IRVING FISHER COMMITTEE
ON CENTRAL-BANK STATISTICS

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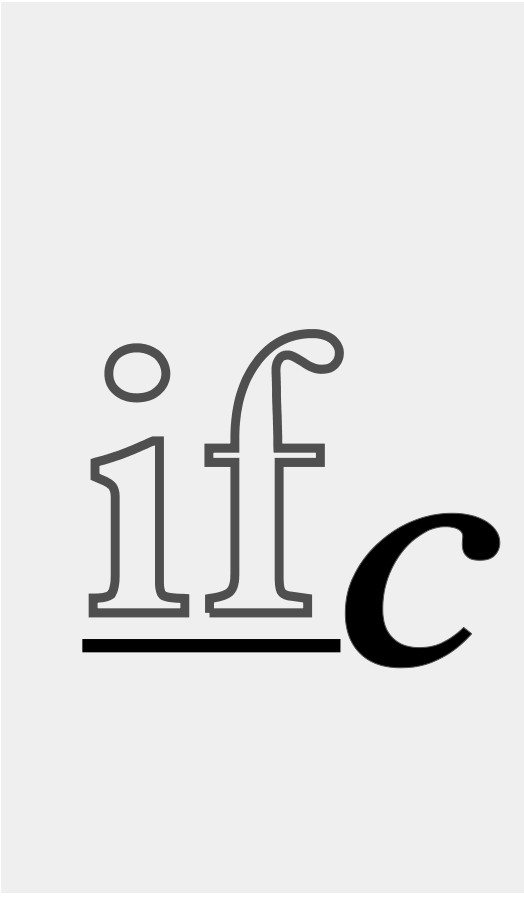
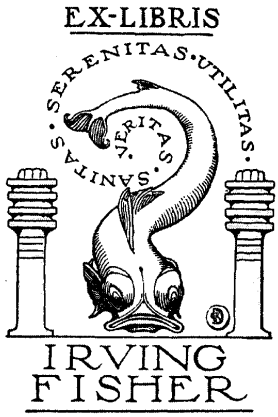


The Irving Fisher Committee is part of the International Statistical Institute

Contents



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Contents

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

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. 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.

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 (BIS), which hosted it at its premises in Basle. 160 statisticians representing 73 countries participated. Some 50 papers were presented. In 2004, another IFC "Basel Conference" was held in cooperation with the BIS. Some 150 statisticians, mainly central bankers, and originating from 65 countries, discussed "Central Bank issues regarding Financial and National Accounts" in three sessions and eight workshops.

In 2003, at the 54th ISI Session in Berlin, the IFC participated with nearly 40 papers, presented in two Invited Papers Meetings and three Contributed Papers Meetings. The General Assembly of the ISI accorded to the IFC the Status of an independent ISI Section on a provisional basis up to the 55th ISI Session (Sydney, April 2005).

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. Institutions and individuals active in the field of central-bank statistics can subscribe to the Bulletin free of charge.

Second "Basel Conference", 9-10 September 2004

The conference on"Central bank issues regarding National and Financial Accounts", organised by the Irving Fisher Committee in co-operation with the Bank for International Settlements (BIS) was attended by some 150 statisticians, originating from 65 countries. More than 50 papers were discussed in three sessions and eight workshops.

The Proceedings of the conference are published in the IFC Bulletin, and are also accessible on the IFC website *(http://www.ifcommittee.org)*. In view of the great number of papers, the conference documents will be spread over several issues of the Bulletin. In the present issue, the Keynote presentation as well as the documents relative to Session 1 and Workshops A and B are reprinted.

Participation of the IFC in the ISI Session, Sydney, 2005

The Irving Fisher Committee will participate in the 55th Session of the International Statistical Institute (ISI), to be held in Sydney, from 5 to 12 April 2005. The IFC contribution to this event will basically be structured along the same lines as in Istanbul (1997), Helsinki (1999), Seoul (2001) and Berlin (2003), which means that a number of meetings will be organised by persons representing our Committee. Some provisional information on these meetings (five Invited Papers Meetings and at least one Contributed Papers Meeting) is presented on the next pages. More recent information is available on the website of the ISI Session: *http://tourhosts.com.au/isi2005*.
The papers presented at these meetings will be published in the IFC Bulletin and on the IFC website.

Recommendations for authors of papers to be presented at the ISI Session

Any persons wanting to submit a paper at a meeting organised on behalf of the IFC are requested to follow strictly the procedures and deadlines laid down by the ISI on its website. **In addition**, the recommendations here below should be respected in order to allow the IFC to properly prepare the meetings and enable publication of the conference documents in the IFC Bulletin and on the IFC website.

Contributed Papers

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

Invited and Contributed Papers

- Submit the **abstract** of your paper **at an early stage**, but not later than 6 December 2004 to both the IFC Secretary *(rudi.acx@nbb.be)* and the Editor of the IFC Bulletin *(wucwo@wxs.nl)*. The abstract should contain no more than 300 words.

- Submit the **final version** of your paper as soon as possible, but **not later than 6 December 2004**, 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 paers), the IFC encourages authors to submit a more **comprehensive** version of their papers for publication in the IFC Bulletin and on the IFC website. Extended versions should be made available to the Editor of the IFC Bulletin immediately after the conference at the latest. They should, as a rule, not exceed 20 pages.

To facilitate reprinting in the IFC Bulletin, any documents should be in accordance with the guidelines on page 7.

Participation of the IFC in ISI Session, Sydney 5-12 April 2005

Provisional Programme

Invited Paper Meetings

Friday 8 April 2005
09:00-11:15

- **IPM 4 – Cost, Quality and Relevance of Financial Statistics**

  Chair: *Coen Voormeulen (De Nederlandsche Bank)*

  Papers:

  Usefullness of commercial statistics
  Paul van den Bergh (BIS)

  Potential impact of Basel II on data availability from banks
  Myrtl D. Halsall (Bank of Jamaica)

  Future challenges in compiling Balance of Payments and International Investment Position
  Jörgen Ovi (Danmarks Nationalbank)

Friday 8 April 2005
13:00-15:15

- **IPM 5 – Financial Soundness Indicators**

  Chair: *Sean Craig (International Monetary Fund)*

  Papers:

  Practical Challenges in producing and using Financial Soundness Indicators
  R. Sean Craig and Armida San Jose (International Monetary Fund)

  Financial Indicators for monitoring risks to financial stability in Europe
  Jukka Vesala (European Central Bank)

  Statistics on real estate prices: the need for a strategic approach
  David Fenwick (Office for National Statistics, UK)

Friday 8 April 2005
15:30-17:45

- **IPM 6 – Accounting Standards and their impact on Financial Statistics**

  Chair: *Michel Stubbe (European Central Bank)*

  Papers:

  A comparison of the main features of accounting standards and statistical standards and review of the latest developments in the field of the accounting standards
  Patrick Sandars and Paolo Poloni (European Central Bank)

  Accruals accounting and budgeting in the General Government sector
  Measurement and collection issues for financial statistics arising from the development of accounting standards
  Lucie Laliberté (International Monetary Fund)

  Discussant: *Jean Cordier (Banque de France)*

Thursday 7 April 2005
15:30-17:45

- **IPM 85 – The development of National Quarterly Accounts by Institutional Sector**

  Chair: *Richard Walton (Bank of England)*

  Papers:

  Producing an integrates set of quarterly institutional sector accounts
  Robin Lynch (Office for National Statistics, UK)

  Links between the Balance of Payments and the compilation of the Rest of the World Account
  Beatrice Timmermann (Deutsche Bundesbank)

  The challenges in producing Quarterly National Accounts by Institutional Sector
  Alessandra Agostinelli (ISTAT, Italy)

  Discussant: *Peter Harper (Australian Bureau of Statistics)* and *Bart Meganck (Eurostat)*

Thursday 7 April 2005
15:30-17:45

- **IPM 89 – Optimal methods for Data Quality Improvements in Financial Statistics**

  Chair: *Luigi Federico Signorini (Banca d'Italia)*

  Papers:

  Optimal filters
  Augustin Maravall (Banco de España)

  Robust statistics for income data
  Maria Pia Victoria-Feser (University of Geneva)

  Assessing data quality
  Carol Carson (International Monetary Fund)

  The use of sample data to improve the quality of financial statistics
  (Banca d'Italia)

  Discussants: *George C Tiao (University of Chicago); Arthur B Kennickell (Federal Reserve Board)*

Contributed Paper Meeting

- **CPM … – Survey methods in Financial Statistics: challenges and opportunities**

  Chair: *Carl Schwartz (Reserve Bank of Australia)*

Guidelines for publication of articles and papers in IFC Bulletin

Articles and conference papers should be supplied as WORD documents and should not contain any colours. Graphs and tables should be editable. Tables should never be embedded as pictures. Texts (also in graphs and tables) should be set in Times New Roman.

It is recommended to send documents also (additionally to the WORD version) as PDF files for publication on the IFC website (colours allowed for this purpose).

Both for publication in the IFC Bulletin and for posting on the IFC website, documents should be sent to the following e-mail address: *wucwo@wxs.nl*.

Articles should, as a rule, not exceed 30 pages. Conference papers should, as a rule, not exceed 20 pages.

A quantitative framework for macroprudential/financial soundness analysis for monitoring economic and financial vulnerability [1]

Biswa N. Bhattacharyay[2]

Introduction

Several emerging market economies witnessed a large number of financial crises since the 1980s, particularly in Latin America, which resulted in severe economic, social, and political problems. In 1997, Indonesia, Republic of Korea, Malaysia, Philippines, and Thailand, reeled from a devastating financial crisis, which resulted to severe economic, social, and political problems. Following years of robust growth, strides in standards of living, and export expansion, these economies suffered from a crippling devaluation, massive capital flight, corporate and banking failures, and spikes in unemployment. In a relatively short span of time, close to US$100 billion of capital flew out of the region.

The cost of a financial crisis could be severe. According to a paper on the Copenhagen Consensus,[3] Eichengreen (2004) states, "*The loss from the average or typical financial crisis is around 9% of GDP (see Bordo et. al., 2001 for details), and the severe crises, such as those of Argentina and Indonesia, caused output or GDP to fall over 20%, an economic loss higher than those incurred due to the Great Depression. According to Chen and Ravallion (2001), the 1997 Asian financial crisis increased the number of people below poverty line in the region by 22 million. Even though one can question the accuracy of such estimates, the avoidance of such crises could benefit emerging-market economies by $107 billion a year".*

On many occasions these financial crisis did not occur in a single country but had a contagion effect to other regional countries as well. For example, the Latin American crisis of 1994 and the Asian crisis of 1997 affected many countries in the respective regions and sometimes across countries. The Asian crisis spawned a massive literature on the economics of crisis, in which numerous hypotheses have been advanced on the origin, development, and resolution of crises. There are however two main explanations for the Asian crisis. First generation models attributed the crisis to weak economic fundamentals such as unsustainable economic policies, vulnerability of the financial sector, and structural imbalances. This traces the crisis to inconsistency in policies such as monetization of persistently large budget deficits under a regime of fixed exchange rates (Krugman 1979). Second generation models, on the other hand, linked the crisis to the arbitrary shifts in market sentiments and emphasize the role of panics and self-fulfilling expectations (Pesenti and Tille 2000; Estanislao, Manzano, and Pasadilla 2000).

1 *An earlier version of this paper was presented at the "IMF Seminar on Financial Soundness Indicators", Singapore IMF Training Institute, 5-9 July 2004, Singapore..*

2 *Principal Reform Coordination Specialist, Office of the President, Asian Development Bank (ADB). The views expressed in the paper are those of the author and do not necessarily reflects those of Asian Development Bank. The author acknowledges the assistance provided by Ms. Ruby Ann Pimentel-Prenio.*

3 *Paper written on Copenhagen Consensus and presented at Copenhagen on 25-28 May 2004.*

The general understanding is that the financial crisis in Asia was multifaceted. As Pesenti and Tille (2000) emphasize, the fundamental imbalances stressed by first generation models make a country vulnerable to shifts in investor sentiment; thereafter, once the crisis has begun, the second generation models explain the spiral and self-fulfilling nature of speculations.

As financial sectors are highly vulnerable to instability and systemic risk, monitoring these sectors as well as spillover effects of weaknesses of the real sector assumes great importance in light of the severity and frequency of financial crises, especially the combined currency and banking collapses of the past decade, such as 1997 Asian financial crisis. The virulence of the contagion among neighboring countries highlighted the need for a regional surveillance mechanism, particularly the peer review process to prevent future crises and financial instability or to minimize their impacts in the region. Numerous calls were made by different sectors for timely, accurate, and transparent statistics. It is in the context of the need to enhance continuous monitoring efforts where the development of statistical indicators of financial soundness such as macroprudential indicators (MPIs) and early warning systems (EWS) are relevant.

This paper reviews developments in MPI identification, compilation, analysis, and interpretation, and proposes a framework for macroprudential and financial soundness analysis that can be used to detect economic and financial sector vulnerability. This paper will also present the role of the Asian Development Bank (ADB) in strengthening Asia's economic and financial surveillance process.

Monitoring the soundness of the financial sectors

The availability of accurate and timely information is very important as demonstrated by the recent financial crisis in Asia, which highlighted the informational gaps in the affected economies. To illustrate, the build-up of currency and maturity mismatches, which had been the core of the weakness of many financial systems in Asia, was masked initially by the high economic growth rates, manageable inflation, and heady capital inflows. This lack of transparency contributed to the vulnerability because, in a world of global capital flows, crises can arise if information surprises cause market participants to sharply change their expectations. In contrast, transparency and a continual flow of market information can help avoid panics and "creditor-grab" behavior.

The lack of data and weak rules of disclosure, at that time, hindered efforts to undertake economic and financial monitoring. Regular monitoring of financial markets allows the early detection of significant fragilities within the financial system that may destabilize the sector. This also involves discovery of potential disturbances emerging from outside the banking system. Early detection and timely recognition of financial vulnerability will allow policymakers to trigger preemptive policy measures, aid financial supervisors to formulate and implement corrective measures, and allow businesses to adjust their business strategies. In this regard, it is imperative for a country to develop an appropriate system for early detection of vulnerability of the financial system.

Monitoring the soundness of the financial sectors of countries is a challenging task. It can be carried out by different groups/sectors¾markets, firms, consumers, policymakers, and regional and international financial institutions¾with each level having differing approaches and objectives.

There are several causes of financial vulnerability. The major reasons include: (i) fragility of the financial sector or system, (ii) spillover effects of weaknesses of the real sector, (iii) weaknesses in governance of financial institutions and their supervising authorities, (iv) macroeconomic policy mismatch, and (v) weakness in international financial system or markets. Ideally, all such possible causes should be monitored. This paper will focus on monitoring the vulnerability of the financial sector and spillover effects of weaknesses of the real sector.

Role of ADB in strengthening Asia's macroeconomic and financial surveillance process

ADB has been involved in macroeconomic and financial surveillance activities in the region. It established the Regional Economic Monitoring Unit (REMU) in early 1999 and at the request of the Association of South East Asian Nations (ASEAN) Finance Ministers to support the ASEAN Surveillance Process. In November 1999, the ASEAN+3[4] Finance Ministers Process was established

4 *ASEAN+3 refers to members of the ASEAN, which includes Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand and Viet Nam; plus People's Republic of China, Japan, and Korea.*

that includes a request for REMU support. Its main objective is to specifically support the efforts of Asian developing member countries to strengthen regional monitoring and to promote monetary and financial cooperation. REMU also supports the need of developing member countries for timely and accurate macroeconomic and financial information by (i) monitoring economic policies and financial architecture issues from a regional and subregional perspective and disseminating the results to promote prudential economic management; and (ii) strengthening the capacity for economic monitoring through provision of technical assistance and advisory services.

REMU currently provides, among others, support to the ASEAN and ASEAN plus 3 (Japan, Korea and People's Republic of China [PRC]) Surveillance Process and houses the Asia Regional Information Center and Asian Bonds Online. The following is a short description of REMU activities.

The ASEAN and ASEAN+3 Surveillance Process

The ASEAN Surveillance Process is the first concrete attempt by a group of developing countries to exchange information on economic developments and policies, and to consider individual and collective responses to events that could negatively impact subregional economic well-being. It was established in October 1998 to strengthen policy-making capacity within the ASEAN grouping. It was expanded later to include PRC, Japan and Korea. The surveillance process monitors the exchange rates, macroeconomic aggregates, as well as sectoral and social policies. It also includes provisions for capacity building, institutional strengthening, and sharing of information. The ASEAN Finance Ministers meet twice a year for policy coordination under this initiative.

REMU supports the ASEAN and ASEAN+3 Surveillance Process through regional technical assistance projects implemented by REMU. These projects will provide inputs to the ASEAN Surveillance Reports, conduct studies on specific topics, and strengthen the capacity of ASEAN officials and institutions on surveillance-related matters.

Capacity building of National Surveillance Units and training of ASEAN government officials

REMU provides capacity building and training support to ASEAN+3 government officials and National Surveillance Units. Through a regional technical assistance project, It has been supporting the capacity building of National Surveillance Units of selected Asian countries, namely, Cambodia, Indonesia, Lao PDR, Philippines, Thailand, and Viet Nam. It developed and conducted several training courses, with a duration of around 6 weeks, on "Regional Economic and Financial Monitoring" for senior ministry of finance and central banks staff of 10 ASEAN member counties as a part of capacity building initiatives under ASEAN Surveillance Process: the modules of the training courses include: (i) Macroeconomics and Financial Programming; (ii) Sources of Information for Surveillance, (iii) Financial and Capital Market Development, (iv) A Framework for Development, Compilation, Analysis, Interpretation and Dissemination of MPI/FSI, (v) Early Warning Systems; and (vi) Preparation/Presentation of Individual Country Reports. So far, more than eighty ASEAN officials have already taken part in this training program. Forthcoming training programs will include participants from PRC.

Asia Economic Monitor

REMU prepares The Asia Economic Monitor (AEM), which is a quarterly review of East Asia's growth and restructuring, financial and corporate sector reforms, and social developments. It covers the ten member countries of the Association of Southeast Asian Nations plus the People's Republic of China and Korea.

Aside from providing regular monitoring reports, REMU also prepare (i) confidential economic reports (that include East Asian economic outlook and assessment of financial vulnerability) on the ASEAN+3 countries that are used as a background document for the ASEAN+3 (finance ministers and finance ministry and central bank deputies) bi-annual policy dialogue meetings; and (ii) economic reports on East Asia (covering the ASEAN, People's Republic of China and Republic of Korea) that are presented to the ASEAN finance ministers and finance ministry and central bank deputies

Early warning systems

The early warning system project (EWS) is an ongoing endeavor that was launched in response to requests by Finance Ministers from the ASEAN+3 for assistance to develop an early warning sys-

tem. Under this project, EWS models are being developed. These models are expected to provide early warning signals for banking and currency crisis. Two types of EWS models are being developed under this initiative, one based on a signaling approach (Kaminsky and Reinhart 1999) and another based on a probit regression (Berg et al. 1999). These models are intended to be customized to suit the unique conditions in each country and are presently undergoing refinements.

Asia Regional Information Center

The Asia Regional Information Center (ARIC) web site (earlier named Asia Recovery Internet Center) was conceived in 1999. It was designed primarily for use by government agencies, the international assistance community, private-sector users, non-government organizations, economic policy analysts, academic researchers, and journalists.

ARIC provides an array of regularly updated information about the economic performance and prospects of 16 nations from South and East Asia, as well as the following functions:

(i) It provides a clearinghouse of information on economic and social developments, financial and corporate restructuring initiatives, and structural reforms.
(ii) It monitors economic and financial indicators to identify vulnerabilities as an early warning device against potential fiscal, banking, or currency crises; and helps identify the risks of external shocks from the globalized economic environment.
(iii) It provides resources on major development and emerging policy issues.

Asian Bonds Online

Asian Bonds Online is an ASEAN+3 initiative that provides links to publicly available information on the Internet, giving investors a comprehensive view of a growing segment of the global financial markets and the following markets, in particular: Brunei Darussalam; Cambodia; People's Republic of China; Hong Kong, China; Indonesia; Japan; Korea; Lao PDR; Malaysia; Myanmar; Philippines; Singapore; Thailand; Viet Nam; and the Asian regional market. It is supported by ADB and funded by the Government of Japan.

The website provides easy and centralized access to information about the region's rapidly developing bond markets. It contains essential data on current market activities, and the legal and regulatory framework of each market, and monitors government policies and initiatives affecting the industry.

Aside from the regular monitoring activities through REMU, ADB's regional departments are also involved in financial sector restructuring and capital market development projects for many Asian countries in order to strengthen the financial sector.

ADB's regional departments are

In 2000, ADB implemented a regional technical assistance project for identifying, compiling, and disseminating 67 seven commonly agreed economic and financial vulnerability monitoring indicators for selected Asian countries. The project utilized an innovative approach for selecting a set of key indicators, which are commonly agreed by selected participating countries from the Asia, and Pacific region; multilateral organizations (World Bank, International Monetary Fund, Bank for International Settlements, and European Central Bank); and academic experts (Bhattacharyay, 2001). The outcome of this project will be discussed later.

Macroprudential indicators (MPIs) in monitoring activities

Compilation and analysis of MPIs are important components of economic and financial sector monitoring activity. MPIs are a broad set of indicators that reflect the vulnerability of the financial and real economic systems to shocks. The importance of MPIs in monitoring the financial sector cannot be overemphasized in light of the extensive damage that currency, banking, and financial crises could inflict on the economy.

The development of MPIs is rather recent, as indicated earlier. The tools that are utilized to quantify and qualify the soundness and vulnerabilities of the financial system are varied and can potentially be made as complex or sophisticated as needed. Macroprudential analysis is a technique that uses information from MPIs to assess and monitor the strength and vulnerabilities of financial systems. Depending on the complexity, the operation of a monitoring system demands resources and technical expertise. The more sophisticated the system, the more costly it is to monitor and conduct macroprudential analysis or operate early warning models. MPIs encompass financial

sectors indicators (FSI) and other relevant information that can provide a broad picture of a country's economic and financial condition such as the status of the institutional and regulatory frameworks, and compliance with international standards (Sundararajan et al. 2002). Financial sectors indicators are a special subset of MPIs that specifically monitors the health and soundness of financial institutions and markets, and their corporate and household counterparts.

The effectiveness of the monitoring system should be evaluated according to the purpose with which they are designed. For instance, MPI analysis will be evaluated on how well it can track the vulnerability of a financial system as well as how it can effectively disseminate information to economic agents in the pursuit of better disclosure. Early warning systems can be evaluated on their record in predicting a crisis. Despite the increasing interest in more complex techniques employed in deploying monitoring and early warning systems (see Berg and Patillo 1999b for a review), it should be borne in mind that there are at least two aspects in monitoring: technical identification and interpretation of the indicators. It is thus important not only to define the purposes to which the indicators are to be used but also the analytical framework within which they are to be interpreted.

Identification and compilation of an appropriate set of macroprudential indicators

Because financial and currency crises are complex phenomena, the identified set of MPIs should be comprehensive in nature. In this light, the MPIs need not be limited only to banking and financial statistics but have to take into account the general macroeconomy as well as the corporate and household sectors. In this manner, a more comprehensive assessment of the condition and health of the economy and financial systems can be conducted.

Maintaining a wide set of indicators, however, has a downside – collecting and monitoring a multiplicity of variables can be a daunting task, and can ultimately entail large costs. However, these costs can be reduced if it is possible to identify, from among the many different indicators, a manageable subset of core indicators, which can effectively give signals of vulnerability to a crisis. To illustrate, one of the criteria for choosing a core set of variables is whether the indicators are leading or coincident. Identifying a core set of indicators is not an easy task and work in this area, like the IMF system of MPI is considered still as work in progress. For work on MPIs to be fruitful, it has to be harmonious with the existing monitoring system of the country, taking into account the data constraints faced by the different countries. Different structures, levels of economic development and degrees of financial sophistication imply that different sets of MPIs are relevant to specific countries.

A review of the selected Asian country practices reveals a number of common elements as well as significant differences in the collection and compilation of MPIs. There is a wide disparity in the institutional setup, nature of financial markets, array of financial instruments, and degrees of sophistication in monetary and financial data collection and design systems among Asian countries. In addition, the historical development of the institutional and legal setup has an important influence on country practices of collecting financial and monetary indicators and statistics. The major problems concerning the collection of MPIs include excessive delay and inaccuracy, inadequate or incompleteness of data. The most common problem is inability of the financial institutions to submit the required data on time. The major reasons behind these general problems and issues in compilation of MPIs include: (i) spread of data in various databases within and outside central bank; (ii) non-availability or non-applicability of some indicators; (iii) incomparability of indicators over time; (iv) lack of transparency and problems in the disclosure of data; and (v) late/incomplete/inaccurate replies from other institutions and agencies. In view of the above, it is essential to create a central database system within the national central bank which will be responsible to collect all raw statistics required to compile a broad set of MPIs. However, the advent of new technologies, as well as the greater demand for timely and accurate indicators by users – both domestic and international – now puts pressure on the central banks to explore other means to improve not only the collection of such data but also the dissemination. There is an increasing trend towards more intensive use of the Internet as medium of collection and dissemination of indicators.

IMF MPIs/FSIs

IMF is actively involved in the development of MPIs/FSIs. IMF (2001a) proposed a broad array of MPIs that could give a comprehensive assessment of the financial system and subsequently a core set of FSIs (Sundararajan et al. 2002) that are more useful and convenient for periodic monitoring. Tables 1 presents an initial list of MPIs.

Table 1 – Initial list of macroprudential indicators

Aggregated Microrudential Indicators	Macroeconomic Indicators
Capital adequacy	Economic growth
Aggregated capital ratios	Aggregate growth rates
Frequency distribution of capital ratios	Sectoral slumps
Asset quality	Balance of payments
(a)Lending institution	Current account deficit
Sectoral credit concentration	Foreign exchange reserve adequacy
Foreign currency-denominated lending	External debt (including maturity structure)
Nonperforming loans and provisions	Terms of trade
Loans to loss-making public sector entities	Composition and maturity of capital flows
	Inflation
Risk profile of assets	Volatility in inflation interest and exchange
Connected lending	Rates
Leverage ratios	
(b)Borrowing entity	Volatility in interest and exchange rates
Debt-equity ratios	Level of domestic real interest rates
Corporate profitability	Exchange rate sustainability
Other indicators of corporate conditions	Exchange rate guarantees
Household indebtedness	Lending and asset price booms
Management soundness	Lending booms
Expense ratios	Asset price booms
Earnings per employee	Contagion effects
Growth in the number of financial institutions	Financial market correlation
Earnings/profitability	Trade spillovers
Return on assets	Other factors
Return on equity	Directed lending and investment
Income and expense ratios	Government recourse to the banking system
Structural profitability indicators	Arrears in the economy
Liquidity	
Central bank credit to financial institutions	Market-based Indicators
Deposits in relation to monetary aggregates	
Loans-to-deposits ratios	Market price of financial instruments, incl. Equity
Maturity structure of assets and liabilities/ Liquid asset ratios	Indicators of excess yields
	Credit ratings
Measures of secondary market liquidity	Sovereign yield spreads
Indicators of segmentation of the money market	
Sensitivity to market risk	
Foreign exchange risk	
Interest rate risk	
Equity price risk	
Commodity price risk	

Source: IMF Macroprudential Analysis: Selected Aspects Background Paper, June 2001

These aggregated MPIs mainly adopt the CAMELS framework, which is comprised of six groups of indicators reflecting the health of financial institutions: capital adequacy, asset quality, management soundness, earnings, liquidity, and sensitivity to market risk.

While a broad array of MPIs could give a comprehensive assessment of the financial system, but oftentimes the process of collecting and interpreting indicators can be tedious and time consuming. Subsequently, IMF proposed a smaller set of MPIs, which are more useful and convenient for periodic monitoring. The core set comprises 15 indicators for the banking system that are found to be highly useful for monitoring, compilation and dissemination efforts by national authorities (see Sundararajan, V., et. al., 2002 for further details). The core set, shown in Table 2, focuses on the banking sector and covers the main categories of bank risk following the CAMELS framework in bank supervision.

Table 2 – Core set of FSIs

Capital	Regulatory capital to risk-weighted assets Regulatory Tier I capital to risk-weighted assets
Asset quality	Nonperforming loans to total gross loans Nonperforming loans to net of provisions to capital Sectoral distribution of loans to total loans Large exposures to capital *
Earnings and profitability	Return on assets (net income to average total assets) Return on equity (net income to average equity) Interest margin to gross income Noninterest expenses to gross income
Liquidity	Liquid assets to total assets (liquid asset ratio) Liquid assets to short-term liabilities
Sensitivity to market risk	Duration of assets ** Duration of liabilities ** Net open position in foreign exchange to capital

** In January 2004, the Board of the IMF decided to move this indicator to the encouraged set of FSIs.*
*** In January 2004, the Board of the IMF decided to remove both indicators from the list.*
Source: Financial Soundness Indicators: Analytical Aspects and Country Practices, IMF 2002

In addition, the IMF selected a set of encouraged indicators, consisting of additional indictors for the banking sector, as well as indicators for the non-bank financial sector, the corporate and household sectors, and real estate markets. It is reported in Table 3. The provision of an encouraged set of MPI in addition to the core set, is designed to provide a degree of flexibility in the section of relevant indicators that takes into account the country specific features of financial systems.

Table 3 – Encouraged set of FSIs

Deposit-taking institutions	Capital to assets Geographical distribution of loans to total loans Gross asset position in financial derivatives to capital Gross liability position in financial derivatives to capital Trading income to total income Personnel expenses to noninterest expenses Spread between reference lending and deposit rates Spread between highest and lowest interbank rate Customer deposits to total (non-interbank) loans Foreign currency-denominated loans to total loans Foreign currency-denominated liabilities to total liabilities Net open position in equities to capital
Market liquidity	Average bid-ask spread in the securities market 1/ Average daily turnover ratio in the securities market 1/
Nonbank financial institutions	Assets to total financial system assets Assets to GDP
Corporate sector	Total debt to equity Return on equity Earnings to interest and principal expenses Corporate net foreign exchange exposure to equity Number of applications for protection from creditors
Households	Household debt to GDP Household debt service and principal payments to income
Real estate markets	Real estate prices Residential real estate loans to total loans Commercial real estate loans to total loans

1/ Or in other markets that are most relevant to bank liquidity, such as domestic foreign exchange markets.
Source: Financial Soundness Indicators: Analytical Aspects and Country Practices, IMF 2002

Even though, the above set of FSIs are very important in assessing the health of financial institutions, many developing countries will face considerable problems in the compilation of some FSIs, particularly the encouraged set. Compared to the compilation of monetary and financial statistics, the FSI compilation process is quite complicated and time-consuming as it will involve intra-deposit taking institutions and cross border consolidation and an inter-disciplinary team consisting of experts in various areas such as accountancy, bank supervision, national accounts, money and finance. Flexibility should be given in compiling some FSIs. Timely compilation of FSIs is crucial even if their coverage (in terms of proportion of institutions) is not adequate. There is further scope for in strengthening FSIs. Under the present definitions of FSIs, Islamic banks and financial institutions cannot be covered. Many Asian countries, such as Indonesia, Pakistan, Malaysia, and some countries in the Middle-East have many Islamic banks. Separate compilation procedure needs to be prepared for Islamic banks. Even though encouraged set includes FSI on security markets, it does not include any FSI on stock market, which is a leading indicator of banking crisis. Banks in many countries give loan against equity as a collateral and any sudden fall in stock market may pose considerable risk to some banks that have large equity exposure. At the same time, stock prices also reflect the corporate health. Some of FSIs should be compared with the size of the economy or GDP in order to assess if these indicators are expanding much faster than the economic growth that may result in increased vulnerability. In the line of household debt/GDP, and assets of non-financial institutions over GDP, there should be a FSI on banking or deposit taking institutions assets over GDP. For real estate indicators, countries can use proxy real estate prices that are available under National Account Statistics Surveys as proper statistics are not presently available. The above comments have been communicated to IMF.

ADB's commonly agreed MPIs

Similarly, ADB is also actively engaged in assisting Asian countries in the development of MPI analysis for vulnerability assessment that includes identification, compilation, dissemination and analysis of MPIs. This section will discuss ADB's work on identifying, compiling and dissemination of MPIs.

Under a regional technical assistance project, ADB conducted an inception workshop in April 2000 in accordance with its objective to identify, compile, and disseminate a set of commonly agreed upon MPIs. One major objective of the inception workshop was to arrive at an agreement on the list of indicators, which should be included in a harmonized financial and monetary monitoring system. On this basis, each participating country would develop, compile, analyze, and disseminate the commonly agreed key indicators on a regular basis.

The participating countries, which includes Fiji; Indonesia; Philippines; Thailand; Taipei, China; and Viet Nam, and, in consultation with representatives from IMF, Bank for International Settlements (BIS), Deutsche Bundesbank, Frankfurt, Bank of Japan, Bank of Korea, Australian Bureau of Statistics, United Nations Economic and Social Commision for Asia and the Pacific (UN ESCAP), and ADB identified 67 commonly agreed MPIs during the Inception Workshop, with the following subsets of indicators:

a) External Debt and Financial Flows (8 indicators)
b) Money and Credit (17 indicators)
c) Banking (14 indicators)
d) Interest Rates (12 indicators)
e) Stock Markets and Bonds (9 indicators)
f) Trade Exchange and International Reserves (10 indicators)
g) Business Survey Data (9 indicators): mainly Manufacturing but also Construction, Retail, and Wholesale Trade and Services

Bhattacharyay (2001) discussed the above commonly agreed indicators in detail.

The system of ADB MPIs can be further classified into three categories, namely, (i) aggregated microprudential indicators of health of individual financial institutions, (ii) macroeconomic indicators concerning the health of financial sectors, and (iii) qualitative business tendency survey indicators.

Prior to the inception workshop, ADB has identified a set of 110 MPIs on the basis of their clear theoretical link with the vulnerability and soundness of the financial sector, as well as findings of empirical studies on banking and currency crisis and availability of data. A survey was conducted in Indonesia, Malaysia, the Philippines and Thailand on the availability, frequency, and time lag of the proposed set of MPIs. The set of indicators was designed to have broad range and breadth for

the purpose of "catching" as many signals from as many sectors of the economy on the possibility of a crisis or weakness of the financial sector.

During the inception workshop, the commonly agreed 67 MPIs were chosen from the above set of 110 indicators identified by ADB. The agreed set of indicators is comprised of the core set (commonly agreed) and some additional ones (specific to country needs). Countries can compile and analyze the additionally agreed indicators for meeting country-specific requirements depending on data availability. Table 4 reports the list of the 67 commonly agreed indicators while the 33 additional indicators that are specific to country needs can be found in Appendix 1. It was agreed in the workshop that participating countries should stick for the time being to these two sets of indicators. This will give them time to gain experience in using this information as an analytical tool before changing this list.

One of the distinguishing features of the leading ADB MPIs is the use a few appropriate Business Tendency Surveys (BTS) indicators. The use of BTS within the framework of MPI is unique in the literature on MPIs. The main reason for incorporating BTS information as part of the MPIs is due to the ability of BTS to capture current and future profitability trends in the corporate sector. Precisely because expectations can play an important role in the business cycle, it can have a significant influence on investments, output, and employment. More importantly, since BTS are by nature forward-looking, the information they convey can augment the early warning capabilities of the conventional quantitative MPIs.

This project helped improve the timeliness of the availability of existing and new statistics and indicators to ADB from participating governments. Eventually, these statistics were integrated into ADB's database system and disseminated in ADB's website to make them widely and easily accessible to users.

Table 4 – ADB's commonly agreed macroprudential indicators

External Debt and Financial Flows

1. Total Debt (% of GDP) – ratio of total debt on nominal GDP.
   a. …of which public debt
   b. …of which private debt
2. Long Term Debt (% of total debt) – ratio of long-term debt to total debt.
3. Short Term Debt (% of GDP) – ratio of short-term debt to nominal GDP.
4. Short Term Debt (% of total debt) – ratio of short-term debt to total debt.
5. Foreign Direct Investment (% of GDP) – ratio of foreign direct (expressed as flows) investment to nominal GDP.
6. Portfolio Investment (% of GDP) – ratio of portfolio investment (expressed as flows) to nominal GDP.

Money and Credit

7. M1 Growth (%) – percent difference from previous period. M1 are liabilities of the monetary system consisting of currency and demand deposits.
8. M2 Growth (%) – percent difference from previous period. M2 equals M1 plus quasi-money.
9. Money Multiplier (Ratio) – ratio of M2 to money base. Money base is the sum of currency in circulation, reserve requirement and excess reserves (with the central bank).
10. M2 (% of International Reserves) – ratio of M2 to international reserves.
11. M2 (% of GDP) – ratio of M2 to nominal GDP.
12. M2 to international reserves growth – the growth rate of M2 over international reserves.
13. Quasi money (% of GDP) – ratio of quasi money to nominal GDP.
14. Money Base Growth (%) – percent difference from previous period.
15. Central Bank Credit to the Banking System – Central Bank's credit to the banking system.
16. Growth of Domestic Credit (%) – percent difference from previous period. Consists of net claims from central government, claims on official entities and state enterprises, and claims of private enterprises and individuals.
17. Domestic Credit (% of GDP) – ratio of domestic credit to nominal GDP.
18. Credit to Public Sector (% of GDP) – ratio of credit to public sector to nominal GDP.
19. Credit to Private Sector (% of GDP) – ratio of credit to private sector to nominal GDP.
20. Capital Adequacy Ratio (%) – ratio of total capital on risk weighted assets (threshold value is 8% meaning that the ratio should not be less than this value). Ratio of Tier 1 + Tier 2 capital to risk-weighted assets. Tier 1 capital includes issued and paid-up share capital, noncumulative preferred stock, and disclosed reserves from posttax retained earnings. Tier 2 capital can include a range of other entities. These are undisclosed reserves that passed through profit and loss account, conservatively valued revaluation reserves, revaluation of equities held at historical cost (at a discount), some hybrid instruments, general loan loss reserves (up to 1.25% of risk weighted assets), and subordinated term debt.
21. Liquidity Ratio (%) – The ratio of commercial banks' liquid assets to total assets: (a) domestic liquid asset ratio and (b) foreign liquid asset ratio.

Banking

22. Bank Capital (% of total asset) – ratio capital equity including reserves, profits, and loss to total assets.
23. Total Assets (% of GDP) – ratio of total assets (as in Monetary Survey without interbank positions) to nominal GDP.

24. Growth of Total Assets (%) – percent growth from previous period.
25. Share of 3 Largest Banks (% of total asset)
26. Net Operating Profits (as % of average assets)
27. Loan-Loss Provisions (% of nonperforming loan) – ratio of loan loss provision to nonperforming loans
28. Nonperforming Loans (% of total loan) – ratio of nonperforming loans
29. Loans to the Key Economic Sector & (% of total loans)
30. Real Estate Loans (% of total loans) – ratio of real estate loans to total loans.
31. Total Loans (% of total deposits) – ratio of total loans to total deposits (i.e., demand deposits, savings deposits, time deposits.)
32. International liability from banks with maturities, total (mn US$) – total international liability from commercial banks.
    a. Short-term borrowing
    b. Long-term borrowing – more than one year
33. International liability with maturities of one year and less (mn US$) - total international liability from commercial banks.

Interest Rates (mean rate)

(In case of monthly data average of daily rates, quarterly data monthly averages are to be applied)

34. Central Bank Lending Rate (a.o.p.) - end of period; rate at which the monetary authorities lend or discount eligible paper for deposit money banks.
35. Commercial Bank Lending Rate (a.o.p.)/ Prime Rate - average of period; ratio of commercial bank lending rate to prime rate. Prime rate refers to the short- and medium-term financing needs of the private sector.
36. Money Market Rate/Inter-Bank Rate (a.o.p.)- average of period; rate at which short-term borrowings are effected between financial institutions.
37. Short-term (3 mos.) Time Deposit Rates – interest rates of savings account held in a financial institution for 3 months or with the understanding that the depositor can withdraw only by giving a notice.
38. Long-term (12 mos.) Time Deposit Rates – interest rates of savings account held in a financial institution for 12 months or with the understanding that the depositor can withdraw only by giving a notice.
39. US$ (international market)/Domestic Real Deposit Interest Rate – unweighted averages of offered rates quoted by at least five dealers early in the day for 3-month certificates of deposit in the secondary market.
40. Bond/Treasury Bill Yield (short-term) – yield to maturity of government bonds (short-term)
41. Bond/ Treasury Bill Yield (long-term) – yield to maturity of government bonds (long-term)

Stock Markets and Bonds

42. Foreign Share in Trading (% of Total Volume of Trading) – proportion of foreign share in trading to total volume of trading.
43. Share of 10 Top Stocks in Trading (% of Total Volume of Trading) – proportion of top 10 stocks in trading to total volume of trading.
44. Composite Stock Price Index (Capital City; in national currency unit) – equity price index of national capital city and expressed in national currency unit.
45. Composite Stock Price Index Growth (Capital City) – percent difference from previous period of equity price index; end of period and based on national currency unit.
46. Composite Stock Price Index (Capital City; in US$)– equity price index of national capital city and expressed in US$.
47. Market Capitalization (% of GDP) – ratio of market capitalization to nominal GDP. Market Capitalization refers to the total market value of stocks or shares.
48. Stock Price Earning Ratio

Trade Exchange and International Reserves

49. Export Growth (%) – export growth (fob) percent difference from previous period.
50. Import Growth (%) – import growth (cif) percent difference from previous period.
51. Trade Balance (mn US$) – difference between exports (fob) and imports (cif)
52. Current account deficit/surplus (mn US$)
53. Exchange Rate (average of period) – national currency unit to the US$
54. Exchange Rate (end of period) – national currency unit to the US$
55. Real Effective Exchange Rate – ratio of an index of the period average exchange rate of a currency to a weighted geometric average of exchange rate for the currencies of selected countries adjusted for relative movements in national prices of the home country and the selected countries. Refers to the definition used in IMF's *International Financial Statistics* series.
56. International Reserves (mn US$) – international reserves include total reserves minus gold plus gold national valuation.
57. Growth of International Reserves (%) – percent difference from previous period.
58. International Reserves (% of imports) – ratio of international reserves to total imports.

Business Survey Data (Manufacturing, Construction, Trade, Services)

59. Assessment of Current Business Situation
60. Expectations on Business Situation in Next Months/Quarters
61. Limits to Business (Present Situation)
62. Stocks of Finished Products (Present Situation)
63. Assessment of Order Books
64. Selling Prices (Future Tendency)
65. Employment (Future Tendency)
66. Financial Situation (Present Situation)
67. Access to Credit (Present Situation)

Identification and evaluation of core set of leading indicators

Following the selection of the commonly agreed indicators, an attempt was made to identify a core set of leading indicators that could give early warning signals of vulnerability of financial markets, based on graphical analysis of the series of MPIs compiled by countries. Bhattacharyay and Nerb (2002) identified a core set of leading indicators, based on trend analysis of the 67 commonly agreed MPIs compiled by selected crisis-affected Asian countries under the aforementioned ADB-supported project. Indicators that exhibited conspicuous behavior prior to 1997 Asian financial crisis are selected.

One of the main objectives of identifying a core set of leading indicators is to identify indicators that appear to be particularly promising for financial and economic monitoring, and which therefore should be included in a core list of harmonized indicators at ADB. Although a broad and exhaustive set of indicators could potentially give a more complete assessment, they can be costly to compile and unwieldy to maintain. For the purpose of periodic monitoring, a separate core set of MPIs of manageable size should be kept and updated regularly.

As indicated earlier, one criterion for inclusion in the core set of MPIs is early warning capacity. Hence, the MPI should be a leading indicator or at the very least, a coincident one. For a short-term monitoring system, however, only indicators that are available on a monthly or quarterly (at least) basis can be useful. Unfortunately, not all countries are able to fulfill this requirement.

Based on this pragmatic approach, the series shown in Table 5 presents the core set of leading MPIs. Indicators that gave warning signals or had large fluctuations prior to a crisis were selected as leading indicators. In cases where a clear lead could not be detected this is labeled as coincident/leading. Further details on this method can be found in Bhattacharyay and Nerb (2002).

The data series provided by the countries are not very long (available only from 1995 onward or even later) and are not always complete over the whole time span. This prevents the use of formal statistical methods like regression or factor analysis to identify the best candidates for a harmonized set of core MPIs. Nevertheless, this should be done in a later stage to identify the exact informational content of those series and to estimate the joint impact of different subsets of indicators for explaining and forecasting banking and currency crises.

Table 5 – Core set of leading MPIs

Type of Indicator*	Title	Characteristics
Money and Credit		
7.	M1 Growth (in %)	leading
8.	M2 Growth (in %)	leading
4. (additional)	M3 Growth (in %)	leading
15.	Central Bank Credit To Banking System	coincident/leading
16.	Domestic Credit Growth (in %)	coincident/leading
17.	Domestic Credit Growth (in % of GDP)	coincident/leading
19.	Credit to Private Sector (in % of GDP)	coincident/leading
Banking		
26.	Net Bank Profits (in % of total assets)	Leading
31.	Total Bank Loans (in % of total deposits)	Leading
33.	International Borrowings with maturities one year and less (mn. US$)	Leading
6. (additional)	Real Estate Loans	Leading
Interest Rates		
36.	Money Market Rate/Inter Bank Rate	Leading
Stock Markets and Bonds		
44.	Composite Stock Price Index	Leading
47.	Market Capitalization (as % of GDP)	Leading
48.	Stock Price Earning Ratio	Leading
Trade Exchange and International Reserves		
55.	Real Effective Exchange Rate	coincident/leading
56.	International Reserves	leading
Business Survey Results		
59.	Current Business Situation	coincident/leading
60.	Expected Business Situation (next 6 months)	coincident/leading
62.	Stocks of Finished Products	coincident/leading
65.	Employment (Present Situation)	coincident/leading
66.	Financial Situation (Present Situation)	coincident/leading

Note: For reference purposes, the numbering is based on the list of ADB Commonly Agreed Indicators found in Table 4.

Use of macroprudential indicators: analysis and interpretation

Progress has been made in identifying and compiling accurate and timely MPIs. The focus is now beginning to shift towards the development of techniques for the proper analyses and interpretation of data. Work on the analysis of MPIs and their interpretation is still recent and there is no consensus on the best analytic framework to use. It needs be appreciated that the task of macroprudential analysis or the framework for identifying, analyzing, and interpreting MPIs is still work-in-progress. The ADB, various international financial institutions such as the IMF, as well as private firms are still in the process of developing or testing different systems. As such, there is no standard system for macroprudential analysis at present. Yet, as the experience of the Asian crisis shows, a systematic monitoring of the financial and economic systems is an important element in crisis prevention strategies.

There are several existing methods that use MPIs to monitor economic and financial vulnerability. The major methods include: (i) trend analysis, which detects vulnerability when there are major fluctuations in a particular indicator; (ii) stress-testing, which gauges vulnerability by estimating the impact of a range of future shocks to the system on certain variables; and (iii) EWS models, which estimate the probability of a crisis occurring through quantitative or econometric techniques.

Trend analysis entails looking at the movement of data over a given period of time and taking note of deviations from an observed pattern or large fluctuations. The major drawback of this technique lies in the interpretation of notable data deviation. It would not be immediately apparent if this signifies stress in the system or simply a result of structural breaks due to changes in regulations or regimes. The reliability of trend analysis depends largely on the skill and experience of the technical staff. It is currently the most common method used today because it is cost-effective, transparent, and simple enough to be easily grasped by policymakers. Institutions that employ this method include like central banks and ministries of finance of Asian countries; financial institutions; the ADB and multilateral institutions like, World Bank, IMF, and BIS; and the academe.

Stress testing is a simulation method designed to evaluate vulnerability against major changes or shocks in the system. It estimates changes in the MPI due to a specific type or a set of shocks that are based on historical or hypothetical (but plausible) circumstances, i.e., the impact of an economic slowdown on the level of nonperforming loans. Stress tests, however, do not estimate the probability of the shock occurring. It also relies on the judgment and experience of monitoring staff to identify the proper set of scenarios to be used in the test and to interpret the result correctly. Moreover, it is complicated and time-consuming to undertake, which makes it an inappropriate tool for high frequency monitoring. Stress testing is regularly used in the Financial Sector Assessment Program of the IMF/WB (Sundararajan et al. 2002). IMF(2001b) provided further details on stress testing.

Early warning models were developed to estimate the probability of a crisis occurring based on the movement of MPIs. Early warning models based on MPI are relatively new approaches introduced and discussed in academic and policy circles. Some of the more recent work in this area are Kaminsky and Reinhart (1999); Kaminsky, Lizondo, and Reinhart (1998); Goldstein, Kaminsky, and Reinhart (2000); Berg and Patillo (1999); Edison (2000); and Berg et al. (2004). This is used as well in the private financial institutions like Goldman Sachs and Credit Suisse First Boston (Berg and Petillo 2004).

There are generally two types of EWS models, one that is based on a composite of leading indicators and another that makes use of probit/logit models. The composite indicator model creates a composite figure using the number of "warning signals" obtained from a set of MPIs and directly tying it with a probability of a crisis. A warning signal is emitted whenever an indicator theoretically associated to a crisis breaches a critical threshold (Kaminsky, Lizondo, and Reinhart, 1998). Probit or logit models, on the other hand, compute a probability of a crisis occurring based on changes in behavior of indicators prior to crises (Berg et al. 1999).

However, the existing literature suggests that the predictive accuracy of the existing models is quite limited (Berg and Patillo 2000). The financial market is highly complex and the composite index technique may be too simplistic to capture the nuances of the sector. Indices are also potentially misleading because in the process of producing a single figure to capture the effect of a set of indicators, positive and negative signals of individual components may cancel each other out (Evans et al. 2000). Quantitative models such as probit and logit, on the other hand, have mixed performance in detecting a crisis or financial vulnerability especially in the context of out-of-sample forecasting. EWS are also complicated, expensive, and nontransparent, and requires extensive time-series data, which is not always available for some countries and certain variables (Berg, Borenzstein and Petillo, 2004).

The choice of approach in analyzing and interpreting MPIs would depend on several factors, such as the desired level of accuracy, cost, timeliness, purpose and nature of policy action expected, and technical capacity of monitoring personnel and policy makers. Clearly, there are trade-offs among these factors. For instance, simple methods can generate indicators faster than more complicated ones but it may only be adequate if the goal is simply to alert the authorities on possible vulnerabilities in the system. It may not be able to generate specific probabilities to the occurrence of crises that more sophisticated techniques can provide. A fundamental issue to consider is whether crises are predictable which, as the literature suggest, is still subject to qualifications. However, using MPIs to predict the probability of an impending crisis using an EWS model may be time-consuming and will be of limited use if it arrives after the onset of the crisis or with insufficient time left to avert it. At the same time, these kinds of models, so far, have not performed well in predicting the occurrence of a crisis, especially for out-of-sample data (Berg, Borenzstein and Petillo, 2004). The choice of the model is also determined by the technical capacity of the agents maintaining the models. The cost and technical capacity required to regularly undertake MPI analysis also vary with the complexity of the technique, with more sophisticated methods requiring more resources and highly trained staff. In the end, the trade off between sophistication/complexity and accuracy is cost.

Proposed framework for using MPI to detect vulnerability

Developing MPIs for a diverse set of countries is challenging given the analytical, identification and measurement hurdles. Several international institutions, particularly IMF, have expended considerable effort and resources in advancing research in this area. ADB, in particular, has been supporting a surveillance process that resulted from collaborative efforts of ASEAN member countries and People's Republic of China, Japan, and Republic of Korea, to monitor emerging macroeconomic and financial vulnerabilities in the region.

Identification and compilation of MPIs

The framework proposed here could be the initial model for the use in MPI analysis for any country. It contains 30 indicators that were selected from ADBs commonly agreed MPIs, IMF MPIs/FSIs, Goldstein, Kaminsky and Reinhart (2000), and Reinhart, Kaminsky and Lizondo (1998). The selection is based on economic rationale as well as findings of empirical studies on currency and banking crises involving various countries and regions. The selection is also based on the frequency of availability of data. The MPIs and the economic rationales for their inclusion and their characteristic (in terms of nature of detecting or predicting vulnerability) can be found in Table 6. A MPI is a leading indicator if it sends early vulnerability signals and coincident if it send signals simultaneously with vulnerability. These MPIs can be grouped into six broad categories, namely (i) Money, Credit And Interest Rates, (ii) Banking, (iii) Public Finance, External Debt and International Flows, (iv) Trade and International Reserves, (iv) Stock Market and (vi) Business Tendency Survey. Some of the leading indicators need to be transformed to ensure that they are stationary and free from seasonal effects first. The level form should be adopted if the indicator does not display any trending or seasonal behavior.

Table 6 – List of leading indicators and economic rationales

Indicator	Rationale	Characteristics
Money, Credit and Interest Rates		
M2 • Growth, y-o-y • Ratio to foreign exchange reserves	Expansionary monetary policy and/or sharp decline in reserves are associated with onset of crises	Coincident/leading
Domestic Credit • Growth, y-o-y • Ratio to GDP	Sharp increases in credit demand over a long time span bear the risk of over-investment In non-productive activity that may cause the deterioration of the credit portfolio of banks	Coincident/leading
Money Market Rate/Inter-Bank Rate	A sharp increase in this rate signals a tight liquidity situation in the banking sector, which can possibly lead to solvency problems	Leading

Banking		
Net Bank Profits • Return on Assets • Return on Equity	Unusually high profitability may be a sign of excessive risk-taking or imperfectly competitive financial sectors, but too low profits can indicate deterioration in credit quality or intense competition	Leading
Total Bank Loans to Total Deposits	A high ratio may indicate stress in the banking system and a low level of liquidity to respond to shocks	Leading
Credit to Private Sector	Over-investment of the private sector could lead to a deterioration in the quality of credit portfolios of the banking sector	Coincident/leading
Central Bank Credit to the Banking System • Ratio to GDP	A large increase in central bank credit to banks and other financial institutions often reflects severe liquidity or solvency problems in the financial sector	Coincident/leading
Household Debt • Growth, y-o-y • Ratio to GDP	Households are more sensitive to changes in interest rates, income and asset prices. A too high proportion of loans to this sector may pose additional risk to the financial sector	Coincident/leading
Real Estate Loans to Total Loans	Boom and bust cycles of real estate prices can spillover to the financial system if loans are concentrated in this sector	Leading
Non-performing Loans to Total Loans	High levels of NPLs indicate deteriorating asset quality of the financial system	Coincident/lagging
Liquid Assets to Short-term Liabilities	This indicator measures a country's capability to meet short-term debt obligations. A too low ratio may result to liquidity problems if debtors decide to pull-out their funds.	Coincident/leading
Public Finance, External Debt and Financial Flows		
Overall Budget Deficit to GDP	Large fiscal deficits could lead to a worsening of the current account position, which could in turn put pressure on the exchange rate	Concident/Leading
Short-Term International Borrowing or External debt with maturities one year or less • Ratio to GDP • Ratio to Total External Debt	Increase in short term debt and or sharp declines in reserves are associated with crises	Leading
Trade and International Reserves		
Trade Balance	Deterioration in the trade balance could signal declining international competitiveness. It also leads to a worsening of the current account, which is often associated with currency crisis	Coincident/leading
Real effective exchange rate	If real appreciation of a currency is not backed by corresponding productivity gains in the real economy, this implies a loss of international competitiveness which can be a possible source of vulnerability	Coincident/leading
International Reserves	A low and declining amount of international reserves signals possible problems for the country to meet international payment requirements	Leading
Stock Market		
Composite Stock Price Index	Burst of asset price precede financial crises	Leading
Stock Price Earnings Ratio	A high and increasing stock price earnings ratio may signal asset inflation, which is unsustainable in the medium term	Leading
Business Tendency Survey (BTS)		
• Current Business Situation • Expected Business Situation (next 6 months) • Stock of Finished Products • Employment (present) • Financial situation (present)	BTS are able to capture current and future profitability trends. Answers on the current business situation as well as on the expected business trend in the next three to six months reflects the perceived profit assessment of managers which are not only important for the real economy but also has implications for the financial sector	Coincident/leading

Macroprudential/Financial Soundness Analysis

These macroprudential/financial soundness indicators are compared to a set of country-specific benchmark figures or threshold values, which should be determined using a suitable econometric model using a long time series of monthly data. The model should be updated continuously by incorporating new data. The threshold values could be determined based on the EWS signaling approach pioneered by Kaminsky, Lizondo, and Reinhart (1998). For those indicators that do not have a long and comparable time series data (such as non-performing loans, net bank profits), alternative methods for threshold determination that are presented in the following section should be used.

A vulnerability signal is flashed when an observed outcome of a MPI crosses its threshold value. It indicates a departure or deviation from normal behavior in an MPI. For example, an abnormally large increase in real estate loan may signal high vulnerability of banking or financial sector, which might lead to a banking crisis.

Countries can also compute benchmarks/thresholds using alternative and appropriate methods. There are various ways to construct benchmarks/threshold values. These include use of: (i) historical averages of MPIs for countries with previous crisis experience, wherein an average around the period of crisis or periods immediately prior to the crisis could be used; (ii) prudential threshold values used by bank supervisory authorities or international financial institutions; (iii) average MPIs of a similar country with a strong financial system; (iv) historical trigger points that caused a currency crisis; and (v) thresholds obtained form econometric/statistical models, such as EWS models. Ideally, econometric techniques should be used to determine benchmarks figures/threshold values. Econometric techniques may be more complicated but these provide the most objective method among the ones enumerated above. A possible and safer alternative would be to use more than one threshold value for one indicator.

The MPIs are monitored on a monthly basis to detect any significant vulnerability or weakness in the economy generally, and financial sector specifically, which could make a country susceptible to a currency or financial crisis. The higher the number of indicators flashing signals at any given period indicates higher vulnerability.

The proposed framework deviates from the Kaminsky, Lizondo, and Reinhart (1998) model, which was originally developed to predict the probability of a crisis event using the estimated benchmarks or threshold values, by focusing instead on determining the magnitude of vulnerability in the system and identifying specific area/s of concentration. The proposed framework will also employ trend analysis to examine the actual values of those indicators that had significant jumps in the number of signals flashed or which had persistently flashed signals throughout the surveillance period. This will confirm if the signals given are unwarranted, stem from institutional or structural changes, or require serious attention so that appropriate policy action and other corrective measures may be suggested to reverse or mitigate the vulnerability detected. However, it is to be noted that the macroprudential analysis under this framework should focus not only on symptoms – whether a MPI is above or below the threshold value – but on the underlying sources of chronic vulnerability. Therefore, trend analysis of related indicators with causal relationship with the concerned MPIs flashing vulnerability signals should be undertaken to assess the underlying sources of vulnerability. Appropriate policy actions are then suggested in order to address the vulnerability as indicated by the flashed signals.

Determination of Threshold Values

The framework proposes the use of the Kaminsky, Lizondo, and Reinhart (1998) methodology to determine the country-specific threshold values of selected indicators with adequate and comparable time series data. Threshold values of an MPI are defined in relation to percentiles of the distribution of observations of the MPI. The threshold value is used to divide the cumulative frequency distribution of an indicator between normal (non-crisis) periods and abnormal (heightened crisis probability) periods. The abnormal region can be in the upper or lower tail of the cumulative frequency distribution. It is in the upper tail if a higher indicator value implies a higher probability of a crisis, and the lower tail if a crisis is associated with a lower indicator value.

The first step for computing the threshold for indicators with long time series data is to rank the observations, depending on the variable being used, in ascending or descending order; the second step is identifying which of them fall within the 10th to the 20th percentiles. The threshold value within this percentile range is set based on (i) which one minimizes the ratio of the probability of an indicator signaling during tranquil times, and (ii) the probability of the indicator signaling during crisis time (or the noise-to-signal ratio). The methodology for computation of thresholds for indicators is described in detail in Kaminsky, Lizondo, and Reinhart (1998).

For those indicators that do not have a long and comparable time series data, historical trigger points that caused a currency crisis or an alternative suitable method should be used.

Proposed framework: An empirical illustration

An empirical illustration used in this section to show how the proposed framework could be used to analyze MPIs for a Country X (whose name is not revealed for confidentiality) in order to detect economic and financial vulnerability. The surveillance was performed on a monthly basis (except for net bank profits and business tendency survey indicators that are available quarterly) for the last three years (2001-2003) and the current year (2004) but, for illustrative purposes, the data provided here is on an annual basis with quarterly performance for 2004. Table 7 below provides a summary of the surveillance results. The complete tabulation of the signals for each indicator over this period is given in Appendix 2.

Table 7 – Vulnerability signals by Indicator Category
Country X

	2001	2002	2003	1st Quarter (1Q) 2004	2nd Quarter (2Q) 2004
Money, Credit and Interest Rate	18	16	16	5	3
Banking	26	25	22	5	5
Public Finance, External Debt and Financial Flows	12	12	12	3	3
Trade and International Reserves	6	2	3	0	0
Stock Market	18	10	8	1	0
BTS	13	12	7	5	5
Total	93	77	68	19	16

Note: These are hypothetical figures given for illustrative purposes only.

Overall assessment

(i) Country X showed a general decline in the total number of vulnerability signals emitted over the surveillance period. It was highest in 2001 at 93, falling to 77 in 2002 and 68 in 2003. The first two quarters of 2004, posted 19 and 16 signals respectively (Table 7). Although the number of indicators that flashed vulnerability signals have declined, the potential causes of vulnerability remain. Excess liquidity and the fiscal deficit are continuing concerns.

(ii) Most of the indicator category improved in comparison to 2001 levels with the exception of public finance, external debt and financial flows, which remained unchanged with 12 signals annually from 2001 to 2003 (Table 7).

(iii) The following indicators persistently flashed vulnerability signals from January 2001 until December 2003: ratio of domestic credit to GDP and ratio of fiscal balance to GDP (Appendix 2).

(iv) Table 8 below shows indicators whose signals in 2003 are higher than 2002. These indicators were limited to real estate loans and the trade balance, but the change in the number of vulnerability signals is only minimal.

Table 8 – Macroprudential indicators with higher number of vulnerability signals; 2003 compared to 2002
Country X

	2001	2002	2003	1st Quarter (1Q) 2004	2nd Quarter (2Q) 2004
Banking					
Real Estate Loans, Ratio to Total Loans	3	2	3	1	0
Trade and International Reserves					
Trade Balance, Ratio to GDP	6	2	3	0	0

Money, Credit and Interest Rates

(v) In 2003, there is very minimal improvement in the money and credit situation in Country X, which emitted 16 signals compared to 18 signals in 2001. The signals can be attributed only to the two indicators for domestic credit, indicating an excess of liquidity in the system that might be used for non-productive activity.

(vi) Non-performing loans account for the bulk of the signals flashed for this category from 2001 to 2003. It gave out 12 signals in 2001, 10 signals for both 2002 and 2003, and 5 signals in first half of 2004. Although Non-performing Loan (NPL) share in total loans is still high, it has remained relatively stable in the last three years.

(vii) Net banks profits, measured by return on assets and equity, also continue to perform poorly over the same period. This may be due in part to tighter prudential regulation, a large proportion of NPL and weak business activities.

(viii) Although the number of signals in this category did not decline significantly, giving out 26 signals in 200, 25 in 2002 and 22 in 2003, actual figures show a definite improvement in the stability of the sector and a general decline in vulnerability despite weak profitability.

Public fFinance, External Debt and Financial Flows

(ix) Only the budget deficit flashed in this indicator category and quite persistently over 2001 to 2Q2004. Government deficit relative to GDP is much higher than the threshold. It stood at 0.04 in 2001, inching upward to 0.052 in 2002, slightly improving to 0.046 in 2003. This indicates that government efforts to curb excessive public spending and to improve revenue generation have failed to seal the gaping fiscal hole.

(x) Despite the growing deficit, indicators for short-term external debt remain stable and had flashed no signal over the observation period.

Trade and International Reserves

(xi) This set of indicators is generally healthy for Country X. From 2001 to 2003, only one indicator (trade balance, ratio to GDP) gave out signals. However, there is no indication of vulnerability in this area since the number of signals from 2002 and onwards is quite low (three at most).

(xii) Supporting data show that there is no real need for concern since (a) the signals were limited only to the first two quarters of 2003; (b) the signals were half the number of signals in 2001; and (c) their actual values even posted positive figures toward the end of 2003. The improvement can be partly attributed to robust export activity.

Stock Market

(xiii) The number of signals in this category has declined over 2001-2003. The stock price index (12-month change) meanwhile, gave a decreasing number of signals over time: 8 in 2001, 6 in 2002, 5 in 2003 and none in the first two quarters of 2004. It actually achieved positive growth rates starting July of 2003 and closed the year with a 62% growth in December. The

stock price-earnings ratio exhibited a similar trend, posting 10 signals in 2001 and dropping to 4 in 2002, 3 in 2003 and none in the fist half of 2004.

Business Tendency Survey (BTS)

(xiv) It appears that business sentiment was generally improving towards 2003, since the number of signals for all five indicators in this category was declining. However, the tide has turned again: 2004 as business sentiment showed a more cautious outlook as international interest and oil prices and domestic budget deficits continue to rise.

The framework proposed above can provide an initial framework for using MPIs to detect vulnerability in the economy and the financial sector. However, the set of 30 indicators is still a relatively large one. Some countries may not be able to monitor all these MPIs on a frequent basis due to resource constraints or the presence of considerable time lags in data availability. More importantly, some countries do not have long time-series data for certain indicators and this prevents estimation of the appropriate threshold or benchmark values.

Countries that cannot meet the data requirement at the moment can consider developing a framework composed of a smaller set of available indicators that best represent the specific characteristic of their economy. It should be noted that some crucial indicators do not have long time-series data available (i.e., level of nonperforming loans, household debt, international bank borrowing with less than one year maturity). The same is true for some qualitative indicators such as credit ratings of the country and its banks and other corporate firms. For these indicators, separate trend analysis on recent data should be performed to detect any large fluctuations of deviations from trend.

One option is to adopt a subset of the 30 indicators of the proposed framework based on availability of adequate time-series data and their monitoring capacity. The use of a smaller set of indicators based on leading indicators like the ones discussed in Bhattacharyay and Nerb (2002) is another alternative. Table 9 presents a core set of 10 monitoring indicators with their rationales. This is based on reviews by Edison (2001) of models developed by government and private institutions, as well as academic literature.

Each indicator should be updated monthly and compared to its threshold value. In terms of policy action, it is more important to monitor how near the figures are to their threshold value rather than wait for them to breach the threshold. It is important, in this sense, to establish rules of thumb when interpreting surveillance results because there may be several options available. For example, one can opt for a disinflationary policy to avoid sharp deviations in real exchange rate relative to its historical trend, or adopt a policy that avoids unsustainable nominal exchange rate appreciation.

Table 9 – Ten Core Indicators

Indicator	Comments
Deviation of real exchange rate	Real exchange rate overvaluation (-) are linked to currency crises
Merchandise exports	Weak external sector is part of currency crisis
Real interest rate differential	High world interest rates may lead to reversal of capital flows
M2/foreign exchange reserves	Expansionary monetary policy and/or sharp decline in reserves are associated with onset of crises
Equity indices	Burst of asset price precede financial crises
M2 multiplier	Rapid growth of credit precede financial crises
Excess real M1 balances	Loose monetary policy can lead to currency crises
Growth of domestic credit	Credit expands prior to crisis and contracts after
Commercial bank deposits	Loss of deposits occur as crisis unfolds
Short-term external debt	Increase in short term debt and or sharp declines in reserves are associated with crises

Source: Edison (2001).

Limitations of MPI analysis

Despite the appeal of using the MPI analysis, its limitation should be recognized. The *first* major drawback of using MPI is its assumption that an economy has a consistent and regular pattern prior to a crisis. It relies largely on historical precedents but because of differences in the origin, severity, and timing of crises, it is possible that indicators that were useful for one in the past may not necessarily be so in the future. Triggering events for different types of crisis also vary, i.e., indicators for a balance of payments crisis may not necessarily be as effective when used to predict a banking crisis. Therefore, the process of identification of MPIs should be dynamic in nature in order to assess the need for new indicators. Emergence of vulnerabilities in a new sector may call for the inclusion of new MPIs in the surveillance process.

Second, MPIs that are useful for crisis prediction in one country may not be for another because of differences in the stage of economic and financial development, giving rise to significant variations in accounting and prudential standards, level of financial sophistication, resilience of institutions, among others. However, tailor-fitting the set of MPIs to suit the unique economic characteristics of each country would give rise to the issue of cross-country comparability.

Third, structural breaks in the time series arising due to changes in regulations or regimes can complicate MPI analysis. In light of these limitations, caution ought to be exercised in analyzing MPIs or more specifically, applying one smaller core set of leading indicators to a group of countries, and encouraging compilation of additional indicators that apply to special situations particular to each country.

Fourth, there are measurement problems in capturing qualitative information. For instance, poor banking supervision, which is identified as a major factor in the Asian crisis, is difficult to quantify and qualitative assessments may vary significantly. Other factors that are possibly important in predicting a crisis but that are difficult to measure include the quality of corporate governance, independence of the central bank, reliability of the legal system, political stability, and other institutional qualities.

MPI analysis, despite its limitations, can play an important role in identifying weaknesses in the macroeconomic and financial system. Given the cost of a crisis, any measure to minimize its recurrence would be useful. Early detection will allow policymakers to put in place mitigating steps to avert the occurrence of a crisis. It is imperative that effective methods of analysis and interpretation of MPIs are available to enable developing countries to derive the maximum benefit from regularly monitoring these indicators.

Existing methods for MPI analysis have their own advantages but much still needs to be done to improve these techniques. For instance, there is no universally accepted or independently determined set of benchmark or threshold values for each MPI, yet it is an important feature of economic and financial surveillance, and is even used in EWS models to predict the occurrence of a crisis.

Concluding remarks

The financial crises in Latin American and Asian have revealed the limitations of the current state of monetary and financial monitoring system in many developing countries in comprehensively addressing financial and monetary problems and issues. In order to prevent financial turmoil and its contagion effect, there is a need for better tools to monitor financial risks and vulnerabilities of developing countries.

In response to this, multilateral organizations, international financial institutions, central banks, and ministries of finance of several developing countries have recently started with the use of leading MPIs to monitor the performance and assess the vulnerability of the economy and the financial sector.

The development of MPIs for monitoring financial vulnerability is rather recent. Some progress has been made in identifying and compiling timely and accurate MPIs. It is to be noted that the identification of MPIs is a dynamic process. Continuous reviewing of selected MPIs needs to be performed in order to assess the need for inclusion of new indicators. It is important that countries should undertake extensive analysis of available qualitative and quantitative data to enable them to assess the capability and strength of the indicators in providing early signs of vulnerability. If the data series for some MPIs are inadequate, it may not be appropriate at this stage to apply formal statistical methods like regression or factor analysis for identification of key indicators. Trend analysis together with a graphical inspection of the series could be a good starting point in the initial round of analysis to identify the best candidates for a set of core MPIs.

The review of selected Asian country practices reveals a number of common elements as well as significant differences in the collection and compilation of MPIs. As discussed, these differences are reflective of the wide spectrum of financial development, the differences in the demand for statistics by end users as well as institutional set up. The major common problems in the compilation of MPIs include excessive delay and inaccuracy, inadequate or incompleteness of data. In view of the above, it is essential to create a central database system within the national central bank which will be responsible to collect all raw statistics required to compile a broad set of MPIs. An increasing trend towards more intensive use of the Internet and new information technology as medium of collection, compilation and dissemination of indicators will strengthen MPI compilation process.

Once the identification and compilation of accurate and timely MPIs is accomplished, focus should be shifted to developing techniques for the proper analysis and interpretation of MPIs. There is no universally accepted standard or system of macroprudential analysis at present. Further work should be done in the analysis and interpretation of MPIs, specifically in the area of applying more formal econometric/statistical methods to identify the exact informational content of the data series. Another important task is to provide the analytical groundwork in devising the appropriate benchmarks or threshold values for higher frequency data. However, it is to be noted that the macroprudential analysis should focus not only on symptoms – whether a MPI is above or below the threshold value – but on the underlying sources of chronic vulnerability.

There is a need to develop the appropriate framework of analysis that will effectively use MPIs in detecting or predicting financial sector vulnerability. This framework should be cost-effective and not too complicated so that most countries can implement it for their high-frequency monitoring. The framework proposed could be the initial model for the use in MPI analysis. An attempt should be made to develop a smaller set of core indicators. What is important is for each country to adopt a framework that is tailor-made for their specific characteristics, simple enough for high frequency monitoring, and based on objective quantitative method for computing threshold values.

The most difficult part of monitoring is to analyze, interpret, and translate the information contained in these indicators into something that could help direct policymakers and decision makers to appropriate policy action. The interpretations discussed in this paper are meant to be starting points for national authorities to develop more country-specific monitoring schemes that take into account their specific needs and circumstances.

Further work on understanding the intrinsic financial structure of individual country financial systems can be undertaken. As yet, it is not advisable to compare the performance of countries solely based on MPIs. The definitions of some MPIs may vary from one country to another. At the same time, each country has its own set of frameworks, standards, and regulations. An understanding of the intrinsic and changing financial nature/structure of each country, therefore, will contribute to better assessments of the situation of a country.

At the moment, it is almost impossible to predict the probability, timing, and kind of a crisis that will occur even with the significant progress in techniques for MPI analysis, especially in EWS models. It may be better to use MPIs in crisis prevention rather than crisis prediction. The vulnerability signals provided by the proposed framework can direct attention to particular issues or problems and trend analysis can then be used to confirm if the indicators are indeed showing signs of vulnerability that may lead to an impending crisis or is simply a result of institutional or structural changes.

In order to avoid the virulence of the contagion among neighboring countries, there is a need for further strengthening of the regional surveillance mechanism, particularly the peer review process.

Further development of deeper and more liquid financial markets and strengthening financial institutions, including greater central bank independence, strengthening prudential supervision and regulation of financial markets, improving corporate governance and greater policy transparency will be essential to prevent future crises and financial instability or to minimize their impacts in the region.

Finally, the scope of capacity building in monitoring is still wide among developing countries. Technical training should be provided to ministries of finance, central banks, capital market supervisory authorities and other relevant supervisory authorities to enable them to perform meaningful interpretation and analysis of MPIs. Effective monitoring calls for a high degree of experience in analyzing the quantitative MPIs, coupled with informed judgment on the adequacy of the institutional and regulatory framework of the concerned country.

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Abstract: Financial sectors are highly vulnerable to instability and systemic risk, monitoring these sectors as well as spillover effects of weaknesses of the real sector assumes great importance in light of the severity and frequency of financial crises of the past. It is in this context that the development of statistical indicators of financial soundness such as macroprudential indicators (MPIs) is relevant. This paper reviews developments in MPI identification, compilation, analysis, and interpretation, and proposes a framework for macroeconomic and financial soundness analysis of a selected set of MPIs that can be used to detect economic and financial sector vulnerability. This paper also presents the role of the Asian Development Bank in strengthening Asia's economic and financial surveillance process.

Some progress has been made in identifying and compiling accurate and timely MPIs. The focus has now shifted towards the development of techniques for the proper analyses and interpretation of data since no universally accepted standard or system of macroprudential analysis exists. The framework proposed here is based on 30 selected leading indicators. The MPIs are compared to a set of country-specific threshold values, which was determined using a suitable econometric model, to detect significant vulnerabilities or weakness in the economy in general and the financial sector in specific. An empirical illustration is also presented.

It is argued that a country should adopt an appropriate framework tailor-made for its specific characteristics, simple enough for high frequency monitoring, and based on objective quantitative method for computing threshold values. In addition to improving MPI analysis and interpretation, other complementary tasks also need to be undertaken to improve financial markets, to strengthen financial institutions, to improve the regional surveillance mechanism and to provide technical training to surveillance personnel.

Key Words: economic and financial vulnerability, macroprudential indicators (MPI), financial soundness indicators (FSI), MPI/FSI analysis, Asian countries, financial sector, financial crisis, Early Warning Models

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Appendix 1 – List of additional indicators

External Debt and Financial Flows

1. Short Term Debt (% of foreign reserves)
2. Use of IMF credit (% of GDP) – ratio of IMF credit to nominal GDP

Money and Credit (these data can be drawn from IFS)

3. Growth of Currency in circulation (%)
4. M3 Growth – percent difference from previous period. M3 equals M2 plus liabilities of other financial institutions.

Banking

5. Nonperforming loans (% of Average Assets): simple average of assets over the period
6. Loans to commercial real estate sector (% total loans)
7. Loans to residential real estate (% total loans)
8. International liability from bank with maturities over 1 year and up to 2 years (mn US$) - total international liability from commercial banks
9. International liability from bank with maturities over 2 years (mn US$) - total international liability from commercial banks
10. International liability from bank with maturities, unallocated (mn US$) - total international liability from commercial banks
11. Gini coefficient of market shares of banks in terms of assets

Interest Rates

12. Real deposit rate (3 mos.) (a.o.p.) - average of period; defined as the difference between deposit and inflation rate
13. Real lending rate (3 mos.) (a.o.p.) - average of period; defined as the difference between commercial bank lending and inflation rate
14. Real lending rate – real deposit rate (each 3 months) – difference between commercial bank lending rate and deposit rate.
15. Real lending rate/Real deposit rate (each 3 months) – ratio of real lending rate to real deposit rate.

Stock Markets and Bonds

16. Gini coefficient of market share of stocks in trading – measure of concentration of market capitalization (inequality of market share among the stocks traded during the day). It is the ratio of the actual concentration of total value stocks among traded companies to the maximum concentration.

$$GiniCoefficient = \frac{N+1}{N-1} - \frac{2}{N(N-1)A}\left(\sum_{i=1}^{N} P_i \alpha_i\right)$$

where:
P_i = the rank of each company in the stock market counting from the top in terms of stock assets or market capitalization

α_i = stock asset of ith company

A = total asset or market capitalization of all securities

N = total number of companies listed

17. Turnover in stocks (as % of market capitalization)
18. Turnover in Bonds (as % market capitalization)
    a. Volume of government bonds traded
    b. Volume of corporate bonds traded
19. Turnover in mutual funds (as % market capitalization)
20. Foreign investment in stock by sector

Business Survey Data (Manufacturing, Construction, Trade, Services)

21. Production/Turnover (Present tendency)
22. Production/Turnover (Expected Tendency)
23. Capacity utilization (present situation)
24. Credit demand by sector (only for survey in financial sector)

Supervisory Surveys

25. Lending and credit standards of financial institutions
26. Proportion of institutions having license withdrawn
27. Spreads between reference lending rates and reference borrowing rates
28. Spreads between depository corporations' securities and the rate of comparable Treasury securities
29. Securities between depository corporations' subordinated debt securities and the rate for comparable Treasury securities
30. Distribution of 3-month local currency interbank rates for different depository corporations
31. Average interbank bid-ask spread for 3-month local currency deposits
32. Average maturity of assets

Others

33. Real estate price index and its growth rate

Appendix 2 – Vulnerability signals by leading indicator for Country X

	2001	2002	2003	1st Quarter (1Q) 2004	2nd Quarter (2Q) 2004
Money and Credit					
M2					
■Growth	0	0	0	0	0
■Ratio to foreign exchange reserves	0	0	0	0	0
Domestic Credit					
■Growth	6	4	4	2	0
■Ratio to GDP	12	12	12	3	3
Money Market Rate/Inter-Bank Rate	0	0	0	0	0
Banking					
Net Bank Profits					
■Return on Assets*	4	3	2	1	1
■Return on Equity*	4	2	2	1	1
Total Bank Loans to Total Deposits	0	0	0	0	0
Credit to Private Sector, Ratio to GDP	0	0	0	0	0
Central Bank Credit to the Banking System, y-o-y growth	0	0	0	0	0
Household Debt					
■Growth	3	8	5	0	0
■Ratio to GDP	0	0	0	0	0
Real Estate Loans, Ratio to Total Loans	3	2	3	1	0
Non-performing Loans, Ratio to Total Loans	12	10	10	2	3
Liquid Assets to Short-term Liabilities*	0	0	0	0	0
Public Finance, External Debt and Financial Flows					
Overall Budget Deficit to GDP	12	12	12	3	3
Short-Term International Borrowing or External debt with maturities one year or less					
■Ratio to GDP	0	0	0	0	0
■Ratio to Total External Debt	0	0	0	0	0
Trade and International Reserves					
Trade Balance, Ratio to GDP	6	2	3	0	0
Real effective exchange rate	0	0	0	0	0
International Reserves, months of imports	0	0	0	0	0
Stock Market					
Composite Stock Price Index, y-o-y growth	8	6	5	1	0
Stock Price Earnings Ratio	10	4	3	0	0
Business Tendency Survey (BTS)					
Current Business Situation*	3	3	2	1	1
Expected Business Situation (next 6 months)*	3	3	1	1	1
spnumStock of Finished Products*	2	1	1	1	1
Employment (present situation)*	2	2	1	1	1
Financial Situation (Present Situation)*	3	3	2	1	1
TOTAL	93	77	68	19	16

Note: These are hypothetical figures given for illustrative purposes only.
** Quarterly data only, maximum of 4 signals per year.*

Proceedings[1] of the Conference on "Central bank issues regarding National and Financial Accounts" Basel, 9-10 September 2004

Keynote presentation

Session 1:
Measuring prices and inflation: methodological issues

Workshop A:
Country papers on CPI and PPI

Workshop B:
Price statistics: special topics

Session 2:
Output, capacity and productivity: key issues

Workshop C:
Productivity statistics

Workshop D:
Output gaps and capacity

Workshop E:
Output and output indicators

Session 3:
Financial Accounts: key issues

Workshop F:
Financial Accounts: general issues and country experiences

Workshop G:
Financial Accounts: domestic sectors

Workshop H:
Financial Accounts: linkage with Balance of Payments

1 *The Keynote presentation and the documents concerning Session 1, Workshop A and Workshop B have been reprinted in the present issue of the IFC Bulletin. Documents of the remaining Sessions and Workshops will be reprinted in forthcoming issues. All documents are available on the IFC website (http://www.ifcommittee.org).*

Economic and financial statistics: a glass half full or half empty?

Keynote Address

William R. White (BIS)

1. Introduction

It is again my pleasure to welcome the members of the Irving Fisher Committee to Basel and to the Bank for International Settlements. You may recall the very successful conference we held here two years ago, and I have every hope that this one will prove as stimulating as the last one. We have a large number of expert speakers on topics that are, well, topical and I have every expectation that people will either go away more knowledgeable or, at the least, more confused at a higher level.

I am particularly glad that you are here because I have been encouraging the BIS, with some success, to become more involved in issues having to do with statistical methodology. These are crucial issues for central bankers as they try to conduct their policies in a world that is both complex and constantly changing. lndeed, data issues have come up very regularly at the meetings of Governors that I have attended at the BIS over the last twenty years.

As an international financial institution whose principal mandate is to foster central bank cooperation, the BIS has sought in recent years to do more for its clients in this area. It has been in that spirit that I supported my colleague Paul van den Bergh's decision to accept the position of Chair of the IFC Executive Body, and also encouraged the BIS staff to cooperate actively with the IMF, the OECD and a number of other international and regional groupings on statistical issues. Among these initiatives I would particularly note the conference on property prices last autumn, which was jointly sponsored by us and the IMF.

The conference two years ago had as its theme "Challenges to central bank statistical activities". You may also recall that the individual sessions and workshops had to do with challenges identified in particular areas such as the pursuit of monetary stability, the pursuit of financial stability, cooperation with national statistical offices and a host of others. This year, the principal theme is: "Central bank issues regarding national and financial accounts". Evidently, it is a somewhat narrower theme, and focused more directly on methodological issues, but it seems to me to be wholly appropriate to start with the big picture and then gradually home in on more practical issues. I have no doubt that "perfecting" the data on prices, productivity, output gaps and the financial accounts, and assuring that everything is internationally consistent, will keep us busy for at least two days. And if we finish early, have achieved perfection, then we can just go home early with a sense of a job well done.

Over the last few years, a lot of progress has been made in the area of compiling statistics and statistical methodology. Yet we all know that there remains a lot to do. Let me review briefly some of the issues under the heading of "Is the glass half full or half empty". I will begin with a review of some good news and bad news with respect to a number of statistical issues, move on to the added problem that the glass seems constantly to be changing both size and shape, and finish up with what we might collectively do to move the agenda forward.

2. Is the glass half full or half empty?

Let me answer this question with respect to four issues: first, methodological issues affecting measurement and measurement bias. Second, the quality of the data we are collecting. Third, issues of intertemporal and international consistency, and finally, the resource issue. Are we doing enough even to know where we are, much less where we are going?

The first and likely most important issue has to do with methodology. Are we measuring accurately what we want to measure? Do we have a clear sense of what the data are for? In particular, can the data be used to test hypotheses that are of interest to central banks as they carry out their most important function; namely, deciding whether policy rates should go up or down in the pursuit of monetary and financial stability?

Here there are many grounds for believing that the glass is half full. At the level of theory, we have a well developed system of National Income and Expenditure Accounts, and an increasingly sophisticated set of Financial Accounts measuring both financial flows and associated stocks of assets and liabilities. In particular, the importance of compiling monetary and credit aggregates is once again being recognised after a long period in the wilderness. Moreover, new models have become available to measure and price financial risks of various sorts: market risk, credit risk, liquidity risk and even operational risk. This is particularly important given the growing importance of financial markets in the modern world, with their promise of greater efficiency but also greater instability. At the level of application, the glass is also half full in that we now possess a whole multitude of agreed international methodologies (eg Balance of Payments, International Investment Positions and Government Accounts) as well as compilation manuals and standards of best practice. Moreover, as this gathering attests, there are now many groups of international statistical experts, and technical assistance is being provided through many channels so that the more knowledgeable can share their insights with the less knowledgeable. This is all to the good.

Yet this particular glass might still be considered half empty. Our theoretical frameworks often have serious shortcomings. Does rapid growth in GDP really measure an increase in human welfare if associated with unmeasured increases in hours worked (with mobiles and laptops we are all on call all the time), or if earned through great environmental degradation (as increasingly evident in a number of emerging market economies). Moreover, our empirical measures often are biased estimates of what we really want to measure or can suffer from sampling errors or other estimation problems. The price deflators in rapidly expanding service sectors also need to be looked at, as does more generally the question of quality adjustments and the use of hedonic pricing. Finally, as globalisation continues and the importance of cross border transactions grow, the implications of intrafirm transfer pricing need to be reassessed. This is obviously an issue with fiscal implications, but there are other implications as well.

Even in the context of the NIA, a myriad of problems can be identified. Not least is the fact that many key data observations are in fact not observed but inferred. Consider the difficulty involved in measuring real output growth and determining in turn whether productivity growth has in fact sped up over the last few years. Deciding whether we are living in a "New Era", or not, obviously has immense policy implications for central bankers. In the medium run, higher productivity growth implies more scope for lower interest rates to foster non-inflationary growth. Over the longer run, however, such faster growth also implies a higher natural rate of interest.

Consider as well, some of the measurement problems in the financial sector. The sectoral breakdowns in the financial accounts are particularly problematic, as are measures of -private sector wealth. As house prices increase, the measured wealth of the housing sector increases even though the future liabilities of households (higher implicit rents on the same properties) have gone up. There is something odd here. And it becomes all the odder, and more worrisome, when we realise that in many countries the household sector has reduced its savings rate dramatically in response to these measured wealth increases.

The second issue I want to deal with is closely related, the quality of the data being collected. On the half-full side of the ledger is the fact that improvements in quality are ongoing, in large part because of the pressure being exerted by various communities of users. International organisations and bodies like the IMF and the Financial Stability Forum are exerting constant pressure for statistical improvements. These pressures are being manifested in the implementation of the SDDS and GDDS standards for the macroeconomic data and FSAPs and ROSCs for the financial sector in particular. But in addition, we have all benefited from the advice and support of policymakers, financial market participants and analysts of various sorts who often make strong arguments for the statisticians to do more and offer specific suggestions as to how to move forward. Paradoxically, it is often the same people making the suggestions for more work who complain the most about the added burden of responding to new statistical requests. Of course, there is nothing new in that.

As expected, however, it is not so hard to make the argument for the glass being half empty. One shortcoming is that data for the emerging market countries tends still to be of lower quality than for the industrial countries. This is particularly unfortunate since, albeit subject to measurement error, such countries are increasingly important at the global level. From 2001 to the present, using PPP for comparisons, China and India are estimated to have accounted for 30% of global growth in real

GDP. That China has made a significant contribution to the run-up in global commodity prices, particularly oil, over the last year can hardly be doubted. Yet equally important is that the persistence of this effect will in part depend on stock building in China, for which there are effectively no reliable numbers. Finally, if the data is generally better and more complete in the industrial countries, major shortcomings remain. House prices seem to play a large role in economic cycles worldwide, yet in many countries there are no reliable statistics. This issue needs to be urgently addressed.

A third issue that merits some attention is that of intertemporal and international consistency. On the one hand, it might be possible to identify some statistical series where revisions seemed to be less significant than previously. This could imply that original estimates have become more accurate though, logically, it could also imply less interest in getting it right at the second round. As for international consistency; there are again grounds for satisfaction. The recently introduced framework for the harmonised EU statistics has remarkable promise, and international comparability (or at least transparent reasons for differences) has been steadily improving. The fact that best practices concerning data quality (the IMF's Data Quality Assessment Framework) are increasingly respected is another plus.

On the other hand (the half empty hand), the frequency and size of data revisions remains important. It is obviously disquieting when policy leans against a recession that is subsequently revised away, although it is perhaps equally disquieting when initial estimates are never subject to revision at all. And the degree of international comparability of data is still not fully satisfactory. In particular, gaps exist between internationally agreed methodologies and actual approaches used nationally. Moreover, the source data for statistics are often rendered idiosyncratic by conventions associated with national accounting conventions. Finally, these deviations are often not well described, perhaps because it would simply be embarrassing to do so. In too many areas there remains too much national discretion as to how things should be done.

The final issue I wish to say a few words about is the amount of resources being directed to statistical questions around the world. There are some grounds for satisfaction and even optimism. Significant levels of spending continue to characterise most of the industrial countries, and governments are becoming increasingly aware of the importance of a good statistical base in many emerging market countries. Statisticians, perhaps even more than others, are also benefiting from the productivity increases being made possible by new IT technology. For similar reasons, great improvements have been made in making data available to users and increasing" its usefulness. There are a growing number of both national and international statistical publications and data bases, and the electronic dissemination of such information via websites is now commonplace. Commercial vendors are now providing all sorts of new data, especially in the realm of financial data. In short, "there is more bang for the statistical buck".

Yet, in this area as well, many possible problems and improvements could be identified. Even given the boost to productivity from IT, statistical activities remain resource intensive. The lack of IT standards limits the integration of platforms and, as a result, the duplication of data bases and the need for customised information flows is much increased. Commercial data bases are costly, and we all know that the vendor's attention to detail and accuracy sometimes leaves a lot to be desired. Finally, reporting burdens remain high both for reporters and for the statistical agencies. One reason for this is the great difficulty we all have in withdrawing from areas that used to be important, so that resources can be shifted to new areas of growing interest. This observation brings me to my next major theme. The glass, whether viewed half full or empty, is constantly changing in both shape and size. How do we keep up with such a changing environment?

3. A glass of changing shape and size

The most obvious example of change on the real side of the post-war economy has been the shift out of agriculture into manufacturing and then in turn into commercial services. Yet, in most countries the shift in statistical resources has by no means been comparable. The end result is that we continue to know too little about developments that are becoming increasingly relevant to our future well-being and might well be amenable to some kind of policy influence.

And if there have been difficulties in keeping up with change on the real side of the economy, the vast changes in the financial sector have proved even more of a challenge. In the past, credit was essentially loans from banks in local currency. Now markets provide credit from many sources in many currencies. We need both better and more timely measures of the risk exposures of the household, corporate and financial sectors and the economy as a whole. As for better numbers, this

is not going to be an easy task. We need better aggregates of balance sheet data. Of particular importance will be indicators of the extent to which currency and maturity mismatch problems are developing given the crucial role such mismatches have played in many recent financial crises. Moreover, attention must also be paid to offbalance sheet data as well and we know virtually nothing about such exposures. In addition, we need better measures of liquidity, both actual and potential, in certain key financial markets. In this regard, measures of institutional concentration might prove useful indicators of potential problems affecting the functioning of markets. As for the problem of timeliness, this will also prove a major challenge. In modern financial markets, exposures can be altered quite drastically in very short time periods, implying that anything short of real time information might well prove misleading. However, such requirements would immediately run into major problems having to do with privacy and proprietary rights, as well as the obvious technical challenges.

4. Can we fill the glass further?

The answer is obviously "yes". One might start by trying to address a number of the specific shortcomings I have just identified as being associated with the glass being "half empty". Moreover, even in areas where current practices are judged quite satisfactory in industrial countries, it would likely prove beneficial to strengthen statistical capacities in emerging market countries as well. This is in everyone's interests in an integrated global economy.

With respect to methodological issues, it is important to regularly review what it is that we wish to measure in the interests of both better understanding and better policy. Moreover, we need to review and adequately maintain international statistical methodologies to ensure they continue to be relevant to a changing world. As for data collection, it is important from time to time to do cost benefit analyses of current procedures, and to investigate the usefulness of alternative data sources. For example, in the financial area a number of unexplored possibilities present themselves: the use of corporate data revealed through enhanced disclosure requirements, supervisory data, and data drawn from payment and settlement systems as well as custodian arrangements.

.As for problems of international consistency, we need to keep up the pressure to have countries conform to internationally agreed standards. Moreover, we need to make it easier to compare data internationally. In this regard, having more and better metadata to allow identification of conceptual differences would be particularly welcome. Finally, we need to pursue the ongoing efforts to develop globally accepted technical standards for statistical data exchange. Given that single data sets must now often be reported to different institutions in different formats, the general acceptance of SDMX would sharply ease reporting burdens and overall costs for everybody.

5. The role of the BIS and the Irving Fisher Committee

The IFC is a very useful platform for discussions on methodological issues. I hope this will become increasingly apparent both today and tomorrow. As for the BIS, our general role is to support central bank cooperation, which of course includes the statistical function of central banks. Both the IFC and the BIS are also in a position to represent the views of central banks and support their interests in international fora from time to time.

More particularly, the BIS has focused on developing methodologies for the collection of international financial statistics, and for collecting, compiling and publishing such statistics. Our original interest in cross-border banking flows has now been extended to international securities markets, to derivatives markets and the markets for foreign exchange. Increasingly, we have tried as well to analyse these numbers as they evolve over time, to see what the implications might be for the efficiency and stability of the international financial system. For those of you who are interested in such questions, I can do no better than refer you to the BIS Quarterly Review, which has changed enormously in recent years, and to our BIS website where all our publications are listed.

I would be remiss if I did not also draw your attention to the BIS Data Bank, which is increasingly a one stop hub for-all of our (or perhaps I should say your) economic, monetary and financial statistics. From its original rather modest coverage of only eleven countries, the macro data base now covers thirty-six countries, and a number of other countries are in the process of joining - including India and China. The same kind of geographical expansion also characterises the financial statistics. We hope this process will continue until the BIS data bank eventually contains all the data and metadata that central banks in a global economy really need to have. As I said, one-stop shopping.

With this advertisement out of the way, let me finish with one last thought. Statistics had their beginning with a wish to measure the state of the here and now; albeit with the usual reporting lags. This is as true of accounting and micro statistics as it is off traditional macro statistics. Over time, however, interest began to shift to more forward-looking statistics which might indicate how the world could evolve over time. Of particular relevance to central banks and the BIS, we began to take more interest in measures of risk exposure to assess how vulnerable the economy and the financial system might be to shocks of various sorts.

With respect to all these statistics, it is important to remind ourselves of the considerable uncertainty which remains as to the relevance and the reliability of the numbers we have collected or calculated. Statisticians would make a material contribution to global well-being if they would sometimes remind their economist friends of the natural limitations of the statistician's trade. If this encouraged economists to be a little more humble about what they know, and a little less dogmatic in their policy advice, this would surely be no bad thing.

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SESSION 1

Measuring prices and inflation: methodological issues

Chair: Coen Voormeulen (De Nederlandsche Bank)

Papers:

Consumer Price Indices: International standards – an overview
Valentina Stoevska (International Labour Organisation)

The new price index manuals
Paul A. Armknecht (International Monetary Fund)

The EU Harmonised Index of Consumer Prices
Keith Hayes and Alexandre Makaronidis (Eurostat)

Monetary policy perspectives on the accuracy of inflation measures
Mark A. Wynne (Federal Reserve Bank of Dallas)

Consumer Price Indices
International standards – an overview

Presented by Valentina Stoevska (International Labour Organisation)

The CPI is:
- a key indicator of the "health" of the economy;
- a measure of inflation as it affects households;
- a proxy for general inflation;
- an adjustment factor for indexation of wages, social security benefits and other payments;
- a basis for estimation of changes to cost of living;
- a deflator of series in nominal terms to derive "real" terms.

Therefore, the use of the the CPI has policy and financial implications for governments, employers, workers, and households.

The ILO is responsible for the estabilshment of guidelines on CPI within the UN statistical system.

The first standards were promulgated in 1925 by the 2nd International Conference of Labour Statisticians (ICLS). Revised resolutions were adopted by the 6th (1947), 10th (1962), 14th (1987) and 17th (2003) ICLS.

An ILO Manual on CPI was published in 1989. A revised "CPI Manual; Theory and Practice" followed in 2004.

The International standards on CPI have been revised against the background of the following efforts:
- the activities of the Ottawa City Group on Prices;
- the US Boskin report;
- research projects in Australia, Canada, France, the United Kingdom;
- the establishment of the Eurostat HICP.

The slow down of the rate of inflation in the 1990s produced a demand for a more accurate, reliable and credible measure. To attain this objective, the revision were to comprise:
- formulae utilized to calculate the CPI;
- the frequency of weights updates;
- procedures for quality adjustment, and introduction of new goods, and new outlets;
- the sampling methods applied;
- the use of one single index for many different purposes.

The objectives of the revised CPI Resolution were:
- to provide guidelines;
- to promote comparability;
- to encourage governments to (i) identify the purpose of the CPI, and (ii) to provide adequate resources and to guarantee professional independence;
- to promote a better understanding of the index by users.

The revised Resolution is presented below in extenso.

Resolution concerning consumer price indices, adopted by the 17th International Conference of Labour Statisticians

Preamble

The Seventeenth International Conference of Labour Statisticians,

Having been convened at Geneva by the Governing Body of the ILO and having met from 24 November to 3 December 2003,

Recalling the resolution adopted by the Fourteenth International Conference of Labour Statisticians concerning consumer price indices and recognizing the continuing validity of the basic principles recommended therein and, in particular, the fact that the consumer price index (CPI) is designed primarily to measure the changes over time in the general level of prices of goods and services that a reference population acquires, uses or pays for,

Recognizing the need to modify and broaden the existing standards in the light of recent methodological and computational developments to enhance the usefulness of the international standards in the provision of technical guidelines to all countries,

Recognizing the usefulness of such standards in enhancing the international comparability of the statistics,

Recognizing that the CPI is used for a wide variety of purposes and that governments should be encouraged to identify the (priority) purposes a CPI is to serve, to provide adequate resources for its compilation, and to guarantee the professional independence of its compilers,

Recognizing that the (priority) objectives and uses of CPI differ among countries and that, therefore, a single standard could not be applied universally,

Recognizing that the CPI needs to be credible to observers and users, both national and international, and that better understanding of the principles and procedures used to compile the index will enhance the users' confidence in the index,

Agrees that the principles and methods used in constructing a CPI should be based on the guidelines and methods that are generally accepted as constituting good statistical practices;

Adopts, this third day of December 2003, the following resolution which replaces the previous one adopted in 1987:

The nature and meaning of a consumer price index

1. The CPI is a current social and economic indicator that is constructed to measure changes over time in the general level of prices of consumer goods and services that households acquire, use or pay for consumption.
2. The index aims to measure the change in consumer prices over time. This may be done by measuring the cost of purchasing a fixed basket of consumer goods and services of constant quality and similar characteristics, with the products in the basket being selected to be representative of households' expenditure during a year or other specified period. Such an index is called a fixed-basket price index.
3. The index may also aim to measure the effects of price changes on the cost of achieving a constant standard of living (i.e. level of utility or welfare). This concept is called a cost-of-living index (COLI). A fixed basket price index, or another appropriate design, may be employed as an approximation to a COLI.

The uses of a consumer price index

4. The CPI is used for a wide variety of purposes, the two most common ones being: (i) to adjust wages as well as social security and other benefits to compensate, partly or completely, for changes in the cost of living or in consumer prices; and (ii) to provide an average measure of price inflation for the household sector as a whole, for use as a macro-economic indicator. CPI sub-indices are also used to deflate components of household final consumption expenditure in the national accounts and the value of retail sales to obtain estimates of changes in their volume.
5. CPIs are also used for other purposes, such as monitoring the overall rate of price inflation for all sectors of the economy, the adjustment of government fees and charges, the adjustment of payments in commercial contracts, and for formulating and assessing fiscal and monetary policies and trade and exchange rate policies. In these types of cases, the CPI is used as more appropriate measures do not exist at present, or because other characteristics of the CPI (e.g. high profile, wide ac-

ceptance, predictable publication schedule, etc.) are seen to outweigh any conceptual or technical deficiencies.

6. Given that the CPI may be used for many purposes, it is unlikely that one index can perform equally satisfactorily in all applications. It may therefore be appropriate to construct a number of alternative price indices for specific purposes, if the requirements of the users justify the extra expense. Each index should be properly defined and named to avoid confusion and a "headline" CPI measure should be explicitly identified.

7. Where only one index is compiled, it is the main use that should determine the type of index compiled, the range of goods and services covered, its geographic coverage, the households it relates to, as well as to the concept of price and the formula used. If there are several major uses, it is likely that compromises may have to be made with regard to how the CPI is constructed. Users should be informed of the compromises made and of the limitations of such an index.

Scope of the index

8. The scope of the index depends on the main use for which it is intended, and should be defined in terms of the type of households, geographic areas, and the categories of consumer goods and services acquired, used or paid for by the reference population.

9. If the primary use of the CPI is for adjusting money incomes, a relevant group of households, such as wage and salary earners, may be the appropriate target population. For this use, all consumption expenditures by these households, at home and abroad, may be covered. If the primary use of the CPI is to measure inflation in the domestic economy, it may be appropriate to cover consumption expenditures made within the country, rather than the expenditures of households resident within the country.

10. In general, the reference population for a national index should be defined very widely. If any income groups, types of households or particular geographic areas are excluded, for example, for cost or practical considerations, then this should be explicitly stated.

11. The geographic scope refers to the geographic coverage of price collection and of consumption expenditures of the reference population and both should be defined as widely as possible, and preferably consistently. If price collection is restricted to particular areas due to resource constraints, then this should be specified. The geographic coverage of the consumption expenditure may be defined either as covering consumption expenditure of the resident population (resident consumption) or consumption expenditure within the country (domestic consumption).

12. Significant differences in the expenditure patterns and/or price movements between specific population groups or regions may exist, and care should be taken to ensure that they are represented in the index. Separate indices for these population groups or regions may be computed if there is sufficient demand to justify the additional cost.

13. In accordance with its main purpose, the CPI should conceptually cover all types of consumer goods and services of significance to the reference population, without any omission of those that may not be legally available or may be considered socially undesirable. Where appropriate, special aggregates may be constructed to assist those users who may wish to exclude certain categories of goods or services for particular applications or for analysis. Whenever certain goods or services have been excluded from the index, this should be clearly documented.

14. Goods and services purchased for business purposes, expenditures on assets such as works of art, financial investment (as distinct from financial services), and payments of income taxes, social security contributions and fines are not considered to be consumer goods or services and should be excluded from the coverage of the index. Some countries regard expenditures on the purchase of houses entirely as a capital investment and, as such, exclude them from the index.

Acquisition, use or payment

15. In determining the scope of the index, the time of recording and valuation of consumption, it is important to consider whether the purposes for which the index is used are best satisfied by defining consumption in terms of "acquisition", "use", or "payment". [1] The "acquisition" approach is often used when the primary purpose of the index is to serve as a macroeconomic indicator. The "payment" approach is often used when the primary purpose of the index is for the adjustment of compensation or income. Where the aim of the index is to measure changes in the cost of living, the "use" approach may be most suitable. The decision regarding the approach to follow for a particu-

1 *See Annex 1.*

lar group of products should in principle be based on the purpose of the index, as well as on the costs and the acceptability of the decision to the users who should be informed of the approach followed for different products. Because of the practical difficulties in uniformly defining consumption and estimating the flow of services provided by other durable goods in terms of "use", it may be necessary to adopt a mixed approach, e.g. "use" for owner-occupied housing and "acquisition" or "payments" basis for other consumer durables.

16. The differences between the three approaches are most pronounced in dealing with products for which the times of acquisition, use and payment do not coincide, such as owner-occupied housing, durable goods and products acquired on credit.

17. The most complex and important of the products mentioned above is owner-occupied housing. In most countries, a significant proportion of households are owner-occupiers of their housing, with the housing being characterized by a long useful life and a high purchase outlay (price). Under the "acquisition" approach, the value of the new dwellings acquired in the weights reference period may be used for deriving the weight (and the full price of the dwelling is included in the CPI at the time of acquisition, regardless of when the consumption is taking place). Under the "payment" approach, the weights reflect the amounts actually paid out for housing (and the prices enter the CPI in the period(s) when the prices are paid). Under the "use" approach the weights are based on the value of the flow of housing services consumed during the weights reference period estimated using an implicit or notional cost (and prices or estimated opportunity costs enter the CPI when the consumption is taking place).

18. Own-account consumption, remuneration in kind and/or goods and services provided without charge or subsidized by governments and non-profit institutions serving households may be important in some countries where the purpose of the index is best satisfied by defining consumption in terms of "use" or "acquisition" (under the payment approach these are out of scope). The inclusion of these products will require special valuation and pricing techniques.

Basket and weights

19. Decisions on the composition of the basket and the weights follow directly from the scope, as well as from the choice between the "acquisition", "use" or "payment" approaches.

20. Once defined, the expenditures that fall within the scope of the index should be grouped into similar categories in a hierarchical classification system, e.g. divisions/ groups/ classes, for compilation as well as analytical purposes. There should be consistency between the classification used for index compilation and the one used for household expenditure statistics. The CPI classification should meet the needs of users for special sub-indices. For the purposes of international comparisons, the classification should also be reconcilable with the most recent version of the UN *Classification of Individual Consumption According to Purpose* (COICOP), at least at its division level. [2]

21. In order to facilitate the analysis and interpretation of the results of the index, it may be desirable to classify goods and services according to various supplementary classifications, e.g. source of origin, durability and seasonality. Calculation of the CPI by using various classifications should generate the same overall results as the original index.

22. The classification should also provide a framework for the allocation of expenditure weights. Expenditures at the lowest level of the classification system, expressed as a proportion of the total expenditure, determine the weights to be used at this level. When the weights are to remain fixed for several years, the objective should be to adopt weights that are representative of the contemporary household behaviour.

23. The two main sources for deriving the weights are the results from household expenditure surveys (HESs) and national accounts estimates on household consumption expenditure. The results from an HES are appropriate for an index defined to cover the consumption expenditures of reference population groups resident within the country, while national account estimates are suitable for an index defined to cover consumption expenditures within the country. The decision about what source or sources to use and how they should be used depends on the main purpose of the index and on the availability and quality of appropriate data.

24. The information from the main source (HESs or national accounts) should be supplemented with all other available information on the expenditure pattern. Sources of such information that can be used for disaggregating the expenditures are surveys of sales in retail outlets, point-of-purchase surveys, surveys of production, export and import data and administrative sources. Based on these data the weights for certain products may be further disaggregated by region and type of out-

2 *See Annex 4.*

let. Where the data obtained from different sources relate to different periods, it is important to ensure, before weights are allocated, that expenditures are adjusted so that they have the same reference period.

25. Where the weight reference period differs significantly from the price reference period, the weights should be price updated to take account of price changes between the weights reference period and price reference period. Where it is likely that price updated weights are less representative of the consumption pattern in the price reference period this procedure may be omitted.

26. Weights should be reviewed and if appropriate revised as often as accurate and reliable data are available for this to be done, but at least once every five years. Revisions are important to reduce the impact on the index of product substitutions and to ensure the basket of goods and services and their weights remain representative. [3] For some categories, it may be necessary to update the weights more frequently as such weights are likely to become out of date more quickly than higher-level weights. In periods of high inflation, the weights should be updated frequently.

27. When a new basket (structure or weights) replaces the old, a continuous CPI series should be created by linking [4] together the index numbers based on the new basket of goods and services to those based on the earlier basket. The particular procedure used to link index number series will depend on the particular index compilation technique used. The objective is to ensure that the technique used to introduce a new basket does not, of itself, alter the level of the index.

28. Completely new types of goods and services (i.e. goods and services that cannot be classified to any of the existing elementary aggregates) should normally be considered for inclusion only during one of the periodic review and reweighting exercises. A new model or variety of an existing product that can be fitted within an existing elementary aggregate should be included at the time it is assessed as having a significant and sustainable market share. If a quality change is detected an appropriate quality adjustment should be made. [5]

29. Some products such as seasonal products, insurance, second-hand goods, expenditure abroad, interest, own production, expenditures on purchase and construction of dwellings, etc., may need special treatment when constructing their weights. The way these products are dealt with should be determined by the main purpose of the index, national circumstances and the practicalities of compilation.

30. Seasonal products should be included in the basket. It is possible to use: (i) a fixed-weight approach which uses the same weight for the seasonal product in all months using an imputed price in the out-of-season months; or (ii) a variable weights approach where a changing weight is attached to the product in various months. The decision on the approach should be based on national circumstances.

31. The expenditure weights for second-hand goods should be based either on the net expenditure of the reference population on such goods, or the gross expenditure, depending on the purpose of the index.

32. When consumption from own production is within the scope of the index, the weights should be based on the value of quantities consumed from own production. Valuation of consumption from own production should be made on the basis of prices prevailing on the market, unless there is some reason to conclude that market prices are not relevant or cannot be reliably observed, or there is no interest in using hypothetically imputed prices. In this case the expenditures and prices for the inputs into the production of these goods and services could be used instead. The third option is to valuate it by using quality adjusted market prices.

Sampling for price collection

33. A CPI is an estimate based on a sample of households to estimate weights, and a sample of zones within regions, a sample of outlets, a sample of goods and services and a sample of time periods for price observation.

34. The sample size and sample selection methods for both outlets and the goods and services for which price movements over time are to be observed should ensure that the prices collected are representative and sufficient to meet the requirements for the accuracy of the index, but also that the collection process is cost-effective. The sample of prices should reflect the importance, in terms of relative expenditures, of the goods and services available for purchase by consumers in the reference period, the number, types and geographic spread of outlets that are relevant for each good and service, and the dispersion of prices and price changes across outlets.

3 *See Annex 1.*
4 *See Annex 2.*
5 *See Annex 2.*

35. Probability sampling techniques are the preferred methods, in principle, as they permit sound statistical inference and control over the representativity of the sample. In addition, they permit estimation of sampling variation (errors). However, they may be costly to implement and can result in the selection of products that are very difficult to price to constant quality.
36. In cases where appropriate sampling frames are lacking and it is too costly to obtain them, samples of outlets and products have to be obtained by non-probability methods. Statisticians should use available information and apply their best judgement to ensure that representative samples are selected. The possibility of applying cut-off or detailed quota sampling [6] strategy may be considered, especially where the sample size is small. A mixture of probability and non-probability sampling techniques may be used.
37. Efficient and representative sampling, whether random or purposive, requires comprehensive and up-to-date sampling frames for outlets and products. Sample selection can be done either by head office from centrally held sampling frames, or in the field by price collectors, or by a mixture of the two. In the first case, price collectors should be given precise instructions on which outlets to visit and which products to price. In the second case, price collectors should be given detailed and unambiguous guidelines on the local sampling procedures to be adopted. Statistical business registers, business telephone directories, results from the point-of-purchase surveys or from surveys of sales in different types of outlets, and lists of Internet sellers may be used as sampling frames for the central selection of outlets. Catalogues or other product lists drawn up by major manufacturers, wholesalers or trade associations, or lists of products that are specific to individual outlets such as large supermarkets might be used as the sampling frame for selection of products. Data scanned by bar-code readers at the cashier's desk (electronic databases) can be particularly helpful in the selection of goods and services.
38. The sample of outlets and of goods and services should be reviewed periodically and updated where necessary to maintain its representativeness.

Index calculation

39. The compilation of a CPI consists of collecting and processing price and expenditure data according to specified concepts, definitions, methods and practices. The detailed procedures that are applied will depend on particular circumstances.
40. CPIs are calculated in steps. In the first step, the elementary aggregate indices are calculated. In the subsequent steps, higher level indices are calculated by aggregating the elementary aggregate indices.

Elementary aggregate indices

41. The elementary aggregate is the smallest and relatively homogeneous set of goods or services for which expenditure data are defined (used) for CPI purposes. It is the only aggregate for which an index number is constructed without any explicit expenditure weights, although other kinds of weights might be explicitly or implicitly introduced into the calculation. The set of goods or services covered by an elementary aggregate should be similar in their end-uses and are expected to have similar price movements. They may be defined not only in terms of their characteristics but also in terms of the type of location and outlet in which they are sold. The degree of homogeneity achieved in practice will depend on the availability of corresponding expenditure data.
42. An elementary index is a price index for an elementary aggregate. As expenditure weights usually cannot be attached to the prices or price relatives for the sampled products within the elementary aggregate, an elementary index is usually calculated as an unweighted average of the prices or price relatives. When some information on weights is available, this should be taken into account when compiling the elementary indices.
43. There are several ways in which the prices, or the price relatives, might be averaged. The three most commonly used formulae are the ratio of arithmetic mean prices (RAP), the geometric mean (GM) and the arithmetic mean of price relatives (APR). The choice of formula depends on the purpose of the index, the sample design and the mathematical properties of the formula. It is possible to use different formulae for different elementary aggregates within the same CPI. It is recommended that the GM formula be used, particularly where there is a need to reflect substitution within the elementary aggregate or where the dispersion in prices or price changes within the elementary aggregate is large. The GM has many advantages because of its mathematical properties.

6 *See Annex 1.*

The RAP may be used for elementary aggregates that are homogeneous and where consumers have only limited opportunity to substitute or where substitution is not to be reflected in the index. The APR formula should be avoided in its chained form, as it is known to result in biased estimates of the elementary indices.

44. The elementary index may be computed by using either a chained or direct form of the formula chosen. The use of a chained form may make the estimation of missing prices and the introduction of replacement products easier.

Upper level indices

45. These price indices are constructed as weighted averages of elementary aggregate indices. Several types of formulae can be used to average the elementary aggregate indices. In order to compile a timely index, the practical option is to use a formula that relies on the weights relating to some past period. One such formula is the Laspeyres-type index, the formula used by most national statistical agencies.

46. For some purposes it may be appropriate to calculate the index retrospectively by using an index number formula that employs both base-period weights and current-period weights, such as the Fisher, Törnqvist or Walsh index. Comparing the difference between the index of this type and the Laspeyres-type index can give some indication of the combined impact of income changes, preference changes and substitution effects over the period in question, providing important information for producers and users of the CPI.

47. Where the change in an upper level index between two consecutive periods such as t-1 and t is calculated as the weighted average of the individual indices between t-1 and t, care should be taken to ensure that the weights are updated to take account of the price changes between the price reference period 0 and the preceding period t-1. Failure to do so may result in a biased index.

Price observations

48. The number and quality of the prices collected are critical determinants of the reliability of the index, along with the specifications of the products priced. Standard methods for collecting and processing price information should be developed and procedures put in place for collecting them systematically and accurately at regular intervals. Price collectors should be well trained and well supervised, and should be provided with a comprehensive manual explaining the procedures they have to follow.

Collection

49. An important consideration is whether the index or parts of the index should relate to monthly (or quarterly) average prices or to prices for a specific period of time (e.g. a single day or week in a month). This decision is related to a number of issues, which include the use of an index, the practicalities of carrying out price collection and the pattern of price movements. When point-in-time pricing is adopted, prices should be collected over a very small number of days each month (or quarter). The interval between price observations should be uniform for each product. Since the length of the month (or quarter) varies, this uniformity needs to be defined carefully. When the aim is monthly (or quarterly) average prices, the prices collected should be representative of the period to which they refer.

50. Attention should also be paid to the time of day selected for price observation. For example, in the case of perishable goods, price observations may need to be collected at the same time on the same day of the week and not just before closing time, when stocks may be low, or sold cheaply to minimize wastage.

51. Price collection should be carried out in such a way as to be representative of all geographical areas within the scope of the index. Special care should be taken where significant differences in price movements between areas may be expected.

52. Prices should be collected in all types of outlets that are important, including Internet sellers, open-air markets and informal markets, and in free markets as well as price-controlled markets. Where more than one type of outlet is important for a particular type of product, this should be reflected in the initial sample design and an appropriately weighted average should be used in the calculation of the index.

53. Specifications should be provided detailing the variety and size of the products for which price information is to be collected. These should be precise enough to identify all the price-determining characteristics that are necessary to ensure that, as far as possible, the same goods and services are priced in successive periods in the same outlet. The specifications should include, for example, make, model, size, terms of payment, conditions of delivery, type of guarantees and type of outlet. This information could be used in the procedures used for replacement and for quality adjustment.
54. Prices to be collected are actual transaction prices, including indirect taxes and non-conditional discounts, that would be paid, agreed or costed (accepted) by the reference population. Where prices are not displayed or have to be negotiated, where quantity units are poorly defined or where actual purchase prices may deviate from listed or fixed prices, it may be necessary for the price collectors to purchase products in order to determine the transaction prices. A budget may be provided for any such purchases. When this is not possible, consideration may be given to interviewing customers about the prices actually paid. Tips for services, where compulsory, should be treated as part of the price paid.
55. Exceptional prices charged for stale, shop-soiled, damaged or otherwise imperfect goods sold at clearance prices should be excluded, unless the sale of such products is a permanent and widespread phenomenon. Sale prices, discounts, cut prices and special offers should be included when applicable to all customers without there being significant limits to the quantities that can be purchased by each customer.
56. In periods of price control or rationing, where limited supplies are available at prices which are held at a low level by measures such as subsidies to the sellers, government procurement, price control, etc., such prices as well as those charged on any significant unrestricted markets should be collected. The different price observations should be combined in a way that uses the best information available with respect to the actual prices paid and the relative importance of the different types of sales.
57. For each type of product, different alternatives for collecting prices should be carefully investigated, to ensure that the price observations could be made reliably and effectively. Means of collection could include visits to outlets with paper forms or hand-held devices, interviews with customers, computer-assisted telephone interviews, mail-out questionnaires, brochures, price lists provided by large or monopoly suppliers of services, scanner data and prices posted on the Internet. For each alternative, the possible cost advantages need to be balanced against an assessment of the reliability and timeliness of each of the alternatives.
58. Where centrally regulated or centrally fixed prices are collected from the regulatory authorities, checks should be made to ascertain whether the goods and services in question are actually sold and whether these prices are in fact paid. For goods and services where the prices paid are determined by combinations of subscription fees and piece rates (e.g. for newspapers, journals, public transport, electricity and telecommunications) care must be taken to ensure that a representative range of price offers are observed. Care must also be taken to ensure that prices charged to different types of consumers are observed, e.g. those linked to the age of the purchaser or to memberships of particular associations.
59. The collected price information should be reviewed for comparability and consistency with previous observations, the presence of replacements, unusual or large price changes and to ensure that price conversions of goods priced in multiple units or varying quantities are properly calculated. Extremely large or unusual price changes should be examined to determine whether they are genuine price changes or are due to changes in quality. Procedures should be put in place for checking the reliability of all price observations. This could include a programme of direct pricing and/or selective re-pricing of some products shortly after the initial observation was made.
60. Consistent procedures should be established for dealing with missing price observations because of, e.g. inability to contact the seller, non-response, observation rejected as unreliable or products temporarily unavailable. Prices of non-seasonal products that are temporarily unavailable should be estimated until they reappear or are replaced, by using appropriate estimation procedures, e.g. imputation on the basis of price changes of similar non-missing products. Carrying forward the last observed price should be avoided, especially in periods of high inflation.

Replacements

61. Replacement of a product will be necessary when it disappears permanently. Replacement should be made within the first three months (quarter) of the product becoming unavailable. It may also be necessary when the product is no longer available or sold in significant quantities or under normal sale conditions. Clear and precise rules should be developed for selecting the replacement product. Depending on the frequency of sampling and the potential for accurate quality adjust-

ment, the most commonly used alternatives are to select: (i) the most similar to the replaced variety; (ii) the most popular variety among those that belong to the same elementary aggregate; and (iii) the variety most likely to be available in the future. Precise procedures should be laid down for price adjustments with respect to the difference in characteristics when replacements are necessary, so that the impact of changes in quality is excluded from the observed price.

62. Replacement of an outlet may be motivated if prices cannot be obtained e.g. because it has closed permanently, because of a decline in representativeness or because the outlet no longer cooperates. Clear rules should be established on when to discontinue price observations from a selected outlet, on the criteria for selecting a replacement, as well as on the adjustments that may be required to price observations or weights. Such rules should be consistent with the objectives of the index and with the way in which the outlet sample has been determined.

63. Deletion of an entire elementary aggregate will be necessary if all products in that elementary aggregate disappear from most or all outlets and it is not possible to locate a sufficient number of price observations to continue to compile a reliable index for this elementary aggregate. In such situations, it is necessary to redistribute the weight assigned to the elementary aggregate among the other elementary aggregates included in the next level of aggregation.

Quality changes

64. The same product should be priced in each period as long as it is representative. However, in practice, products that can be observed at different time periods may differ with respect to package sizes, weights, volumes, features and terms of sale, as well as other characteristics. Thus it is necessary to monitor the characteristics of the products being priced to ensure that the impact of any differences in price-relevant or utility-relevant characteristics can be excluded from the estimated price change.

65. Identifying changes in quality or utility is relatively more difficult for complex durable goods and services. It is necessary, therefore, to collect a considerable amount of information on the relevant characteristics of the products for which prices are collected. The most important information can be obtained in the course of collecting prices. Other sources of information on price-relevant or utility-relevant characteristics can be producers, importers or wholesalers of the goods included and the study of articles and advertisements in trade publications.

66. When a quality change is detected, an adjustment must be made to the price, so that the index reflects as nearly as possible the pure price change. If this is not done, the index will either record a price change that has not taken place or fail to record a price change that did happen. The choice of method for such adjustments will depend on the particular goods and services involved. Great care needs to be exercised because the accuracy of the resulting index depends on the quality of this process. To assume automatically that all price change is a reflection of the change in quality should be avoided, as should the automatic assumption that products with different qualities are essentially equivalent.

67. The methods for estimating quality-adjusted prices [7] may be:

(a) *Explicit (or direct) quality adjustment methods* that directly estimate the value of the quality difference between the old and new product and adjust one of the prices accordingly. Pure price change is then implicitly estimated as the difference in the adjusted prices.

(b) *Implicit (or indirect) quality adjustment methods* which estimate the pure price change component of the price difference between the old and new products based on the price changes observed for similar products. The difference between the estimate of pure price change and the observed price change is considered as change due to quality difference.

Some of these methods are complex, costly and difficult to apply. The methods used should as far as possible be based on objective criteria.

Accuracy

68. As with all statistics, CPI estimates are subject to errors that may arise from a variety of sources. [8] Compilers of CPIs need to be aware of the possible sources of error, and to take steps during the design of the index, its construction and compilation processes to minimize their impact, for which adequate resources should be allocated.

7 *See Annex 2.*

8 *See Annex 3.*

69. The following are some well-known sources of potential error, either in pricing or in index construction, that over time can lead to errors in the overall CPI: incorrect selection of products and incorrect observation and recording of their prices; incorrect selection of outlets and timing of price collection; failure to observe and adjust correctly for quality changes; appearance of new goods and outlets; failure to adjust for product and outlet substitution or loss of representativity; the use of inappropriate formulae for computing elementary aggregate and upper level indices.
70. To reduce the index's potential for giving a misleading picture, it is in general essential to update weights and baskets regularly, to employ unbiased elementary aggregate formulae, to make appropriate adjustments for quality change, to allow adequately and correctly for new products, and to take proper account of substitution issues as well as quality control of the entire compilation process.

Dissemination

71. The CPI estimate should be computed and publicly released as quickly as possible after the end of the period to which it refers, and according to a pre-announced timetable. It should be made available to all users at the same time, in a convenient form, and should be accompanied by a short methodological explanation. Rules relating to its release should be made publicly available and strictly observed. In particular, they should include details of who has pre-release access to the results, why, under what conditions, and how long before the official release time.
72. The general CPI should be compiled and released monthly. Where there is no strong user demand for a monthly series or countries do not have the necessary resources, the CPI may be prepared and released quarterly. Depending on national circumstances, sub-indices may be released with a frequency that corresponds to users' needs.
73. When it is found that published index estimates have been seriously distorted because of errors or mistakes made in their compilation, corrections should be made and published. Such corrections should be made as soon as possible after detection according to publicly available policy for correction. Where the CPI is widely used for adjustment purposes for wages and contracts, retrospective revisions should be avoided to the extent possible.
74. The publication of the CPI results should show the index level from the index reference period. It is also useful to present derived indices, such as the one that shows changes in the major aggregates between: (i) the current month and the previous month; (ii) the current month and the same month of the previous year; and (iii) the average of the latest 12 months and the average of the previous 12 months. The indices should be presented in both seasonally adjusted and unadjusted terms, if seasonally adjusted data are available.
75. Comments and interpretation of the index should accompany its publication to assist users. An analysis of the contributions of various products or group of products to the overall change and an explanation of any unusual factors affecting the price changes of the major contributors to the overall change should be included.
76. Indices for the major expenditure groups should also be compiled and released. Consideration should be given to compiling indices for the divisions and groups of the COICOP.[9] Sub-indices for different regions or population groups, and alternative indices designed for analytical purposes, may be compiled and publicly released if there is a demand from users, they are judged to be reliable and their preparation is cost effective.
77. The index reference period may be chosen to coincide with the latest weights reference period or it could be established to coincide with the base period of other statistical series. It should be changed as frequently as necessary to ensure that the index numbers remain easy to present and understand.
78. Average prices and price ranges for important and reasonably homogeneous products may be estimated and published in order to support the research and analytical needs of users.
79. Countries should report national CPI results and methodological information to the International Labour Office as soon as possible after their national release.
80. Comparing national CPI movements across countries is difficult because of the different measurement approaches used by countries of certain products, particularly housing and financial services. The exclusion of housing (actual rents and either imputed rents or acquisition of new houses, and maintenance and repair of dwelling) and financial services from the all-items index will make the resulting estimates of price change for the remaining products more comparable across countries. Therefore, in addition to the all-items index, countries should, if possible, compile and provide for dissemination to the international community an index that excludes housing and financial

9 *See Annex 4.*

services. It should be emphasized, though, that even for the remaining products in scope, there can still be difficulties when making international comparisons of changes in consumer prices.

Consultations and integrity

81. The compiling agency should have the professional independence, competence and resources necessary to support a high quality CPI programme. The UN *Fundamental Principles of Official Statistics* [10] and the ILO *Guidelines concerning dissemination practices for labour statistics* [11] should be respected.
82. The agency responsible for the index should consult representatives of users on issues of importance for the CPI, particularly during preparations for any changes to the methodology used in compiling the CPI. One way of organizing such consultations is through the establishment of advisory committee(s) on which social partners, as well as other users and independent experts, might be represented.
83. In order to ensure public confidence in the index, a full description of the data collection procedures and the index methodology should be prepared and made widely available. Reference to this description should be made when the CPI is published. The documentation should include an explanation of the main objectives of the index, details of the weights, the index number formulae used, and a discussion of the accuracy of the index estimates. The precise identities of the outlets and goods and services used for price collection should not be revealed.
84. Users should be informed in advance of any changes that are going to be made to the scope, weights or methodology used to estimate the CPI.
85. Technical guidance on the compilation of consumer price indices is provided in the *Consumer price index manual: Theory and practice*. [12] This manual should be updated periodically in order to reflect current best practice.

Annex 1

Terminology and definitions

(a) "Consumer goods" are goods or services that are used by households for the satisfaction of individual needs or wants.
(b) "Consumption expenditures" are expenditure on consumer goods and services and can be defined in terms of "acquisition", "use", or "payment":

- "acquisition" [13] indicates that it is the total value of the goods and services acquired during a given period that should be taken into account, irrespective of whether they were wholly paid for or used during the period. This approach could be extended to include the estimated values of own-account production and social transfers in kind received from government or non-profit institutions. The prices enter the CPI in the period when consumers accept or agree prices, as distinct from the time payment is made;
- "use" indicates that it is the total value of all goods and services actually consumed during a given period that should be taken into account; for durable goods this approach requires valuing the services provided by these goods during the period. The prices (opportunity costs) enter the CPI in the period of consumption;
- "payment" indicates that it is the total payment made for goods and services during a given period that should be taken into account, without regard to whether they were delivered or used during the period. The prices enter the CPI in the period or periods when the payment is made.

(c) "Scope of the index" refers to the population groups, geographic areas, products and outlets for which the index is constructed.

10 *UN Economic and Social Council, 1994.*

11 *Sixteenth International Conference of Labour Statisticians, 1998.*

12 *Consumer price index manual: Theory and practice (International Labour Office, International Monetary Fund, Organisation for Economic Co-operation and Development, Statistical Office of the European Communities (EUROSTAT), United National Economic Commission for Europe and the World Bank, Geneva, 2004).*

13 *This definition differs from the one adopted by the 14th ICLS (1987).*

(d) "Coverage" of the index is the set of goods and services represented in the index. For practical reasons, coverage may have to be less than what corresponds to the defined scope of the index.
(e) "Reference population" refers to that specific population group for which the index has been constructed.
(f) "Weights" are the aggregate consumption expenditures on any set of goods and services expressed as a proportion of the total consumption expenditures on all goods and services within the scope of the index in the weight reference period. They are a set of numbers summing-up to unity.
(g) "Price updating of weights" is a procedure that is used to bring the expenditure weights in line with the index or price reference period. The price updated weights are calculated by multiplying the weights from the weight reference period by elementary indices measuring the price changes between weight reference and price reference period and rescaling to sum to unity.
(h) "Index reference period" is the period for which the value of the index is set at 100.0.
(i) "Price reference period" is the period whose prices are compared with the prices in the current period. The period whose prices appear in the denominators of the price relatives.
(j) The "weight reference period" is the period, usually a year, whose estimates of the volume of consumption and its components are used to calculate the weights.
(k) "Probability sampling" is the selection of a sample of units, such as outlets or products, in such a way that each unit in the universe has a known non-zero probability of selection.
(l) "Cut-off sampling" is a sampling procedure in which a predetermined threshold is established with all units in the relevant population at or above the threshold being eligible for inclusion in the sample and all units below the threshold being excluded. The threshold is usually specified in terms of the size of some relevant variable (such as some percentage of total sales), the largest sampling units being included and the rest excluded.
(m) "Quota sampling" is a non-probability method where the population is divided into certain strata. For each stratum, the number ("quota") of elements to be included in the sample is specified. The price collector simply "fills the quotas", which means, in the case of outlet sampling, that the selection of the outlets is based on the judgement of the price collectors and the specified criteria.
(n) "Imputed expenditures" are the expenditures assigned to a product that has not been purchased, such as a product that has been produced by the household for its own consumption (including housing services produced by owner-occupiers), a product received as payment in kind or as a free transfer from government or non-profit institutions.
(o) "Imputed price" refers to the estimated price of a product whose price during a particular period has not been observed and is therefore missing. It is also the price assigned to a product for which the expenditures have been imputed, see (n).
(p) "Outlet" indicates a shop, market stall, service establishment, internet seller or other place where goods and/or services are sold or provided to consumers for non-business use.
(q) "Linking" means joining together two consecutive sequences of price observations, or price indices, that overlap in one or more periods, by rescaling one of them so that the value in the overlap period is the same in both sequences, thus combining them into a single continuous series.
(r) "Price" is defined as the value of one unit of a product, for which the quantities are perfectly homogeneous not only in a physical sense but also in respect of a number of other characteristics.
(s) "Pure price change" is that change in the price of a good or service which is not due to any change in its quality. When the quality does change, the pure price change is the price change remaining after eliminating the estimated contribution of the change in quality to the observed price change.
(t) "Quality adjustment" refers to the process of adjusting the observed prices of a product to remove the effect of any changes in the quality of that product over time so that pure price change may be identified.
(u) "Consumer substitution" occurs when, faced with changes in relative price, consumers buy more of the good that has become relatively cheaper and less of the good that has become relatively more expensive. It may occur between varieties of the same product or between different expenditure categories.

Annex 2

Quality adjustment methods

Implicit quality adjustment methods

1. The "overlap" method assumes that the entire price difference at a common point in time between the disappearing product and its replacement is due to a difference in quality.
2. The "overall mean imputation" method first calculates the average price change for an aggregate without the disappearing product and its replacement, and then uses that rate of price change to impute a price change for the disappearing product. It assumes that the pure price difference between the disappearing product and its replacement is equal to the average price changes for continuing (non-missing) products.
3. The "class mean imputation" method is a variant of the overall mean imputation method. The only difference is in the source of the imputed rate of price change to period t+1 for the disappearing product. Rather than using the average index change for all the non-missing products in the aggregate, the imputed rate of price change is estimated using only those price changes of the products that were judged essentially equivalent or were directly quality-adjusted.

Explicit quality adjustment methods

4. The "expert's adjustment" method relies on the judgement of one or more industry experts, commodity specialists, price statisticians or price collectors on the value of any quality difference between the old and replacement product. None, some, or all of the price difference may be attributed to the improved quality.
5. The "differences in production costs" approach relies on the information provided by the manufacturers on the production costs of new features of the replacements (new models), to which retail mark-ups and associated indirect taxes are then added. This approach is most practicable in markets with a relatively small number of producers, with infrequent and predictable model updates. However, it should be used with caution as it is possible for new production techniques to reduce costs while simultaneously improving quality.
6. The "quantity adjustment" method is applicable to products for which the replacement product is of a different size to the previously available one. It should only be used if the differences in quantities do not have an impact on the quality of the good.
7. The "option cost" method adjusts the price of the replacements for the value of the new observable characteristics. An example of this is the addition of a feature that earlier has been a priced option as standard to a new automobile model.
8. A "hedonic" regression method estimates the price of a product as a function of the characteristics it possesses. The relationship between the prices and all relevant and observable price-determining characteristics is first estimated and then results are used in the estimation of the index.

Annex 3

Types of errors

- "Quality change error" is the error that can occur as a result of the index's failure to make proper allowance for changes in the quality of goods and services.
- "New goods error" is the failure to reflect either price changes in new products not yet sampled, or given a COLI objective, the welfare gain to consumers when those products appear.
- "Outlet substitution error" can occur when consumers shift their purchases among outlets for the same product without proper reflection of this shift in the data collection for the index.
- "New outlets error" is conceptually identical to new goods error. It arises because of the failure to reflect either price changes in new outlets not yet sampled, or the welfare gain to consumers when the new outlets appear.
- "Upper level substitution error" arises when the index does not reflect consumer substitution among the basic categories of consumption owing to the use of an inappropriate method for ag-

gregating elementary aggregates in the construction of the overall index value. Only relevant to a COLI, although an equivalent (representativity error) may be defined from the perspective of the pure price index.

- "Elementary index error" arises from the use of an inappropriate method for aggregating price quotations at the very lowest level of aggregation. The elementary index error can take two forms: formula error and lower level substitution error. The index suffers from formula error if, as a result of the properties of the formula, the result produced is biased relative to what would have been the result if a pure price change could have been estimated. The index suffers from lower level substitution error if it does not reflect consumer substitution among the products contained in the elementary aggregate.
- "Selection error" arises when the sample of price observations is not fully representative of the intended population of outlets or products. The first four types of errors listed above can be seen as special cases of this type of error.

Annex 4

Classification of Individual Consumption According to Purpose (COICOP) [14] (breakdown of individual consumption expenditure of households by division and group)

01 Food and non-alcoholic beverages
01.1 Food
01.2 Non-alcoholic beverages
02 Alcoholic beverages, tobacco and narcotics
02.1 Alcoholic beverages
02.2 Tobacco
02.3 Narcotics
03 Clothing and footwear
03.1 Clothing
03.2 Footwear
04 Housing, water, electricity, gas and other fuels
04.1 Actual rentals for housing
04.2 Imputed rentals for housing
04.3 Maintenance and repair of the dwelling
04.4 Water supply and miscellaneous services related to the dwelling
04.5 Electricity, gas and other fuels
05 Furnishings, household equipment and routine household maintenance
05.1 Furniture and furnishings, carpets and other floor coverings
05.2 Household textiles
05.3 Household appliances
05.4 Glassware, tableware and household utensils
05.5 Tools and equipment for house and garden
05.6 Goods and services for routine household maintenance
06 Health
06.1 Medical products, appliances and equipment
06.2 Outpatient services
06.3 Hospital services
07 Transport
07.1 Purchase of vehicles
07.2 Operation of personal transport equipment
07.3 Transport services
08 Communication
08.1 Postal services
08.2 Telephone and telefax equipment
08.3 Telephone and telefax services
09 Recreation and culture
09.1 Audio-visual, photographic and information processing equipment

14 *Explanatory notes are available on http://unstats.un.org/unsd/cr/registry/.*

09.2 Other major durables for recreation and culture
09.3 Other recreational products and equipment, gardens and pets
09.4 Recreational and cultural services
09.5 Newspapers, books and stationery
09.6 Package holidays
10 Education
10.1 Pre-primary and primary education
10.2 Secondary education
10.3 Post-secondary non-tertiary education
10.4 Tertiary education
10.5 Education not definable by level
11 Restaurants and hotels
11.1 Catering services
11.2 Accommodation services
12 Miscellaneous goods and services
12.1 Personal care
12.2 Prostitution
12.3 Personal effects n.e.c.
12.4 Social protection
12.5 Insurance
12.6 Financial services n.e.c.
12.7 Other services n.e.c.

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The new price index manuals

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1. Introduction

The IMF and the ILO are responsible fo r publication of two new price index manuals—*Consumer Price Index: Theory and Practice* and *Producer Price Index: Theory and Practic*e. The consumer price index (CPI) and the producer price index (PPI) measure rates of change in prices of goods bought and sold by consumers and producers, respectively. As such, they serve as the key measures of inflation in most economies. The new *Manuals* serve the needs of both compilers in national statistical organizations and most other users of these indices in the public and private sectors. We expect that the *Manuals* will be widely used by academics, central banks, ministries of finance, and many private businesses and research organizations.

The *Manuals* are not "cook books" that provide a simple set of rules and procedures that all countries can follow. Rather, they present detailed explanations of the basic statistical and economic concepts and procedures that are appropriate for institutions to use when compiling CPIs and PPIs. They provide the compiler with detailed information on how to build the index, given the economic circumstances of the country, along with the conceptual and theoretical reasoning for making alternative formulations.

2. Background to present revision

2.1 Use of outdated formulas

The standard fixed basket price index methods used in most countries today date back over 80 years to those proposed by W.C. Mitchell (1927) and G.H. Knibbs (1924). Index number theory has advanced substantially, particularly in the past thirty years, to provide us with better information on what our target index number formula should be. In particular, various approaches have been used to evaluate index number formula and derive those best suited for inflation measures. These can be broken down into four ways of viewing the basic index number problem (i.e., separating a value change into its price and volume components):

- Fixed basket and symmetric averages of standard formulas,
- The stochastic (statistical estimator) approach,
- The test or axiomatic approach, and
- The economic approach.

All these approaches are explored in the *Manual*s. As it turns out, all of these views lead to a small set of target index numbers—Fisher, Walsh, and Törnqvist—that have sound statistical and economic underpinnings.

2.2 Index number practice and theory differ

The concerns with current index methods arise from the fact that, in practice, the index numbers in use often do not really correspond to those espoused in theory or those in countries' published methodology documents. For example, many countries say they use a standard Laspeyres index, but the actual formula used is different. For a Laspeyres index, the price reference (base) period must be the same as the weight reference period. Often, the weight reference period is, in fact, earlier than the price reference period. Thus, these compilers are producing either a Lowe or a Young price index rather than a Laspeyres. If the value weights used in the index are from an earlier period

1 *The paper has been presented by Neil Patterson (IMF). The views expressed are those of the author and do not necessarily reflect the views of the IMF or IMF policy.*

and updated for price change to the price reference period, the formula is a Lowe index. If the weights are simply introduced with no price updating, the formula is a Young index.

In addition, different formulas are used at different stages of aggregation. At the elementary or first stage where prices are first combined to form an index many countries will not use weights. At the second and higher levels, weights are applied, but these weights relate to some period in the past that becomes less representative with the passage of time. Now compare this with the approach for the target (superlative) indices such as Fisher, Walsh, or Törnqvist, and it becomes apparent that the indices produced in practice are of substantially lower quality than the target indices. The new *Manuals* discuss these issues thoroughly and provide approaches that countries can implement over time to move closer to the target measures.

2.3 Quality change and new goods

There are also issues related to quality change and the introduction of new goods in our price indices. With the release of the Boskin Report (Michael J. Boskin and others, 1996), users of price indices have become more concerned about the effects of quality change on price index measures.

Most countries do not attempt to make quality adjustments as products disappear and replacements are made. New goods often are added with weight updates only when the market basket is replaced. Most countries' price indices have an indeterminate bias from not treating quality change properly as a volume change. The new *Manuals* deal extensively with methods for making quality adjustments and introducing new goods.

2.4 Seasonal products

Yet another area of concern is the treatment of seasonal products. Seasonal products often have quite large price changes, and their prices may be missing at various times throughout the year.

Thus, price changes for seasonal products can distort month-to-month price movements. Standard index number approaches may not be adequate to handle seasonal products, and the new *Manuals* address this problem and evaluate alternative approaches..

2.5 Coverage of services

In both CPIs and, particularly, PPIs the number of service items is limited. The service sector is the fastest growing sector in many economies, but the coverage of this sector is not keeping pace.

Many services are difficult to price. The services statistical offices cover tend to be those that are easier to collect. Most PPIs are limited to industrial activities, and, only recently, have there been concerted efforts to expand PPIs to include services activities. The new *Manuals* provide practical examples for countries to follow in implementing difficult to price services.

2.6 Different indices for different users

There are a variety of users for CPIs and PPIs and many require different indices depending on the usage of the index. There are users who want measures of inflation for different segments of the population such as urban and rural, or poor and moderate income families, in addition to that for the total population. Some users may want a measure that reflects changes in pensioners' cost of living or those for wage and salary workers. For the PPI, there is interest in both output PPIs (at basic prices) and input PPIs (at purchasers' prices) or indices by stage of processing. In addition policymakers may want certain analytical measures such as the "core" CPI or PPI that exclude certain volatile components.

3. Efforts to address these index number concerns

3.1 Ottawa Group (International Working Group on Price Statistics)

In the early 1990s concern was growing among many of the advanced statistical agencies that there were no organized efforts to address the problems being identified with price index measures.

Research by academia, central banks, and statistical agencies provided evidence that the existing measures were inadequate and there was a need to delve into these problems and address the perceived shortcomings. These concerns led to the formation of a group of price index specialists to conduct additional practical research into these problems and how they can be resolved operationally. The first meeting of the group took place in Ottawa in October 1994 and has resulted in a

continuous flow of research over the past decade. This research has been used in the development of the Manuals.

3.2 Voorburg Group (International Working Group on Services Statistics)

The Voorburg Group has included in its activities practical development of PPIs in services. Its areas of research have focused on PPIs for business and professional services. Research cond ucted by this Group undelies the practical examples in the *PPI Manua*l.

3.3 Inter-secretariat Working Group on Price Statistics

The UN Statistical Commission approved formation of the Inter-secretariat Working Group on Price Statistics (IWGPS) in 1998 to oversee the revision of the two price statistics *Manual*s. In November 1997 the ILO/ECE biannual Meeting on Consumer Prices recommended to the Statistical Commission that the ILO *CPI Manua*l, published in 1989, should be revised to reflect changes in index number methodology and theory that had been developed over the past decade.

The Statistical Commission also charged the IWGPS with developing a *PPI Manual* to replace the one published by the UN Statistical Division in 1979. The two Manuals would be developed in lock-step with the *CPI Manual* completed first, followed closely by the *PPI Manua*l. They would.share a common structure and similar approaches where appropriate. In December 2003, the IWGPS subsequently agreed to oversee development of an *Export and Import Price Index Manual* following the completion of the *CPI* and *PPI Manual*s.

4. Organization for the *Manual* revisions

Seven international agencies concerned with inflation and inflation policies were initially represented on the IWGPS. These were the ILO, IMF, UN ECE, Eurostat, World Bank, and UN Statistics Division. Price experts from each agency were appointed to the group, and the ILO was the secretariat. In April 2004, the IMF took over the secretariat responsibilities. Each agency had one or two representatives on the IWGPS.

The *Manuals* were closely linked. In addition to sharing common structural features, there were two technical expert groups (TEGs) formed to complete the drafting, review, and initial editing of the each of the *Manual*s. Representatives from the IWGPS served on each of the TEGs. Also, the TEG membership included experts from national statistical offices and academic institutions.

5. Acknowledgements

The Preface to the *Manuals* include the list of authors for each chapter and the editors, as well as the membership of the IWGPS, the TEG-CPI, and the TEG-PPI. All of the authors are well-known in their field of expertise. An important aspect in the development of the *Manuals* was the vetting of the draft text in two separate user seminars. The *CPI Manual* seminar was held in Singapore during June 2001, and the PPI seminar was held in Pretoria during June 2003. Seminar participant gave valuable comments that were incorporated in the both *Manuals* as they were finalized. For example, one major input was the ordering of the chapters. Because the primary users of the *Manuals* are compilers, the seminar participants insisted that the practical chapters should appear first.

6. Overview to the *PPI Manual*

The overall structure of the *Manuals* are similar. Table 1 provides the sequence of chapters in the *PPI Manua*l. The Preface and Reader's Guide discuss the problems, issues, and importance of different chapters to different users. Chapters 1-13 focus on compilation issues. Chapters 14-22 provide the theory and conceptual framework of the PPI.

One of the key advantages of the *PPI Manual* is that it contains very detailed compilation procedures and presentations of the theory underlying alternative procedures. Not all readers will be interested in reading all chapters—that is, in reading the *Manual* cover to cover. The Preface,

Chapters 1-3, and Chapter 14 are meant for all readers. Chapters 4-13 are primarily for compilers, although many users will have an interest in selected topics, particularly Chapter 11 on errors and bias in the PPI. Chapters 15-22 will be of special interest in economists and students of eco-

nomics although many compilers will find Chapters 15 and 19 of special interest. Policymakers and researchers, for example, should have particular interest in chapters 1 (Introduction), 9 (PPI calculation in practice), 11 (Errors and bias in the PPI), and 15 (Basic index number theory).

There is an extensive Glossary of key terms in index number theory and practice as well as an exhaustive Bibliography of the price index number literature..

7. Where to find the *Manual* chapters?

Draft versions of the *Manual* chapters are available on the websites of the organizations responsible for their publication. For the *CPI Manual* these are on the ILO website at www.ilo.org/public/english/bureau/stat/guides/cpi/index.htm, and for the *PPI Manual* these are on the IMF website at www.imf.org/external/np/sta/tegppi/index.htm. The *Manuals* are considered living documents, and the IWGPS will conduct periodic reviews and update them as necessary on their respective websites.

Hard copies of the *CPI Manual* are available for order from the ILO publications office and through the ILO website using the Publications menu. Likewise, hard copies of the *PPI Manual* should be available in September from the IMF publications office and through the IMF website using the Publications menu..

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Table 1 – List of *PPI Manual* Chapters

Chapter Title

Contents and Foreword
Preface
Reader's Guide
1 Abbreviations and Introduction
2 Background, purpose, and uses of Producer Price Indices
3 Coverage and classifications
4 Weights and their sources
5 Sampling issues in price collection
6 Price collection
7 Treatment of quality change
8 Item substitution, sample space, and new goods
9 PPI calculation in practice
10 Treatment of specific products
11 Errors and bias in the PPI
12 Organization and management

Abstract: The International Monetary Fund (IMF) and the International Labour Organization (ILO) have recently completed work on two new price statistics manuals—*Consumer Price Index Manual: Theory and Practice* and *Producer Price Index Manual: Theory and Practic*e. This paper discusses the background and concerns that led to the development of for these complementary volumes. It also provides a brief overview of their contents. While the primary users of these Manuals are expected to be index compilers, other users in government and business also will find them of interest in explaining price index number theory and practice.

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The EU Harmonized Index of Consumer Prices

Keith Hayes and Alexandre Makaronidis (Eurostat)

1. Introduction to the HICPs

The HICPs, launched in 1997, are the set of EU Consumer Price Indices calculated according to a harmonised approach and a single set of definitions. The most important HICPs are the Monetary Union Index of Consumer Prices (MUICP) for the euro-zone, launched in 1998, and the European Index of Consumer Prices (EICP) for the EU Member States There are also HICPs for the individual Member States, interim HICPs for the Candidate Countries and for the European Economic area ([1]).

The HICPs are published each month to a strict, rapid, pre-announced schedule, in general between 16 and 18 days after the end of the month. Eurostat also releases each month a 'flash estimate' for the MUICP, based on the results from the first countries to publish their national estimates and on energy price data. The HICP flash estimate is released on the last working day of each month.

2. Conceptual basis and coverage of the HICPs

The HICPs aim to cover the full range of final monetary consumption expenditure for all types of households in order to give a timely and relevant picture of inflation.

Conceptually the HICPs are 'Laspeyres-type price indices' rather than 'cost of living indices', this reflecting their key role in measuring price stability. Thus the HICPs can be viewed as measuring, broadly, the prices of a fixed expenditure pattern – rather than as being founded on economic concepts of consumer utility. The conceptual differences between the two types of price indices may but do not generally lead to substantial differences of practice.

The coverage of the HICPs is defined in terms of 'household final monetary consumption expenditure', by reference to the national accounts concepts of the European System of Accounts (ESA 1995). Some practical consequences of this are:

- The geographical and population coverage is of all purchases by households within the territory of a country, those by both resident and non-resident households (the so-called 'domestic concept').
- The HICPs cover the prices paid for goods and services in monetary transactions. So for example imputed rents for owner- occupied housing (where there is no equivalent monetary transaction) or some special fees and taxes paid to government for licenses will be excluded (when there is no equivalent good or service received in return).
- The prices measured are those actually faced by consumers, so for example they include sales taxes on products, such as Value Added Tax, and they reflect end-of-season sales prices.
- The HICPs exclude interest and credit charges, regarding them as financing costs rather than consumption expenditure.

1 ***Euro-zone countries****: Belgium, Germany, Greece, Spain, France, Ireland, Italy, Luxembourg, Netherlands, Austria, Portugal, Finland.*
EU countries*: The euro-zone plus Czech Republic, Denmark, Estonia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Slovenia, Slovak Republic, Sweden, United Kingdom.*
European Economic Area countries: The EU countries plus Iceland, Norway.
Candidate countries*: Bulgaria, Romania and Turkey.*

Differences between the HICPs and national CPIs

Consumer Price Indices (CPIs) may be used for a wide variety of purposes: as a guide for monetary policy; for the indexation of commercial contracts, wages, social protection benefits or financial instruments; as a tool for deflating the national accounts or calculating changes in national consumption or living standards. In many countries national CPIs were set up to serve a variety of purposes, and some of the underlying concepts and methods of national CPIs are therefore inappropriate for the HICPs as a 'pure' inflation measure (of the impact of inflation on purchasing power).

The differences between HICPs and individual national (CPIs) can sometimes be significant in practice, though the differences have in general been diminishing. Some examples of the differences are:

- The treatment of subsidised healthcare and education. The HICP includes the net price paid by consumers (after reimbursements), while some national CPIs exclude these purchases or record the gross price.
- The treatment of owner-occupied housing. In the HICPs, the imputed prices for the services provided by owner-occupied housing are excluded. As explained later in this paper, an index based on housing acquisition costs is being piloted for possible inclusion in future. It will be compiled separately from the HICPs on an experimental basis before any decision is made to incorporate it within the HICPs. National CPIs use a variety of methods – for example some use an approach involving imputed rents, some include mortgage interest in their CPI, while others entirely exclude the shelter costs of owner-occupiers.
- The aggregation formulae used at the most detailed level of stratification in the index calculations to produce the so-called elementary aggregates. The HICPs use ratios of arithmetic mean prices or of geometric means, while some national CPIs use other formulae.
- The geographical and population coverage. As noted above, the HICPs cover all expenditures within the territory, whether by residents or visitors. Some national CPIs aim to cover expenditures by domestic residents both within and outside the country.

3. The HICPs – price stability and international comparisons

The driver for the HICP harmonisation project has been their use as the main measure for monitoring price stability in the euro-zone. The HICPs have been set up to provide the best measure for international comparisons of household inflation in the euro-zone and the EU.

In the early stages of the HICP project the most important use of the HICPs was in the assessment of the price stability and price convergence – required for entry into the Economic and Monetary Union. More recently, the focus of interest has shifted towards country-group aggregates and in particular to the MUICP. This change of emphasis reflects the European Central Bank's objective of price stability and the view that the HICPs are the most appropriate price measure for assessing price stability. The ECB has defined price stability as a year-on-year increase of below 2% in the MUICP, to be maintained over the medium-term. In 2003 the ECB re-affirmed its inflation target and added that 'At the same time, the Governing Council agreed that in the pursuit of price stability it will aim to maintain inflation rates close to 2% over the medium term.'

The focus of the HICP on measuring price stability and convergence, and on international comparisons, does not mean that a wider range of users should not or can not use them for other purposes. Depending on the precise purpose the user has in mind, the HICPs may be the best available price statistics. All users of the HICPs should note however that, unlike some CPIs, the HICPs are revisable – the indices may change after the first results are published.

4. The harmonisation process

Legal basis

The first milestone in the development of HICPs, in October 1995, was the adoption of a Council Regulation setting the legal basis for establishing a harmonised methodology for compiling comparable CPIs, as required by the convergence criteria in the Maastricht Treaty.

Process

The programme to develop a harmonised methodology has relied on the active participation of the EU national statistical offices' prices experts, co-ordinated and led by Eurostat.

The HICP Working Group has been the platform for developing the project. The Working Group, attended by representatives of Eurostat, the Member States, European Economic Area and Candidate Countries, has also benefited from the participation of user representatives – from the European Central Bank, national central banks and the Commission's Directorate-General for Economic and Financial Affairs. The European Advisory Committee on Statistical Information in the Economic and Social Spheres (CEIES) was also involved in the early years. The opinion of the Statistical Programme Committee, the highest level EU Committee for statistical work, is sought for all HICP legislation.

Minimum standards

The approach taken towards harmonisation was firstly to adopt the framework Council Regulation, setting out the broad principles and scope of the HICP. This has been built on over the years using a series of legally binding implementing regulations, each addressing one or more specific areas of methodology. The methods specified in these Regulations can usually be applied with some flexibility, since comparability is required only with a tolerance of 0.1 percentage points in either direction at the level of the overall indices. The aim has been comparability of results rather than the application of uniform methods in all circumstances.

5. Legal requirements for HICPs

This section outlines the main subjects covered by the legal Regulations on the HICP since 1995 and identifies the main issues addressed.

The first Council Regulation, in 1995, set the legal basis for the establishment of a harmonised methodology for compiling CPIs in the Member States. It also gave some basic definitions to be applied, and set out the first standards on issues such as initial scope of the indices, the timetable and frequency for their production and publication. It also set out arrangements for funding the additional work in Member States that would be necessary.

Implementing Regulations

The Council Regulation has been followed by, up to now, thirteen implementing Regulations, each dealing with one or more aspects of the harmonised methodology. An overview of the main points covered in the Regulations is given below. For further details, the Compendium of HICP Reference Documents contains the HICP legal texts and guidelines.

Starting in 1996, the Regulations set standards on:

- The initial coverage of the indices – essentially all goods and services available on the domestic market, but with a staged introduction for certain items and the specific exclusion of a very few. Since that time the coverage of products has been extended to include some goods and services that were initially excluded (e.g. COICOP 06.2.1 'Medical Services') and to extend the coverage of some other products that had only been partly included (e.g. COICOP 04.4 'Other services related to the dwelling').
- The treatment of newly significant goods and services – all product types with a weight of at least one part per thousand should be covered.
- The formulae to be used for the elementary aggregates – forbidding the use of arithmetic means of price relatives except where this can be shown not to affect comparability.
- Quality adjustment – explicit quality adjustments should be made whenever possible and the whole of a price change should never be ascribed to quality differences without justification.
- Sampling – the sample must be sufficiently representative of the products taking account of their price variability. The target sample must be maintained.
- Missing price observations – carrying forward the most recent observation for more than two months is not permitted.
- The classification to be used (the then provisional version of the international COICOP classification) and the level of sub-indices to be calculated (a disaggregation of the COICOP groups).
- Arrangements for the transmission of HICP data to Eurostat.
- The quality of the weights of the HICPs – the weights should relate to a period not more than seven years before the index year. Checks should also be made each year to see whether any important changes have taken place and selective adjustments introduced when necessary.
- The geographical and population coverage. The HICPs cover purchases by households within the territory of a country, by both resident and non-resident consumers. All sections of the popu-

lation are covered in principle, including the extremes of the income distribution and including the institutional population.
- The treatment of tariff prices (for example as can apply for electricity or telephone charges), giving rules for dealing with changes in tariff structures.
- The treatment of insurance transactions. The price of gross insurance premiums is used as the price indicator, but weights use the so-called 'insurance service charge'.
- The new classification framework to be used (the COICOP/HICP classification) – in line with the final version of COICOP defined by the United Nations.
- The recording of prices in the health, education and social protection fields. In particular the prices to be included in the HICPs are those paid by households net of any reimbursements from government, social security administrations or other non-profit institutions.
- The timing of inclusion of purchaser prices for goods and services – prices for goods should be included in the HICP when they are observed, whereas prices for services should be entered for the month in which the consumption of the service can commence.
- The treatment of price reductions – setting out when the HICPs should take account of price reductions and other inducements to purchasers.
- The treatment of service charges proportional to transaction values – for example some of the charges that can be paid for financial and legal services.
- Revisions procedures – for example when new or improved information is received or when there are changes to the rules governing the production of the HICPs. The HICPs are revisable, subject to some procedural rules.
- Guidelines - in addition to the Regulations, some guidelines were also been agreed, on revisions practices (since converted into a Regulation); the treatment of certain price reductions; price observations which are rejected for use in the indices and the treatment of data processing equipment.

6. Agenda for further harmonisation

In the last few years, Eurostat has focussed on quality adjustment and sampling and on owner-occupied housing. These are seen by Eurostat and by key users as the most important issues requiring further standards for the HICPs. The development of new standards is technically difficult, and takes time, and proposals must be carefully prepared and assessed. But as reported below, some progress is being made.

Quality adjustment and sampling

The Regulation which addressed quality adjustment issues in 1996 was only a first step – it is not in itself a sufficient guarantee of full comparability. Eurostat and the Member States are actively following-up an Action Plan on quality adjustment and sampling with the aim to recast the '96 general standard on quality adjustment and agree specific standards for a range of specific goods and services (in particular for cars, consumer durables, books and CDs, clothing, computers and telecommunications services).

A Task Force with representatives from nine Member States has drafted recommendations on cars, consumer durables, books and CDs and clothing. A second Task Force is currently working on computers and telecommunications. Following from that work, the preparation of new HICP standards for some of these products will begin during the second half of 2004.

Owner-Occupied Housing

The imputed prices for the consumption of the service provided by owner-occupied housing are excluded from the HICPs. Pilot studies have seen calculations carried out in five countries using an approach based on the acquisition costs of housing which is new to the household sector (mainly this means newly-constructed dwellings). Reviewing the work of the pilot studies completed so far, Eurostat recently proposed to adjust the approach and extend and widen the pilot phase. The acquisition cost approach will still be followed, but the calculations will be based on the prices of all dwellings rather than just newly-constructed ones.

The owner-occupied housing price indices will be compiled separately from the HICPs on an experimental basis before any decision is made to incorporate them within the HICPs.

Other developments

The t of HICPs at constant taxes is given priority by HICP users. Eurostat and the Member States have reached broad agreement on the methodology that should be used and pilot work in the Member States is likely to begin later in 2004 or in early 2005. If that work is successful then the next step could be to work on a methodology for calculating an HICP excluding the effects of 'administered prices' – so excluding, for example, prices which are determined or strongly influenced by government.

Discussions with the Member States are currently taking place on proposals for new HICP standards on the treatment of seasonal items, improved methods for the rounding of HICP indices and rates of change, and on proposals for standards for price collection periods.

The definition of consumption segments by purpose with the aim to widen and harmonise elementary aggregation in the HICP, and the construction of a common detailed classification of expenditure by purpose for the HICP are also under consideration.

The development of more comprehensive systems to assess Member States' compliance with the HICP Regulations is another issue. More comprehensive quality assurance of the HICP compilation process in the widest sense is needed.

The consolidation of the legal framework for HICPs, and the production of a methodological manual to assist both compilers and users.

More EU countries are now producing very rapid monthly estimates of inflation, which will enable the quality of the MUICP flash estimates to be improved further.

7. Further information on HICPs

For more detailed assessments of the harmonisation process see the reports from the European Commission to the Council - COM(2000) 742 final and COM(1998) 104 final. These documents are included in the 'Compendium of HICP reference documents'
(http://europa.eu.int/comm/eurostat/Public/datashop/print-catalogue/EN?catalogue=Eurostat&product=KS-AO-01-005-__-I-EN).
The Compendium also contains the HICP legal texts and guidelines.

For a short introduction to HICPs see: Harmonised Indices of Consumer Prices (HICPs): A Short Guide for Users, March 2004 (http://forum.europa.eu.int/irc/DownLoad/).

Concerning the ECB's monetary policy strategy and the HICPs, see Statement by Mr. Wim Duisenberg, President of the ECB, defining ECB Press conference, Frankfurt 13.10.1998 (http://www.ecb.int/press/pr981013_1.htm) and ECB press release of 8 May 2003 concerning monetary policy strategy (http://www.ecb.int/press/03/pr030508_2en.htm).

Abstract: The Harmonized Indices of Consumer Prices (HICPs) are calculated according to a harmonized approach and a single set of definitions. This paper outlines the aims and history of the HICPs and summarises the most important HICP standards. It also notes some remaining key issues on the agenda for further harmonization.

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Monetary policy perspectives on the accuracy of inflation measures[1]

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"For all these conceptual uncertainties and measurement problems, a specific numerical inflation target would represent an unhelpful and false precision. Rather, price stability is best thought of as an environment in which inflation is so low and stable over time that it does not materially enter into the decisions of households and firms."
Alan Greenspan, "Transparency in Monetary Policy," remarks to the Federal Reserve Bank of St. Louis Economic Policy Conference, October 11, 2001

"*The ECB's Governing Council was of the view that the quality of the HICP made it feasible to set a precise definition of price stability as part of its monetary policy strategy."*
Otmar Issing, "The Relevance of Reliable Statistical Systems for Monetary Policy Making in the Euro Area", speech to CEPR/ECB Workshop on Issues in the Measurement of Price Indices, November 16, 2001.

Introduction

Four key developments account for the greater attention that central bankers now pay to the accuracy of inflation measures. First, the success of central banks around the world in bringing inflation down to levels that have not been seen in a generation. Measurement error is more likely to account for a significant portion of reported inflation when inflation is running at 2 percent than when it is running at 20 percent. Second, the growing popularity of inflation targeting as a strategy or framework for monetary policy. If headline inflation statistics are known to overstate the true rate of inflation, then inflation targets need to take this into account. Third, the information technology (IT) revolution that has drawn attention to the problem of quality change and new goods. Quality change has always been a major source of difficulties in the measurement of inflation, but the extraordinary pace of innovation in the IT and related sectors over the past decade has given new urgency to making progress in dealing with this issue. And fourth, globalization, which has broadened the range of varieties of products available to consumers in all countries. Whether new consumer goods become available through innovation or trade, in both cases they pose problems for making intertemporal comparisons of the cost of living. This greater interest in measurement issues has spawned a significant amount of new research in recent years, though nowhere near enough to fully resolve the debates about the accuracy of inflation measures.

This paper reviews what we know about the presence of measurement bias in inflation statistics, with particular attention to the US and the euro area. The paucity of basic research on the accuracy of various components of consumer price indexes in different countries argues for consideration of alternative, indirect methods of estimating bias. I illustrate the approach suggested by Nordhaus (1998), and use a variant of that approach to derive an estimate of bias in the Harmonised Index of Consumer Prices (HICP). I then show how information about bias should be used in setting an inflation target.

What do we know about the accuracy of measures of consumer price inflation?

Measures of consumer price inflation play a pivotal role in the deliberations of central banks around the world. All of the avowed inflation targeting central banks have their inflation target defined in terms of some measure of consumer price inflation. The ECB has defined its treaty mandate of price stability in terms of a measure of consumer price inflation. The Federal Reserve,

1 *The views expressed in this paper are those of the author and do not necessarily reflect the views of the Federal Reserve Bank of Dallas or the Federal Reserve System.*

which eschews any quantitative definition of price stability, nevertheless pays close attention to the personal consumption expenditures deflator, a measure of inflation at the household level. This makes the question of the accuracy of these indexes of central concern to central bankers. So how accurate are measures of consumer price inflation? How much do we know about the presence of measurement biases? It depends, but on balance, remarkably little.

The bulk of the research on the accuracy of price indexes to date has focused on the US. One of the earliest reviews of the accuracy of US conflation statistics was conducted by the Stigler Commission in 1961. With the acceleration of inflation around the world in the late 1960s and 1970s, measurement issues ceased to be of first order importance. But the legacy of the Great Inflation meant that the issue became a matter of political interest in the United States in the 1990s, when the US Congress realized that the presence of measurement error in the US CPI had potentially significant fiscal implications, given the widespread indexation of many components of the federal budget to the CPI. This led of course to the appointment of the Boskin Commission, which issued its report in December 1996, and concluded that the US CPI probably overstated the true rate of increase in the cost of living by about 1.1 percentage points a year, with a plausible range of estimates of between 0.8 and 1.6 percentage points. Other reviews by Wynne and Sigalla (1996), Shapiro and Wilcox (1996) and most recently Lebow and Rudd (2003) reached broadly similar conclusions, although of these Wynne and Sigalla were the most agnostic. In response to the Boskin Commission, the Bureau of Labor Statistics has made a number of significant changes to the way it constructs the US CPI, all with the intention of making it a better measure of the cost of living.

The debate over the accuracy of the major inflation measures in the US is far from settled. While the studies cited suggest that the CPI might overstate inflation by something like 1.0 percentage points, give or take a couple of tenths of a percentage point, recent research by Bils and Klenow (2001) and Bils (2004) suggests that these numbers may be too low. As all students of price measurement acknowledge, quality change is the most intractable of the problems confronted by statisticians trying to measure inflation. Bils and Klenow (2001) estimate quality Engel curves for a large number of durable goods included in the US CPI and find evidence that the BLS does not fully account for the effect of quality upgrading on prices. They estimate that the average annual rate of quality improvement for the goods they look at is 3.7 percent, of which 2.2 percent gets recorded (incorrectly) as higher inflation. By comparison, the Boskin Commission estimated a quality bias of 1.0 percent a year for consumer durables. Bils and Klenow rightly point out that their estimate is subject to a considerable degree of uncertainty, but argue that at a minimum the CPI for consumer durables is upwardly biased by 0.8 percent a year. Bils (2004) argues based on an examination of BLS micro data that quality growth for durables may in fact be higher than estimated by Bils and Klenow, as high as 5.8 percent a year on average. The implied overstatement of inflation for consumer durables is 3 percent a year, much higher than the Boskin Commission estimate. However, other recent research by Gordon (2001) and Gordon and vanGoethem (2003) has found the presence of substantial downward bias in the apparel and housing components of the US CPI, vindicating Triplett's (1971) caution against assuming that the measurement biases were all in one direction (i.e. up) and Wynne and Sigalla's (1996) more agnostic conclusion about the magnitude and uncertainty of overall bias estimates.

So much for the US. What of other countries, and the euro area in particular? In earlier paper (Wynne and Palenzuela (2004)) I noted that many of the attempts to estimate bias in measures of consumer price inflation in the EU relied rather heavily on studies that were done with US data. The exception was (and, to the best of my knowledge, still is) Hoffman's (1998) excellent review of potential biases in the German CPI. In addition to using estimates from studies done using US data, Hoffman also conducted a number of original studies of his own and concluded that the German CPI probably overstated inflation by about 0.75 percentage points a year. Later Hoffman (1999) revised this estimate down to 0.5 percentage points, based on improvements in the Federal Statistics Office's methods. Most of the other studies reviewed in Wynne and Palenzuela simply extrapolated from US studies to arrive at estimates of overall bias. Encouragingly, there is now some research going on in various countries that will allow independent assessments of national (and Europe wide) measures of consumer prices.[2]

Much of the research on measurement problems to date has highlighted the implications of measurement error for estimates of long run inflation and output and productivity growth. An issue that has attracted relatively little attention is whether there might be a cyclical bias that could have an adverse impact on inflation developments. The concern about the distinction between list and transactions prices may come into play here, although it has received relatively little attention in recent discussions of measurement error, and is unlikely to be a major source of error in consumer

2 *Some of this research was reported at a workshop on measurement organized by the ECB in 2001. See Camba-Mendez, Gaspar and Wynne (2002) for a summary of the workshop.*

prices in most industrial countries.[3] But one might conjecture that the pace of innovation and quality change has an important cyclical component, with quality change being relatively more important during business cycle expansions and relatively less important during downturns, and the attendant biases being greater and lesser as well.

One of the greatest obstacles to arriving at reasonable estimates of the extent of measurement error in consumer price statistics in many countries is the relative paucity of basic research.[4] Thus it is worth exploring what we can learn from alterative approaches to estimating bias. One of the more ingenious suggestions in this regards is Nordhaus' (1998) idea of comparing of growth in median household income deflated by the CPI with self assessed measures of well being as reported in the University of Michigan's Survey of Consumer sentiment. The idea is that equal numbers of households should report themselves as being better off as report themselves as being worse off when median income is constant in real terms. If more households report themselves as better off than report themselves as worse off when measured real income is stagnant, it suggests that inflation is being overstated.

Figure 1 – Updated Nordhaus Regression for US
Data from 1968-2002

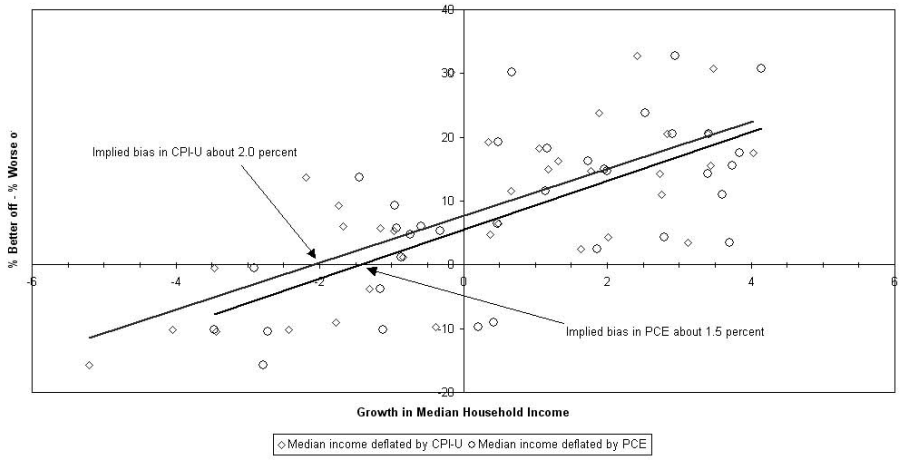


Figure 1 replicates and updates Nordhaus' calculation for the United States. In his original paper (which used data from 1968-1994), Nordhaus estimated an implicit upward bias in the CPI of 1.5 percent. Figure 1, which uses data through 2002, suggests a bias of about 2.0 percent. The second scatter and line shown in the Figure is based on the personal consumer expenditures deflator (PCE), which should be a better measure of inflation, given that it is constructed using a chain-weighted formula. And as we would expect, the implied bias is lower still, about 1.5 percentage points per annum. Note that Gordon (1999) refers to Nordhaus' original findings as important external corroboration of the Boskin Commission's estimates, although the Nordhaus approach is not without its shortcomings (see in particular the critique of Krueger and Siskind (1998)).

For the EU it is worth exploring the potential of alternate routes to estimating potential bias (leaving aside for one moment the issue of the conceptual problems with the HICP that were of concern to Wynne and Palenzuela (2004)). Calculations along Nordhaus' lines could be used to arrive at some ballpark estimates of the potential magnitude of bias. This issue was explored to some degree in Wynne and Palenzuela (2004). We found that limited availability on the distribution of household income made it difficult to apply Nordhaus approach in many EU countries. For those few countries where we were able to obtain data, we found that crude application of the Nordhaus approach suggested that far from overstating inflation, national CPIs in these countries seem to understate it! We were reluctant to read too much into this finding, however, given that it was based on very short samples of data, and the critique of Krueger and Siskind.

An alternative to the Nordhaus approach is however feasible in the EU. The Harmonised Consumer Survey (HCS) conducted by the European Commission every month is another source of potential information on inflation bias. Each month the survey asks households across the EU about their perceptions (and expectations) of inflation. Question 5 of the survey asks

3 *Although Lequiller (1997) does draw attention to the possible existence of such a source of error in the French CPI. Hoven (1999) states explicitly that list prices are used in the compilation of the CPI for new cars in the Netherlands. In the United States it is an open question whether the use of clipped coupons or store loyalty cards may impart such a bias to the CPI.*

4 *Hoffman (1998) cited this as a problem for Germany, and Shiratsuka (1999) mentions it as a problem for Japan.*

"Compared with what it was 12 months ago, do you think that the cost of living is now

++	1	"very much higher"
+	2	"quite a bit higher"
=	3	"a little higher"
-	4	"about the same"
- -	5	"lower"
N	6	"don't know"

Note that the mid point of the responses (what for most of the other questions on the survey is "no change" or "stayed the same") allows for some increase in the cost of living. The response to the question is reported each month as a characteristic value defined as c = {"+ +" + ½ "+" – ½ "-" – "- -"}. Using reasoning similar to that underlying Nordhaus calculation, one might conjecture that when measured inflation is zero, then equal numbers of households should report that the cost of living has risen as report that it has fallen. A positive measured rate of consumer price inflation when equal numbers of households are reporting that the cost of living has risen as are reporting that it has fallen would be suggestive of upward bias in the measured inflation rate.

Figure 2 – Measured inflation and self-assessed changes in the cost of living EU
1990-2004

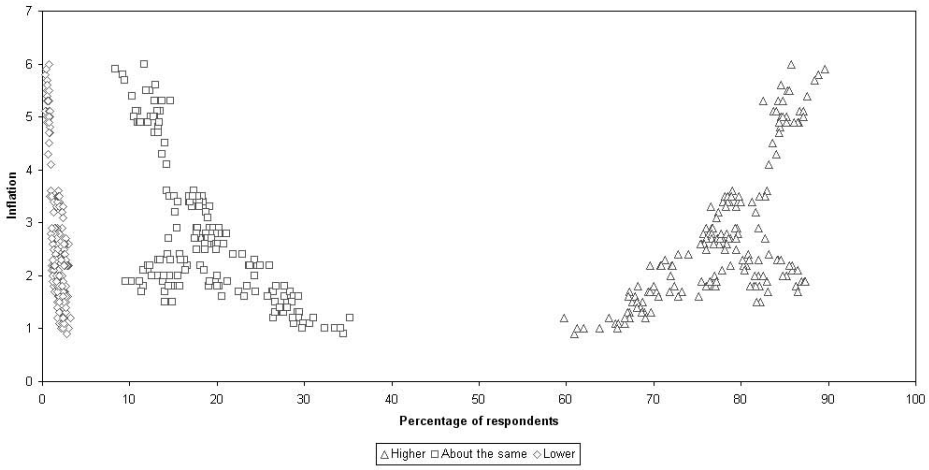
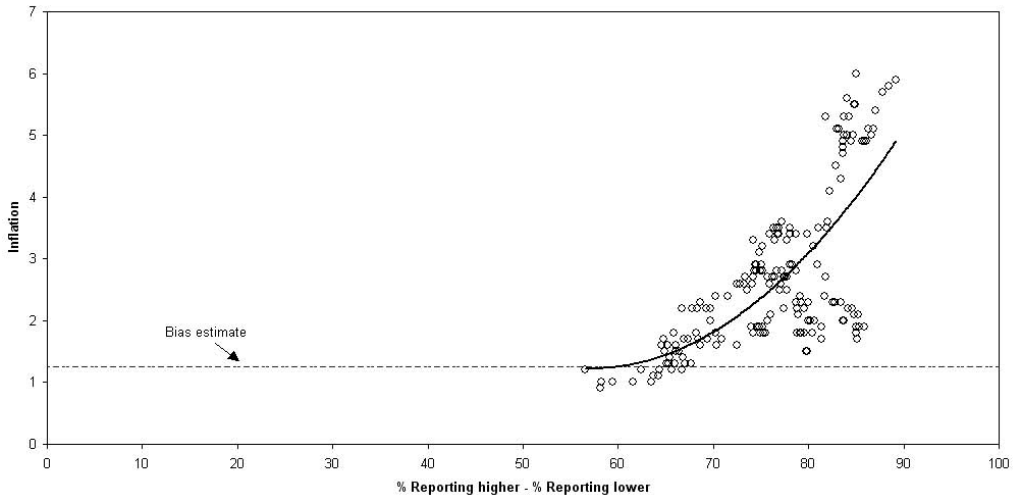


Figure 2 summarizes the response to the relevant question on the European Commission's survey for the EU as a whole. The figure shows the percentage of survey respondents reporting that the cost of living is higher than it was twelve months ago (i.e. the sum of the percentages responding "very much higher", "quite a bit higher" and "a little higher"), the percentage reporting that the cost of living is lower and the percentage reporting that the cost of living is about the same, plotted with the relevant twelve month HICP inflation rate. As we would expect, the percentage responding that the cost of living has risen increases as the inflation rate increases. Likewise the percentage responding that the cost of living has fallen declines as the inflation rate increases. This should make us reasonably confident that the survey is eliciting meaningful information.

For the purposes of assessing whether there is bias we need to compare the opinion of the average survey respondent with the measured rate of inflation. One way to do this is simply to subtract the percentage of respondents replying that the cost of living has fallen from the percentage reporting that the cost of living has risen. Figure 3 shows the relevant scatter plot. At the EU level, the limited amount of variation in the responses to the survey and the measured rate of inflation makes it difficult to make strong inferences about the presence of bias. However, in Wynne (2004) I explore this issue further and find that by exploiting the fact that the HCS and HICP are harmonised across EU (at least in principle), I can derive an estimate of the bias in the HICP. Using various nonparametric methods and pooling observations from the fourteen EU countries that have participated in the HCS since 1996, I estimate that the HICP may be biased by between 1.0 and 1.5 percentage points a year.[5] The figure is remarkably close to the sorts of numbers that most alternative approaches to estimating bias have obtained in other countries.

Figure 3 – Measured inflation and self-assessed changes in the cost of living EU
1990-2004



Defining price stability

How should we use information about bias in the measurement of inflation in setting inflation objectives for central banks? Cecchetti and Wynne (2003) proposed a simple framework for combining information about the volatility and measurement error in inflation statistics to define a central bank's target inflation rate. The specific question we were concerned with in that paper was whether the data support the use of a zero to two percent range for the HICP as the objective for monetary policy in the euro area, but the method is of more general applicability. We propose a simple two-step procedure: first, estimate the central point of a range – what might be considered a "point inflation target", second, use information about the volatility of inflation and uncertainty about the extent of measurement error to construct an interval about this target that represents a range within which measured inflation can fluctuate without concern that the target is being compromised.

In an ideal world central bankers would aim for zero inflation, properly measured. Furthermore, this objective should be defined in terms of a welfare-based measure of inflation, such as a cost-of-living index. If published consumer price indexes contain bias relative to the cost-of-living ideal, the quantitative definition of the price stability objective should reflect this bias. Thus, a finding of positive bias in the index used to define price stability would argue for defining price stability at some positive measured rate of inflation rather than zero. While the evidence on which to base point estimates of bias is slim for most countries, a point estimate of an upward bias of about 1.0 percent seems to be a reasonable guess for most countries. These estimates are of course subject to some degree of uncertainty. Lebow and Rudd (2003) present a range from 0.3 to 1.4 percent, while the Boskin Commission presented a range from 0.8 to 1.6 percent. Cecchetti and Wynne (2003) worked with a bias estimate of 0.75 for the euro area, although they noted the high degree of imprecision associated with this figure. For the sake of illustration, let's take the midpoint of the range suggested by Wynne's (2004) comparison of the HICP and HCS, i.e. 1.25 percentage points. And let's assume, again for the sake of illustration, a standard deviation of 0.5 associated with this estimate. Greater uncertainty about the accuracy of a measured consumer price index would warrant a higher figure; greater precision, a lower one.

An estimate of the bias provides a baseline for any central bank's inflation objective. But central bankers are generally concerned with more than the average rate of inflation over time: they also care to some extent about the distribution of inflation outcomes. Specifically, central bankers seem to be more concerned about low rates of deflation than low rates of inflation. Some of this is driven by the experience of the US during the Great Depression, and the more recent experience of Japan.[6] These experiences have convinced many monetary policymakers that deflation may pose greater risks than inflation, and seem to have made many of them more tolerant of small amounts of

5 *Luxembourg only started participating in the HCS in 2002.*

6 *Although see Atkeson and Kehoe (2004) for an alternative interpretation of the empirical record on the relationship between deflation and depression.*

inflation than they are of small amounts of deflation. This deflation aversion needs to be taken into account in the construction of the inflation target.

Let's assume that the monetary policymaker's tolerance for the possibility that the inflation target actually implies steady deflation is small – say 2½ percent, or 1 in 40. With this level of tolerance, we need to shift our target measured inflation (1.25 percent, say) up by an increment equal to 1.96 times the standard deviation of the estimated bias.[7] Suppose we take a figure of 0.5 percent for the standard deviation of the estimates of measurement error. Multiplying this by 1.96 we have an adjustment of 0.98 percentage points. Adding this to a point bias estimate of 1.25 percentage points yields 2.23 percent as appropriate midpoint of an inflation target range. Cecchetti and Wynne interpret this as meaning that when measured consumer price inflation is running at a rate of 2.23 percent, there is less than a 2½ percent chance that prices properly measured are actually falling.[8] Increasing the willingness to accept deflation risk would reduce this number, while reducing the tolerance for deflation will increase it. For example, accepting a 10 percent probability that prices are actually falling would imply a target of 2.0725 percent (1.645 times 0.5 plus 1.25), while a probability of 1 percent implies a target of 2.538 percent (2.576 times 0.5 plus 1.25).

Figure 4 – Probability of deflation in true price level as function of measured inflation

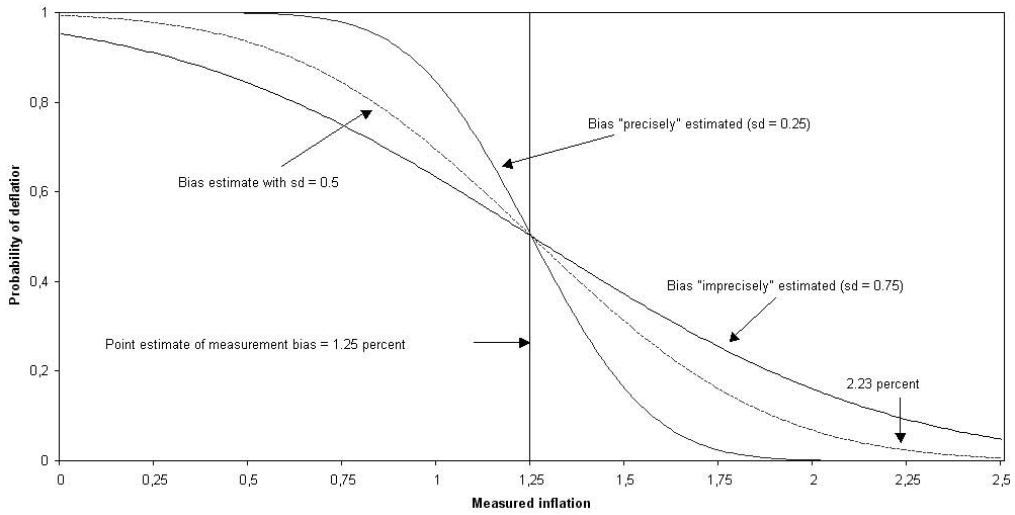


Figure 4 plots the relationship between measured consumer price inflation on the horizontal axis and the probability that there is deflation on the vertical axis for different degrees of uncertainty associated with a given point estimate of measurement error. For any degree of willingness to accept the risk of deflation, it is then straightforward to read off the appropriate point inflation target.

The second step in this exercise is to figure out the width of the target range. For example, the ECB's monetary policy strategy states explicitly that its inflation objective is to be attained "over the medium term." Indeed, most central banks, whether inflation targeting or not, try to get beyond erratic month-to-month movements in headline price indexes by using various measures of core inflation in their policy deliberations. Suppose that policymakers would like there to be a high probability, say 90 percent, that a reading on the 12-month change in the headline consumer price inflation measure is not different from the target. Given this, we can compute a range around the target. Using the 90 percent tolerance for error, we take ±1.645 times the estimated volatility of the headline series to obtain the relevant band. For example, an estimated volatility of 0.4 gives us a band of plus or minus 0.658 percentage points. If the point inflation target were 2.23 percent (as implied by a 2½-percent tolerance for the possibility that it implies deflation, along with a point bias estimate of 1.25 percentage points, with an associated standard error of 0.5) then the appropriate target range for inflation would be 1.572 to 2.888. This range could be rounded to something like 1.5-3.0 percent so as not to convey a spurious sense of precision.

7 *1.96 being the ordinate that cuts off 2½ percent of the tail of a standard normal distribution.*

8 *Cecchetti and Wynne (2003) point out that there are two sources of uncertainty associated with the definition of an inflation target using the HICP. The first is the uncertainty associated with the estimated bias in EU cost-of-living indexes (which they put at 0.5 percent). The second is the uncertainty associated with the estimated bias in the HICP as a cost-of-living index (which they put at 0.33 percent). They assume that these two sources of uncertainty are independent, which gives them a standard deviation of 0.60 percentage points (that's the square root of* $(0.5)^2 + (0.33)^2$*).*

Conclusions

In 1961, the Stigler Commission noted:

"If a poll were take of professional economists and statisticians, in all probability they would designate (and by a wide majority) the failure of the price indexes to take full account of quality changes as the most important defect of these indexes. And by almost as large a majority, they would believe that this failure introduces a systematic upward bias in the indexes – that quality changes have on average been quality improvements.

We have very little evidence at our disposal with which to support – or deny – the belief in progressive quality improvement. Indeed we are impressed with how little empirical work has been done on so widely held a view and potentially so important a problem. Even the concept of quality change is not free of difficulty. Changes in buyers' tastes will lead to the appearance of new goods – an uncontroversial example would be fashionable apparel – which are not improvements judged by either previous or subsequent tastes, and the line separating taste changes from quality improvements will depend on the time span invoked." (Stigler, 1961, p. 35)

I think it is fair to say that the prejudice identified by the Stigler Commission still exists today. We do have more evidence of overstatement of inflation in certain categories of goods due to failure to account for quality improvements than was available to the Stigler Commission. Importantly, we also have examples of understatement of inflation in other categories of goods, which should serve as a reminder of the need to approach the issue of measurement bias with an open mind. One of the major recommendations of the Stigler Commission in 1961 was that the BLS use the cost of living as the measurement objective of the CPI. The Boskin Commission repeated this recommendation, and the BLS does now use the cost of living as its measurement concept for the CPI. However, the BLS is almost alone in this. Many other statistical agencies eschew the theory cost of living index as the conceptual framework for their consumer price indexes. Most prominently, Eurostat states that the HICP is not a cost of living index and thus should not be criticized from this perspective. If we accept this, then we need to know what the conceptual framework of the HICP is, so that it can be evaluated in its own terms. Until such a framework is elaborated, it is reasonable to continue to evaluate the HICP from the cost of living perspective. As central banks have been granted greater independence in recent years to pursue the goal of price stability, they have also faced demands to be more transparent in their deliberations and to be held countable for the outcomes they deliver. National statistical offices produce the raw materials with which central bankers work every day, and it seems reasonable to apply the same standards of transparency and accountability to them.

Above I reviewed some of the recent discussions about measurement error in consumer price indexes. Most studies find an upward bias of about 1 percentage point a year, but these estimates continue to be based on a remarkably small number of detailed studies. Many assessments of overall bias are based on a simple extrapolation of findings for the US, where there seems to have been the greatest volume of basic research. While this is a useful starting point, it is no substitute for more individual country studies. In the meantime it is worth exploring alternative indirect approaches assessing the accuracy of measures of consumer price inflation, such as that suggested by Nordhaus and the variant thereon suggested above.

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Abstract: The issue of the accuracy of price measures has received increased attention from central bankers in recent years. Citing the difficulty of accurately measuring prices in a dynamic economy, the Federal Reserve has shied away from offering a quantitative definition of price stability. However, the ECB, and a multitude of inflation-targeting central banks, do not seem to share these concerns, but do cite the presence of measurement error as a reason for defining price stability as prevailing at some positive rate of inflation. This paper reviews the debate about price measurement as it pertains to the conduct of monetary policy. I present some new evidence on bias in the US CPI, and some evidence of comparable bias in the HICP. I also present a simple framework for using information about measurement bias to define inflation targets.

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Inflation targeting and targets: the role of a statistical office and the move to a new target in the United Kingdom

David Fenwick (Office for National Statistics, UK)

Introduction

1. On 10 December 2003, in his statement on the Pre-Budget Report, the Chancellor of the Exchequer confirmed that he was changing the basis of the UK inflation target from one based on the Retail Prices Index excluding mortgage interest payments (RPIX) to one based on the Consumer Prices Index (CPI), previously published in the UK as the Harmonised Index of Consumer Prices (HICP). At the same time, the Chancellor confirmed that pensions, benefits and index-linked gilts will continue to be calculated on exactly the same basis as previously, in other words with reference to the all-items Retail Prices Index (RPI) or its derivatives.

2. The reasons for the change in the inflation target and implications for the conduct of UK monetary policy are set out by HM Treasury in the Pre-Budget Report 2003 and in the annex attached to the new remit for the Bank of England's Monetary Policy Committee.

3. The purpose of this paper is twofold:
- To give an insight in the role of a national statistical office in providing the necessary statistical infrastructure for inflation targeting.
- To promote understanding of the new target measure from a statistical perspective, in the context of its use in the UK as a key element in the range of published inflation measures used in public policy.

Institutional arrangements

4. Her Majesty's Treasury sets the inflation target, the Bank of England is responsible for meeting the target[1] and the Office for National Statistics is responsible for the production and publication of a wide range of economic statistics including the inflation target.[2]

5. The institutional relationship between the Office for National Statistics and the rest of government is codified under the National Statistics Framework Document and other legal documentation and is supported by a number of protocols and bi-lateral agreements that provide the operational guidance.

1 *An inflation target was first introduced in 1992. Prior to that there were money supply targets that could be monitored from Bank of England data. Responsibility for setting interest rates and meeting the target transferred from the Chancellor of the Exchequer to the Bank of England in 1997. Further details can be found in "The UK Office for National Statistics and the Inflation Target", Rowlatt. A, published in "Statistical Implications of Inflation Targeting", IMF 2002.*

2 *A number of Central Banks use a measure of core inflation as an operational guide and analytical tool for monetary policy. There is, however, no universal definition of core inflation. Removal of erratic movements may be focussed on specific components of the headline Consumer Price Index (CPI), such as food, energy, mortgage interest payments or the impact of indirect taxes, but is also applied to volatile price movements more generally or large outliers in price movements. Other approaches involve the isolation and removal of those components of inflation which are considered to be short-term, with no impact on future economic output, or the isolation of core components which are the best predictors of future inflation. See "Core inflation, seasonal adjustment and measures of the underlying trend", Fenwick. D, published in the proceedings of the UNECE/ILO Conference on Inflation Measurement, November 2003.*

6. The Framework Document also defines the role of UK National Statistics. It states that the primary aim of UK National Statistics is "to provide an accurate, up-to-date, comprehensive and meaningful picture of the economy and society to support the formulation and monitoring of economic and social policies by government at all levels".

7. The Framework Document supplements this with objectives and responsibilities in pursuit of the aim:

- "to improve the quality, timeliness and relevance of its service to customers both within government and the wider community";
- "to improve public confidence in official statistics by demonstrating that they are produced to best professional standards and free from political interference".

8. It is the responsibility of the National Statistician to ensure the professional statistical quality of all outputs comprising National Statistics.

9. The Framework Document also refers to special arrangements that apply to the RPI:
"In the case of the RPI special arrangements apply: the National Statistician will take the lead in advising on questions concerning the RPI but the scope and definition of the index will continue to be matters for the Chancellor of the Exchequer".

10. The RPI has a uniquely wide range of very important uses, and changes in its scope and definition have unrivalled potential for far reaching policy implications. The index (and its derivatives) was and continues to be used for numerous different purposes, including for up-rating of pensions and social security benefits, indexing tax thresholds and allowances and excise duty rates, calculating returns on index-linked gilts, wage bargaining, setting inflation trigger clauses in commercial contracts, and for price setting formulae applied by regulated industries. Most of these purposes are enshrined in legislation and set the RPI apart from other economic statistics and explain why, in line with long-standing arrangements and unlike other economic statistics, its scope and definition remain under the ultimate authority of the Chancellor. This means that on matters of scope and definition there is direct accountability to Parliament.

11. These special arrangements do not apply to the CPI.

12. Reflecting its new role as the main UK domestic measure of inflation for macroeconomic purposes, the National Statistician decided that the UK Harmonised Index of Consumer Prices (HICP) would in future be known as the "Consumer Prices Index" (CPI) in all National Statistics releases and publications. It was made clear that this should not be interpreted as implying that there is any intention to develop the CPI differently from the HICP. But it does mean that the CPI is not subject to direction from the Statistical Office of the European Community and the statistical legislation that defines and regulates the HICP.

Historical context to inflation measurement

13. The historical contexts of the all-items Retail Prices Index (RPI) and the CPI are very different. The RPI began life as a compensation index, developed as an aid to protect ordinary workers from price increases associated with the First World War, and it was only much later that it came to be used as the main domestic measure of inflation from a macroeconomic perspective. When a government inflation target was first adopted in 1992 it was expressed in terms of the RPIX. The all-items RPI is used to adjust benefits, tax allowances and thresholds, and also index-linked gilts.

14. In contrast, HICPs were developed in the European Union (EU) expressly from a macroeconomic perspective, and launched in 1997. Initially, HICPs were used to assess which EU Member States passed the inflation convergence criterion for membership of Economic and Monetary Union (EMU), and so cross-country comparability was a key issue in designing the HICP. Since EMU has been established, it is used by the European Central Bank to assess price stability in the euro area.

RPIX and the CPI: what do they measure and to what extent are they similar?

15. Notwithstanding their differing evolution, the basic approach to the measurement of inflation adopted by both the CPI and RPIX is the same insofar as both track the changing cost of a fixed basket of goods and services over time. The baskets are 'fixed' in the sense that the relative quantities purchased of the various items in the baskets are assumed to be constant from month to month, although the baskets are updated on an annual basis. This ensures that within-year changes in the indices reflect only changes in prices.

16. As fixed quantity indices, both the CPI and RPIX are likely to 'overstate' changes in the cost of living in that, faced with rising prices overall, consumers are likely to substitute purchases of items which become relatively expensive for those which become relatively cheaper. This will help to limit the increase in the cost of their own 'shopping basket'. A cost of living index (COLI), by contrast, would allow for substitution of this type as it takes place: so as the prices of individual items go up, and at different rates, a cost of living index will always show a lower rate of change in prices overall than a fixed basket index. But neither the CPI nor RPIX are designed specifically to be cost of living indices and in practice the difference is mitigated by annually updating the contents of the CPI and RPI baskets and the expenditure weights associated with them.

17. Despite essentially using in large part the same prices data, there are persistent and sometimes significant differences in the UK rate of inflation according to the two measures. Since January 1989, RPIX inflation has exceeded CPI inflation by an average of 0.7 percentage points and the difference can vary quite markedly.

18. These differences can be explained in terms of a series of detailed choices about how the two indices are constructed, for example:
- which particular consumers or households the index is designed to represent;
- the range of goods and services that should be included; and
- the way that their prices should be measured.

19. At a more technical level, the CPI and RPIX also use different techniques to combine together the individual prices collected each month. This also affects their respective inflation rates and is called the formula effect. These differences between the CPI and RPIX measures are summarised in Annex A.

20. Statistical credibility is of major importance for an inflation target. ONS publishes each month a numerical breakdown of the contribution of these factors to the difference between the annual rate of inflation according to the CPI and RPIX, although this is only available from January 1997. It is important to note that this period is too short to view the resulting differences as the long-run deviation between the CPI and RPIX, or the longer-term contribution to that difference from any single factor. In particular, the housing components excluded from the CPI have risen relatively rapidly over this period.

21. The analysis shows that, in practice, there are two main factors that serve to raise RPIX inflation relative to the CPI. First, the exclusion from the CPI of council tax and a range of owner-occupier housing costs included in RPIX has had the largest effect, on average lowering CPI inflation by 0.56 percentage points relative to RPIX from January 1997 to the change in inflation target at the end of 2004. Similarly, the formula effect has, on average, lowered CPI inflation relative to RPIX by 0.51 percentage points over the same period. The contribution from the housing components excluded from the CPI has varied markedly over this period, whereas the formula effect has been much more stable. On average, the impact of the other differences between the CPI and RPIX, have been less important.

22. The formula effect arises because RPIX uses arithmetic means to combine individual prices in each detailed product group whereas the CPI uses the geometric mean (GM). For given price data, the geometric mean nearly always gives a lower estimate of price change. This is because within each detailed product group the use of GM implicitly assumes that consumers switch purchases away from particular brands or varieties which become relatively more expensive, whereas arithmetic means do not. In addition, in producing a chain-linked index spanning several years, in some circumstances one of the arithmetic techniques used in RPIX can lead to a small upward bias known as 'price bounce'.

23. Although it is less familiar than RPI and RPIX, the CPI's explicit development as a macroeconomic indicator means that it has some distinct advantages over RPIX for this purpose. In particular, it benefits from greater coherence with other macroeconomic data, reflecting its foundation in National Accounts principles in determining index scope and population. The use of the GM averaging technique also has advantages, and is increasingly preferred in other countries. The GM formula is not susceptible to any bias due to price bounce and, in the context of cross-country comparisons, is much less influenced by detailed differences in index and sample design in individual countries.

24. The CPI's exclusion of most elements of owner-occupier housing costs is an outstanding issue, and lessens its relevance for some users. However, this should be put in the context of the significant difficulties encountered in measuring such costs appropriately, reflected in the absence of an international consensus in this area. The RPI's inclusion of owner-occupier housing costs partly reflects its use as a compensation index, but has necessitated some significant compromises in terms of the conceptual consistency of the index.

Owner-occupier housing costs

25. The various options for the treatment of owner-occupier costs in the RPI were last considered by an RPI Advisory Committee in 1992-94 (*Cmd 2717*). The Committee concluded that mortgage interest payments should continue to be included in the RPI and that a new component of shelter costs should be introduced to represent the cost of depreciation of owner-occupied dwellings. Depreciation was intended to represent the ongoing, though typically infrequent, major costs homeowners face in maintaining the standard of their properties[3], and it was decided that depreciation costs should be measured via a smoothed house price index.

26. RPIX excludes mortgage interest payments but includes the depreciation component, as well as a range of other owner-occupier housing costs including buildings insurance and various house purchase costs including estate agents' and conveyancing fees. RPIX also includes council tax, primarily reflecting its importance in household budgets, and the fact that it might be viewed as expenditure for specific local services received. However, from a National Accounts perspective, council tax is treated as a direct tax rather than household final consumption, and so is not included in the HICP.

27. The current treatment of owner-occupier housing costs in the RPI can be seen as a compromise in terms of the conceptual consistency of the index. The inclusion of mortgage interest payments, as a key component of actual payments made by owner-occupier households, can be viewed as important from the perspective of the income-related uses of the RPI, even though the index can be seen as acquisitions-based in most other areas. For both RPI and RPIX the measurement of depreciation costs through house prices also causes problems in that the latter are strongly influenced by land prices in the UK, which is likely to distort estimates of depreciation costs for the dwellings. Moreover, inclusion of house prices means that the index is affected by changes in the price of a major household asset, and hence a wide range of factors that determine household investment portfolio decisions.

28. An alternative approach to measuring owner-occupier housing costs is one based on the net acquisitions concept. Under this approach owner-occupier housing costs would include total expenditure on acquiring newly built or converted dwellings or existing dwellings newly acquired by the household sector (for example, purchases of council houses from local authorities). It is argued that the land element should be excluded from house purchase costs in principle in that it is a non-produced asset, whereas the focus for a consumer price index should be the acquisition of produced goods and services only, in this case the dwellings.

29. In practice, none of the house price indices currently available in the UK exclude the price of land, and this can exaggerate changes in the cost of the dwellings themselves. The impact will be significant if land represents a high proportion of overall house prices and its price moves differently from the house construction costs and construction companies' profits. Indeed, there is good

3 *Depreciation might be thought of as the costs of major repairs and renovations, with minor maintenance and decorating costs covered elsewhere in the index.*

evidence, for example at the regional level, that changes in the price of land have a strong impact on UK house prices.

30. While it is likely that the total weight of owner-occupier housing costs could be at least as large in an augmented HICP as in RPIX, the composition would be different. In particular, the weight of depreciation or major repairs and renovations would be lower in the HICP, possibly 2-2.5 per cent, compared with their current weight of 4.4 per cent in RPIX. Since major repairs and renovations would probably be measured in an extended HICP through an index of construction costs, this is likely to mean that the weight of house prices would be lower than in RPIX. Further details are given in the table below. The figures are illustrative based on the best available data.

Table 1 – Possible treatment of owner-occupier housing in the HICP compared with RPI & RPIX

	Treatment	RPIX weight (%, 2003)	Indicative HICP weight[1]
Major repairs and renovations	Represented in RPIX by house depreciation, and proxied by house prices. Represented by construction costs in HICP	4.4	2.5
Net acquisitions of dwellings	Excluded from RPIX. Represented by price of new houses and purchases from other sectors in HICP	excluded	2.0-2.5
House transactions costs	RPIX includes conveyancing fees and estate agents' fees. In addition, the HICP would also include stamp duty	0.6	1.0-2.0
Dwellings insurance	Weight in RPIX based on cost of gross premiums. HICP weight based on net premiums (i.e. net of claims paid out)	0.7	0.1
Total		5.7	5.6-7.1

[1]*Based on the net acquisitions approach. Illustrative figures using best available data.*

31. Notwithstanding the conceptual arguments, the exclusion of land prices is not regarded as essential in some other countries that include house prices in their national consumer price indices. Moreover, in countries where households often purchase plots of land separately (as distinct from a dwelling including land), it is in some cases considered important that the coverage of the national consumer price index should include land.

32. The ONS, along with the national statistical offices of Spain, Germany, Poland and Finland, has been taking part in a preliminary Eurostat pilot study to assess the possibility of including in the HICP an index of owner-occupier housing costs based on the net acquisitions approach. Under this approach, costs would also include estate agents' fees, conveyancing fees, stamp duty, dwellings insurance and major repairs and renovations, which are currently excluded from the HICP, as well as the cost of the dwelling itself (excluding land). However, there are a number of difficult implementation issues to be addressed, and this means that the longer-term outcome cannot be assessed with any certainty at this stage and the addition of owner-occupier costs to the HICP, if it happens, is likely to be some years away.

Methodological Research Programme

33. The Office for National Statistics has an ongoing programme of research to support the methodological development of its consumer price indices and this has resulted in the introduction of a number of improvements in methodology over recent years. Three changes were made to the February indices published in March 2004:

- The introduction of local probability sampling for the selection within retail outlets of some high turnover, high technology goods;
- The introduction of digital cameras into the basket of goods priced for both the CPI and the RPI. Hedonic regression will be used to produce valuations of changes in quality;
- The extension of the hedonic quality adjustment method for PCs from the CPI to the RPI.

Local probability sampling

34. Under current methods, price collectors are sent to shops with a generic item description, for example a 24"– 32" widescreen television or freestanding, 12 place setting, dishwasher. It is then the collector's task to choose for price collection the model most representative of customers' purchases in terms of sales, where possible seeking the advice of the store managers, who will know which varieties sell well. However, this is not always the case and the evidence suggests that collectors' lack of detailed product knowledge, and their brand loyalty, can result in non-representative goods being selected.

35. Market sales data indicate that this is a particular problem with high technology goods, where initial selection problems are compounded by a high rate of change in the market which limits the life of the sample.

36. Several alternative selection methods were tested and subsequently rejected. The approach that has been adopted uses local probability sampling that reflects and is operationally defined in terms of the selling patterns of a combination of attributes (e.g. for televisions these are screen size, sound quality, picture frequency etc.) rather than, for instance, model numbers, to create a representative sample. Scanner data[4] is stratified by attributes to produce a matrix of the proportion of total sales represented by each combination of attributes the latter because it yielded a low coverage rate when piloted in the field and therefore was not cost effective.

37. This matrix is then used as the reference for a Probability Proportional to Sales (PPS) scheme to select the combinations of attributes that each collector will search for. PPS gives each combination of attributes a chance of being included proportional to its total expenditure. The final sampling produces a list of six prioritised attribute groupings for each price collector. Each collector is asked to find an item matching the first attribute group on the list in their outlet, if this is not possible they move on to the second etc. They have six choices and if the sixth is not found they revert to the current method of looking for the best sold in the outlet. The appropriate attributes are identified by hedonic regression techniques which identify price determining characteristics.

38. Local probability sampling has been implemented for digital cameras, vacuum cleaners, dishwashers, washing machines and widescreen televisions.

Hedonic regression for the valuation of quality changes

39. The principle underlying the use of hedonic regression for explicit quality adjustment in a consumer prices index is that the pure price change and the quality change can be disentangled by looking at the observable relationships faced by customers between a good's characteristics and its prices. These observable relationships are measured by hedonic regression techniques that estimate the value placed by the market on individual characteristics. These valuations can then be used to estimate the difference in value between goods that are broadly similar but in their detail have different bundles of specific characteristics[5].

40. The range of goods studied initially has been systematically chosen[6] on the basis of two indicators:
- The relative expenditure share of the good or service in the RPI/CPI basket.
- The associated Implicit Quality Index (IQI.)[7].

4 *Scanner date is based on Electronic Point of Sale (EPOS) information, recorded by bar-code readers.*

5 *For more detail see "The introduction of hedonic regression techniques for the quality adjustment of computer equipment in the Producer Prices Index and the Harmonised Index of Computer Prices", Economic Trends, Number 592.*

6 *This is more systematic than the targeted intuitive approach, which has been employed by the US Bureau of Labor Statistics, whereby items are selected that are" thought a priori to have undergone quality change".*

7 *IQIs were first developed by Jorgen Dalen and Don Sellwood. They are a measure of the effect of the operational adjustments that have been made to the raw price data in order to obtain the published "quality adjusted" price index. That is the aggregate effect of adjustment, including explicit and implicit methods, to remove non-price effects and ar-*

41. The hedonic regression is calculated on the basis of a single month's data, using unweighted price data obtained from websites. When a quality change occurs, the regressions are used to estimate the prices of the original and replacement models. These are compared and used to compute prices adjusted for quality change.

42. Hedonic quality adjustment has been introduced in RPI and the CPI for PCs and digital cameras.

43. Investigations will continue to identify other items in the RPI and CPI baskets that may benefit from either local probability sampling or hedonic quality adjustment.

Concluding remarks

44. Credibility is important in choosing and compiling inflation indices, no less so than when an index is adopted for an official inflation target. In the UK, the Office for National Statistics has built up that trust based on a number a number of principles and practices:
- The codification of the institutional relationship between the Office for National Statistics and the rest of government under the National Statistics Framework Document and associated protocols defining in more detail how business is conducted, all of which are in the public domain.
- The publication each month of a detailed numerical reconciliation between the different measures of consumer inflation that it publishes.
- The publication of detailed article to promote understanding of the new target measure from a statistical perspective and in the context of the family of indices that the ONS' publishes.
- Publication of detailed articles explaining the methodological improvements to be introduced into price indices. These are published a month prior to implementation.

Acknowledgements

45. This paper draws heavily on a detailed article by Roe and Fenwick entitled "The new inflation target: the statistical perspective", which was published towards the end of 2003. The views expressed in this paper are those of the author who takes full responsibility for any errors.

Annex A: Comparing the CPI and RPIX

In terms of **commodity coverage**, the CPI excludes a number of items that are included in RPIX, mainly related to housing:
- Council tax.
- Owner occupier housing costs such as house depreciation and buildings insurance.
- House purchase costs such as estate agents' and conveyancing fees.
- Trade union subscriptions and vehicle excise duty.

Conversely, the CPI includes the following items that are not in RPIX:
- Unit trust and stockbrokers fees.
- University accommodation fees.
- Foreign students' university tuition fees.
- Foreign exchange commission for purchases of sterling by overseas visitors.

This partly reflects the differences in the **population base** for each index:
- RPIX is representative of private UK households excluding the highest income households and pensioner households mainly dependent on state benefits.
- The CPI covers all private households, institutional households and foreign visitors to the UK.

rive at the "true" price change. Relatively large IQIs for specific items may indicate areas where particular attention needs to be given to the quality adjustment techniques particularly where only implicit methods are applied.

There are also some specific differences in **price measurement** between the two indices:
- New car prices in RPIX are imputed from movements in second-hand car prices whereas the CPI uses a quality-adjusted index based on the published prices of new cars.
- The CPI classifies insurance spending net of claims receivable, whereas RPIX is based on gross premiums.

Finally**, individual prices are combined** in the CPI and RPIX within each detailed expenditure category according to different formulae:
- The CPI uses the geometric mean, which allows for the substitution of cheaper goods for more expensive goods when relative prices change.
- RPIX uses arithmetic means, which do not allow for substitution.

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The Mexican experience on enhancing CPI credibility

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Introduction

Mexico's Central Bank published its first price index with the base year set in 1927, considering 16 food items quoted in Mexico City. The coverage of the index expanded through time, and currently it is composed of more than 170,000 monthly price quotes in 46 cities, and it is published on a fortnightly basis. The inclusion of more locations and a wider selection of goods and services made the CPI a better indicator of the cost of living of the average Mexican household. In addition, several institutional factors related to the construction of the indicator improved continuously since its implementation. However, the recurring inflationary bouts experienced during the seventies, eighties and mid nineties diminished the credibility on the inflation measure.

Inflationary episodes had a negative effect on CPI credibility since they came together with a severe dislocation of relative prices and because of the differences in the consumption baskets of the population, price increments faced by different social groups diverged from the headline indicator. Furthermore, lack of transparency in the CPI construction in an environment of high inflation arose queries on its integrity and capability to measure price changes accurately.

Although CPI credibility is inversely related to the inflation level and restoring lost credibility in the indicator comes together with lower rates of inflation, an effort to disinflate would be more costly without an accompanying attempt to reestablish credibility in the measure. The strategy followed in Mexico, to enhance credibility in the statistic, was based on the establishment of a quality management system for the calculation of the indicator audited by internal and external agents, together with a heightened degree of transparency on the CPI methodology and results. This strategy benefited from the autonomy granted to the Bank of Mexico in 1993 and the successful implementation of monetary policy in the late nineties that produced significantly lower inflation levels than in the previous three decades.

The paper describes in detail the CPI evolution since its beginning to its current state, explains the mechanisms used to enhance its credibility and draws some lessons on its importance to attain a successful disinflationary process. The article is divided in four sections: the first presents a brief description of the evolution of the different price indexes in Mexico and the changes adopted in those institutional factors that have a direct impact on the quality of the CPI. The second describes the inflationary process experienced in Mexico between the seventies and nineties and its impact over the relative price of the representative consumption basket for different population groups. Some measures implemented to partially restore confidence in the CPI are also highlighted. The third section explains the strategy that Bank of Mexico adopted in order to enhance CPI credibility. The final remarks are in the fourth section.

1. Antecedents of the Consumer Price Index in Mexico

1.1. Brief history

The CPI had its first predecessor in a Food Price Index published by the Bank of Mexico with the base year set in 1927. This index used information solely on weekly retail price quotes of 16 food products in Mexico City. The construction of the index was done with a Laspeyres formula. The

1 *Respectively, Deputy Director and Director of Prices, Wages and Productivity, Bank of Mexico. We thank Lorenza Martínez and Gabriel Vera for useful comments. The views in this document are the sole responsibility of its authors and do not necessarily coincide with the Bank of Mexico.*

basket products were the following: corn, corn dough, tortillas, beans, milk, beef, bread, tomatoes, onions, sugar, bananas, rice, pork lard, coffee, eggs and pork meat.[2]

A second effort to measure the cost of living came with Mexico City's Retail Price Index, published initially by the Ministry of Economy in 1939 and later continued by the Bank of Mexico in 1950. This index had 64 generic concepts divided in five categories: cereals, fresh vegetables, processed vegetables, meats and dairy products, and clothing. The weights corresponding to each concept were derived from the National Accounts (Table 1). Another cost of living indicator published in 1939 by the Ministry of Economy was the Workers Living Cost Index. The publication of this index was also continued by the Bank of Mexico and it was composed of 23 generic concepts grouped into three categories: food, clothing and domestic service.[3]

Table 1 – CPI evolution in Mexico

Main features	Food Cost Index	Retail Price Index in Mexico City*	Consumer Price Index				
Comparison base	1929	1950	1968	1978	1980	1994	June 2nd F, 2002
Weighting base	1927	1950	1960-1963	1963	1977	1989 updated to 1993	2000 updated to June 2H, 2002
Number of prices quotes	16	64	172	172	302	313	315
Cities included	64	160	13,000	35,000	90,000	170,000	190,000
Timing	Mexico City	Mexico City	7 Cities	16 Cities	35 Cities	46 Cities	46 Cities
	Monthly from 1929 to 1974	Monthly from 1950 to 1978	Annual from 1968-1977; monthly from 1969 to 1977	Monthly from 1978 to 1979	Monthly from 1980 to 1993	Forthnightly from 1988 to June 2H, 2002	Forthnightly from June 2H, 2002 to present time

** Initially published by the Ministry of Economy in 1939.*
Source Banco de México Historical Records, Consumer Price Methodological Handbook, Banco de México.

Also, in 1939 the Bank of Mexico introduced a Wholesale Price Index, based on 600 price quotes of approximately 300 articles which yielded 210 generic concepts, divided in consumption and production articles. The Consumption Price Subindex was disaggregated in food and non-food products (clothes, shoes, electric appliances and other household products). The Production Price Subindex was grouped in raw materials, fuels and energy, and vehicles. This index became the leading inflation measure until 1968, when the CPI originally appeared. However, this indicator lacked a national perspective of the behavior of prices. Furthermore, the sample was small and based on wholesale rather than consumer prices which missed concepts such as transportation costs (FOB) and taxes and it did not include services; hence, it did not reflect adequately the cost of living of the population as a representative consumption basket would do.

Alternate cost of living indexes appeared in the late fifties, probably because of the evident shortcomings in Mexico City's Wholesale Price Index. Among these, two indicators stand out: a retail price index of 14 cities published between 1957 and 1963 by COPARMEX (an organization from the private sector where major entrepreneurs participate), and a price index for the city of Monterrey published by the "Universidad Autónoma de Nuevo León" since 1955.

The Bank of Mexico began producing the CPI on a monthly basis since 1968, presenting the first results in 1969. In its first stage, the CPI had 172 generic products and services. Price quotes were obtained from seven large cities: Mexico City, Guadalajara, Monterrey, Ciudad Juárez, Mérida, Morelia and Mexicali. The weights used to aggregate price information were estimated with the Household's Income and Expenditure Survey of 1963. Monthly price quotes were approximately 13,000 per month. In a second stage, price information from nine cities was added to the CPI yielding a total of about 35,000 price quotes per month (Table 1).

In its third stage, the CPI expanded the sample of generic concepts from 172 to 302 and the number of cities from 16 to 35. The weights for the index were updated with the Households' Income and Expenditure Survey of 1977. Monthly price quotes increased from 35,000 to 90,000. In January of 1988, using the third stage structure (base year), the Bank of Mexico started publishing the CPI on a fortnightly basis. The higher frequency of the data was a forward looking strategy to

2 *This index was published until 1974 with the same basket, then it was substituted by the CPI subindex of food and non-alcoholic beverages. The Bank of Mexico interrupted the publication of the Mexico City's Food Price Index in 1980.*

3 *The Bank of Mexico interrupted the publication of both indexes in 1980.*

unwind wage demands as part of a stabilization program adopted in the midst of an inflationary crisis (known as *Pacto de Solidaridad Económica*).

The fourth stage of the CPI was implemented in 1994, with 11 cities and 11 generic concepts added to the indicator. The weights were updated according to the results of the Household's Income and Expenditure Survey of 1989 (ENIGH 1989). Price quotes increased to approximately 170,000 per month. In its fifth and current stage, the CPI was revised with the Household's Income and Expenditure Survey of 2000 (ENIGH 2000) using June 2H, 2002 as the comparison base and the generic concepts expanded to 315.[4]

Table 2 shows the results of expenditure patterns by families obtained from several Income and Expenditure Surveys from 1963 to 2002. The data show that the consumption pattern of the population changed significantly over the years, e.g. in 1963 household expenditures in food, beverages and tobacco were 42.02 %, while in 2002 the same item went down to 23.55 %. Therefore, it is evident the need to have a constant revision of CPI weights.

Table 2 – Household expenditure composition: 1963-2002 (%)

Concepts	1963	1968	1977	1984	1989	1992	1994	1996	1998	2000	2002
Food, Beverages and Tobacco	42.02	39.44	37.39	36.57	32.20	30.38	29.41	28.24	26.89	23.20	23.55
Apparel	13.06	13.16	9.88	8.79	8.16	7.79	6.75	5.57	5.74	5.72	6.17
Housing	15.70	17.28	17.77	21.16	20.78	22.27	22.22	26.66	25.89	26.15	27.57
Housing Equipment	5.43	7.29	6.21	5.29	7.35	6.11	5.69	4.30	5.27	5.36	5.15
Medical and Personal Care	7.79	6.98	5.81	7.16	6.75	6.92	6.77	8.75	8.20	8.50	8.93
Transportation	5.85	6.56	11.30	11.49	12.85	13.76	15.19	12.56	13.68	13.72	12.26
Education	1.96	1.98	2.09	2.85	3.68	4.05	4.72	5.84	5.63	6.60	7.30
Entertainment	3.45	3.49	3.67	2.34	2.20	2.81	2.94	2.64	2.68	4.22	3.02
Other Services	4.74	3.82	5.88	4.36	6.13	5.91	6.31	5.43	6.02	6.53	5.96
Total	100	100	100	100	100	100	100	100	100	100	100

Source: National Households' Income and Expenditure Survey, Banco de México, SPP, INEGI.

The evolution of expenditure patterns in Mexico that constitute the raw data to build the CPI weight base has tended to move in the same direction as in more industrialized economies. This is, as the economy grows, larger expenditure shares are allocated towards services (transportation, education and health care) and less towards food, beverages and tobacco. In this respect, Table 3 shows international comparisons including Mexico and a group of industrialized as well as developing economies. Mexico's weights for the year 2000 seem to be similar to those of France and Japan.

Table 3 – International comparison of expenditure shares: Selected countries (%)

Concepts	Mexico 2000	USA 1996	Canada 1992/94	France 1996	Japan 1995	Haiti 1987	Honduras 1979	Equador 1995	Brazil 1986
Food, Beverages and Tobacco	23.20	12.46	17.08	21.32	25.50	49.42	45.00	32.06	35.28
Apparel	5.72	5.33	6.82	6.25	8.48	8.48	9.11	11.17	11.66
Housing	26.15	28.19	27.88	18.46	16.01	9.08	20.36	11.73	14.25
Housing Equipment	5.36	5.91	5.67	8.31	5.06	4.96	6.26	6.82	8.97
Medical and Personal Care	8.50	8.49	6.35	14.12	4.36	7.21	7.01	8.35	7.52
Transportation	13.72	17.14	17.22	14.56	13.51	8.72	3.03	9.48	10.51
Education	6.60	4.40	2.10	3.02	13.91	2.01	2.42	4.81	3.59
Entertainment	4.22	4.35	8.07	3.50	6.88	5.18	2.87	3.69	4.21
Other Services	6.53	13.73	8.81	10.46	6.29	4.94	3.94	11.89	4.01
Total	100	100	100	100	100	100	100	100	100

Source: For USA and Canada: CPI Methodological Handbooks; for France and Japan: OECD CPI Manuals; for Haiti, Honduras, Equador and Brazil: ECLAC Manuals for CPI.

In Mexico, as it happens in other countries with a high inflationary history, the release date of CPI statistics is very close to the calculation period. However, the frequency of the CPI publication in Mexico differs from most of the countries since it is done on a fortnightly basis, while the common practice is to have a monthly publication. In some countries, e.g. the United States, CPI data are published monthly only on a national basis and for the largest metropolitan areas. In contrast, the Bank of Mexico publishes fortnightly CPI statistics for the 46 locations audited in the index (Table 4).

4 *The weights obtained from the ENIGH 2000 were projected using relative prices to June 2H, 2002.*

Table 4 – CPI release date and publication frequency: Selected countries

Region	Frequency	Release date
America		
Argentina	Monthly	3 to 5 days on month that follows
Brazil	Monthly	7 to 11days on month that follows
Canada	Monthly	15 to 24 days on month that follows
Mexico	Fortnightly	8 to 10 days on fortnight that follows
United States	Monthly *	14 to 17 days on month that follows
Europe		
France	Monthly	13 to 14 days on month that follows
Spain	Monthly	11 to 14 days on month that follows
United Kingdom	Monthly	10 to 18 days on month that follows
Australasia		
Australia	Quarterly	28 days on quarter that follows
Japan	Monthly	25 to 30 days on month that follows
Malaysia	Monthly	14 to 19 days on month that follows

** CPI results are published monthly on a national basis and for the three major metropolitan areas (New York, Los Angeles and Chicago). For the next twelve major cities results are published every two months. For a third group of eleven areas results are published semi-annually.*
Source: IMF, Dissemination Standards Bulletin Board.

1.2. Institutional framework and the quality of the CPI

The institutional framework determining the construction of the CPI has undergone significant improvements since the inception of the indicator. These changes coupled with the increased coverage and higher frequency of publication had a positive effect on the quality of the CPI as an indicator of the cost of living. The main institutional factors that have been taken care of are the following:

- *Legal framework*. The absence of a legal framework that supports the attributes and responsibilities embedded in the construction of price indexes might generate a problem with potential misuses of the information. This situation, in turn, slows down the data collection process and hinders opening new information sources. In Mexico, to close this legal loophole, in 1981 Congress approved a Statistics Law which states that providing information to official agencies (such as the Bank of Mexico) in care of producing statistics was compulsory, together with the warranty of its secrecy.[5] In addition to that law, the Federation's Fiscal Code (article 20bis), since 1989, assigns to the Bank of Mexico the task of calculating and publishing the CPI.
  - As informants have the certainty that the price quotes provided to the Bank of Mexico are kept in secrecy they allow full disclosure of their pricing policies. In order to guarantee confidentiality, the Bank of Mexico publishes only the average price of the specific items that compose a generic, keeping information sources anonymous.

- *Consistency in the information sources to produce index weights*. A trustworthy continuous information source has to be used to produce the index weights. Prior to 1984 there was no systematic collection of household consumption expenditure data. The same applies to the methodological aspects of such surveys. However, since that year, the Income and Expenditure Survey (ENIGH) started to appear at regular intervals providing a higher degree of methodological consistency.

- *Representativeness*. Stale price indexes may jeopardize their reliability. Therefore, the continuous effort that the Bank of Mexico has undertaken to update the following aspects of the CPI is important to improve the quality of the indicator.
  - *Basket of items*. Including obsolete generic items or exceeding the inclusion of others that could prove of less importance diminishes the credibility on the index.

5 *"Ley de Información Estadística y Geográfica".*

  - *Weights*. Inadequate generic weights misrepresent the average consumer. Therefore, the heightened quality standards of the Households' Income and Expenditure Survey (ENIGH) have allowed the identification of changes in the consumption patterns of society and hence proceed with the rebasing of the CPI, when it is required.
  - *Information sources and brands*. Its selection is key for the CPI representativeness of the average consumer. Informants have to be convinced about the importance of supplying information to calculate the indexes. The Bank of Mexico has an ongoing training program for price auditors so that they can collect accurate information from the information sources, and it monitors continuously the appearance of new sources or products, as well as the consumption preferences over those already in the market.
  - *Price audit frequency.* Depending on the characteristics of each generic item (e.g. its price volatility), a more accurate representation of its price dynamics can be obtained with a higher auditing frequency.

- *Non-official prices indexes*. In periods of high inflation due to the lack of credibility in official data, non-official agencies tend to produce their own price indexes. The ample number of price indexes tends to generate confusion among economic agents regarding their accuracy and soundness. In this respect, in Mexico non-official price indexes arose during the period previous to the Bank of Mexico's initiating the CPI. It is important to mention that this last indicator prevailed through the modern inflationary periods.

- *Auditing Mechanisms*. The existence of monopolies or information sources that concentrate a large share of data may generate a certain manipulation of regional indicators. In addition, using advertised prices might create a bias because some of such items are subject to availability. The Bank of Mexico always carries *in situ* price audits of all CPI specific items.

- *Ethics*. Unethical behavior from statistics officers limits the reliability of the price quotes. The Bank of Mexico conducts internal and external price audits to the CPI production process to have early detection mechanisms of possible wrongdoings.[6]

- *Blueprints*. The existence of CPI construction records guarantees the continuity of price indexes within different administrations. This aspect is fully covered with all the documents that stem from the application of the ISO-9000 methodology described in Section 3.

- *Disclosure of methodology and price statistics*. Opacity produces mistrust in the quality of price indexes. Hence, the Bank of Mexico publishes all available information on the matter (specific information sources cannot be identified).

These institutional factors have increased the quality of the CPI. However, during inflationary bouts credibility in price indexes might deteriorate for a number of reasons described in the following section. This would require that an effort to attain price stability would have a higher probability of success if accompanied by a mechanism that generates a positive confidence shock in the inflation measure.

2. Inflation and CPI credibility

Inflationary bouts have a negative effect on the quality of price indexes if the auditing frequency of prices that enter in the calculation is not increased. In a high inflation environment prices change more often, therefore if the audits are kept with no change, the reliability of the index is maimed. However, doubts may arise even in cases where such strategy is followed as it is the case of Bank of Mexico where price audits were heavily increased during inflationary periods, as shown in the previous section. In fact, it may be argued that one of the reasons behind the decision to increase the CPI publication frequency in 1988 was the need to maintain the credibility in the indicator and to have a closer look at the pace in which inflation was unwinding.

High inflation rates may produce a confidence loss in the measure for another reason, since the divergence from the headline indicator of price increments experienced by different groups increases with inflation. During the early seventies, after a long period of price stability in Mexico, an extended inflationary process began. Inflation reached its historical peak in February 1988 with a record high of 179.7 percent. After this episode, a stabilization program was implemented in or-

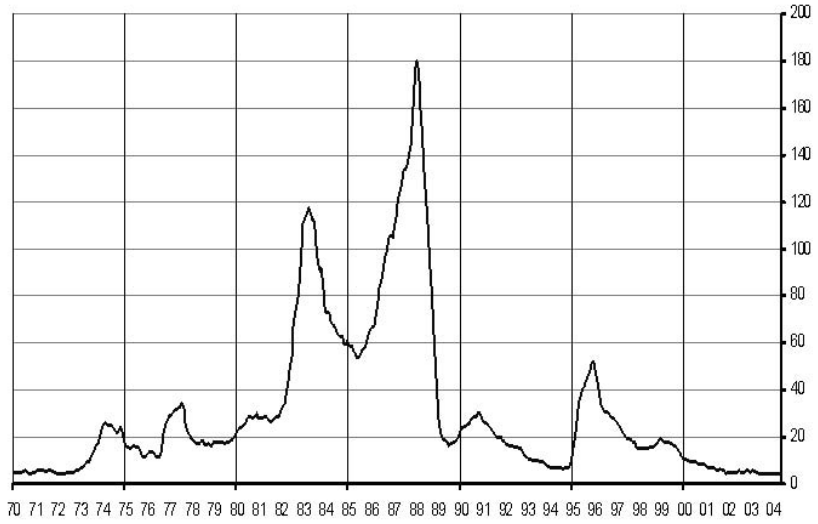
6 *See Section 3 on the ISO methodology.*

der to attain lower inflation levels. However, instability surged back with the 1994 devaluation, and by the end of 1995 inflation reached almost 52 percent (Graph 1). Since then, a new stabilization program was implemented with inflation decreasing gradually to its current level near 4 percent.

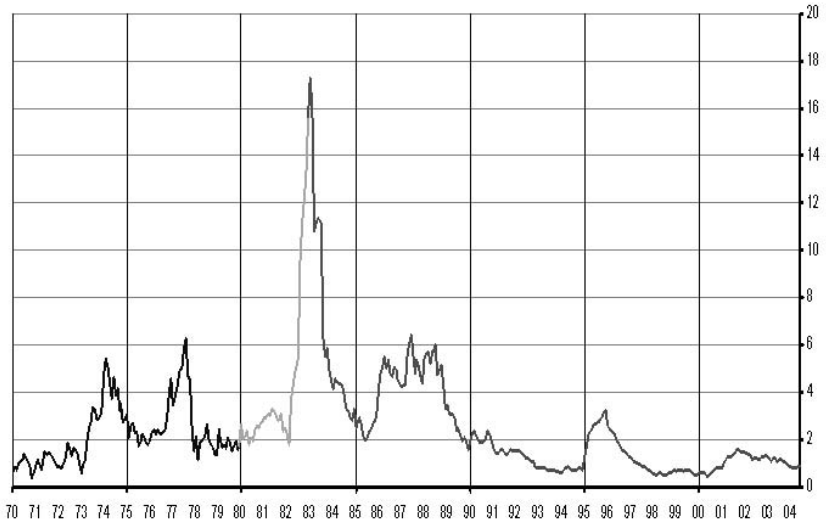
A byproduct of the recurring inflationary bouts in Mexico was volatility, since it is a known fact that a higher mean in a time series implies a higher standard deviation. Hence, inflationary episodes had the effect of increasing the differences between CPI inflation and price variations in different regions as well as individuals with distinct consumption baskets, this was particularly evident between 1982 and 1990 (Graphs 2 and 3).

This outcome has a special relevance in countries in which there are large differences in the consumption patterns across regions or social groups. In Mexico, according to the latest income and expenditure survey (ENIGH 2000) families within the first decile allocate 47 percent of their expenditure in food, while the ones within the tenth decile allocate only 15 percent. On the other hand, their expenditure in education represents 3 and 16 percent, respectively. Therefore, during inflationary episodes price increments experienced by poor and rich families have had significant differences, with the corresponding complaints on the accuracy and representativeness of the inflation indicator (Graph 4).

Graph 1 – Annual CPI Inflation (%)

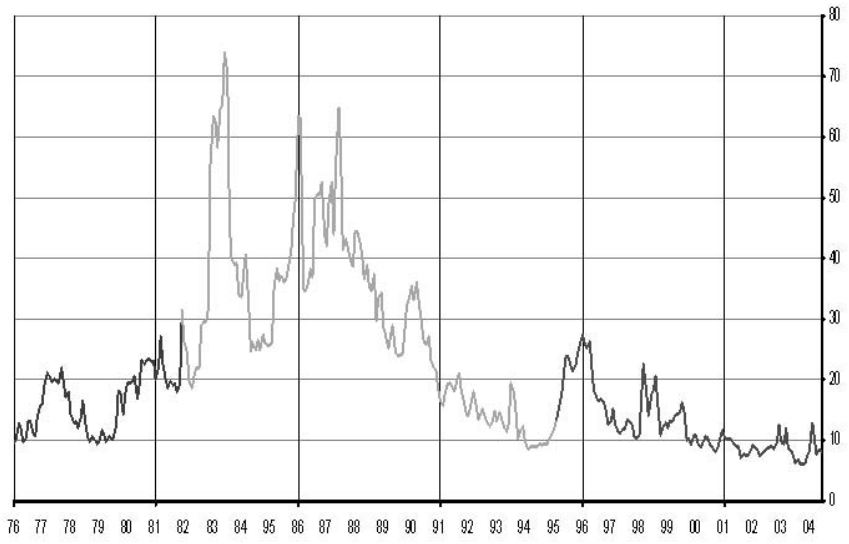


Graph 2 – Inflation volatility (Variance) between CPI locations



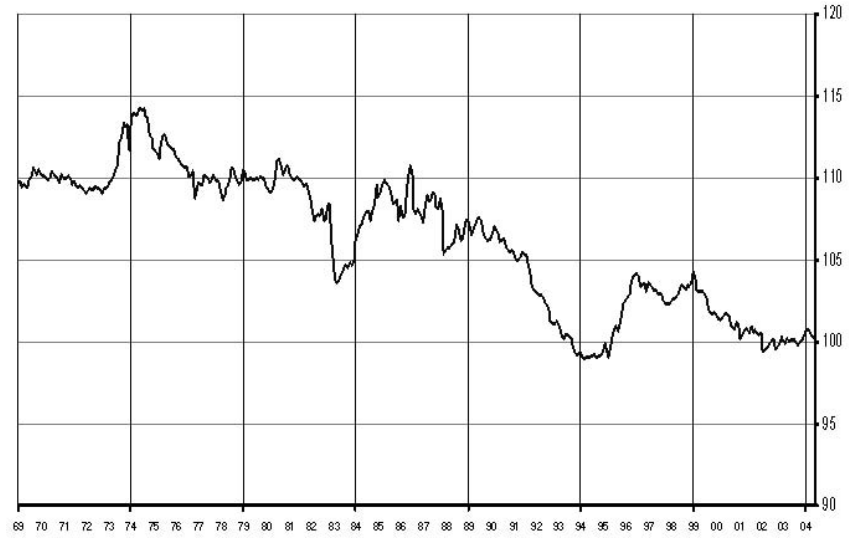
[7 cities][16 c.][35 cities][46 cities]

Graph 3 – Inflation volatility (variance) between CPI generics



[201 generics][302 generics][313 generics][315 g]

Graph 4 – Price Index of the first decile consumption basket relative to the tenth decile



In Mexico, during the eighties and early nineties the Government's official inflation forecast (GOIF) was typically below the observed annual inflation rate (Table 5).[7] The main effect of the recurring prediction error was to reduce the credibility on the Central Banks' ability and commitment to lower inflation. However, it could also damage the credibility in the inflation figures produced by the Central Bank. Then, if the general public believes that the official inflation measure underestimates true inflation, it might introduce an inflationary bias, since price, wage and contract revisions will incorporate such believes. Hence, one of the crucial aspects in a strategy aimed at lowering inflation is to restore credibility in the CPI indicator. For this purpose, the Central Bank would have to make a serious commitment warranting the CPI integrity. The next section describes the strategy that the Bank of Mexico adopted in order to produce a positive confidence shock.

7 *The Ministry of Finance (MOF) publishes its official inflation forecast for each year in the booklet "Criterios Generales de Política Económica".*

Table 5 – Annual inflation and Government's official forecast (end of year)

Year	GOIF	Observed	Year	GOIF	Observed
1984	55	59.16	1994	5	7.05
1985	35	63.75	1995	4	51.97
1986	45-50	105.75	1996	20.5	27.70
1987	70-80	159.17	1997	15	15.72
1988	95	51.66	1998	12	18.61
1989	18	19.70	1999	13	12.32
1990	15.3	29.93	2000	10	8.96
1991	14	18.79	2001	6.5	4.40
1992	9.7	11.94	2002	4.5	5.70
1993	7	8.01	2003	3 (+/- 1)	3.98

A common source of misunderstanding among the general public, during disinflationary periods, was the fact that prices continued to escalate. The effect was adverse to CPI credibility since agents that did not have a good grasp of the concept of inflation could attribute the situation to price measurement errors instead of blaming their misunderstanding of the phenomenon and failing to recognize that price increments were evolving at a slower pace. This problem was dealt by the Bank of Mexico with a significant communication effort.

3. Enhancing CPI Credibility: Transparency and ISO-9000

The first step towards bringing transparency to the CPI was taken on January of 1989, with the publication of the methodology and aggregated weights of the indicator in the "Diario Oficial" (Official newspaper of the Federal Government).[8] At that time a fortnightly presentation of the indicator was developed in order to assess the progress of the disinflationary process pursued by the Federal Government. On January 1990 average prices of each generic item together with the chaining of new products that enter the CPI calculation were released in the same publication.

On April 29th 1995 a rebasing of the index was announced in the "Diario Oficial" with the base changing from 1980=100 to 1994=100. The geographical coverage was augmented (from 35 to 46 cities to provide full state coverage of the country) and the generic items considered in the index increased from 302 to 313. On June 1995, the first publication of the CPI in the Bank of Mexico's Web Page was introduced with only 8 aggregated subindexes by consumer expenditure. Yet, more disclosure was needed on the entire contents of the CPI. On July 2000, a data bank on the particular subindexes of the 46 cities and the 313 individual generic items was published in the Bank of Mexico's Web page, together with a weight matrix for the 313 generic items that comprise the CPI.

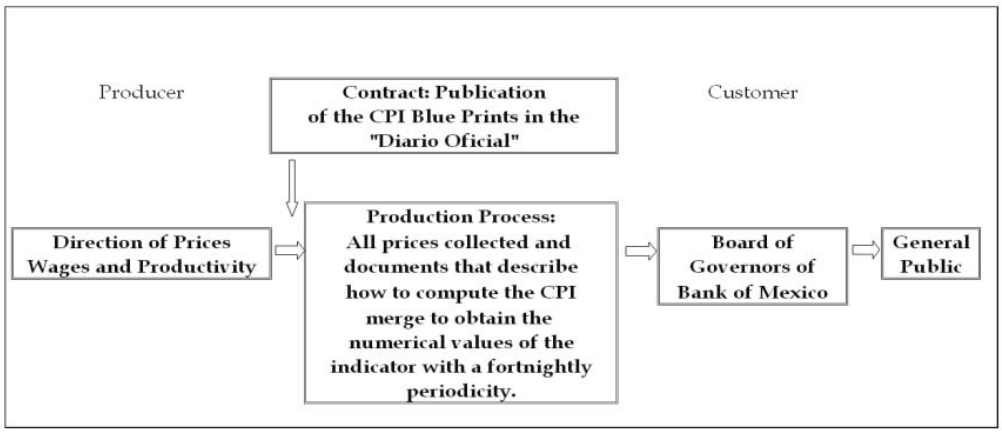
Nevertheless, a general set of procedures of how the CPI is constructed, from data collection to the final calculation of the index, was required. Working routines that would provide certainty that the information used to produce the indicator is representative and quality checked from deviations and errors. One course of action would have been to subject the available methodology to an external audit to pursue some sort of quality certification, but certainly that would not guarantee that the audited standards would hold into the future. It is clear that a given set of guidelines to calculate the CPI could deviate through time if they are not properly embedded in a system capable of revising itself and geared towards systematic improvement. Therefore, this alternative would not generate the necessary permanent positive confidence shock in the measure since it could erode through time.

This concern led to the adoption of a model like the ISO-9000 that not only provides a high standard of quality in the construction of the indicator, but also establishes an operational methodology with statistical controls, an overall improvement in the input collection process (price quotes in this case) and the appropriate working routines that specifically apply to each of the participants in the project. In addition to the aforementioned facts, technical improvement in terms of systems and equipment has been achieved and investment in human capital systematically pursued since the ISO-9000 model was implemented.

The ISO-9000 model applied to the CPI puts together the elements that involve a Producer and a Customer in a production line (similar to an industrial process) as shown in Figure 1.

8 *At that time the CPI had its base in 1978.*

Figure 1 – CPI production process



The ISO-9000 model applied to the construction of the CPI in Mexico has a Quality Policy as well as operational Objectives. In these statements the quality goals of the CPI are laid out, as well as the guidelines for further improvement of the process. The Quality Policy is the following:

> "*To provide a reliable, timely measurement of the evolution of prices at the consumer and producer levels, considering baskets representative of urban population consumption in the first case and of the industrial production of the country in the second, to provide satisfaction to the Customer and achieve a general improvement of the indicators through time*".[9]

With respect to the operational Objectives, the first two refer to the timely publication of the CPI and the PPI. The third objective is related to the design and application of statistical techniques that would guarantee the quality and consistency of the information (price quotes) used in constructing the indicators. The fourth objective requires periodical rebasing of the indexes to have representative baskets to perform price comparisons. Finally, the fifth objective calls for a general upgrade in the computational systems and computer equipment used in the process. It seems quite obvious that the correct application of the Quality Policy and Objectives will certainly lead to well built transparent indicators.

The operational Objectives related to the CPI process are met according to the following criteria:

i. CPI Release Dates.- Compulsory by law and have to be published in the "Diario Oficial" on the 10^{th} or 25^{th} day of the month or the day/days before in case the aforementioned dates are not working days.

ii. Statistical Techniques.- The statistical techniques have been developed from the generating processes of the CPI, and entail several mechanisms to maintain a given set of standards of the index, as follows:
- Price volatility analysis by city in order to determine if the monthly results are within the expected range, or else, non-recurrent events that affect such quotes might have happened;
- Failure in computational equipment or systems has to be identified in order to have the appropriate contingency strategies;
- Evaluation of the number of non conforming product (price quotes) that is refused to enter in the calculation. An inquiry is made to determine if these are of human origin or because of problems with the computational systems;
- Number of price quotes per city that are subject to a chaining procedure in a given month. The reasons for chaining are classified and analyzed;
- Given that housing (both rents and imputed cost of ownership) is the generic item with the highest weight in the CPI, it is necessary to follow closely the percentage of rents that change in a given month of the year, with a historic perspective to assess the particular situation of the housing market in a city at a given point in time;

9 *In this particular case the Customer is the Board of Governors of the Bank of Mexico who approves the publication of the indexes.*

– Construction of a catalogue of generic items to guarantee that all cities have a balanced number of specific price quotes per generic item, as well as having uniform definitions of the 315 products and services that comprise the CPI.

The statistical techniques are very useful not only to guarantee the quality of the information that enters the construction of the CPI, but also to evaluate the performance of price auditors.

iii. Rebasing of the CPI.- A general methodology to rebase the indexes was developed. This procedure is to take place every time new information is available and implies a certain deviation in the respective index weights. In the case of the CPI the basic information source is the ENIGH. The latest rebasing of the CPI took place in the second fortnight of June 2002.

iv. Improvement in the Computational Equipment and Systems.- Maintain modern informational systems and calculation platforms.

The ISO-9002 quality certificate was granted to the CPI on January of 2001. On July of the same year, the certificate was upgraded to the ISO-9001, once the Blue Prints for the rebasing of the index were finished. As mentioned before, this last project was carried out successfully on June 2002, with the new base set on the average prices of the second fortnight of the month (given that the CPI is published on a biweekly basis). Finally, on January 2003 the certificate was extended to cover the CPI under the ISO-9001:2000 model.

Carrying the CPI calculations under the ISO-9000 model has been a very constructive experience, because it has provided a homogeneous standard where all price quotes are obtained and processed under the same set of rules. All the employees working in the different stages of the process have a well defined set of manuals and working formats that apply to them. Hence, the results of the CPI computation twice a month are easier to analyze, correct and publish with the certainty that they were produced under a highly supervised process.

The ISO-9001 certificate for the CPI was granted to Bank of Mexico's Direction of Prices, Wages and Productivity for a three year period. However, this process is audited each semester by the certifying institution in order that compliance with the ISO norms is proven. Furthermore, recurrent internal audits and supervisory field trips are mandatory in order to comply with the norm. The auditing process is an instrument that strengthens credibility in the indicator.

4. Final remarks

The high inflation period experienced in Mexico from the early seventies to the mid nineties had a negative effect on the credibility of the official inflation figures. However, CPI coverage and frequency of publication were increased together with a significant improvement in several institutional determinants of the quality of the price indexes. Hence, the credibility effect was linked to high inflation, since it increased volatility among the price increments experienced by agents located in different regions or with different consumption baskets. In a scenario of high inflation, uncertainty over the reliability of the CPI statistics might produce an inflationary bias that increases the cost of attaining price stability. The strategy that Bank of Mexico implemented to build credibility in the inflation measure was based on two main elements: transparency of the information with timely publication of a full set of indicators and the ISO-9000 quality system. These mechanisms reinforced the positive confidence shock in the index that lower inflation rates provided, since the ISO-9000 system guarantees a high standard of quality, establishes an operational methodology and statistical controls.

An institutional factor which is not linked directly to the construction of the CPI but might have had a positive effect on its credibility is the autonomy that the Bank of Mexico obtained in 1993. Finally, a significant determinant in enhancing credibility on the inflation measure has been the Bank of Mexico's successful monetary policy framework which has attained low levels of inflation and compliance with the inflationary targets since the late nineties.

Abstract: The recurring inflationary bouts experienced in Mexico during the seventies, eighties and mid nineties had a negative effect on the credibility in the inflation measure. This phenomenon took place even though the Consumer Price Index (CPI) coverage was significantly increased, the frequency of its publication shortened and several institutional determinants of its quality improved. The inflationary episodes came together with a dislocation of relative prices, and because of the various consumption patterns of the population price increments faced by different groups were amplified with respect to the ones shown by the headline in-

dicator. Furthermore, in an environment of high inflation the absence of public information about the construction of the CPI arose queries on its accuracy and transparency to measure price movements. In turn, weak credibility on the reliability of the CPI might induce an inflationary bias since price, wage and contract revisions incorporate such believes; hence, credibility enhancement is an important element in a disinflationary effort. In this respect, the strategy was based on the establishment of a quality management system for the indicator that would be audited by internal and external agents together with a heightened degree of transparency on the CPI methodology and results. In addition, CPI credibility had a positive shock derived from the successful monetary policy framework that attained significantly lower levels of inflation since the late nineties. The paper makes a detailed description of the CPI evolution to its current state, explains the mechanisms used to enhance its credibility and draws some lessons on its relevance.

JEL Classification: E30, E50 and E60

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The role of the CGPI in the process of monetary policy making in China

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I. Background of the development of the CGPI

At the beginning of the 1990s, the Chinese economy rode on the fast growing trend after the sluggish crawling during 1989-1991. At the beginning of 1992, both investment and consumption gathered robust momentum, the nominal growth rates of investment and consumption reached their peaks of 61.8% and 28.4% year on year in 1993 respectively. With aggregate demand quickly expanding, the inflation rate gradually hiked up. The inflation pressures continued to build up rapidly; the CPI reached 24.1% year on year in 1994. In this juncture, the People's Bank of China (PBC), as the central bank, paid close attention to the development of prices.

As the economic reforms deepened further, the price controls over industrial materials were abandoned in the early 1990s. As a result, more and more commodities' prices started to be determined by market forces rather than government plans. In order to effectively achieve price stability, which is the ultimate goal of the monetary policy in China, sufficient information on the price dynamics is crucial. Unfortunately, the price statistics were weak and incomplete at that time.

In the early 1990s, there were just a few price indexes, such as the retail price index (RPI), the consumption price index of 25 cities, and the price index on agricultural goods traded in free markets. Incomplete price statistics made it difficult for the PBC to closely monitor developments in the general price level. As a result, the PBC had to develop the Corporate Goods Price Index (CGPI) in 1994 as a supplement to China's price statistics framework as well as a tool for obtaining information of changes in both prices and aggregate demand and supply. After almost eight years of compilation on a trial basis, the PBC formally published the CGPI on a monthly basis starting from October 2001. By now, the CGPI has increasingly attracted attention from both academia and government agencies at home and abroad.

II. The methodology of compilation of CGPI

1. The coverage of CGPI statistics

The design of CGPI basically followed three principles: first, it covers domestic products only; second, the index only covers physical commodities. Services such as telecommunication and financial services are not included. Third, property transactions are excluded because their weight is heavy but unstable. Similarly, the CGPI does not cover transactions in weapons, aircraft, ships etc.

The CGPI shares some common characteristics with PPI. Both reflect the variations of commodity prices prior to goods' entering into the final consumption market. However, there are differences between the two in that the prices are collected at different stages in the goods circulation process. For the CGPI, the prices come from wholesale transactions, and the prices usually include transportation costs and other transaction costs, such as rent, in addition to production costs. However, in the PPI prices are collected directly from producers with no transaction costs.

2. Selection of sample goods

The sample selection is a vital step in the compilation of price statistics. In PBC's statistics, the sample selection process complies with the internationally recognized methodologies. The first selection criterion is a significant volume of trade. The second one is a sufficiently long life cycle. In general, the second condition fellows the first. In practice, we selected the samples based on the information from the industrial census carried out in 1985. A total of 1400 categories of goods are included in the samples. In order to take account of shifts in market structure and allow the samples

to track new trends, we adjust the samples every five years based on the information of industrial census.

3. Calculation of weights

In the process of compilation of CGPI, we use fixed weights. The calculated weight of each sample is based on the input-output table compiled by the State Bureau of Statistics. Following the adjustments in samples, the weights are recalculated every five years.

4. Formula used

The majority of the price statistics in the world employ the arithmetic mean in calculating the price index. However, in recent years, there is a clear trend towards using the geometric mean. In practice, at the PBC we also use the geometric mean. The formula is as follows:

$$I = \prod_{i=1}^{n} \left(\frac{P_{i_1}}{P_{i_0}} \right)^{\frac{w_i}{\sum_{i=1}^{n} w_i}}$$

Here, P_{i_1} represents the price of good i on the reporting date; P_{i_0} is the price in the base period; w_i stands for fixed weight of the good. I is the CGPI index.

5. The method used in computation

In actual computation, we have to face a choice between the index approach and the price level approach. The so-called index approach is to calculate a month-to-month index for the price of each single good, then use specific weights to calculate next the level index. Based on these calculations, we get a general index of CGPI. The so-called price level method refers to computing an average price level with specific weights first. And calculating the index with two average price levels on the reporting date and in the base period respectively. Now a majority of countries adopt the index approach in the price statistics. We use the first approach in CGPI compilation.

6. Price gathering

In compiling the CGPI, prices are taken when individual goods enter the whole market for the first time. For those that don't go through intermediate transactions, prices are collected directly from the producers. In most cases, given the costs of collecting prices, prices are collected from wholesalers or at big shopping malls. In this way a large amount of prices can be collected in a short time in many cities. The prices for vegetables or grain are usually collected from free markets. Also, the prices for all the sample goods are spot prices rather than forward or futures prices. If the prices are discounted, the collected prices should be the real sale prices.

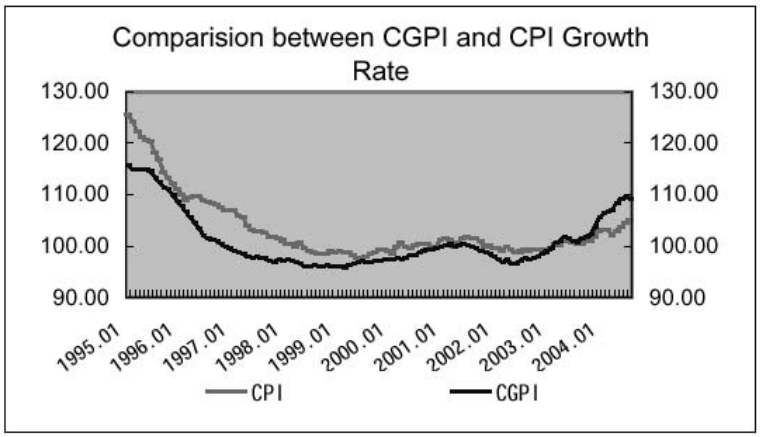
7. Operational arrangement

In the compilation of the CGPI statistics, the PBC branches play an important and active role. Their responsibilities are two-fold: identifying wholesalers from which prices are to be collected and collecting the data. For example, staff of our branches hires data-collectors who work for the wholesalers or administrative offices that oversee free-markets. Every month, these data-collectors collect prices three times, on the 5th, 15th and 25th of the month respectively, and submit the data to the PBC local branch. The PBC local branches across the country report the data to the PBC headquarters. The data is collected from 2500 wholesalers in 230 cities among 30 provinces excluding the Tibet Autonomous Region.

III. The Quantitative relationship between CGPI and CPI

Since the CPI is one of the key indexes in the price statistics framework, we should examine the relationship between CGPI and CPI to determine the usefulness of the CGPI. First, we analyzed the behaviours of the two indexes in the past decade. Since the beginning of the 1990s, China's economy has experienced two cycles: one was during the period from 1992 to 2001; the other is the one we are in right now, which began in 2002. In order to clearly identify the leading indicator between the CGPI and the CPI, we compare them in the two cyclical periods separately. In the first cycle,

the CGPI growth rate became negative 16 months earlier than did that of the CPI, as shown in the diagram below:



In the current cycle, the CGPI growth rate has fluctuated more widely than did that of the CPI. As can be seen in the above graph, the CGPI accurately reflects the build-up of inflation pressures.

Second, we tested the correlation between the two indicators. Both time series of the CGPI and the CPI are stationary as shown in Tables 1 and 2 in Appendix I. This indicates that the two time series do not contain any unit root. Therefore, we can directly examine the correlation and Grander causality between the CGPI and the CPI without co-integration test in advance. The econometric test confirms that the CGPI is a leading indicator to the CPI by around 10 months (see Table 3 in Appendix I). The causality between the CGPI and the CPI is confirmed as well (see Table 4 in the Appendix I).

IV. The role of CGPI in making monetary policy

Because the CGPI has the sound quality as a leading indicator of inflation in China, it conveys useful information to monetary policy makers at the PBC. During the first business cycle in the 1990s in China, the CGPI played a very important role in formulating the monetary policy. In April 1995, the second year when the CGPI was put in use, the month-to-month growth rate of the CGPI reduced gradually and reached zero, signalling the upward trend of price began to lose momentum. This indicated that the demand-supply picture of China's economy had radically changed and inflation pressure was gradually losing steam. Accordingly, the monetary policy should be eased. However, at the time many other economic indicators still showed signs of overheating, with the fixed investment increased by 31.5% on annual basis. Had PBC followed these economic indicators, it would have made the wrong decision by continuing the tightening.

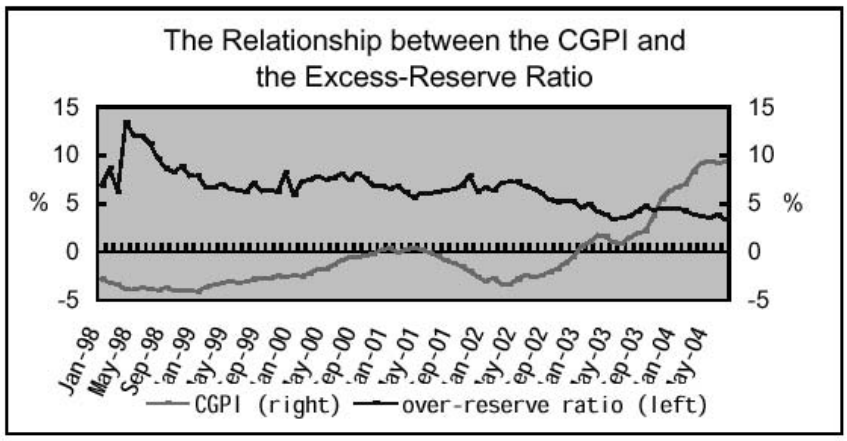
Similarly, in current cycle the CGPI has been frequently used for the monetary policy purpose as well. By the end of 2002, China's economy was in deflation, both the CPI and the CGPI decreased. While at the same time, the investment and consumption still maintained a moderate growth. By November 2002, the sub-index of the CGPI for fixed investment goods stopped decreasing and embarked on an upward path. The overall CGPI followed this trend just one month later. Since then the CGPI had gained momentum as time went by. Several months later the CPI started to pick up in speed as well. Investment and consumption increased rapidly. However, the unexpected attack of SARS disrupted the growth trend of China's economy in the second quarter of 2003, with the rapid growth of demand being tamed. The month-to-month CPI drifted from positive to negative again. However, the sub-index of CGPI for fixed investment goods kept its positive moth-to-month growth. All of these signs strongly implied that China's economy would enter a new cycle of overheating. After a careful analysis of the CGPI and other statistics indexes, PBC decided to adjust the policy stance: the required reserve ratio was raised from 6% to 7% in September 2003, and was raised again, to 7.5%, one month later. At the same time, in open market operations, the PBC increased the amount of the central bank bill issuing. During the second half year of 2003, PBC issued 65.2 billion RMB of bills and effectively reined in the fast growing bank credit.

The quantitative examination also confirms the crucial role of the CGPI in the monetary policy making at the PBC. In order to evaluate the contribution of the CGPI to monetary policy making, we have to find a quantitative indicator as a proxy of the monetary policy effectiveness. In our analysis we picked the excess-reserve ratio as the indicator. Indeed any measures in the monetary policy will impact directly or indirectly the commercial banks' excess-reserve ratio. For example,

central bank lending, rediscounting, open market operations, adjustments of the required reserve ratio and so on, all directly affect the excess-reserve ratio.

1997 marked a turning point in the PBC's monetary policy operation. Before 1997, the PBC mainly relied on lending ceilings as a monetary policy instrument. Despite its powerfulness, lending ceilings tend to result in misallocation of financial resources. After 1997, the PBC moved to using indirect policy instruments, mainly aiming to control commercial banks' excess-reserve ratio through which the PBC controls the capacity of bank lending and hence the money creation.

We investigate the relationship between the CGPI and the excess-reserve ratio since 1998, and find the following negative correlation.



The diagram shows that once the CGPI changes its growth rate there is a corresponding change in the monetary policy. When the CGPI speeds up, the PBC tightens monetary policy through reducing commercial banks' excess-reserve ratio in order to keep the CPI inside the controlling band. In reverse, when the CGPI goes downward and indicates sluggish aggregate demand, the monetary policy injects stimulus in the economy to maintain a robust growth.

The test shows that the excess-reserve ratio is a stationary time series like the CGPI (see Table 1 in Appendix II). As in the case of the CPI, we can directly examine the correlation between the CGPI and the excess-reserve ratio. Because PBC's monetary policy operation always to against the development in the CGPI, the CGPI shows a negative correlation with the excess-reserve ratio. Our analysis shows that the correlation coefficient is 0.65. In the meantime, the examination with cross-relation shows that the CGPI leads by about 5 months ahead of the excess-reserve ratio. This means there is a time lag between the variation in the growth of CGPI and monetary policy action. The PBC usually doesn't take immediate action when changes are observed in the CGPI. It takes time to see how the situation would develop before making any policy move (see Table 2 in Appendix 2). The impulse test with VAR also indicates that the excess-reserve ratio has an obvious negative response when a standard innovation is added to the CGPI (see Chart 1 in Appendix 2). However, the response is a time lag, which is consistent with the result showed in Table 2.

V. Conclusion

With the help of the econometric test we can confirm that the CGPI is a leading indicator to the CPI, which conventionally is a measure of inflation. Meanwhile, we also find the close correlation between CGPI and the excess-reserve ratio. It implies that the CGPI plays a significant role in formulating monetary policy.

Theoretically, the CGPI and the CPI show diverse leading time patterns if inflation is driven by different forces. Roughly speaking, for demand-driven variation in prices, the CPI would be a leading indicator to the CGPI, while for cost-driven inflation, the CGPI would be a leading indicator to the CPI. From this point of view, we could say that in China, in the last decade, the basic driving force to the fluctuations in prices came from the supply side, specifically from the alteration in production costs, such as labour cost and raw material cost. Furthermore, based on our findings in this paper, we could predict that the time leading relationship between the CGPI and the CPI will continue to evolve as the economic picture of demand-supply changes over time. No doubt, the role of the CGPI in the process of the monetary policy making will change as well.

Appendix I – The test on the leading relationship between CGPI and CPI

Table 1 – The test of unit root on the CGPI

ADF Test Statistic	-2.806264	1%	Critical Value*	-3.4946
		5%	Critical Value	-2.8895
		10%	Critical Value	-2.5815

**MacKinnon critical values for rejection of hypothesis of a unit root.*

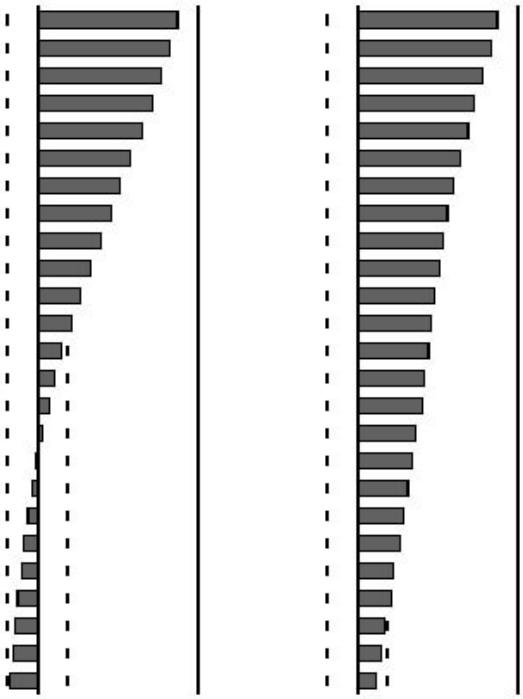
Table 2 – The test of unit root on the CPI

ADF Test Statistic	-4.359741	1%	Critical Value*	-3.4946
		5%	Critical Value	-2.8895
		10%	Critical Value	-2.5815

**MacKinnon critical values for rejection of hypothesis of a unit root.*

Table 3 – The time leading test to the CGPI

Sample: 1990:01 2004:12
Included observations: 108
Correlations are asymptotically consistent approximations



CGPI, CPI (-1)	CGPI, CPI (+1)	i	lag	lead
		0	0.9138	0.9138
		1	0.8596	0.8635
		2	0.8003	0.8158
		3	0.7391	0.7691
		4	0.6739	0.7209
		5	0.6043	0.6712
		6	0.5383	0.6279
		7	0.4730	0.5893
		8	0.4091	0.5585
		9	0.3424	0.5314
		10	0.2784	0.5068
		11	0.2201	0.4828
		12	0.1630	0.4606
		13	0.1132	0.4413
		14	0.0679	0.4184
		15	0.0278	0.3902
		16	-0.0077	0.3605
		17	-0.0353	0.3327
		18	-0.0590	0.3045
		19	-0.0820	0.2759
		20	-0.1050	0.2458
		21	-0.1249	0.2171
		22	-0.1426	0.1883
		23	-0.1604	0.1592
		24	-0.1724	0.1286

Table 4 – Grander Causality Test

Pairwise Granger Causality Tests
Date: 08/18/04 Time: 16:32
Sample: 1990:01 2004:12
Lags: 12

Null Hypothesis:	Obs	F-Statistic	Probability
CPI does not Granger Cause CGPI	96	1.34653	0.21271
CGPI does not Granger Cause CPI		2.90501	0.00255

Appendix II – The Correlation Test of the CGPI and the excess-reserve ratio

Table 1 – The test of unit root on the excess-reserve ratio

ADF Test Statistic	-3.141735	1%	Critical Value*	-3.5200
		5%	Critical Value	-2.9006
		10%	Critical Value	-2.5874

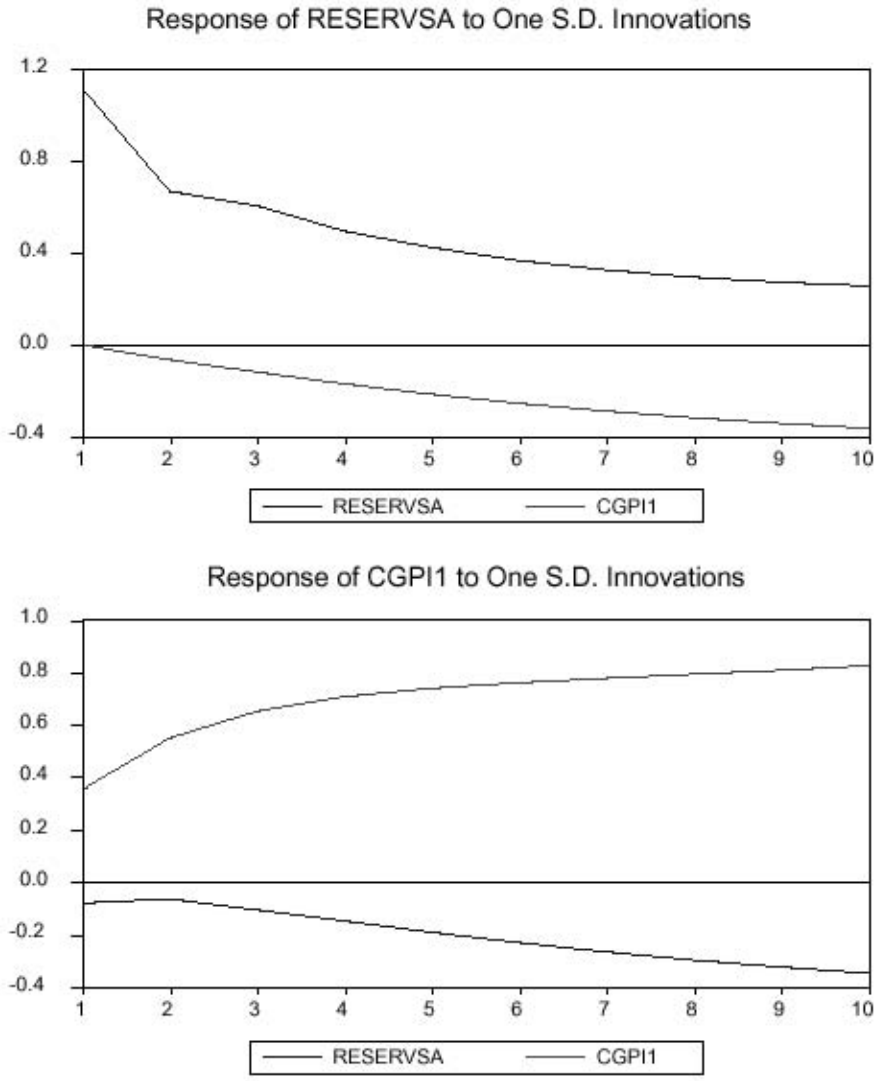
**MacKinnon critical values for rejection of hypothesis of a unit root.*

Table 2 – The time leading relationship between the CGPI and the excess-reserve ratio

Date: 08/25/04 Time: 08:39
Sample: 1998:01 2004:07
Included observations: 73
Correlations are asymptotically consistent approximations

RES_RATIO, CGPI (-1)	RES_RATIO, CGPI (+1)	i	lag	lead
		0	-0.6515	-0.6515
		1	-0.5854	-0.6405
		2	-0.5180	-0.6341
		3	-0.4538	-0.6248
		4	-0.3626	-0.6108
		5	-0.2828	-0.6097
		6	-0.2070	-0.5886
		7	-0.1437	-0.5362
		8	-0.0947	-0.4782
		9	-0.0517	-0.4123
		10	-0.0052	-0.3649

Chart 1 – Response of the monetary policy to CGPI



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Abstract: The Corporate Goods Price Index (CGPI) was established at the beginning of 1990s when China's economy witnessed painful overheating. It has continued to serve the monetary policy very well afterwards. Its predictive quality to the CPI provides policy makers an opportunity to adjust their policy stance in time. In this paper, the quantitative investigation confirms the CGPI's predictive quality to CPI and its active role in the monetary policy formation. In order to provide a complete and clear picture, the paper describes the entire process of CGPI compilation.

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Fuzzy analysis of the Zambian Overall Weekly Inflation
Measures of Headline versus Core Inflation

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1. Introduction

The concept of core inflation has been discussed widely in the literature. It is perceived as a long run concept as well as an expectational variable (Eckstein 1981, Wynne 1999). Core inflation originates from the expectations from the business and the household minds (Morana 2000). Core inflation is also defined as the highly persistent component of inflation (Bryan and Cecchetti 1994). Modeling or measurement of core inflation has received considerable attention. In Morana (2000), a measure of core inflation derived from a Markov switching ARFIMA model is used to measure core inflation in the euro area. Several other techniques have been applied in estimating core inflation and an overview of these techniques is given in Morana (2000) and Wynne (1999). Inflation has also been analysed using fractionally intergrated ARMA process (ARFIMA) which reveal the long-memory characteristic for inflation (Delgado and Robinson 1994, Hassler and Wolters 1995, Ooms and Doornik 1999). Analysis of long memory times series has also been studied using Chaos theory in Peters, (1994). Long memory implies that the past events affect movement of inflation in future. From the literature, it can be seen that the models used in estimating inflation reflect the statistical view points of inflation. Since core inflation is a long-term and an expectational variable, its evaluation is characterized by uncertainty. There are two types of uncertainty, namely: randomness and vagueness (Kruse and Mayer 1987, Peters 1999). Randomness is processed by means of probability while vagueness is dealt with by fuzzy set theory.

In this paper, vagueness of inflation is considered and fuzzy logic is applied to analyse the Zambian overall weekly inflation percentage data for the period 15/09/1993 to 18/08/04 . Fuzzy set theory provides the appropriate framework to assess the possibility of events rather than their probability (Zadeh 1978). It deals with the uncertainty or vagueness from human thought, which inherently exists in inflation. For example, when people talk about inflation, they use expressions such as "inflation is low", "inflation is moderate", "inflation is high". These expressions are characterised by vagueness and ambiguity, and are possibilistic in nature (Zadeh 1978, Tanaka and Guo 1999a).

A wide application of possibility theory exists and this includes portfolio selection (Tanaka and Guo 1999b), analysis of the mood of investors (Musongole 2002), analysis of the Zambian consumer price index (Musongole 2004), regression analysis (Kacprzyk and Feddrizzi eds, 1992), group decision making with a fuzzy linguistic majority (Kacprzyk 1986), in industry (Yen et al. 1998, Chen and Hwang 2000), economic and financial problems as well as vagueness in expected returns (Meres and Mesiar 1999, Meres 1999).

In this paper, the movement of inflation will be assumed to have three states, namely: "Low", "Moderate" and "High". The possibility distributions in form of membership functions of these states are computed by the method of extracting membership functions from historical data (Dubois and Prade 1986). Such possibility distributions will give meaning to inflation. The meaning is achieved by way of representing the compatibility of a crisp value with a fuzzy concept (Zadeh 1978, Dubois and Prade 1988) in this case the fuzzy states "Low", "Moderate" and "High". A fuzzy Markov chain to monitor the fuzzy movements of the inflation between the fuzzy states is also computed.

This paper consists of ten sections. The first section is the introduction. In the second section, the sources of vagueness and ambiguity in inflation are discussed, while in section three, the data used

in the analysis is described. In section four the fuzzy set theory and possibility theory, are discussed. The membership functions are explained in section five. A brief discussion of the necessity measure is given in section six. The possibility-probability consistency and the fuzzy Markov chains are respectively described in sections seven and eight. In section nine the findings of the analysis are presented. The conclusion of the analysis is given in the last section.

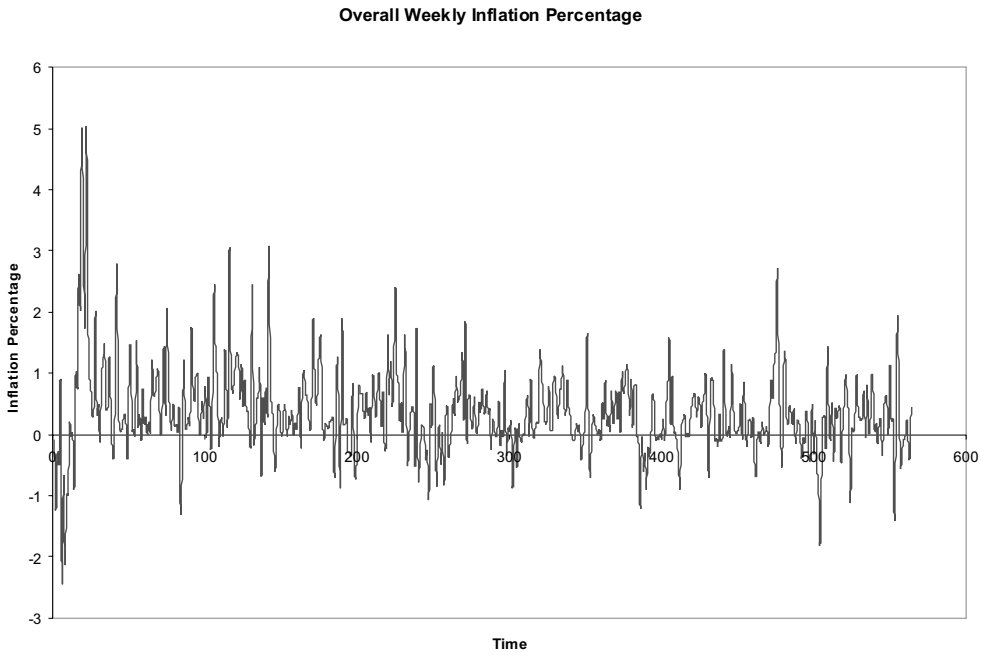
2. Sources of vagueness and ambiguity in Inflation.

In this section, the sources of vagueness and ambiguity in inflation are discussed. Vagueness in inflation comes from the verbal terms used in describing inflation for example "low inflation", "high inflation" etc. Since core inflation is described as a long run concept and expectational variable it is characterized by uncertainty and thus induces vagueness to inflation. The factors of inflation such as exchange rate, money growth etc. contribute to vagueness of inflation in that these factors may not affect inflation in exactly the same manner. Other contributors to inflation may change from time to time creating further uncertainty in inflation. In other cases reliability of inflation figures may be questionable and this is a source of ambiguity. Vagueness exists in inflation because at certain times it is difficult to completely grasp and describe the conditions behind the movement of inflation. There is also ambiguity from the unclear relationship of the Consumer Price Index (CPI) inflation and other various indicators of inflation. Contribution of CPI inflation by category is also a source of ambiguity that is the extent to which inflation is interpreted to take account of the categories is not a clear cut issue. Other sources of vagueness may include the political issues, government policy, the fiscal policy as well as monetary policy, culture of a country and public expectation on inflation.

3. Data

In this section, the data used in the analysis is described. The data comprises the Zambia overall weekly inflation percentages from 15/09/93 to 18/08/04. The plot of the data is given in Figure 3.1. The plot shows no trend and the data seems to be fluctuating around some typical value**.**

Figure 3.1. – Overall weekly inflation percentage from 15/09/93 to 18/08/04



4. Fuzzy Set Theory and Possibility Theory

Fuzzy sets were discovered by (Zadeh 1965). "The main motivation of fuzzy set theory is the desire to build up a formal, quantitative framework that captures the vagueness of human knowledge as it is expressed vial natural language" (Dubois and Prade 1991a, 1991b). Zadeh introduced fuzzy set theory to translate mental representations into computable entities to deal with some limitations of the traditional models.

The theory of possibility described in Zadeh (1978) is related to the theory of fuzzy sets by defining the concept of a possibility distribution as a fuzzy restriction which acts as an elastic constraint on the values that may be assigned to a variable. Possibility may also be interpreted as a physical measure of material difficulty of performing an action (Dubois and Prade 1988) or imprecise boundaries or fuzziness (Yager 1986). Possibility theory deals with forms of uncertainty which are not probabilistic in nature. That is, possibility theory is applied to data analysis where the problem is to deal with uncertainty due to subjective belief rather than randomness. In other words it is about modeling of partial knowledge, mainly from human thinking. However, there are some connections between possibility and probability and these are explained by the *possibility – probability consistency principle* (Moral 1986 and Zadeh 1978).

The fuzzy concept of a possibility distribution (Zadeh 1978) is appreciated once the notion of membership function is understood. The definition of a membership function is given as:

Definition 1; *A fuzzy set (Zadeh 1965) F in a given set U is characterized by a membership function* $\mu_F(u)$ *which associates with each point u in U a real number in the interval [0,1], with the value* $\mu_F(u)$ *representing the grade of membership of u in F*

The concept of possibility distribution bears close relation to the concept of fuzzy restriction (Zadeh 1978). Let *X* be a variable which takes values in a finite set *U* and suppose we have fuzzy information about the values of *X*, that is a fuzzy restriction "*X is F*", where *F* is a fuzzy subset of *U*. In this situation the fuzzy information is associated with a possibility distribution which coincides with the membership function of *F* (Moral 1986). According to Zadeh (1978) a formal definition of a possibility distribution is given as:

Definition: Let *F* be a fuzzy subset of a universe of discourse $U = \{u\}$ which is characterized by its membership function μ_F, with a grade of membership, $\mu_F(u)$ interpreted as the compatibility of *u* with the concept labeled *F*. Let *X* be a variable taking values from *U*, and let F act as a fuzzy restriction, *R(X)*. Then the proposition *"X is F"*, which translates into

$$R(X) = F$$

associates a possibility distribution, Π_x, with *X* which is postulated to be equal to *R(X),* i.e.

$$\Pi_x = R(X)$$

Correspondingly, the possibility distribution function associated with *X* (or the possibility distribution function distribution of Π_x) is denoted by π_X and is defined to be numerically equal to membership function of *F* i.e.

$$\pi_X = \mu_F$$

Thus, $\mu_F(u)$, the possibility that $X = u$, is postulated to be equal to $\mu_F(u)$. And $\mu_F(u)$ is interpreted as the degree to which the constraint represented by *F* is satisfied when *u* is assigned to *X*. Equivalently $1-\mu_F(u)$ is the degree to which the constraint in question must be stretched in order to allow the assignment of *u* to *X*.

If $A(X)$ is an implied attribute of *X* taking values in *U*, then $R(X) = F$ is written

$$R(A(X)) = F$$

In this paper, the procedure used to compute the possibility distribution of the overall weekly inflation percentages is based on extracting membership functions from a histogram and is given as follows:

Let the w_i's be reordered such that $p_1 \geq p_2 \geq .. \geq p_n$ and

$$A_j = \{w_1, w_2, \ldots, w_n\} \text{ for } j = 1, \ldots, n; \quad A_0 = \varnothing$$

The possibility distribution $\Pi_A = (\pi_1, \pi_2, \ldots, \pi_n)$ of A is such that the π_i's are computed by

$$\pi_i = \sum_{k=1}^{n} \min(p_i, p_k), \quad i = 1,2,\ldots,n$$

A detailed exposition of the procedure is given in Dubois and Prade (1986).

5. Membership Function

In this section, the membership function of a fuzzy set is described. The membership function is pivotal in the analysis of vagueness or fuzzy sets. The definition of a membership function was originally given in Zadeh (1965). The process of generating a membership function varies from situation to situation. The techniques to generate membership functions have been widely discussed in the literature (Nowakowska 1977, Zadeh 1978, Dubois and Prade 1980, Civanlar and Trussel 1986, Klir and Folger 1988, Zimmermann 1991, Ramer and Kreinovich 1994, Mares and Mesiar 1999, Tanaka and Guo 1999). A fuzzy set A, in X is denoted by $A \subseteq X$; its membership function is

$$\mu_A : X \to [0,1]$$

Informally, fuzzy sets are equated with their membership functions. When X is finite, say,

$X = \{x_1, x_2, \ldots, x_n\}$, a fuzzy set $A \subseteq X$ is written as

$$A = \frac{\mu_A(x_1)}{x_1} + \frac{\mu_A(x_2)}{x_2} + \cdots + \frac{\mu_A(x_n)}{x_n}$$

where, + is meant in the set-theoretical sense (Zadeh 1973, Kacprzyk 1986).

6. Necessity Measure

Let X be a sample space. The degree of necessity for an even $A \subseteq X$ denoted *N(A)* is defined in Dubois and Prade (1983) as follows:

Given a finite set $X = \{x_i \mid i = 1,2,\ldots,n\}$. The x_i's are ranked so that $p_1 \geq p_2 \geq .. \geq p_n$, where

$p_i = P(\{x_i\})$, $\sum_{i=1}^{n} p_i = 1$ and P is a probability measure. A_i denotes the set $\{x_1, x_2, \ldots, x_i\}$.

$A_0 = \varnothing$ by convention. The degree of necessity of an event $A \subseteq X$ is the extra amount of probability of elementary events in A over the amount of probability assigned to the most frequent element outside. That is

$$N(A) = \sum_{x_j \in A} \max(p_j - \max_{x_k \in A} p_k, 0)$$

If $A = A_i$ we get

$$N(A_i) = \sum_{j=1}^{i} (p_j - p_{i+1}), \quad i = 1,2,\ldots,i$$

Where by convention $p_{n+1} = 0$. It is clear that $N(A_i) \leq P(A_i) := \sum_{j=1}^{i} p_j$.

7. Possibility – Probability Consistency

In order to measure coherence between randomness and vagueness, possibility – probability consistency is used. The possibility – probability consistency is defined by Zadeh (1978). If a variable X can take the values $w_1, \ldots, w_n$ with respective to the possibility distribution $\Pi = (\pi_1, \pi_2, \ldots, \pi_n)$ and probability distribution $P = (p_1, p_2, \ldots, p_n)$ then the degree of consistency of the possibility distribution with the probability distribution Π is expressed by

$$\lambda = \sum_{i=1}^{n} \pi_i p_i$$

It is also described as the coherence between information provided by the possibility distribution Π, and the probability distribution P (Moral 1986).

In order to measure the relationship between subject belief about the occurrence of events and chance of events occurring, the possibility – probability consistency will be computed for the overall weekly inflation percentages.

8. Fuzzy Markov Chains

In this section the concept of fuzzy Markov chains is discussed. A detailed outline of the fuzzy Markov chain is given in Xiang (1982). Assume that the Markov chain has k states, $E_1, E_2, \ldots, E_k$. The one step transition probabilities p_{ij} are obtained by statistical estimation. In the usual Markov prediction practices, to predict the future state the system will enter is based on maximum transition probability criterion: assuming the current state is E_i, if

$$p_{ij^*} = \max_{j \in K} \{p_{ij}\}$$

where $K = \{1,2,\ldots,k\}$, the system will transit to state E_{j^*}. If

$$p_{ij^*} >> p_{ij}, \quad j \in K, \quad j \neq j^*$$

then the confidence is high to predict that the next state will be E_{j^*}, otherwise the confidence is low. For Markov chains with fuzzy states, assume a time series $X(t): x_1, x_2, \ldots, x_n$.
Let $E_i, \quad i = 1,2,\ldots,k$, be a fuzzy partition of the range in which $X(t)$ takes its values then

$$\sum_{i=1}^{k} \mu_{E_i}(x) = 1, \quad \forall x \in X.$$

It is critical to determine the initial probabilities p_i^0, $i = 1,2,\ldots,k$, for each of the fuzzy states and transition probabilities p_{ij}. Let $\tilde{n}_i$ denote the number of $x_1, x_2, \ldots, x_{n-1}$ falling into fuzzy set E_i, $i = 1,2,\ldots,k$. Define

$$\tilde{n}_i = \sum_{l=1}^{n-1} \mu_{E_i}(x_l), \quad i = 1,2,\ldots,k.$$

The quantity

$$\tilde{F}_i = \frac{\tilde{n}_i}{n-1}, \quad i = 1,2,\ldots,k,$$

is defined as the fuzzy frequency in which the fuzzy state E_i happened. The initial probability of the state E_i is

$$p_i^0 = \tilde{F}_i, \quad i = 1,2,\ldots,k.$$

Define

$$\tilde{n}_{ij} = \sum_{l=1}^{n-1} \mu_{E_i}(x_l)\mu_{E_j}(x_{l+1}), \quad i = 1,2,\ldots,k.$$

Then the transition probabilities are

$$p_{ij} = \frac{\tilde{n}_{ij}}{\tilde{n}_i}$$

For a given realization at time n, x_n, the membership function with respect to each state E_i, $\mu_{E_i}(x_n)$, $i = 1,2,\ldots,k$ denoted by $\tilde{\mu}$ is given by

$$\tilde{\mu}(x_n) = (\mu_{E_1}(x_n), \mu_{E_2}(x_n), \ldots, \mu_{E_k}(x_n))$$

Then

$$\begin{aligned} \mu(x_{n+1}) &= (\mu_{E_1}(x_{n+1}), \mu_{E_2}(x_{n+1}), \ldots, \mu_{E_k}(x_{n+1})) \\ &= \tilde{\mu}(x_n) \cdot P \end{aligned}$$

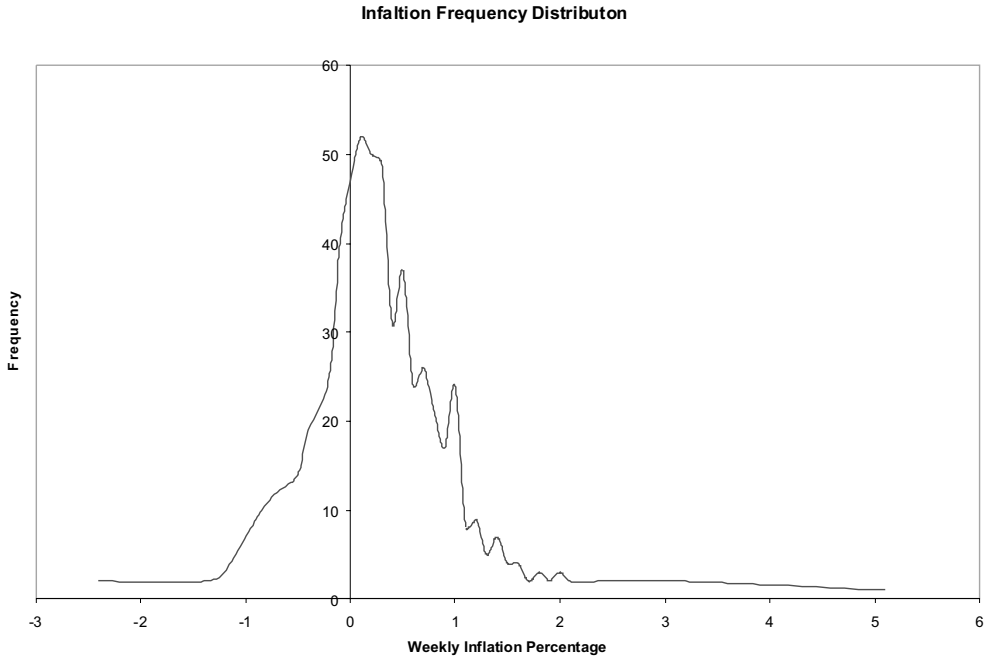
where $P = (p_{ij})_{k\times k}$.

The fuzzy Markov chain transition matrix between the fuzzy states of the overall weekly inflation percentages will be computed.

9. Data Analysis and Findings

The plot of the frequency distribution of the data is given in Figure 9.1. The data is characterized by a sharp peak and long tails.

Figure 9.1 – Frequency plot for the overall weekly inflation percentages



9.1. Fuzzy Analysis of the Overall Weekly Inflation percentages

In this section, the possibility distributions of the fuzzy states: “Low”, “Moderate” and “High” of the Zambian overall weekly inflation percentages will be computed. The overall weekly inflation percentages data are assumed to be characterized by uncertainty which is partly due to vagueness. Using the method of extracting the membership grades from statistical data (Dubois and Prade 1983, 1986) the overall weekly inflation percentages data are partitioned into the three fuzzy states: “Low”, “Moderate” and “High”. The overall possibility distribution is extracted from the frequency distribution as:

$$\pi_X = \frac{.13}{-2.4} + \frac{.13}{-1.4} + \frac{.18}{-1.2} + \frac{.39}{-.9} + \frac{.48}{-.7} + \frac{.53}{-.5} + \frac{.65}{-.4} + \frac{.77}{-.2} + \frac{.93}{-.1} + \frac{.98}{0} + \frac{1}{.1} + \frac{1}{.2} + \frac{.99}{.3} + \frac{.84}{.4}$$

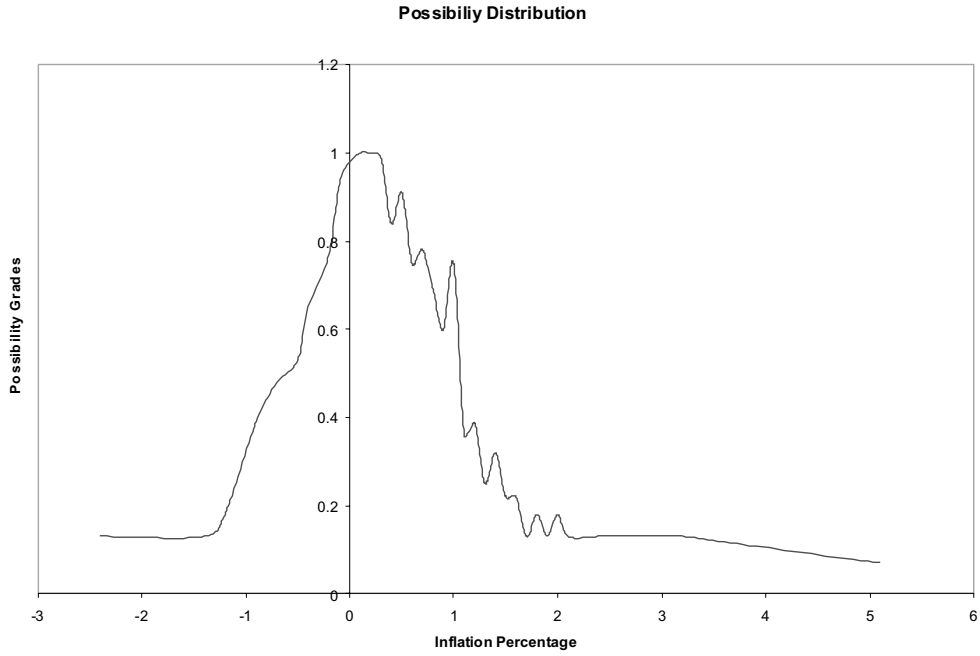
$$+ \frac{.91}{.5} + \frac{.75}{.6} + \frac{.78}{.7} + \frac{.69}{.8} + \frac{.6}{.9} + \frac{.75}{1} + \frac{.36}{1.1} + \frac{.39}{1.2} + \frac{.25}{1.3} + \frac{.22}{1.5} + \frac{.22}{1.6} + \frac{.13}{1.7} + \frac{.18}{1.8} + \frac{.13}{1.9} + \frac{.18}{2}$$

$$+ \frac{.13}{2.1} + \frac{.13}{2.4} + \frac{.13}{2.6} + \frac{.13}{2.8} + \frac{.13}{3.1} + \frac{.13}{3.2} + \frac{.07}{5.1}$$

The distribution represents knowledge and information about the Zambian overall weekly inflation percentages. According to knowledge and information obtained from the data, the inflation percentages of 0.1 and 0.2 are the most possible for the Zambian overall weekly inflation percentages. The percentage 5.1 is the least possible.

The plot of the overall possibility distribution is given in Figure 9.2.

Figure 9.2. – Possibility distribution of the overall inflation percentages



The overall possibility distribution is partitioned into three fuzzy states such that

$$\sum_{i=1}^{k} \mu_{E_i}(x) = 1, \quad \forall x \in X$$

where μ_{E_i} is the i^{th} membership function of the fuzzy state and is an observation of X and X is a time series.

The possibility distributions of the fuzzy states are obtained as follows:

$$\pi_{Low} = \frac{.87}{-2.4} + \frac{.87}{-1.4} + \frac{.82}{-1.2} + \frac{.61}{-.9} + \frac{.52}{-.7} + \frac{.47}{-.5} + \frac{.35}{-.4} + \frac{.23}{-.2} + \frac{.07}{-.1} + \frac{.02}{0}$$

$$\pi_{Mod} = \frac{.13}{-2.4} + \frac{.13}{-1.4} + \frac{.18}{-1.2} + \frac{.39}{-.9} + \frac{.48}{-.7} + \frac{.53}{-.5} + \frac{.65}{-.4} + \frac{.77}{-.2} + \frac{.93}{-.1} + \frac{.98}{0} + \frac{1}{.1} + \frac{1}{.2} + \frac{.99}{.3} + \frac{.84}{.4}$$

$$+ \frac{.91}{.5} + \frac{.75}{.6} + \frac{.78}{.7} + \frac{.69}{.8} + \frac{.6}{.9} + \frac{.75}{1} + \frac{.36}{1.1} + \frac{.39}{1.2} + \frac{.25}{1.3} + \frac{.32}{1.4} + \frac{.22}{1.5} + \frac{.22}{1.6} + \frac{.13}{1.7} + \frac{.18}{1.8} + \frac{.13}{1.9} + \frac{.18}{2}$$

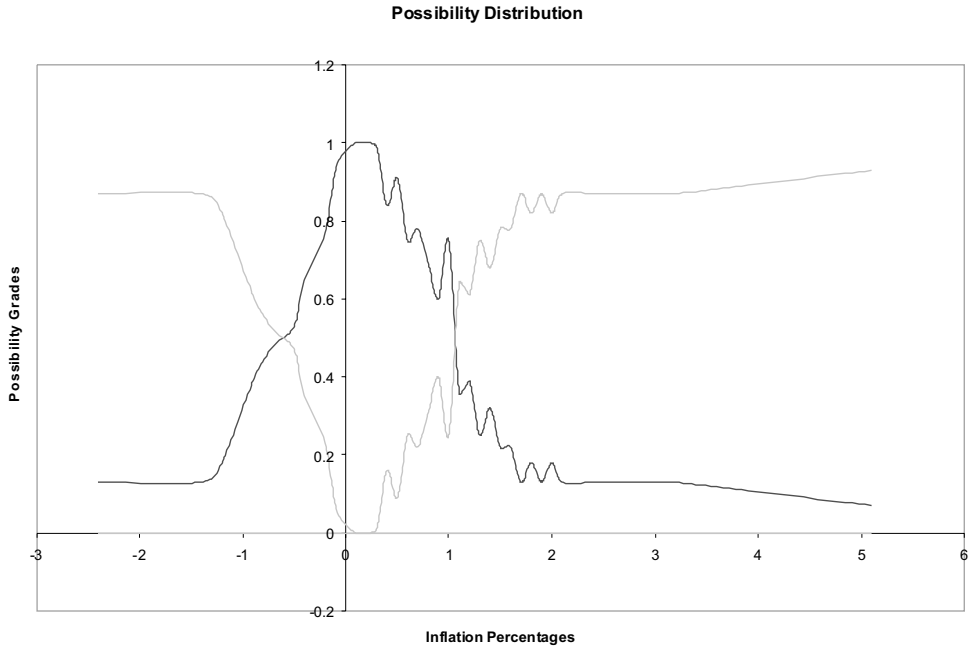
$$+ \frac{.13}{2.1} + \frac{.13}{2.4} + \frac{.13}{2.6} + \frac{.13}{2.8} + \frac{.13}{3.1} + \frac{.13}{3.2} + \frac{.07}{5.1}$$

$$\pi_{High} = \frac{.01}{.3} + \frac{.16}{.4} + \frac{.09}{.5} + \frac{.25}{.6} + \frac{.22}{.7} + \frac{.31}{.8} + \frac{.4}{.9} + \frac{.25}{1} + \frac{.64}{1.1} + \frac{.61}{1.2} + \frac{.75}{1.3} + \frac{.68}{1.4} + \frac{.78}{1.5} + \frac{.78}{1.6} + \frac{.87}{1.7} + \frac{.82}{1.8}$$

$$+ \frac{.87}{1.9} + \frac{.82}{2} + \frac{.87}{2.1} + \frac{.87}{2.4} + \frac{.87}{2.6} + \frac{.87}{2.8} + \frac{.87}{3.1} + \frac{.87}{3.2} + \frac{.93}{5.1}$$

The plot of the possibility distributions for the fuzzy states is given in Figure 9.3. The possibility distributions show that for the "Low" state, the percentage -2.4 had the highest grade of being low, while in the "High" state the percentage 5.1 had the highest grade of being high.

Figure 9.3. – Possibility distributions for the "Low", "Moderate", and "High" fuzzy states



The following table gives the probabilities (P), necessity measure (N) and the possibility – probability consistency (γ) of each fuzzy state.

Table 9.1. – Probabilities (P), necessity measure (N) and the possibility – probability consistency (γ) of each fuzzy state

States	Probability	Necessity	Possibility –Probability Consistency
Low	0.31	0	0.24
Moderate	1.00	1	0.78
High	0.51	0	0.36

The table shows that the "Moderate" state for the overall weekly inflation percentages is more frequent and certain than the other states. The overall weekly inflation percentages also have high necessity of being in the "Moderate" state. That is the "Moderate" state is more deterministic than the "Low" and "High" states. The "Low" and "High" states are prone to randomness as shown by their necessity values equal to 0. The coherence $\gamma = 1$between subjective belief about the occurrence of the overall weekly inflation percentages and their frequency in the "Moderate" state is very high, showing that subjective belief and frequency of occurrence are in agreement.

9.2. Fuzzy Markov Chain Transition Matrix

The fuzzy Markov chain transition matrix between the fuzzy states of the overall weekly inflation percentages is computed as follows:

$$\begin{pmatrix} 0.03 & 0.93 & 0.04 \\ 0.03 & 0.92 & 0.05 \\ 0.02 & 0.88 & 0.10 \end{pmatrix}$$

Where the first row and column represent the "Low" state, the second row and column stand for the "Moderate" state and the third row and column are for the "High" state. The fuzzy transition matrix shows that generally there is high probability for the inflation percentages to move to the "Moderate" state from other states. This reveals the tendency of the overall weekly inflation percentage to move to the "Moderate" state and rest there. The small transition probabilities of the overall weekly inflation percentages from the "Moderate" state to the "Low" or "High" states shows that the inflation percentages rarely left the "Moderate" state to the other states.

10. Conclusion

This paper has achieved describing the Zambian overall weekly inflation percentages using fuzzy logic techniques. The overall weekly inflation percentages were partitioned into three fuzzy states namely: "Low", "Moderate" and "High". The possibility distributions, probabilities, possibility-probability consistency and the necessity measures of each fuzzy state were computed. To investigate the fuzzy movement of the overall weekly inflation percentages, the fuzzy transition matrix between the fuzzy states was computed.

The results show that knowledge and information about the movement of the overall weekly inflation percentages was achieved by computing the possibility distributions of the fuzzy states. The computed possibility distributions represent information conveyed by the use of natural language when describing movement of inflation. The possibility grades expressing to what extent the overall weekly inflation percentages are compatible with a particular state have been revealed. Such grades reveal the subjective meaning of the overall weekly inflation percentages. The results also show that the probability of the overall weekly inflation percentages in the "Moderate" state was higher than that of the "Low" and "High" states. This shows that the movement of the overall weekly inflation percentages is predictable to be in the "Moderate" state over time. It is also shown that there is high coherence between the subjective belief and the frequency of occurrence of the overall weekly inflation percentages in the "Moderate" state. The necessity measure has revealed that the movement of the overall weekly inflation percentages has some deterministic aspect, suggesting that the movement of the inflation percentages is not purely random. The fuzzy Markov chain transition matrix, revealed that there is a tendency for the overall weekly inflation percentages to always move to the "Moderate" state and rest there. The meaning of the overall weekly inflation percentages revealed in this study may be useful in formulating policies on issues related to inflation.

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Abstract: Headline and core inflation contribute to inflation outlook. The techniques used to estimate headline and core inflation bring out their statistical view point. In this paper it is observed that the information represented by inflation should be vague in nature though the figures themselves are crisp numbers. Based on this observation, the Zambian overall weekly inflation percentages data for the periods 15/09/93 to 18/08/04 are classified into fuzzy states and analysed using fuzzy set theory. A set of membership functions associated with the fuzzy states are extracted. The possibility analysis and the necessity measures of the fuzzy states are carried out. The meaning of the overall weekly inflation percentages figures is achieved.

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WORKSHOP B

Price statistics: special topics

Chair: Hans-Peter Glaab (Deutsche Bundesbank)

Papers:

Bamking Services Price Index: an explanatory analysis for India
R.B. Barman and G.P. Samanta (Reserve Bank of India)

Measuring prices from financial instruments: Yield curve modelling
Per Nymand-Andersen, Mora Golding and Antonio Moreno
(European Central Bank)

Measuring and monitoring property prices in Hong Kong
Kelvin Fan and Wensheng Peng (Hong Kong Monetary Authority)

Monitoring property prices in the Czech Republic
Petr Vojtisek (Czech National Bank)

Discussants: Richard Walton (Bank of England)
Henning Ahnert (European Central Bank)

Banking Services Price Index: an exploratory analysis for India

R.B. Barman (Reserve Bank of India) and
G.P. Samanta (School of Management,Indian Institute of Technology)

1. Introduction

The measurement of financial services rendered by banks is still a subject of much debate. The issues in dispute relate not only to theoretical ideas, such as estimation, but also in conceptualization of banks' output set. So, it is no surprise that though banks form an integral part of any financial system and despite the importance of banks for providing services in relation to mobilizing and allocating funds in any modern economy, only a few indices for banks' financial services are available in the world[1].

There have been two related measurement issues; measuring bank services/output and estimating the prices charged by the banks to its customer. In effect, the need clearly is to present a break-up of turnover into prices and quantity/output but the task is often difficult. For output, a major problem is that the financial service output of banks is not directly countable (Fixler, 1993). Problem also lies in identifying banks' output set – primarily in resolving the input/output status of deposits. As Ricardo says, *"the distinctive function of the banker begins as soon as he uses the money of others"*[2] and indeed this aspect of intermediation as part of banking, explained by Fixler and Zieschang (1992), lies in the foundation of the difficulties encountered in measuring bank output. On the one hand, deposits have the characteristic of input because these are used to produce loans as output. On the other hand, many bank services, such as safe custody, are linked to deposit accounts. If deposits are considered as input, then all deposits-linked services, which represent final services, are not counted as part of banks' output but rather as part of the payment for inputs (Fixler and Zieschang, 1992; Fixler, 1993).

The quantification of prices of bank services, particularly those in relation to financial intermediation, is also extremely difficult for many reasons. Banks generally charge a bundle of financial services as a whole and it is difficult to derive explicitly the service-wise break-up of the total price charge. Banks also provide many apparently free services (such as those linked with deposits products) and recover cost of these services by setting the loan rate higher than the deposit rate. As a matter of fact, this interest rate spread helps banks to meet their major part of expenses and make profit.

With the above background, this paper aims primarily at examining the issues involved in constructing a price index of bank services with reference to India. The scope of the paper, however, is somewhat limited, as it focuses primarily on banks services in relation to financial intermediation. The organization of the rest of the paper is as follows. In section 2, we provide a brief account of issues and debate surrounding the measurement of banks' financial services. Section 3 discusses the available methodologies for constructing a bank output price index. Section 4 presents some empirical results in relation to banks' financial intermediation services for the Indian economy. Finally, section 5 concludes.

2. Measuring Bank Financial Services

2.1. Banks' Financial Services

A major part of earnings and profits of a bank comes from the services rendered through financial intermediation, which generally are not charged explicitly. Banks accept funds from the depositors

1 *To our best of knowledge, the official series on Corporate Service Price Index (CSPI) published by Bank of Japan has a banking component, which covers banks' direct/auxiliary services.*

2 *Taken from Fixler and Zieschang (1992), who in turn said the statement to have been quoted in Bagehot (1951, 21).*

and produce loans and advances out of mobilized deposits. In the process of intermediation, transactions take place between depositors and banks and between borrowers and banks. Banks often provide many ostensibly "free" services, which indicates that bank revenue understates the value of the financial services sold (Fixler, 1993). Banks render services to the customers by maintaining customers' accounts. A host of financial services (e.g. safe keeping of money, cheque facility, etc.) are also linked to the deposits accounts. In return for these services, customers may be charged a nominal amount, which is substantially smaller than the expenses incurred.[3] Banks cover this cost indirectly. Banks pay lower rates of interest than would otherwise be the case to those who lend them money and charge higher rates of interest to those who borrow from them[4]. As a consequence, banks provide loans and advances with the returns higher than the rate paid to the depositors. The resulting net receipts of interest are used to defray their expanses and provide an operating surplus. This scheme of interest rates avoids the need to charge customers individually for services provided and leads to the pattern of interest rates observed in practice. For these features of financial intermediation services (i.e. provided in a bundle and also charged implicitly), it is very difficult to measure them properly by any direct approach. Researchers, therefore, proposed some indirect ways of measuring them.

Banks also provide various kinds of auxiliary services, e.g. activities like currency exchange, advice on and investment, purchase of real estate or taxation, etc. In fact, in recent years banks are increasingly tending to provide these services. These services are explicitly charged for – banks earn directly from these services in the forms of fees or commissions – and can be valued easily (SNA, 1993).

2.2. Difficulties in Measuring Price and Quantity of Financial Services

A price measure should capture both direct and indirect charges made on the provided services (Eggleston, 2002). As direct services like those attached to activities in relation to currency exchange, advice on investment, etc., are charged explicitly, prices are simply equal to the actual fees/commissions charged for performing the services. But the issue is extremely complex in case of financial intermediation services, as charges of these services are not fully explicitly made. Though a part of these services are charged explicitly in the form of fees or so, the major part of the price charged remains implicit. For example, the price charged on a loan product may have two components; a payment towards, say, loan processing fee or so, and another part which is charged indirectly through the mechanism of differential interest rates for depositors and borrowers. If a bank sets the loan rate equal to the the rate paid to the depositors, then the value of the services rendered would simply be the explicit service fees charged. But in reality, the loan rate is higher than the rate depositors get. In such a case, the price of the service attached to a loan (deposit) would consist of an implicit/indirect payment and the explicit service fees charged.

For measuring bank output, it is important (i) to have a clear understanding of the means of trading "financial services" and (ii) to identify bank services which form the output set. As Fixler (1993) describes, pertinent questions in regards to the first issue are "how are financial services sold? Are they attached to the financial instruments accompanying the transaction or are they attached to the monetary units being transacted?". In the literature, both the views (i.e. transaction-based and money-based) have been used for measuring financial services output and price. Benston, et al. (1982), for instance, argue "output should be measured in terms of what banks do that cause operating expenses to be incurred". In case of banks, financial services are rendered by means of processing different documents (such as checks, accounts, deposit/withdrawal forms, etc.) and dealing with customers. In the transaction-view, all these documents are considered for measuring financial services output. Following this principle, Benston, et al. (1982) proposed a methodology for constructing a "Divisia index" of bank output using the information on the number of accounts served under five important banking services, viz., "demand deposits", "time and saving deposits", "real estate loans", "installment loans", and "commercial and industrial loans".

Bank services can also be thought of being associated with each unit of money in financial products. As Sealey and Lindley (1977) argues, though the measure of bank output in monetary units may look somewhat different than conventional output in physical terms, there is no reason why a monetary unit cannot be used as a 'physical' measure in a manner similar to physical measures used in other context, such as inches, pounds, etc. In a recent study, De Boer (1999) develops a value index for banks' FISIM and also its breakdown in volume and price indices, based on a

3 *A part of the expenses may also be met from the revenue generated through direct services rendered by banks.*

4 *A part of the mobilized deposits is kept in the form of required reserves and the rest of the deposits funds are used to produce loans and advances.*

much bigger set of quantity indicators, classified under six broad categories, viz., "mortgages", "consumer credit", "business credit", "savings", "commercial pay-transfers" and "other pay-transfer". The basic statistical data under each of these categories includes both the number of accounts/instruments (transaction-view) and the average amount of money involved (money-based view) per such accounts/instruments. But an index is ultimately constructed based on aggregate indicators derived by the multiplication of the number of physical accounts/instruments with the corresponding average money, thus assuming the total amount of money transacted as measure of output.

The "user cost approach" provides a sensible method to deal with the financial intermediation services (Hancock, 1985; Fixler, 1993). A key element in this approach has been the "reference rate" or the "opportunity cost rate" of money. The theory behind the reference rate method assumes the existence of a "pure rate of interest" in each economy, which measures the average preference of people for consuming today instead of tomorrow, and this pure rate is termed as "reference rate" (OECD, 1998). The difference between the interest rate received (paid) on loans (deposits) and this opportunity cost of money would provide a simple estimate of the implicit component of price of a loan (deposit) product. Using the same strategy, the output from financial intermediation services can also be measured.

2.3. User Cost Approach

The user cost approach takes the money-based view in measuring bank output and assumes that financial services are attached to each unit of money being transacted through a financial product. Banks sell a bundle of financial services attached to a financial product and a price is not charged separately for each individual service. Instead, pricing is made for the entire bundle of services. Thus, the total financial services output of a bank is equal to summation of all money volume in each product provided by the bank and prices are charged on each unit of money involved in each financial product. The money-based view may have a practical advantage over the transaction-based view in a sense that available public-domain bank data are generally reported in monetary terms. Fixler (1993) develops a framework for bank output price/quantity indices under user cost approach.[5]

2.3.1. User Cost of Money

By selling a financial product, banks essentially sell a bundle of services specified in a contract. Two important financial products are deposits and loans. The contract in a deposits product is standard; depositors keep some amount of money with the bank and the bank promises to pay the money on demand. The bank generally does not charge explicitly for the associated services, such as record keeping, safekeeping of money, etc. Sometimes, even if a bank charges a nominal fee or so, this amount is much lower than the actual expenses. But the provision of services does not impinge on liquidity. The natures of loan products are more variable than deposits products – the contract may vary over the type of borrower and even within the same category of borrowers depending upon the size of the loan, the associated credit risk, or so (Fixler and Zieschang, 1992).

The user cost of money is defined as the negative of the net economic revenue earned on money, and financial service prices are defined as the user cost of money involved in a financial product (Hancock, 1985; Fixler and Zieschang, 1992; Fixler, 1993). The concept of 'user cost' can be explained by a simple example. Assume a bank provides only two products, a liability, say a demand deposit, and an asset, say a loan[6]. Suppose that payment and receipt of interest take place at the end of the period and that the discount rate for the bank is ρ, meaning that ρ represents the bank's opportunity cost of money[7]. Let k denotes the reserve requirement per Rupee of deposit, s_l the service fee charged per Rupee of deposit, r_l the interest rate paid per Rupee of deposit and x_t the quantity of demand deposit between time periods t and t+1. Given that (1-k) represents the proportion of total deposits the bank can invest, the discounted net cost (negative variable profit) arising from the deposit product can be written as:

5 *Fixler (1993) argues that the same methodology can also be used for constructing transaction-based indices of bank output.*

6 *The user cost approach discussed here relies on the money-based measure of financial services. Fixler (1993) noted that a transaction-based index can also be constructed using the same method.*

7 *The opportunity cost of money (ρ) to the bank is defined from the perspective of the next best alternative use, in contrast to the typical opportunity cost of capital in finance literature, which focuses on the cost of capital as determined from its sources (Fixler and Zieschang, 1992).*

$$\frac{r_l x_t - [\rho (1-k) + s_l] x_t}{(1+\rho)} = \frac{(hc - \rho)}{(1+\rho)} x_t \quad \text{..... (1)}$$

where hc denotes the 'holding cost' and equals to $(r_l + \rho k - s_l)$. The expression $(hc - \rho)/(1+\rho)$ is the user cost of the deposit.

The user cost of an asset can be derived in a similar way. Let x_t be the Rupee quantity of an asset. Then, the net discounted cost arising from asset product, in simplified form, can be expressed as below:

$$\frac{\rho\ x_t - [\ r_a + s_a] x_t}{(1+\rho)} = \frac{(\rho - hr)}{(1+\rho)} x_t \quad \text{..... (2)}$$

where, r_a and s_a are the interest rate received and service fee charged on one Rupee of asset (say, a loan) respectively, $hr = (r_a + s_a)$ is the holding revenue and the term $(\rho - hr)/(1+\rho)$ is the user cost of financial asset.

If we ignore the discount factor and reserve requirement, user cost of a liability and assets product can be simply written as:

User Cost (Liability) = (rate paid – rate of fees income) – reference rate
User Cost (Asset) = reference rate – (rate received + rate of fees income)

..... (3)

2.3.2. Determining Input/Output Status of Financial Intermediation

The user cost approach considers all financial services as output but recognizes that financial products can play the role of "financial input" or "financial output" in the banks' financial operation. A financial product may also change its financial input/output status over time. The deciding factor of the financial input–output status of a product at any time is the user cost of the product at that time. As can be seen from Eqns. (1) - (3), user cost of a financial product may be positive or negative; the determining factor is the relationship between the holding revenue/cost and the opportunity cost of money. The sign of a product's user cost determines its financial input/output status. If the user cost is negative, then the product is a financial output because the user cost is the negative of the contribution to the revenue associated with the product. If the user cost is positive, then the product is a financial input.

It may be noted here that as the user cost approach allows a financial product to change its financial input/output status over time, the traditional problem in identifying the input/output status of deposits is resolved indirectly. Because, services attached to a deposits product (such as safe keeping of money, book-keeping) constitute a banks' output but the deposit product/contract, as a bundle of services, can be either a financial input or output.

2.3.3. Prices of Financial Intermediation Services

The user cost of a financial product determines the price of the product. As the sign of the user cost may vary over time, financial service prices are defined as the absolute value of the product's user cost. For example, if the user cost of a product in period 0 is –u and that in period 1 is u (i.e. there is only a change in the status), the value of "financial prices" in both periods is |u|, the absolute value of u/-u. Thus price change of the product from period 0 to period 1 is zero, whether or not a change in the financial input/output status of the product takes place.

In a simple case, suppose an asset that earns an interest rate r_a and a service fee s_a, and a liability that pays an interest rate r_l and charges a service fee s_l. Then ignoring the discount factor and reserve requirements, the price of the services rendered per unit of money in asset may be written as $|\rho - r_a - s_a|$ and the same for the liability will be $|r_l - s_l - \rho|$.

2.4. FISIM: Financial Intermediation Services Indirectly Measured

In the previous section, we have explained the user cost approach for pricing of financial services banks provide to their customers. It is also clear that the total value of bank output consists of two components: (i) commissions and fees (direct payments for services) and (ii) earnings from financial intermediation services. While the measurement of the first case can easily be done based on

earnings from fees and commission services, estimating the value of output of financial intermediation services is difficult. As per the conventional practice in compiling national accounts, the value added concept would be used for the purpose. However, value added from financial intermediation services must be estimated with care. As the direct charges made on these services are relatively less than the expenditure incurred, the usual procedure of estimating value added for the banking sector would produce very small or negative value added[8]. This created a paradox as it was showing a negligible positive or even negative contribution by the prospering banking sector/industry to the national product. So, pioneers of the national accounts proposed imputing an additional component to the gross output of banks, which consisted of "free services" that banks were assumed to be providing to their customers. The imputed income, equivalent to the interest and dividend receipts of banks net of interest paid to depositors, was considered to be the income earned by the banks through financial intermediation (CSO, 1989; OECD, 1998).

The System of National Accounts (SNA) 1968 retained the convention of imputation with certain modifications, such as (i) defining the imputed service charge more precisely by noting that "the property income (banks) receive as a result of investing own funds should not be taken into calculating the imputed service charge", thus restricting the imputed service charge as being generated through loans produced using only other people's money; and (ii) the imputed services charge was treated as intermediate consumption of a sector "nominal industries". In this process also, the imputed services charge had no impact on gross domestic product (GDP) as no part of the imputed charge entered into final consumption expenditure, exports or imports.

The next (and also the latest) version of SNA (i.e. SNA 1993) proposes to rectify the problem (arising out of making the imputed service charge to make no impact on GDP as per the SNA 1968 convention) by allocating the underlying service charge to the consuming sectors (enterprises, households, government, NPISHs: non-profit institutions serving households, and rest of the world). This new system (of national accounts) also gives a more precise description of the imputed bank service charge, namely, "financial intermediation services indirectly measured (FISIM)", defined as "the total property income receivable by financial intermediaries minus their total interest payable, excluding the value of any property income receivable from the investment of their own funds, as such income does not arise from financial intermediation (SNA 1993, page 140-41)". The SNA 1993 drops the word "imputed" to emphasis that just like bank services directly charged for, these free services really are being produced and consumed; the only difference being that they have to be measured by an indirect method (OECD, 1998). But the major problem in handling FISIM relates to its allocation to the different consuming sectors.

The measurement and allocation of FISIM are done by means of what is sometimes called as "reference rate method", which actually has root to the "user cost approach". In OECD (1998), an example of FISIM calculation is presented in respect to loans and deposits as below:

(i) FISIM on Loans
= Average Balance on Loans * (Effective Interest Rate on Loans – Reference Rate)

and

(ii) FISIM on Deposits
= Average Balance on Deposits * (Reference Rate – Effective Interest Rate on Deposits)

where effective interest rate on loans/deposits has been derived as the interest received/paid by bank on loans/deposits divided by the corresponding average money balance.

….. (4)

In Eqn. (4), it is clear that the FISIM estimate would be positive or negative. A negative FISIM on loans arises if the reference rate exceeds the effective interest rate on loans. On the other side a negative FISIM on deposits occurs when the reference rate is lower than the effective rate on deposits. Interestingly, it is clear to see that the expressions within the first parenthesis in Eqn. (4) actually are simplified forms of user cost (as obtained by ignoring direct payments, such as fees, commissions, etc. and also a discount factor) given in Eqn. (3). If we assume that the bank service/output is attached to each unit of money being transacted, as is the case in the "user cost approach", the FISIM on loans/deposits, so derived above, actually presents the "total user cost" of the corresponding financial product (i.e. user cost per each unit of money in the product *multiplied by* the average money balance in the product).

8 *If banks are treated like any other production enterprise, their income in the production account would be limited to the charges made on customers, which would mean that the banks have negative/small operating surplus and most likely negative/small value added (CSO, 1989).*

2.5. Difficulties in Implementing User Cost Approach and Measuring FISIM

The concepts of user cost and FISIM have intuitive appeal but pose certain difficulties for practical implementation. In this context, a pertinent question that needs to be addressed first is: When are these concepts suitable to implement? Putting it differently: Do these approaches provide reliable estimates for all economies/countries? As well documented in the literature, a necessary precondition of meaningful estimates from the 'user cost approach' is a deregulated environment in which banks behave like profit-maximizing firms, facing interest rates, which are fully market determined. Thus the estimates provided by the user cost approach would be crucially related to the profitability of the banking sector. If the risk of default is high, banks might not be willing to disburse more credit as the amount disbursed might turn into a non-performing asset (NPA). If NPAs of banks increase, the effective returns from these assets would decrease. In such situations, the banks might tend to allocate a substantial portion of their funds in approved securities. Thus, if the profitability of the banking sector decreases, returns from advances would become closer to the return from the benchmark rates and, for some periods, might be less than these rates. This would lead to a change in financial input/output status of some of the asset instruments and create problems in measurement. Thus, the user cost approach would be a good way of measuring financial products, and hence banking services, in a country where banks are run like profit maximizing firms. Thus, in a strict sense the scope of the user cost approach is limited in the context of many developing countries, where fixed/administered interest rates mechanism are in existence.

Another question has been: How do we estimate/choose the reference rate? As seen above, estimates of user cost and FISIM are sensitive to the choice of reference rate/pure interest rate and at practical level, the main hurdles for implementing these concepts, therefore, has been the estimation of the reference rate itself. A simple strategy would be to consider a suitable benchmark rate of interest as a proxy for the reference rate. Some such benchmark rates would be (i) the interest rate on short-term loans between banks (interbank rate), as suggested in SNA 1993, or (ii) the average of rates on treasury bills and notes as used by Fixler (1993) in the context of US banks. These rates relate to assets with virtually no risk and negligible transaction costs. But in practice, it is seen that the use of these "benchmark rates" as measure of "reference/pure interest rate" may lead to frequent changes in input/output status of a financial products and also may lead to highly volatile or even negative FISIM. To reduce the severity of this problem, some researchers (Collins, 1993; OECD, 1998) have suggested to use the average of "interest rate earned on all assets" and "interest rate paid on liability products" as the "reference rate". In his empirical study for India, Samanta (2003) also reports that use of such an average interest rate as "reference rate", eliminates/reduces volatility in financial input/output status of financial products to a considerable extent.

3. Bank Output Price Index

A bank output price index should have two basic components, one for auxiliary/direct services and the other for intermediation services. So, a sensible strategy would be to construct indices separately for each component and then combine them to arrive at a single overall/composite index. In the combined index, allocation of total weight (100.00) to two components (i.e. direct services and intermediation services) would be made proportional to the contributions of the components to total income of the banking sector.

For direct services, the production price index would be constructed easily following the methodology adopted for the goods sector. But the construction of a price index of financial intermediation services is a challenging task.

3.1. Price Deflators for Financial Intermediation Services

The behaviour of prices charged on financial intermediation services can be analysed based on an implicit price deflator, derived as the ratio of bank output measured in current price and the output measured in constant price. So, the task here has been the measurement of bank output and as seen above, the task is extremely difficult. Traditionally, the problem was solved by developing certain production or price indicators. For example, till the end of 1980s, the US Bureau of Economic Analysis (BEA) used one such indicator for conversion of gross product originating in the banking sector from current prices to constant prices (see Srimany and Bhattacharya, 1998, for a discussion). Output at constant prices was obtained by extrapolating the benchmark value by a factor based on the number of persons engaged in production, assuming no labour productivity growth in banking.

An alternate strategy can be devised from the FISIM literature. As proposed in OECD (1998), we can have FISIM at both current and constant prices and an implicit price deflator would be derived as the ratio between current price FISIM and constant price FISIM.

3.2. Bank Output Price Index Under User Cost Approach

In recent years, the "user cost" approach is frequently discussed for constructing an index of financial intermediation services rendered by banks. Fixler (1993) proposed a method for constructing a price index of financial intermediation services using the concept of user costs of money. Though this method has the advantage of deriving both quantity and price indices, we concentrate here only on price index.

3.2.1. Coverage, Price Relatives and Weighting Diagram

In order to construct a bank output price index, first of all the output set needs to be defined. As per the user cost approach, all bank services are output but the financial product, consisting of a bundle of services, can be either a financial input or a financial output in the banks financial operation. Thus, for constructing the price index, one may cover all financial products (say deposit product, loan product, etc.) banks sell in the process of financial intermediation.

Now if x_a and x_l are amounts (each having a sign opposite of the sign of the corresponding user cost) of asset and liabilities respectively. If we ignore the discount factor, the price charge on each unit of money in asset products is $(|\rho - r_a - s_a|)$ and on each unit of money in liability products is $(|r_l - s_l - \rho|)$ implying that the contribution of these asset and liability products to banks' "variable profit[9]" or "net revenue" would be $(|\rho - r_a - s_a| x_a)$ and $(|r_l - s_l - \rho| x_l)$, respectively. Thus, the total contribution of all financial intermediation services to the variable profit of a bank can be calculated by adding the contributions of all asset and liability products served by the banks. In other words, the total contribution π may be expressed as:

$$\pi = j\Sigma\, |\rho - r_a^j - s_a^j|\, x_a^j + \Sigma k\ |r_l^k - s_l^k - \rho|\, x_l^k \qquad \ldots\ldots (5)$$

where x_a^j and x_l^k amount in rupees (as stated above signs are adjusted according to the signs of user costs) of j-th asset products and k-th liability products of the bank respectively; r_a^j and s_a^j are interest rate earned and service fee charged on one Rupee of j-th asset product; r_l^k and s_l^k are interest rate paid and service fee charged on one Rupee of k-th liability product, ρ is the opportunity cost and S_j and S_k denote summation over all assets and liabilities, respectively.

The "price relative" of a product is simply the ratio of the price of the product in the reference period and the base period. The weight of a "price relative" (associated with a financial intermediation services/products) is proportional to the share of the product in "net financial revenue". For example, from Eqn. (5), the weight of the j-th asset would be $(|\rho - r_a^j - s_a^j|\, x_a^j)/\pi$. These weights can be calculated at different time point following the same technique.

3.2.2. Index Number Formula

Given the price relatives (of various financial products) and their weights, one can derive price and quantity indices. Actually, here the price index is estimated first. Then using the price index and the factor reversibility condition, the quantity/output index is derived. If we have n financial intermediation services/products and if we define x_{jk}, p_{jk} and w_{jk} as amount (in Rupees), financial price and weight of j-th financial product (asset or liability) respectively in k-th period, k=0,1,2,3, ….; j=1,2,3, …., then the index number at time t (with period 0 as base) can be derived by using a suitable aggregation rule. Various alternative index number formulae can be used, the choice ranges from the Laspeyres/Paasche formula to the geometric mean/Fisher Ideal Index to some forms of superlative index, such as the Törnqvist Index. The literature in the user costs approach, however, gives preference to the superlative Törnqvist Index. The price index (with base period '0') is defined as:

$$I_{0t}(price) = \prod_{j-1}^{n} (p_{jt} \,/\, p_{j0})^{(w_{jt} + w_{j0})/2} \qquad \ldots\ldots (6)$$

9 *Variable profit is defined as bank's revenue less variable cost (Hancock, 1985; Fixler, 1993). The variable profit function is defined on production possibility set which includes financial variables as well as non-financial inputs, viz., number of employees and officers, premises and fixed assets, etc.*

The formula given in Eqn. (6) provides a simple index (for time period t with base period '0'). One may also derive chain-indices by multiplying successive period-by-period simple indices (Fixler and Zieschang, 1992; Fixler, 1993).

4. Estimates with Reference to Indian Economy

In this section, we estimate the price index of banks' financial intermediation services with reference to India. We ignore the index component corresponding to the auxiliary services of banks, as no useful data on this component is available in the public domain. The basic methodology adopted for measuring financial intermediation has been the method suggested by Fixler (1993) based on the "user cost approach".

In India, prior to the recent economic liberalization, most of the rates were administered. The banks – in particular, the public sector banks – were forced to keep a substantial portion of their fund in treasury bills and approved securities and also had to lend a good portion of their fund to the priority sectors. In the new era of sweeping economic reforms that were initiated in the late 1980s and accelerated in the 1990s, particularly after the deregulation of interest rates in almost all segments of the financial market, the user cost approach is likely to provide reasonably good estimates of financial intermediation services in India, though the proposition needs to be validated empirically. But, as indicated by Samanta (2003), we are severely constrained on the task as required dis-aggregated level time series data (with reasonably high frequency) are not available at present. In what follows, however, are estimates based on published data, though we do recognize that much improved estimates would be provided once the data gap is removed.

4.1. Basic Data on Bank Financial Intermediation Services

The source of our basic data on banks financial intermediation activities is the published balance sheets/annual accounts of "scheduled commercial banks (SCBs)", thus data frequency is annual. This information is available in various issues of "Statistical Tables Relating to Banks in India", published annually by Reserve Bank of India (RBI). Basic data pertain to 11 financial years; from 1991-92 to 2001-02. The categories of SCBs are "State Bank of India and its Associates", "Nationalized Banks", "Foreign Banks" and "other SCBs except Regional Rural Banks (RRBs)". We exclude RRBs for the sake of computational simplicity. The number of banks in our sample differs in different years and varies from 74 (in 1993-94) to 104 (in 1998-99).

While estimating various parameters, we face several problems due to data limitations. A major difficulty lies in the non-availability of direct measures of "rate of interest paid on liability products" and "interest rate received on assets". Instead what is available in the database is "total interest earnings (interest expanded) for certain categories of assets (liabilities)". A data gap also exists in case of fee income or commissions earned – available data pertain to bank-level information without any product-wise break-up for each bank. With the lack of any direct information, required interest rates have to be derived indirectly from the available data. One solution to the problem has been to divide interest earnings (paid) in asset (liability) product by money balance in corresponding financial product. But still a difficulty that remains is that while interest earnings/expended represent flow variables, the data on money balances represent stock variables (positions as on the end of each financial year). Thus, the interest rate would be better estimated by dividing total interest earnings/expended during the year by average money balances in the corresponding financial product during the year. But in the available database, we get only one outstanding figure each year (i.e. as on end of the year). We, therefore, adopt a simple averaging strategy. For estimating average outstanding money amount in the year t, we derive simple arithmetic average of outstanding in the end of years (t-1) and t. We then divide interest earnings/expended during a year by corresponding average outstanding money balance. Thus proxy for interest rate received from assets or paid on liability product is derived below:

$$\text{Interest Rate in Year t} = \begin{cases} \dfrac{\text{Interest Earnings in Year t}}{\frac{1}{2}[\text{outstanding in Year t} + \text{outstanding in Year (t-1)}]} & \text{for Asset Product} \\ \dfrac{\text{Interest Expended in Year t}}{\frac{1}{2}[\text{outstanding in Year t} + \text{outstanding in Year (t-1)}]} & \text{for Liability Product} \end{cases} \quad \ldots\ldots (7)$$

Another data limitation pertains to the mis-match between the level of disaggregation for outstanding money balances on different asset/liability categories reported and that for interest earning/paid on assets/liabilities. It is seen that, data on outstanding money balances are available with finer disaggregation levels. So, we are left with using the disaggregation levels at which data on interest earnings/expended are available. From this consideration, we consider three categories of asset products, viz., "advances and bills discounted", "investments" and "balances with RBI[10] banks". We denote these assets categories by "advances", "investments" and "balances", respectively. For liability products, two categories, namely, "deposits" and b"orrowings from RBI/banks" are considered and are denoted by "deposits" and "borrowings", respectively. In Table 1, we provide the estimated rate of interest received/paid (in per cent) on these categories of financial products. For a financial product, the overall interest rate in a year is the weighted average of the corresponding bank-wise estimates in the year, weights being proportional to the average money balances. Thus, if $O_j(t)$ denotes average money outstanding/balance on the financial product for j-th bank in year t, weight for j-th bank is:

$$\omega_j(t) = [O_j(t) / \sum_{j=1}^{m} O_j(t)]\,; \text{ with } \sum_{j=1}^{m} O_j(t) = 1$$

where m denotes the number of banks under consideration in year t. Then, denoting $E_j(t)$ as the interest earnings/expended by j-th bank in year t, the estimate of overall interest rate on the financial product is as below:

$$\text{Overall Interest Rate } (t) = \sum_{j=1}^{m} \omega_j r_j(t), \text{ with summation of weights } \omega_j \text{ 's is 1.}$$

$$= \sum_{j=1}^{m} \left(\frac{O_j(t)}{\sum_{j=1}^{m} O_j(t)} \right) \left(\frac{E_j(t)}{O_j(t)} \right)$$

$$= \frac{\sum_{j=1}^{m} E_j(t)}{\sum_{j=1}^{m} O_j(t)} \quad \ldots. (8)$$

From Eqn. (8), it is clear that the overall interest rate on a product can also be estimated simply by taking the ratio of "total interest earnings/expended on the product by all select banks" and "total of average outstanding money balances on the product by all select banks". Relevant estimates are presented in Table 1. Note that though basic data are available since 1991-92, for the averaging scheme described above, we have estimated rates of interest only for the years 1992-93 onwards.

10 *The word RBI denotes Reserve Bank of India, which is the central bank in the country.*

Table 1 – Estimated interest rates on asset/liability products

Year	Financial products				
	Liability products		Asset products		
	Deposits	Borrowing	Advances	Investments	Balances
1992-93	8.16	11.00	12.98	11.96	9.45
1993-94	7.45	5.97	11.98	10.43	6.10
1994-95	6.82	8.29	11.73	11.52	5.23
1995-96	7.31	9.56	13.50	11.63	5.04
1996-97	8.19	5.36	14.48	11.68	4.88
1997-98	7.91	7.65	12.83	12.08	5.11
1998-99	8.04	7.20	12.32	11.90	6.18
1999-00	7.68	7.03	11.69	11.69	5.95
2000-01	7.34	7.00	11.43	11.13	6.44
2001-02	7.14	4.56	10.13	10.62	7.68

4.2. Choice of Reference Rate

The choice of "reference rate" can be made from many alternative "benchmark rates", viz., "bank rate (BR)", "average call money rate (Call)", cut-off yield rates of 91-day and 364-day treasury bills. Moreover as per the recent literature, the weighted-average of estimated rates paid/received on chosen liabilities and assets would be another sensible alternative for representing "reference rate". Prior to the economic reforms in the 1990s most of the rate were administered and hence were not market related. In fact, in India, the auction system for 364-day and 91-day treasury bills (T. Bills) started in April 1992 and January 1993 respectively (Reserve Bank of India Bulletin, November 1996, pp. 591-92). In our empirical exercise, we consider three alternative choices/proxies for a reference rate: two benchmark rates, viz., bank rate, cut-off yield on 364-day T. Bills and a average rate derived as the weighted-average of rates on asset and liability categories (i.e. three asset categories and two liability categories stated above), weights being proportional to the average outstanding money balances derived above. Henceforth, we call this proxy as "weighted-average rate".

Variations in different alternative proxies for a reference rate are given in Table 2. From this table, certain characteristics of alternative rates are noticeable. First, benchmark rates, at times are too high and generally are more volatile than the weighted-average rate. This phenomenon indicates the innate difficulty of having a stable, market-related benchmark rate in India. However, (as reflected in Table 2) the use of "weighted-average rates" (i.e. weighted average of rates received/paid on different categories of asset/liability products discussed earlier) would have reduced the volatility in reference rate to a considerable extent.

Table 2 – Alternative Benchmark Interest Rates

Year	Proxy for Reverence Rate				
	Bank Rate*	Average Call Money Rate	Yield Rate on 91-Days T.Bills	Yield Rate on 364-Days T.Bills	**W**eighted-Average Rate#
1992-93	12.00	14.42	10.04	11.23	10.13
1993-94	12.00	6.99	8.87	11.06	9.00
1994-95	12.00	9.40	9.17	10.15	8.83
1995-96	12.00	17.73	12.67	12.87	9.56
1996-97	12.00	7.84	9.67	11.67	10.12
1997-98	10.21	8.69	6.83	7.15	9.78
1998-99	9.00	7.83	8.56	9.52	9.72
1999-00	8.00	8.87	9.03	10.09	9.36
2000-01	7.62	9.15	8.97	9.76	9.08
2001-02	6.83	7.16	6.95	7.30	8.56
Variation	6.83 to 12.00	6.99 to 17.73	6.83 to 12.67	7.15 to 12.87	8.56 to 10.13

4.3. Estimated User Costs/Prices of Different Financial Intermediation Products

The user costs of different asset and liability products are calculated ignoring the discount factor mainly for making compatibility with what is generally the practice for estimating FISIM. We also ignore the direct component or the price (i.e. fees, commissions, etc.) due to non-availability of information in required details. The expression for user costs used for our empirical calculations are as below;

$$\text{User Cost} = \begin{cases} \left(\text{Reference Rate} - \dfrac{\text{Interest Earned}}{\text{Average Money Balance}} \right) & \text{for an Asset Product} \\ \left(\dfrac{\text{Interest Expended}}{\text{Average Money Balance}} - \text{Reference Rate} \right) & \text{for a Liability Product} \end{cases} \quad \ldots\ldots (9)$$

Table 3 – Estimated User Costs of Different Financial Products

Year	Financial Products				
	Liability Products		Asset Products		
	Deposits	Borrowings	Advances	Investments	Balances
(A) Proxy for Reference Rate: "Bank Rate"					
1992-93	-3.8448	-0.9980	-0.9801	1.0360	2.5511
1993-94	-4.5451	-6.0279	0.0143	1.5673	5.8956
1994-95	-5.1822	-3.7042	0.2728	0.4822	6.7651
1995-96	-4.6869	-2.4428	-1.4995	0.3733	6.9628
1996-97	-3.8062	-6.6444	-2.4761	0.3198	7.1233
1997-98	-2.2951	-2.5625	-2.6197	-1.8745	5.1016
1998-99	-0.9560	-1.8030	-3.3203	-2.8977	2.8198
1999-00	-0.3215	-0.9698	-3.6905	-3.6911	2.0486
2000-01	-0.2776	-0.6188	-3.8131	-3.5105	1.1787
2001-02	0.3066	-2.2731	-3.3018	-3.7915	-0.8506
(B) Proxy for Reference Rate: "Yield on 91-days Treasury Bills"					
1992-93	-1.8848	0.9620	-2.9401	-0.9240	0.5911
1993-94	-1.4151	-2.8979	-3.1156	-1.5627	2.7656
1994-95	-2.3522	-0.8742	-2.5572	-2.3478	3.9351
1995-96	-5.3569	-3.1128	-0.8295	1.0433	7.6328
1996-97	-1.4762	-4.3144	-4.8061	-2.0102	4.7933
1997-98	1.0849	0.8175	-5.9997	-5.2545	1.7216
1998-99	-0.5160	-1.3630	-3.7603	-3.3377	2.3798
1999-00	-1.3515	-1.9998	-2.6605	-2.6611	3.0786
2000-01	-1.6276	-1.9688	-2.4631	-2.1605	2.5287
2001-02	0.1866	-2.3931	-3.1818	-3.6715	-0.7306
(C) Proxy for Reference Rate: "Yield on 364-days Treasury Bills"					
1992-93	-3.0748	-0.2280	-1.7501	0.2660	1.7811
1993-94	-3.6051	-5.0879	-0.9256	0.6273	4.9556
1994-95	-3.3322	-1.8542	-1.5772	-1.3678	4.9151
1995-96	-5.5569	-3.3128	-0.6295	1.2433	7.8328
1996-97	-3.4762	-6.3144	-2.8061	-0.0102	6.7933
1997-98	0.7649	0.4975	-5.6797	-4.9345	2.0416
1998-99	-1.4760	-2.3230	-2.8003	-2.3777	3.3398
1999-00	-2.4115	-3.0598	-1.6005	-1.6011	4.1386
2000-01	-2.4176	-2.7588	-1.6731	-1.3705	3.3187
2001-02	-0.1634	-2.7431	-2.8318	-3.3215	-0.3806
(D) Proxy for Reference Rate: "Weighted-average Rates on Assets/Liabilities"					
1992-93	-1.9768	0.8699	-2.8480	-0.8319	0.6832
1993-94	-1.5466	-3.0294	-2.9842	-1.4312	2.8970
1994-95	-2.0166	-0.5386	-2.8928	-2.6834	3.5995
1995-96	-2.2472	-0.0031	-3.9392	-2.0664	4.5232
1996-97	-1.9281	-4.7662	-4.3542	-1.5584	5.2452
1997-98	-1.8692	-2.1366	-3.0456	-2.3004	4.6758
1998-99	-1.6816	-2.5287	-2.5946	-2.1720	3.5454
1999-00	-1.6863	-2.3345	-2.3257	-2.3263	3.4134
2000-01	-1.7418	-2.0829	-2.3489	-2.0463	2.6428
2001-02	-1.4273	-4.0070	-1.5679	-2.0576	0.8833

If we confine to our estimations ignoring the discount factor, the user costs derived in Eqn. (9), appear somewhat underestimated, as it ignores fees incomes and commissions. However, though prices are absolute values of user costs, one is not sure of whether prices are underestimated or not.

This is because the absolute value of any number may or may not be lower than the absolute value of the original number added with a positive number. To clarify the point, let u be the estimated user cost of a product and let $\delta > 0$ represents the extent of underestimation in u due to non-inclusion of fee incomes and commissions. Then, true user cost would be $(u + \delta)$, which is greater than the estimate u. Now, true price $|u+\delta|$ has been estimated as $|u|$. But as $\delta > 0$ and u can be positive or negative, we cannot say whether $|u+\delta|$ is greater than $|u|$ or not.

Estimated user costs of five financial products using a different proxy for "reference rate" are presented in Table 3. We do not report the results corresponding to the reference rate proxy "call money rate", as the estimated user costs for this proxy lead to extremely volatile and often too high/low estimates of price index.

As can be seen from Table 3, when we use the "weighted-average rate" proxy for "reference rate", the estimated user costs for each product are quite stable with almost no sign change of user costs. But benchmark rates generally provide highly volatile user costs with more frequent changes of financial input-output status of financial products.

4.4. Empirical Estimates of Price Indices

One important aspect of any index number is its base year. In the Indian economy, currently, the base year of many other index numbers, viz., index of industrial production, wholesale price index number, is 1993-94. Even, the latest series on GDP and related aggregates at constant prices also relate to prices in the year 1993-94. On this consideration, we consider the base year 1993-94 = 100 for our empirical estimates of price indices. We, however, do recognize that already ten years are passed since then (i.e. 1993-94) and for practical implementation it would be better to choose a more recent period (instead of 1993-94) as base year.

In Table 4, we present the estimates of simple and chain price indices (with base year 1993-94=100) of bank financial intermediate services. As the base year is 1993-94, the chain-indices, for the years 1992-93 to 1994-95 are actually the simple indices derived directly with base 1993-94. For deriving chain-indices for the remaining years, year-to-year simple indices are estimated and multiplied (Fixler, 1993). It is seen that the estimated indices differ substantially across the proxies for the reference rate. Besides, index series pertaining to each choice of reference rate is highly volatile over time. In some instances, say for when Yield on T.Bills is chosen as reference rate, the price index is too high and makes us suspicious about the accuracy in measuring reference rate. As expected, use of "weighted average rate" as proxy for reference rate eliminates/reduces the volatility in price index to a great extent. A common feature in almost all sets of price index series is that prices for financial intermediation services are following a declining path in recent years.

Table 4 – Estimated Simple and Chain-Based Price Indices (Base Year 1993-94=100)

Tear	Simple Price Index				Chain-based Price Index			
	Bank Rate	Yield on 91-Day T.Bills	Yield on 364-Day T.Bills	Weighted Average Rate	Bank Rate	Yield on 91-Day T.Bills	Yield on 364-Day T.Bills	Weighted Average Rate
1992-93	121.30	111.95	99.92	111.26	121.30	111.95	99.92	111.26
1993-94	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1994-95	120.22	118.98	98.26	118.49	120.22	118.98	98.26	118.49
1995-96	164.63	163.87	127.84	111.03	119.14	168.13	135.63	126.64
1996-97	201.53	127.09	140.30	126.97	118.04	129.17	164.04	149.35
1997-98	121.86	234.22	184.54	112.57	97.38	224.73	824.37	132.34
1998-99	108.66	102.56	81.28	104.11	88.48	137.81	433.34	121.63
1999-00	72.28	102.86	82.36	102.67	85.68	138.12	427.54	119.84
2000-01	70.63	103.16	83.82	103.19	85.91	138.36	428.41	120.09
2001-02	96.80	100.29	43.00	93.42	86.08	128.90	284.48	107.65

In order to crosscheck the estimates of price indices, we calculated implicit price deflators based on current and 1993-94 prices FISIM. Relevant results are presented in Table 5. From these results and those in Table 4, some interesting points are noticeable. First, unlike the price index, the implicit price deflator for FISIM is extremely robust on the selection of the reference rate. Second, price deflator series are much less volatile over time than price indices. Third, when the "weighted

average rate" is chosen as proxy for the reference rate, the price indices become very close to the price deflators. Fourth, both price index and implicit price deflators for FISIM are showing a declining trend in recent past. The strikingly high degree of stability (over time) and also robustness of the estimates of the price deflators has an important implication for policy makers. Particularly, there is a case now to examine as to whether the overall trend in prices of intermediation services would be assessed based on an implicit price deflator.

Table 5: Estimated Implicit Price Deflators for FISIM (Base Year 1993-94 = 100)

Year	Proxy for Reference Rate			
	Bank Rate	Yield on 91-Day T.Bills	Yield on 364-Day T.Bills	Weighted Average Rate
1992-93	101.99	101.63	101.93	101.65
1993-94	100.00	100.00	100.00	100.00
1994-95	122.02	121.00	122.75	121.51
1995-96	129.04	125.24	127.33	127.51
1996-97	127.77	127.25	127.50	127.89
1997-98	114.02	113.99	114.27	113.66
1998-99	103.95	104.58	104.29	104.82
1999-00	103.21	103.73	103.58	103.75
2000-01	104.85	103.98	104.26	103.98
2001-02	94.18	92.72	93.52	92.02

5. Concluding remarks

The paper reviews existing literature on measuring banking services, with particular reference to constructing a bank output price index. It is argued that any such index should include both (i) direct services for which explicit charges are made and (ii) the financial intermediation services. Though "direct services" may be measured directly based on relevant information, financial intermediation services should be measured indirectly. The "user cost" literature provides a potential method for constructing indices of intermediation services. However, in the Indian context, the method should be applied with prudence, as apart from conceptual problems, there are certain practical difficulties in specifying/deriving the "reference interest rate". We found that estimates of a price index are highly sensitive to the reference rate. While the traditional benchmark rates, such as yield rate on treasury bills, bank rate, are extremely poor estimates of reference rate as they lead to frequent changes in financial input/output status of different products and produce extremely volatile indices (and often too high/low indices) the use of the "weighted average rate" (on assets and liabilities) reduces the problem substantially. These findings clearly indicate for searching for suitable estimates of the "reference rate" before constructing user-cost based price index. Another interesting finding of our empirical exercise is that unlike the price index, implicit price deflator for FISIM is extremely stable over time and is also practically not sensitive to the choice of the reference rate proxy.

An important implication of our empirical results is that among the alternative proxies of the reference rate, the "weighted average rate" appears to be the best in a sense that it leads to substantially less volatile price index. Besides, the strikingly high degree of stability (over time) and almost no sensitivity of price deflators to the reference rate also make a case for using an implicit price deflator for FISIM while analysing the price trend, at least until one gets satisfactory estimates of a price index. We hope that future research in this area will address these vital issues.

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Abstract: In this paper we examine the issues involved for constructing a bank output price index for India. As well know, traditionally, the major part of banks' revenue comes from their activities in relation to financial intermediation, though in recent years, banks are increasingly tending to provide many direct services. Thus, an ideal price index for banking services would cover prices of both direct and intermediation services. As direct services are charged explicitly, measuring and pricing these banking services pose no special conceptual problem, except possibly the difficulties due to certain data deficiencies. But the issue is very complex conceptually for intermediation services. Besides, the implementation of the existing theory of price index of

financial intermediation services is limited mainly due to the lack of required data and/or pronounced estimation problems. In this context, this paper presents some empirical results in respect to prices of banks' intermediation services for India.

Key Words: Financial Intermediation Services of Banks, FISIM, User Cost and Financial Input/Output, Indices of Banking Services.

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Measuring prices from financial instruments: Yield curve modelling[1]

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1. Introduction

In the financial markets of the euro area, it is essential to develop and apply methodologies for calculating meaningful and comparable financial market indicators. Aiming at consistency and comparability there is a need for a common methodology for yield curve estimation within the European System of Central Banks. This paper reviews the literature on yield curve modelling with the objective to pave the way for an empirical exercise of testing the various models and define a financial market statistical indicator useful for E(S)CB purposes.

The paper is structured as follows, firstly, the paper outlines the rationale and importance of market price information for central banks. Secondly, the paper provides an overview of the fundamental financial concepts that appear in yield curve modelling. Thirdly, a survey of the literature on yield curve models and estimation techniques is presented. This section furthermore highlights the strengths and weaknesses of the various models and indicates some preliminary findings. Finally, the paper outlines the framework for obtaining prudent results and a possible implementation strategy.

2. The use of financial market statistics and market price information for central banks

The legal framework for the single monetary policy is provided by the Treaty establishing the European Community (Treaty) and the Statute of the European System of Central Banks and of the European Central Bank (Statute)[2]. Therein the objectives and tasks as well as institutional and organisational provisions for the single monetary policy are defined.

In order to perform its tasks, the ESCB and its decision-making bodies need access to appropriate statistical information. As laid down in Article 5 of the Statute, the ECB assisted by the National Central Banks (NCBs) is asked to collect the necessary statistical information, either from national authorities or directly from economic agents. Furthermore, "The ECB shall contribute to the harmonisation, where necessary, of the rules and practices governing the collection, compilation and distribution of statistics in the areas within its fields of competence."[3] With these provisions the Statute recognises the high importance of statistical information for the ESCB and its monetary policy decision-making processes and stresses the active and fundamental role of statisticians within the ESCB.

To avoid duplication of statistical work at Community level and to promote high quality and consistent statistics, the ECB and the European Commission (Eurostat)[4] clarified the respective areas of responsibilities in economic and financial statistics. According to these clarification of re-

1 *The views expressed in this paper are those of the authors and do not necessarily reflect the views of the European Central Bank.*

2 *The Treaty and the Statute established both the ECB and the ESCB.*

3 *Article 5.3 of the Statute.*

4 *Memorandum of Understanding on economic and financial statistics between the Division General Statistics of the ECB and Eurostat, March 2003 (MoU), para.1. This is e.g. in particular important since it is necessary to ensure consistency across areas of statistics within the framework of the European Systems of Accounts (ESA 95).*

sponsibilities the ECB has prime responsibility for money, banking and *financial markets statistics* at Community level[5]. That means that the ECB takes responsibility for *financial markets statistics* with due regard to the interests of the European Commission.

Financial markets are a key channel for the transmission of monetary policy impulses to the real economy. Financial markets statistics are intensively used in order to analyse in a systematic way the relationship between monetary policy and financial markets' structure and dynamics and as such play an important role in the monetary policy strategy of the ECB.

Financial markets statistical indicators are valuable for monetary policy makers in at least three respects: First, they represent leading indicators regarding market expectations about macroeconomic developments. Second, movements in prices of financial instruments affect economic wealth and economic sentiment and, via these channels, domestic spending decisions. In addition, financial instrument price movements are indicative of changes in the expectations of the private sector regarding economic prospects. Good reference measures of market uncertainty therefore represent a rich source of information for monetary policy making. Third, financial market prices give insights into the expectations of market participants with regard to monetary policy decisions. Euribor and Eonia swap rates are especially helpful in this respect as they allow the construction of a yield curve for the short-term fixed-income market. Additional information can be derived from e.g. three-month futures. Thus, a good picture of anticipations prevailing in the market with regard to monetary policy moves can be drawn. Furthermore financial markets statistics are used for different research purposes in the area of monetary policy and provide indicators for financial stability and prudential supervision.

The different segments of financial markets may contain useful and complementary information. Generally the collected information includes financial instruments, asset prices (respectively rates) and volumes. The latter is of particular interest to assess the importance of an instrument and its price developments. The more liquid a market is and the more trades are conducted, the better is the information content of prices in this market. In addition volume statistics can shed light on developments concerning shifts between different asset classes, which may have influence on (the components of) M3 and the functioning of the financial system in general. Asset prices are mainly used to gain insight in market expectations and to monitor reactions on shocks.

The ECB, as part of its forward looking statistical strategy, needs to provide high quality financial markets statistical indicators to its users, market participants and the general public as a means to facilitate the transparency and the integration of financial markets. An ongoing integration process in financial markets should have beneficial effects for monetary policy, for example by facilitating policy signalling and transmission through enhanced market liquidity. In addition enhanced integration of financial markets improves in turn the availability of euro area-wide comparable financial markets statistics. "If new information indicates risks to price stability, and markets understand the strategy, expectations will adjust in anticipation of the appropriate reaction of monetary policy. This fosters a smooth implementation of policy, where much of the work is done by the market's adjustments of the term structure of interest rates"[6].

The particular challenge for the Eurosystem consists in the provision of "pan-euro area" financial markets statistics. The euro area is one of the largest economies of the world, comparable to the USA and Japan. However at present stage there are limitations regarding the availability of comparable euro area statistics, which represent more than the sum of national contributions.

The ECB has to overcome this lack of immediate euro area statistics by using a large amount of available data series, mostly on a national level, in a sophisticated manner. The ECB develops and implements methodologies to ensure that the quality of the financial markets statistics in terms of reliability, consistency, comprehensiveness and timeliness are available for the users.[7] In the still fragmented financial markets of the euro area, it is essential to develop and apply methodologies for calculating meaningful financial market indicators on the basis of available raw data as well as for interpreting these statistical indicators. The process for the operational framework of financial markets statistics follows the following steps:

5 *In other areas, such as general economic statistics, the European Commission has prime responsibility or the responsibility at Community level is shared, e.g. in the case of balance of payments statistics*

6 *Issing, Otmar (2002), Monetary Policy in an Environment of global financial markets, Speech at the launching Workshop of the ECB-CFS Research Network, Frankfurt 29 April 2002.*

7 *See "The use and availabilityof financial markets statistics for the euro area", Michel Stubbe and Per Nymand-Andersen, IFC Bulletin 14, February 2003.*

Table 1 – The operational statistical framework of the financial markets statistics.

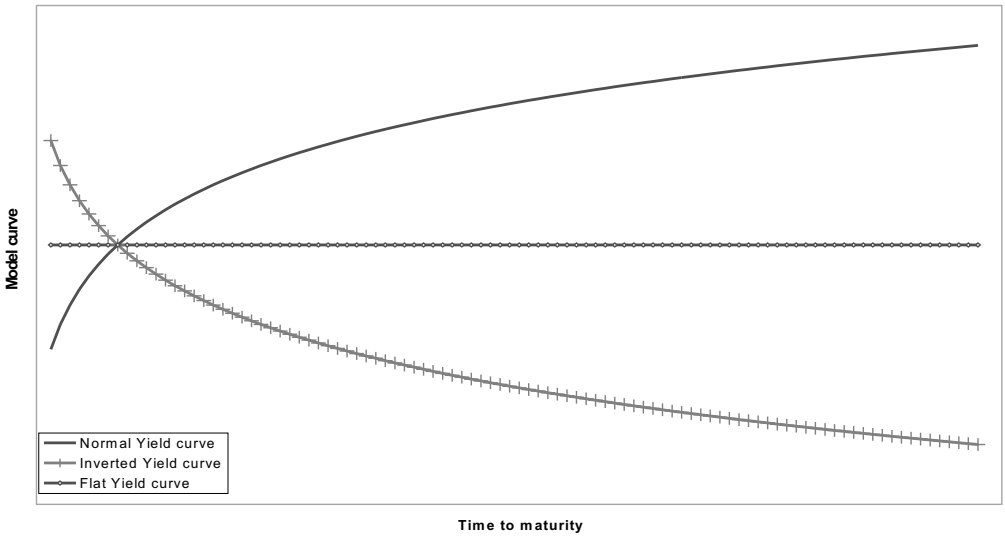
1. The selection and collection of the necessary data series from mainly external sources
2. The conduct of a data quality management system that filters the incoming raw data
3. The application of agreed methodologies to obtain meaningful and comparable indicators for covering mainly the euro area, and
4. The interpretation of the financial markets statistical indicators for monetary policy purposes and other central banks tasks and functions

The following chapters relate to step 3 of the process described above for the statistical methodology related for the provision of one comparable financial markets statistical indicator, mainly yield curves.

3. Pricing models for debt securities

A yield curve is a graphic representation of the relationship between the returns and the terms to maturity of securities at a certain time. Usually, the term "yield curve" refers to the term structure of interest rates of zero-coupon bonds without default risk. The yield curve shows if short-term interest rates are higher or lower than long-term rates. The information content of a yield curve is the result of the asset pricing process on financial markets. An investor calculates the price of an asset by discounting the expected future cash flow associated with the asset. The discount rate is determined by the compensation for bearing the risk and the compensation for postponing the consumption into the future. In pricing the asset the investor incorporates therefore his/her expectations on risk, inflation and real interest rates[8].

Graph 1 – Possible yield curve shapes



Assuming a risk free bond with known maturity and coupon payments, and we assume that the interest rates at the different times are known, then the price of a coupon paying bond can be written as follows.

8 *The theories underlying the term structure of interest rates can be briefly summarised as: Liquidity preference theory – risk premia increase with time so, other things being equal, one would expect to see a rising yield curve. The pure expectations hypothesis – according to this theory the forward rates govern the curve, these are simply expectations of future spot rates and do not take into account risk premia. Segmented Markets Hypothesis – the yield curve depends on supply and demand in different sections and each section of the yield curve is only loosely connected to each other. Preferred Habitat – again investors have a maturity preference, but will shift from their preferred maturity if the increase in yield is deemed sufficient compensation to do so.*

$$P_t = \sum_{m=1}^{M} \frac{C}{(1+s_{t,m})^m} + \frac{N}{(1+s_{t,m})^M}$$

Where: C = Coupon
N = Redemption value
s = Interest rates
M = Maturity

In this case the credit risk is negligible and the interest rate is solely determined by the expectations on inflation and real interest rates. If held to maturity, the discount rate equals the yield to maturity (or the internal rate of return). This is the interest rate at which the present value of the future cash flow discounted with this rate equals the bond price.

To identify the term structure of interest rates, implied by the prices of government bonds, two fundamental problems have to be addressed. First, government bonds are usually not available for the whole range of maturities of interest. Second, most government bonds pay coupons. It is therefore not possible to derive directly the yields from zero-coupon bonds. Since the long-term fixed-income markets in the euro area are not fully integrated and each government (and the private sector) issues bonds for their individual purposes, there are no area-wide identical fixed-income securities with sufficient liquidity and for the whole range of maturities available. To overcome the problem of gaps in the maturity spectrum and the lack of zero-coupon bonds different models for yield curve estimation have been developed and are used by central banks, academia and private agents. In what follows we first briefly outline the fundamental financial concepts that appear consistently in yield curve modelling.

3. Fundamental financial concepts

The fundamental financial concepts that underlie yield curve models can be listed as: (1) zero-coupon rates (spot rates), (2) forward interest rates, (3) discount factors and (4) par yields. To derive one of these is sufficient for the determination of the other three elements. We shall review their basic definitions, and outline their relationship with each other.

At the outset we note that in general practice, interest rates are compounded at discrete intervals. However, for theoretical and methodological purposes it is important to apply the concept of interest rate in a continuous time setting; the main reason being that in order to construct continuous interest rate functions (zero-coupon or forward rate curves), the compounding frequency must also be made continuous. As such we shall use this convention below.

The spot (or zero-coupon) yield curve, represents the term structure of spot interest rates. The spot rate is the interest rate applicable today on a loan with a certain maturity. The spot rate at a certain time t reflects the average rate of return from t to maturity (m). The spot (zero-coupon) yield curve represents the yield to maturity on a pure discount bond with a set of spot rates $St(t=1,2,...,m)$ is the term structure of spot interest rates or, alternatively, zero coupon yield curve.

On a continuously compounded basis, the zero-coupon rate, $s(t,m)$, can be expressed as a function of the discrete zero-coupon rate, $S(t,m)$, and the term to maturity, m, as follows:[9]

$$s(t,m) = e^{\left(\frac{S(t,m)}{100} * (m-t)/365\right)}$$

The implied (instantaneous) forward interest rate curve displays (very) short-term interest rates for future time periods, implied by the observed today's spot rates for different maturities. It can be regarded as the marginal increase in the total return from a marginal increase in the length of an investment. The zero-coupon rate of the same time, *s(t,m),* can be regarded as the average cost of borrowing over this period. The instantaneous forward rate is the first derivative of the zero-coupon rate with respect to term to maturity (equivalently, the zero coupon rate is the integral of the instantaneous forward rate in the interval from t to m):

Assume continuous compounding with $t_2 > t_1$ gives:

$$e^{s_{t_2} t_2} = e^{s_{t_1} t_1} \, e^{f_{t_1,t_2}(t_2 - t_1)} \qquad \Rightarrow f_{t_1,t_2} = \frac{s_{t_2} t_2 - s_{t_1} t_1}{t_2 - t_1}$$

Since the implied forward rates of interest reflect the market's expectations about the future path of interest rates it is a useful tool for monetary policy purposes.

9 *David Bolder & David Streliski, Yield Curve Modelling at the Bank of Canada, Technical Report. No 84, Feb 1999 p 5.*

Discount Function, an investor calculates the price of a bond as the discounted future cash flow. Mapping the discount rate to time *t* results in the *discount function* The discount function describes the present value of one unit payable at any time in the future. The discount function therefore reflects the present value of a zero-coupon bond with a redemption of one unit, paid on the maturity date[10].

The price of a zero coupon bond at time *t* with maturity at *m* and face value *FV* = EUR 1, can be found via the discount function denoted:

$$d_{t,m} = e^{-\left(\frac{S(t,m)}{100} * (m-t)/365\right)}$$

From the discount function it is then possible to obtain the par yield curve and implied forward rate curve.

The par yield curve is a transformation of the zero-coupon yield curve. It is assumed that the bond involves regular coupon payments. For a given maturity the par yield is the coupon yield that a bond would have to be priced at par (face value), i.e., a bonds yield to maturity is equal to its coupon rate. It is very rare that Government bonds are priced at par in the secondary market, and hence par yields must be estimated from existing bonds yield to maturity.[11]

$$100_t = \sum_{m=1}^{M} \frac{(Par(t,T/2) * 100}{(1+s_{t,m})^{m/2}} + \frac{100}{(1+s_{t,M})^{M/2}}$$

4. Description and review of recent literature of yield curve modelling

A number of estimation methodologies exist, some more complex then others, with which we can derive the zero coupon and forward rate curves from observed data. Anderson et al (1996) characterise these in to two distinct groups: first, there are those models that make specific assumptions about the evolution of state variables and asset pricing methods using either equilibrium or arbitrage arguments; second, there are those models based on statistical techniques where the current yield curve is described by "smoothing"[12] data obtained from asset prices. However, each technique, whether from the former or latter group, can provide surprisingly different shapes for these curves. As a result, estimation technique selection depends primarily on its final use. It is the later models, those based on statistical techniques, which are of interest for central banking purposes. In what follows, we intend to survey the different statistical approaches adopted in estimating the yield curve. In particular, we will pay attention to the estimation complexities mentioned above.

Anderson et al (1996) present an excellent coverage of different approaches used, some of which we reproduce here. The main modelling approaches surveyed in this paper can thus be briefly summarised as,

- (1) the McCulloch (1971), (1975) method which fits a cubic spline to the discount function using an implicit smoothness penalty;
- (2) the Fisher, Nychka and Zervos (1995) (FNZ) method, which fits a cubic spline to the forward rate function and makes the smoothness penalty explicit by imposing a (constant) roughness penalty;
- (3) the Waggoner (1997) approach which differs from FNZ in that it introduces a variable roughness penalty; and
- (4) the parametric approach, put forward by Nelson and Siegel (1987) and extended by Svensson (1994), which fits an exponential approximation of the discount rate function directly to bond prices.

The first three methodologies are spline based techniques,[13] where as the fourth approach is a parsimonious parametric[14] approach. The different approaches will, in essence, involve a trade off between flexibility to accommodate genuine bends in the term structure and "smoothness".

10 *Anderson et al. (1996), p.5.*

11 *David Bolder & David Streliski, Yield Curve Modelling at the Bank of Canada, Technical Report. No 84, Feb 1999 p 55.*

12 *removing the noise from the data.*

4.1. Spline-based models

Spline-based methods model a curve by a piecewise cubic polynomial, with segments joint at so called knot points (McCulloch (1971)). Further developments in these techniques apply constraints so as to ensure that the pieces join up and look smooth (FNZ (1995), Waggoner (1997)). Spline based models were pioneered by McCulloch (1971) (1975). The method put forward by McCulloch is one in which the discount function is estimated using a regression spline. To estimate the discount function $d(m)$ at some maturity m, McCulloch proceeds as follows: he uses the bond price equation and the discount function equation.[15]

$$P(t,t+m)= \Sigma\, c*d(t,t+k) +100*d(t,t+m)$$

$$d(m)=1+ \Sigma\, aj*fj(m)$$

He implemented the polynomial function within the price and discount function equation, where $fj=m^j$, (j=1,2,…,k); this results in a discount function which is a simple k^{th} degree polynomial. However, when increasing the order of the polynomial k to solve problems of bad fit at either the long end or the short end, problems will tend to be caused in the stability of the parameter estimates. To correct for this instability McCulloch proposed the use of splines to approximate the discount function. The main advantage of this method is its flexibility in obtaining special shapes or curvature in different regions of the term structure. To correct against the forward rate curve displaying "knuckles" McCulloch (1975) increased the order of the estimating function and used a cubic spline. His specification, the basis functions $f(m)$ are designed to be smooth at each knot point, giving the model the flexibility to model any reasonable shaped discount function and hence yield curve. The suggested number of knot points in McCulloch is the square root of the bonds used in the estimation and are spaced so that roughly an equal number of bonds mature between adjacent nodes. Within this model the number of knot points determines the number of parameters. Bliss (1997) found that, although the number and spacing of the node points is somewhat ad hoc, the choice seems to work well in practice.

However, although this approach is useful when maturity data are not regularly spaced, it has several drawbacks. The forward rate curves produced by this method often tend to oscillate (particular at the long end). Further developments of the spline-based models addressed the shortcomings of McCullochs approach, namely unreasonable shapes of the forward curves. The family of B-splines uses another set of basis functions, with an augmented set of knot points around the short and the long end of the curve.

Fisher, Nychka and Zervos (1995) (FNZ) developed a technique that fit smoothing splines instead of regression splines that include a penalty for excess 'roughness' to extract the forward rate curve. This roughness penalty is constant across maturities, and as a result, the spline is stiffened, which in turn reduces the oscillatory behaviour. The recommended number of nodes is approximately one third the number of bonds used in the estimation and the nodes should be spaced so that roughly an equal number of bonds mature between adjacent nodes. Since the penalty forces an implicit relationship between the parameters of the spline, the effective number of parameters is reduced. However, the FNZ method also reduces the fit, and Bliss (1997) found that the use of a constant roughness penalty tends to misprice short term securities. He argues that this does not allow for greater flexibility, which is necessary at the short end, where there is more true curvature in the term structure.

Waggoner (1997) follows a similar approach taken by FNZ in that he uses a cubic spline to approximate the forward rate function. His approach, though, differs in that instead of using a constant roughness penalty he uses a penalty that varies over all maturities, this approach thus dampens the oscillations on the long end, whilst retaining flexibility on the short end. Moreover, he uses the same approximate number and spacing of node points as FNZ.

Vasicek and Fong (1982) also use an spline based model to derive the discount function. They modify the exponential form of the discount function to fit bond price data, from which yields are

13 *Anderson et al give an intuitive explanation of spline as "….a polynomial spline can be thought of as a number of separate polynomial functions, joined 'smoothly' at a number of so- called join, break or knot points" (Anderson et al (1996) Estimating and Interpreting the Yield Curve, page 25).*

14 *A parametrically parsimonious model for yield curves has the ability to represent the shapes generally associated with yield curves: monotonic, humped, and S-shaped (Nelson & Siegel (1987).*

15 *Anderson et al describe the discount function to be a linear combination of a set of k linearly independent underlying basis functions, where fj is the jth basis function, and aj is the corresponding coefficient (j=1,2,…..k). Once the discount function has been estimated the implied forward rate, spot rate and par yield can be obtained using their respective formulas.*

derived. Mastronikola (1991) fits a par yield curve, the drawback of such a model is that it does not allow for bonds with the same maturity date to be discounted at the same rate.

4.2 Parsimonious functional forms

The N&S model is a parametric model which specifies a functional form for the instantaneous forward rate, $f(t)$ as follows:

$$f(t) = \beta_0 + \beta_1 \exp\left(-\frac{t}{\tau}\right) + \beta_2 \frac{t}{\tau} \exp\left(-\frac{t}{\tau}\right)$$

This model has the ability to capture the stylised facts, describing the behaviour of the forward rate curve. The parameters of these models can be interpreted as follows, where β_0 is the long term rate, it must be positive and it is the asymptotic value of (t). β_1 is the spread between the long and short term and hence, $\beta_0 + \beta_1$ is equal to the short term rate (the rate at zero maturity). Furthermore, τ_1 specifies the position of the first hump or U-shape. β_2 determines the magnitude and direction of the hump.

The original motivation for this model was to create a parsimonious model of the forward interest rate curve that could capture the range of shapes generally seen in yield curves: monotonic form and with humps at various areas of the curve. Their method allows the yield curve to be described by a few parameters representing the long run level of interest rates, the slope of the curve and humps in the curve. The key to their approach is that they explicitly attempt to model the implied forward rate curve rather then the term structure of interest rates. The N&S and Svensson extension are basically the McCulloch model constrained to prevent forward curve from taking undesirable shapes.

An important property of the model is that the forward rate asymptotes horizontally at the long end, because the expected future interest rates in 20 to 25 years are assumed to be indistinguishable. This methodology of estimating forward curve was found to be sufficient to give a close fit to the data since real yields tend to converge to a constant level at relatively short maturities. In effect this means that the real yield curve is flat over all but the shortest maturities. This real forward curve then translates into real discount function.

To increase the flexibility and improve the fit of the N&S model, Svensson added a forth term.

$$f(t) = \beta_0 + \beta_1 \exp\left(-\frac{t}{\tau_1}\right) + \beta_2 \frac{t}{\tau_1} \exp\left(-\frac{t}{\tau_1}\right) + \beta_3 \frac{t}{\tau_2} \exp\left(-\frac{t}{\tau_2}\right)$$

The model has two more parameters than the Nelson-Siegel model. The additional parameters can be interpreted as β_3 is analogous to β_2, (as expressed above for the N&S model). It determines the magnitude and direction of the second hump. τ_2 specifies the position of the second hump or U-shape.

4.3. Comparing different methods used:

Waggoner tested the McCulloch, FNZ and Waggoner variable roughness penalty methods by comparing their in sample and out of sample performance in correctly pricing bonds. He found that the FNZ method performs slightly better than that of McCulloch in pricing securities with more than one year to maturity, however the converse is true for pricing securities with less than a year to maturity. This is because in the choice of using a constant roughness penalty over all maturities, it is difficult to both dampen oscillations at the long end and price short term securities as well. The absence of a roughness penalty, as is the case in the McCulloch spline method, allows the concentration of the nodes to determine the flexibility of the spline, and since there are many more short term securities then long term securities, the nodes tend to be more concentrated on the short end and hence the McCulloch spline is more flexibile.

In his use of a variable roughness penalty Waggoner finds that flexibility is retained at the short end whilst it has a dampening effect on the oscillation at the long end, thus helping to make this methodology perform better than the McCulloch method across all maturities and also better than the FNZ method across short maturities. Waggoner concludes, however, by pointing out that the results produced by the McCulloch method and the roughness penalty (whether variable or constant) method is very similar.

Anderson et al (1996), in their comparative summary, take four different methods for working out a zero coupon yield for the UK. They find that the resulting four shapes of the estimated yield curve do not seem to differ very much. However, the forward rate curves of each model are quite different. In both the N&S and Svensson models, for instance, the implication is that the forward

Table 2 – Summary of yield curve methodologies reviewed in this paper

	Curve	Functional form	Advantages/ disadvantages according to literature review
Spline based models			
McCulloch (1971), (1975)	Discount function	Cubic spline to the discount function	+ Flexible + Fit the data better
Fisher, Nychka and Zervos (1995)	Forward rate function	Cubic spline to the forward rate function with explicit smoothness penalty (constant)	- A polynomial cannot fit adequately both ends of the term structure simultaneously - Shea (1984): Discount function could be negative in sections - Lack of smoothness - Influenced by selection of knot points - Outliers are an issue
Waggoner (1997)	Forward rate function	Cubic spline to the forward rate function with explicit smoothness penalty (variable)	
Mastronikola (1991)	Par yield curve	Par yield curve derived from observed prices	
Vasicek and Fong (1982)	Discount function	Exponential spline to derive the discount function	
Parsimonious parametric models			
Nelson and Siegel (1987)	Discount function	Exponential approximation of the discount rate function directly to bond prices	+ Smoothness + Yield curve relatively independent of individual observations (better for monetary policy purposes) + Enable plausible extrapolation - Not as flexible as spline based - Change of a data point may affect the whole curve (especially the short end) - Not flexible enough to capture price movements - Cannot identify abnormalities in individual maturity segments - Fit the data less well
Svensson (1994)	Discount function	Extension of Nelson and Siegel model	

rates gravitate smoothly toward a flattened long end. In the McCulloch model, on the other hand, the forward rates fluctuate according to maturity, ascending steeply as the term to maturity lengthens. Finally, an examination of the forward rate curve in the Mastronikola (1991) model shows that it flattens at the long end, simultaneously exhibiting greater curvature than the N&S and Svensson models.

Anderson and Sleath (1999) apply and provide a summary of a comparison of the techniques mentioned above. In particular, they compare the N&S and Svensson methods with the spline based method put forward by FNZ and Waggoner. They raise the question that, although the N&S and Svensson method provide smooth yield curve estimates due to their parsimonious nature, are they sufficiently flexible enough to capture movements in the underlying term structure? They find that the Svenson model, due to the imposition of an extra parameter, in out of sample performance is superior to the N&S model. In comparing the fit of the two spline based techniques, Anderson and Sleath find that the variable roughness penalty curve proposed by Waggoner outperforms the FNZ curve. Intuitively, they conclude that this is because the FNZ suffers from the same lack of flexibility at the short end as the N&S method. Moreover, they find that the main differences between the variable roughness penalty and Svensson model relate to the stability criterion and constraints imposed at the long end. The Svensson model is constrained to converge to a constant at long maturities. The variable roughness curve, in contrast, is constrained only to be very smooth at these maturities. Anderson/Sleath further show that the Svensson curve changes dramatically, particularly at the short end when a single data point at the long end is changed. Curves based on parametric models are generally less well suited to identifying abnormalities in individual maturity segments or individual bonds[16].

Bliss (1996) tests and compares, in sample and out of sample, five distinct methods for estimating the term structure: the un-smoothed and smoothed Fama-Bliss method, the McCulloch method, the FNZ method and the Svensson method. He finds that the FNZ, both in and out of sample, performs badly compared to the other methods. He highlights that the FNZ method has systematic problems in handling short maturities and is susceptible to measurement errors in the data. He concludes that the parsimonious smoothed Fama-Bliss and Svensson method, as well as the less parsimonious McCulloch cubic spline method performed comparable to each other.

16 *See Schich, Sebastian (1997).*

Generally speaking, as the comparative studies above have shown, there is a trade-off between smoothness and the fit factor in yield curve estimates depending on which model is used. It is necessary, then, to reach a balance between those models on the one hand that are too flexible, that over fit the data and that take outliers as the norm, and those, on the other, that are too parsimonious. Also of importance is the intended final use of the yield curve. A yield curve, estimated for monetary policy purposes, by applying the aforementioned techniques should not fit every possible data point (and outlier) but represent a smooth curve as an indicator of market expectations. Nevertheless the curve should reflect the actual expectations and therefore be flexible enough to capture the movements in the underlying term structure.

5. Outlining the framework for obtaining harmonised yields curve statistics

The sections above provided an overview of the various yield curve models from the recent literature, which offers a good starting point for the necessary empirical studies to be conducted. As part of the process of selecting a yield curve model or a combination of yield curve models, empirical studies are required to assess the performance of the theoretical models in operational terms and to test if they can meet Central Banks monetary policy purposes. A consideration for the latter is that a yield curve estimation for Central Bank purposes should represent a smooth curve as an actual indicator of market expectations. The result of the literature survey above implies that the assess-

Table 3 – Overview of financial markets yields curve methodology and methods used by selected NCBs

NCB	Estimation Method	Estimates available since	Minimized error	Shortest maturity in estimation	Adjustments for tax distortions	Relevant maturity spectrum
Belgium	SV or N&S	1st September 1997	Weighted prices	Treasury certificates: >few days. Bonds:>one year	No	Couple of days to 16 years
Canada	SV	23rd June 1998	Weighted prices	Bills: 1 to 18 months Bonds: >18 months	Effectively by excluding bonds	1 to 30 years
Finland	N&S	3rd November 1997	Weighted prices	-	No	1 to 10 years
France	SV or N&S	3rd January 1992	Weighted prices	Treasury Bills: All. Treasury Notes: = 1 month. Bonds: = 1 year	No	Up to 10 years
Germany	SV	7th August 1997 January 1973	Yields	> 3 months	No	1 to 10 years
Italy	N&S	1st January 1996	Weighted prices	= 1 month	No	Up to 10 years
Japan	Smoothing splines	29th July 1998	Prices	= 1 day	Effectively by price adjustments for Bills	1 to 10 years
Norway	SV	21st January 1998	Yields	Money market rates: > 30 days Bonds: > 2 years	No	Up to 10 years
Spain	SV N&S before 1995	January 1995 January 1991	Weighted prices Prices	= 1 day = 1 day	Yes No	Up to 10 years Up to 10 years
Sweden	Smoothing spline and SV	9th December 1992	Yields	= 1 day (T-Bills with maturities 3, 6, 9, and 12 months, repo rate Bonds: > 2 years	No	Up to 10 years
United Kingdom	Smoothing spline	2 Jan 1979 2 Jan 1985	Yields	1 week/2 years	No	Up to 30 years
United States	Smoothing splines (two curves)	3rd January 1995	Bills: Weighted prices	-	No	Up to 1 year
			Bonds: Prices	= 30 days	No	1 to 10 years

***SV** = Svensson**; N&S** = Nelson and Siegel*

ment of methodologies should be based on the trade-off between flexibility and smoothness in the light of the final use of the yield curves. Much empirical work has been carried out and is continuously being carried out by NCBs and other monetary financial institutions and alike. The BIS collected in 1999 contributions from various central banks concerning the methodologies applied in different countries. This collection exercise is presently being updated by the BIS including the most recent changes and will be published soon. Nevertheless from the BIS 1999 paper, the most commonly used financial markets yield curve estimation methodology is the functional form proposed by Nelson-Siegel, and extended by Svensson. Japan, UK, SE and US uses smoothing spline method and are an exception to this. Nevertheless it seems to indicates a change in recent years of some NCBs, who have moved from Nelson-Siegel models to spline based models.

As indicated within the table above, several other factors need to be accounted for before conducting the empirical study as they may influence the price of a bond and therefore the results of the empirical testing. The objective would be to agree on some assumptions for these factors and keep them constant during the empirical study. These influential factors are related to tax considerations, maturity spectrums, the selection of bonds and its characteristics (benchmark bonds, illiquid bonds, embedded options, credit ratings of issue/issuers, weighting schemes, market segments, dividend effects), the volatility of the derivative market, the selection of the data range, the removal of outliers (days with abnormal volatility), the number of observations included within each estimation, if the yield curve is within a downwards or upwards slope and the applied statistical tests (mean average error, root mean squared error, t-tests and double length regression tests, robustness tests).

6. Possible implementation strategy and way forward for the ESCB

In order to take advantage of already implemented work at community level, the ECB has defined a two step implementation strategy for the yield curve project. Step one will cover the implementation of the present methodology applied by the EU Commission (Eurostat) within the current ECB financial markets statistical production environment as part of ECB prime responsibility for financial markets statistics at community level. These results can then be released internally within the ECB and for the Commission.

Step two will build on the NCBs' expertise in financial markets yield curve methodologies. The results of the two step implementation strategy can then be released on a daily basis to the general public via the ECB web-site. This two step approach will fulfil the immediate internal need of the European Commission for the ECB to provide financial market yield curve information during 2005. In addition, it will allow a continuation of the thorough and critical assessment of the yield curve methodology presented above, which will subsequently lead to the release of high quality financial market yield curves using harmonised agreed methodologies by the E(S)CB.

7. Conclusions

This paper highlights the important role financial market statistics play for central bank purposes, in order to analyse the relationship between monetary policy and financial markets' structure and dynamics. It stresses the importance of central banks to work together and share their extensive and long experiences in developing new financial markets statistics. The current and primary challenge for the Eurosystem within this field is to develop and release representative and comparable "pan-euro area" financial markets statistics and indicators in a coherent and timely manner. However, at present stage there are limitations regarding the availability and comparability of financial markets statistics covering the euro-, community and other important economic areas. It is therefore essential to develop and apply common and agreed methodologies for calculating meaningful financial market indicators as well as for interpreting these statistical indicators.

Aiming at servicing the purpose of developing consistent and comparable financial markets statistics, the paper focuses on one key financial markets statistical indicator, the yield curve modelling for central banks. The paper reviews and highlights the rich availability of literature within this field and presents the yield curve models implemented by Central Banks across the world. A consideration for a yield curve estimation for Central Bank purposes should represent a smooth curve as an actual indicator of market expectations. The result of the literature survey implies that the assessment of methodologies should be based on the trade-off between flexibility and smoothness in the light of the final use of the yield curves.

The paper defines in a forward looking way the implementation strategy with the objective to pave the way for conducting an empirical exercise of testing the various models and for defining a financial market statistical indicator useful for E(S)CB purposes.

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Abstract: Financial market statistics play an important role in the monetary policy strategy of the European System of Central Banks. Such statistics are used in order to analyse the relationship between monetary policy and financial markets' structure and dynamics. The availability of relevant data and the ability to apply appropriate methodologies determine the quality and comprehensiveness of the available indicators. This paper therefore reviews the recent literature on pricing models for debt securities and sets out the different approaches in estimating yield curves. The literature review provides the basis for subsequent empirical work that aims at establishing a proper framework for the development and publication of reference yield curves for the euro area and the EU as a whole.

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Measuring and monitoring property prices in Hong Kong

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I. Introduction

The property market plays an unusually important role in the Hong Kong economy. Housing is the most important form of savings for many households, and mortgage loans are the most important part of household indebtedness. The banking sector is significantly exposed, as more than half of domestic credit comprises mortgage loans and loans for property development and investment, and properties are widely used as collateral for consumer and business loans. Land sales, profits taxes from real estate industry, and stamp duties on property transactions have been a significant source of government revenue. Indeed, the sharp decline in property prices in the years following the Asian financial crisis contributed to depressed consumption and investment, weak demand for bank credit, and persistent fiscal deficits. After reaching a trough in July 2003, property prices have rebounded sharply in the recent quarters. While the recovery is from a very low base, the speed of the rise has raised some concerns about whether this is sustainable.

This paper reviews the latest developments in the residential property market in Hong Kong, and makes use of a combination of indicators to gauge market conditions and assess concerns about excess movements. The next section summaries the recent developments in both prices and transactions in the residential property market, including indicators of speculative transactions. Developments in bank credit, particularly mortgage lending are also covered. Section III provides three alternative measures, namely housing affordability, the cost of buying a property relative to that of renting (buy-rent gap), and a present-value estimate, to assess whether the rise in property prices has been broadly in with fundamentals. The last section offers some concluding remarks.

II. Market developments

After six years of slump, activities in the property market rebounded sharply since the summer of 2003, before moderating somewhat in 2004 Q2. Both prices and transaction volumes have increased strongly, while there are signs of a rise in speculative activity. On the other hand, the outstanding value of mortgage loans has only risen modestly, despite a marked increase in new residential mortgage loans.

a. Property prices

Residential property prices rose for nine straight months in April 2004 by a cumulative 35% from the trough in July 2003, before declining by a total of 7% in May and June (Chart 1). While the recovery is broad-based, price increases in the high-end segment have been particularly pronounced. Chart 2 shows that, between July 2003 and June 2004, prices of large flats (floor area of 160 m^2 or above) rose by a cumulative 47%, while those of small flats (floor area less than 40 m^2) increased by a much less 20%. Notwithstanding the recovery, flat prices on average are still more than 50% below their peak levels in 1997.

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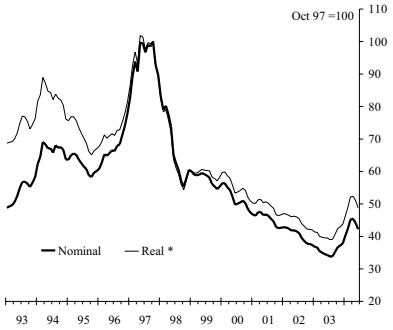
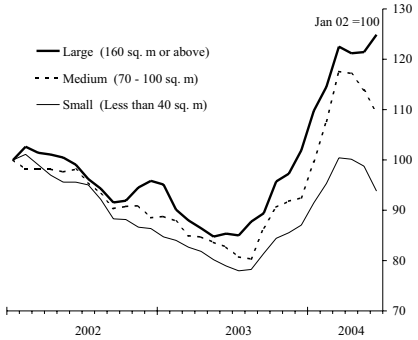
2 *This paper was prepared for the BIS Irving Fisher Committee Conference on "Central Bank Issues Regarding National and Financial Accounts", 9-10 September 2004. The views expressed are solely the authors' and not necessarily those of the HKMA.*

Chart 1
Nominal and real residential property prices



Note: * Deflated by the Composite Consumer Price Index.
Source: Rating and Valuation Department and staff estimates.

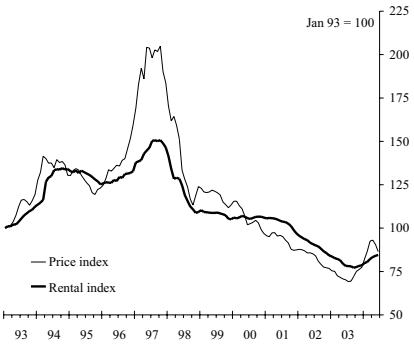
Chart 2
Residential property prices by flat size



Source: Rating and Valuation Department.

Rental yields have dropped since mid-2003, as prices increase faster than rents (Charts 3 and 4). Specifically, the average rental yields on medium-size flats dropped from 5.1% in August 2003 to 3.8% in March 2004, before rising slightly to 4.2% in June. Rental yields for the medium- and large-size flats at the current levels are relatively low compared with those in the past two decades. This points to either future upward pressures on rentals or downward pressures on housing prices.

Chart 3
Price and rental indices



Source: Rating and Valuation Department.

Chart 4
Rental yields by flat size

Source: Rating and Valuation Department.

b. Property transactions

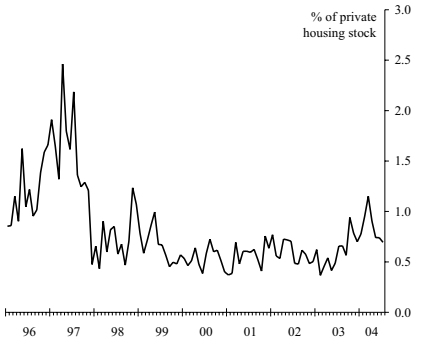
The rise in prices has been associated with a significant increase in transactions since the last quarter of 2003, with the high-end of the market being particularly active. The number of Sales and Purchase Agreements of residential properties almost doubled in 2004 Q1 from a year earlier. Its share to total private housing stock also rose to 0.75%–1% in recent months, from an average of about 0.5% in the past few years (Chart 5). Having recorded a five-year high in March, the number of transactions declined moderately in 2004 Q2.

The number of confirmor transactions, which is sometimes taken by analysts as an indication of speculative activity, also increased markedly from the beginning of 2004. Confirmor transactions are transactions whereby a buyer re-sells the flat to a sub-purchaser before the legal completion of the original sale. Confirmors can possibly be buyers (speculators) with a view to obtaining short-term gains before completion of the sale of the property. Therefore, the number of confirmor transactions would provide indication about the extent of speculative activities in the market. It jumped from below 50 in the earlier part of 2003 to above 550 in April this year, before falling to below 350 in June (Chart 6). While the number of transactions remains substantially below that in mid-1997, its share in total market transactions rose sharply to over 7% in May, compared with the peak of about 8.5% in May 1997. before declining to about 4.5% in June.

However, whether the number of confirmor transactions is a good indicator for speculative activity is subject to debate, and interpretation of its movements requires caution. In particular, a rise in the number of confirmor transactions does not necessarily represent an increase in active speculations. For example, some confirmor transactions could be induced by an unexpected sharp rise in property prices rather than a result of active speculations. It is possible that buyers, who bought

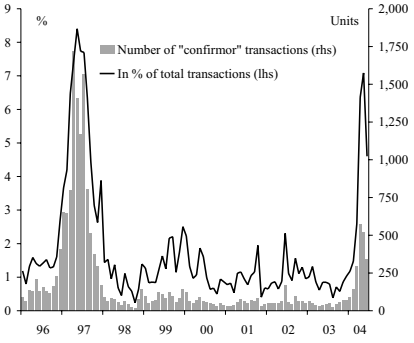
flats for own use or long-term investment initially, sell their flats shortly after acquisition as prices increase much faster than earlier expected. Thus, an unexpected sharp rise in prices may increase confirmor transactions. Therefore, it would be useful to distinguish between the "active" and "passive" confirmor transactions, but it is difficult to do so in practice.

Chart 5
Number of property transactions



Source: Land Registry and Rating & Valuation Department.

Chart 6
Number of "confirmor" transactions

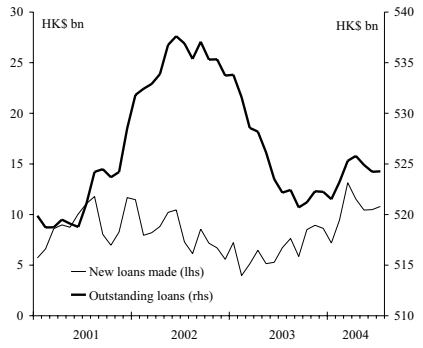


Source: Land Registry and Centaline Property Agency Ltd.

c. Bank credit

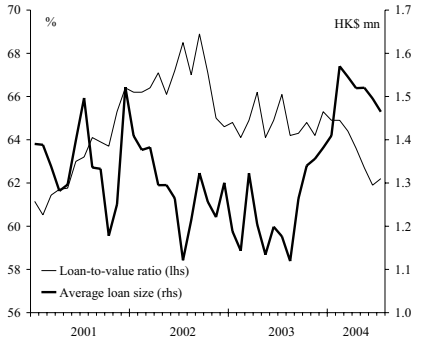
International experience suggests that bank credit can play an accelerator role in property price swings. In Hong Kong, the booming housing market in the earlier part of the 1990s also led to strong growth in bank credit, particularly mortgage loans (Gerlach and Peng, 2002). In the past few quarters, new residential mortgage loans have increased significantly along with the recovery in the property market, but the outstanding value of mortgage loans has only risen modestly (Chart 7). This was because repayments on existing loans, which was associated with higher property values in the earlier periods, have largely offset the increase in new mortgage lending. There are a number of factors that may account for this. First, some households may have swapped one residence for another and, in some cases, the outstanding loan for the previous residence is larger than the mortgage loan for the new flat due to the price decline in recent years. Secondly, some households have refinanced their negative equity mortgage loans by repaying the unsecured portion so as to reduce interest costs. Banks usually charge higher interest rates on mortgage loans in negative equity. Thirdly, it is likely that purchases of the second home or rental properties have not increased significantly or such purchases are not financed by mortgage loans. The average size of new mortgage loans has increased considerably in recent months, but is still substantially lower than that in 1996-98, reflecting lower housing prices. In sum, credit expansion is unlikely to have been an important factor in the current run-up in property prices. Indeed, the average loan-to-value ratio remains well below the maximum ratio of 70% in accordance with a HKMA guideline (Chart 8).

Chart 7
Residential mortgage loans



Source: HKMA.

Chart 8
Average loan size and loan-to-value ratio



Source: HKMA.

III. Fundamental Property Values

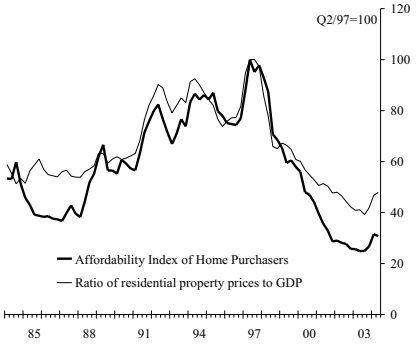
In this section, we compare residential property prices with a set of fundamental indicators, such as household income, interest rates, and rents. Three alternative measures, namely housing affordability, a buy-rental gap, and a present-value estimate of fair value, are used to gauge the support of fundamental factors. All these measures suggest that property prices at the current levels are generally in line with fundamentals.

a. Housing affordability

Housing affordability measures suggest that flats remain affordable to households. Specifically, the Rating and Valuation Department's *Affordability Index of Home Purchasers*, which measures the effect of changing property prices, mortgage interest rates and household incomes on the ability of purchasers to afford a mortgage, indicates that housing affordability has improved significantly from the boom period (Chart 9).[3] This reflects a fall in housing prices relative to median household income since 1997, as well as reduced mortgage interest rates. A simpler measure, the ratio of property prices to nominal GDP, shows a similar pattern, but with a smaller decline from the peak, as it does not reflect the effects of lower mortgage interest rates.

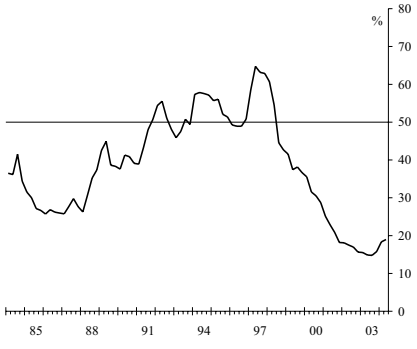
The income gearing ratio, which is defined as the ratio of mortgage repayments for a representative 50 m^2 flat to the 75th percentile household income, indicates that debt-servicing burden remains low. The ratio rose modestly to about 20% in 2004 Q2, but is still well below the 50% ceiling generally observed by banks when marking residential mortgage loans (Chart 10).[4] The 75th percentile household income, instead of the median household income, is used in the calculation, because about half of the households are covered by the public housing programme and most of these belong to the low-income group. The 75th percentile household income thus better reflects the income level of homeowners.

Chart 9
Housing affordability



Source: Rating & Valuation Department and Census & Statistics Department.

Chart 10
Income gearing ratio



Source: Staff estimates.

b. Buy-rental gap

Notwithstanding the increase in property prices, the cost of purchasing and maintaining a flat remains lower than that of renting it. The "buy-rental gap", which measures the difference between effective funding costs and rental yields, is calculated as:

$$[(1-d)\times r_m + d \times r_0] - y \qquad (1)$$

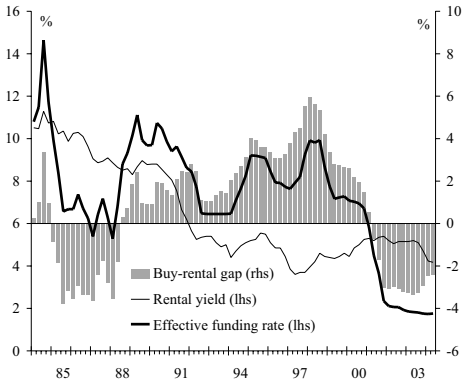
3 *The Affordability Index of Home Purchasers is derived by dividing a typical mortgage repayment by the median household income. Thus, a rise in the index represents deterioration in affordability. The typical mortgage payment is estimated by assuming a 20-year mortgage on 70% of the purchase price for a 50 m^2 flat. The purchase price is estimated by applying the average unit price for a class B residential unit (flat of floor area between 40 m^2 and 69.9 m^2). The number of properties in this class accounts for about half of the total private housing stock.*

4 *The corresponding measure, new home affordability ratio, in the US was 24% and 18% for fixed-rate and adjustable-rate mortgages in June 2004 respectively (Economic and Mortgage Market Developments, Fannie Mae, August 2004). In Hong Kong, an overwhelming majority of mortgages is on adjustable-rates.*

where d is the ratio of downpayment to purchase price, r_m is the average interest rate for new mortgage loans, r_0 is the opportunity cost of lost interest earnings on the downpayment, and y is the rental yield. The term in the square bracket represents the effective funding rate. To derive the latter, the downpayment ratio is taken as 30% and the opportunity cost is proxied by the one-month time deposit rate. Rental yield refers to the average of yields on small and medium size flats.

Chart 11 shows that the "buy-rental gap" has been negative since mid-2001. This implies that it is cheaper to buy than rent a housing unit, although the gap has narrowed somewhat in the recent quarters on lower rental yields. The persistence of the negative gap point to continued incentives for households to purchase rather than rent, subject to expectations of future price movements.

Chart 11
Buy-rental gap



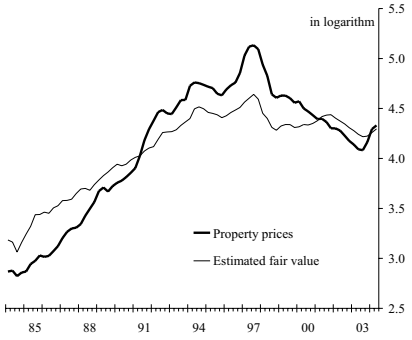
Source: Staff estimates.

While it is difficult to estimate the fair values of property prices, a simple present value model constructed by Peng (2002) supports the argument that a property bubble developed and burst in the 1990s. The model is based on the efficient market hypothesis that prices equal to capitalised rents (sum of the discounted expected future rents).[5] Specifically, regressions are run to test for cointegration between the log rent-price ratio and the homeowner cost of capital. Specifically, this can be done by testing whether the residuals from the following regression are stationary.

$$rent_t - p_t = \alpha + \beta i_t + \varepsilon_t \qquad (2)$$

where *rent* and *p* are logarithms of rents and property prices respectively, and *i* is the homeowner cost of capital, which is proxied by the mortgage interest rate. The unit root test indicates that the log rent-price ratio and the residuals are not stationary, suggesting a bubble component in property prices.

Chart 12
Actual property prices and estimated present values



Source: Staff estimates.

5 *This approach is based on the present value relationship proposed by Lo and Mckinlay (1997). Sarno and Taylor (1999) used this approach to test for bubbles in stock prices in East Asian economies in the period before the Asian financial crisis. Herrera and Perry (2001) applied the same method to asset prices in Latin America. A similar approach was used by Meese and Wallace (1992) in testing the present value relation for housing prices in the U.S.*

Based on the derived relationship, an estimate of the fair value of property prices could be obtained. Specifically, the present value series for property prices is derived from the fitted values of equation (2), adjusted for the rent series. An updating of that analysis implies that flat prices at the current levels are broadly in line with the present-value estimates (Chart 12). Nevertheless, caution is required in interpreting these estimates. In particular, it should be noted that the gap between the observed and estimated present-value prices could also reflect high transaction costs in the property market as well as a misspecification of the fundamentals.

IV. Concluding remarks

The sharp rebound in property prices since last summer has raised concerns over the sustainability of the pace of increase and the consistency of market prices with economic fundamentals. Various indicators suggest that the risk of overheating pressures in the property market remains low. In particular, three alternative measures suggest that property prices at the current levels are broadly in line with fundamentals. First, debt-servicing costs remain low from a historical perspective. Secondly, the cost of purchasing and maintaining a flat is still lower than that of renting it, although the gap has narrowed moderately in the recent quarters. Thirdly, the present value model implies that current property prices are roughly in line with the long-run fundamentals.

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Abstract: This paper reviews recent developments in the property market in Hong Kong, making use of a combination of indicators. In addition to prices, transactions, and bank credit, three alternative measures are employed to gauge the housing market conditions: housing affordability, buy-rental gap, and a present-value estimate of the fair value.

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Monitoring property prices in the Czech Republic

Petr Vojtisek (Czech National Bank)

The importance of the property market for monetary policy

In recent years, economists have for various reasons been paying close attention to property market developments in general, and property prices in particular. First, property wealth is an important part of the net wealth of the private sector and, as a consequence, property-related expenses are an important part of household expenditure. Thus, changes in property prices, rents and related interest rates have a significant impact on demand and eventually on inflation. Second, rents are a component of the consumer basket and therefore directly influence the consumer price index. Third, variations in prices – particularly episodes of sharp fluctuations – influence financial stability. Fourth, the housing market and its functioning might have implications for the supply side of the economy, especially labour force mobility.

For all these reasons, property prices are playing an increasingly important role in the conduct of monetary policy by the central bank as well. This is true not only with regard to monetary policy, but also for financial stability issues, which are of growing interest to central banks generally. As regards monetary policy issues, the importance of property prices increases in correlation with the level of development of the financial market. Information from the financial market can be used for monetary policy considerations. The effectiveness of the monetary policy response to changes in property prices depends on their importance in the transmission mechanism and on the factors that influence them. As regards financial stability issues, this area is closely linked to developments in asset prices generally. Property prices are among the fundamental indicators of the development of asset prices and they also rank among the financial soundness indicators.

There are no doubts about the primary importance of household income among the factors influencing property prices at least in the long term, but interest rates also play an important role in this field. Property prices are interest rate sensitive. They react to monetary policy changes and thus contribute to the transmission of central bank impulses into the economy. A decrease in short-term interest rates leads to a lowering of mortgage rates and to an increase in demand for property and thus to an increase in property prices. This mechanism is supported by sticky supply in the short run. An increase in interest rates imposes a higher debt load, which can be critical for low-income households. The higher the number of property owners in the economy and the higher the proportion of flexible mortgage rates, the more sensitive is the reaction to a property price rise, for instance in consumption.

Economic research has identified several channels through which property prices affect economic agents and their activities:

- a rise in the market value of the property stock (a rise in prices) relative to reproduction costs stimulates the construction of new dwellings as well as the renovation of existing dwellings;
- variations in prices may influence non-housing consumption expenditure and thus aggregate demand; it is also worth mentioning that there is a redistribution of resources between tenants and prospective new buyers on the one hand, and current homeowners on the other, due to changes in rents as well;
- an increase in property prices permits households and firms to borrow more to finance both consumption and investment, with property serving as collateral;
- monetary policy changes have a visible affect on mortgage rates; such interest rate variations influence households' disposable income and thereby their consumption, since mortgage payments are an important part of households' expenses.

There are also certainly relations between property prices and monetary variables. Excess money supply leads, among other things, to property acquisition and thus to rising property prices. An increase in property prices accelerates lending.

The Czech National Bank (CNB) considers property market developments, and particularly property prices, to be an important source of information for monetary analyses. Since 1998, the CNB's monetary policy has been based on inflation targeting. It is clear that the inflation target itself and the inflation forecast play the key roles under this regime. When creating the forecast, the CNB proceeds from a number of theoretical postulates and from empirical information stemming from analyses of the transmission mechanism in the Czech Republic. The monetary transmission mechanism is most often broken down into five channels. Besides direct monetary transmission (demand for money), the interest rate channel (from official rates to financial market rates), the credit channel (the supply and price of loans) and the expectations and uncertainty channel (related primarily to the credibility of the central bank's monetary policy), the asset price channel has been recognised. The effectiveness of the asset price channel is closely linked to the level of financial market development. However, the way in which monetary policy impulses affect asset prices is not straightforward. The transmission is influenced by expectations.

Property prices are a part of the asset price channel and so the CNB monitors developments in this field. The developments in recent years, in particular a strong increase in property prices, have also played an important role in financial stability issues. Their role in monetary and financial stability analyses remains rather indicative, mainly because of insufficient current information and the impact of the transition period in our country. Nevertheless, it does not mean that we have given up on making improvements in this field, especially now that new incentives for monitoring have appeared. A recent example is introduction of a new product called the "American mortgage", under which consumer credit is offered against property collateral. In addition, the transition effect is expected to become steadily less important. The Czech Statistical Office and the CNB are currently discussing how to tackle the lack of information sources. The current situation and future development of property price monitoring is discussed in this paper.

Current property price monitoring situation in the Czech Republic

a) Official sources

The Czech Statistical Office (CZSO), assisted by the Ministry of Finance, has been developing a system to monitor property prices in the Czech Republic since 1997. This was the first attempt to gather information from the property market during the transition period in our country. The introduction of Act No. 151/1997 Coll., on Asset Valuation, which requires the tax authority to pass on to the Ministry of Finance and the CZSO data from tax declarations concerning prices established by property price valuations and prices agreed for properties in the case of sale, was considered an important milestone. The Act took effect on 1 January 1998.

The CZSO has already released two publications on property prices. The latest one, published this year, covers the prices of selected properties in 2000–2002 (the former one covers 1998–2000). The aim of this publication is to provide information on the price level of various types of properties – broken down by location and other factors – and on the development of prices over time. The data come from the tax declarations that property owners or sellers are obliged to provide to the tax authority within 30 days of receiving a registered purchase agreement from the Land Register. The CZSO receives this information broken down by type of property. The publication contains the lower number of property types than received from the tax authority depending on the sufficient volume and number of cases necessary for having reliable figures. Five property types are included in the publication: family houses, residential premises, apartment houses, garages and building plots. The inclusion of price indices is the main improvement in the second publication. Price indices for each property type and an overall index are calculated.

This publication is a valuable source of information in the field of property prices. It meets several of the criteria usually required by users. The prices are based on real transactions, the monitoring covers the whole country, the data source provides information regularly, and an overall index is calculated. As regards the structure of the market, the figures seem to be reasonable. There are significant differences between property prices in various cities and towns (depending mainly on population), a higher price range in locations with a higher price level, a quite exact dependence on amortisation (particularly as regards family houses, residential premises and apartment houses) and significant seasonality in sales. For monetary analyses, the most valuable information is the development of prices over time. The data series are only five years long, but they yield some interesting information:

- there was average annual growth of 10.9% for the overall market;

- residential premises and apartment houses recorded higher growth than the overall market, contrary to family houses, garages and building plots;
- prices have shown an unbroken rise over the whole period (no decline in any quarter).

Nevertheless, there are also some drawbacks. The time lag is the most significant one. Although quarterly periodicity was introduced in the second issue, the publication is released once a year and the time lag is more than one year. A breakdown by new and existing dwellings and by urban and non-urban areas is another missing set of information being considered for analytical purposes.

b) Commercial sources

There are several commercial sources of information on properties and related variables, e.g. rents. They serve primarily for commercial purposes, i.e. to attract potential customers. The nature of the information is dependent on this purpose. It seems that the advantages and drawbacks are almost completely opposite to those of the official sources. There are at least three drawbacks for analytical work. First, the information is based on offer prices, not on real transactions. Second, there is no overall index. Third, time series are not usually available. On the other hand, there is almost no time lag in publishing and the prices are updated quite often, although not in all segments every time.

Nevertheless, these sources provide some useful information about the property market, and especially about its structure, when all additional information is taken into account. This is particularly true in the case of residential properties, since this segment is still highly affected by regulation of rents. There is some interesting information on price levels (the following ratios have been rounded):

- premises in Prague are five times more expensive than those in small towns;
- premises in the historical parts of Prague are twice as expensive than in the suburbs;
- market rents in Prague are three times higher than those in small towns; the ratio is the same for regulated rents;
- market rents are three times higher than the corresponding regulated rents; in specific cases the ratio is even five to one;
- prices of premises are equivalent to fifteen years' rent; the ratio is higher for more expensive premises.

The official and commercial sources are not compatible and we are not able to combine them.

The way forward – intentions of the CNB

The Czech Republic became a member of the European Union in May this year. Before entering the EU, our country underwent intensive preparatory work. The area of statistics was coordinated by both the ECB and Eurostat. Most of the harmonisation work concerned the monetary statistics and balance of payments statistics. The housing market statistics have so far not received the same attention. In our country the proper methodology is now being discussed.

In designing the property price statistics, the following main considerations are being taken into account:

- the information should be produced by an official institution;
- prices should be based on real transactions;
- the information should be published at least quarterly, with the shortest time lag possible;
- an overall index should be available;
- time series should be available.

In addition, the most convenient property segment should be selected for analytical purposes. The costs related to introducing/changing this field of statistics are also being taken into account. It seems that residential property price statistics could cover most of these requirements. As regards monetary policy needs, residential property prices have both direct and indirect impacts on inflation. The indirect path influences inflation through domestic demand. Property price changes affect household income and consequently private consumption, which in turn has a significant impact on inflation. The direct impact works through the level of rents, which are closely related to property prices. Rents form part of the consumer basket and directly influence the consumer price index. As regards financial stability issues, loans provided to households are the most dynamic component of lending. A significant proportion of household loans are closely related to residen-

tial property. Potential changes in prices could jeopardise the financial position of both the creditor institution and households. As mentioned above, banks have recently started offering mortgage loans even for consumption.

The CZSO and CNB have reached agreement on the further development of the property price statistics based on these considerations. First, the CZSO will continue monitoring and publishing property price indices based on tax declarations. There are already five-year time series and it is worth adding more years in the future. The intention is to shorten both the periodicity and the time lag to six months.

Second, in order to overcome the main drawback of the time lag in a systematic way, new data sources will be used. The intention is to survey estate agents and introduce monitoring of property prices based on real transactions. The envisaged periodicity is quarterly, with a time lag of no longer than 90 days for publishing. As regards the structure of the resulting information, an overall index accompanied by a breakdown into new and existing dwellings and urban and non-urban areas is being considered. These plans will be verified in a CZSO-led pilot project in 2005. The project will be evaluated and then a decision will be made on whether to include this monitoring in the standard set of surveys conducted by the CZSO.

Conclusions

Property prices are an important indicator for both monetary policy and financial stability analyses. Nevertheless, their role in the Czech Republic remains rather indicative, owing to insufficient available information. The CNB uses the existing information based on tax declarations for property purchases and sales. This information is of good quality, but the time lag between publishing and the period to which they relate is too long. A switch from this source to information obtained from estate agents seems to be the most promising way forward to create more up-to-date information for analyses.

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DISCUSSANTS' COMMENTS

Papers for discussion

R.B. Barman and G.P. Samanta:
"Banking Services Price Index: an explanatory analysis for India"

Per Nymand-Andersen, Mora Golding and Antonio Moreno:
"Measuring prices from financial instruments: Yield curve modelling"

Discussant: Richard Walton (Bank of England)

R.B. Barman and G.P. Samanta: "Banking Services Price Index: an explanatory analysis for India"

General

The paper is limited to bank services in relation to financial intermediation. It gives a good summary on the literature and the different views propounded in this area over the years and then goes into detail of the empirical work conducted by the Reserve Bank of India. The paper includes a sentence which seems to sum-up this field "The concept of user cost and FISIM have intuitive appeal but pose certain difficulties for practical implementation" – it is a challenging area and thus attracts a lot of attention.

Comparisons with the UK

The paper does demonstrate that the Reserve Bank of India had to deal with similar issues to those which we faced in the UK. The paper notes that fees information is relatively easy to measure, and acknowledges the prime difficulty is indirect measurement of the service element within the interest charged. It reaches a similar conclusion to ours: that the key to solving the problem is identification of a reliable reference rate. The UK went through a similar study before concluding that repo was the most appropriate. But, we accept that, as does the Reserve Bank of India (page18) that our price index remains sensitive to changes in repo.

Because of the focus on the reference rate, little attention is given in the paper to other difficulties which the UK tried to address. One of these was estimating the fees element, since fees by sector of the economy were not available prior to the introduction of new reporting Form to be completed by banks and collected by the Bank of England. Another was the need to adjust service income (to obtain the service price) to account for the changing number of loans and deposits and for the changing sample coverage of banks. We also considered the Banking Corporate Service Price Index (CSPI) in the context of the overall CSPI, whereas the Reserve Bank of India project appears to have been conducted independently.

FISIM: Technical comments

Occurrence of negative FISIM

One can disagree with the statement on negative FISIM. The concept of calculating FISIM is the net production of FISIM and the calculation of loans and deposits should not be analysed separately. In other words, negative FISIM should be considered as a problem when occurring at an aggregate level for loans and deposit together (margin of FISIM), and not when it occurred on loans or deposits individually.

The good news is the occurrence of negative FISIM (allocated) is only sporadic and rare.

Reference rates

According to the European Council Regulation 448/98, Annex III, two reference rates are required to calculate and allocate FISIM output. An "internal" reference rate is required to obtain FISIM output of the resident Financial Institutions by institutional sector, and is calculated as the ratio of interest receivable on loans between S122 and S123 to stocks of loans between S122 and S123.

$$\frac{\text{interest receivable on loans between S.122 and S.123}}{\text{stock of loans between S.122 and S.123}}$$

Part of the FISIM output is exported and imported. To determine FISIM imports and exports, the reference rate used is the average interbank rate weighted by the levels of stocks in the headings `loans between S122 and S123 on the one hand, and non-resident Financial Institutions on the other hand' and `deposits between S122 and S123 on the one hand, and non-resident Financial Institutions on the other hand', which are included in the balance sheet of the financial intermediaries. This calculated rate is the "external" reference rate, which is used to calculate FISIM exports and imports.

$$\frac{\begin{array}{l}\text{interest receivable on loans between FIs resident and FIs non - resident +}\\ \text{interest payable on deposits between FIs resident and FIs non - resident}\end{array}}{\begin{array}{l}\text{stock of loans between FIs resident and FIs non - resident +}\\ \text{stock of deposits between FIs resident and FIs non - resident}\end{array}}$$

FISIM at constant prices and price deflators

The following simplified formula, as in Eurostat "Handbook on Price and Volume in National Accounts", can be used to calculate FISIM at constant prices.

$$\frac{\text{effective margin x stocks}}{\text{price index}} x \frac{\text{base year margin}}{\text{effective margin}} = \text{stocks at constant prices x base year margin}$$

Calculation of FISIM at constant prices starts from calculation of the base-year margin for loans and deposits by user sectors and export and import. The margin is equal to the difference between the effective rate on loans and deposits and the reference rate for base year. The effective rate is the ratio of accrued interest to stocks of loans and deposits. Then the stocks of loans and deposits are deflated using the implied price deflator for domestic final demand.

The average volatility of FISIM at constant prices is low and its impact on GDP growth is quite small. However, in some countries, where large deposits are held in foreign currencies and thus would required adjustments for the fluctuation in exchange rates before applying the price deflator.

Per Nymand-Andersen, Mora Golding and Antonio Moreno: "Measuring prices from financial instruments: Yield curve modelling"

General

This is a fairly uncontroversial paper which reviews the methodologies of yield curve modelling. The objective is to conduct empirical tests of various models and to define and produce financial market yield curves using an agreed European methodology. The paper doesn't take a stand on a particular method.

Comparisons with the UK

The Bank of England estimates and publishes yield curves for the UK on a daily basis. They are two kinds. One is based on yields on UK government bonds and on yields in the general collateral repo market. It includes nominal and real yield curves and the implied inflation term structure for the UK. The other set is based on sterling interbank rates (LIBOR) and on instruments related to LIBOR (short sterling futures contracts, forward rate agreements and LIBOR-related interest rate swaps). These commercial bank liability curves are nominal only.

Technical comments

Some minor comments are presented here:

- Section 2; fourth paragraph: The yield curve is associated with market expectations of future policy rates. However, this is only the case if investors do not require compensation for facing risk. Otherwise, these risk premia will drive a wedge between the yield curve and market expectations. Therefore, it may be optimistic to write that "Thus, a good picture of anticipations prevailing in the market with regard to monetary policy moves can be drawn".

- Section 3; first paragraph: The final sentence only holds if one is considering the nominal term structure. By contrast, real term structures will not reflect future inflation. It is surprising that a brief discussion of the demarcation between nominal and real yield curves and the different inferences one may draw from them, is not included in the paper.

- Footnote 8 contains references to old theories of the term structure. However, none of the new models are mentioned in the paper. For instance, there is an ECB Working Paper: Hordahl, Peter, Oreste Tristiani, and David Vestin (2002). "A Joint Econometric Model of Macroeconomic and Term Structure Dynamics". The literature reviewed in the paper could be more "up-to-date".

- Section 4.2.: Unlike spline-based methods, parametric models result in yield curves that asymptote at long maturities. The text does not say that this property runs counter to the observed stylised fact that market long-maturity bond yields tend to be lower than shorter yields due to convexity: the relationship between bond prices and yields is convex. Specifically bond prices increase more for a fall in yield that they decline for an equivalent rise in yield. As such, one could argue that this is an important disadvantage to parametric models such as N&S.

- Section 4.3: the paper does not go into the intuition about why Waggoner chooses a variable roughness penalty. The paper just says that it allows flexibility at the short-end; but it is also because the market can be split into bills, notes and coins. The paper is probably right that this basically boils down to the short-end being more flexible than the long-end, but the bills/notes/coins argument should at least be referred to. Similarly, Anderson/Sleath (2001) argue that since our expectations of the long-end should be constant, the curve should be less flexible further out.

Notes on the Bank of England UK yield curves

The methodology used to construct the yield curves is described in the Bank of England *Quarterly Bulletin* article by Anderson and Sleath (1999) and a detailed technical description can be found in their Bank of England Working Paper no.126, 'New estimates of the UK real and nominal yield curves'. The way in which the methodology is adapted for the commercial bank liability curves is described in the *Quarterly Bulletin* article by Brooke, Cooper and Scholtes (2000) – see especially the appendix. For examples of the way in which the Bank uses and interprets these data, see the Money and Asset Prices chapter of the Bank's *Inflation Report*.

The government liability nominal yield curves are derived from UK gilt prices and General Collateral repo rates. The real yield curves are derived from UK index-linked bond prices. By appealing to the Fisher relationship, the implied inflation term structure is calculated as the difference of instantaneous nominal forward rates and instantaneous real forward real rates. The instruments used in the construction of the commercial bank liability curve are first converted into synthetic bonds and the same method is then used to produce the commercial bank liability curve as is used for the nominal government curve.

The spreadsheets on the Bank's website provide spot rates and instantaneous forward rates for each type of curve. They show available points on each curve out to a horizon of 25 years at half-yearly intervals. For horizons out to five years, points on the curves are also available at monthly intervals.

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DISCUSSANTS' COMMENTS

Papers for discussion

Petr Vojtisek:
"Monitoring property prices in the Czech Republic"

Kelvin Fan and Wensheng Peng:
"Measuring and monitoring property prices in Hong Kong"

Discussant: Henning Ahnert (European Central Bank)[1]

1. Introduction

It is a pleasure to have the chance to comment on two interesting papers of three distinguished authors. Since for obvious reasons the work on property price statistics within the ECB is focussed on euro area price statistics, I cannot claim to be an expert in the statistical issues of property prices neither in the Czech Republic nor in Hong Kong. Nevertheless, I hope to be able to very shortly summarise the main messages that I deduct from the papers, and raise some issues for further consideration. Moreover, I will try to review the papers against the perspective of international developments in the field of property price statistics.

2. Monitoring property prices in the Czech Republic

Petr Vojtisek (Czech National Bank, CNB) reviews in his paper the use and availability of property price statistics for the Czech Republic. He underlines that it is important for monetary policy to understand the causes and effects of asset price changes, as they have implications for the development of other macroeconomic variables and for the impact of monetary policy on these variables. The author distinguishes between the factors that influence property prices (notably household income, interest rates, and the sticky supply) on the one hand and effects of changes in property prices on the economy (investment, consumption and lending) on the other. Unfortunately, and similarly to many other countries, the information provided by the existing Czech property price statistics are only "indicative" due to their limited quality. Two sources are described in some detail; the official and main source is a property price index compiled by the Czech Statistical Office. This index is derived from comprehensive administrative files, but suffers from publication delays of more than 12 months. The second source is price data from commercial sources, mainly estate agents. Whilst very timely, these data have a number of serious statistical shortcomings (providing offer prices; lack of consistent time series).

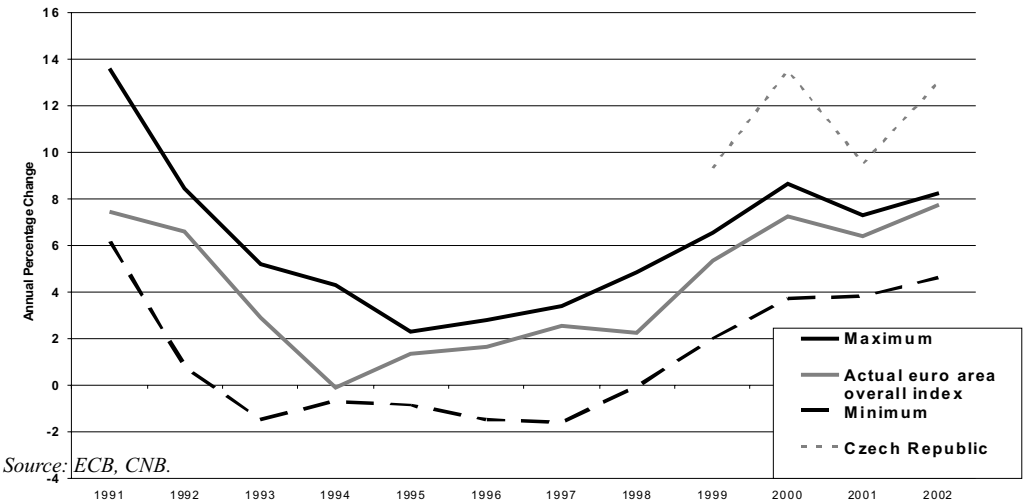
When discussing the envisaged improvements to property price statistics in the Czech Republic, it is useful to underline the most important precondition for initiating it: the CNB considers good quality, high frequent and timely property price statistics as indispensable for conducting monetary policy and ensuring financial stability. Improvements to property price statistics are considered a high priority and agreement was reached between the central bank and the national statistical institute on the way forward. Moreover, joint targets have been formulated that, as far as I am able to judge, inline with existing recommendations by the IMF Financial Soundness Indicators, work done by Eurostat in the HICP context and, last but not least, broad objectives formulated by the Statistics Committee of the ECB, for monitoring residential property price changes in the EU.

1 *The author is Head of the General Economic Statistics Section in the ECB; the views expressed in this paper are those of the author and do not necessarily reflect the views of the ECB.*

As regards the latter it should be in particular supported that the work in the Czech Republic targets a quarterly index published after 90 days, the availability of an aggregate "overall" residential property price index for the country, with a breakdown into existing and new dwellings, as well as urban and non-urban areas. The close cooperation of the CNB and NSI in this respect is perhaps the most notable achievement. It may serve as an example for other countries, or, at EU level, also as an input for the co-operation between Eurostat and the ECB.

It is difficult to disagree with any of the views put forward by Petr Vojtisek. If there is one, then it is the seemingly very critical assessment of the available official Czech property price statistics. The author concludes that "a switch from this source to information obtained from estate agents seems to be the most promising way forward to create more up-to-date information". Considering the reported qualities of the existing data source, this statement appears to deserve further discussion. Compared to the very difficult situation in several other European countries, including most of the largest countries, the primary source available in the Czech Republic has a number of features which seem to be very valuable: it covers all or almost all transactions rather than just a small sub-sample; it shows actual transaction prices, rather than offer prices; it is derived from mandatory tax registries, which may be assumed to be a high quality source; it is made available to the statistical office every month and the primary information is available no later than 30 days after the purchase has been agreed by the Land Register, which seems to suggest that a quarterly and timely index is possible. We may also assume that the tax registers contain some, at least, basic information on the property type which could be used for quality adjustment (size, location, age?). Most importantly, it is a source for statistics that already exists and one that can be built on, given the stable institutional environment. The question may arise whether data derived from real estate agents would achieve a similar quality. Experience from other EU countries also tells that developing alternative property price indicators could raise new questions, since there are hardly any two property price indicators which show fully consistent results. In order to demonstrate this, the ECB has taken for each of the countries where we have at least one alternative source (DE, GR, ES, FR, IE, IT) the highest and lowest reported annual growth rate for each period from the alternative series and then created a "minimum" and a "maximum" euro area aggregate. For countries where only one reasonable national source exists, we have used the same series in both aggregates. The results are presented in chart 1 together with the actual ECB euro area overall index. For comparison, we also added results for the Czech Republic.

Residential property prices in the euro area and the Czech Republic
(annual percentage changes)



Source: ECB, CNB.

3. Measuring and monitoring property prices in Hong Kong

Kelvin Fan and Wensheng Peng (Hong Kong Monetary Authority, HKMA) provide a very interesting survey of recent property market developments in Hong Kong. When discussing it, it is perhaps most useful to focus on the particularities of the market in Hong Kong and the difference to other countries or the euro area. Prices in Hong Kong have been very volatile over the last decade; they roughly doubled from 1993 to 1997, but then fell sharply below 1993 levels by mid 2003.

However, recently a significant increase took place, which has been, in view of the authors, in line with economic fundamentals.

Interesting observations on the market in Hong Kong are: the role of the property market is substantial: half of domestic credits are for property development and investment; properties are widely used as collateral for consumer and business loans; land sales and property taxes are a significant source of government revenue; property prices impact significantly on CPI developments through the direct channel on rent prices, and indirectly via demand effects. The number of property transactions varies sharply, despite the recent activity on the housing market it is only about a quarter of the number during the bubble period before 1997.

The authors give a very useful example of how to integrate the analysis of property prices in a broader analysis of the financial conditions and the interaction with the real economy. This analysis allows the authors to derive the essential conclusion that the recent sharp price increase is not in contrast to the economic fundamentals. Some of these indicators are well known, such as the measures of affordability (in its simplest form the ratio of property prices to nominal GDP). Others are less well known, such as the "Buy-rental gap", calculated as the difference between funding costs and rental yields.

Two observations may be made on the paper. First, the paper proves how useful and important it is to have high frequent and up to date statistical information on the property market. The Hong Kong Rating and Valuation Department (RVD) supplies a number of price and volume indicators on behalf of the Government. This includes unit values and price indices on rents and property prices, data on completions and statistics on transactions. Most of the results are available both for residential as well as commercial property, broken down by regions and building classes. The publication available on the Internet contains monthly results available up to July 2004.[2] It goes without saying that this source – combined with the information from financial statistics of the HKMA – provides an excellent source for the analysis of the property market in Hong Kong. The statistical data appears to be also sufficient to meet several of the definitions of the Financial Soundness Indicators of the IMF (e.g. the encouraged indicator on property prices, and related structural indicators).

Given that the paper is called Measuring and Monitoring Property Prices in Hong Kong, their paper could be further enhanced by providing more information on the statistical methods used for measuring property prices. Some information is available in a previous paper by the authors as well as from the RVD website. According to this, the indices measure price changes as the ratio of sales prices divided by a fixed annual rental value adjusted for quality differences, weighted by the number of transactions. Further information on *how* the adjustment is done is not available. My understanding is that the statistical quality of this price indicator depend on the accuracy of the quality corrections made for rental values. The method used for quality adjustment itself is not explained in the available documents. One might object, however, that this implies the use of the same quality features and the same implicit valuation of quality features for rented and purchased dwellings. This is a strong assumption. For example, in a dynamic market such as Hong Kong the land size of the dwelling is likely to be an important factor, and expected increases in the land price are likely to be positively valued by the purchaser of a house, but less relevant for tenants. Another example may be the age of the house which usually has higher relevance for purchases of a dwelling than for the rent. Furthermore, in a volatile market it may also be discussed whether the aggregation of sub-indices according to transaction shares should possibly be compared with results weighted by shares in the housing stock. The latter would lead presumably to more stable results, since the influence of changing weights on the price index development is reduced. However, while these measurement issues are relevant from a statistical methodology point view, they are in a housing market which is, as dynamic and volatile as in Hong Kong, unlikely to result in a fundamentally different economic analysis.

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2 *See Hong Kong Property Review Monthly Supplement, Rating and Valuation Department, September 2004 (www.info.gov.hk/rvd/).*

3 *The author is Head of the General Economic Statistics Section in the ECB; the views expressed in this paper are those of the author and do not necessarily reflect the views of the ECB.*