	0.590	2.150
2	1 - 5 bln HRK	7.239	5.916	4.388	3.549	4.328	3.449
3	0.5 - 1 bln HRK	4.654	9.658	4.463	3.293	2.378	4.920
4	less than 0.5 bln	13.753	7.746	8.629	4.723	3.780	4.864

Regarding the homogeneity of the peer groups, in general, the smaller the banks are, the less homogeneous they are in their efficiency. Table 4 provides further evidence of a trend of equalization in the domestic banking market, as measured by coefficients of variation of average efficiency from within the peer group mean. For peer groups 2-4 a strong process of equalization is evidently present, while within the peer group 1, coefficient of variation remained low throughout the period.

The hypothesis of private banks being more technically efficient than those that are state-owned has also been tested. Here, the basis for grouping was the dominant type of ownership, thus classifying all the banks with more than 50% of their capital in government hands as state, with the same principle being applied to private domestic and foreign-owned banks.

Figure 6 – Operating efficiency by ownership status (CCR model)

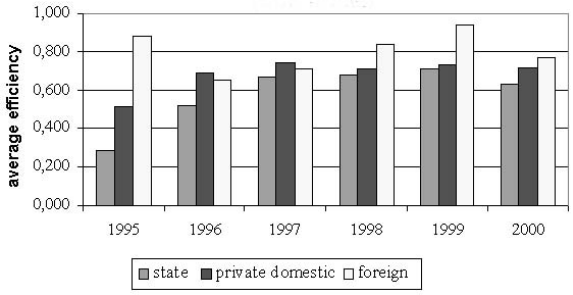
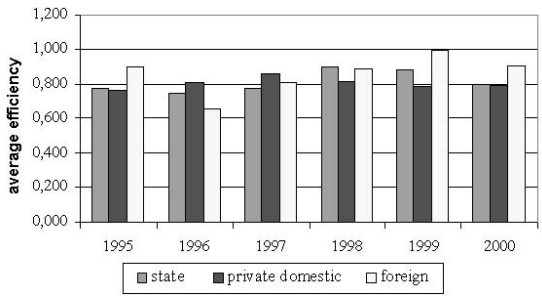


Figure 7 – Operating efficiency by ownership status (BCC model)

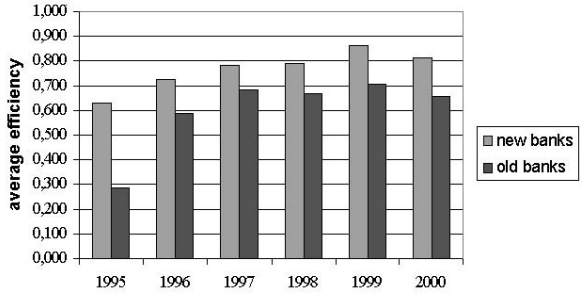


Under the constant returns to scale case state banks are constantly least efficient, which is consistent with previous finding since three out of four of them are Peer Group 1 large banks. Foreign owned banks, on the other hand, dominate under both models, being clearly most efficient, except in 1996 when a small number of them that had just entered the market had high start-up costs, and little revenues. Also, under both constant and variable returns to scale, state owned banks catch-up

in terms of average efficiency after the rehabilitation process in four of them started, and under variable returns to scale even become more efficient than private domestically owned banks.

We also compare new with the old banks. Banks established in 1990 or later are treated as new, while those established in 1989, or earlier, as old.

Figure 8 – Operating efficiency by age (CCR model)



Clearly, in the whole period, new banks were more efficient than the old ones. Under constant returns to scale, again, most of the efficiency equalization happened until 1997. New banks have, however, kept a significantly higher average efficiency until the end of the period. The same conclusion can be obtained under the variable returns to scale, although banks' efficiency is more equal (by the construction of the model) and the difference between new and old banks' efficiency less pronounced.

A particular problem for old, as well as for state-owned banks, were non-performing portfolios dating back to the previous system; this problem has been improved with rehabilitation of four old state-owned banks. The rehabilitation process in the large state-owned regional banks, which were in constant liquidity problems and, therefore, created high and low-risk demand in money market before their rehabilitation process has started, has helped a substantial decrease in interest rate spreads and, therefore, created a more competitive environment. The first rehabilitation process started in 1995 in a regional bank that was most badly hurt by the war. In 1996 rehabilitation was initiated in two other regional banks. Both of them received liquidity injections, and had their bad assets carved out. Finally, at the beginning of 1997, the rehabilitation process started in the country's second largest bank. The final restructuring of the rehabilitated banks (focus of business, staff reductions…), however, is still under way after the banks were taken over by foreign owners.

4.3. Relative efficiency - intermediation approach

An interesting finding appears from the above efficiency analysis of the Croatian banking system. It seems that most efficient in various specifications are either smallest, or largest banks. On average, the most slippery territory appears to be being a medium-sized bank. Another often used specification of the efficiency measurement in DEA models hints at that conclusion even more then the above results. Here we present the results of what might be called measurement of the intermediation efficiency. The idea is to look more mechanically at what banks do. Under the "pure" intermediation approach banks use labor, capital and deposits in order to produce loans and other investments. The actual production process is a black box whose efficiency is simply judged by the amount of output produced combining certain amount of inputs.

4.3.1. Summary results

First we present the summary results of the analysis for both CCR and BCC models in Table 4 (the meaning of Average efficiency (M) is analogous to that in Table 1 for operating approach).

Table 5 – Summary results of the intermediation approach

Summary results (CCR model)

	1995	1996	1997	1998	1999	2000
Number of DMUs:	39	42	45	48	47	43
No. of efficient DMUs:	2	2	5	7	8	5
Average efficiency (M):	0.429	0.336	0.450	0.517	0.629	0.505
Average inefficiency ((1-M)/M):	1.332	1.973	1.222	0.933	0.589	0.979
Standard deviation (sigma)	0.249	0.216	0.229	0.261	0.228	0.269
Interval I = [M-sigma; M+sigma]	(0.18;0.68)	(0.12;0.55)	(0.22;0.68)	(0.26;0.78)	(0.40;0.86)	(0.24;0.77)
Percentage of DMUs in I	79.49%	80.95%	77.78%	66.67%	65.96%	67.44%

Summary results (BCC model)

	1995	1996	1997	1998	1999	2000
Number of DMUs:	39	42	45	48	47	43
No. of efficient DMUs:	10	11	12	12	16	15
Average efficiency (M):	0.614	0.602	0.656	0.686	0.748	0.659
Average inefficiency ((1-M)/M):	0.630	0.662	0.524	0.457	0.337	0.518
Standard deviation (sigma)	0.265	0.289	0.264	0.261	0.234	0.303
Interval I = [M-sigma; M+sigma]	(0.35;0.88)	(0.31;0.89)	(0.39;0.92)	(0.43;0.95)	(0.51;0.98)	(0.36;0.96)
Percentage of DMUs in I	53.85%	57.14%	53.33%	43.75%	48.94%	39.53%

As in the previous approach, this one also confirms gradual equalization of efficiency in the Croatian banking market, although the trend is much less visible. For both models, the average efficiency is lower in the whole period than in the operating approach and the number of efficient banks is half of those obtained in the operating approach in almost all years. Therefore, being efficient in Croatian banking business was more unusual from the intermediation point of view.

4.3.2. The Structural Insight

In both model specifications average efficiency among peer groups in many years is U-shaped, i.e. either largest, or smallest banks were using their inputs in a way to produce most of outputs, while medium sized banks were often less efficient.

Figure 9 – Intermediation efficiency by size (CCR model)

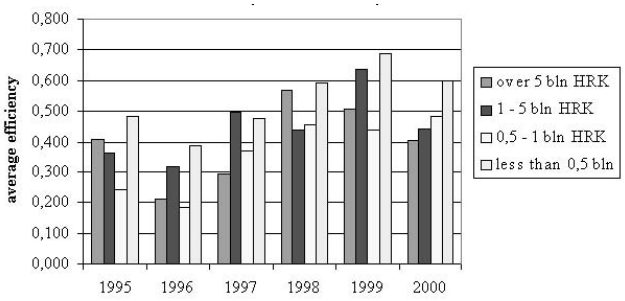
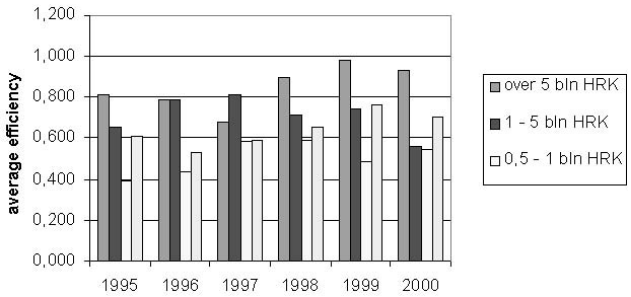


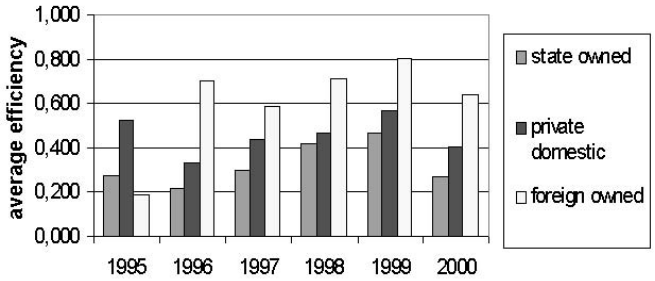
Figure 10 – Intermediation efficiency by size (BCC model)



It might be the case that what looks as a middle sized banks relative inefficiency is actually attributable more to the fact that many of those banks are regional banks, and that efficiency problems arise more from the environment in which they operate, than from their size. On the other hand, the smallest banks are often niche banks. Being a small bank, however, also does not guarantee relative efficiency, as the coefficient of variation of efficiency scores in that group is relatively high.

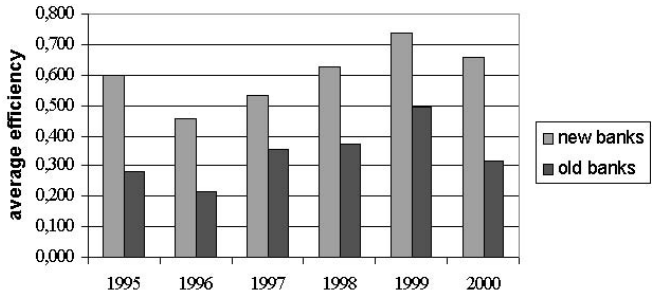
The intermediation approach confirms above findings on the relative efficiency of new/old, and state/private/foreign banks. Since both models support the same conclusions, in the rest of the paper we present figures only for the CCR model.

Figure 11 – Intermediation efficiency by ownership status (CCR model)



Under the intermediation approach, foreign banks are even more efficient relative to private domestic and state owned banks, than was the case when costs and revenues were taken as inputs and outputs. In other words, except in 1995 when there was only one foreign bank, foreign banks were capable of producing equal amount of output (loans and securities) using much less inputs (fixed capital, labor and deposits) than other banks. Therefore,the intermediation approach emphasizes even more the dominant position of foreign banks relative to other banks in the market. Again, equalization is observable over time. Under the constant-returns-to-scale model, state owned banks demonstrated rapid improvement in average efficiency relative to other banks after the rehabilitation process started in 1996. In 2000, after being privatized, the three largest state owned banks joined the group of foreign banks which has caused a modest decline in average efficiency of that Peer Group, but also a much more pronounced decline in the average efficiency of state owned banks (of which only three remained in 2000).

Figure 12 – Intermediation efficiency by age (CCR model)



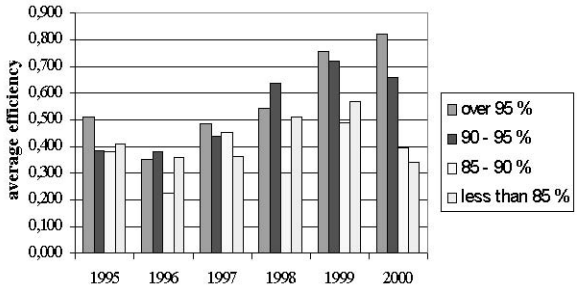
In the case of a bank's vintage, the intermediation approach also emphasizes an even more superior performance of new banks relative to the old ones. And, again, it demonstrates catch-up of old banks to the new ones before privatization of three state owned banks, with the same kind of post-privatization effect on two Peer Groups as in the case of state-owned vs. foreign banks.

Regarding particular inputs, from the results of the DEA analysis it appears that the most significant cause of inneficiency among state owned and old banks vs. foreign and new ones is the number of employees and fixed assets. Under different specifications both at the beginning, and at the end of the period between one half and two thirds of the inefficient banks had excess labor and too high costs of fixed assets.

Finally, we look at the intermediation efficiency of banks grouped by percentage of zero-risk assets. We did the same for technical efficiency, but do not present results here, as the conclusions are the same as for the intermediation efficiency. With the exception of the first two years, when the picture was somewhat mixed, results show that more efficient banks are also banks that have, on

average, more zero-risk assets. As we move towards the end of the analyzed period, this conclusion becomes more evident[5].

Figure 13 – Intermediation efficiency by zero-risk assets (CCR model)



This finding may be interpreted as suggesting that, in spite of the process of equalization in the banking industry, there still exists a group of banks with a relatively high proportion of non-performing loans and a low level of efficiency for which it might become difficult to withstand challenges in an increasingly competitive environment. The fact that two banks which belonged to the rightmost peer group in 2000 in Figure 13 have failed in 2001 confirms validity of such a conclusion.

5. Conclusions

We used the Data Envelopment Analysis to analyze efficiency of the banks in the Croatian banking market in the period 1995-2000, the years for which relatively reliable bank balance sheets are available, and a period in which the macroeconomic environment was stable.

Overall, the analysis leads to the conclusion that foreign owned banks are on average most efficient, and that new banks are more efficient than the old ones. Particular problem for old, as well as for state-owned banks, were non-performing portfolios dating back to the previous system; this problem has been improved with rehabilitation of large old state-owned banks. The rehabilitation process in the large state-owned banks has not only improved their own efficiency, but also helped a substantial decrease in interest rate spreads and, therefore, created a more competitive environment in the banking market.

In terms of size, smaller banks are globally efficient, but large banks appear to be locally efficient. The question remains whether the frontier is adequately spanned for a small number of the largest banks. Another conclusion is that, since 1995, strong equalization in terms of average efficiency has happened in the Croatian banking market. That conclusion is supported by the fact that, under the constant-returns-to-scale assumption, large banks, which started with approximately 45% of smallest banks' average efficiency in 1995, became actually somewhat more efficient in 2000. In a case of state-owned and old banks, they started with 32% and 46% of foreign and new banks' efficiency, respectively, and ended up in 2000 with 81% and 82% of their efficiency, respectively. We have also demostrated that the process of equalization happened within peer groups, as mesured by coefficients of variation of average efficiency from the peer group mean.

It appears that the most efficient in various specifications are either the smallest or the largest banks. On average, the most slippery territory appears to be the one in which medium-sized banks operate. It might be the case that what looks as a middle sized banks' relative inefficiency, is actually attributable more to the fact that many of those banks are regional banks, and that efficiency problems arise more from the environment in which they operate, than to their size. On the other hand, the smallest banks are often niche banks. Being a small bank, however, does not guarantee relative efficiency, as the coefficient of variation of efficiency scores in that group is highest, and as a number of banks from that group failed in the recent past.

Regarding particular inputs, from the results of the DEA analysis it appears that the most significant cause of inneficiency among state owned and old banks vs. foreign and new ones is the number of employees and fixed assets. Under different specifications, both at the beginning and at the end of the period, between one half and two thirds of the inefficient banks had excess labor and too high costs of fixed assets.

5 *The last couple of years were also years in which reporting of the quality of assets to the CNB was best.*

Finally, results also show that technically more efficient banks are also banks that have, on average, less non-performing loans. This is true for both the operating and intermediation approach. In years prior to the banking crisis, this correlation was somewhat blurred, but as we move towards the end of the analyzed period, i.e. as the situation in the banking sector consolidates, that conclusion becomes increasingly evident. However, in spite of the consolidation and equalization in the banking market, a group of banks with a high level of non-performing loans, and low technical efficiency still exists.

What we have empiricaly shown on the Croatian example is that some of the typical transition questions appear to have easy answers. Private banks are more efficient than state-owned ones and foreign banks are more efficient than domestic ones. Therefore, decision to privatize and let foreign banks come in was a right one. New owners introduce new production methods and optimize the use of inputs. As a result efficiency rises, and the interest rate spread declines. Weaker banks can not withstand the increased competition and either exit from the market, or become targets of other banks. Keeping the state ownership of the banking sector, keeping the foreigners out of the domestic market or keeping afloat weak banks prevents a consolidation process in the banking market. The consequence is a lower efficiency in the banking sector. That, in turn, hurts the real sector of the economy, and hampers growth through a higher interest rate spread, and an inferior supply of banking products. We have shown how, free from interference, the market brings equalization in efficiency through competitive pressure. It eliminates weak banks, and improves the operation of remaining market participants. In a competitive banking market, low average (relative) efficiency is simply not a viable equilibrium.

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Abstract

An understanding of a bank's relative efficiency is important for analysts, practitioners and policymakers alike. In this paper we analyze bank efficiency in Croatia between 1995 and 2000, by using the Data Envelopment Analysis. We find that foreign owned banks are on average most efficient, that new banks are more efficient than the old ones and that smaller banks are globally efficient, but large banks appear to be efficient when we allow for variable returns to scale. We also find that strong equalization in terms of average efficiency has happened in Croatian banking market, both between the peer groups as well as within the peer groups of banks.

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Discussion comments

Richard D. Porter (Board of Governors of the Federal Reserve System)

(1) Maravall

Augustin Maravall supplies an automatic detection scheme that works by identifying and obtaining the exact maximum likelihood estimate of a linear regression model subject to an additive ARIMA residual. The ARIMA term itself is quite general within a family of nested low-parameter (including multiplicative) models and may also include calendar effects such as Easter or Leap years as well as outlier terms representing additive outliers, level shifts, transitory changes in a series, or various combinations of these terms. Taking the estimated model over history, series outliers can be revealed with a high degree of precision by comparing forecasts with actual observations, with larger forecast errors indicative of potential outliers.

What one does next with an identified outlier is not clear. As an immediate, but very short-run fix, one could always take the predicted value from the analysis and substitute that for the errant observation. The Federal Reserve was willing to live with such an ad hoc solution to if there had been widespread reporting difficulties in the event of Y2K disruptions. Fortunately, there were not. But such pragmatic solutions are clearly not as satisfactory in theory as going back to the source and asking the reporting entity to reexamine what they reported. That is, one would like to address the source of the problem directly and not indirectly.

On balance, Agustin Maravall has taken up the challenge that was laid out by the prestigious Moore Committee. That committee was created over two decades ago to advise the Board of Governors of the Federal Reserve on seasonal adjustment procedures.[1] They concluded that model-based methods of seasonal adjustment held significant promise but their practical usefulness remained somewhat in doubt because of difficulties in computing such models and in selecting the appropriate time-series models to compute. At the time of Moore Committee in the early 1980s, the research being undertaken by the Board staff – in particular Bill Cleveland, David A. Pierce, and Agustin Maravall – was on the overall frontier of the research on seasonal adjustment methodology. But soon after the Committee's report was released, resources at the Board devoted to that subject were dispersed to other tasks and the seasonal adjustment effort at the Board slowed to a significant degree. Ironically, some of the resources were reassigned to the problem of applying statistical procedures to editing data – the very problem that Agustin has presented to us in this session.

As the person who played a key role in assembling the original team of statisticians and econometricians at the Board that worked with the Moore Committee, I would like to conclude with a more personal observation. I would note that, while we at the Federal Reserve were not steadfast in the research program recommended by the Moore Committee but moved on to other tasks, Agustin did stay the course at the Bank of Spain. He steadfastly continued to draw upon new developments in statistics and computation and make continuous improvements in the area of seasonal adjustment. The result is a body of work and suite of programs that are second to none for seasonal and trend extraction and now for outlier detection. Agustin, together with his colleagues at the Bank, should be commended for persevering and coming up with this sterling achievement. A vote of thanks is in order to Agustin, in particular, for this continued high-level stream of serious, thoughtful, and *useful* tools for the empirically minded macro economist.

(3) Hawkins

In looking at the forecasting record, presented by John Hawkins, a simple question arises: Have the inflation and growth forecasts for emerging countries any substance at all? To that end Hawkins does show that the private and official forecasters do better than a naïve forecast, defined as one in which the forecast of next period's outcome is equal to the last observed value. Recent work on forecasting might suggest a more robust naïve rule would be to go one derivative deeper and forecast that the next change in the growth rate of a series is the same as the last change in the growth

1 *Moore, Box, Kaitz, Stephensen, and Zellner [1981]*

rate. If we assumed for simplicity that the forecasts were unbiased, than one would expect that if the forecasts had much content, the standard deviation of the forecast errors would be smaller than unconditional standard deviation of the series themselves. But the table shown below, relating to the period 1996-2001, demonstrates that this is not the case as the implied standard deviations are larger than the realized ones in every case that we can make pairwise comparisons.[1]

Table – Sample Standard Deviation and Implied Forecast Standard Deviation, 1996-2001

Regions	Real GDP		Inflation	
	Unconditional Standard Deviation	Implied Standard Deviation	Unconditional Standard Deviation	Implied Standard Deviation
East Asia	3.8	4.8	3.2	4
Central Europe	1.8	2.3	8.8	11
Latin America	7.7	9.6	127.6	NA
Other	2.7	3.4	8.3	10.4

Given the simplifications that enabled me to derive the simple table, this disappointing result raises the question of whether one should forecast at all? If one had to choose between devoting more resources to forecasting next year's outcomes or spending more effort figuring out where the economy was now, an emphasis on current and near-term outcomes is probably appropriate.

On the other hand, the period in question is not an easy one. Few economists had the East Asian crisis in their sights before it happened, which, in turn, generated reverberations across the increasingly interconnected emerging and developed worlds.

Further, in comparing the results for the large developed economies with those of the small open emerging economies, unanticipated external changes, which could have large effects on the current account given the larger role that exports and imports tend to play in these economies, the greater inherent difficulties in forecasting are perhaps not too surprising. Finally, one should also bear in mind that while developed countries have had a fairly long track record and considerable experience in computing national income estimates and forecasts, several emerging economies are typically newer to the task. They do not have the same degree of institutional wherewithal to engage in these activities, for example, tax compliance maybe not be high and the transparency of various institutional arrangements more limited than in advanced economies.

These two papers present contrasting views of the supply side of the process generating inflation in small, open economies, Switzerland and Israel, respectively.

(5) Tanya Suchoy and Amit Friedman

Suchoy and Friedman's typical expectations augmented Phillips curve assumes that the lagged inflation rates sum to unity, which subjects them to a form of a Lucas critique that Sargent identified.[2] Such a specification is often adopted econometrically because the sample period includes observations in which a random walk in inflation is a good approximation. The authors avoid this trap by taking differences of their data in order to account of the declining trend inflation that they observe.

The authors consider three models each with a differing degree of complexity. To keep matters simple, I will focus on the intermediate model, which has three equations, a Phillips curve in difference form, a time series model in which the NAIRU follows a random walk without drift, and an autoregressive equation in the unemployment gap.

(5) "Differenced Phillips" Curve

$$\Delta\pi_t = \alpha(L)\Delta\pi_t + \rho(L)(u_t - u_t^n) + \beta x_t + \varepsilon_t^{\Delta\pi}$$

(6) Natural Rate is a random walk without drift

$$u_t^n = u_{t-1}^n + \varepsilon_t^n$$

1 *The mean absolute deviation statistics were converted to "standard deviation units" by multiplying them by* $1/\sqrt{\frac{2}{\pi}}$, *which would be the right scaling factor assuming the forecast errors followed a Gaussian distribution.*

2 *"A Note on the "Accelerationist" Controversy", Thomas J. Sargent, Journal of Money, Credit and Banking, Vol. 3, No. 3. (Aug., 1971), pp. 721-725.*

(7) Autoregressive equation in the unemployment gap but with no restrictions on the autoregressive terms

$$u_t - u_t^n = \delta_1 (u_{t-1} - u_{t-1}^n) + \delta_2 (u_{t-2} - u_{t-2}^n) + \varepsilon_t^{gap}$$

To estimate the model they use the EM algorithm in which one alternates in iteration between a set of unknown parameters and latent value components until convergence is achieved. This algorithm represents a neat computational trick, which simplifies the calculations considerably.

In what follows I will focus on the Phillips equation since the other parts of the model are convenient time series representations but with less economic content. As macro economists, it would be nice to know the strength of the relationship between the unemployment gap and inflation? The paper is not too informative on this point.

My colleague, Thomas Laubach, has stressed that in economies with slowly changing inflation, it is difficult to tease out very much about the relationship between inflation and the unemployment gap. That is, lagged inflation just absorbs too much to identify the relationship with any precision. The coefficients on the unemployment gaps in Table 3 seem consistent with the viewpoint that the link is not particularly strong.

As a concept, the NAIRU is important in so far as it helps predict inflation or changes in inflation. But direct credible measures of inflation expectations matter in this as well. In this light, some more explicit exploration of inflation expectations that are available for Israel might be fruitful. Economies with credible inflation policies have more scope to respond to temporary supply or demand side disturbances. Israel does have a long history of issuing indexed debt and it is one of the few countries where central bank officials readily admit to the usefulness of such series. Wouldn't it be informative to try to integrate such a series on inflation compensation series into this model?

John Hawkins[1] (BIS)

Comments on Dr Stalder's paper "Forecasting Swiss inflation with a structural macromodel: the role of technical progress and the 'mortgage rate-housing rent' link"

This is an interesting paper, dealing with two "real-life" challenges for central banks in their analysis of statistics, production of forecasts and setting of policy.

An initial comment is that I find it odd that the Swiss central bank seems to have an inflation target that dares not speak its name. But they otherwise seem to behave like inflation targeters. This coyness seems more odd as in many ways Switzerland has a better basis than most for an inflation target. It had the lowest average inflation in the world in the 20th century. So a 0-2% range which might be regarded as low and narrow elsewhere seems more plausible in Switzerland. And despite being very open with its location in the middle of Europe, the record of forecast errors for inflation is typical of that of other inflation targeters; a bit worse than Canada, similar to Australia and New Zealand and better than Sweden and the emerging economy targeters.

The first problem addressed in the paper is the impact of interest rates on the CPI. While this is due to tenant protection legislation in Switzerland, it occurs elsewhere for other reasons. For example, in Australia, the cost of repayments on home loans used to be included in the CPI with a large weight. This made the CPI quite sensitive to interest rates because most homes were mortgaged at floating rates.

The model currently assumes a constant proportion of the increase in rents allowed in response to interest rate rises by the legislation is actually passed through. It may be worth experimenting with relating the extent of pass-through to vacancy rates or the business cycle more generally.

Would not an alternative to changing legislation be for the SNB to target a measure of "underlying" inflation that excludes this housing cost? This was done in Australia before the central bank convinced the statistics agency to change the method of calculation.

The second question addressed is the impact of higher productivity. My reading of history is that the gains have mostly, at least in longer run, gone to users in the form of lower prices (see Bill White's Opening Address). This is why I was not surprised that the technology shocks have not earned the profits required to underpin their high share prices. Section 5.1 of the paper comments that "the extent to which the higher growth potential of the economy is actually absorbed by a stronger increase of aggregate demand is decisive". In the US it seemed demand actually increased *more* than the true increase in the growth potential, giving rise to various sorts of bubbles, causing problems only now being worked out. It is a hard, but important question, what policy could or should have done to avoid this.

1 *Views expressed are those of the author and not necessarily shared by the BIS.*

Igor Jemrić (Croatian National Bank)

Comments on the paper: "Cassandra and the Sirens: Economic forecasting in emerging economies" by John Hawkins

"Cassandra and the Sirens..." is a very interesting and relevant paper (with a great title) that gives an interesting comparison of the accuracy of forecasts in emerging countries to those from advanced economies. Although one may say that the findings of the paper confirm what we already know, the main value of the paper is that it empirically proves those "already known facts" by using the most current data from the countries included in the research.

It is a short, clear and well-written paper that leaves a little room for comments. In spite of that, one can find some minor methodological deficiencies worth to mention. First, the period covered with the analysis is rather small (6 years), having in mind that the countries concerned do not have that smooth economic history as advanced economies. This particular choice of the period, for example, probably overestimates the average relative error for East Asian countries, since it covers the recession/crisis episodes in most of those countries. The suggestion would be to cover the longer period and to analyse the behaviour of the errors for different regions in different sub-periods.

The second binding fact of the research is the choice of the samples. While those chosen for East Asia and Latin America might be considered as representative, the Central European sample, including only three countries, is too small. It is not that it does not represent well the geographic region (or, to be precise, the "emerging" part of it) but the region itself is what one would expect to be put in the context of the transition countries. And for that wider context the sample is not representative at all, having in mind all those different paths (and different timings of bifurcation points faced on those paths) that different transition countries went through in the last decade. The suggestion would be to replace the "Central Europe" item in the tables with "Transition Countries" and then, given the heterogeneity of the groups (not only the transition one), to analyse some suitably chosen sub-groups within all three main groups of countries.

In his attempt to explain the findings of the research, the author gives two basic reasons why forecasts are less accurate in emerging economies than in advanced economies: (1) less accurate and less timely data and (2) greater share of volatile agricultural products and commodities, which are subject to basically unpredictable factor such as weather.

Again, this need to be modified a bit for transition economies. Here, the importance of the structural change needs to be put at the centre of attention. Even for transition countries that have not undergone any territorial changes during the transition process, important structural changes have occurred that make it very difficult to estimate a model that utilizes a longer period. Many elasticities have probably changed substantially between 1991 and 2002, for example. And, of course, methodological changes in data series are another speciality of the transition countries that creates major headaches.

All in all, the paper empirically confirms the common knowledge and, regarding the policy implications for central banks, gives the good conclusion that the inflation targeting in emerging countries is much more difficult because of less accurate forecasts. I completely agree with that and, if we talk about the transition countries, I would suggest the monetary authorities to give up from the inflation targeting at this stage of development of transmission channels (and of the knowledge of those channels), but this goes beyond the scope of "Cassandra and the Sirens...".

SESSION 5

Central bank cooperation on statistical issues

Panel Discussion

Chair: Paul van den Bergh, *Head of Information, Statistics and Administration, Monetary and Economic Department, BIS*

Secretary: Gert Schnabel, *BIS*

Papers: "Central bank cooperation on statistical issues – Discussion note"
Paul van de Bergh, *BIS*

"Statistical improvement and harmonisation for the West African Monetary Institute"
Richard Walton, *Bank of England*, and R. D Asante, *West African Monetary Institute*

Panel: Paul van den Bergh, *BIS*,
Marius van Nieuwkerk, *IFC,*
Michel Stubbe, *ECB*,
and others.

Session 5: Central bank cooperation on statistical issues

Discussion note

Paul Van den Bergh (BIS)

The collection, compilation, analysis and dissemination of statistical information relating to macroeconomic, monetary and financial developments are in most cases an important activity of central banks. This often involves a considerable number of economists, statisticians and support staff and major investments in IT infrastructure (eg databases, telecommunication infrastructure, statistical packages). It also involves a number of different departments, including research, international relations, financial markets and banking supervision.

Similar to activities in other areas of central banking, the statistical work at central banks does not take place in isolation. Indeed, for many areas, internationally agreed standards or methodologies have been developed by international institutions (eg IMF, OECD, BIS, UN) or regional central banking organisations. With respect to regional initiatives, efforts at monetary integration in many parts of the world have imposed specific requirements for the harmonisation of statistical methodologies across participating institutions, particularly with respect to monetary statistics. The experience with the successful implementation of a common monetary framework in the euro zone[1] is but one example, other similar initiatives are also being taken in other parts of the world, such as the Gulf region (Gulf Cooperation Council) and Western Africa[2] (Western African Monetary Institute). Moreover, discussions on monetary integration are also high on the agenda of policy makers and central banks in Asia, Latin America and Southern Africa (and in the African region more generally, following the recent initiative of the African Union). Individual central banks participate not only in the implementation of international or regional methodologies but they are typically also actively involved in the elaboration of these standards and best practices.

Many new initiatives or ideas for improving economic, monetary or financial statistics are often generated in established fora for central bank cooperation, one example being the international banking statistics collected, compiled and disseminated by the BIS and sponsored by the Committee on the Global Financial System (earlier known as the Euro-currency Standing Committee).[3] Policy discussions at other international organisations and research carried out by economists at these organisations as well as at individual central banks may also lead to specific initiatives, as in the case of the recent work on early warning systems and Financial Soundness Indicators. Moreover, international organisations and their constituents are increasingly cooperating in areas of common interest, one example here being the Interagency Task Force on International Financial Statistics.[4]

Apart from such "multilateral" activities, central banks also often cooperate on a bilateral basis, for instance to obtain data from other countries. Examples include the exchange of trade data from trading partners to allow the compilation or checking of balance-of-payment statistics, the collection of information on offshore holdings of domestic currency deposits, or the communication between host and home country supervisors relating to consolidated reporting by banks. In all these cases central banks are exposed to methodologies used elsewhere and often need to find ways to reconcile differences in methodologies across countries. In the context of bilateral cooperation, mention should also be made of support given by various central banks in major financial centres

1 *The coordination of statistical activities in the euro-zone central banks takes place in the ECB Statistics Committee.*

2 *See the note presented by Messrs. Walton and Asante for this panel discussion.*

3 *More recently the Financial Stability Forum has also become involved in making recommendations with respect to the data needed to monitor international capital flows, including those through the international banking system.*

4 *The Task Force has been responsible for establishing and maintaining the Joint International Debt Statistics (based on the creditor data from the various international organisations involved) and has also worked on elaborating the methodology for External Debt Statistics to be used by debtor countries.*

to capacity building in the statistical area for emerging market countries. The bilateral agreements between recipients and donors contribute to an active network between central bank economists and statisticians from different regions. This is supplemented by the training and technical assistance in the statistical domain provided by various international organisations, particularly the IMF and World Bank, though the latter in many cases also draw on central bank experts from more advanced economies to provide assistance.

A number of different central bank groups have taken initiatives to develop and maintain shared statistical databases. The oldest such initiative has probably been the BIS Data Bank, which was set up by the central banks of the G10 countries in the 1970s. In the 1990s the central banks of the European Community started to build up a similar database in anticipation of monetary integration in Europe. More recently regional data bank activities have been set up by regional central banking groups, including SEACEN (South East Asian Central Banks) and CEMLA (Centre for Economic and Monetary Studies in Latin America) and SADC (South African Development Community). Through such databases, central banks exchange data with one another covering key areas of common interest, particularly in the areas of money and banking, financial markets, government finance and balance of payments (including capital flows). Data often include unpublished data or data released prior to their public dissemination and are usually well documented and made accessible through common code structures. The data are typically also shared through a single platform maintained by a central institution, which serves as a clearing house. This greatly facilitates research by central bank economists in participating institutions as well as the inclusion of timely and reliable data in policy documents prepared for meetings of senior officials organised in the respective groups. In some cases the exercise also serves to mobilise peer group pressure for participating institutions to develop and provide quality statistics. Moreover, as a result of the regular reporting and discussions of methodological issues, active network are established between central bank statisticians working in similar areas.

The development of such "data banks" has required that participating central banks work together not only on methodological and content issues but also on developing procedures and infrastructures to facilitate the exchange of data. This explains the initiative that the BIS and the EMI/ECB, with the cooperation of Eurostat, have taken in recent years to develop standards for electronic data exchange, first the so-called EOB standard and subsequently GESMES/CB, based on the available EDIFACT syntax. Very recently other international organisations, including the IMF, the OECD and the UN, as well as other regional central banking groups, have adopted GESMES/CB as the de facto global e-standard for statistical data exchange. Together with the BIS, the ECB and Eurostat, the international organisations have also agreed jointly to extend this and other related standards to the emerging new technologies of web services (through the Statistical Data and Metadata Exchange initiative).[5]

Perhaps somewhat surprisingly, no major international platform for central bank cooperation on statistical issues has emerged, similar to what has happened in major policy areas relating to monetary and financial stability or the regular contacts that exist amongst central bank economists (eg the various Basel-based groups). One reason may have been that statistical issues have, at least until recently, been perceived to be of a technical or routine nature and of second-order [i.e., lower?] importance compared to economic analysis and related policy work. Another may have been that central bank statisticians have been less active than their economist colleagues to draft articles and contribute to public debates. All that seems to be changing. Statistical questions are increasingly becoming boardroom issue – witness the increasing familiarity of many central bank governors with the minutiae of statistical methodologies and analysis. Moreover, the divide between the world of central bank economists and statisticians may gradually come to narrow, as both increasingly have similar academic backgrounds and as the understanding of the details of statistical information used for assessing monetary and financial conditions become increasingly important.

There is no shortage of potential topics for active discussion amongst central bank economists and statisticians, some of which are on the agenda of the conference. To list (or repeat) just a few:

- what are the challenges posed by various international initiatives such as the IMF's SDDS and GDDS and the related quality assessment framework?
- what new type of indicators could usefully be elaborated for macroeconomic monitoring and surveillance, i.e. pertaining to the central bank's role in promoting monetary stability?
- what new type of indicators could be developed for macroprudential monitoring and surveillance, i.e. pertaining to the central bank's role in promoting financial stability?

5 *For more information on the SDMX project, see the SDMX website www.sdmx.org. Some of the background papers on the initiative were contributed to Workshop A (see eBIS). Central banks interested in contributing actively to the SDMX projects are welcome to contact the SDMX Secretariat at the BIS or the IMF.*

- what is the inter-relationship between statistical indicators for macroeconomic and macroprudential surveillance?
- what challenges are posed by inflation targeting regimes for the collection, compilation and dissemination of statistical information?
- how can new statistical measures be developed, covering, for instance, market expectations, market liquidity conditions, information implied in financial market variables?
- how can the timeliness of statistics available to central bank policy makers (internal) and to the general public (external) be improved?
- can sampling, survey and other estimation techniques be substitutes for comprehensive but burdensome reporting requirements for statistical data collection and compilation?
- which future adjustments need to be envisaged to existing statistical methodologies, for instance national income accounting, survey of conjunctural developments, or balance of payments methodologies?
- what are possible new methodologies with respect to macroeconomic and monetary indicators, e.g. new methodologies to measure productivity, output gaps or labour market conditions?
- how should the cost benefit analysis of reporting requirements imposed on banks and financial institutions for statistical purposes be carried out?
- what internal organisational structures do central banks develop for collecting, compiling, analysing and disseminating statistical information?
- which new statistical and technical tools are available to central bank statisticians and what are the specific challenges posed by technical innovation?

As can be seen, the list of possible topics is quite diverse and many additional ones will have been raised during the IFC conference. The question arises whether there may be an interest in the global central banking community in having a platform to discuss, in a structured and ongoing way, statistical questions amongst central bank economists and statisticians. And a related question is what role the IFC can play in this regard in the future and how the BIS and other international organisations, as well as regional central banking groups, can support central bank cooperation in this field.

Issues for discussion

1 In which particular areas or on which topics could central banks benefit from regular international consultation or discussion? How do existing formal and informal arrangements for central bank cooperation provide a platform for discussion on these topics amongst central bank economists and statisticians? Do central banks have adequate opportunities to participate in the elaboration of international standards and methodologies relating to their statistical activities? Is there amongst central banks a willingness to contribute actively to the development and implementation of technical solutions, for instance for data exchange and web dissemination?

2 Which existing forms of central bank cooperation could be strengthened: bilateral contacts, capacity building through training and technical assistance, regional cooperation, global platforms?

3 What future do central banks see for the activities of the IFC? Are the proposals for making the IFC more professional as outlined in the document for the Administrative Meeting at the IFC conference useful? What role could the BIS and other international organisations as well as regional central banking groups play in supporting central bank cooperation in the statistical area?

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Statistical improvement and harmonisation for the West African Monetary Institute

Richard Walton (Bank of England) and R. D Asante (West African Monetary Institute)

The West African Monetary Institute (WAMI) has been established by five countries-Nigeria, Ghana, Guinea, Sierra Leone and the Gambia as an embryo central bank for a second monetary union, just as the EMI in Europe was the forerunner of the ECB. Statistics are to be harmonised to cover the West African Monetary Zone (WAMZ). Such aggregation requires harmonisation of country data and common minimum statistics and metadata. The standards for the supply of data are to include frequency, timeliness, quality and availability. In order to facilitate and enhance the effectiveness of the multilateral surveillance mechanism, WAMI has been focusing on strategies to accelerate efforts to improve data quality in the sub region. This recognises the need to enhance comparability of data across countries for convergence and the implementation of the common monetary and financial policy of the envisaged monetary union. A study conducted by WAMI has revealed that member countries have all got structures in place for the production of the required statistics. They are all members of the IMF and have had or are currently implementing IMF supported adjustment programmes. The quality of the statistics however differs widely across countries. There are also wide disparities in the timeliness and coverage of key macroeconomic variables. The need for human and technical capacity building in the national statistical agencies was also evident. Scarcity of budgetary resources from the fiscal authorities highlight the need for increased donor involvement to support countries' own efforts.

Strategy for statistical improvement

The Statutes of the WAMZ require the WAMI to undertake the task of monitoring and assessing convergence of economic and monetary policy. This includes tracking performance in respect of primary convergence criteria, specified as ratios of budget deficit to GDP, low consumer price inflation, a ceiling on the level of central bank credit to government and a floor for the level of gross official reserves. In addition, a set of secondary criteria have also been stipulated designed to support the sustainability of the primary criteria.

Given that the pace improving the data is not in line with the timeframe set for the monetary integration program, the strategy adopted by the WAMZ is to identify the key problem areas needing urgent action in consultation with country experts and propose measures to address them.

The key areas identified were the quality and comparability of the CPI and the national accounts. The national accounts are subject to frequent and substantial revisions making it difficult to rely on and data are often only available on an annual basis.

There was a general consensus that the money and banking statistics are timely and of reasonably good quality. There is adequate coverage of the deposit money banks. The outstanding issue is with respect to the inclusion of non-bank financial institutions, which are growing in importance.

The fiscal data is also of good quality but not timely in some countries. As far as covering the financial operations of central government is concerned, the reporting of arrears has also not been satisfactory and capturing the full extent of quasi-fiscal operations.

The balance of payments suffers from irregular and outdated compilation techniques and lack of monthly and quarterly data.

For WAMI, the immediate task was to assess currently available statistics, ongoing improvement programmes in the countries and to establish a Zone database covering the key macroeconomic accounts relevant to the monitoring of convergence.

This was combined with the assessment of the existing rules and practices for the collection compilation and dissemination of statistics with a view to bringing them up to date with international standards. Member countries were in this regard urged to adopt the IMF GDDS under which the country standards and needs could be clearly identified and addressed.

Areas of work outstanding include the technical issues pertaining to the aggregation of statistics particularly those required for the conduct of the common monetary policy. WAMI therefore continues to closely study the balance sheets of the central banks of the Zone, the structure of interest rates and other financial sector statistics.

Emphasis is placed on close collaboration with statistical agencies of the Zone but also at the sub regional level. The Institute is collaborating with the Economic Community of West African States (ECOWAS), which is implementing the ECOSTAT project with assistance from the European Union. Under this project, the national statistics offices will collaborate with AFRISTAT to improve and harmonise the Consumer Price Index and the National Accounts.

WAMI recognises the human resource constraint and the high financial cost of improving statistical systems and therefore places great importance in collaborating with and learning from the experience of other organisations with a track record in monetary and financial integration. International co-operation and Technical assistance would continue to be vital to these efforts and WAMI in its short mandate has been trying to forge links in that regard.

Annex 1: Key areas of work to be done

- *Agreeing the definition of banks in West Africa*. Efforts are underway to expand coverage to include all institutions that issue deposits, such as postal savings banks, savings and credit companies and village-based savings and credit associations.
- *Improving the frequency of publication in general economic statistics*. Timely GDP data are needed: a range of dates, 1994-2000 are available in IFS.
- *Harmonising the methodology for national accounts*. Different methods of computation of national accounts exist-SNA68 or SNA93. Compilation methods are outdated and base years are old. NCBs sometimes provide some of the surveys for national accounts.
- *Measurement of informal economy and contribution of accounts for agriculture.*
- *Central government deficit definition*. There remain questions on whether to include State deficit and district assemblies. How then should transfers from CG to State Government or surpluses of State Government be treated? Should consumption and production subsidies be explicitly budgeted for and included or excluded from the criteria.
- Improving data in the *IFS* and *GDDS* for each country.
- To overcome the different treatments by countries in treatment of various characteristics underlying the *measurement of consumer price indexes*. These include computational methodology, weighting, price outlets, base year, sampling and the basket. Base years vary from 1974-1985-1995. Coverage of the CPI can vary by region or city and by low-income or by all income groups. Coverage should be as broad as possible, with appropriate weights from household surveys. Should there be a new household survey for a new agreed base year? And which base year should be chosen? Has UN-supplied free rice distorted index?
- *Labour market data* based on censuses are out-of-date and with no time series. There are no wage statistics. Is the way forward annual national employment surveys?

Annex 2: West African Monetary Institute

The West African Monetary Zone (WAMZ) comprises countries that have undertaken to adopt a common currency by the year 2003,creating a second common currency by the year 2003. This would create a second common currency in the Economic Community of West African States, the first being the CFA zone. The West African Monetary Institute (WAMI) has been established by the group of five countries – Nigeria, Ghana, Guinea, Sierra Leone and the Gambia – as an embryo central bank for this second monetary union, just as the EMI was the forerunner of the ECB. It is planned to merge with the existing monetary union in West and Central Africa – the CFA franc zone[11] – in 2004 to form a single monetary zone in the sub-region.

The West African Monetary Institute assisted by the national central banks has statistical responsibilities:

- To establish harmonised rules for the collection, compilation and distribution of statistics from member states, relating to the monitoring and operation of a common monetary policy.
- To harmonise statistical methodologies and measurements of macro-economic aggregates.
- To harmonise accounting procedures of national central banks to facilitate the construction of the consolidated balance sheet.
- To monitor and report on the convergence programme (criteria) of economic and monetary policy.
- To develop a macroeconomic database.
- To maintain a close relationship with international organisations on statistical matters.

WAMI is to design reporting formats for all data generating agencies in each of the participating countries. It is to design a harmonised consumer price index which would be calculated and compared to national consumer price indices.

Richard Walton, Monetary and Financial Statistics Division, Bank of England

R. D Asante. Technical Advisor, West African Monetary Institute.

1 *Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Congo, Cote d'Ivoire, Equatorial Guinea, Gabon, Guinea-Bissau, Mali, Niger, Senegal and Togo.*

Summary of the discussion

Panel members and participants proposed a number of initiatives by means of which international organisations could contribute to the development and improvement of statistics in an international context, e.g.:

- organising an annual conference for compilers of statistics;
- setting up regional workshops (possibly at BIS regional offices) to tackle specific (regional) problems;
- setting up a series of working groups on specific issues;
- creating an electronic forum for technical questions;
- building up a framework for guidance to statistical offices;
- organising regular contacts with the press to "sell" statistics.

It was also suggested to involve statisticians in international statistical issues by means of a "push system" via e.bis. This suggestion was supported by another participant, who, however, stressed the need of a trade-off between security and accessibility of the system.

Others observed that the development of an improved international statistical infrastructure should be coordinated by organisations like the IMF or the UN Statistical Office.

Conversely, it was suggested that individual countries, which were leading in particular areas, should initiate bilateral contacts.

As regards the Irving Fisher Committee, several participants saw a significant role for this organisation, such as facilitating "cross-fertilization" and harmonization of statistics across countries, in particular those needed for monetary policy purposes. It was emphasised that the IFC must not confine itself to central banks statisticians, but open up to "outsiders". It was welcomed that the IFC Executive Body and the Programme Committee included representatives of Eurostat and the IMF.

Monetary and financial statistics were seen as closely interrelated with general economic statistics, and it was felt important to persuade the ISI of this fact, with the purpose of reinforcing the IFC's position within that Institute.

There was also a suggestion to make the organisation of the IFC more professional and to assign working groups with the preparation of issues to be dealt with at its conferences.

WORKSHOP A

Constraints on central bank statistical activities

Chair: Kenneth Coates, *Director, CEMLA*

Secretary: Karsten von Kleist, *BIS*

Papers and presentations:

"Central bank data challenges: an Antipodean perspective"
Clive Thorp, *Reserve Bank pf New Zealand* (Paper)

"Experience and problems in developing a balance of payments statistics data base in Bosnia and Herzegovina"
Danica Lucic, *Central Bank of Bosnia and Herzegovina* (Paper)

"Sample survey design and maintenance: a new challenge to central bank statistical activities?"
Paola Battipaglia, *Bank of Italy* (Presentation)

"Selective editing as a tool to increase efficiency in survey data processing – An application to the Bank of Italy's Business Survey on Industrial Firms"
Paola Battipaglia, *Bank of Italy* (Background paper)

"A financial information system for India: data warehousing approach"
R.B.Barman and A.K. Nag, *Reserve Bank of India*
(Background paper)

"Use of information technologies to meet demands of timely release of statistical data: experience at the Bank of Japan"
Akira Mizusaki, *Bank of Japan* (Paper, not released for general publication)

"Common open standards for the exchange and sharing of socio-economic data and metadata: the SDMX Initiative"
Paul van den Bergh, *BIS* (Paper)

Workshop A: Constraints on central bank statistical activities

Issues Paper

Kenneth Coates (CEMLA)

It is important to emphasize the difference between "challenges" (the title of the Conference) and "constraints" (the title of Workshop A). If a challenge can be thought of as a reasonably difficult goal, the constraints should be seen as those difficulties involved in achieving it. The constraints must therefore be defined in terms of objectives, either general or specific, of central bank statistical activities (such as to improve the "timeliness" or "relevance" of monetary and financial series, or to make systems more "user friendly"). The presentations in Workshop A should stress the difficulties encountered or expected during the process of attaining the relevant goal, and possible ways of overcoming them.

What follows is a non-exclusive list of general headings under which these constraints may be grouped, with each heading containing specific issues that the speakers may wish to comment on and illustrate with references to their papers. These headings are not clear-cut boundaries, since many of the specific issues may bear upon more than one of them.

1. Budgetary

Budgetary constraints refer to such issues as: (a) a low level of staffing, either in number or preparation; (b) the labor intensity of methodologies employed in reporting, processing and disseminating statistics; (c) the high cost of investments in upgrading statistical activities, both in systems and human resources; and (d) the strain placed on existing capacity by requests for multiple data reporting to different organizations and according to different templates.

2. Institutional

Institutional constraints are those arising from political, legal or social features particular to the institution concerned, such as: (a) the lack of definition of statistical responsibilities in the organizational charter; (b) the lack of a legal framework enforcing the obligations of respondents in data reporting; (c) jurisdictional aspects arising from multiple political entities; (d) conflicts of interest between responsibilities assigned and measurement of performance (for example, preparing price indices); (e) staff resistance to change.

3. Conceptual

Conceptual constraints are those pertaining to the question of whether the actual data being reported, processed and divulged are of theoretical and practical relevance. There are two separate issues here: (a) Is the concept which the data attempts to measure of relevance to policy-makers, analysts and researchers? (b) Does the data accurately measure the concept?

4. Structural

This heading is closely related to the previous one, and refers to the fact that structural changes in the financial sector or shifts in the focus of monetary policy may render certain statistical series and practices outdated or un-useful, or may require new coverage. Specific issues here are: (a) financial sector complexity and permanent innovation in instruments; (b) the usefulness of "legacy" se-

ries in monetary aggregates when policy focus has shifted to "inflation targeting"; (c) the need for dis-aggregation of data when financial transactions with non-residents grow in importance; (d) complications introduced by the presence of multiple currencies.

5. Methodological

Constraints pertaining to questions of methodology in the different stages of central bank statistical activities are also very relevant issues. Here we can mention the problems of (a) splicing time series when there has been a qualitative change in their definition; (b) the provision of metadata to end-users; (c) the introduction of labor saving techniques.

6. Market

Market constraints refer to the needs and preferences of both ends of the data chain where the Central Bank interacts with stakeholders: the providers of raw statistical data to the Central Bank and the end-users of Central Bank statistical output. The issues here are: (a) the costs and benefits associated with the migration from paper-based to electronic systems; (b) the security considerations involved in data transmission and access; (c) the "user friendliness" of these systems with respect to their operation; and (d) the ability to provide data to end-users in ways which provide them with flexibility of analysis.

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Central bank data challenges: an Antipodean perspective

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1. Introduction

The word "Antipodes", apart from being a northern hemisphere term for Australia and New Zealand, also means "the direct opposite of something". This is far too strong a characterisation of some of the views put forward in this paper in relation to contemporary data perspectives, but a mild pun in the title is intentional. The paper describes the "data strategy" of the Reserve Bank of New Zealand for the collection, analysis and dissemination of quantitative data from financial intermediaries for monetary policy purposes since the late 1980s. Because the Reserve Bank of New Zealand became a member of the IFC only this year, a brief background is provided in section 2. Secondly, in the context of our work in New Zealand, the paper raises several contemporary "data challenges" that may be relevant to other central banks and describes our approach to them.

2. Background

For most of the relatively short history of the Reserve Bank of New Zealand, founded in 1934, the framework for its data collection process has been quite orthodox. From the start, balance sheets were obtained from banks regularly and key data items extracted to provide money and credit constructs for macro-economic analysis. As legislation admitted and regulated a wider variety of financial institutions, the Reserve Bank obtained relevant asset and liability data and integrated them into money and credit aggregates, for a long time on a quarterly frequency.

Less orthodox perhaps was the range of institutions surveyed, and the paucity of market price data for the time. With a highly regulated financial system, wholesale money markets didn't develop to a degree that provided reliable interest rate data for many decades. Tracking the price of retail money for most of the fifty years until deregulation in 1984 was more a case of recording administrative decisions in setting them, and advising on price changes, than surveying market prices. Surveys of financial data conducted by the Reserve Bank went beyond deposit-taking institutions however, notably including life insurance companies, which were the main repository of long-term savings until the 1990s. Survey efforts were also made to record data, never published, from the unregulated mortgage market operated through solicitors, which blossomed from the late sixties in response to increasingly binding constraints on credit from financial institutions.

The quantitative data collected were central to financial market policy decisions in the context of macro-economic policy. Data were published monthly in the Reserve Bank of New Zealand *Bulletin* and significant resources were devoted to their collection and dissemination. Quantities of credit, in particular, were watched closely. From the 1960s on, as financial markets slowly developed in scope, the principal means of regulating credit for many institutional groups was by ratios prescribing proportions of deposits required to be held in government bonds. Direct controls featured also: for example, for almost two years in the early 1980s, as part of an attempt to control inflation, the rate of growth of credit at banks had a monthly limit prescribed, monitored and enforced by the Bank.

While the framework for data collection and use over the period to deregulation may be described as "orthodox", the financial market these data described was anything but orthodox by today's developed economy standards. (New Zealand was simply a decade or two "late" in freeing its financial markets from controls – most countries have had experience of a closely regulated financial market). The price of money and credit played a role only through administered mechanisms and a burgeoning non-institutional financial market.

From mid-1984, rapid and thoroughgoing financial market deregulation occurred. In the space of less than five years, almost all regulatory distinctions among financial institutions, other than a

1 *The views expressed here are the author's and may not represent the views of the Reserve Bank of New Zealand. The paper was prepared for the August 2002 Conference of the Irving Fisher Committee on Central Bank Statistics.*

new category of registered bank, were removed. The bulk of the financial liabilities and assets of non-bank financial intermediaries at 1985 became by 1990 part of the portfolios of registered banks. This occurred through various processes, such as the merger of savings bank and building society groups and their subsequent registration as banks, and through market share gains made by the banks in the deregulated environment.[2] The data framework in use at the time of deregulation was changed in 1987 to meet the requirements of the new paradigm. A universal "standard statistical survey" (SSR), using generic data descriptions, was applied and this template, with some modifications, remains in use today.[3]

Deregulation of financial markets included the floating of the currency and full opening of capital markets, as part of a broad programme of economic liberalisation. A new Reserve Bank of New Zealand Act was introduced in 1989, mandating the achievement of stability in the general level of prices as the primary goal of monetary policy, with an initial 0 to 2% target for annual CPI inflation (now 0 to 3%) achieved by 1991.[4] With the price of money driving the attainment of the Bank's main policy objective, the implementation from 1987 of the new SSR, designed to measure quantities, received somewhat less focus than might otherwise have been the case.

During the first half of the nineties the Bank reviewed its options for implementing a prudential supervision regime, to meet its statutory responsibility for the "efficiency and soundness of the financial system". From 1995, within the registration framework for banks established in the late eighties, a "disclosure regime" for banks was implemented. Matters of relevance from a data perspective include a requirement to publish financial and prudential data on a quarterly basis to a set of minimum standards prescribed by the Bank, to enable monitoring of each bank's financial condition. Banks must provide an external audit opinion on the financial statements, and directors' accountability for material elements of them is implemented by a requirement for "attestations" with regard to these. There is no "on site" component in the prudential supervision regime.[5]

3. Data strategy

The policy mandate of the Bank drives the data strategy and data requirements. The primary function of the Bank is "to formulate and implement monetary policy directed to the economic objective of achieving and maintaining stability in the general level of prices". The Bank is responsible for the stability of the financial system and for the issuance of currency. In acting as New Zealand's central bank, the Reserve Bank of New Zealand is also expected to advise on the operation of the financial system. These central functions govern the Bank's interest in and use of financial data. Its Act empowers the Bank to require any financial institution to supply it with information and data relating to its business. This paper discusses the data strategy for all data purposes other than those met by the Disclosure regime.

The broad goal of the Bank's data strategy is to meet performance standards with financial data comparable to those achieved for inflation targeting and prudential management. Our aim is efficiently to obtain and disseminate, within a comprehensive framework, financial data that meets the needs of the Bank as defined by its policy mandate, paying close regard to respondent burden and resource use.

Efficiency is very important to us. No more than four full-time "staff equivalents", or 2% of all staff, are allocated to these data functions. In pursuit of efficiency we adjust the periodicity of surveys according to volatility and the relevance of data for policy. In our concentrated market, we obtain around 90-95% coverage on a monthly or quarterly basis from relatively few respondents in our major surveys. We conduct annual "census" surveys of all financial institutions to monitor this coverage and to enhance our market understanding. We undertake surveys jointly with Statistics New Zealand (SNZ), have used agents to collect data, and we make use of data series of reputable private sector entities. We use the internet and commercial software for data collection and dissemination purposes. All data dissemination is web-based – no data is published in hard copy.

Comprehensive coverage is a goal of our data strategy. Whereas forty years ago a close focus on the main deposit-taking financial intermediaries may have served monetary policy well, today's fi-

2 *See Thorp C, 'Developments in credit markets over two decades', Reserve Bank of New Zealand Bulletin Vol 65, No 2, June 2002, pp38-50, for an overview of these institutional changes (www.rbnz.govt.nz.)*

3 *The appendix describes the principal surveys conducted by the Bank.*

4 *The inflation rate target is contained in a Policy Targets Agreement between the Governor and the Treasurer in accordance with the provisions of the Act.*

5 *See the Bank's website for a full description of the prudential supervision regime.*

nancial markets are more diversified and the role of data from banks is less dominant in assessments of financial data for monetary policy purposes. We consider long-term savings intermediaries, collectively termed "managed funds", to be increasingly important as we seek to assess financial data that may assist us with monetary policy. We do not have good information about direct equity holdings, in unlisted domestic, and all global, markets. Increasingly, monetary policy data practice is turning attention more to sector balance sheet composition. For households, institutional surveys can provide required periodicity and timeliness in data delivery, but coverage is a key issue.

Long-run series, by and large, are most useful (as is more frequent periodicity) and we have tried, and try, hard to preserve consistent data series. The changes undergone in the real economy in the second half of the eighties however were very marked, no less so than those in financial markets. As a result, analytical results obtained from time series analysis of monthly or even quarterly financial data prior to the late eighties are not very rewarding. Therefore, beyond efforts to deliver monthly M1 data from 1981, we have concentrated on maintaining data series for the post-1987 period. On an annual basis, some major sectoral credit and financial asset series have been constructed recently from 1980, to provide a broad context for current analysis, especially of household wealth.

Common frameworks and terminology are an objective of our strategy. We harmonise with Australia in particular, given that most large financial institutions operating in New Zealand are Australian, and institutional structures and other economic and social conditions are similar. We adopt what we observe works well elsewhere and will apply in our environment, and help in learning about others' procedures has been given unstintingly. Several objectives are served by "lining up" our data outputs with others': clear communication through use of the same terminology for the same data, reduced development times and costs by learning from others' experiences, and facilitation of data comparisons are the main ones.

A forward-looking data strategy, as for monetary policy, is necessary. It has to start with monetary theory and stay in close touch with developments, inviting data "wish lists" from the central bank's economists. We constantly monitor data initiatives of other central banks and potential data opportunities in New Zealand to try to anticipate how we might improve monetary policy outcomes through provision of relevant data. The task of enhancing the relevance of data series is made more difficult by long lead times before data series are of real value, risks of data redundancy through institutional change and tight limits on practical options for collection. New possibilities however appear as technology lowers data collection and storage costs, as non-traditional survey techniques prove their worth, and particularly as a convergence of needs and wants emerges among financial market participants and authorities.

Data dissemination via our website is a key part of our data strategy. We aim to make available there all of our own data series used in our publications, so that others may replicate graphs and tables and calculate different outputs from the same data. There is an important international dimension to this process, as global markets and international organisations seek to monitor our financial markets. Clearly vital to helping to ensure the best possible information is available for efficient markets, this policy has the added benefits of reducing work in responding to *ad hoc* data requests and promoting a climate of co-operation from survey respondents.

4. Uses of survey data

The Bank uses its survey data in four main contexts: economic forecasting, evaluation of monetary conditions and monetary policy formulation, monitoring of the structure and behaviour of financial markets, and macro-prudential indicator analysis. Taken together, using financial data for these purposes also endows the Bank with general financial market knowledge that responds to the broad expectations of it from the wider community.

The financial data used for economic forecasting is obtained on a monthly and quarterly basis. It is used primarily in indicator analysis work. Various credit aggregate and sub-aggregate series tend to be most useful, although in practice what is obtained corroborates, rather than leads, real sector indicators available to us. For the household sector, pricing and quantity data are available on residential mortgages and credit cards, for example, and these data contribute to assessments of monetary conditions, along with all the other non-survey market data available.

Monitoring the structure and behaviour of financial markets requires a longer-term perspective, and annual data series that are comprehensive across the household, business and agriculture sectors have been constructed from 1980 to provide this. Conducting these and all other financial data surveys from the central bank in a small market provides close understanding of current market practice, arising out of discussions around the surveys. This has value from the macro-prudential standpoint also, increasing confidence in the meaning of the data. A macro-prudential focus on our data requirements is more recent than the other sources of interest, has attained significant prominence, and its needs mesh quite well with existing interests.

5. Data issues

The set of challenges to central bank statistical activities considered below are, with one or two exceptions, in effect sub-categories of one: how to respond to the (increasing) difficulty of providing *relevant* data for monetary policy purposes. The orthodox data available from deposit-taking institutions that are formatted into money and credit aggregates by and large are not delivering as significant a payoff in economic forecasting or monetary policy terms as hoped for. The ongoing, rapid innovation that has become a feature of financial markets and the practice of monetary policy, inflation targeting in particular, have reduced the value of investment in these data frameworks and surveys for these purposes. Comprehensive data series on quantities of broad money and total credit are increasingly elusive, and expensive and difficult to chase and maintain, whereas prices are much cheaper and easy to survey, while seeming to suffice, for inflation targeting at least.

Monetary authorities have responded to these changes by seeking data that provide as broad an understanding as possible of financial markets, and by innovation in the nature of the data obtained, using qualitative surveys more, for example. There are new uses for quantitative data, underpinning to an extent the maintenance of existing data "investments". The following discussion refers mainly to our experience in New Zealand, and groups a few selected data challenges under broad headings

i) The value of traditional aggregates

Our money and credit aggregate data framework is valuable as a construct for collecting data in a coherent manner. The formal money and credit aggregates themselves however are not the most valuable data series we obtain from the relatively comprehensive survey from which they are derived. In our open economy we find that we need to exclude repos and the non-resident component of the money and credit aggregate series. For decades we obtained a limited weekly balance sheet from the "M3 institutions", but ceased to recently (following the Reserve Bank of Australia's example), as we found we could make no real use of it. We place much less emphasis on aggregate resident private sector credit than its sectoral components.

One challenge for us is in fact to try to prevent inappropriate inferences from being drawn from our aggregates on the basis of some users' general assumptions about this framework. Another is to develop other data series, which has required us to minimise the resources applied to maintaining the aggregates survey, to free them for other uses. Given the central role played by money and credit aggregates for so long, we consider that there may be a degree of inertia in users' minds about their worth. We have reformatted our data, downplayed the release of the money and credit aggregate series and developed sub-aggregate series to try to lead users to series we believe are more useful for the time being. Of course, our published work does this, directly and by implication. We illustrate the proportional role M3 institutions' balance sheets play in household and business sector financial activities by providing data series that integrate all of our survey data across a sector.

ii) Sub-aggregate data looks more promising

The term "sub-aggregate data" is used here for sector or product data series that we compile, that may be drawn simply from the aggregates, or from wider surveys and be for the household, or agriculture sector, for example. The monthly SSR survey we conduct of M3 institutions provides a wide range of data, such as household sector deposits and a breakdown of term deposits, that we find useful. Household claims from this survey however need supplementation from another to give the best available series on household credit, whereas agricultural credit from this survey is quite comprehensive. Our annual census surveys of financial data serve to benchmark the scope of the monthly sub-aggregate series.

We are using sub-aggregate data as a response to the challenge of maintaining relevant data. These sector and sub-aggregate series in New Zealand seem to be more useful than the money and credit aggregates for economic forecasting purposes, and in contributing to judgements about

monetary conditions. We need to develop several for business sector credit, which although itself a "sub-aggregate", is too volatile at the total business credit level. We want to initiate a small-to-medium enterprise (SME) credit series, and will consult with banks (which we know are their principal credit source) about other indicators we might obtain. Little timely data is available for business balance sheets and profitability and we are seeking data for this area.

iii) Partial data

One of the main practical challenges to central bank statistical activities in many areas is how to obtain a comprehensive view of a sector and to monitor it reliably in the short term, given that only partial data is available frequently. New Zealand has not got a significant component of its financial data universe in non-institutional form – yet. This is an area of major challenge elsewhere, and it is being met in many financial markets, for example the credit market, with surveys of securities on issue that appear to cover the corporate credit market well. The widespread use of nominees to hold portfolios is a problem for some of our data breakdowns, in our government bond survey and others. In New Zealand we are only just at the stage of developing an official private sector securities market survey, having a very small market covered reasonably well by private sector participants. The corporate sector borrows around half as much again directly from overseas as it has from banks onshore, and we need to use the International Investment Position (IIP) data from the balance of payments survey to monitor this source on a quarterly basis. Given this offshore share of business credit, close monitoring of banks' monthly total business credit by itself is unlikely to be as helpful as otherwise.

It seems clear that tracking household wealth over time is of value to policy-makers, but only some of its components may be captured regularly by institutional and other surveys. We have inadequate data for equity holdings by households, for example, being unable to monitor direct holdings of offshore equities with confidence. We are using registry surveys on a quarterly basis for households' domestic market holdings. Our difficulties in obtaining data in the IIP survey on the country of issue of securities from managed funds have led us to ask whether better data might not be obtained from a co-ordinated survey of the major global custodians, with results provided to all national authorities. A cross-section household wealth survey, conducted by SNZ in 2001 and recently released, may enable us to benchmark our existing surveys of household financial assets and liabilities, providing an indication of how much of the total we are monitoring regularly.

iv) Series redundancy

We have few financial data series longer than fifteen years at a monthly frequency, and this appears to be relatively short, on an international comparison. But a long-run series is only valuable if its relationship with the dependent real sector variable remains stable. It often seems to us that our series enter the favoured "econometric zone", with enough observation points, at about the time that the underlying relationships change and whatever value may have been there is eroded. Data collection and maintenance of its quality is costly, and this long-run vulnerability seems to be increasing as financial innovation and change in business structures gather pace. While time series analysis has become more sophisticated and may overcome some practical difficulties, there comes a point where time series analysis gymnastics give rise to more doubts than they resolve.

Our response to this increasing challenge is not to worry too much about it, and to develop alternative series that may provide better returns, more quickly. We certainly do what we can to deal with series breaks and to provide judgement regarding the degree to which underlying meaning in any series has changed. But we have finally decided to take a relatively sanguine view where data series seem to have become too costly or difficult to continue. Pressures from some econometric users can encourage a "macho" attitude to series length, which may run the risk of distorting priorities in seeking the best value for money in collecting data.

v) Measurement

Our method of measurement of financial data has an accountancy metric. The standards of generally-accepted accounting practice, including financial reporting standards that have received the force of law in New Zealand, are the basis on which values are identified for reporting in our surveys. Innovation in financial practice is rapid, accountancy standards by their nature take time to agree and standards are not universal. One of the challenges we face is to understand the nature of the data we receive. Whether, for example, certain values are in the nature of a deposit or not, whether values are better measured on- or off-balance sheet and how, are questions that are often complex and debatable. The accountancy profession will come to its own decision about the best representation of a balance sheet entry, but the increasing degree of complexity in "financial engineering" places stress on conceptual underpinnings.

One approach to measurement may no longer serve all purposes – we experience considerable uncertainty about the meaning of some of the quantities we record, and naturally about consistency of interpretation among respondents. This is less of a problem perhaps under "on site" prudential supervision regimes. The regulator can in principle stipulate a meaning that can be widely applied with confidence. Nonetheless, the general problem of concordance between the conceptual scheme required for monetary policy and that for financial reporting seems to us to be greater now than ever, and a significant challenge to statisticians.

A practical illustration from our experience illustrates one consequence of this kind of issue. In the year to May 2002, PSC grew 17 per cent, but the resident credit series we focus on was up only nine per cent. Much of the difference is accounted for by non-resident transactions formerly likely to have been of an off balance sheet nature, but now required by accounting standards to be on balance sheet. Legitimate inter-country financial transactions (with taxation implications) give rise to much of this difference in growth rate. We cannot readily extract economic meaning from PSC in these circumstances.

It may be that central banks could join together to reduce costs in monitoring these kinds of technical matters and could disseminate results of such work among themselves. For a small central bank like the Reserve Bank of New Zealand, being a member of such a group in order to gain expert assistance in this field would be very much appreciated.

vi) International comparisons

There is a growing tendency, motivated in part by international organisations, to want to collect increasing amounts of comparative financial data. Despite the complexity of country-specific data issues in this field, we receive many requests to complete templates in a particular format, with comparative outputs subsequently circulated. Where there is a supra-national agreement, for example within the EU, to implement monetary policy, there is good reason to undertake the work required to achieve some form of relatively reliable comparability. Beyond such a reason however, we believe great care must be taken in compiling and disseminating data represented, by inference from a common format, as "like" data. We also think the benefits of such exercises with financial data need to be better demonstrated, given the modest returns to their use even in one jurisdiction.

The concern we have with this tendency relates to the degree of prescription in requests for data. We support efforts to encourage central banks and others to explain their methodology more clearly and to label and explain data. If this is done well, then those with an interest in cross-country comparison, from any quarter and for any reason (short of a lack of data), should be able to undertake their work. Templates by definition require inferences to be drawn regarding meaning by those completing them, and they can in practice lead to incorrect assumptions by users about such data. The best way to learn from the experience of others where financial data are concerned would seem to us to be for those seeking to make the comparisons to be responsible for decisions regarding data allocation. They can only do that if a country's data are made available with extensive labelling. This is a not inconsiderable challenge that we are taking up with regard to our own data.

Where we baulk, for example, is to be asked for our data series to be seasonally adjusted, when of course we do so only when that is warranted. We prefer not to make decisions on how to shoehorn our data into formats not designed for our institutional framework. We decline invitations to complete financial data templates that do not match our institutional structure, and weather the criticism implied by our absence from data compendia for failing to do so. The challenge we think central banks face is to find a way to learn lessons from other countries, without resorting to templates, or we will begin to produce "McData", for which econometric techniques appear hungry. There are signs that too many users of these comparative data pay little attention to the health warnings attached to them by their compilers.

iiv) Data dissemination and other practical matters

Websites are a wonderful tool for responding to some of the data challenges faced by central banks. Objectives of transparency, universal and timely access, exhaustive explanation and so on can all be met at relatively low cost to banks and users. We are all still learning how to use them to greater advantage, which is a welcome challenge. In New Zealand we are working towards the goal of being able to say to enquirers that if the data are not on the website, we haven't got them (or they may not be disclosed). Provided adequate explanation is supplied, which we think is particularly important, researchers and all others interested in the work of the central bank should be able to obtain what they need without direct contact with the bank (which has its advantages). The website is a powerful means for a central bank to provide a service to a community that sometimes doesn't see it as a friend – good information from it is a worthwhile contribution.

While we are keen to label data as clearly as possible and to use the website to communicate, we don't regularly provide a commentary with data releases. When there are market changes that

affect a series, we provide a "special note" to explain the impact. Recently for example, the conversion of a store card customer base to a surveyed credit card introduced a series break that we could not splice. We explained how this had affected the series and for the first month provided the series growth rate, seasonally adjusted, without the newcomer. We write about financial market developments in our *Bulletin* and provide background notes on the website, but refrain from monthly commentaries on each data series as it is released. We receive no requests for them. Our reticence stems from concerns about implicitly revealing too much about particular institutions in a commentary, from doubts that we would add any value by doing so (a month's data by itself is not usually helpful) and concerns that (wrong) inferences about policy might be drawn from any commentary, to say nothing of the effort required to comment.

In New Zealand, the burden imposed on business in general by official surveys has come under close scrutiny. Our survey changes since the late nineties have been able to reduce the imposition on respondents, by using electronic survey methods, among other techniques. One way to increase the reliability and quality of survey inputs is to discuss data needs with respondents in a way that may result in their obtaining data that they will find useful for their activities – in other words, to provide direct market benefits from the survey. Delivering market value is a benefit that is an offset to survey cost, and we find it to be relevant to market participants' attitudes to the work involved in completion of surveys.

Private sector data series are frequently used as indicators for monetary policy work, with large banks and others providing reliable and very useful "public good" indicators for their own purposes. It may be that central banks can continue to improve their access to the kinds of data that can contribute to their understanding of financial markets by extending various forms of co-operation with private sector entities that can give rise to new series development.

Finally, are central bank statisticians well enough able to explain the nature of the data they produce to users in their own institutions? Often, the data are collected and compiled well away from end-users, who may have little direct contact with the respondents or adequate current market knowledge. On the basis of our own experience, where both functions are integrated in the central bank, we nonetheless find we must remain vigilant in ensuring that the data we collate is understood exactly for what it is. With data specialisation there is a risk that data users become too remote from the messy business of obtaining it, coming somehow to treat data series as the "truth", rather than statisticians' best efforts to represent elusive reality. We may need to insist more noisily that the labels we attach to our data be read!

Appendix

The surveys discussed here (there are several omitted) include two annual "census" surveys of financial institutions not regularly surveyed (deposit-taking institutions and managed funds), three monthly "quantitative" surveys and one quarterly one. The Bank also commissions two surveys of inflation expectations. Data from these and its other surveys are disseminated on the Bank's website.

The techniques used for data collection since the late nineties have relied on the internet and use of Excel spreadsheets as questionnaires. Banks and others send Excel workbooks as e-mail attachments, although this is not a requirement – disks could be sent by courier. The workbook for the main SSR survey contains over 200 data cells on five tabs and includes validation checks to higlight inconsistencies in data. Guidelines for questionnaire completion are included as well as a "backdating" template to assist with revisions when necessary. The latest month's data entry is done alongside those for the previous two months, with variance calculations immediately computed to try to prompt trouble-shooting at source. Workbooks for most other surveys contain these features, which were well received when implemented.

At the Bank the Excel workbooks are aggregated with software developed in-house, based on Powerbuilder and Sybase. Seasonal adjustment is carried out in SAS, using set criteria for determining seasonality. All sources, dates and cells can be queried, in a pivot table environment that is a powerful tool for examining the quality of input, and for delivering *ad hoc* output formats. Regular formats for dissemination on the website are computed in Excel and converted to html for "short form" presentation: "historical" data from series inception remains in Excel. For the SSR, an aggregate of each data cell in the format in which it is collected is disseminated so users may compile their own tables from any of the data. In addition, copies of the questionnaire workbooks, which include data definitions, are available on the website.

The SSR is completed by 14 respondents in addition to the Reserve Bank and is due at the Bank within 12 working days. A number of the respondents send their templates from regulatory accounting divisions located in Australia, which is no impediment to our work, although we have

made fewer visits for discussion directly with them than is the case with respondents based in New Zealand. With a limited number of respondents, we are able to build personal relationships with relevant staff of respondents, something that we believe contributes significantly to the quality of the results we obtain. On the other hand, with five large survey contributors responsible for over 80 per cent of aggregate values obtained, unusual data events one of them may experience, or the need to estimate because of unavoidable delay, are likely to influence the aggregates more obviously than in a larger respondent population.

The SSR generates a number of formal tables that present the money and credit aggregates, as well as others, such as those for sub-aggregates and weighted average interest rates on funding and claims. It was revised in mid-1998, when around thirty smaller contributors to the former paper-based data collection system were dispensed with, as the larger ones retained delivered 95% of the broad money and private sector credit totals previously obtained. Since then, an annual survey of all deposit-taking institutions (and for household financial assets and liabilities only, all financial intermediation connected with them) has been conducted. This survey, apart from its intrinsic value, is used to benchmark the coverage of the SSR.

Although the revised SSR from 1998 obtained 95 per cent of credit values from the previous survey, it excluded a significant proportion of household credit data from smaller institutions. To capture a fuller percentage of household liabilities, a "household claims" survey was introduced to collect limited credit data for households only – it now has 10 respondents. Data in this survey include securitised residential housing and "other personal" liabilities. Together with the bulk of similar household data from the larger institutions in the SSR, these data contribute to an aggregate monthly household claims series that monitors about 95% of total household financial liabilities revealed by the annual "census" survey.

The third quantitative monthly household survey conducted is of 10 credit card issuers, most of which are banks. This survey was initiated in 1981 when credit cards were first introduced in New Zealand and was revised in 2000 to improve knowledge about weighted interest rate costs to credit card borrowers, to distinguish personal from business credit and to show "deposits in the cards" owned by customers. Since 1998, issuers in New Zealand have strongly promoted credit cards as a means of payment, using rewards such as airpoints. A feature of the new survey is an attempt to measure that part of total outstandings that bears interest, as opposed to the "float" on the card, which has grown with reward schemes. Two timely data series that are useful as indicators are obtained from the billings data ("amounts financed"): these are spending abroad by New Zealand cardholders, and spending in New Zealand by visitors (broadly categorised as "tourists").

A quarterly managed funds survey (MFS) was introduced in 1995 to supersede the "life offices survey" in order to respond to the changing institutional structure of the long-term savings market. Revamped in 1999 to use the Excel workbook collection system begun with the SSR and broadly modelled on the survey conducted by the Australian Bureau of Statistics, the survey covers large fund managers. Respondents are the asset management arms of life insurance companies, independent fund managers offering unit trust products and fund management subsidiaries of banks. This survey is operated by the Reserve Bank but conducted jointly with SNZ, for which respondents complete data for the international investment position requirements. The Bank's objective is to categorise funds under management by tax regime (which influences product types, eg unit trusts, which are a proxy for the tax-driven product orientation in this market) and asset class, and to measure the share of funds under management directly from households. An annual MFS was introduced in 2001 to survey the full market, for the same reasons as for the annual survey of deposit-taking institutions.

Other monthly surveys conducted by the bank include one of a limited number of retail interest rates and a survey of non-resident holders of government securities, as well as surveys of foreign exchange turnover, inter-bank cash and government bond turnover.

Abstract

This paper describes the "data strategy" of the Reserve Bank of New Zealand for the collection, analysis and dissemination of quantitative data from financial intermediaries for monetary policy purposes since the late 1980s. Drawing on experience in data collection in New Zealand, the paper raises several contemporary "data challenges" that may be relevant to other central banks and describes the approach to them in New Zealand.

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Experiences and problems in developing a balance of payments statistics data base in Bosnia and Herzegovina

Danica Lučić, Central Bank of Bosnia and Herzegovina

About the Central Bank's activities

The Central Bank of Bosnia and Herzegovina (CBBH) was founded in accordance with the Law on the Central Bank. The objectives and tasks of the CBBH are very significant for the establishment and the functioning of the economic system in Bosnia and Herzegovina as a whole, especially in view of the central bank's assignment as the monetary authority. Bosnia and Herzegovina (BH) is composed of two entities: the Federation BH and the Republika Srpska, while the Brèko District, established in March 2000, now also constitutes an essential part of BH. The CBBH has acquired by law an independent status, with the aim of a more objective accomplishment of its tasks; it is completely independent of the entities and of any other public agency or organ.

The CBBH operates according to a currency board arrangement, which determines its emission policy and its policies directed at the stabilisation of the domestic currency. The domestic currency, the convertible mark, is issued with full coverage by freely convertible foreign currency.

During the five-years of its existence, the central bank has achieved the following results:

- It has continuously maintained the stability of the domestic currency – the convertible mark (KM). Since January 2002, the convertible mark has been directly tied to the Euro at the rate: 1 KM=0.5112292 EUR, i.e. 1 EUR=1.955830 KM.
- It has consistently and continuously implemented the currency board arrangement.
- The convertible mark is fully represented in internal payment transactions.
- Coordination has been achieved between the activities of the central bank and those of the entities' banking agencies responsible for the issuing of work licenses/permits and bank supervision; this applies also to the establishment of standards for the banks' functioning, in accordance with the practice in countries with developed markets.
- By introducing the RTGS and the gyro clearing system, the functioning of a modern payment system, similar to the payment systems in many other European countries, has been made possible. This project was realized with the assistance of the international community, including USAID.
- The management of foreign exchange reserves held by the Central Bank has been effectuated in accordance with the directives of the Governing Board of the CBBH.
- The stability of the domestic currency and low inflation have contributed, in great measure, to the fact that foreign banks started active work in BH, in both entities. Confidence in the banking sector has returned, the population's savings are in constant increase, which is an important factor.
- A deposits insurance agency was established.

The efficiency of the currency board arrangement is measured according to a comprehensive set of macroeconomic indicators, including the balance of payments of BH (current account balance, foreign direct investments and foreign exchange reserves). To obtain full control of monetary policy and to be able to assess the macroeconomic situation in BH, it is necessary to improve the quality of input information and to use a macroeconomic approach to investigations for the purposes of the CBBH.

Organization of balance of payments statistics in the CBBH

Balance of payments statistics are complicated because they are compiled at both entity and state level. At the state level, relevant data sources are the Ministry of Foreign Trade and Economic Affairs, the Ministry of the Treasury, the Foreign Investment Promotion Agency, the Agency for Statistics, and international organizations and foreign embassies in BH. At the entity level (Federation BH and Repulika Srpska) and for the special administrative unit Brcko District relevant data sources are the Statistics Institutes, the Ministries of Finance, the Ministries for Foreign Economic Affairs, the Customs Administrations, commercial banks and enterprises. The diversity of data sources makes improvement of balance of payments statistics in BH more difficult: the existing data are not based on international standards, their coverage is poor, and evidence systems are not adequate as they contain data on stocks, not on flows

The Law defines the CBBH as the responsible agency and as the coordinator of the activities on collection of monetary, financial and balance off payments data. The theoretical basis for balance of payments statistics is the 5th edition of the IMF Balance of Payments Manual (BPM5). Compiling and publishing Balance of payments statistical reporting is being done in accordance with the IMF methodology.

An IMF statistics advisor, having office at the CBBH, is in charge of improving the work of the statistical agencies of the entities and the State Agency for statistics. A current activity of the IMF advisor is the further development of the balance of payments statistics of BH, especially on foreign direct investments.

It will takes some time for BH to get balance of payments statistics meeting the standards of comprehensiveness, timeliness and quality. The CBBH is in a convenient position to organize balance of payments statistics, in view of the fact that there are three government statistical agencies. All agencies use different methodologies, and face certain difficulties in the collection of statistical data. For most data sources (private enterprises, embassies and international organizations in BH) the CBBH is a trustworthy partner that will treat their data as strictly confidential, because the Law states that data will be used exclusively for statistical purposes and will be published in an aggregated form only.

Problems with data source for BOP purposes

The central bank's main problem with respect to data sources for balance of payments (BoP) purposes are:

- lack of authority to require data from local, foreign, and government organizations and institutions;
- the Law has not defined sanctions for non-reporting of data:
- poor coverage and poor quality of data in existing surveys;
- poor coverage of main data sources,
- most of the sources do not report in a timely manner, especially for quarterly BOP reports.

Successful CBBH activities in the BOP area

The central bank has achieved a number of successes in the balance of payments area:

- data sources for BOP statistics have been extended;
- compilation and publication of BOP statistical reports are being done in accordance with the IMF methodology;
- the IMF statistics advisor's assistance in the estimation of BOP items;
- improvement of estimation methods.

The Central bank of Bosnia and Herzegovina undertook some activities in organizing meetings with various BH institutions that are involved or can help in establishing BOP statistics. The aim of these meetings was defining the type of data, data source, dynamics of collection and coverage of the BOP data, so that they could be used for BOP estimates. The CBBH staff collects data directly from the above mentioned institutions by means of forms and instructions, which are in accordance with the IMF methodology.

To emphasize the significance of the balance of payments of BH and the role of the central bank in that area, the CBBH organized a Round Table on the Balance of Payments of Bosnia and Herzegovina. The attendants were representatives of government institutions and eminent professors from the BH universities, who are also members of the CBBH expert team.

Steps to the further development of BOP statistics

In order to develop and improve the BOP database, priority tasks for the BOP Division of the CBBH in the year 2002 are:

- establishing foreign direct investment statistics (a survey of commercial banks has been completed);
- setting up of surveys in order to identify new source data (a letter was sent to embassies to ask their help in the identification of foreign branches and business units in BH);
- improving incomplete data estimates (estimates of BOP items for previous years, starting with 1998, were made, while work on estimates for Q1 and Q2 2002 is in progress);
- presentation of a new ASYCUDA system for processing customs declarations;
- visits to local and foreign institutions that could assist in improving balance of payment statistics.

The CBBH will collect data by forms that have been distributed in BH to government institutions, commercial banks and enterprises, foreign embassies and international organizations. It has been agreed to visit embassies and international organizations in BH, as well as large direct investment enterprises, to achieve a more precise collection of data.

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Sample survey design and maintenance: a new challenge to central bank statistical activities?

Outline of presentation

Paola Battipaglia (Bank of Italy)

In the light of the challenges posed by increasing demands on scope, quality and timeliness of Central Banks' output statistics, maximising effectiveness of information processing with respect to cost has become of utmost importance. Sample surveys can be viewed as a possible means to cope with this challenge, but of course they pose some new problems in terms of design, maintenance, estimation, as well as response burden control.

This presentation first describes the Bank of Italy's experience with sample surveys; subsequently it focuses on the most recently developed strategies to increase efficiency, especially at the stage of quality control and processing of survey data. Here, by means of selective editing procedures, we have managed to reduce the amount of checks and follow-ups of survey returns without compromising the quality of the final output statistics. This goal is achieved by targeting controls where the largest gains in the quality of final statistics are expected, on the basis of model-predicted values and accounting for sample expansion weights.

Finally, the presentation discusses strategies to pursue efficiency gains, with reference to the new challenge posed by the ECB requirements for the sample-based harmonised interest rate statistics.

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Selective editing to increase efficiency in survey data processing – An application to the Bank of Italy's Business Survey on Industrial Firms

Background paper

Paola Battipaglia (Banca d'Italia) [1] [2]

1. Introduction

Editing is the set of procedures for detecting and for adjusting, manually or automatically, individual errors in survey data records, with the aim of increasing estimates accuracy. Editing activity is usually carried out during data collection, during data entry, and finally at the time of production of the survey output statistics. Outlying or inconsistent data are first identified and then flagged and checked as potential errors: in doing so, a certain number of survey units are re-contacted and asked to either confirm or amend the anomalous data.

'Classical' editing systems aim at follow-up of all suspicious survey returns, in order to release an error free data set. However, recent studies within major statistical agencies have shown that this approach is excessively demanding and time consuming. This is particularly true for business surveys, where for many variables (e.g. investments) the magnitude of population variance is huge, and survey returns often turn out to be over-flagged .

With selective editing, validation is made more efficient by targeting follow-up where the largest gains in the quality of final statistics are expected. Editing impact is assessed by taking into account the distance between the observed and the expected amended value (under a model), as well as the grossing up sample weights.

Through this approach, editing activity outcome can be maximised with respect to cost, with a resulting better quality – for given timeliness and resources – and minimum respondent re-contact.

This paper traces the development of selective editing applied to the Bank of Italy's annual survey on industrial firms. With increasing needs for timeliness and quality of survey output, the appeal of a selective procedure is huge. A more efficient data processing and a reduced total respondent burden are the expected gains from this new approach. Moreover, highlighting the most influential observations can help with the interpretation of survey results.

2. Basic principles underlying selective editing

2.1. Survey errors and editing

Results from surveys are subject to a range of non sampling errors which may arise from different sources: the respondent may misunderstand the question, or he/she may not be able to recollect or trace the right answer, the interviewer may make mistakes in recording the answer, etcetera.

To deal with these multiple sources of errors, identification and treatment of incorrect responses are usually carried out in more than one step.

During the data collection, respondents are prompted with a few queries based on consistency checks, which should be solved by contextual interaction with the interviewer.

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2 *The views expressed in this paper are those of the author and do not involve the responsibility of the Bank.*

In the data entry phase, further checks on domain and consistency of variables are introduced, in order to capture coding and other processing errors.

Finally, immediately before and at the preliminary stage of the analysis, outlying or inconsistent data are flagged for follow-up, which often involves re-contacting the respondents.

When editing is done at the stage of processing it is also referred to as 'input editing', while 'output editing', which is performed on an almost complete data set, aims at the identification of units with high contribution to estimates.

At each stage, editing activity requires a combined use of automated procedures and subjective judgement. The whole process is very labour intensive: for large surveys with many data items, the median costs of editing can be as large as 40% of the total survey cost (Latouche and Berthelot, 1992).

2.2. Selective editing and survey costs

In recent times, methodologists in government statistical agencies have looked critically at the process of editing survey returns, with much attention to the goal of reducing both internal costs and respondent burden. Research carried out under this new approach has shown that classical editing systems, aiming at the production of a complete and error free survey data file, are very expensive, time consuming and unrealistic. Moreover, the strategy appeared unnecessary to obtain good quality final estimates: most of the times, only a limited number of classical editing failures results in any meaningful change to estimates (see for example K. Farwell and Mike Raine, 2000, Latouche and Berthelot, 1992).

These findings spurred research on a new approach to editing aimed at rationalising resource usage through prioritising editing activity. Selective (also called significance) editing isolates data with the most significant impact on the final statistics: at the input editing stage, when the data base is searched for potential errors, this approach will highlight the edit failures with the largest expected impact on the final statistics; during output editing, (when basic errors have been fixed, response rate is sufficiently high and we want to finalise estimates) selective editing will identify units with highest contribution to estimates, helping with the analysis and explanation of survey results.

Selective editing is not, per se, a tool for reducing the amount of editing performed in a survey: this should be based on the acceptable amount of non-sampling errors. Efficiency gains from selective editing can be exploited to raise the standards of quality output and/or improve the timeliness of data release, and/or identifying errors sources to prevent errors arising.

2.3. The corner stone of selective editing: the score function

In input editing, a convenient way of translating this strategy into an operating procedure is to assign each observation a relative score, which should indicate the expected impact of the editing activity on the final survey output.

The score must highlight for the data analyst the suspicious returns that deserve most attention. It may do so by expressing the unit contribution to quantities like level, absolute or relative change, or variance. Usually, editors prefer to use scores that directly address the final estimates they target; in this case, the functional form of the estimator will influence the one of the score.

The basic components of the score function are:

- the estimate of the likely impact due to editing;
- the sample expansion weight w_i for unit i.

In order to work out the score function during input editing – that is, when many of the responses from the final sample are not yet known – approximations are required for both the above quantities. However, since the score only needs to be a relative measure to assign priorities, its absolute value is not important for the purpose of selective editing. Hence, a fairly large degree of approximation can be tolerated without compromising the effectiveness of the score (Lawrence and Mc Kenzie, 2000).

The estimate of the likely impact due to editing is based on a model that will reflect a predetermined view of how population should behave. Again, this model must not necessarily be the best fitting model for each variable's behaviour: it may rely on multivariate regression analysis, but it may as well be based on simple rules of range or consistency.

Expansion weights are usually calculated as the approximate inverse of selection probabilities. They can be interpreted as the number of population units that are represented by each unit in the

sample: therefore, they also provide a direct measure of the leverage of each observed value on the final estimate: the larger the expansion weight associated to an outlier, the larger will be the impact of this anomalous observation on the final estimate, and viceversa. Survey weights are usually determined once all survey data have been processed, as they are usually adjusted for non-response. However, design weights can be used to work out the score function as the data collection is still ongoing.

If known, it would be useful to also introduce in the function the probability that the response is erroneous for item X in unit i. However, this is usually difficult to estimate. In some circumstances, there could be some information or assumption about a particular unit or sector of the population being more likely to misreport: for example, new units might be considered less reliable than panel units; if no information of this kind is available, the probability will be set equal to 1, assuming that all responses are erroneous.

The absolute value of the score – also called 'benefit' – will provide the ranking to gear editing efforts.

3. Use of selective editing in the Bank of Italy's survey on industrial firms

3.1. Main features of the survey

Since the seventies, the Bank of Italy has been carrying out an annual business sample survey, focused on the medium and large industrial firms. The sample is currently made of about 3000 firms, with a predominant panel component. The questionnaire, which is made up by a fixed and a variable set of questions, collects information on approximately 300 variables. Interviews are most often personal, and they are carried out by the Bank's personnel working in the local branches.

Like with most business surveys, for many of the variables it is difficult to identify a regular, normal behaviour because of their naturally large variability: ensuring high data quality standards is therefore very labour intensive. Editing is performed at different levels: at the time of the interview, through interaction between the respondents and the interviewers that will also rely, when possible, on information given by the same firm in the previous wave; at the data entry stage, by checks on ranges, internal consistency and other bounds – like totals; during data processing, by more in-depth checks on longitudinal and cross-time consistency. This latter part of data quality processing is carried out iteratively: at each stage, amended data re-enter the data set and the thresholds for consistency checks are updated. At the same time, each item is flagged after final validation, so that only unresolved queries keep being proposed for follow-up.

The survey output is exploited at two levels: to provide indicators of economic activity, which are released with the Bank's Annual Report, and as a multi-year, multidimensional source of information supporting research into the determinants of firms' behaviour and strategies.

To allow for narrower domain analysis, the sample size has recently been more than doubled, making it more challenging the task of releasing the core survey output very shortly after data collection. In this context, the need for a selective editing strategy has become a key issue.

3.2. Choosing the functional form of the score

In our first experiment with selective editing, we decided to go for the score function with the tightest link to the final survey statistics. We concentrated on the key indicators published at the time of the first release of the survey, since a proper balance between timeliness and quality of the output is most difficult to obtain at this stage. Such indicators are mainly annual rates of change in variables of core interest for industrial activity (such as investments, employment and turnover).

When the final estimate is a total of the form $\hat{X} = \sum w_i x_i$, the functional form of the score for unit i on variable X is straightforward:

$S_i = w_i \delta x_i$, where:

δx_i is the difference between the reported value and the expected amended value for the i-th unit;

w_i is the sample weight associated with unit i.

Individual contributions to ratios are less straightforward: we were hence confronted at first with the problem of finding the appropriate functional form of the score. Among several approaches that we tried, the best one proved Taylor Series expansion, with first order approximation (Law-

rence and McKenzie, 2000). For a function R of two variables $R = f(Z, X)$, this approach brings to a score of the form:

$S_i = \frac{\partial R}{\partial Z}\delta Z + \frac{\partial R}{\partial X}\delta X$, where:

δZ and δX are the expected changes in Z and X as a result of replacing the reported value for unit i with the expected amended value;

$\frac{\partial R}{\partial Z}$ and $\frac{\partial R}{\partial X}$ are the partial derivatives evaluated at the point of the expected value.

For a ratio $\hat{R}$ between survey estimates of – say – total investments at time t and t-1

$\hat{R} = \hat{I}^t / \hat{I}^{t-1}$:

$Z = \hat{I}^t = \sum w_i I_i^t$ is the survey estimate of total investments at time t;

$X = \hat{I}^{t-1} = \sum w_i I_i^{t-1}$ is the survey estimate of total investments at time t-1;

w_i is the sample expansion weight for unit i.

Resolving for partial derivatives, the score function for unit i becomes:

$$S = \frac{1}{\hat{I}^{t-1}}\left(w_i \delta I_i^t - \frac{\hat{I}^t}{\hat{I}^{t-1}} w_i \delta I_i^{t-1} \right)$$

The value S_i provides a good approximation of the expected change in the ratio following changes of magnitude δI_i^t and δI_i^{t-1} as a result of editing unit i with respect to the reported values I_i^t and I_i^{t-1}.

3.3. Calculating the expected amended values

Each component of the score needs to be estimated. A quick estimate of the quantities δI_i^t, δI_i^{t-1}, $\hat{I}^t$, $\hat{I}^{t-1}$ can be obtained by the 'drop-out' or 'deletion' method. It basically consists in assuming that the effect of editing would be to remove the i-th observation from the survey data set: the score here indicates the difference between the final statistic – e.g. the rate of change – calculated with and without the i-th observation.

We decided to try a slightly more sophisticated approach, relying on regression models to provide a benchmark for each reported value. That is, the expected values under the model were used as the best proxy of the expected result of editing activity: the score was accordingly made to represent the change in the final statistics (ratios) due to potential errors of magnitude equal to the residuals. Models were built up as simplified versions of those that we use for imputing missing values. In selecting 'the best' model for each variable, we decided to keep complexity at a minimum, for the sake of an easier control and a better timeliness of the process. As it was pointed out before (par 2.3), for the purpose of significance editing the model only needs to provide a ranking for the reported items: a simple model will provide a simple edit rule, while complex models would unnecessarily slow down the process, also making it more prone to errors.

The major difficulty with model estimates produced during data processing is that at this stage there are still unresolved queries on survey returns: sample means, which tend to be unduly influenced by even a small number of gross errors, can be unreliable. To circumvent this problem, we adopted the strategy of dropping each observation in turn from the parameter estimates and then taking the residual from such a fitting as the expected effect of editing that particular observation. This approach corresponds to fixing, as a benchmark for each reported figure, the value that the model would have predicted on the basis of all remaining observations. The problem of sensitivity of the parameter estimates to erroneous items in the data set is somehow dealt with, although not completely overcome.

In carrying out the regression, as well as in implementing the score function, design weights replaced sample weights until the data set of survey returns did not reach a steady state.

These quantities were then fed into the score function, as defined in the previous paragraph. Absolute values of the score helped targeting follow-up, on each particular variable, based on the expected impact of editing activity on the final estimate of rates of change.

3.4. Implementing selective editing

Implementing selective editing at the stage of data processing requires that the score function be worked out recursively, any time a significant batch of new and/or amended data is made available.

We made each query, once resolved, to activate a different flag according to the edit outcome (item amended or confirmed). Amended data, re-entering the data set, change the model expectations of 'normal' behaviour; validated outliers too re-enter the data set, but not the procedure for scoring suspicious observations. During output editing, when the survey estimates are produced, these 'true outliers' receive special treatment: those which are worth commenting on are interpreted; as a whole, their effect on the final statistics is smoothed by means of robust estimators, like winsorised means.

The system of flags allows evaluation of the percentage of edit queries which spotted response or other non-sampling errors. This will help assessing the predictive power of the models underlying the new editing strategy. The ability of the model to provide a useful benchmark is not, however, entirely dependent on its 'hit rate': it is valid to identify outliers and check them even when they are correct, since the correctness of such data is in itself an interesting outcome.

There are several more aspects that we had to consider while implementing selective editing. For example, we decided not to apply it to cells with a low response rate, or to somehow peculiar sub-samples (like the sector of energy, gas and water), that we decided to edit thoroughly.

As for the existing procedure for outlier identification, we decided to exploit it as a supplement to the score function. While the scoring helps concentrating time and energy on the most significant units, the old procedure – which relies on a broader information set including data from previous runs of the survey – helps providing further evidence on the peculiarity of the outlying figures.

This choice was made in the belief that greater efficiency in the outlier identification process must not be pursued at the expenses of editing documentation: the more sound the justification provided to edit queries, the more rigorous the process will be. Also, sharing quality control criteria with interviewers and respondents can help understand the error generating mechanism, hence prevent errors arising: this latter goal must remain the main concern of survey managers.

3.5. Conclusions

Selective editing is a tool to achieve efficiency gains in the quality control of survey data. As such, it is receiving increasing attention by major statistical agencies, which are more and more concerned with improving the timeliness and quality of their survey-based end products, as well as with reducing respondent burden.

This paper explains how selective editing was introduced in the context of the Bank of Italy's business survey on industrial firms and integrated with the existing quality control procedure.

Operationally, the major innovation from this approach consists in the introduction of a score function that will help targeting editing activity. This score, obtained by Tailor series expansion of the ratio-type target statistics, is able to predict the impact of follow-ups of survey returns on the final survey estimates. By doing so, the score allows to concentrate time and energy on the most influential amongst the potentially erroneous data, also limiting re-contacts of survey participants.

For the past two waves of the Bank of Italy's business survey, application of selective editing has allowed for considerable reduction in time and number of re-contacts during the data quality control phase. It has also helped scoring the 'good' answers, by identifying the true outliers and assessing their impact on the final estimate.

Ongoing further research is addressing the issues of constructing formal indicators for the performance of the procedure, setting cut-off scores and working out a multidimensional global score. Application of selective editing to other surveys with response errors of similar patterns is also planned.

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Abstract

Editing survey returns requires a multi-stage, labour intensive activity which ends up with re-contacts of a few respondents for follow-up of suspicious items. Recently, many statistical agencies have devoted considerable attention to increasing the efficiency of their production process, improving the quality of their end products, and reducing respondent burden. Selective editing attempts to rationalise quality control activity by concentrating respondent follow-ups to suspicious units that may have an important impact on the estimates.

The method is based on a score function that predicts the effect on the survey estimates of resolving the edit queries for each unit. Both the distance between the observed and the expected value (under a model) and the sample grossing up weight contribute to the scoring. This strategy can be particularly effective with data sets where a relatively small number of units contributes a large percentage of the total estimate, like in business survey returns.

The main goal of this paper is to trace the development of selective editing applied to the Bank of Italy's annual survey on industrial firms. A more efficient data processing and a reduced total respondent burden are the gains from the new approach. Moreover, highlighting the most influential observations can help in the interpretation of the survey results.

Keywords: Efficiency, Respondent burden, Score function, Significance, Survey costs.

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A financial information system for India: data warehousing approach

Background Paper

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Introduction

Building of an appropriate infrastructure for collecting, processing, analyzing and acting on information spells the very essence of success in the business world of today. Information, when converted into knowledge through analysis and accumulated learning, help decision makers, whether in government or business, to evaluate uncertainty and anticipate events. In the knowledge-based society of the present day, expectation formed on the basis of information is a key component of decision-making process. The advancement in information technology has made it possible to capture and access a variety of information and undertake complex analysis to discover dependencies and understand evolving scenario in the market economy.

The economic agents operating in the financial sector, as compared to their counterparts in the real sector, act on market information with much shorter response-time lag and are typically expectation driven. Thus availability of timely and accurate information is of critical importance to such agents. In spite of explosive growth in information dissemination, the global financial market has encountered a number of crises in the recent period, to some extent due to insufficient or inaccurate information. It is said that the crisis in Mexico during 1994-95 was caused partly on account of insufficient information about financial sector developments taking place in the debt market. The most recent Southeast Asian crisis has also underscored the need for reliable and timely information on financial markets. Taking cognizance of this need, the IMF has prescribed standards for dissemination of data as a part of Special Data Dissemination Standard (SDDS), and thereby has reemphasized the principle that disclosure norms, transparency and accuracy aspects should form an integral part of a sound system of financial data dissemination.

The advancements in information technology and availability of sophisticated analytical tools in user-friendly packages have brought about far reaching changes in information management infrastructure. In recent years the trend has been to create a fully integrated enterprise-wide data base management system making use of relational and multidimensional database management systems, client/server architecture, metadata modeling and repositories, graphical user interfaces and web. Such an integrated database management system provides the capability for on-line analytical processing of data and for structured and unstructured querying and hence meets the information and analytical requirement of various levels of decision-makers in a user-friendly environment of data warehousing. It is an endeavour of modern organizations to develop data warehouses to take advantage of immense capabilities of information technology and data mining for informed decision-making and thereby improve efficiency.

In the recent years the Reserve Bank of India (RBI) has taken a number of steps to make available a variety of data on financial sector to the users to have greater transparency. These data are available in the Bank's publications and web site on the Internet. The next step is to build a repository of data with facilities of on-line analytical processing and decision support. This will be a single source of data collected by RBI along with external data required to provide analytical content and facilities to the users. The objective of this paper is to set out the problems in the context of

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subject orientation required for building this data warehouse, christened as the Central Database Management System (CDBMS). This objective will be served well if the paper evokes response from users through discussions and suggestions by way of inclusion of new information to make the analytical content of the data warehouse as rich as possible.

The remainder of the paper is organized as follows. In section I we briefly review the existing information system in the financial sector with a view to understanding its effectiveness as a decision support infrastructure. In section II we discuss the basic features of the data warehousing technology that will provide the foundation of the proposed CDBMS. In section III some of the subject areas to be dealt with in the proposed warehouse are discussed.

Section I

The Financial Sector and Financial Statistics

The financial sector or the "Financial Corporations" sector as per SNA 93 terminology consists of resident corporations or quasi-corporations principally engaged in financial intermediation or in auxiliary financial activities, which are closely related to financial intermediation. By financial intermediation we refer to the activities of incurring liabilities by intermediaries on their own account to raise fund for the purpose of lending or acquiring securities or other financial assets. Banks overwhelmingly dominate financial intermediaries, which also include the central bank and other non-bank financial companies. Financial auxiliaries include brokers and foreign exchange dealers.

The Manual on Monetary and Financial Statistics of the IMF has identified the balance sheets and transaction accounts of the sectors and sub-sectors as the basis for construction of monetary and financial statistics. Thus data pertaining to financial sector are mainly of two types, namely transactional data and positions or as-on-date data. While transactional data are primarily required for measurement of activity, the bulk of financial sector data are of snapshot types giving balance sheet positions of the sector and its different sub-sectors. The general practice is to use the change in the outstanding position in a financial instrument as a proxy for a transaction, although such a practice sometime may be misleading because of revaluations, write-offs etc. Financial instruments are essentially financial contracts between institutional units, created through a formal or implicit agreement between contacting units that defines a creditor/debtor relationship or an ownership relationship (equity) between the units. These cover currency, deposits, loans, financial leases, derivatives guarantees etc.

For the purpose of collection, compilation, aggregation and presentation of financial sector statistics, the general principle is to classify transactional or balances data on the basis of one or more attributes, like type of instruments involved, institutions, currency, country, maturity type (short-term or long-term), category of market (primary or secondary) etc. Spatial attributes are also considered as basis for classification for certain categories of data.

A Review of existing information system in India

The existing information system for the financial sector can best be described as a legacy system that has evolved more as a response to the growing and varied requirement of data by regulators and to some extent by the financial institutions themselves. As a result the system has grown somewhat in an uncoordinated fashion, leading to a situation where there is no dearth of data but it cannot be ensured that policy makers and analytical users get right data at right time.

The main agency for collection and dissemination of financial and banking statistics is RBI. It is to the credit of RBI that India is one of the few developing countries that can boast of having continuous time series for a very long period on a wide range of monetary and banking statistics of a very high quality. This has happened because RBI itself is also a major user of these data by virtue of the fact that it formulates monetary and exchange rate policy and supervises banks. The data collected, compiled and published by RBI cover not only areas of money and banking, but also developments in money market, capital market, external payments, term lending market, and developments relating to prudential aspects of the institutions. RBI has an elaborate mechanism to collect, process and publish these data. There are a number of regular RBI publications right from the 1940s providing continuous data series on many of these areas. A list of these publications is given in Appendix. RBI also sets up committees from time to time to look into concepts and definitions and other aspects of collection and dissemination of data. Reports of these committees are rich

sources of metadata for many of the important data series. The Working Group Report on " Money Supply: Analytics and Methodology of Compilation" and the Technical Group Report on "External Debt" are the latest examples in this regard.

Thematic and definitional integration Issues

One of the major problem of the existing information system that the analytical users face is the lack of integration among multiplicity of sources for same or similar data items. Since each source follows its own definition to reflect the specific purpose for which data are collected there could also be serious problem in lack of definitional compatibility among various data sources. As the current paper-based system of data dissemination does not allow a seamless integration of metadata with data, users are not always well informed about the implications of such definitional peculiarities.

Let us consider the example of monetary aggregates, which are at the heart of the monetary survey of RBI data system. The monetary aggregates presently compiled by RBI are reserve money, M1, M2, M3 and M4. Reserve money is a weekly series which measures the creation of reserve money in the form of currency circulation, bankers deposit with RBI and sources of Reserve money creation classified as RBI's credit to Government (net), commercial and co-operative banks, NABARD, commercial sector and RBI's accumulation of net foreign exchange assets, Government's currency liabilities to the public net of other non-monetary liabilities.

The components of M1 (narrow money) include currency with public, demand deposits with banks and other deposits with RBI. M3, broad money, includes all the components of M1 plus time deposits with banks. Sources of M3 include net bank credit to Government, bank credit to commercial sector, and net foreign exchange assets of banking sector and Government's currency liability to the public net of banking sector's net non-monetary liabilities.

If we consider the generic item "currency" we observe three closely similar concepts- "notes in circulation", "currency in circulation" and "currency with public". The present system does not automatically inform the users that three closely related concepts represent liabilities in the form of notes and coins of three related sectors namely RBI, RBI plus Government and the banking sector plus Government respectively. Let us take another data item like "bank credit to commercial sector". The data on this item is available in statistics of monetary aggregates as well as in various other RBI publications giving outstanding credit data or data on "loans and advances" compiled from bank's balance sheets. Although all these items can be generically defined as "credit" there are subtle definitional and coverage differences (like "gross" vs. "net" credit) among the similar sounding data items published in different sources. Although it may not be feasible or even desirable to do away with these definitional peculiarities as each definition has its own use, the users should be able to get one long-term consistent and compatible series based on any definition that has the most important analytical usage. Another important deficiency of the present system is that the relationship of different data items is not very transparent to the users of data. For example for a given as-on-date, all data items are inexorably related to some parts of the balance sheet and it should be possible to clearly bring out the hierarchical relationship among the different components of a broad data item like "advances, bill discounted etc."

RBI has been the primary source of information on government securities. RBI publishes information of auctions of government securities, both dated securities and treasury bills, as also of repos regularly giving details of the notified amount of issues, the cut-off yield/price, the development, if any, weighted average yield/price at the cut-off price, and maturity patterns. RBI has also been disseminating daily information on prices and yields and face value of all government securities in the secondary market reflecting those transactions that are undertaken through the Subsidiary General Ledger (SGL) account maintained at the RBI. Information on money market operations in India on treasury bills, as also on other instruments such as Commercial Paper, Certificates of Deposit, term money and inter-bank call money are available on daily basis from RBI's press release and publications. Foreign exchange rates, turnover in forex markets and sales and purchase of foreign exchange, both in spot and forward segments – RBI publishes all these data regularly. Thus there is no doubt about the richness of the data made available to the general public about the gilt market, money market and forex market. But to an analytical user what is important is whether this mass of data can be meaningfully related to various central themes of analysis relevant for these markets like term structure of interest rate, yield curve analysis, changes in the risk premium etc. To give an example, "Redemption Yield(s)" on dated government securities is published security-wise for some broad maturity brackets. It is not possible under the given technology to enable users work out the average yield for finer maturity brackets readily from the published data. If users have to examine any shift in the yield curve that has been taking place in the gilt market he has to first grapple with the onerous problem of collating relevant data from a number of issues of RBI

bulletin, find out the compatibility of available data in various issues and then get into his real work of analyzing data.

RBI publishes a comprehensive and wide range of banking statistics giving a very detailed profile of commercial banks' activities, based on a set of returns known as Basic Statistical Returns (BSR). RBI introduced the first two BSR returns (BSR 1 and BSR2) in 1972 on a half-yearly basis. Until 1989, all commercial bank branches submitted these returns twice a year- as on the last Friday of June and December – and effective from March 1990, on an annual basis – as on March 31 of each year. The BSR system is unique in the sense that through one set of returns it is possible to get: (a) spatial (by region /state / district and center), (b) institutional (by public /private /foreign banks) and (c) purpose wise distribution of two major banking variables, namely deposit and credit. Although RBI publishes a great many details based on these two returns, it cannot be said that the full potential for analytical use of this rich source of data is currently exploited. This is mainly due to non-existence of direct access of users to the database. As the present emphasis is on generating standard reports and publishing them in paper form, the end users are constrained to dovetail their analysis with the format of standardized reports. A different view of the data cannot be generated, as the users do not exercise any control over the reporting format.

RBI is also the primary source of major components of the balance of payment statistics, which consists of all economic transactions entered into by the residents of a country with the rest of the world during a particular period of time. The system of collection, compilation and publication of data on BoP is guided by the 5th edition of Balance of Payments Manual of IMF, which is harmonized with SNA93. In the interest of the users and to bring greater transparency in the external sector transactions, RBI has started publishing a number of details on various aspects of balance of payments transactions. This includes detailed data on external assistance, commercial borrowing, NRI deposits, foreign investment, both direct and portfolio etc. Notwithstanding recent availability of such rich details, users cannot get a user defined disaggregated view of data along some meaningful dimension readily, because of present mode of storage of and access to data. If a user is interested in getting country wise details of merchandise credit or debit from the published aggregate, the present technology does not permit him to do so.

The above quick overview of the present state of affair in respect of the Information System of India's Financial Sector reveals the following important deficiencies which merits serious attention on the part of data providers: -

1. In terms of richness of contents, depth and breadth of coverage and availability of timely data, Indian financial sector stands in a comparable status as that of any developed country. However, much of these data are in the form of legacy databases, published in a variety of paper-based publications. There is a serious problem of conceptual and statistical integration of data available in different publications. This undermines its utility for serious economic analysis without a substantial data collating effort on the part of the analyzers.
2. There is no readily accessible metadata for the end users. Users cannot get to know readily the concepts and methodologies underlying the data. There is no central catalogue, which provides one-point interface to all the data.
3. The users' access to data is restricted to the standard reports that the data providers decide to supply and the system is not optimized for generating user defined view of data on an on-line basis.

In other words, what we have currently is a passive un-intelligent database system that is not capable of presenting a view of itself as per requirement of individual users. The system is not oriented towards providing an analytical perspective to the subject areas that the available data are supposed to represent. The present system thus cannot become the foundation for an intelligent knowledge management system that understands users' diverse needs, provides information and not merely data by intelligently conceptualizing data and helps users to transform information into knowledge. The current requirement is to provide an intelligent information system that becomes an organic part of decision-making process for the sector.

Fortunately we are now in a technological milieu that allows us even to think of building an intelligent information system which becomes an integral part of knowledge management system, not only for one financial institution but for the sector as a whole. In the next section we present a blueprint of our vision of building an intelligent information system for India's financial sector and an account of the major initiative that RBI has started towards this direction.

Section II

Data Warehousing Approach

The above enumerated deficiencies of the existing financial information system for India is neither unique to the financial sector nor to this country. With the evolution of technology the data management architecture has undergone radical changes in phases and the existing legacy systems are but reflections of this evolving process. As the computerization of operational information systems progressed, each one was considered on its own term without any regard to its integration and compatibility with other operational information systems. As a result a collection of separate islands of information have come into existence in most of the financial institutions including RBI. That there is a pressing need for providing some integrated and temporally consistent view of trends and patterns in the available mass of data is obvious from the growing demand of services of information providers like CMIE, Data-stream etc. In fact RBI itself from time to time bring out compendiums to meet such needs of data users. One recent example is the publication titled "Statistical Database of the Indian economy".

Definition – A Data warehouse is a state of the art system of database management dedicated to discovery of knowledge. This process of discovery is made possible by organizing data from different operational information systems in an integrated manner within the overall architecture of a well articulated data model, possibly a relational database model. It may be noted here that relational databases were themselves not developed to provide a synthetic view of enterprise wide data and in fact were not optimized for end users' direct access and use. Recent technological breakthroughs such as multidimensional database engines, various flavours of On-Line Analytical Processing (OLAP) tools, client/server architecture, web publishing tools etc have made it possible to conceive of and build an integrated data repository which allows users quick and multi faceted access to this repository.

Data warehouse, in the words of Bill Inmon, considered to be the father of the concept, is a data repository which has the following attributes. It is (a) subject oriented, (b) integrated and consistent across the system, (c) time stamped and (d) non-volatile. These four important features are elaborated further below.

a) *Subject-orientation* – This is the most important feature that will distinguish a Data warehouse data from any conventional databases. This term signifies that data will be made available to users through a thematic structure. As the books in a modern library are organized according to various subject areas, similarly data in a data warehouse would be organized subject-wise for retrieval and further analytical processing. To illustrate, all relevant data on money market operations or the FOREX market will be available to the users/analysts without requiring any programming effort on the part of users. Each subject can be considered as a customized window to the central repository of data through which users can access the data most relevant to them. This, however, would not mean that users couldn't transcend the subjects that the builder of the warehouse in his or her wisdom has decided to provide in the warehouse. The subject orientation only takes away the burden of collating related information from the end user.
b) *Integration* – This means that the same item will have the same meaning to any user of the warehouse irrespective of the time of access to the repository. There will be consistency in terms of definition as well as in terms of usage of notation across all databases in the warehouse.
c) *Time-stamped* – This means that data on most of the items will have time as an important attribute. The users' need for compatible and consistent time series data will be met by CDBMS, to the extent possible.
d) Data available from the warehouse will be having some finality about it. Data will be carefully assembled from a variety of information sources, cleaned up, quality assured and then loaded in the central repository. In this sense data in the data warehouse will be different from raw transactional data.

Another most important feature of the warehouse would be the presence of a comprehensive electronic catalogue called metadata associated intrinsically with the data in the data warehouse. Metadata is nothing but data about data. It will help users to get an easy to understand perspective of the nature of information held in the data warehouse.

The warehouse is designed to be web enabled. This will ensure that users need not be burdened with any costly software on their desktop to access the warehouse, provided they have the neces-

sary access authorization. Through Internet technology public domain data will be made available to anybody at anywhere and any time basis.

Special Data Dissemination Standards of IMF and Data Warehouse

The data warehouse initiative will go a long way to meet the requirements of the special data dissemination standards (SDDS) of IMF. Under SDDS four dimensions of data dissemination standards have been identified, namely

1. The data: coverage, periodicity and timeliness;
2. Access by the public;
3. Integrity of the disseminated data; and
4. Quality of the disseminated data.

As we have already explained the discipline of data warehousing technology will ensure adherence to standards at items no 3 and 4. As regards standard at item no 1, the warehouse will at least make it totally transparent through its extensive metadata. The web enablement will take care of item no 2.

Given the basic architecture of the warehouse, as explained above, the most important issue that needs to be discussed is the nature of subjects to be incorporated in the warehouse. The success of the warehouse will depend critically on how best the analytical requirement of the decision makers and other users have been understood and modeled. In the next section a tentative proposal is mooted for discussion and feedbacks received from various group of users will be of utmost help to the builders of the proposed warehouse.

Section III

Identification of subject areas- main issues

Among the users of financial sector data we can readily identify two major groups, namely market analysts and macro-economic analysts. The former type includes business analysts focused to a specific segment of the financial sector, analysts with regulating authorities, entrusted with the job of regulating a particular type of financial institution and market participants themselves. The later type includes policy researchers, policy makers and academic researchers also. While the data and analytical needs of the former group are more focused, predictable and well structured, those of the later group are more wide ranging and unstructured. The latter kind of users should be able to get whatever data they want out of the warehouse by navigating the metadata catalogue and selecting a customized subset of the central data repository according to his or her analytical needs. To help such users locate the right data, a very powerful search engine needs to be provided so that users can get to know the availability of any specific data by keying relevant keywords. The users can then download such data to his or her desktop and undertake further analysis as per his requirement. But warehouse will not be a mere provider, albeit an intelligent one, of information; it will help analysts to cut through the labyrinth of the huge mountain of data with built in analytics required for decision making. For this we require to construct a thematic structure and weave the mass of data and associated analytics around this. Each theme or subject will define what is generally called a data mart, which will consist of a carefully chosen subset of central repository of data.

The issue of bringing subject orientation in a financial sector database can be approached from three, not necessarily independent, perspectives. Thus data in a data mart can be organized according to: a) institutional attributes of units to which data are related, b) instrumental attribute of data elements as large mass of financial data will reflect volume or rate property of some financial instruments and, finally, c) market attribute encompassing features of both the previous attributes. Each of these approaches of data organization will provide a specific analytical framework for data access and analysis. It needs to be emphasized here that independent data marts can be constructed based on all or any of the three approaches in a mutually non-exclusive way, as all of them will be derived from the central data repository.

In the recent period, as a part of financial sector reforms, the stance of policy measures has been to develop and deepen money, foreign exchange and government securities markets and direct indirect instruments of monetary policy such as repos, auctions, open market operations, refinance facilities to provide liquidity to influence these markets. In this paper we take market approach to specify data requirement as raw material to help users develop framework for on line analytical

processing through accessing the RBI web site. However, the basic data to be made available through this process can be analyzed in different ways as per convenience and approach of the user as data warehouse is expected to provide this flexibility.

Proposed modules

Macroeconomic Environment Data Module

Optimization of a well articulated social objective function with due regard to the underlying structural constraints defines the business of economic policy making. The immediate concern of a policy maker delineates the relevant objective function and associated target variables. The historical trajectory of these variables along with that of selected structural/control variables, when presented on-line with interactive graphics will be of great help to policy makers and model builders too. This module will provide policy makers and model builders historical information on all possible macro variables that are required to formulate or analyze financial sector policies at macro level like monetary policy, exchange rate policy, interest rate policy and so forth.

Building of an analytical framework for organization of macro-economic data for the financial sector must begin with the recognition of the primary concern of monetary policy formulation – which is maintenance of internal and external value of domestic currency or price stability. It is, therefore, necessary to understand the mechanism of price formation and the role of financial factors in that. The data on price indices, output indices, imports and exports of commodities at detailed level is expected to help in understanding of dynamics of inflation.

The analytical framework must also take into account the requirement of data for analysis of the business cycle since one of the prime policy concerns is to bring about structural adjustment required for long-term growth of the economy and stabilize short-term fluctuations. The pursuit of monetary policy formulation also requires a deep understanding of the transmission mechanism of monetary policy impulses.

The contour of the framework as outlined above will determine with what variables and at what level of details the proposed data mart will be populated. For example it is evident that over and above data on the quantity and price of money and price of goods and services the data mart must contain data on revenue and expenditure of government, domestic output, external trade, investment, saving, credit, stock prices, wages etc. all of which are intricately related with the business cycle.

Money Market Module

The instruments transacted in the money market have the maturity of one year or less at the time of their issue. While the largest part of the market deals with fund in the form of money balances (i.e. call money market) trading in the rest of the market takes place through short-term debt instruments. These instruments include treasury bills, certificates of deposits, commercial paper, commercial bills etc. These are convenient instruments for liquidity management by financial as well as non-financial corporate entities who actively participate in this market to even out short-term mismatches of supply and demand of funds. This market is primarily a wholesale market, participants being banks, large financial institutions, primary dealers, large non-bank financial corporations, money-market mutual funds, large non-financial corporations and the RBI.

In a non-administered interest rate regime, existence of a broad based and deep money market is said to provide enabling conditions for smooth conduct of monetary policy. This is so because a central bank generally operates at the shorter end of the maturity spectrum of the market for financial instruments and thereby expects to affect the entire term structure of interest. As the economy becomes more market oriented and different segments of financial market gets integrated, the developments in the money market lead to sympathetic developments, contemporaneously or with some time-lag, in other markets like foreign exchange market, capital market and debt market. A close surveillance of the developments in this market is, therefore, of paramount importance to the RBI.

In its endeavour to broad-base and deepen the money market, the RBI has been taking a number of steps since the mid eighties. In the recent period measures like introduction of rupee derivatives, like interest rate swaps and floating rate agreements, allowing participation of a large number of non-bank entities into the repo market etc., have been directed towards deepening this market.

The operations in the money market have of late become more transparent with the availability of various details on inflows and outflows by type of instrument, call rate, maturity period, spot

and forward rate, details of auctions, cut-off price, devolvement, outstanding position, term structure, repo transactions, secondary market transactions etc. In addition data on inter-bank borrowing rate are available from Reuters. In the monetary policy of 29 October 1999 it has been announced to release call-market transactions rate data to improve transparency.

However, there is still a need for certain more transactional data for effective policy formulation. Thus, it is necessary to capture data on inter-bank trade in money market on own account and on behalf of other participants to identify and assess the sources of pressure in the market. At present these data are collected through a reporting system, which covers only major transactions. In the course of time with the setting up of an on-line clearing system it will be possible to collect data which will allow analysis of price and volume of transactions by seller and buyer. This will help in better understanding of the transmission channel of money market operations.

The data on the money market have to be correlated with data on other financial markets like gilt market so that it facilitates analysis of the term structure of interest rates in its totality and the effect of demand and supply pressure in various markets on the overall term structure. Graphical user interface will be built for different types of transactions, both in terms of volume and rate. It must be however mentioned that not all data will be made available to every user. Depending on its likely impact on expectation formation some data may be made available only with a policy determined time lag for different classes of users. It will also be possible to provide a rich collection of user-friendly tools for undertaking standard analysis like yield curve analysis etc.

Capital Market Module

The capital market has two main functions: (1) It equilibrates the demand and supply of long term finances of investors and savers and (2) it provides flexibility to both investors and savers to unload their financial assets and liabilities at a price determined by the market. In the primary market transactions take place for new issues and in the secondary market existing instruments are traded. The health of the primary market depends critically on the functioning of the secondary market. The yield, liquidity and volatility in the secondary market have an important bearing on participation in the primary market. The prices ruling in the secondary market give signals to the issuer of security as to how the investors perceive their effort at using the fund raised in the market and what is their prospect for raising additional funds for expanding business. The impulses generated in the secondary market influence the entire investment climate, including operations of banks and financial institutions.

The capital market in India is very large with high volume of transaction of a large number of companies registered at various stock exchanges. The liberalization of foreign institutional investment in the stock market and development of mutual funds have provided the depth, spread and sophistication for investment. The Securities and Exchange Board of India, Stock Exchanges, brokers and dealers, underwriters are the primary sources of data on capital market.

The Reserve Bank analyses annual accounts of a large number of companies to provide information on income, expenditure, balance sheet structure, sources and uses of funds, and certain other aspects such as imports, exports etc. of companies. Based on this analysis RBI estimates the saving investment gap for the non-financial corporate sector. This estimate provides a very important clue to the policy makers about the demand for fund that is likely to emanate from this deficit sector. The resulting impact on long-term interest rate and other rate variables in different segments of the financial market can then be analyzed and appropriate policy responses can be formulated. Results of such analysis along with data on various other aspects of capital market operations will give an integrated picture of factors affecting price formation in the capital market and the signals it gives and receives from other markets. The transparency in the operations of companies as reflected in these data will help in increasing efficiency in the operation of the capital market and thereby creating a better investment climate.

External Sector Module

For a close and insular economy, developments in other national economies are of much lesser importance as compared to those in domestic sector and requirements for international economic data also go down in priority. However, for an economy that is opening up and getting globalised and integrated with the international economy, data pertaining to the external sector are of critical importance to policy makers.

As the financial sector is getting more quickly integrated with the rest of the world because of technology as well as policy measures adopted in recent years, external data needs for the policy makers as well as economic agents operating in this sector are more pressing. It needs to be also understood that some important variables for the external sector like exchange rates are extremely

volatile and available at a high frequency on a real time basis. In fact, since the breakdown of the Bretton Woods system in the early 1970s the international financial system has been in constant flux. The transaction in international currency and flow of funds across national borders has been growing at an exponential rate, increasing in its wake risks and uncertainties, which at times cause acute payment and banking crises in vulnerable domestic economies. In an integrated global economic system, such a crisis in one part of the world economy has an immediate contagion effect on the rest of the world economies. The most recent example of this is the turbulence witnessed in the Southeast Asian financial markets. It is therefore of utmost importance to the policy makers that developments in international markets are constantly watched, monitored and any signals emerging anywhere in the world market are quickly captured, analyzed and reported. It is expected that a technology like data warehousing will go a long way to meet such information requirement on the part of policy makers.

In order to build an analytical framework for organizing external sector data for use by the policy makers and analysts, we have to take into accounts various possible ways to model exchange rate dynamics and other determinants of the external sector balance for a small open economy like ours. The accounting framework for the external sector balance is available from the balance of payment statement and the national accounts statistics, both of which must find a place in this module. There are many domestic economic factors like domestic interest rates, the domestic inflation rate, the level of domestic absorption, the interest rate differential, the maturity profile of international debt of domestic agents including banks and government, the level of foreign exchange reserve etc. that affect the demand and supply conditions in the foreign exchange market. All such data, stated to reflect economic fundamentals, must be included, in an analytically tractable form, in this module.

As the exchange rate channel is one of the possible channels of transmission of effects of monetary policy under a flexible exchange rate regime, data on market expected future exchange rate as reflected in various derivative products like futures, forward rate agreements also needs to be constantly monitored. It will be also an endeavour on the part of the warehouse builders to provide enough analytical capability in this module to help decision makers identify the speculative element in the exchange rate movement as opposed to the one driven by economic fundamentals. Apart from these variables, this module should include certain standard variables that measure various aspects of the exchange rate market like nominal effective exchange rate, real effective exchange rate, purchasing power parity index and so on.

It needs to be understood here that many of the above data series have to be culled from a variety of data sources – national and international – and integration of these data through a common definitional metadata architecture will pose a formidable challenge to the warehouse builders. It will require close coordination among various data generating and providing agencies to build this module effectively. Use of web-based technologies may be of great help in this regard.

Module on Banking Sector

The RBI is entrusted with the sole responsibility of regulation and supervision of banks under the provision of various regulatory enactments. Flowing from the powers vested with it, RBI collects a variety of information on the whole gamut of operations of banks and other financial institutions through returns some of which are statutory in nature. A great deal of information that is collected is meant for internal use of RBI and the proposed warehouse will structure them accordingly. In other words, they will address to the supervisory concern of the RBI and not accessible to anybody outside the supervisory orbit. However, there are also a large body of information about the credit deployment pattern of the banking sector, composition of ownership of deposit, about health and functioning of the banking sector etc. that will be of abiding interest to analysts and decision makers in related areas. We have identified two such subject areas, discussed below, that will be a part of the general module on the banking sector.

Bank Credit Market Module

The bank credit market in India is characterized by the presence of severe discontinuities in terms of spatial, institutional and sect oral distribution of credit. Historically, the RBI has played a stellar role, almost unique in the annals of central banking, in attenuating the effect of such discontinuities, by taking a highly pro-active developmental role in credit allocation decisions of the banking institutions. In the process a vast and unique credit information source has been created in India, which has no parallel in any country. We are referring here to the information treasure house available in the form of Basic Statistical Return (BSR) system submitted by each bank branch as on 31 March every year. RBI is collecting these data from 1972. Although there have been substantial

changes in the regulatory environment for credit deployment by the banking institutions in recent periods, the utility of this data source has far from diminished.

The BSR system gives data on distribution of bank credit by district, population group, i.e. rural, semi-urban, urban and metropolitan, industry group, bank group, interest rate range, type of account etc. The very nature of classification of the available data allows us to take a natural multi-dimensional view of the data and standard techniques of "on line analytical processing (OLAP)" like drilling down, drilling up and pivoting can provide very useful analytical insight into the dynamics of credit market and its role in the growth process. In particular the role of credit in the regional dimension of the growth process can be most effectively analyzed with this data. For example, one can find out which districts have been attracting high disbursement of credit and why. Likewise, the causes of low credit absorption by population group and region can be useful for devising policy for reversing the trend.

These are a number of other sources of information on bank credit. For example, credit given to corporate by financial institutions and banks are available in RBI company finances studies. Similarly, credit given to exporting units is also available in RBI. At the macro level, data on monetary aggregates give information on credit to public and private sectors. When these data are integrated under data warehousing and related with other variables they will give very useful insight on credit view of monetary policy and role of financial factors in economic development.

Module on Performance of Banking Institutions

The concern for health of the banking system of any country is not restricted to the supervisory authority at the national level only. At the international level also there is rapidly growing realization that smooth operation of the international financial system is crucially contingent upon the existence of a sound banking system at individual country level. As a result there is now a convergence of views among national supervisors about the need for having an internationally accepted framework for prudential norms for banks. One of the main features of this internationally accepted framework is the insistence of effective use of market discipline. This essentially means that banking institutions must subject themselves to an evaluation by market, through increased level of disclosure about their functioning and health. RBI also as a part of its effort to about structural reform in the Indian banking sector has been setting more and more stringent norms about transparency and disclosure norms for the banks functioning in India. This has resulted in making the annual balance sheet and profit and loss accounts into a veritable gold mine of information about the health of the banking sector

RBI has been regularly compiling information available in these annual accounting statements and publishing them in Statistical Tables Relating to Banks in India. A multi-dimensional view of these data will be made available through the proposed warehouse.

This module will also contain data on quality of assets of banks, composition of its liabilities in terms of maturity, profile of its non performing assets etc. These data will provide important insight about the state of health, risk profile of assets, profitability etc. of banks. A multivariate analysis of these data will help in identifying factors that determine a bank's performance, in revealing incipient weakness of a bank in terms of its ability to withstand future market volatility, in ranking them on a composite scale and in suggesting policy imperatives required to improve their financial health.

Data gaps

In this paper we have made some suggestions about the information architecture for the proposed data warehouse for RBI. This architecture is designed mostly with currently available data in view. A data warehouse architecture should, however, be flexible enough to accommodate new data needs as and when such needs arise. In an emerging market like India pace of financial innovations are accelerating due to globalization and deregulation of financial markets. New instruments and new institutions are regularly emerging in the financial market. There is increasing demand for information on such new instruments and institutions. Supervisory concerns of the regulators are also undergoing changes due to changes in the operating environment of the financial entities. For example data on international exposure of banks and on cross border flow of funds are hardly collected on a systematic and regular basis. Recognizing this data gap, RBI is in the process of putting into a place a data collection and monitoring system for such data items. There is also need to collect, compile and disseminate data on many new instruments like interest rate swaps, forward rate agreements, private placements of corporate debts etc. The coverage of current financial statistics in respect of informal markets are also rather poor and the estimate of value added available from national accounts statistics from this segment of the financial sector can at best be termed as a

guesstimate. In fact, the discipline of data warehousing technology will help us in revealing a number of such gaps, deficiencies, definitional incompatibility, insufficient coverage etc. of the existing database.

A data warehouse is constructed to meet the data needs of users who could be decision makers, analysts and policy researchers. While building a large econometric model also researchers are able to identify various data gaps that exist in the existing information dissemination standard. Articulation of such felt data needs and identification of existing data gaps will be of immense help to those engaged in building the warehouse.

Common open standards for the exchange and sharing of socio-economic data and metadata: the SDMX Initiative

Paul van den Bergh (BIS)

I. Introduction

> "The BIS, ECB, EUROSTAT, IMF, OECD, and UN have joined together to focus on business practices in the field of statistical information that would allow more efficient processes for exchange and sharing of data and metadata within the current scope of our collective activities. The goal is to explore common e-standards and ongoing standardization activities that could allow us to gain efficiency and avoid duplication of effort in our own work and possibly for the work of others in the field of statistical information."

This quotation is from the statement that was distributed prior to a Workshop on Statistical Data and Metadata Exchange that was sponsored by the above institutions and held at the International Monetary Fund in Washington, D.C. on September 6–7, 2001. More than 100 participants from all regions of the world attended the meeting. At the concluding session of the workshop the participants recommended that the sponsoring institutions lead an international endeavor resulting in the creation of the standards envisaged in the quoted statement.

Immediately following the September workshop, the sponsoring institutions met to initiate the process of creating a framework to respond to the recommendations made at the workshop. They agreed to formalize a task force to address Statistical Data and Metadata exchange (SDMX).

Part II. of this paper provides an historical perspective for SDMX. Part III. identifies the growing need to exchange data and metadata. Part IV. sketches the requirements for exchange standards, while Part V. identifies the relevant technologies. Part VI. suggests how a standards creation process may be organized.

II. A brief history of standards

International attention to the topic of standardized cross-national statistics dates back at least to the League of Nations, which held the International Conference Relating to Economic Statistics in 1928. In the post WW II period, standardization was carried forward with the issuance of *Measurement of National Income and the Construction of Social Accounts* by the United Nations in 1947 and the Balance of Payments Manual by the International Monetary Fund in 1948. These documents provided standard definitions of statistical concepts, and work on these and a variety of other statistical topics has continued to the present.

The advent of commercial computing in 1953 led to the development of internal standards for coding statistical data. However, it was the advent of inexpensive electronic communications in the last quarter of the twentieth century that led to the development of standards for electronic exchange of information. This occurred first in the commercial world with the Sabre airlines reservations system and the SWIFT network for banking transactions.[1] The public sector stepped into the arena with the publication of the "Guidelines for Trade Data Interchange" (GTDI) by the UN/ECE in 1981, which led to ISO 9735 Electronic Data Interchange for Administration, Commerce and Transport (EDIFACT) syntax rules published in 1988.

1 *The truly pioneering Sabre system went on-line in 1960 and the Society for Worldwide Interbank Financial Telecommunication (SWIFT) initiated transactions in 1977.*
See www.sabre.com/about/index2.html?b=1&a=history and www.swift.com/index.cfm?item_id=1243.

In the early 1990s, the syntax for an EDIFACT message called Generic Statistical Message (GESMES) was developed. This led to the implementation of BOPSTA (a GESMES type message) in the mid-1990's by EUROSTAT, the IMF, and a limited number of their member countries. A new GESMES profile called GESMES/CB was introduced in 1998-99 by the Bank for International Settlements, the European Central Bank and EUROSTAT (and adopted by the IMF). By the turn of the millennium, electronic exchange of statistical data had become a standard business practice among these central agencies and their member countries.

While the above was taking place, an alternative to EDIFACT, which involved a different form of exchange, was also in the making. This part of the story begins with the issue of ISO 8879: *Information processing – text and office systems – Standard Generalized Markup Language (SGML)* in 1986. SGML was developed to address the difficulties of moving text into formatted (photocomposed) documents in a generalized and reusable manner. A derivative of SGML, called Hypertext Markup Language (HTML), was developed together with the World Wide Web (WWW) by scientists at CERN.[2]

HTML, a non-proprietary derivative of SGML, is used to control the layout of web pages on computer screens. HTML's strengths lie in its ability to format text, graphics, and links to other text etc. in an environment of overlapping pages on a computer screen and in its ease of use. It became, and remains, one of the driving technologies of the Internet.

As the amount of information on the web exploded, the need for a markup language that addressed the content of information embedded in text began to be recognized. To meet this need, the World Wide Web Consortium (W3C) created the Extensible Markup Language (XML) initiative in May of 1996. The result of this initiative was the publication of version one of XML in February of 1998.[3]

The power of XML is that it structures the information contained in text or associated with data and metadata.[4] This structure allows information to be found within the body of text without doing a full text search. It also allows the exchange of information in an unambiguous manner. The power of XML was quickly recognized by the information processing industry. Today XML products and standards abound.

III. The need for data and metadata

New needs for economic data on a cross-national basis coincided with the above history. The economics of general equilibrium and emergent Keynesian macroeconomics, which implied that whole economies could be managed, generated a need for macroeconomic data. In addition, the lessons of the great depression of the 1930's lead to the understanding that economies need to cooperate if a more stable world economy was to be achieved. These events also drove the development of statistical methodologies.[5] The need for increasing volumes of macroeconomic data that were definitionally comparable across economies became the conventional wisdom of national and international economic managers and market participants.

These events also defined the need for a new type of standardized information. This information consisted of comprehensive descriptions of who, what, where, when, and how national data are produced and disseminated.

An example of this new form of information about the data is the OECD *Quarterly National Accounts: A report on the sources and methods used by OECD Member Countries* (1979). The IMF began developing comprehensive frameworks for macroeconomic metadata for the Special Data Dissemination Standard (SDDS), which was established in 1996. This was followed by the introduction of the General Data Dissemination System (GDDS) in 1997. [6] EUROSTAT introduced Euro indicators, a collection of data and metadata covering the euro-zone and EU-15 in 1999, in the wake of the new European Monetary Union.[7] In early 2001, the Euro indicators were pulled together into a single web site, where metadata are shown in the SDDS format. Many countries have also developed their own web sites containing a mix of data and SDDS or GDDS metadata.

2 *HTML was used to create the original web site at CERN. The general release of the WWW on CERN computers occurred in May of 1991. See www.w3.org/History.html and public.web.cern.ch/Public/ACHIEVEMENTS/web.html.*

3 *See www.w3.org/Press/1998/XML10-REC.*

4 *See www.w3.org/XML/1999/XML-in-10-points for a summary of the basic concepts of XML..*

5 *A list of statistical methodologies is located at http://esa.un.org/unsd/progwork (see Methodological Publications in Statistics).*

6 *See dsbb.imf.org..*

7 *See europa.eu.int/comm/euroindicators..*

During the 1990's, the work undertaken within the UN/ECE work sessions on statistical metadata (METIS) produced a significant consensus on some conceptual issues and more specific guidelines, such as the "Guidelines for Statistical Metadata on the Internet". Statistical metadata were defined as "data which are needed for proper production and use of the data they inform about"; data describing statistical data and – to some extent – processes and tools involved in the production and usage of statistical data.[8]

Following the pattern for data, the newly developed sets of metadata are also being exchanged between and among national states, regional and international organizations, and the general public. The need for standardization of metadata exchanges is a logical outcome of the increasing need to exchange metadata.

IV. The scope of the SDMX initiative

The scope of SDMX initiative is, in general terms, the exchange of data and metadata within the collective activities of the SDMX organizations. Therefore, the activity is currently limited to the topical ground of socio-economic statistics. This section covers many of the core business issues relating to the exchange of this statistical information.

Business models for exchange

Two distinct paradigms for the exchange of statistical data and metadata have emerged. The first paradigm it that of direct exchange of files between parties who have made prior arrangements for the exchange. The second paradigm involves the placement of data/metadata on a web site that then can be selected by consumers using efficient tools and processes.

The first of these models may be described as the partner – hub model, named to describe the typical relation between the parties. In this model the partners all ship sets of data/metadata to a central collection authority (the hub). At a national state level, the partners are the economic units in an economy and the hub is a national authority responsible for the particular type of data/metadata being collected. At the international level the partners are member states and the hubs are international or supranational organizations such as the BIS, ECB, Eurostat, IMF, OECD and UN. In this model the principal responsibilities for the information producer are to prepare the data/metadata and to initiate the transaction. The data/metadata receiver is the more passive participant, waiting for the information to be sent.

The second exchange model has been described as the dissemination model. In this model a data/metadata producer places the information on a site that is accessible to data/metadata consumers. The consumers then access the site and read the information. In this model the transaction is initiated by the information consumers that pick and choose what data/metadata they want. With the advent of Internet technology, the site of choice has become a web site[9].

Many international organizations and national agencies already have on-line databases available to external users. Because the design and content of these databases vary enormously, there is wide variation in the ability of such on-line facilities to meet user requirements. Furthermore, the evolution of such databases and their creation by other agencies will mean that data will become even more accessible. This trend highlights the need for organizations to make metadata even more available. Unfortunately, experience to date is that the provision of metadata with data significantly lags the availability of data.

Both of these models will continue to be actively used. Each has clear advantages in specific contexts. The first is more suited where the data requirements of users are "stable" over long periods of time, the second where requirements are either ad hoc or subject to frequent change. The business requirements of both models need to be addressed.

In both models there is a need to design metadata content standards in parallel with the data exchange standards. Designing standards in this way would allow metadata to be used more effectively than is now possible to compare national methodological practices.[10]

8 *See UN Statistical Commission and UN/ECE publications "Guidelines for the Modeling of Statistical Data and Metadata", United Nations, Geneva, 1995 and "Guidelines for Statistical Metadata on the Internet", CES Statistical Standards and Studies, n° 52, Geneva, 2000..*

9 *A special case of the dissemination model is where data consumers poll a number of data producers for a specific piece of information that is needed.*

10 *See Developing a Common Understanding of Standard Metadata Components: A Statistical Glossary at http://www.unece.org/stats/documents/2002.03.metis.htm..*

Data and metadata models

One question that arises when speaking of standards for data and metadata exchange is whether data and metadata should be taken together in one standard. Alternatively, should different exchange standards be developed for data and metadata. In order to address this issue, we need begin to look at how data and metadata are used (i.e., the business models for data and metadata).

Pure data is barren. For example, the game scores 4 to 3 and 2 to 1 mean almost nothing until you identify the sport, the team names, and when the games were played. The data are 4, 3, 2, and 1. The metadata (information about the data) provided is that these data are game scores. The metadata needed for the data to be useful are the sport, team names, and dates. It would also help if it were explained that these were women's Olympic soccer (football) games.

The point of the example is that all data comes with a substantial amount of metadata, and that these data and metadata are inseparable. That is, neither is very useful without the other.

However, there is another type of metadata which can stand alone when separated from the data and make good sense.

Examples of this metadata are the information in the OECD's sources and methods publications and the information about national data systems of a country found on the IMF's Dissemination Standards Bulletin Board (DSBB). The information in these publications defines how data on a given topic may best be organized into a structure of component parts and how it is to be or was compiled. None of these publications contains any data.

Given that we have at least two different ways of approaching data and metadata, it appears that we may need two different standards for their exchange. One standard would describe data and its associated metadata. The second standard would describe metadata that resides in some form of catalog.

Time series and tabular data

There is yet another fundamental way to differentiate classes of data that are commonly used in socio-economic statistics. These classes are time series data and tabular data.

Working with data where each observation is associated with a particular span or point in time has its own set of problems. A time series is a collection of observations on the same phenomenon where all the time signatures are either points in time or spans of time. With time series you must deal with which type of time, points or spans, definitions of the calendar you are using, and social conventions applied to that calendar (e.g., what is the work week). Macroeconomic data are typically expressed in time series.

For tabular data one needs to define the dimensions of the matrix and the logic of the breakdowns along each dimension. Some of these dimensions may not be numeric (e.g., the race of the head of household or the existence of running water, electricity, indoor toilets, etc. in the household). Census data is typically presented in tabular form.

SDMX would begin with an attempt to develop common standards. However, the different approaches may follow different business rules and there may therefore be a need for separate models for data and metadata that are time series and data and metadata that are tabular.

V. The technologies of the standards

The title of this section uses the plural in both of its nouns. Earlier, the paper outlined the need for a number of standards. It is also the case that different standards are likely to use different technologies. Moreover, as technological innovation may be expected to continue to move forward, new standards will need to be developed in order to attain the advantages offered by the newer technologies. At present, there is a need to address at least two technologies that are applicable to statistical data and metadata exchange. These are the GESMES specifications of UN/EDIFACT and the Extensible Markup Language (XML) specification standard of the World Wide Web Consortium.

The technologies used need to comply with three technical principles. These are:

- the structure should be captured in a standard way so that it can be used by any tool or technology and not be dependent on a specific vendor's product;
- the structure should be described in a language that is extensible, allowing for additions as new information is created; and
- the language used to describe the structure should be independent of formatting and presentation features, thus allowing these features to be determined by each user.

EDIFACT

The EDIFACT technology facilitates the construction and interpretation of messages containing statistical data and associated metadata. EDIFACT is very compact and highly suitable for fully automated, repetitive data exchanges. These messages can be self-contained and logically complete. A perceived weakness of the EDIFACT message format is that it takes considerable effort to set up EDIFACT based exchanges, so that it is not well suited for ad hoc exchanges. It would also be unsuitable for exchanges that arise out of browsing a collection of web sites and picking up pieces of data here and there.

XML

XML is far less compact (though compression techniques may take care of this) but well supplied with commercially developed tools and more appropriate for data sharing over the web. XML is extensible, platform independent, and supports internationalization and localization[11]. XML-based messages are self-contained and logically complete; they can be human readable and they are also well suited for small ad hoc data exchanges.

VI. The standards creation process

The open process

The sponsors of the SDMX initiative endeavor to focus on the creation of common standards that will suit the needs, not only of themselves, but also of their member states and their data user communities. A general view is that there is a need to create an open and transparent process for participation of member states and data/metadata consumers in the development of the standards. However, the specifics of the implementation of this view are complex. They are still under discussion by the SDMX sponsors. As expressed in the literature on this topic, the idea of an open process centers on a few key principles.[12] They are as follows:

- all parties interested in engaging in the effort to create a given standard and willing to provide their own time and effort may participate;
- the cost of participation should be born by the participants;
- the cost of participation should be minimized to the extent that it is not a significant barrier to willing participants;
- the intellectual property developed by the process should be freely available for public use at no cost;
- the process should be governed by a formal democratic process; and
- the deliberations taking place within the process should be archived and publicly visible.

The SDMX initiative intends to use these ideas as guidelines for the process it intends to employ in facilitating the development of standards for data and metadata exchange. By doing so, it is expected that barriers to the sharing of the intellectual property developed by SDMX will be minimized. In addition, these ideas are intended to encourage the widest possible adoption and to encourage the marketplace to develop products that support usage of the standards created.

SDMX Work Program

This paper has suggested some important topics that could be within the scope of the SDMX initiative, in synergy with other already existing groups. These include the following:

- Time series data with metadata;
- Tabular data with metadata;
- Metadata catalogues, glossaries, dictionaries, etc.;
- Partner – hub exchange models;
- Dissemination exchange models;
- EDIFACT syntax based implementations; and
- XML syntax based implementations.

11 *See XML in 10 points at www.w3.org/XML/1999/XML-in-10-points.*

12 *See A Scalable Process for Information Standards at www.xml.com/pub/a/2001/01/17/oasisprocess.html..*

It was agreed at an early stage among the SDMX sponsors that the initiative would build, as much as possible, on existing data models and message structures. This, of course, is not an easy task. Different organizations have good reason to protect the investments they have already made. Existing working groups, task forces, and committees have their respective mandates and procedures to be respected and accommodated. The global setting adds complexities. Thus, a concrete work program, with assigned tasks, is still being discussed among the sponsors, as is a formal organizational structure.

In order to support its work program, SDMX has created is own web site www.sdmx.org and e-mail address SDMX@imf.org. This web site now includes all the presentations from the September SDMX Workshop and information about contacting SDMX partners. It is expected that the work on a number topics will be initiated in 2002. These activities will be announced on the web site together with any relevant mailing lists to keep their participants and observers informed.

SDMX solicits all statistical agencies and all persons involved in reporting to or using the data produced by these agencies, who have an interest in participating in any part of the work of SDMX, to contact SDMX at the above e-mail address and express their interests, business requirements and priorities.

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Discussion comments

Kenneth Coates (CEMLA)

Five papers were presented. The first speaker, *Mr. Clive Thorp* provided an illuminating summary of the Reserve Bank of New Zealand's data activities and challenges, in terms of its overall monetary policy goals and intermediate data strategies. The conceptual issues highlighted were primarily those of relevance, coverage and methodology, particularly in view of the changes in the instruments of monetary policy (it should be recalled that New Zealand was one of the first "inflation targeters"). Other background complications were present in the complexities of financial innovation, the financial interaction with non-residents, and structural changes in the economy. More practical constraints were represented by multiple reporting requirements from the bank to different international organizations, and efforts to reduce the reporting burden on local respondents.

The second paper, delivered by *Ms. Danica Lucic*, dealt with the daunting task faced by the newly created Central Bank of Bosnia and Herzegovina in gathering and reporting statistics in a country constituted by two separate political entities with individual government structures. Further complications arose from the prior circulation of various currencies. While work in monetary and financial statistics was well underway, there were problems in developing a data base from scratch in the specific area of the balance of payments, such as the lack of sanctions for non-reporting, poor coverage and quality in data surveys and sources, and tardiness. Among the proposals for development were a survey on foreign direct investment, improved source identification and a new customs form.

Ms. Paola Battipaglia, of the Bank of Italy, concluded the first part of the session by presenting a paper on selective editing. Survey data processing in its current form requires highly labor intensive editing, a large part of which has little impact on the final results. Selective editing, which reduces time and labor, seeks to single out only those "suspicious" items which may have significant impact. The methodology presented employs score functions and expansion weights to determine which these items may be. Its application to Bank of Italy's industrial survey has allowed for significant reduction in time and number of re-contacts. As a result, this methodology will be extended to other surveys.

Comments were led off by the discussant, Mr. Barman from the Reserve Bank of India, who in addition had submitted a most interesting background paper on the multi-dimensional organizational structure of Reserve Bank of India's data warehouse project, which in fact is already a successful reality.

Many members of the audience participated in the general discussion, offering instances of their experiences with similar problems and specific suggestions to overcome them, such as the use of trade partner information in the case of balance of payments statistics.

There were questions as to the kinds of data Central Banks should produce. Should they be strictly for purposes of implementing monetary policy? Or was there a public good component in them? Irrespective of the merits of each case, there was a consensus that, at least in most of the developing world, central banks were saddled with the production of data well beyond the immediate field of their monetary and financial responsibilities. An interesting discussion arose with respect to the use of information technology for survey sampling techniques, as opposed to an outright census, in view of the growing sophistication and accuracy of the former.

At the outset of the second part of the session, *Mr. Akira Mizusaki* from the Bank of Japan described the importance of electronic reporting as a time and labor saving innovation that had substantially reduced the delay between the date of publication of figures and the date the figures actually referred to. While in the case of Bank of Japan the reliability, security and confidentiality of data transmission was guaranteed by a closed network, the situation differed in the case of open electronic network transmissions. For such cases the adoption of standards for data transmission was required.

This was the topic of the final presentation, by *Mr. Paul van der Bergh* from the Bank for International Settlements. This paper summarized the advances among leading international financial institutions in agreeing on a common standard, GESMES-CB, and the advantages such a standard

represents for multiple data reporting requirements on responding central banks. It was generally felt that this is an area that will provide for much activity in the future.

In view of both the wide coverage of topics achieved, and the degree of audience participation obtained, Workshop A can be considered a success.

WORKSHOP B

Challenges to central bank statistical activities

Chair: Bart Meganck, *Director, Economic Statistics and Economic and Monetary Convergence, Eurostat*

Secretary: Gert Schnabel, *BIS*

Papers and presentations:

"The central bank of Tunisia statistics: methodology and compilation"
Rekaya Ben Youssef, *Bank of Tunisia* (Paper)

"The Centralised Securities Database"
Jean-Marc Israël, *ECB* (Paper)

"The mission of central bank statistics in the development of the information infrastructure in an open market-driven economy"
Józef Oleński, *National Bank of Poland* (Paper)

"Cooperation between central bank and national statistical office as prerequisite of statistics development in transitional economies"
Ekaterina Prokounina, *Bank of Russia* (Paper)

"Outsourcing central bank operational tasks to a national statistical office – the Swedish case study"
Jan Schüllerqvist, *Sveriges Riksbank*, and Anders Norrlid, *Statistics Sweden* (Paper)

"Steps toward international comparability in general economic statistics"
Richard Walton, *Bank of England* (Paper)

"Challenges facing a monetary union in cooperation in statistical activities; the case of the Eastern Caribbean Currency Union"
Gale Archibald, *Eastern Caribbean Central Bank* (Presentation)

"The role of Eurostat in the exchange of statistical knowledge between statistical offices and central banks: the CMFB experience"
Bart Meganck, *Eurostat* (Background paper)

The central bank of Tunisia statistics: methodology and compilation

Rekaya Ben Youssef (Bank of Tunisia)

Financial statistics worked out by the Central Bank of Tunisia represent an assessment instrument of the monetary policy. They are used as forecasting means as a basis for policy decision making.

Two kinds of statistics are compiled :

- statistics related to monetary, banks and credit;
- statistics related to external finance.

The first kind of statistics concern the situation of different lending institutions of the Tunisian financial system, the statistics related to monetary policy instruments and those related to financial system activity .

The Tunisian financial system is made of :

- the central bank;
- fourteen deposit banks with 859 branches;
- a postal cheques centre;
- five joint-venture banks;
- ten leasing companies;
- a postal savings centre;
- eight offshore banks;
- two merchant banks;
- three factoring companies;
- six collection companies.

The Central Bank of Tunisia proceeds every month to statistic drawing up of consolidated situations of deposit banks, development banks, leasing companies and non resident banks from accounting monthly situations conveyed to the central bank by each financial institution in accordance with banking regulations.

For each kind of those institutions, a sector-related situation is compiled at the assets level. All claims held up by the issuing institution vis-à-vis other financial institutions, the State and foreign countries are posted in assets. All commitments towards each of the agents mentioned above appear in liabilities.

Three situations are set up from consolidated sector-related statements elaborated for each of the categories of financial institutions enumerated above. It concerns the monetary system, the resident financial system and the overall financial system.

Worked out, statistics related to monetary policy instruments help us define aggregates concerning useful concepts to monetary analysis, notably in the framework of monetary policy, monetary programming and the adjustment of the central bank's intervention tools.

Statistics related to financial system activity are used by the central bank in its subsequent supervision of financial intermediation activity to control compliance with prudential norms.

The financial system, the public sector (ministries, boards, institutes, etc.) and the private sector, are the sources of information for data collected by the central bank.

The data asked for by the central bank are transmitted by on-line transmission through the national informatics network, dissemination on disks and dissemination on paper.

The second kind of statistics – statistics related to external finance – concerns items such as the flow of exchange and external payments, overall external position and the exchange rate.

The approach for the compilation of the balance of payments in the Central Bank of Tunisia is based on three steps:

- Drawing up the statement of financial settlement made between residents and non residents by taking into consideration the financial operations made by the central bank and those made by authorized intermediaries in the form of transfer in hard currency, movements of foreign accounts in convertible dinar and purchase and sale of foreign banknotes.

- Determining the value of operations without financial counterparts or without payments registered in the customs declarations and in the data fund of the National Institute of Statistics and by recourse to periodic surveys with economic agents, specialised bodies, embassies and other diplomatic missions in Tunisia.
- Adding the two results thus obtained by making the necessary adjustments.

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The Centralised Securities Database

Jean-Marc Israël [1] *(ECB)*

1. Introduction

The ideas developed here are under my own responsibility and do not represent a statement by the European Central Bank (ECB). Some of them were considered internally by the ECB/European System of Central Banks (ESCB); others were discussed with the BIS and in international fora such as the IMF Balance of Payments Committee (BOPCOM) or the Working Group on Securities Databases commissioned to work on the concept and practical aspects of a Global Securities Database (GSDB).

2. The business case for the CSDB

Securities represent the largest class of financial instruments in the euro area financial system. Excluding equities and shares/units issued by collective investment institutions, EUR 8 trillions worth of debt securities issued by euro area residents were outstanding at end-June 2002, an amount growing by some 7% a year. The gross issuance amount can exceed EUR 600 billion a month. Most of the outstanding amount issued by euro area residents (EUR 7 trillion) is denominated in euro. In addition to that, there are EUR 1 trillion of euro-denominated securities representing claims on non-residents of the euro area. Moreover, as securities represent about 20% of the aggregated Monetary Financial Institutions (MFI) balance sheet in the euro area, securities of various kinds are an important and fast-growing component of broad money.

Changes in the financial structure of the main economic sectors have prompted an increasing interest in securities statistics by central bankers, market regulators, macro- and micro-supervisors, and private banks. Developments in securities are of clear interest for financial stability, risk management, and operations (e.g. in connection with collateral). The ECB carries out formal analyses of developments closely related with securities issues, e.g. Monthly Bulletin articles on the financial structure of the euro area.[2] The scope of securities issues and trading in the euro area differs from that in the USA. It seems likely that they will grow as a source of financing.[3]

For borrowers, securities are an alternative to bank finance. Holders of financial assets may view bank deposits, negotiable instruments issued by banks and other securities as partial substitutes. Data on the outstanding amount of securities indicate the depth of capital markets. Information on securities issues in euro is relevant to assessment of the role of the euro in international financial markets.

In addition, due to cross-border trading/holdings in securities the importance of securities in the balance of payments (b.o.p.) and international investment position (i.i.p.) is immense. Related income has become the third largest component of current account transactions and ranks just behind services [4] in the euro area b.o.p. Their significance in money and banking statistics and the b.o.p., together with their importance as a source of finance for non-financial corporations, non-monetary financial institutions, and governments, gives securities a prominent place in the Monetary Union financial accounts (flow of funds statistics for the euro area as a whole economy).

It is the ECB's responsibility, under Article 5 of its Statute, to ensure that the statistics mentioned above, needed for the execution of its tasks, are harmonised where necessary and remain relevant and accurate as securities business evolves over time.

Securities present statistical difficulties. In the financial accounts tables currently published by the ECB, there is no sector breakdown of the holdings of securities. Thus, it is not possible to evaluate, for example, how far increasing debt of households and business is matched by holdings of financial assets.

1 *This paper was drafted with the assistance of Jose Faustino and Wolfgang Schwerdt. It has benefited from comments by Peter A. Bull, Peter Neudorfer, Rainer Widera (BIS) and Per Nymand-Andersen.*

2 *The ECB publishes aggregated information on Securities Issues according to a "short term approach".*

3 *Whereas, in the euro area, three-quarters of non-financial corporations' indebtedness are vis-à-vis banks in the euro area, this share is around a third in the USA, the remainder being securitised.*

4 *In 2001 for direct and portfolio investment income the credits were EUR 152.6 bn and the debits were EUR 184.3 bn.*

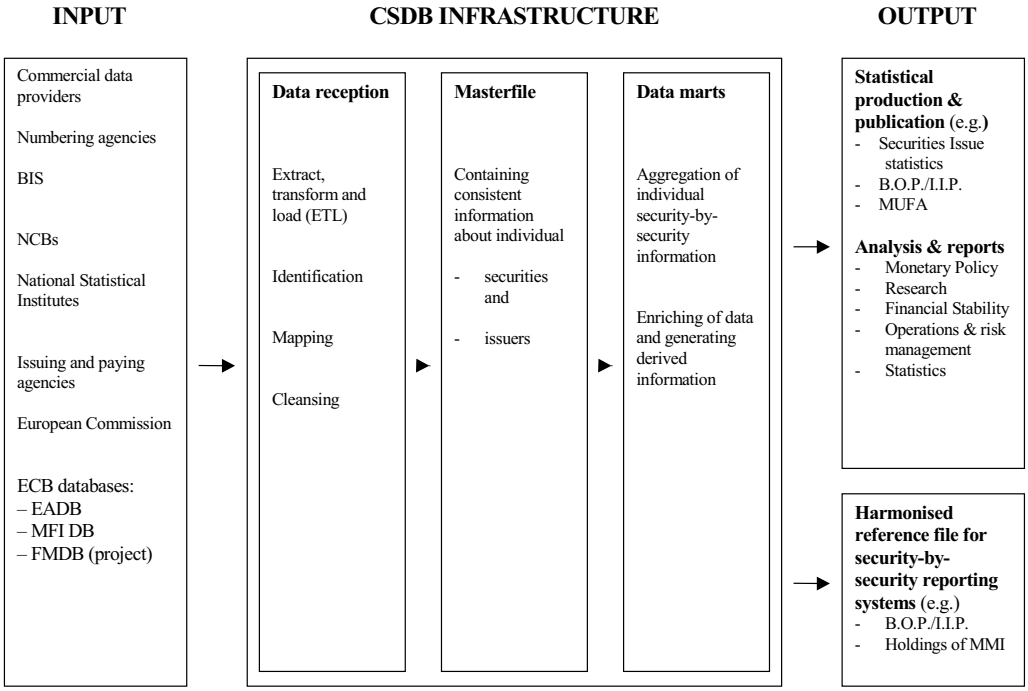
The best way to ensure a correct statistical treatment of securities is to compile a reference database of those securities which euro area residents are likely to hold or transact in. Such a reference database will be a valuable tool even if reporting agents report their securities transactions and positions in the aggregate. It is indispensable if they report security by security, since the compiler needs a reference list of securities with reliable structural information about each[5]. (Security-by-security reporting – recording individual securities issued or held – may seem cumbersome and a heavy burden on reporting agents, but for issuers, holders or their agents who are highly automated it is deemed easier, as well as providing more flexibility to compilers, than aggregated reporting; nine euro area countries and two pre-ins already use security-by-security reporting, or plan to introduce it.)

This reference database should be unique (or one master list and exact copies) in order to allow the consistent construction of statistics across euro area countries. Existing sources have uneven quality and timeliness, as well as methodological inconsistencies such as the treatment of residency, sectors and double counting of international securities. To maximise the reliability of such a database one has to assemble data about individual securities issues, clean it up, and incorporate all available information about holders. Assembling the data means developing feeds from various sources[6]. Cleaning it up means eliminating overlaps, choosing the best sources for the large amount of supplementary data, and in general ensuring that the database is as comprehensive, reliable and up-to-date as possible. Incorporating data about holders means storing data from surveys or commercial sources.

3. The CSDB Project

The set-up of the CSDB within the institutional framework of the ESCB [7] showed some complexity which is reflected in the duration of the preparation phase of the project. The main cause of such a long phase was the tender procedure for an adequate system supplier. It could only be launched once the user requirements (the main features are described in Annex 1) had been defined and main features of the feasibility of the CSDB system as an ESCB database had been outlined. This already took a year. Then the tender and the evaluation of the much differing offers received proved

Figure 1 – Flow of information within the CSDB-network



5 *Such as a unique identifier, outstanding amount, nature of the instrument, currency, coupon and payment date(s), sector and country of residence of issuer, maturity, current market price etc.*

6 *Apart from securities databases in some national central banks, there are several sources of data on individual securities (commercial databases; the European Commission; the BIS, which has a large database of international issues and would support and accompany work on the CSDB).*

7 *The European System of Central Banks (ESCB) comprises the European Central Bank (ECB) and the 15 national central banks of EU Member States.*

difficult. The final decision was taken 15 months after the publication in the OJ of the European Community of the call for tender.

However, tasks were undertaken in parallel to this procedure. The preparation phase contained the identification of potential data sources (their data limitations, and the legal and commercial aspects), the design of the technical infrastructure of the CSDB, and the approach toward data quality management.

From July 2002, the CSDB project entered its implementation phase 1 which will see the development and undertaking of its technical infrastructure as well as the set-up of a "CSDB-network" (for the data quality management). While the ECB, supported by an external developer, can set up the framework, it is impossible for the ECB alone to do all the work of setting up and maintaining the database. This is why the CSDB was designed as an ESCB project. The cooperation within the ESCB may take different forms, which are detailed in the next chapter. National central banks (NCBs) will be major users of the information contained in the CSDB. Figure 1 gives an overview of the flow of information in the future CSDB framework.

3.1. Legal and commercial aspects

The database may contain confidential individual information. This is not the case, in principle, for data on issues and issuers. These will be derived from authoritative public or commercial sources. This may not always be the case for some private placements or instruments which, though tradable by nature, may not be traded in effect. Data on holdings, whenever available, are not foreseen to be individual and, thus, not subject to specific protection. Protecting confidentiality, where relevant, will be ensured by the system and managed by the database administrator.

Data received from commercial sources are generally under licence. For commercial data providers, information notably on prices is a core part of their business; often dealing with front or medium offices or market analysts, the more frequent and timely the data, the higher the price. However, in the case of the CSDB, both the system itself and the data will be covered by provisions so as to grant access to the whole ESCB for statistical purposes (monthly data, not in real time) and, under specific arrangements, to some other institutions (e.g. national statistical institutes in some EU member states, the BIS and NCBs in accession countries). As contracts are not yet ready, it is too early to define accurately which institutions will have access to what data. In addition, the data quality management is deemed to confer the property right on (at least some descriptive) data, whatever their sources, to the ECB so as to afford for the extraction of a subset and their transmission to reporting agents to allow them to make accurate breakdowns when reporting statistical data to national compilers.

3.2. Basic organisational models to run a CSDB

The cooperation within the ESCB could in principle take three different forms:

- *Clearinghouse approach:* A central clearing institution receives the contributions of participating countries and puts them into a single database without any further quality checking. The advantage of this approach is that partial results would be available fairly soon and that the resource implications for the clearing institution are limited as the participating countries remain responsible for the comprehensiveness and accuracy of their own data. Its main disadvantage, however, is that it is likely to take a long time until a sufficient degree of comprehensiveness and consistency of data was achieved.
- *Centralised approach:* In this approach an international organisation purchases all relevant data from commercial databases, performs the quality control, harmonises the data and makes them accessible to official users. This approach is very attractive to users of the data because they do not have to contribute to the cost and have no responsibility for the quality of the data[8].
- *Network approach:* A co-ordinating institution will not only collect the relevant information from national statistical agencies and central banks, but also supplement any missing data from commercial data sources with the aim of achieving a maximum degree of comprehensiveness. In addition, the co-ordinating institution may perform quality controls on the data, fill remaining gaps using reasonable estimates and set standards for data compilation in order to ensure accuracy and consistency of the information collected.

8 *The centralised approach was favoured by the US. The US felt that this approach would ensure sufficient comprehensiveness and accuracy of the data at the lowest cost.*

The disadvantages of the clearinghouse approach does not only lie with the timing to obtain a comprehensive database, but also with the lack of harmonisation in concepts and definitions entailing a risk of building a "tower of Babel" (e.g. homonyms may hide different meanings; similar concepts are to be found under different words; securities and prices may be described with somewhat differing sets of attributes). The centralised approach is the most demanding for the agency which develops and manages the global/centralised securities database. There also exist doubts that the quality of data from commercial databases is a priori higher than that from official sources[9].

3.3. The "network" approach of the CSDB

The ESCB adopted the network approach as the general framework in which to set up the administrative and technical infrastructure of the CSDB. It involves an important degree of co-operation between the ECB, the EU national central banks and the BIS while defining and implementing the CSDB. In a "CSDB-network" all EU countries and the ECB will share the responsibility of monitoring the coverage and quality of information on securities issued by their respective residents on their domestic markets. The BIS will provide data on securities issued on international markets on a best effort basis.

a) Most NCBs are already running, or intend to build, a securities database on issues by residents and are ready to provide data feeds to the CSDB ("data providing countries").
   A data feed by an NCB should ideally cover issues of residents of their jurisdiction on domestic markets and abroad. Where some of the information is missing, potential gaps should be identified and the CSDB operator will provide the relevant information via external sources, e.g. commercial sources or the BIS database.
b) All ESCB countries[10] are sharing the responsibility of monitoring the coverage and quality of information on the issues by their residents on the domestic markets as well as abroad. Where a country is not in a position to provide or share data on issues by residents, the operator of the CSDB will be responsible for retrieving all information available but the country would remain responsible for the monitoring of these data. In the data quality management process, all NCBs would need to check data related to issuers (e.g. sector in ESA 95) and cross-check data on securities with aggregated information from other national sources (e.g. MFI balance sheet statistics, national accounts, Other Financial Intermediaries and Central Balance Sheet Office statistics, etc.).
c) Finally the same rules and responsibilities apply to the operator of the CSDB for issues by the "rest of the world" which were identified (or considered) to be relevant for financial statistics within or outside the euro area.

4. Data quality management

Based upon the "network" approach outlined in the preceding section, parts of the CSDB will be fed or updated "bottom-up" via participating NCBs and parts "top-down" via external sources made available by the ECB. Where the cost and effort to cover certain information in a decentralised way would be higher than via a centralised approach, the operator of the CSDB may take over the responsibility of retrieving this information[11]. Figure 3 in annex 2 shows the organisational structure of the CSDB data quality management. The main data quality tasks, unification (mapping) and cleaning are displayed as core tasks to be accomplished within the CSDB system.

5. Outlook – Toward a "Global Securities Database"?

The experience which will be derived from the "CSDB-network" may be extended in due course to other areas – eligible assets, prudential supervision, risk and operational management – and may lead to an expansion of the network to include other statistical compilers (international organisa-

9 *The BIS has the impression that commercial data are often earlier available than official data, but that official data are normally more accurate than commercial data.*

10 *And possibly accession countries. The principle of granting them access to the CSDB and requesting them to contribute for their own residents will be considered by the Statistics Committee of the ECB. Modalities will be discussed at a later stage.*

11 *A typical example for this is the information on prices, i.e. quotations that would not be provided by NCBs. A decentralised provision from NCBs would be unduly costly and they therefore may be bought by the ECB from a number of commercial data providers yet to be determined.*

tions, central banks and national statistical offices) in the near future, perhaps in the form of a Global Securities Database (GSDB).

In its last two meetings in October 2000 and 2001, the IMF Balance of Payments Committee has called for the development of a GSDB. In response to these developments, the BIS offered to explore the feasibility of creating a global securities database by expanding their existing databases on international and domestic securities issues. This approach was then considered by the IMF and BIS as less promising than the one that consists of developing the CSDB "network" within the ESCB and, once operational, considering the possible cooperation with main partners (US and Japan in particular) on data quality management for residents of their jurisdiction and sharing of information and costs. The network could be implemented with the BIS as the co-ordinating institution. The advantage of this approach would be that the BIS could learn from the ESCB project and proceed with a comprehensive and consistent database with more analytical and operational value than with any other approaches.

The resource implications for the BIS and other institutions involved would need careful consideration. For their part, the ECB and ESCB would only be willing to open the contents of the CSDB to other countries – given that contractual arrangements could be made – if it/they could expect a similar data quality on issues by residents from these countries:

- the number and diversity of countries is larger than in the euro area/EU, with an effect on the need and difficulty for undertaking data quality management;
- the data collection from various (e.g. commercial) sources on some markets may be of uneven quality.
- standard setting on a more global level relies on voluntary compliance.

In a paper on this issue, the BIS notes that "While all three approaches above entail major shortcomings, we believe that under the current circumstances the network approach of the ECB, which combines data collection from official and commercial sources and involves standard setting, represents the only reasonable way forward."

Therefore, the BIS brings forward the proposal for the development of a global securities database along the following lines:

- As issuance in securities markets is highly concentrated, the countries with the largest markets, which account for almost 90% of global issuing activity, could form the core of the global securities database. The BIS could explore with these major economies (notably the US, Japan and the EU) which types of data are available and under which conditions and when they could be included in the global database[12].
- Once an agreement has been reached with the core countries to create the global database in principle, the IMF and the BIS could develop common standards for the data compilation jointly with the ECB, the US and Japan.
- Countries other than the US, Japan and the EU countries, which maintain securities databases and are willing to share their data with other countries, may be invited to participate in the global database as soon as the core countries have joined.
- In analogy to the ESCB-CSDB project and in order to limit the cost for the institution maintaining the global database (e.g. most likely the BIS), each country would in principle remain responsible for the accuracy of data on securities issues of its own residents, independent on whether the data are collected from official or commercial sources.

Finally, the main benefits of a global securities database would be twofold:

- to improve the quality of b.o.p. and i.i.p. statistics and the from now on annual IMF Coordinated Portfolio Investment Survey;
- to enhance the analysis of financial market developments, in particular on securities markets.

However, other contributors may also expect using the database for fostering consistencies across a large set of financial statistics (of which flow of funds) and for other analytical purposes.

12 *For this purpose, a joint task force or working group could be formed. To the extent that sufficient coverage cannot be achieved from official sources, like in the US, the question of how to share the costs for commercial data would have to be addressed.*

Annex 1

Main features of the CSDB

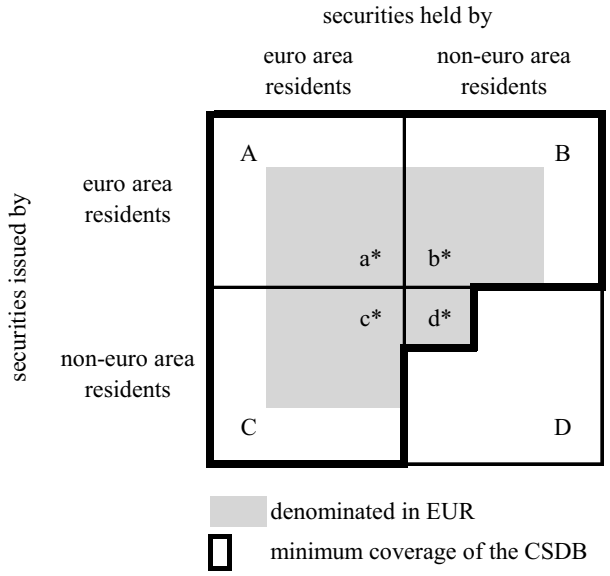
Scope

The objective of the CSDB is to hold complete, accurate, consistent and up-to-date information on:
1 the different types of securities relevant for the ESCB's statistical purposes, and
2 final holders of these securities (broken down by institutional sector and geographical area).

Thus, the CSDB should provide the ESCB with up-to-date information about the issuers and holders of securities (both debt securities and shares), stocks and their financial transactions like issue and redemption of securities and change of holders. The statistical information should be complete, coherent, and consistent. It should be available on-line to the ESCB, and possibly to other statistical agencies and users.

The minimum requirements – as presently identified – are marked by a fat borderline. In addition the dimension of denomination (EUR/non-EUR) is highlighted. The figure illustrates that the CSDB should on the one hand cover the total set within the fat border line and on the other hand should allow for identification of sub-sets (A to C and a* to d*).

Figure 2 – Scope of securities covered in the CSDB



Thus the envisaged coverage is all securities issued by residents of the euro area (in euro or in foreign currencies) as well as securities issued in euro by non-residents. All securities are going to be broken down by instrument type, issuer's sector, maturity or other characteristics of the securities.

Ideally, the CSDB should also cover (i) issues by corporations whose parent company is resident in the euro area, i.e. the location of the ultimate risk, and (ii) securities (denominated in currencies other than the euro and issued by non-euro area residents) which are held/traded by euro area residents. The CSDB is also likely to comprise issues and holdings of residents of EU countries that have not adopted the euro yet, the so-called pre-in countries. Data related to issues by residents of accession countries may also be considered upon request.

Furthermore, the coverage of the CSDB will be based on the definition of securities in the European System of Accounts [13] (ESA) 95, According to ESA 95, securities comprise the categories F.3 (Securities other than shares) and F.5 (Shares and other equity). Category F.3 includes short- and long-term securities other than shares and financial derivatives, category F.5 quoted and unquoted shares and other equity as well as mutual funds shares. However, presently the CSDB is not considered to cover the full set of instruments, in particular data on financial derivatives will not be collected. Above table 1 shows the expected number of securities in the CSDB by issuer category and instrument type.

13 *This classification is considered consistent with Balance of Payments Manual 5th edition (BPM5), cf. BPM5 table 4 p.127.*

Sector breakdown and valuation

The CSDB will be designed in such a way that the system of accounts for securities can be derived as outlined in ESA 95, which is in compliance with IMF Balance of Payments Manual, Fifth Edition (BPM5)[14]. For money and banking as well as for b.o.p./i.i.p. statistics, outstanding amounts of securities at the end of each period and, separately, new issues and redemptions during that period are required. The value of stock of securities at the end of the reporting period can be derived by adding all financial transactions, other volume changes and re-valuations to the value of stock of securities at the beginning of the reporting period.

According to ESA 95, the recording of financial transactions is to be on a net basis. The valuation principles for securities transactions are the valuation according to market or transaction value[15] as well as the nominal value. The nominal value refers to the face value of the security. In case one (or both) price information is (are) not available estimations or approximations will be obtained using state of the art statistical inference methods.

Information on holders

In addition to the information on the issue of securities, the CSDB should also enable the compilation of information on the holders of securities. Data on the residency of the holders of securities issued by euro area resident Monetary Financial Institutions (MFIs) is essential. In addition to the amount purchased/sold (flows) or held (stocks) by each holder or each category of holder two types of information should also be included:

(i) The sector of resident holders: this is of substantial value for the compilation of quarterly MU financial accounts, individualised data set on securities need to be specified by institutional debtor and creditor sector. This breakdown will be based on the residence concept, in order to receive reliable statistical information on the liabilities and assets side of institutional units.

(ii) The residency of non-resident holders of securities issued by euro area residents: the minimum regional breakdown has to include the USA, Japan, American countries other than USA, the pre-in countries and the accession countries. All countries within this scope have to be identified by the individual ISO code.

Incorporating information about holders will be a difficult task as current data sources are much less comprehensive than on the issuer side, and is therefore deferred to a later stage in the project, when also the technological and organisational framework will be fully available.

Annex 2

Data quality management and technical infrastructure of the CSDB

Unification and mapping

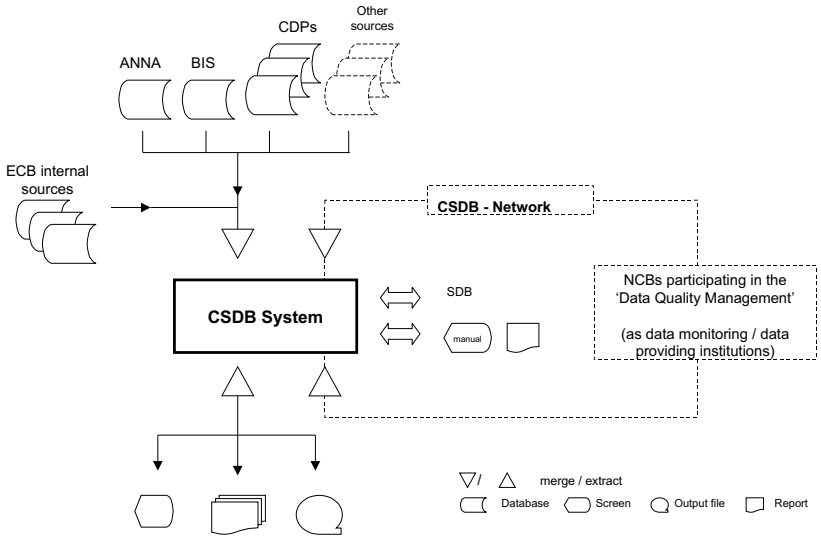
In combining separate databases, the mapping and cleaning process shall ensure the extraction of the best possible quality information: cleaning it up means eliminating overlaps, choosing the best sources for the large amount of supplementary data, and in general ensuring that the database is as comprehensive, reliable and up-to-date as possible. This will enable to overcome the present frag-

14 *Accordance with ESA 95 implies accordance with the System of National Accounts (SNA) 1993 as well as BPM5. For euro area resident issuers/holders of securities, financial accounts and money and banking statistics need a detailed sector classification which is consistent with but goes beyond the one for b.o.p./i.i.p. Especially, the sectors "financial corporations" and "general government" have to be fully extended (sub-sectors).*

15 *The relevant accounting rules are defined in ESA 95 as well as BPM5. The market value is based on the price quoted in the market, whereas the transaction value refers to the value at which the security is created, exchanged or liquidated excluding charges and taxes.*

mented approach which probably contains inconsistencies and duplication as existing sources are deemed to have uneven quality and timeliness, as well as methodological inconsistencies such as the treatment of residency, sectors and double counting of international securities.

Figure 3: Organisational structure of the CSDB data quality management



The objective of a mapping process is to obtain a single, master securities data file containing reference securities data from disparate sources. This master file has to meet a number of criteria, of which are data consistency and data comprehensiveness. This mapping process is done through means of a migration tool. This tool should allow the CSDB maintenance team to select data sources, identify master file data attributes, set up mapping rules and allow for compound data attribute matching. A suitable migration tool has to fulfil the following functions in order to enable the transition to an error free securities master file: identification and selection of data sources, data cleaning and matching, estimating missing information, and definition of quality benchmarks.

Identification and selection of data sources

The identification and selection of data sources is a crucial input dependency for the mapping process. Basically two options can be considered.

One option is to define ex-ante the data attributes from each source available one intends to use in the master file. This implies to know beforehand which is the best source to deliver the required data attribute, hence omitting possibly better alternatives available. An additional shortcoming in this approach is that the database administrator is unaware of the degree of comprehensiveness of the master file as the end result is already determined before the actual mapping is initiated.

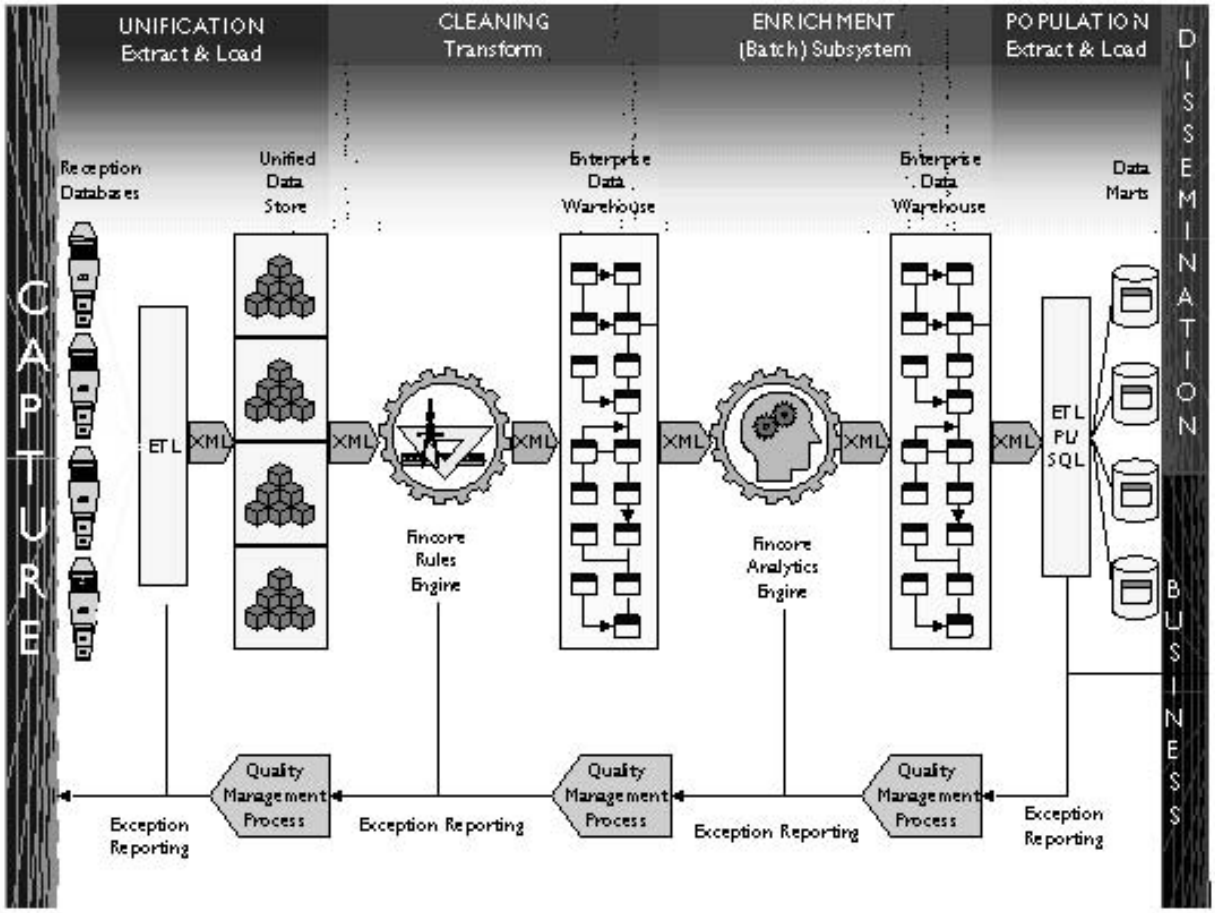
An alternative approach is to include all data attributes from all sources to be taken through the mapping application. This will allow the securities data reconciliation to be exhaustive and comprehensive. Additionally it permits data validation and data integrity checking by means of highlighting data differences and allowing for a specific cleansing process.

In the CSDB a mix of the two approaches will be applied: a strict selection of data attributes from selected sources (e.g. NCBs), complemented by a broader integration of information from the remaining data feeds (e.g. commercial sources). Experience gained in the second approach would assist in defining dynamically (i.e. by changing the rules for the data mapping without programming) the data attributes mentioned in the former.

Other tasks to be performed in the unification and mapping process are:

- identification along adequate keys;
- application of mapping rules;
- transformation to a common format.

Figure 4 – Logical architecture of the CSDB system



Data cleaning and matching

Once the several data sources have been unified via the outlined mapping process, the task consists in construction a unique, "cleaned" database with only one entry for each security / attribute. It consists of compounding all source data attributes for a given instrument mapped to a unique data attribute in the master file. This data cleaning is an iterative process monitoring validation, integrity checking and cleansing of the compound data attributes.

The most desirable and ideal situation is the one where all source data attributes yield the same value for the master file data attribute. In case the source data attributes are not equal in value a correction needs to be triggered. It has to be taken into account that a decision must be reached on which source data attributes supply a "correct" or "most reliable" value. If it is not possible to detect a "most" reliable value a decision has to be taken not to use this specific source data attribute in the compound view. This process can be referred to as definition of "matching rules".

As the "logical data differences" (i.e. data not meeting data integrity requirements) have been filtered out in the previous data mapping step, the remaining discrepancies may be described as "real data differences". Logical errors and integrity violating data would have been set to a default value allowing to be recognised by the matching engine as void.

Estimating missing information

Given the market valuation principle, the calculation of market prices or relevant proxies for securities for which the market value is missing is of importance[16]. In principle, the appropriate method

16 *According to the CSDB – URD (User Requirement Document), securities are to be recorded with their market or transaction value as well as with their nominal value.*

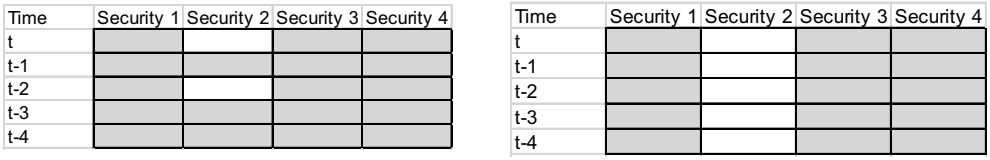
to derive such approximations depends on the type of the security and the character of the missing value.

For *debt securities* (bonds, bills, etc.) there is a well-established set of calculation methods for securities for which a (minimum) number of basic attributes (principal, maturity, coupon, discount rate) is available. The implementation of these methods is straightforward in the sense that the necessary data and software packages are readily available in the market[17].

However, things are less evident for *equities*. Equity market prices often reflect a whole bundle of influences – such as book values, profit expectations or mergers & acquisitions-related influence purposes – which differ significantly in their character. These factors are difficult to measure and most of them will not be sufficiently represented in the CSDB. This difficulty leads to a set of purely statistical methods to value equities and debt securities, for whom the basic set of attributes is not known (e.g. private placements).

Another important distinction can be made concerning the *nature of the missing value* (see figure 5). For the case that the missing value concerns only one or a limited number of observations (left-hand side) it may be possible to fill it by interpolation or by more elaborate statistical methods.

Figure 5 – Possible nature of missing values (white boxes) on a database



Note: the actual value of a security (Security 2) is only missing for one period, whereas it is available for the previous period (left hand-side). The value of a security is missing at all (right hand side).

More difficult cases are securities for which there is no information – except their existence – available (see right-hand side of the figure). This applies for instance to private placements or to barely traded securities. In this case one needs to identify a link between the security and other securities in the market and derive a value from here. This link will usually come through similarities in the structure of the security (in case that it is a debt security), through similarities via the issuer (comparison to other securities issued by the same issuer) or through the underlying asset / industry sector.

Definition of quality benchmarks

The implementation of the data quality management requires the definition of transparent agreements ("benchmarks") which the participants of the network have to respect. These agreements will ensure a level playing field for all participants of the network. The following types of benchmarks may be distinguished:

- Benchmarks for *data transmission* of each data feed (commercial, non-commercial, NCB,…) comprising a description of the elements of information (attributes, events), frequency, timeliness of data transmission and the degree of compliance with international standards.
- Benchmarks for *monitoring the quality* of the data finally stored ("cleaned") in the CSDB, in particular the information under shared responsibility of NCBs and the operator of the CSDB. Such operational quality checks can either be performed (i) on attributes of individual securities or (ii) via comparison of (semi) aggregated statistics derived from independent sources;
  - the comparison of information for an individual (attribute of a) security derived from several sources can produce inconsistent and contradictory results;
  - alternatively, quality checks can be based on (aggregated) statistics. In case results from independent sources (e.g. statistics on securities issues, MFI balance sheet statistics) or logically linked systems (e.g. recordings of stocks and flows) would be available, potential discrepancies might indicate the existence of wrong recordings in individual items of the database[18].

17 *For the CSDB a state-of-the-art software package will be implemented which allows the performance of a comprehensive set of financial statistical functions.*

18 *The identification of individual problems requires of course the technical possibility to narrow down the scope of investigation step by step.*

The benchmark would apply to data on securities and related data issued by resident issuers of the jurisdiction of each NCB. However, as the CSDB is seen as a single set of data, the matching/cleansing process may be iterative as (authoritative or commercial) sources may show securities on international or "foreign" markets; where such securities are deemed having been issued by residents of a particular jurisdiction, they need to be checked by the concerned NCB in liaison with the operator of the CSDB. The organisational aspects of the data quality management are not yet fixed (this is an important task during phase 1 of implementation, in particular through the work of the Business Coordination Group) and may differ depending on what sources and/or tools are available in the NCBs. NCBs will either be able to process the data and send a clean set to the CSDB; or download data from the CSDB in a in-house securities database, check them and send them back; or proceed directly in the CSDB.

Abstract

Securities are the most important class of financial instruments in the euro area (EUR 8 trillions of debt securities issued by euro area residents are outstanding). Yet statistics on them have many deficiencies. The CSDB will be a comprehensive reference database with a range of statistical applications and also much relevance for economic analysis, financial stability issues and operations (eligible assets, risk management). The availability of information on equity and debt securities would greatly contribute to overcome shortcomings in the quality of financial statistics.

This paper provides an examination of the increasing importance of information on a security-by-security basis for accurate and timely (monetary, securities issues, balance of payments and flow-of-funds) statistics. The paper briefly describes the present difficulties with statistical treatment of securities, and potential sources of inconsistency and inaccuracy.

The development and set-up of the CSDB within the institutional framework of the European System of Central Banks (ESCB) proved to be a complex task; hence the duration of the preparation phase of the project. This phase contained the identification of the requirements of users within the ESCB, the identification of potential data sources (their data limitations, and the legal and commercial aspects) as well as the design of the organisational and technical infrastructure of the CSDB.

From June 2002, the CSDB project enters its implementation phase, which will see the implementation of its technical infrastructure as well as the set-up of a "CSDB-network". The cooperation may take the form of "clearing-house", "network" or centralised approach; the paper discusses each and explains why the second was chosen; it stresses the importance of co-operation between the ECB, the EU – and Accession Countries' – National Central Banks (NCBs) and the BIS in defining and implementing the CSDB. In the "CSDB network", which will be implemented in a stepwise approach, the NCBs will have the responsibility of monitoring the coverage and quality of information on the issues by residents of their jurisdictions, while the ECB and BIS, using authoritative official and commercial sources, will ensure overall consistency and contribute data on issues by residents of countries outside the EU which are internationally traded, held by euro area residents or denominated in euro.

The experience to be derived from the "CSDB network" may benefit in due course other areas – prudential supervision, risk and operational management – and may lead to an expansion of the network to other statistics compilers (central banks and national statistical offices) and further cooperate with international organisations (in particular the IMF and BIS) in the future, perhaps in the form of a Global Securities Database (GSDB). The results should foster transparency and efficiency of the markets.

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The mission of central bank statistics in the development of the information infrastructure in an open market-driven economy

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1. Information infrastructure of the economy – definitions and identification

The *information infrastructure of the economy* (national, supranational, international) is a complex of:

- *information standards*
- *information resources*
- *information systems*

necessary for the maintenance and development of information systems of governments, regional self-governments, businesses and non-profit social and political institutions as well as for any social or economic activity.

In a modern economy, functionality, efficiency and technological level of the information infrastructure is the prerequisite of development of other branches of the economy. A high technological and organizational level of the information infrastructure is also indispensable for practical implementation of the instruments of economic policy of governments and supranational organizations in a modern, open, market-driven economy.

Infrastructural information standards are the information standards – specific, methodological and generic – commonly used on a national or international scale and indispensable for a proper performance and interchange of data between economic, social and political information systems. Some important infrastructural information standards are introduced in the form of laws. Many standards used at the national level are based on international recommendations and agreements.

In practice, almost all information standards developed and used in official statistics, including standards of central bank statistics, are *infrastructural* information standards [1]. The majority of infrastructural information standards used in the financial sector at the national level are elaborated by international organizations and recommended for common use by respective international organizations. Those standards are implemented directly at the national level or are used as the basis for specific national standards.

In the financial sector of the economy, particularly in the banking sector, information standards recommended by international organizations are directly used for elaboration of infrastructural standards at the national and supranational level.

Infrastrucutral information resources are information resources stored in administrative records and registers, archives, libraries, databases (including statistical database systems) used directly or indirectly by governments, businesses, non-profit organizations, researchers or citizens [2].

Infrastructural information systems are the information systems, interrelated with management information systems of public administration and businesses, which are the prerequisite of proper functioning governments and businesses.

1 *Oleński J., Standardy informacyjne w gospodarce (Information standards in the economy), Wydawnictwa Uniwersytetu Warszawskiego, Warszawa 1998..*

2 *Oleński J., Elementy ekonomiki informacji (Foundations of Economics of Information), Wyd. Wydział Nauk ekonomicznych Uniwersytetu Warszawskiego - Nowy Dziennik, Warszawa 2000..*

The information infrastructure provides governments and businesses with the standard data and metadata for the development, maintenance of information systems and for the use of their own, "internal" information systems [3]. In a modern, open, global market-driven economy, the information infrastructures of national economies and supranational economic structures (e.g. free trade zones, monetary unions) are and should be coherent with international, global or supranational infrastructural information standards, resources and systems.

2. Layers of information infrastructure of the economy

The following layers of information infrastructure of the economy are specified:

I. Infrastructural information standards:

1 ethnic languages;
2 information standards for data elements;
3 information standards (methodological, generic and specific) for metadata: concepts and definitions, classifications, codes, messages, standards for data interchange;
4 IT standards.

II. Infrastructural information systems:

5 national and supranational identification systems of individuals, legal persons, territory and specific types of objects;
6 national, supranational and international public information systems: official statistics, scientific information, legal and administrative information systems etc.;
7 information systems supporting basic functions of governments: taxes, customs, financial sector supervision (banks, insurance, stock exchange, investment funds etc.), social security, health insurance, government budgeting;
8 infrastructural information systems of non-governmental sectors of the economy: financial institutions;
9 mass media;

III. Infrastructural information resources:

10 archives;
11 libraries;
12 scientific, technical and administrative databases.

In a modern economy, the financial sector is fully dependent on modern information and telecommunication technologies and on the reliability and availability of the information infrastructure information (standards, systems and resources) at the national and international level. Any disturbances in the performance of the infrastructural information systems at the national or international level, any incoherence in the standardization layer of the information infrastructure of the economy, any gaps in the relevant and pertinent information resources, always cause serious disturbances in the activities of the financial sector on national or international scale. Some national and global infrastructural information systems must be fully operational and reliable 24 hours a day and 365 days a year.

The financial sector and financial institutions are fully dependent on reliability and efficacy of modern information and telecommunication infrastructure at the national and international level.

Infrastructural information standards are the main tools of control of reliability and coherence of information within the financial sector on a national and global scale. International organizations most active in defining infrastructural information standards relevant for central banks are: IMF, BIS, UNSC, and – for the European region – ECB and Eurostat. The standards of special importance for coherence and integrity of information are the standards for statistical data interchange, i.a. GESMES of the UN/EDIFACT and Eurostat and GESMES/CB. The role of those standards is much broader then the simple facilitation of statistical data interchange (EDI) between official statistical agencies, within central banks and international organizations. More important than that seems to be the role of "GESMES family" standards for the harmonization of representation of (a) data elements, (b) statistical microdata and (c) statistical aggregates (macro level) both within national statistical systems, within information systems of national central banks, within the national banking sector and in the banking sector on a global scale.

3 *Ibidem.*.

3. Recent trends in development of official statistics – the perspective of central banks

The last two decades are the period of deep "re-engineering" of information infrastructures of governments, businesses and of international organizations. This re-engineering is the consequence of the "IT revolution" (global telecommunication, internet, mass storage devices, global accessibility to very large resources of data in a very short time and at very low cost, better confidentiality and reliability of global ITT networks). Official statistical systems of many countries are also in the process of deep restructuring and re-engineering. The main factors stimulating the reengineering and the changes of functions of official statistics and of national statistical institutes are:

- use of administrative records for statistical purposes;
- global accessibility and dissemination of statistics via internet and mass media;
- wide and direct use of official statistical data for economic and political decisions (*formula-driven decision-making*) by international organizations, governments and businesses;
- commercialization of official statistics.

Analyzing the changes in official statistics, one may observe the following tendencies:

- a *decreasing role* and contribution of national statistical institutes in the production of statistics by national official statistics;
- a *decreasing role* and contribution of national statistical offices in the development of statistical standards and methodology and to the centralized coordination of official statistics on a national scale;
- *"internationalization"* of standardization in official statistics, an increasing role and growing importance of international statistical standards like methodological standards, standards for representation and interchange of statistical data, technical and organizational standards used in official statistics; national statistical services directly implement or adopt international standards for national statistics;
- an *increasing role* of statistical activities undertaken by public institutions other then the national statistical offices: ministries, local self-governments, central banks, governmental institutions for supervision and control (e.g. in banking and finances, energy, construction, social insurance etc.);
- *integration* of administrative data processing and production of official statistical data by ministries, central banks, public organizations managing infrastructural information systems; official statistical data are more often the "by-product" of administrative data management systems than the product of specific statistical surveys;
- statistical surveys and statistical estimates produced by recognized public or private research institutes, by some rating and auditing firms, by private firms offering consulting and analytical services, are used by end users as if they were official statistical data.

The processes of decentralization and "diffusion" of production of official statistical data and the production of statistics by non-official organizations will – sooner or later – lead to the disintegration of statistical systems on a national and international scale. To avoid that, much stronger centralized coordination of programmes of surveys, the standard-driven coordination of methodology and the use of common survey frames and registers are necessary.

Coordination of national statistical systems may be realized:

a. by national statistical councils or similar national coordinating units (e.g. most common form of coordination in Europe);
b. by centralized financing of official statistical surveys (e.g. in USA);
c. by national chief statisticians (UK, Canada) in cooperation with ministries and representatives of main institutional users of official statistics.

Central banks are often participating in coordinating the national systems of official statistics. Their representatives take part – as a rule – in the processes of formulating the programmes of official statistics, in consulting the methodology of surveys relevant for central banks as end-users.

At the international level this coordination is realized by the participation of representatives of central banks in statistical activities of international organizations, in which central banks are represented (e.g., BIS, IMF, OECD ECB in Europe etc.) in programming and in elaborating statistical standards.

The contribution of central banks to coordinating national statistical systems is rather often limited to control, if the information needs of central banks are properly represented in the pro-

grammes of official statistical surveys. It seems that in the recent phase of re-engineering the information infrastructure of the economy and of official statistics, the contribution of central banks to coordinating national statistical systems and international statistics may and should be more active.

4. The approaches of central banks to official statistics: active end-user vs. active partnership

The dominating approach of central banks to the systems of official statistics is the approach of an "active end-user". Central banks identify rather precisely their information needs and formulate their information requirement to official national statistical agencies (specification of statistical indicators required, methodological standards, timeliness of delivering the data). Central banks expect that official statistical services shall produce data needed by central banks. That *"active end-user"* approach the most frequent way of behaviour of representatives of central banks in the bodies coordinating national (NSS) and international (ISS) and – in the European Union – supranational statistical systems (ESS).

Central banks are very active end-users of statistical data. The data are used not only for extending the knowledge of experts, but some statistical indicators are directly used for decisions. Statistical data needed for decisions taken by central banks are produced within the banking system as well as by organizations (official and non-official) outside central banks:
- international and supranational banking institutions: BIS, ECB;
- other central banks;
- international agencies supplying official statistical data (UN statistical offices, IMF, World Bank, OECD, Eurostat);
- national official statistical agencies;
- other official institutions producing statistical information;
- commercial information services;
- research institutes.

For proper use of statistical data coming from outside the banking sector, central banks need full knowledge on methodology and quality of the data produced and a wide spectrum of metadata. Often this knowledge is available only if the experts of central banks are directly involved in the elaboration of the methodology and in the control of processes of production of statistics.

Central banks are active producers of some official statistical data. Central bank statistics cover – as a rule – the following areas:
- monetary statistics;
- banking statistics;
- balance of payment statistics;
- statistics of finances of the non-financial sector;
- financial accounts;
- business cycle statistics of special interest for monetary policy.

If statistical data needed by central banks are not available from reliable official statistical sources, if national statistical offices or other official statistical services are not able to deliver their statistical data requested by them, the central banks organize relevant statistics themselves, on their own capacity [4].

However, if national statistical institutes or other official statistical agencies produce statistical data needed by central banks, the central banks use those sources of information and they respectively reduce their own production of official statistics and their involvement in contributing to official statistics. Consequently, the scale of direct active involvement of central banks in the production of official statistics is the derivative of the production of official statistical data by national statistical offices and by other official institutions. This involvement is steadily and continually growing.

4 *A good example of that strategy is the development of the statistical information system of the National Bank of Belgium and the "division of labor" between the national statistical institutes of Belgium and the Bank.*

5. Coordination of infrastructural information standards and systems by central banks

Central banks are and should be in the position to be more actively involved in the coordination of some important layers of the information infrastructure of the national economy. That is necessary for their own benefit, as well as for the benefit of other government units and economic entities. In most of the the laws regulating the competencies of central banks in national economies, the central banks are entitled to collect and exchange information necessary for their statutory tasks and duties. The scale of statistics collected, produced and disseminated by central banks depends in fact on the interpretation, what "necessary information" means. From that point of view, central banks are – as a rule – in a better position then other governmental units.

The coordinating involvement of central banks on selected elements of the information infrastructure of national economies may be direct or indirect. Direct coordination refers to the areas of information infrastructure that are *ex officio* managed or supervised by central banks. Indirect coordination refers to the areas that are managed by other governmental units or by other organizations, but for which the approval or opinion of central banks is necessary.

The layers of information infrastructure of national economies pertinent to central banks interest and coordination are *inter alia*: standards, registers and information systems.

I. Standards

- specific standards for representation of data elements used in the financial sector;
- classification standards (i.a., bookkeeping standards);
- identification standards (identification systems of natural and legal persons in the banking sector, identification of bank accounts);
- standards for basic messages for data representation and interchange, both generic (e.g. GESMES/CB) and specific (e.g. GESMES/CB for the key-family for balance of payments statistics).

II. Registers

- register of banks;
- registers of bank accounts,

III. Information systems

- "operational" systems of central banks;
- information systems for banks supervision;
- statistics of the banking sector, monetary statistics, balance of payments statistics etc.;
- information systems of settlements (clearinghouses);
- governments' accounts in central banks: taxes, customs, government budget;
- governments' bonds and securities deposits;
- credit information systems.

There are differences between countries in direct or indirect involvement of central banks in particular standards, registers and information systems. The main differences, which are most important for the functions of central banks in the information infrastructure of national economies, are the consequence of the operational functions of central banks for government finances. In some countries, central banks are responsible for the maintenance of accounts of central governments and local self-governments (for taxes, customs, government budgets). In other countries, central banks are only partly involved in banking services for governments (e.g. for central governments but not for local self-government). Anyway, in any case central banks have a (direct or indirect) view on the records of public finances.

In modern economies, all financial operations important for statistics are processed *via* banks: commercial banks, or directly *via* the central bank. That means that in the banking sector there is created and systematically updated the dynamic "financial picture" of almost all economic activities on individuals and legal persons stored in the form of the data on accounts of clients of commercial banks. Information systems of the banking sector are becoming more complete and an updated mirror of activities of economy and society. The development of *e-commerce* accelerates the total coverage of economy and society by data stored and processed in banking systems. Moreover, computerized information management systems of companies electronically interchange

data with the banking system. *Electronic banking* facilitates data interchange between businesses, governments and the banking sector. The only sector that is not reflected in banking information systems is the shadow economy.

Theoretically, we can imagine the situation that the banking information system is used for capturing source information for statistical purposes on all economic activities of which the financial side is mirrored in the banking system. It is not a futuristic idea. From a technological point of view, the use of records stored in the banking system as the source data, not only for banking and financial statistics, but also for many other statistical purposes, is possible and effective. All companies and many more individuals are leaving "electronic traces" of all their activities in the banking sector of the economy. In many countries many kinds of transactions between governments and companies must go through banks electronically. Some must go directly via central banks.

We should also note that in many countries some financial activities of governments go via special banks. e.g. in some countries the government subsidies (to farmers, to housing, etc.) are serviced by special banks. Administrative records of those banks are the proper place for collecting the information adjusted for compilation of economic statistics on the given aspect of the economy.

All developed economies are now, and less developed economies will – in the non distant future – be equipped with reliable computerized networks for public use. So then, banks will register all financial operations representing all activities of the real economy. Rather sooner then later, the banking sector will be the potential source of complete and regularly updated information on any activities with financial consequences.

The question to be answered today is: are societies willing and ready to accept the use for statistical purposes of this huge amount of information on their activities stored in the banking system? Are they willing and ready to adjust banking information systems to the functions of economic and social data sources? In really democratic societies such architecture of an information infrastructure of the economy seems to be rather safe and attractive. However, we should also notice that such information systems in the hands of non-democratic regimes would be a powerful tool of control of the society and a real threat for freedom and democracy.

Central banks should answer the question, what should be their position and policy in the *e-society* and the *e-economy*? Shall central banks be only the observers following activities of IT business and using modern information technologies for their own internal operations? Or rather *shall central banks be the creators of the new information infrastructure* of the information economy?

Central banks are part of the government sector. The mission of central banks should be re-defined. Central banks should take their part of responsibility for the development of the modern information infrastructure of economies, states and societies. Where should be the division of responsibility between central banks, national statistical services and ministries and self-governments in creating a modern information system on the economy and the society?

6. The segments of information infrastructure controlled by central banks

As it was mentioned above, national central banks may and should play a more active role in the creation of a new architecture of official statistics. National central banks are the exclusive managers or supervisors of or may have decisive influence on some infrastructural information resources and systems of strategic importance for the financial sector and for the national economy as a whole. The following information resources and systems may be mentioned:

- registers of clients of banks;
- administrative records of banks;
- government units accounts in the central bank:
- information systems of clearinghouses.

Registers of banks' clients (in central banks and commercial banks) contain data on all legal and natural persons who are clients of banks. The concatenated set of registers of legal persons/clients of banks covers all legal persons of the national economy. The concatenated set of registers of natural persons/clients of banks in developed economies covers all individuals who are active economic units, i.e., those who receive some incomes and realize some expenditures. In less developed economies the number of natural persons in the banking system is lower, but it is rapidly growing.

The registers of legal and natural persons maintained by banks cover all data needed for the *identification of companies* (names) or *of natural persons* (names, date of birth etc.), location, address. In many countries they include the personal identification numbers from official identifica-

tion systems (official personal registers, official business registers etc.). For legal person additional classification information is often required: legal form of company, kind of activities.

If identification and classification of clients of banks were homogenized and coherent with the identification and classification of the same units in other infrastructural information systems (e.g. in official business registers, in personal registers, tax information systems, social security information systems etc.), the central banks would have at their disposal strong frames for statistical surveys. Concatenated registers could also be used for updating the statistical survey frames maintained by official statistical agencies, without any threat for confidentiality.

To achieve that effect, the institutions managing specific registers of companies and individuals (central banks, tax offices, courts, social insurance institutions, public health insurance, population register etc.) should introduce – if possible – common identification and classification standards. But first of all, they should understand their common interest in mutual cooperation, they should see the synergy effect of integrity and data interchange, instead of continuing their "splendid isolation" policy.

The records of banks containing data on operations of individual clients and their financial operations may be used for statistical purposes as important administrative records. The methods and procedures of using bank information are the same, as in using other administrative records for statistical purposes (e.g. tax records or social security records). Problems and difficulties are also the same. The scope of information, codes, identification rules and classifications are tailored to specific "narrow" needs of banks, revenue services etc. Analyzing the scope and forms of data, it becomes obvious that minor extension of data and implementation of common standards may qualitatively change the usefulness. They may be very useful as the traced data or directly as the source data for statistical compilations.

Central banks in many countries are the banks of the central government; i.e., the taxes, customs and other duties are paid by legal and natural persons to the accounts of the respective government units (or "para-governmental" institutions) in central banks or in special banks selected by the government. Central banks are also often responsible for transferring budgetary resources to respective units financed by the government budget. e.g. all money transfers between all tax- payers and all tax offices are registered and stored, with full identification of subjects and objects. Introducing simple economic classification units and kinds of transfers, one could produce data for the statistical monitoring of the public sector of the economy.

Special attention should be paid to the use for statistical purposes of data stored in administrative record of clearinghouses. This kind of information, if well classified, may help to produce statistics representing detailed structures and dynamics of economic processes. An equally important and valuable source of information are information systems on debtors and credits.

Information systems of central banks could be used as the entry to administrative records of governmental information systems interchanging data with central banks. Also commercial banks providing banking services to governments are a relevant source of information for the production of statistics.

However, data and metadata stored, processed and used in the information systems of banks are not adjusted to direct use for the compilation of statistics. They should be adjusted to using them for statistical purposes by *introducing homogenous standards for codes, identifiers, classifications and other types of metadata* necessary for the compilation of statistics. Central banks are the institutions authorized to initiate the process of adjusting banking information systems as sources of economic information.

Financial data should be made interpretable in the categories of non-financial statistics. That was very difficult in the past. But in the last two decades new methods called *data mining* supported by modern information technology were developed. Analyzing the experiences and achievements of other disciplines in which data mining techniques are used, it seems that data mining methods and techniques may be very helpful in producing economic statistics from financial administrative records. However, up to now the experiences with the development of data mining and with practical verification methods for the production of statistics on the basis of primary records stored in central banks and in the banking sector are in a rather preliminary stage. More research is necessary to elaborate data mining standard models and procedures for the compilation of economic statistics.

7. The mission of central bank statisticians in the modern information infrastructure of the economy

In the modern information infrastructure of the economy, which is now under construction in many countries of the world, the central bank statisticians should re-think and re-define their mission.

Will they stay in their end-user position limiting their contributing to national and international statistical systems to traditional monetary and banking statistic, balance of payments and (in some countries) to financial accounts? Or – forecasting a strategic role of administrative records of the banking sector in the economy – will they take the advantage and responsibility for constructing a new architecture of official statistics based on the highly computerized financial infrastructure of modern economies?

Up to now most of administrative records are oriented to the needs of their owners. This must be changed. To utilize administrative records for statistical purposes, their owners should accept the fact that the information collected by them is – first of all – a national resource of social and economic knowledge, which should be available for all authorized users within the framework of the law. The development of administrative records should be coordinated as one common resource of knowledge, with minimized redundancy, a coherent methodology and uniformed retrieval mechanisms.

Four institutions seem to be predestinated to play a leading role in official statistics in a modern IT environment:

a National statistical offices (NSOs), as methodological and programming coordinators of the whole system of official statistics;
b Central banks , as managers and/or coordinators of information systems reflecting the financial side of the economy (businesses, households, governments);
c Ministries of finances monitoring the economy via the information systems of public finances: taxes, customs and government budgets,
d Social security systems, incl. health insurance monitoring labour, employment, unemployment, incomes of households etc. via information systems of social security records, pension funds, health insurance and social benefits.

The statisticians working in those four domains should jointly re-define their missions. Their main task should be the development and maintenance of coordinating tools (information standards), statistical frames (registers, database systems) and data mining methods for the production of statistics from administrative records.

The prerequisite of the harmonization of the information infrastructure of national economies and their international coherence is the implementation of common standards for mail layers of infrastructural information systems: common identification of subjects (legal and physical persons), classifications of types of units, economic activities, products and operations. They can be developed jointly by statisticians responsible for basic segments of the information infrastructure of the economy.

Central banks statisticians are predestinated to play an active role in creating the new, modern information infrastructure in cooperation with official statisticians working in the four areas specified above.

In adjusting information systems of the banking sector to its potential active role in the modern information infrastructure of the economy, the following barriers should be overcome:

- *"Legal gap"*. Respective changes should be introduced in laws regulating official statistics. In statistical laws the central banks should be given statistical competencies adequate to their duties. It seems that there is no need to change the laws on central banks. However, adjusting statistical law to a new partnership of statisticians may need more time then expected.
- *"Coordination gap"*. New forms of coordination of official statistics (programme, methodology, organization of surveys, dissemination of data) should take into account the specific position of central banks in official statistics. Coordination of official statistics requires specific organizational forms of cooperation of NSOs and central banks.
- *"Psychological gap"*. Central bank statisticians should identify their mission in official statistics as a part of the information infrastructure of the national economy. They shall understand that their responsibility is not limited to delivering statistical services to subject matter departments of the central bank itself and producing some statistics for international financial organizations, they are not "fine little helpers" of central bank economists. They should identify and accept their mission of architects of a modern information infrastructure of the national economy. Respectively official statisticians working in national statistical offices should accept the relations of partnership with statisticians of central banks.

The Irving Fisher Committee as the professional organization of central bank statisticians seems to be the best forum for discussion on the new mission of central bank statisticians in developing a modern information infrastructure of the economy. I hope that this – maybe controversial – paper

will stimulate the discussion on the problem of the mission of central banks statistics in official statistics and in the creation of a modern information infrastructure of the economy.

Summary

In this paper the potential possibilities, needs and advantages of a more active role of central banks in coordinating the information infrastructure of the national economy for better and more comprehensive informing of governments, businesses and central banks are analyzed. The use of information systems of and statistical standards developed within central banks as the tools for the coordination of official statistics is discussed.

Information stored and processed by banks represent financial aspects of all economic activities. In a modern IT environment data mining methods and techniques extend the possibilities of the use of this information for statistical purposes. To achieve that, the adjustment of those standards to the needs of coordinating official statistics, especially economic statistics is necessary. It is the prerequisite of integrity of banking statistics and statistics of the non-financial sector of the economy.

The mission of central bank statisticians and central bank statistics in a new information economy and in an information society should be re-defined. It seems that central banks statistics is predestinated to play an active role in creating a new, modern information infrastructure of economies and in coordinating official statistics.

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Cooperation between central bank and national statistical office as prerequisite of statistics development in transitional economies (Russia as a case study)

Ekaterina Prokounina (Bank of Russia)

The implementation of two long-term federal target programmes in Russia in the last 10 years has led to the emergence of new statistics, corresponding on the whole to the social and economic conditions of a country at the stage of transition to market relations. Russian statistics has managed to resolve a number of fundamental problems: to build a system of national accounts, compile a balance of payments and monetary statistics and create foreign trade and price statistics. A legislative framework has been shaped for statistical activity and co-ordinating of various government agencies in this area. As is the case in most other countries, the principal producers of statistical data in Russia are the National Statistics Office, known by its acronym as Goskomstat, the Central Bank, or the Bank of Russia, and the Ministry of Finance. This report presents a survey of the joint activities of Goskomstat and the Bank of Russia in creating and promoting the development of national statistics.

1. Rights and duties of Goskomstat and the Bank of Russia in the Field of Statistics

The powers and sphere of responsibility of Goskomstat have been determined by the Government of the Russian Federation. The Russian Government's Provision on Goskomstat describes the latter's duties as follows: (1) regulating and ensuring inter-sectoral co-ordination in creating national statistical resources, (2) compiling, protecting, storing and disseminating in accordance with the established procedure official statistical data on the social, economic and demographic situation in the country, (3) introducing and developing scientifically substantiated statistical methodologies and harmonising them with international statistical standards.

Each year Goskomstat draws up on the basis of proposals made by government bodies and other users of statistical data and submits to the Federal Government a Federal Statistics Programme, which establishes the main areas of statistical monitoring of the social and economic processes in Russia. In its various sections, the Programme contains a list of activities relating to the compiling of national accounts, price statistics, the labour market, living standards, foreign trade, performance indicators for non-financial organisations, etc., with a breakdown and periodicity of its implementation and deadlines for presentation to outside users. These activities are financed out of the federal budget. Statistical activities conducted by other federal government agencies (Ministry of Finance, State Tax Service, State Customs Committee, etc.) and the Bank of Russia, which are also regarded as part of national statistical resources, are described in a separate section.

The statistical activities of the Bank of Russia arise from the functions it performs and are regulated by the Federal Law on the Central Bank of the Russian Federation (the Bank of Russia). There are three main spheres of interest and responsibility of the Bank of Russia in the field of statistics.

First, the Bank of Russia compiles statistical data that are normally compiled by a central bank – monetary and banking statistics and balance of payments statistics. For this purpose, the Bank of Russia is empowered by the law to request and obtain from credit institutions the necessary data on their activities and require credit institutions to elucidate on the data it receives. In addition, a Russian government resolution requires the federal government bodies and foreign trade organisations

to pass statistical data to the Bank of Russia for the purpose of compiling the country's balance of payments.

Second, the Bank of Russia is a body that provides methodological guidance for statistical activities in the banking sector. To this end, the Bank of Russia establishes for credit institutions mandatory rules of compiling and presenting statistical data. These rules as well as reporting forms are contained in a separate regulatory document, approved by the Bank of Russia Board of Directors and published (with changes and amendments) in the Bank of Russia official publication *Vestnik of the Bank of Russia* (the Bank of Russia Newsletter).

Third, to perform the functions assigned to it by the legislation, the Bank of Russia conducts economic analysis and projections for Russia as a whole and for its regions and publishes the corresponding materials and statistical data. In this capacity the Bank of Russia is a major user of statistical data and therefore it is interested in seeing official statistical data improve in quality and become more analytical.

2. Areas of co-operation

It should be noted that the present forms and methods of co-operation between Goskomstat and the Bank of Russia did not appear overnight. When new Russian statistics emerged (1992-1996), the principal goal was to develop a methodology of statistical monitoring of the processes that reflected the establishment of market relations in the economy and lay down new organisational principles of inter-relationship between the structures compiling statistical data in the conditions of the changed system of economic management. Such principles were formulated in the Federal programme for Russia's transition to internationally accepted market-based accounting and statistical practices, which provided for co-operation between various government agencies in developing a methodology of *compiling macroeconomic statistical data.* One of the most difficult tasks solved by the Bank of Russia and Goskomstat at that stage was jointly elaborating such a methodology and beginning experimentally to compile the country's balance of payments.

Later, when the Bank of Russia began to compile monetary and financial statistics and conduct an in-depth analysis of the economy, the two organisations widened the area of their co-operation and realised the need to arrange a regular *exchange of information.*

To this end, in 1997 Goskomstat and the Bank of Russia introduced the practice of signing annual agreements on information co-operation. Since 2001 the two organisations have had a permanent agreement, which may be changed and amended whenever necessary. Today they co-operate in the following areas: (1) exchange of statistical and analytical data; (2) standardisation of identification of credit institutions in the Goskomstat and the Bank of Russia registers; (3) co-operation in introducing and using standard national classifications in processing statistical data.

The exchange of information is conducted in compliance with the lists contained in the appendixes to the agreement, which require the sides to provide information on a bilateral basis at federal and regional levels. Data included in the agreement are provided free of charge. The agreement also empowers the Bank of Russia to obtain from Goskomstat and its regional branches some other data not mentioned in the agreement (these include, for instance, data from the Goskomstat Register of Enterprises and Organisations needed for the Bank of Russia surveys of business activity of non-financial enterprises) for a charge covering the cost of preparing such information.

About half the statistical data received by the Bank of Russia under this agreement are data reported by non-financial organisations to Goskomstat and used in compiling the balance of payments. These are data on foreign investments in Russia and Russian investments abroad, the movement of corporate entities' foreign currency funds, foreign trade turnover, exports and imports of individual goods and services, Russia's cost-free financial and other aid to other countries, and so forth. All other data received under the agreement with Goskomstat are used by the Bank of Russia for analysis when preparing and publishing materials on the state of the country's economy, banking sector and payment system in a monthly issue entitled "Russia: economic and financial situation", the Annual Report and other analytical materials.

Under the agreement, Goskomstat receives on a regular basis the following data compiled by the Bank of Russia: monetary indicators (money supply, monetary base and monetary survey indicators), balance of payments data, data on the international investment position, data on interest rates on operations conducted by the Bank of Russia and credit institutions, exchange rates of foreign currencies, precious metal prices set by the Bank of Russia, government securities market indicators and selected performance indicators of credit institutions. These data are used by Goskomstat in compiling national accounts and balances of household income and spending and in drafting and submitting to the Government monthly reports on the social and economic situation in Russia and its regions.

Informational exchange in the form of an agreement was chosen according to the legal basis. As it is mentioned above the law determines the Bank of Russia accountability and reporting system. Under the law the Bank of Russia is accountable only to the State Duma and in this case can not provide the reporting information to other governmental bodies. Though Goskomstat may receive necessary information from the Bank of Russia only on the basis of mutual agreement. It should be noted that we haven't problems in informational exchange and the list of information provided by the Bank of Russia is expanding regularly.

Developing and introducing in national statistics the common Russian classifications of technical, economic and social information to replace the antiquated all-union classifications *is a significant area of co-operation between the two organisations.* Realising the importance of classifications for the exchange of information at all levels, the Russian government has set the procedure for conducting work in this area and established the sphere of responsibility of the government agencies and the Bank of Russia involved in this work. Specifically, the Bank of Russia is responsible for developing and introducing the common national classifications of currencies and payment turnover and preparing the section "Financial Intermediation" of the Russian classification of economic activity. Goskomstat, for its part, is to create classifications of the governmental bodies, regions, enterprises and organisations and forms of ownership. In addition, Goskomstat has been charged with the task of awarding classification codes to economic agents when identifying them and including them in the Goskomstat Register of Enterprises and Organisations and automatically introducing the common national classifications using its computer network, providing information from that database to all users. Under the agreement, Goskomstat performs this function by awarding credit institutions common national classification codes and including these institutions along with their codes in the Goskomstat Register of Enterprises and Organisations. The Bank of Russia also uses these codes by identifying banks in its Register of Credit Institutions. Goskomstat is also to provide the Bank of Russia on-line with the common national classifications necessary for compiling aggregate data on the country's banking system. The Bank of Russia, for its part, is to ensure the use of common national classifications in its computer and telecommunication systems.

As for other forms of co-operation, mention should be made of the joint organisation and holding of international seminars on monetary statistics and financial accounts, the participation of the Bank of Russia representatives in meetings of Goskomstat top management and the activities of the Goskomstat Methodological Council. The Council is comprised of government representatives and specialists and is a collegiate advisory body designed to promote inter-sectoral co-ordination of statistical activities, develop statistical methodologies and respond to the needs of users in official statistical data. The Bank of Russia representatives are members of three sections of the Council, dealing with macroeconomic, financial and money circulation statistics and IT uses in statistics.

3. Role of international standards in broadening co-operation

The initiative displayed by international financial organisations in developing standards in economic and financial spheres of their member countries activity had a favourable effect on the expansion of co-operation between Goskomstat and the Bank of Russia. Having realised the importance of complying with the requirements of one of the said standards, the IMF's Special Data Dissemination Standard (SDDS), Goskomstat and the Bank of Russia in 1997 urged the government to evaluate observance of the Russian practice of disseminating major macroeconomic and financial data with the SDDS. Taking into consideration the inter-agency nature of the project, the Government formed a working group composed of representatives of Goskomstat, the Ministry of Finance, State Customs Committee and the Bank of Russia, and appointed Goskomstat the project co-ordinator. The agencies concerned agreed the procedure for exchanging data inside the country, which complied with SDDS requirements, and additional improvements in their data dissemination practices to be in observance with prescribed requirements. As a result, in 1999 Goskomstat created the National Summary Data Page on its web-site, making available all data on Russia as required by the SDDS, except a data template on Russia's international reserves and international liquidity in foreign currency.

The dissemination of reserve template data in 1999 was considered by three organisations premature until the economic situation stabilises after the 1998 crises. Nevertheless the Bank of Russia started compiling the foreign debt, international investment position and reserve template data in accordance with SDDS. The main thing at this stage is the co-operation with the Ministry of Fi-

nance because this body provides a lot of information on future payments in foreign currency regarding foreign debt liabilities of the government. Besides there should be a joint decision on disseminating reserve template data because of the new approach to their disclosure allowing the users to predict foreign exchange reserves of the country.

4. Prospects for Co-operation

Russia has now formulated its priorities for statistics development until the year 2005, which arise from the objectives of the country's mid-term social and economic development and rest upon the basic principles of official statistics, approved by the UN Statistics Commission in 1994. The necessary condition of success in carrying out these tasks is considerably improving co-ordination between the organisations conducting statistical activities in Russia. As for the Bank of Russia, its principal objective is to promote the development of monetary and financial statistics in compliance with international requirements, bearing in mind that this way it will build a basis for compiling the financial accounts of the System of National Accounts (SNA).

The need to broaden the range of disclosed information on the country's financial sector and its individual components is linked with the efforts being currently exerted by the international public and governments, the Russian government included, to ensure transparency of the financial system, which is a crucial element in the evaluation of its stability. A major step in this direction will be the introduction to the Russian statistics of the principles of the IMF's new Monetary and Financial Statistics Manual, which recommends the transition from compiling a monetary survey on the basis of banking sector data to a survey of the financial corporations as a whole, including data on other financial intermediaries (insurance companies, non-governmental pension funds and investment trusts, leasing and other companies). At the first stage the Bank of Russia intends to include in these statistics data on insurance companies, investment trusts and non-governmental pension funds, which are most likely to have elements of money supply in their liabilities. A possibility is being discussed of obtaining such information from the agencies that regulate the activities of other financial intermediaries, such as the Ministry of Finance, Federal Securities Commission, Inspectorate for Non-Governmental Pension Funds, etc. Using its experience in inter-agency co-operation, the Bank of Russia is currently considering the possibility of tackling this problem with the participation of the Government and Goskomstat as the co-ordinator of the development of national statistics in Russia.

The new Monetary and Financial Statistics Manual may also requires a review of the sources of information and the methods of collecting and processing data. At present monetary statistics are compiled on the basis of accounting statements, which guarantees the necessary level of credibility of data, because the new Chart of Accounts, introduced in January 1, 1998, complies with the main international accounting and reporting standards and principles (residency, the use of currencies, the breakdown of internal operations into sectors and the classification of financial instruments). At the same time it is clear that it is impossible to derive information on stocks and flows from a balance sheet, as recommended by the new Manual, so special forms of statistical reports will have to be introduced and sample survey methods of collecting data may have to be used, depending on the amount of information requested. When tackling these problems, the Bank of Russia may find helpful its experience in compiling balance of payments data and Goskomstat's experience in ensuring credibility of statistical data during the transition to sample survey methods of data collection.

Prospects are good for co-operation between Goskomstat and the Bank of Russia in drawing up national accounts. At present the Bank of Russia calculates and passes to Goskomstat a number of aggregate indicators on the banking sector for GDP calculation and for the compiling of SNA current accounts. Since, in the opinion of the Bank of Russia, the SNA 1993 leaves some of these questions unsolved, a number of methodological problems arise in drawing up current accounts for the banking sector. These problems include the calculation of indirectly measured financial intermediation services (FISIM) and the choice of a market interest rate indicator for their distribution between intermediate and final consumption in various sectors of the economy as well as whether to take into consideration the data on banks with revoked licenses.

Possible solutions to these and other problems are now being actively discussed by Goskomstat and the Bank of Russia representatives with the participation of international experts. In addition, further steps are contemplated to develop the SNA, with special emphasis laid on the elaboration of the general principles of compiling and calculating the main account indicators for the institutional sectors and compiling on this basis a comprehensive system of accounts comprising the financial account and balance of assets and liabilities. The necessary condition of success in carrying out the tasks set for the current stage is the Bank of Russia's participation in building the

SNA, because a large part of information needed for compiling the financial account passes through the national banking system.

The Bank of Russia is interested in participating in broad discussions of the problems involved in compiling financial statistics and building a database for drawing up financial sector accounts, and we hope that the IFC will not ignore this vital area of present-day co-operation between central banks and national statistical offices.

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Outsourcing central bank operational tasks to a national statistical office – the Swedish case study

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General considerations on central bank activities

Over time the Riksbank has become involved in a number of activities, some of them not necessarily to be regarded as part of what is now seen as core business of the Swedish central bank. In order to increase the legitimacy and confidence with its principal, the Parliament, as well as with the general public at large, the ultimate owners – the taxpayers – the Riksbank has found it necessary to focus on its *core business*. This is particularly important for an institution that is granted substantial independence, such as the Riksbank.

The core business of the Riksbank includes the objectives according to the Riksbank Act, i.e. to maintain price stability and to promote a safe and efficient payment system. Other tasks according to the Act that should be seen as core business, is issuing notes and coins and managing gold and foreign reserves.

Legitimacy and confidence with owners, formal and ultimate, also requires that the Riksbank is as *efficient* as possible when performing its work. Hence, the Riksbank must not only consider what is has to do, but also how it is done. Efficiency aspects include cost as well as quality.

One way of focusing on efficiently performed core business is to separate policy tasks from operational tasks. This can be done by using *different departments* for the different tasks. One example of this is that the Financial Stability Department is responsible for payment system policy issues, while the Market Operations Department is responsible for running the large value payment system operated by the Riksbank. Similar division of responsibilities can be seen in the monetary policy area.

Another way of separation is that *outside organisations* performs the operational tasks (outsourcing). One example, in the past, the Riksbank owned the paper mill that produced the security paper and the printing works that printed the notes, Tumba Bruk. The Riksbank has now divested from its ownership of Tumba Bruk, and will in the future buy the notes from suitable producers.

Another example of outsourcing can be found in cash handling. The Riksbank has during many years taken a number of steps to make its distribution of bank notes and coin more efficient and cost-effective. In the 80's and 90's this was mainly achieved by a reduction of the number of Riksbank branches and staff (substituting staff with machines). This was followed up in 1999 by the establishment of a wholly-owned subsidiary, Pengar i Sverige AB ("PSAB"), into which the function of cash handling was transferred. The current operations of the PSAB can be described to fall into two parts:

(i) wholesale handling of cash and related services to department stores, banks and other customers in a highly competitive business environment, and
(ii) handling of the Riksbank's logistical stocks of cash, deliveries from and distribution of cash to banks, post offices and others (including value dating in the Riksbank's books).

In April this year the Riksbank decided to separate these two functions and to eventually transfer them to two separate companies, wholly owned by the Riksbank, with a view to preparing them both for sale. The first company might attract interest from private companies already in the market concerned, while the second company could possibly be purchased by the banking system or other supervised financial entities. One of the purposes of the system for cash distribution under construction is to have a cost structure which encourages the banks to re-circulate banknotes and coin between themselves so as to avoid deliveries to and distributions from the PSAB and thereby

decreasing the costs for society of cash distribution. Another purpose is to reduce the government subsidies embodied in the current system.

Another measure of this nature taken in recent years is to use external consultants in various fields more frequently as temporary support to the Riksbank staff. This is probably not unique among central banks. This has been the case both where necessary expertise is not available within the Riksbank (the recruitment of which would not be warranted on a permanent basis) or at temporary peaks of normal duties. The great bulk of such consultants contribute to the activities of the Riksbank in the areas of IT and legal (mainly corporate finance) support, security installations and management of the Riksbank's buildings. Such temporary external assistance is equivalent, in this context, to outsourcing of certain functions, wholly or in part.

Challenges for money and banking statistics in the Riksbank

The Riksbank is not the financial supervisory authority in Sweden, and the Riksbank does not focus on money supply in its monetary policy. Hence, the money and banking statistics produced by the Riksbank are probably more used by institutions outside the Riksbank than the Riksbank itself. These institutions include especially the ECB.

In recent years, the production of money and banking statistics within the Riksbank has confronted a number of challenges. These challenges were related to the quality of the statistics as well as the timely implementation of new statistical requirements or preparation for future requirements. This situation was in turn explained by lack of sufficient competence and IT-support.

In order to handle these challenges, the Riksbank was faced with two options. One option would be to rebuild the statistical organisation from top to bottom with additional competence and new IT support, while another one was to outsource the operations to an outside institution while keeping and concentrating the policy issues within the Riksbank.

When evaluating the pro's and con's with the two alternatives, it was considered whether or not there was a suitable vendor available. It was also analysed whether the operational task depended on a unique competence that only existed within the central bank

Statistics Sweden (SCB) is the National Statistical Institute in Sweden and is highly reputed as a producer of statistics, and the Riksbank had previously outsourced different statistical tasks to the SCB. The Riksbank has decided to change its collection of balance-of-payment statistics from entire-population reporting based on bank settlements to survey-based reporting. The conduction of parts of the survey is commissioned to the SCB. The Riksbank is also using other statistical information produced by the SCB as part of the statistics that is reported to other institutions, e.g. the BIS.

Since the Riksbank retain also for the future the responsibility for handling the policy issues, including regulatory tasks, decisions on methods and reporting requirements, within the Riksbank, there was no unique central bank competence required for collecting and producing the money and banking statistics. These tasks could instead benefit from the operational statistical expertise within the SCB. The SCB, as a government agency, is subject to the same secrecy legislation as the Riksbank.

There is no a priori necessity that all statistical information that is analysed within an organisation is produced by the same organisation. For example, inflation and GDP are key variables in the monetary policy analysis of a central bank. However, information about these variables is often not produced by the central bank.

Taking the above arguments into account,, the analysis showed that an outsourcing was a possible option. That option was also chosen for a number of reasons, one of the most important ones being that it was considered to imply the best preconditions of implementing the necessary investments and adaptations to prepare the Riksbank for EMU membership without undue delays.

This collaboration between the Central Bank and the National Statistical Institute also seems to be the best way of using the financial resources for the economy as a whole.

The future role of the Riksbank in money and banking statistics

With regard to the policy tasks, the future role equals the present role. The Riksbank will continue to be responsible for providing the statistics to its "clients", including institutions like the ECB, the BIS and the IMF, as well as to the general public. The Riksbank has the sole regulatory powers, and will decide on reporting guidelines and forms.

The role will change with regard to the operational tasks. The Riksbank will here be the principal and the SCB its agent. The agreement between the Riksbank and the SCB covers also future

new or changed reporting requirements. This is important taking into consideration Sweden being a member of the EU and a potential future member of the EMU.

Statistics Sweden – the centre in a clustered production of statistics

During the last decade the responsibility for official statistics in Sweden has been dispersed to several government agencies including the SCB. The objective of this change was to minimize any gap between competence in various subject matter areas and the actual production of statistics. The about two dozen agencies have thereafter developed the statistics in their fields aiming for accuracy and timeliness. The agencies were free to organize the production of statistics by their own assessments. This means that the production could be carried out by themselves, by outsourcing, on commission by others or in any other way. Adjusting to this the SCB, parallel to its own responsibility for official statistics, became an agent for statistical production on commission. The bulk of the official statistics under regulation of other agencies is produced by the SCB today. Close formal as well as informal relations have emerged in the system of official statistics, and the SCB might be seen as the centre in a clustered production of statistics, even more so when as the SCB is responsible for coordination of methods and other issues within the system.

The SCB offers a natural environment for money and banking statistics

Statistics on the economy is the single largest area of statistics at the SCB where core statistical products are National Accounts, Consumer Price Index and Financial Accounts. A consequence of the latter is that the SCB is an important domestic user of the Riksbank's money and banking statistics since this is a cornerstone in Financial Accounts and competence on the subject matter is therefore at hand. When the Riksbank approached the SCB assessing the SCB as a potential producer of the statistics, both the statistical cluster and the already existing competence at the SCB seemed to open for a solution similar to other agreements in the statistical network.

An agreement was set up in late 2001 defining the division of responsibilities and labour between the Riksbank and the SCB. As mentioned above, all responsibilities due to regulations and policymaking remain at the Riksbank, while all operational tasks will be transferred to the SCB. Ongoing decisions on which statistics should be gathered, compiled and disseminated will be for the Riksbank to make; decisions on operational issues such as technical data collection methods, IT-support etc will be for the SCB to make. This is in close harmony with how comparable production on commission is organised in the system for official statistics in general, and also a natural elaboration of earlier established statistical matters between the Riksbank and the SCB.

The task should not be underestimated

Even though the preconditions for the transfer were suitable, producing money and banking statistics is a major undertaking since it is an area of great complexity and reflects a sector of increasing importance where changes are rapid and sometimes dramatic. In order to meet the challenge, a project organisation has been set up at the SCB with the objective to create a fully working production group equipped with the necessary IT-tools and other abilities well in time for the start of the production in April 2003. The project focuses on the development of a tailor-made IT-system for data capture, compilation and dissemination, on subject matter competence and on planning for new statistics required by the ECB, the BIS and others. The regular production of money and banking statistics will take place within the same unit that produces Financial Accounts, and the integration of the two areas is aimed to synergistically enhance the quality of both products. The SCB welcomes the opportunity to produce the statistics and will add the commission to its production of core economic statistics.

Parallel to the project at the SCB, the Riksbank runs a project that approaches the same objectives from the principal's perspective. The two projects are working closely together on the transfer and on the building of the two-part organisation that will continuously collaborate on money and banking statistics from the point of time when it is in production at the SCB.

Conclusions

- The Riksbank had to solve problems with lack of quality of, competence in and IT-support for its production of money and banking statistics.
- The Riksbank had two options – to build a new statistical organisation from top to bottom or to outsource the production to a competent statistical organisation.
- The outsourcing option was the best way to prepare the Riksbank for EMU membership without undue delays and of using the financial resources for the economy as a whole.
- The Riksbank will keep the policy issues – being responsible against the users of the statistics, issuing regulations deciding on methods etc, with Statistics Sweden being the agent responsible for collecting and producing the statistics.
- Statistics Sweden has a longstanding experience as an agent for statistical production on commission, producing the bulk of the official statistics under regulation of other Swedish agencies.
- Statistics Sweden is responsible for and produces core economic statistics within the official statistical system such as National Accounts, Consumer Price Index and Financial Accounts

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Steps toward international comparability in general economic statistics

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1. Challenges

Monetary, banking and financial statistics now go far beyond supporting monetary policy decisions. For instance, they also support the analysis of financial stability. Priorities in general economic statistics do, however, fall short of user requirements in Europe, in particular with regard to the euro area and European aggregates. The challenges raised affect all Central Banks whether within the euro area or external to it[2]. Within Europe these areas of statistics fall within the Action Plan on EMU Statistical Requirements (EMU Action Plan). The EMU Action Plan covers quarterly national accounts, quarterly accounts for the government sector, statistics on labour markets, short-term business statistics and statistics on external trade. A fourth progress report was endorsed by the European Council (ECOFIN) in October 2001. To improve the statistical basis for economic and monetary policy making in EMU/EU, the Council asked that further improvements must be achieved in timeliness of key indicators so that EMU statistics get close to US standards of availability and timeliness within the next five years. This fourth report also stressed the need for a broader statistical basis on service activities, and a better balancing of priorities between speed, detail and quality of statistics. Among many challenges central banks and statistical institutes face, meeting improvements in quality (especially improvements to data timeliness) are particularly taxing. While the EMU Action Plan covers a wide range of macroeconomic statistics this paper highlights labour market statistics, productivity measurement and quarterly institutional sector accounts. The paper reviews these challenges and concludes with a section suggesting ways forward to meet these challenges.

2. Improving data timeliness without damaging quality

Continuous improvements in data timeliness (i.e. the amount of time after the reporting period with which a data point becomes available) is an ever elusive "holy grail" for central banks and their data suppliers. Monetary policy is forward looking but the results of the majority of macroeconomic statistics refer to the past. Therefore, in order to improve the understanding of the starting point for monetary policy assessment the preference for central bankers and similar users of short-term statistics is for more and more timely data. Data such as opinion surveys are not a substitute for quantitative data. This is because although they tend to be available after relatively short time delays they are normally based on consumers or producers subjective assessments and are therefore subject to external influences that quantitative data tend not to be. Short-term movements in these qualitative indicators therefore can give misleading messages if viewed in isolation to other data. It should also be recognised that data quality (in all its aspects) is an important factor when discussing data timeliness. It is not in the interests of central bank users to have timely data which is unreliable. However, if too much emphasis is given to timeliness the temptation is to improve it at the expense of accuracy. An example of this is the recent large revision of annual GDP in the United States which may, in part, be related to the speed with which the first estimates were made.

Nonetheless, an examination of the publication timeliness of harmonised statistics within the European Union shows a wide disparity and a general trade-off between timeliness and accuracy

1 *The views expressed in this paper are those of the authors and do not necessarily reflect those of the Bank of England or the European Central Bank. The Authors would like to thank Henning Ahnert (European Central Bank), Eunice Lau and Chris Daffin (UK National Statistics) for their comments and suggestions.*

2 *See also ECB Requirements in the field of general economic statistics, August 2000..*

is, in this cross-country comparison, not evident from the available data. For example the most timely producer of the publication of quarterly national accounts data in the European Union is the United Kingdom with a first estimate of GDP around 20 days after the quarter, and a number of EU countries release first and relatively stable first estimates after around 45-60 days. First European aggregates are published 65-75 days after the reference quarter (main aggregates and constant price figures only). At the other extreme, some of the slower reporting countries take 120 days or more[3]. It should be acknowledged that the currently used methods of compiling European aggregates (by aggregating national components) mean that they are unlikely to ever be as quick as the first national releases.

An international comparison of timeliness and the underlying factors, with a particular emphasis on speeding the compilation of Euro area results, was examined in detail in 2001 by a high level group of statisticians and users chaired by Statistics Sweden and Eurostat. Following this work the Statistical Programme Committee (chaired by Eurostat comprising the directors of European national statistical institutes) agreed a selection of further work which included:

a. Making a strategic commitment that by 2007 the release times for EU/EMU statistics should be as timely as in the US.
b. That studies should be initiated aimed at developing European wide surveys.
c. That actions and studies of methods to improve the timeliness of short-term economic statistics.

Among the suggestions to improve timeliness were: in-depth studies of good statistical practice within the EU; a common dissemination platform; more monthly statistics; benchmarking of monthly and quarterly statistics to annual statistics; earlier reference periods; and use of data estimation techniques. Work is underway to follow-up on these topics and even at this relatively early stage some improvements in timeliness can be discerned. However, from the point of view of a central bank user much of the timeliness challenge still remains to be achieved.

3. Improving data comparability and availability

While, as explained in the previous section, improved timeliness is an important issue for central banks the international comparability and availability of the macroeconomic data are also important. In order to explain this point further this section examines a non-exhaustive list of data-sets both from a European and a United Kingdom perspective.

3.1 Employment statistics

Occasional users of labour market statistics are often confused by both the plethora of data available for a particular variable and the different messages that data presents. For instance, a harmonised quarterly data point for a particular country for the level of employment in manufacturing can be potentially obtained from the European Labour Force Survey (LFS)[4], from data arising from the European short-term statistics Regulation (STS)[5] and from the ESA95 national accounts[6]. These different sets of statistics are produced in different ways and for different purposes. At the current juncture, it can be difficult to gain access to this data for some countries and some European aggregates are not yet available or have very poor timeliness because missing national contributions stop their calculation. This is likely to be a transient phase while the appropriate collection mechanisms are put in place by European Union countries in response to European regulations. This multi-source approach also brings challenges to producers of the data especially where data from the three sources exhibit very different trends.

When the definitions of the three sets of data are examined closely it is possible to see why the different results are reported. The data cover different sample populations, have different collection methods, etc. Nonetheless users in central banks, as principal users of short-term macroeconomic statistics, are often faced with the question of which result is the "correct" data. The answer given by data providers is often guided by the use being made of the statistic but, from a user point of view, where a statistic is at a high level of aggregation this can be a rather unsatisfactory re-

3 *See "Timeliness of Euro area general economic statistics" ECB Monthly Bulletin April 2001 for a more detailed discussion of this subject.*
4 *Council Regulation (EC) No 577/98 of 9 March 1998.*
5 *Council Regulation (EC) No 1165/98 of 19 May 1998.*
6 *Council Regulation (EC) No 2223/96 of 25 June 1996 (ESA 95).*

sponse. This is because for a user without in-depth knowledge of the collection methods underlying the data, it is difficult to understand why an aggregate level of employment differs between sources and is not indisputable.

Looking at the three sources mentioned above one can see that there are three different types of statistics which lead to these non-expert user difficulties.

a. Labour Force Survey (LFS): The data from the LFS are collected using sample surveys of households. The resultant microdata collected cover a wide range of variables about the status in the labour market (employed, unemployed, inactive) which can be cross classified by many aspects (area of the economy the respondent works in, skill level, educational level, number of hours worked, etc.). The data also look retrospectively at the respondents' labour market status potentially allowing some inter-temporal analysis. The LFS is therefore a very rich source of labour market data. However, it will not be possible to calculate quarterly average European aggregates from this source until 2005 due to the lack of data from Germany. The data at that point is expected to have a timeliness of around 90 days. At present, annual point estimate data is collected in the Spring of each year with results becoming available only after around 9 months. European aggregates are calculated only when all underlying national data is available.

b. Short-term Statistics (STS) Regulation: the data from the STS Regulation comes from Business surveys. It is divided into very detailed data for:
   (i(Industry: Main Industrial groupings and NACE 2-digit activities.
   (ii) Construction: at least NACE 2-digit activities.
   (iii) Retail trade: only for total, food and non-food plus the breakdown of non-food activities (three sub-groups).
   (iv) Other services: NACE 2-digits activities for wholesale trade, hotel and restaurants, transport and communications, computer and related activities.

   The data are produced at a quarterly frequency (although in particular countries monthly data is available for some of the breakdowns) and is expected to be available after 90 days. There is some discussion to improve this timeliness but these are at a very early stage. European aggregates are calculated when 60% of the underlying data are available. The remaining 40% are estimated using simple Arima forecasts.

c. ESA95: National accounts data are often amalgamated from the two former sources along with any other reliable sources. Quarterly data are expected to be available after 120 days for a breakdown by six main economic activities although an amendment to the ESA95 Regulation, which is under discussion as part of the EMU Action Plan, stipulates this should fall to 70 days. The same amendment to the Regulation will additionally provide hours worked data for the same breakdown.

Given the process of amalgamation of the different sources of data the ESA95 data are figures which are most often advised by European Statisticians for use for short-term economic analysis as performed in central banks. Unfortunately, the link to the useful detail provided by the data in the LFS and STS Regulations is lost in the compilation process. This is a drawback for both short-term analysis of the data and for structural analysis. One approach which can be used to reconcile the differences and allow linking of different sources is to have some sort of satellite accounts attached to the ESA95 accounts. This approach (known as social accounting) is being investigated by several countries and at a European level as well as being in operation in the Netherlands. Unfortunately, the procedure remains at an experimental level and it remains to be seen if the process could achieve results which can also fulfil central banks needs for high timeliness of data.

3.2 Productivity, Compensation per employee and Unit Labour Cost estimates

All three of these ratios are important to Central Banks for macroeconomic analysis (especially inflation) as well as comparisons of international competitiveness. They also depend crucially on the timeliness and quality of the input data needed for the calculations. Productivity is difficult to measure accurately as it combines data on output and employment and these have historically been measured using different surveys and different methodologies. Some of the current challenges for each are described below:

a. Productivity is defined for the purposes of this paper as either GDP per person employed or per hour worked. As discussed above the current reliability of employment data can be called into question and remedial work is required. Quarterly data on hours worked is, at present, not obligatory under the ESA95 Regulation although an amendment of the Regulation is underway to change this aspect. This means that a reliable comparison of productivity cannot currently be easily made.

b. Compensation per employee – this variable also relies on the quality of the employment data. In addition, the ratio requires the availability of data on compensation of employees on a timely basis. The ESA95 Regulation currently stipulates that the compensation data should be available on a quarterly basis within 120 days of the quarter and broken down into six branches of the Economy although it is expected that a change to the Regulation will mean that this will drop to 70 days. At present this timetable is unfortunately not fulfilled by all Member states of the European Union. This means that European aggregates cannot be calculated in the most timely basis. Eurostat published for the first time whole economy compensation data in 2002. This estimate was produced in Eurostat's 3rd release of national accounts data after 120 days which for Central Bank purposes is rather late. The breakdown of the data has not yet been made available.

c. Unit Labour Costs (ULC) are the ratio of compensation per employee and labour productivity. They are often used by Central Banks as a broad measure of labour costs and hence in the assessment of inflation and competitiveness. Obviously the quality of the ULC data depends on the input variables of its components.

3.3 International Comparisons of Productivity (ICP) – work being undertaken in the UK

In the UK, the Office for National Statistics (ONS) has instituted a range of developments to improve the national measure of productivity. The foundation for this has been a new, comprehensive Annual Business Inquiry which collects output and employment data together across the whole economy. The existing employment data have been reconciled with this and the resultant new productivity series for the whole economy published in a press release, 'Productivity'. Until now, the ONS has not published productivity estimates for the service industries and the ONS places a high priority on improving measures of service sector output. Productivity for the production industries has been published for some time and new experimental data has provided labour productivity measures for non-production industries[7].

Measures used by the ONS under International Comparisons of Productivity (ICP) are output per worker and output per hour. The latter is only published as experimental data, reflecting the fact that methodologies of average hours worked estimates have not achieved satisfactory consistency yet across countries (see also Section 3.1 c). Apart from employment, average hours worked measures may also require the same level of international attention. ONS official labour productivity measures for the UK and the breakdowns are in terms of output per job, as opposed to output per worker (and output per hour worked). This is to achieve data consistency between the numerator and the denominator of the productivity ratio. This shows that just getting more timely and accurate employment data (for industrial subsections) is only one part of the story. As highlighted in the discussions in the previous section on employment data one needs to check if the classifications of the component series are consistent or not and if they are coming from different data sources (say, business surveys – such as for the STS versus household surveys – LFS). The ONS has taken over from the UK Department of Trade and Industry, the responsibility of publication of international comparisons of productivity. The ONS does have a series of international comparisons of productivity based on sources at the OECD and published twice a year to dovetail with the publication of the component data[8].

3.4 Quarterly sector accounts

Central Bank users would like to analyse quarterly financial accounts for all sectors and the indicators for the household and company sectors. These indicators would show household savings and

7 *See www.statistics.gov.uk/press_rerlease/Experimental.asp.*

8 *Details are available at, www.statistics.gov.uk/productivity.*

wealth ratios, investment of non-financial companies, profitability and net borrowing and lending of companies. At present, long series of annual data are not available: annual data for some years are incomplete; and significant differences exist in the comparability of euro area accounts when broken down by institutional sector.

3.5 International comparisons of business investment – the UK experience

In the UK, the Department of Trade and Industry and HM Treasury have expressed interest in the ONS taking responsibility for international comparisons of business investment. The ONS are currently conducting a study as to how this might be done. Difficulties so far identified include: the definition of business investment. There are potentially three approaches – by assets, by ownership and by industrial sectors. An international definition does not exist and having a well defined one would help the start of the project. When doing international comparisons of investment, it is normally scaled by a particular variable, the most common one id GDP. While investment as a percentage of GDP has a precise meaning at current prices, its meaning is less clear at constant prices. Thus, consideration may be given to other scaling variables, such as investment per capita or investment per worker. There is also the choice of which PPPs to use. The choice is more complicated when one has to consider whether a deflator for consumption or a deflator for investment goods should be used.

Internationally comparable data sets for productivity and investment are not readily available. Eurostat's Structural Indicators only have growth rates while the data held on New Cronos (Eurostat's main public database) has a strong disclaimer. Similarly, the OECD data set does not guarantee comparability.

In using the NSIs' National Accounts, there are two difficulties: data required to derive consistent business investment are not necessarily available and non-harmonised metadata leading to difficulties in comprehension of the data. International comparisons of business investment must also be informed by the development of software investment estimates across countries. Any international comparisons of productivity and investment would have to include US or they would not be complete. Note that the US (and Canada and Mexico) have plans to move to a new, completely different classification from the Standard International Classifications in the not so distant future. This is likely to further complicate the difficulty in international comparison.

4. Conclusions

As detailed in the Challenges section the ideal from a central bank perspective are timely indicators without sacrificing quality. A wide breadth of information is important without necessarily significant detail. Integration of sources is also desirable and a good starting point for this is the integrated system of ESA national accounts.

Until the preparatory work at a European level of the potential methods aimed at to improving timeliness is completed it is not easy to see exactly which of the list will bear most fruit. However, the large amount of work being undertaken on this aspect is testament that producers of the data also believe that this is both worthwhile and achievable. Whatever the results of the work it is likely that timeliness in most indicators can be improved without deterioration in quality. The fact that the work is being done at all also shows the benefit of close co-operation between producers of data and central bank users. In this case the co-operation has led to the statistical system working to satisfy users needs.

Given the preference for integrated statistics it seems sensible that those monthly and quarterly statistics which underpin the quarterly national accounts are the ones which deserve priority. This is particularly the case when aiming for improvements in the timeliness of the national accounts themselves. The EMU Action Plan proposes that European countries produce a full set of quarterly national after 70 days. This would lead to a much faster and complete compilation of European aggregates based on a fuller underlying country coverage and rather than the current situation of a first release of a reduced set of European aggregates after around 70 days, a second release with higher underlying coverage and increased number of variables after around 100 days and a large, but still incomplete, set available after 120 days.

The improvements in timeliness of ESA95 national accounts data are likely to be as a result of improvements in the timeliness of the source statistics needed in compilation process. If this is the case it may also be possible for a much earlier flash-estimate of European national accounts main aggregates potentially based on source data rather than aggregating national series – perhaps with a timeliness of around 45-50 days.

A timely set of social data accounts-closely integrated within the national accounts framework-would also be beneficial. However, a fully integrated data set is still only at an experimental level. Therefore, an interim improvement would be the establishment of either clear guidance to data users regarding the linkages between the ESA data-set and the more detailed data provided by the LFS. Or, preferably, the establishment of an integrated data-set based on statistical and econometric relationships of the data, rather than the more in-depth analysis and compilation processes underlying fully-fledged social accounts. To improve timeliness in the calculation of this data-set particularly for European aggregates the use of statistical techniques, could be undertaken to fill missing national data rather than waiting for all underlying data to become available before calculating an aggregate.

The improvements both in terms of availability of data and coverage outlined above in both the national accounts and social statistics domains would allow improvements to productivity and compensation variables which are closely monitored by central banks. This should, in turn, lead to coherent international measurement of productivity and investment, ensuring consistency in the definitions and methodology.

The area of quarterly accounts by institutional sector is now under review by an Eurostat/ECB Task Force. Work could lead to a proposal for a regulation on quarterly sector accounts.

Abstract

Central bank responsibilities to ensure price stability depends in part on the provision of accurate, consistent and timely data with long time series. Central bank responsibility for the stability of the financial system requires consistent data for the structural analysis of the economic sectors and for the monitoring of possible threats to financial stability. In the case of general economic statistics, this depends on co-operation with national statistical offices to produce timely economic indicators. This enhanced co-operation between the European System of Central Banks and the European Statistical System is already proving beneficial with many improvements already in place or on track. However, the challenges of meeting new data requirements continues to require a greater focus on setting priorities for developing further the present set of economic statistics by concentrating on the production of timely and quality statistics for a more aggregated set of indicators. While these aims are relevant for many general economic statistics this paper sets out these challenges for specific cases of international comparison both at a European level and from the perspective of a the United Kingdom. It also tentatively suggests potential ways that the issues can be taken forward.

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Challenges facing a monetary union in cooperation in statistical activities: the case of the Eastern Caribbean Currency Union

Outline of presentation

Gale Archibald (Eastern Caribbean Central Bank)

This presentation outlines some of the statistical activities that the Eastern Caribbean Currency Union (ECCB) has engaged in or encouraged, with the sole objective of improving the statistical capacity of its member states. It describes the challenges facing a monetary union of small open economies, where resources are scarce and social and economic needs are great. The challenges facing the ECCB are described with examples of activities under four roles assumed by the central bank: co-ordinator, catalyst, facilitator and assistant. The bank takes on these roles to employ strategies for co-operation without compromising or undermining its relationship with the components of the statistical system that describes the union.

The statistical system is characterised by eight national statistical offices (NSOs), each established in the ministry of finance of the respective member states. The system also includes activities of the ministries of finance which produces data on the government fiscal operations and of course the central bank, as the producer of monetary and financial statistics.

An ideal statistical system for monetary union is one where all the stakeholders are actively involved in all processes to produce relevant and timely data. These stakeholders would include users, producers, respondents and governments. They would have recognised and accepted that statistics is a public good, applicable to, and needed by, all sectors of a nations' society and economy.

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The role of Eurostat in the exchange of statistical knowledge between statistical offices and central banks: the CMFB experience

Background paper

Bart Meganck (Eurostat)

This paper focuses on the learning, rather than the teaching, of statistics in the context of Eurostat's role in developing statistical programmes and the transfer of statistical knowledge for the implementation of monetary union in Europe. It was against this background that the Committee on Monetary, Financial and Balance of Payments Statistics (CMFB) was established, bringing together senior officials responsible for statistics at central banks, senior statisticians at statistical offices, Eurostat and the European Central Bank statistics directorate in order to foster consultation and cooperation in areas of common interest. One of the important milestones achieved in the CMFB concerns work on new statistical methods, harmonisation, the exchange of experience in the use of statistical techniques and the general exchange of new statistical knowledge. Such knowledge transfer has not been restricted to members of the European Union but has also influenced statistical programmes of other countries, in particular candidate countries for accession to the European Union. They have a major interest in exchanging knowledge and learning more.

1. Preliminaries

The signing of the Treaty of Maastricht in February 1992 set Europe on the road to monetary union by the end of the century. Eurostat was keen to anticipate the new statistical needs which monetary union would give rise to, in terms of both the economy "proper" (essentially the responsibility of the statistical offices) and the financial sphere (basically the jurisdiction of the central banks). The Statistical Programme Committee (SPC), which was created in 1988 and brings together the directors-general of the national statistical offices, was able to meet many of those needs, particularly those relating to the economy "proper". Others, however, could only be met with the help of the central banks. The European Commission was all too aware that central banks were accustomed to deciding for themselves what information they required for policy purposes, and that it would not be easy to persuade them to take part in constructive cooperation if their own interests could not be guaranteed. A committee on which only the central banks were represented was liable to take decisions which conflicted with those of the SPC. It was therefore important for that Committee to include representatives of the statistical institutes. Eurostat, in particular the Director-General Mr Franchet, undoubtedly played a pioneering role by setting up the CMFB (Committee on Monetary, Financial and Balance of Payment Statistics) in April 1991, bringing together senior statisticians from the statistical offices and top-level representatives of the central banks.

The CMFB has been in existence for 10 years now. Can it be regarded as a success story? Or is it just another talking shop, with precious little to show in the way of action? Or is it the other way round? Certainly, its first few years were less than a dazzling success: the fault lines between the central banks and the statistical offices were simply too great. Most of the national representatives of the two sides had hardly met until the Committee's inaugural session in Luxembourg in April 1991. The Committee spent its first years in search of an identity, defining its role and trying to resolve conflicts of competence. Gradually, however, the two groups got to know and appreciate each other, and the Committee's political importance quickly became apparent, which certainly

helped to foster a spirit of cooperation. A major breakthrough occurred when it was decided that the Committee should no longer operate solely on behalf of the European Commission (its original purpose had been to advise the Commission on the integration of monetary, financial and balance-of-payments statistics in the European Statistical System), but should also advise the forerunner of the European Central Bank on statistical cooperation. Once that decision had been taken, the Committee was in a position to reconcile central bank autonomy with the aim of creating a genuinely *European* statistical system.

Before addressing the substance of this paper, it is worth noting some milestone developments in the history of the CMFB:

- the compilation of an inventory of requirements for the future European Central Bank;
- the CMFB's role in coordinating the compilation and use of statistics by the European System of Central Banks and the European Statistical System (via a network of European statistical institutes);
- its role as quality watchdog for Maastricht-related statistics, which were crucial for deciding whether the Member States had passed of failed their EMU "entrance exam", and which were therefore politically extremely sensitive;
- its part in securing greater independence for statistical procedures vis-à-vis the respective governments, which were keen to apply creative accounting techniques to their own advantage in their national data;
- last but not least, its important role in the exchange of statistical knowledge between statistical offices and central banks.

2. The CMFB and the exchange of statistical knowledge

As already mentioned, one of the CMFB's main achievements over its ten years of existence has been the role it has played in the exchange of statistical knowledge between statistical institutes and central banks. This exchange of knowledge has focused on four major themes:

- aspects of methodological approach and the associated harmonisation of EU statistics;
- harmonisation of statistical techniques;
- contribution to TES (Training of European Statisticians) courses;
- transfer of knowledge to candidate countries and other countries.

2.1. Methods and harmonisation

Like the International Monetary Fund (IMF), the United Nations Statistical Commission and the OECD, Eurostat has always played a leading role in the development of new sets of statistics and in adapting existing ones. Generally speaking, however, international institutions tend to restrict themselves to creating a reference framework (e.g. the System of National Accounts 93, the fifth Balance of Payments Manual). This leaves individual states plenty of scope for interpretation when compiling a particular set of statistics. The fact that Member States enjoy such a broad measure of freedom when filling in this reference framework certainly does not make for greater comparability – hence the increased need for harmonisation.

The acute need to harmonise certain sets of statistics of key importance in the policymaking sphere became very apparent in Europe in the 1990s with the creation first of an economic union and then of a monetary union. Examples of this are legion – the most striking one being that of GNP, which is used as the basis for calculating Member States' contributions to the budget of the European institutions. Other extremely important sets of statistics were the Maastricht criteria (inflation, development of public deficit and debt), which were the decisive factors in the Member States' "entrance examination" for monetary union. Separately, there has been a greater demand of late for statistics enabling comparisons to be made between the most important currency zones: the euro zone, the USA and Japan.

Experience has shown that it is impossible for a single institution on its own to fill in the reference framework using the specified methods. The task can only be accomplished if various institutions from the Member States are brought together in order to conduct, together with Eurostat, an in-depth analysis of the problems involved. By bringing the strength of the central banks and the national statistical institutes into focus in the CMFB, Eurostat created a genuine forum in which national approaches can be compared with the aim, amongst other things, of distilling out the best practices. Whenever economic phenomena are measured, it is usually the case that various methods are used which are acceptable to varying degrees. In such circumstances it is not always obvi-

ous how to secure a sound compromise between Member States as to which methods should ultimately be discontinued. To this end, the CMFB uses its various working parties and task forces comprising representatives from Eurostat, the European Central Bank, national statistical institutes, central banks and sometimes external experts. This has even led to Eurostat developing, in some statistical domains, a kind of "case law" which has been adopted by other international institutions. A recent example of this was the posting in the national accounts of the auctions for third-generation mobile phone licences.

The exchange of experience gained with national methods and the associated in-depth discussions enable Eurostat subsequently to draw up reference handbooks which give a detailed description of how general statistical concepts are to be harmonised. Here, too, examples are legion: over recent years, Eurostat has, together with its partners, produced handbooks on public deficit and debt, volume and price measurements in national accounts, the drawing up of quarterly accounts and input and output tables. Thanks to the transfer of knowledge generated by this approach, the statistics produced by the various Member States have become much more comparable, as the methods used have become distinctly more transparent. This aspect of harmonisation is of course extremely important given that recent years have seen a major increase in the use of statistics for administrative purposes.

2.2. Harmonisation of statistical techniques

The harmonisation of statistics involves harmonising not only concepts and statistical methods but also statistical techniques. How can comparability be guaranteed if the Member States' sampling techniques differ markedly or if seasonal adjustments are made in different ways. In the latter field in particular, the CMFB and Eurostat have played a leading role. Seasonally adjusted series are becoming more and more important in the case of statistics used as a basis for policy-making. Only seasonally adjusted series give a clearer idea of the economy's underlying momentum (whether it is speeding up, slowing down or has reached a turning point) and facilitate comparisons with other major economies (USA, Japan). The compilation of such seasonally adjusted series for the euro zone and the EU is currently unsatisfactory, and this attracts criticism from the main users, such as the European Central Bank, scientific circles and financial market operators. Uncertainties concerning the momentum of the economy definitely have a negative effect on monetary policy.

Member States use a whole range of seasonal adjustment techniques, including various versions of Arima, Tramo Seats and in-house developments; this makes the comparison and interpretation of national series a virtually impossible task. The CMFB felt it could play an important part in the exchange of national expertise in this field. The most important challenge facing CMFB task forces was to convince national experts that their (national) methods were not necessarily the best ones and that everyone would benefit if an identical method were used. Such a task naturally involves challenging long-established traditions, which is not always the obvious course of action to take. It became clear that progress could only be made if the debate were not restricted to the theoretical domain but were also conducted in the practical arena, in other words by working with case studies. Only by reference to concrete cases can Member States be convinced of the appropriateness of taking a new approach.

The CMFB wishes, however, to pursue still further the avenue it has struck out along and has brought together the leading experts in the two most important seasonal adjustment techniques, namely the US Bureau of Census (Arima model) and Professor Maravall from the Bank of Spain (Tramo Seats model), with a view to integrating the best aspects of the two systems.

Another important and recent example of the transfer of statistical knowledge relates to the problems involved in sampling. Central banks generally have little experience of this technique, which they will be obliged to use in the near future in the context of a thorough-going reform of the European system for collecting data for balance of payments statistics. With the introduction of the euro (international payments in the euro zone are regarded as national payments), banks no longer have to report individual transactions. Instead, a survey-based system is being introduced to cover companies. An exchange of sampling experience between countries with a bank-reporting system and countries with a survey system is currently underway and must enable the former to adapt their data-collection system quite quickly to the changed circumstances.

2.3. Contributions to TES courses

In 1990, Eurostat established the TES (Training of European Statisticians) Institute with the aim of organising training courses covering all possible fields relating to operational statistics. Thanks to

the creation of the CMFB, central banks also became more and more involved in this training, primarily as participants in courses but gradually also on the instruction side. Given their virtually exclusive competence in certain statistical domains (financial statistics), they created specific added value in this training project.

2.4. Exclusivity of EU Member States?

From this outline of three subject areas, it is clear that Eurostat, via the CMFB, has played a central role in the statistical learning process. During the initial phase of its existence, the Committee was of course run along the lines of a "select club", with everything being restricted to the "inner circle". The more the CMFB took on its own identity, however, and the better its role was defined, the more it opened up for other partners.

This primarily happened by way of involving the candidate countries in its activities. Since 1996 annual meetings have taken place with representatives of these countries in order to map out the strategy for the transfer of expertise. The approach has been to pursue the widest possible range of options:

- observer-status participation in CMFB working parties and task forces;
- seminars on specific topics conducted by members of the CMFB and Eurostat;
- organisation of occasional conferences, particularly in the context of national accounts and price index figures.

The overall aim is to prepare the candidate countries for accession to the European Union, which will only be possible when they have met all the requirements (including statistical ones) applying to the current Member States. Without a major transfer of knowledge, particularly in the conceptual and methodological fields, it would clearly be impossible for the applicant countries to achieve this.

Cooperation was subsequently extended to include countries outside Europe, particularly on the African continent, where two monetary unions *"avant la lettre"* already exist. During seminars organised respectively with the UEMO (Union Economique et Monétaire de l'Ouest Afrique) and the CEMAC (Communauté Economique et Monétaire d'Afrique Central) the CMFB model was presented. The aim was to promote a transfer of statistical knowledge between statistical institutes and central banks. It is doubtless the case that, in countries where statistical resources are much thinner on the ground, it will not be possible to make substantial progress until such time as the expertise built up in these international fora can be drawn on and closer cooperation can take place between two important – if not the most important – producers of statistics in a particular country.

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