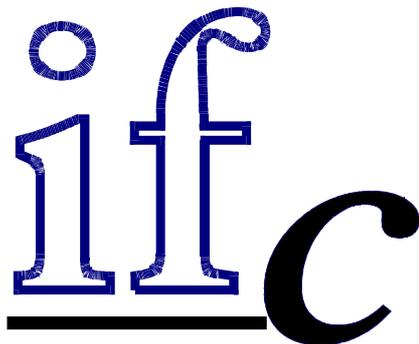


IRVING FISHER COMMITTEE  
ON CENTRAL-BANK STATISTICS

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*ifc Bulletin*

Nr. 1 • November 1997



The Irving Fisher Committee is part  
of the International Statistical Institute

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*First Meeting of the Irving Fisher  
Committee*

*18-26 August 1997  
Istanbul*

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**Commemoration of Irving Fisher**

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**Contributed Papers**

# *ifc Bulletin*

Nr. 1 – November 1997

## Irving Fisher Committee on Central-Bank Statistics

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# ADMINISTRATIVE MEETINGS

## Minutes of the Administrative Meetings, Istanbul, 20 and 21 August 1997

### Meeting on August 20, 1997 (4.30 PM)

*The meeting was attended by the following persons:*

*Rudi Acx, Gregor Bajtay, João Cadete de Matos, Orlando Caliço, Mohammad Hossein Farnoudi, António Garcia, Jose M. González-Mínguez, Igor Jemriæ, Mahmut Kalkan, Louis Kincannon. Ahmet N. Kipici, Paolo S. Lopes, Fredric Malek, John McLenaghan, Bart Meganck, Assadollah Monajemi, Manoocher Noorbakhsh, Jacques Pécha, Ay<sup>o</sup>e Peker, Ebrahim Sheibany, Hans van Wijk, Carlo Winder, Emerico Zautzik.*

The *Chairman* (Mr. Van Wijk) opened the meeting noting that the Irving Fisher Committee, although it had been established some time ago, could be considered as coming to life at the present meeting, and that this meeting therefore could be regarded as its inaugural meeting. He announced a modification of the provisional agenda, as Dr. Kenessey's speech on Irving Fisher as a national accountant had to be postponed to a second meeting on the following day. That meeting would be devoted to a discussion of the future of the Irving Fisher Committee and to the election of a new Chairman.

After this introduction the Chairman delivered a speech in commemoration of Irving Fisher.

In the second part of the meeting attention was given to the three contributed papers.

Dr. Barta's paper entitled, "Irving Fisher and the Modern Theory of Indices", was – given the author's absence – introduced by Mr. Meganck, who commended the very fundamental treatment of the characteristics of Fisher's Ideal Index.

The paper written by Messrs. Kalkan and Kipici and Mrs. Peker on leading indicators of inflation in Turkey was introduced by the last-mentioned author. During a short discussion some surprise was expressed about one of the findings, viz. that in Turkey the interbank interest rate behaved as a good leading indicator of inflation.

Mr. Monajemi's introduction of his paper on Price Compilation and Construction of various Price Indices in Iran was listened to with interest. The author answered a question on the division of competencies between the central bank and the statistical office in Iran.

The *Chairman* reminded the audience that the papers to be dealt with during the Invited Papers Session to be held on the following morning were to be considered as part of the first harvest of the Irving Fisher Committee. He urged those present to attend that meeting, as well as the second Administrative Meeting to be held the next day in the afternoon. He also specified a series of issues concerning the future of the Irving Fisher Committee which he intended to raise in the latter meeting.

The Chairman closed the meeting at 6.30 PM.

**Meeting on August 21, 1997 (4.30 PM)**

*The meeting was attended by the following persons:*

*Rudi Acx, Gregor Bajtaj, Peter Bull, João Cadete de Matos, Orlando Caliço, António Garcia, Jose M. González Mínguez, Igor Jemrić, Zoltan Kenessey, Mrs. Kenessey, John Kidgell, Paolo S. Lopes, Fredric Malek, John McLenaghan, Bart Meganck, Assadollah Monajemi, Jacques Pécha, Ebrahim Sheibany, Almut Steger, Hans van Wijk, Emerico Zautzik, Willem R. van Zwet.*

The *Chairman* opened the meeting and invited Dr. Kenessey to deliver his speech on “The Significance of Irving Fisher’s Ideas for National Accounts”.

As an introduction to a discussion on the future of the Irving Fisher Committee, the *Chairman* briefly reviewed the events that had preceded the present meeting.

At the 1995 ISI-Session in Beijing, a few central bankers agreed with a proposal to establish a forum, within the ISI, in which central-bank statisticians would be able to meet ordinary ISI-members in order to discuss topics that were of special interest to central banks. The topics could range from the development of indicators, to the development of classification systems (Financial Accounts), survey sample theory, regression analysis, time series analysis (index number problems, seasonal adjustment methods). These proposals were presented to the President of the ISI and to Dr. Kenessey.

With respect to the set-up of the forum, Dr. Kenessey proposed to establish a special committee within the ISI, to be called the Irving Fisher Committee, which could organise its own sessions. This committee would be chaired by a central banker, and all central banks would have the right to participate.

It was agreed that discussions about the proposal, between one or two representatives of the central banks and Dr. Kenessey would continue, provided that a sufficient number of central banks displayed interest. As Dr. Kenessey resided in the Netherlands, where he directed the Permanent Office of the ISI, Mr. Van Wijk was requested to act as an intermediary between central banks and the ISI.

By the beginning of 1996, Mr. Van Wijk had assessed the interest of a number of central banks and several international institutions in regard to this kind of co-operation with the ISI. The responses had been somewhat mixed, but there appeared to be a clear majority in favour of the proposal.

Dr. Kenessey had recommended proceeding on with establishing the Irving Fisher Committee. It was agreed that Dr. Kenessey would propose the creation of this committee to the Executive Committee/Council of ISI, which was to meet in March 1996. As Dr. Kenessey deemed it necessary to be able to announce the name of the chairman of the Irving Fisher Committee, Mr. Van Wijk had volunteered for this function, and Mr. Meganck offered to organise the first meeting of the Committee. In order to ensure that the work of the Irving Fisher Committee would be closely coordinated with the International Association for Official Statistics (IAOS), Mr. Meganck attended the IAOS 5th Conference in Reykjavik in July 1996.

By that time, most of the development effort had shifted to Mr. Meganck. He tried to arouse the interest of a wider group of central banks to attend the Istanbul meeting of the Irving Fisher Committee.

The *Chairman* thought that the “Invited Papers” Session, which had been scheduled for the morning of the present day, had in some respect been disappointing. There had been some excellent papers, the number of participants had been higher than expected and the meeting had been well organised. Nevertheless the primary purpose of the Irving Fisher Committee had not been attained, given that discussions between central bankers and ordinary ISI-members had not taken place.

The discussion then turned to the future of the Irving Fisher Committee. The *Chairman* proposed structuring the discussion around the following questions:

1. Shall the activities of the Irving Fisher Committee be continued?
2. Which categories of statisticians should be members of the Committee and – related to this question – which topics should be studied in the Committee?
3. How should future meetings be organised?
4. How should members communicate in the period between meetings?
5. Who should be the next *Chairman*?

*Mr. Kidgell* thought that the future set-up of the Committee would very much depend on the kind of topics focused upon, but that these topics were not as yet clearly defined. In the course of the ensuing discussion it was noted that the value added by the Irving Fisher Committee should be seen in providing for opportunities not available to central banks participating in other associations.

*Mr. Lopes* added that, before organising the Istanbul meeting, it would have been necessary to broaden the basis of the Committee by securing the attendance of more central banks. He recommended getting in touch with a senior statistician in a great number of central banks.

*Mr. Meganck* considered that the Committee, once its viability is proven, would consolidate its position by requesting access to the IAOS.

*Mr. Jemrić* noted that the ISI at large could probably benefit from the existence of the Irving Fisher Committee, since financial statistics did not seem to get much attention within the ISI.

*Dr. Kenessey* advised the Irving Fisher Committee to focus on financial market statistics.

*Mr. Cadete de Matos* reckoned that only an enhanced attractiveness would motivate central bankers and ordinary ISI-members to participate in its meetings and strengthen the Committee's position. This should be achieved through a thorough analysis of the needs existing in central banks.

In response to the question whether membership should be confined to central bankers, it was reiterated that the primary objective was to foster communication between central bankers and ordinary ISI-members. To reach that goal it would be necessary to extend membership beyond central bankers and to co-operate closely with them on the subjects to be dealt with at the meetings. However, in the ensuing discussion it was generally felt that the final selection of the topics should fall under central bankers' competence.

The *Chairman* noted that he was close to retirement from the Nederlandsche Bank, and he urged that a successor be found by the Committee since he considered it very important that the Chairman have the backing of the institution which employs him.

After some discussion, *Mr. Zautzik* was nominated Chairman. *Mr. Zautzik* accepted the nomination, but he had to check with his superiors to ensure that his responsibilities at the Banca d'Italia were compatible with the chairmanship of the Committee. It was agreed that a written procedure to elect a new Chairman would be used in the case that *Mr. Zautzik* would be unable to continue in that capacity.

It was agreed that a Bureau of the Committee should be established, comprising the new and the outgoing Chairman, *Mr. Meganck* and *Mr. McLenaghan*, in order to formulate the future strategy and to decide on the topics for the following meeting. Although it was felt that the Irving Fisher Committee should seek an early opportunity to manifest itself, it was considered, that from a technical point of view, it would hardly be possible to organise a meeting before the 52nd ISI-Session in Helsinki (1999).

The Chairman promised to consider whether he might be able, after his retirement from the Nederlandsche Bank, to continue contributing to the organisation of the activities of the Irving Fisher Committee, by helping with the edition of a Newsletter. This additional help from *Mr. van Wijk* would only be possible provided that he could have the assistance of a secretarial office. *Mr. Meganck*, of the National Bank of Belgium, agreed to provide the necessary support (printing of publications, mailing). For the sake of continuity, he suggested to establish the secretarial office of the Irving Fisher Committee within the National Bank of Belgium.

There was some discussion on procedures for generating interest in the Committee by a wider range of central banks. *Mr. McLenaghan* offered to arrange for the International Monetary Fund to make available its list of IFS statistical correspondents for this purpose.

The Chairman closed the meeting at 7.15 PM.

# COMMEMORATION OF IRVING FISHER

## Scholar in pursuit of the common good

*Speech delivered at the Inaugural Meeting of  
the Irving Fisher Committee, Istanbul, August 20, 1997,  
by Hans van Wijk, Chairman of the Committee*

### Introduction

The Committee has attached its existence to the person of Irving Fisher, who died fifty years ago, eighty years old. It had been envisaged for a very long time that a person far more competent than I would deliver a speech to commemorate this great American economist and statistician. As this essential element of our inaugural meeting threatened to fall away, I will endeavour to present you in this meeting with at least an outline of Fisher's life and achievements. As I am not a true scientist, I know that this is a risky venture. It is to be expected that my presentation will lack the necessary quality to honour our illustrious forerunner and will not be up to your standards.

When Fisher died, he had become renowned, not only as a scholar, but also as a crusader and social activist, as an inventor and as a businessman. At first sight, this seems to be a somewhat bizarre combination of qualities, but it makes one realise that Fisher was a very practical man, with an open eye for the problems and requirements of the day. Indeed, fundamental scientific issues did not keep his attention for a long time; also as a scholar, he had the attitude of an engineer, inventing quick and efficient solutions for practical problems. He was busy with many things simultaneously and he would rapidly switch between subjects and activities. In this respect, it might be illustrative to quote a substantial, though somewhat abbreviated passage from Allen's book:

“On March 23, 1925, for example, he might spend the entire morning alone, ... puzzling through a labyrinth of equations and partial derivatives at the frontier of economic theory. ... all in preparation for a scientific book that would not appear in print for five years. The afternoon he might have invited his two graduate students to his office for his weekly seminar. The students were studying a paper, “Our unstable Dollar and the So-called Business Cycle”, that Fisher had presented at the last American Statistical Association Meeting. In it he challenged the notion of the business cycle and endeavoured to explain fluctuations in production by changes in the price level. ... Later, when his students had left, he would change direction and write furiously for two hours on his next book, a condemnation of alcohol and enthusiastic support for Prohibition. In support of another of his causes, he would give a speech to a Yale student group on the absolute necessity for America to join the League of Nations in order to maintain world peace. Alternatively, he might address a group of nurses on the importance of fresh air, exercise, and a proper diet for the maintenance of good health. ... The next morning Irving Fisher might take the train from New Haven to Grand Central Station in New York. There he would take a taxi to the Kardex-Rand Company to continue negotiations of its merger with Index Visible, Inc., a company he owned and operated, in which his 15-year-old invention of a card-indexing system was the principal asset. ... In the afternoon he would confer with a leading New York physician, persuading him to write a contribution for a new edition of *How to Live*, the

best-selling hygiene book that he had originally contributed to, edited, and published in 1915. After dining at the Yale Club, he would talk to a publisher's representative about issuing a new and revised edition of his 1922 statistics book, *The Making of Index Numbers*."

### Early life and character

This kaleidoscopic view of two days' activities will have given you a good first impression of the person of Irving Fisher. I will now dwell somewhat longer on his personality and character. He was born in 1867 in a harmonious and devout family. His father was a minister of the Congregational Church. At a very young age he already gave evidence of an inquisitive and original mind and a strong sense of right and wrong, which certainly was fostered by the climate of New England Puritanism in which he was brought up. All his life he felt a responsibility for the well-being of mankind at large, and he espoused many causes which promised to create a better world. He had a tremendous capacity for work and he committed himself to his many tasks and projects with an optimistic mind and an unbounded energy. He was also devoted to the people close to him. After the early death of his father, he supported his mother and younger brother. He adored his wife and he was a dedicated father to a son and two daughters.

Strong and weak points in one's character are mostly closely bound up, and we can also notice that in Fisher's case. He was considered as excessively serious and devoid of any sense of humour. The doggedness with which he strove for a better world was depreciated by many as obsessive. The kind of causes on which he spent his energy and the originality of many of his views and convictions made him an eccentric in many eyes. He was impatient, which gave him a short-term attitude. He was too restless for lengthy projects. He preferred to accomplish several small tasks in a short period. His optimism gave him strength to persevere, but it made him also vulnerable to risks and to the wickedness of others. Optimism made him imprudent, even reckless, in business. His wife seems to have saved him from many accidents and misfortunes.

He was not a diffident man. On the contrary, he was always very much satisfied with himself and he could use every means to propagate his ideas and convictions. He might have been irritating to others by his lack of flexibility, his shunning of compromise and his domineering attitude; he always considered himself as the only person fit to bring a project to its successful completion. He was also very dominant at home, he saw himself truly as the head of the family.

A more trivial fact, which nevertheless could give us some idea about his personality, was his fancy for expensive motor cars and fast driving.

For most of his life, Fisher was a physically strong and healthy man. As a boy he had already been very much interested in a healthy way of living. But in the earlier part of his professional career, just after he had become a full professor, he contracted tuberculosis and had to be treated for several years in a sanatorium. This experience added to his addiction to everything that could contribute to his own health as well as to the state of public health, in the first place abstention from alcohol and smoking.

### Irving Fisher as a scholar

After having broadly typified the personality of Irving Fisher, it is time to describe more in detail his achievements, his fortunes and misfortunes. I shall start with his work as a scholar. As a boy, he decided that he could serve society best by becoming a teacher. In 1884, the year that his father died, he was admitted to Yale University in New Haven to prepare himself for a career as a teacher of mathematics. There were some financial worries, but by tutoring he managed to overcome these problems. In the course of his mathematical study, his interest in economics was aroused. He started to consider mathematics as an applied science, as a convenient tool to analyse and describe economic processes. Indeed, his doctoral thesis, *Mathematical investigation in the theory of value and price*, evidenced the shift in his interest. This book, his most thorough contribution to pure theory, undertook to determine the value of goods by marginal utility equilibrium analysis and could be classified as much as a study in economics as one in mathematics. It should be noted that at the time the world knew only half a dozen economists who made use of mathematics; none of them Americans. For the benefit of non-mathematicians a pictorial representation of a

mechanical-hydraulic device was offered, which suggested how the economy, according to Irving Fisher, worked. The book received much acclaim. Later on, it was highly commended by Schumpeter and Frisch. Tobin typified it as a masterful exposition of Walrasian general equilibrium theory. Paul Samuelson has called it the greatest doctoral dissertation in economics ever written.

After having acquired his Ph. D., Fisher remained at Yale, where he started to teach mathematics as an assistant professor. During this period he wrote a textbook on mathematics for his students and he built the 'price-level machine' presented in his thesis, to depict how general equilibrium was attained.

In 1893 he married Margaret Hazard, the daughter of a wealthy manufacturer. The couple spent a lengthy honeymoon in Europe, which offered Fisher an opportunity to meet nearly all leading economists of his time. In 1895, he switched, still as an assistant professor, from the mathematics department to the department of political economy. Distressed by the insufficient mathematical knowledge of his students, he wrote *A Brief Introduction to the Infinite Calculus*. This book was regularly reprinted for more than 40 years.

In 1898 he became a full professor of economics. In his scientific work he turned to issues which were more related to the real world. He saw it as his task as a scholar to explain how the economy actually works and how practical problems could be resolved. In this respect two domains should be mentioned explicitly: the investigation of economic interdependencies and the role of money in the economy.

### ***Economic interdependencies***

Fisher's main achievement in establishing economic interdependencies was his reformulation, with mathematical precision, of the vaguer notions which had been presented by earlier and contemporary economists, structuring them in a coherent neo-classical theory. He brought clarity by using exact definitions and by investigating quantitative relationships by the use of empirical analysis, based on statistical methods. Good examples of how he fitted definitions into a rational scheme are offered by *The Nature of Capital and Income*, published in 1906, and *The Rate of Interest*, which appeared one year later.

All his life, Fisher had been fascinated by the phenomenon of interest. As early as 1896, he tried to demonstrate with statistical methods that a movement in the price level tended to be compensated by a proportional movement in the rate of interest. Later he established that interest changes would not fully compensate price changes. He believed that this lack of complete adaptation was a temporal aberration, which explained the existence of business cycles. In the twenties he became convinced that the business cycle was an essentially monetary phenomenon. I shall come back to this in my exposition of Fisher's views on the role of money. In 1933, during the Great Depression, Fisher conceded that over-indebtedness was an additional factor which could explain the economic slump.

However, before the Great Depression, Fisher had not been very much concerned with the business cycle. He was much more interested in analysing the conditions determining the underlying trends. In this respect, he attached great importance to saving. He saw saving as the driving force behind economic growth. In this reasoning, Fisher was very much removed from the vision of the working of the macro-economic system as it was presented at a later stage by Keynes.

In 1930 Fisher published *The Theory of Interest*, which restated his earlier studies on the interest rate. This book came close to the foundation of macro-economic analysis, the analysis of the functioning of a national economy as a whole. Allen quotes James Tobin, who has recognised that; Tobin wrote:

"In his neo-classical writings on capital and interest Fisher had laid the basis for the investment and savings equations central to modern macroeconomic analysis. Had Fisher pulled these strands together into a coherent theory, he could have been an American Keynes. Indeed, the 'neo-classical synthesis' would not have had to wait until after the Second World War. Fisher would have done it all himself."

### ***The role of money***

With respect to the role of money in the economy, Fisher contributed more to statistics and policy than to theory. Throughout his life Fisher considered instability of the value of money as a major social and economic evil. He took up the very old notion laid down in the quantity theory of money to analyse the role of money in the economy. His Equation of Exchange,  $MV = PT$ , is probably the best-known formula ever used by an economist. He introduced this equation in 1911, in his book *The Purchasing Power of Money*. To eliminate the social drawbacks of price instability, he propagated a kind of indexation by adapting the gold content of the dollar to the movements in the general price level.

It is interesting to note that in Fisher's view the money supply consisted not only of currency and banknotes, but also of bank deposits. The management of the money supply was primarily to be directed at the process with underlies the creation of bank deposits. This kind of reasoning is nowadays so self-evident that it is difficult to imagine that it was not generally understood when Fisher first came up with it.

In the twenties, in a period of rising prices, Fisher came to consider the business cycle as a monetary phenomenon, to be explained directly by price instability. He reached this conclusion after a statistical analysis of data on prices and production, in which he established a positive correlation between movements in the production level and movements in the price level. In a later stage he discovered a similar relationship between changes in prices and changes in employment. Solow reminds us in a recent article that some readers concluded that Fisher, by establishing this relationship, had been anticipating the Phillips curve, but Solow observes that Phillips saw the causal relationship the other way round. Fisher concluded that the business cycle could be prevented by a policy directed at strict price stability. In his view, price stability should be warranted by controlling the money supply.

During the Great Depression, Fisher shared the view of many other economists that a devaluation of the dollar would be a precondition for breaking the deflationary spiral. After that devaluation, the money supply should, in Fisher's view, be expanded to such an extent that prices would move back to their 1926 level. The monetary expansion should be effectuated by the Federal Reserve System. This recommendation characterises him as a monetarist *avant la lettre*. He was opposed to any kind of fiscal policy, which means that his prescription differed fundamentally from the one Keynes would put forward a few years later in his *General Theory*. Allen doubts whether Fisher has ever understood Keynes' magnum opus.

### ***Statistics***

A review of Fisher's activities as an economist brings us as a matter of course to his achievements as a statistician. When developing his Equation of Exchange, he felt the need to construct an index which would adequately measure the values of P and T. He scrutinised all kinds of index numbers and arrived, in 1920, at the conclusion that the ideal one would be approached by the geometrical average of the indices of Laspeyres and Paasche. This index, which subsequently became to be known as Fisher's Ideal Index, met two important conditions: the time reversal test and the factor reversal test. More information about these tests is contained in the paper of Janos Bárta.

Towards the end of the twenties, when analysing the relationship between price movements and production movements, Fisher was the first to apply the concept of distributed lags, as he realised that price changes would not exert their influence on production in one period, but gradually over several periods.

It might also be interesting to note that Fisher, in a paper written in 1917, gave an important impetus to the use of the logarithmic chart, a device virtually unknown before.

His many accomplishments in the field of statistics make him one of the pioneers in the application of statistical analysis in economics. Together with Schumpeter and Frisch, he established, in 1930, the Econometric Society and became its first president.

Opinions diverge on Fisher's contribution to national accounting. Allen contends briefly that Fisher created the national accounting systems of the United States and other countries. This seems

to be an exaggeration, as will be put forward to us by Dr. Kenessey. At any rate, it is worthwhile to note that Fisher's definition of income differed essentially from that in modern National Accounts. He did not consider savings as part of income as long as they were not spent. This fitted in with his philosophy that taxes should be levied not on income but on expenditure, in order to prevent that savings would be taxed twice.

### **Irving Fisher as a crusader**

In the broader public sphere, Fisher was better known as a social activist, as a crusader, than as a scholar. Allen notes that Fisher spent more than half of his time on the promotion of the common good. His causes were numerous and various, but the objectives he most persistently pursued were monetary reform, tax reform, the improvement of public health, and the promotion of the League of Nations and the campaigning for America's joining of the League. Religion did not inspire him with excessive zeal; he remained all his life a Congregational Christian, but without the passion that characterised so many of his fervant endeavours in other fields.

### ***Monetary Reform***

Before the First World War, when the Gold Standard was still functioning satisfactorily, Fisher already had tried to mobilise public opinion in favour of a stable currency by way of a regular correction of the gold content of the dollar proportional to changes in the general price level. He devoted several books and innumerable articles and pamphlets to what he called the "unshrinkable dollar", but he never got much support. Implicitly, his proposal meant abolition of the Gold Standard, and for a long time this was not a popular issue. In 1920, in a period of rising prices, he established the Stable Money League, as a pressure group to foster his cause. It existed for more than ten years, but exerted not much influence; in 1932 it was dissolved. His best-known book on the stable purchasing power of the currency, *The Money Illusion*, became a best-seller, but scientists considered it as irrelevant.

In 1935, in the Great Depression, Fisher espoused the so-called "100% Money Plan", which had been promoted by some other economists. This plan envisaged splitting commercial banks so as to establish a deposit-taking and a credit department in each bank, much along the lines of the formal split of the Bank of England. This reform should make it impossible for banks to create deposit-money by making new loans. Fisher considered this scheme a necessary and sufficient condition for extinguishing the business cycle, and for many years he devoted much time to it. But from the outset it should have been clear to him that the 100% Money Plan was generally considered as too far-fetched and too theoretical.

### ***Tax Reform***

Equally ill-fated was Fisher's recommendation for a reform of the tax system. As he considered savings as the most important driving force behind economic growth, he advocated the exemption of savings from taxation, and the levying of taxes exclusively upon expenditure. At the age of 75, he wrote *Constructive Taxation*. His ideas were positively commended, but they found no political support.

### ***Improvement of health***

Fisher's interest in improvement of the conditions of health, both private and public, was aroused by his misfortune, when he was 31 years old, in contracting tuberculosis. He had always been convinced of the importance of fresh air and physical training and the abstinence from alcohol and smoking, but now he came to consider diet and nutrition important issues. In 1909 he published a *Report on National Vitality*, in which he argued that the conservation of health was as important and economically as beneficial to a country as the conservation of national resources. His most successful venture in the field of health was the editing of the book *How to Live*, a textbook on hygiene with contributions from experts. It was regularly revised and reprinted; 400,000 copies have been sold. For some time, his campaigning against alcohol and smoking absorbed most of his energy. He joined several committees and organisations which dealt with these issues. In 1919 the sale of alcohol was prohibited in the United States, but a decade later doubts arose whether this had

been a wise step. Fisher defended with renewed vigour the cause of Prohibition, but he was on the losing side; in 1933 the sale of alcohol was legalised again.

### ***The League of Nations***

At an early stage, in 1915, Fisher joined a group of influential people who propagated the idea of creating a League of Nations. In 1920, he was one of the founders of the Pro-League Independents, more a pressure group than a political party. It supported the Democrat Cox, who was in favour of America's entry into the League. Cox, however, was defeated in the presidential election, and President Harding opposed American participation. Fisher continued to campaign and in 1923 he published his book *League or War*, in which he argued that it was America's responsibility, as the leader of the world, to help the promotion of peace by backing the world peace organisation. During the new election campaign he made hundreds of speeches to convince the American public, but the election of Calvin Coolidge dashed his hopes. To see his vision to become reality, he had to have patience until the forties, when the upheavals of the Second World War created the climate for the foundations of the United Nations.

### **Fisher as an inventor and as a business man**

A few words about Irving Fisher as an inventor and as a businessman, in this combination, cannot be omitted. Among his inventions were a tent for the treatment of tuberculosis patients and a new projection method for geographical maps. As a spin-off of his investigations in the field of index numbers, Fisher perceived there was a market for statistical information. In 1923 he established the Index Number Institute which made and sold index numbers and other economic information to the press. In 1930 he sold the highly successful enterprise to the Institute of Applied Econometrics.

It was one of his inventions that made him a multimillionaire (although, a few years later, he lost everything in the 1929 stock-exchange crash and ended his career as a heavily indebted man). This invention was a rather simple office device, a card-indexing system, which he had patented in 1912. As it appeared that nobody was interested in it, he had this system produced in a company of his own, the Index Visible Company. In 1925, he sold the operation to a company which, after a merger, would become Remington Rand Company. Fisher, who had received stock in Remington Rand, profited immensely by the stock market rally which followed the deal. It was Fisher's tragedy that this success incited him to large-scale speculation on the stock exchange with borrowed money.

The stock-market crisis, which started in October 1929, hit Fisher totally unprepared. A few days before the crisis, when tension was already accumulating, he spoke to several professional organisations, stressing that no crash was impending and that after the first half of 1930 there would be a resumption of the bull market. Even after the initial crash his optimism was unbroken and for a long time he maintained that the crash would not necessarily be followed by a depression. He was clearly closing his eyes to the catastrophe that swept away his fortune – like that of so many other people – and that left him for the rest of his life a poor and debt-ridden man. In February 1930 already, he published a book, *The Stock Market Crash and After*, in which he suggested that the stock market would move to new highs. It is strange that he could write such an ill-conceived book in the same year that he published *The Theory of Interest*, which is generally considered as about the best he had ever produced. It confirms Irving Fisher as a man of extremes.

### **Fisher's inheritance**

Up till 1935, Fisher was a professor at Yale, but it is notable that in that long period he had not made his mark on the economic faculty. Indeed, he had not many students and many of his colleagues considered him as slightly odd. He has not created a "Fisherian School" of thought. It was not by his teaching that he exerted his greatest influence. His contribution to economics is primarily to be found in his books. It is generally acknowledged that several of his books have been essential for the development of economic thought. It is tragic that the policy prescriptions for which his scientific work tried to lay the foundations received so little appreciation. They came in a period when politicians were looking for a *deus ex machina* who would solve the many problems which had

amassed. It was Keynes who presented such a *deus ex machina*. It eliminated for at least a generation any interest in the sound reasoning underlying Fisher's economic messages.

It was, however, not only the spirit of the time which prevented the acceptance of Fisher's ideas. It was also the fact that Fisher, in much of his analyses, was ahead of his time. The latter phenomenon can explain the scant success Fisher earned with his *Elementary Principles of Economics*. He wrote this book in 1912 for students following his economics introductory course, because he was not content with existing textbooks. At the time it was considered eccentric and too difficult.

As a crusader, Fisher achieved many small victories. His effort for the League of Nations helped to pave the way for the United Nations. For the most part he failed at what he hoped to accomplish. Particularly, it was a great disappointment for Fisher, who considered himself as an important adviser to President Roosevelt, that his recommendations to overcome the Depression received little attention. It may be that Fisher had lost credibility in the eyes of those who remembered too well his denial of the danger of a major business downturn and his assertion that investment in equity would remain the most profitable form of investment.

### Retirement and death

His retirement from Yale, in 1935, marked also the close of his creative scientific work, but up to the last day he continued campaigning for his many causes. In 1940 he lost his beloved wife and he had to give up his comfortable house in New Haven. His financial situation remained disastrous; and following the stock-market crisis he was supported by his sister and her family.

In February 1947, on the day after his 80th birthday, an inoperable cancer was detected and he died on April 29.

It would have been a consolation to him that, among the many commemoration addresses that recorded his scientific achievements, there have been some by the real giants in the profession, like Schumpeter, Samuelson and Tobin, who acknowledged his true greatness.

By using Irving Fisher's name for our Committee, we pledge to honour his memory.

*The author relied mainly on the biography of Irving Fisher, written by Robert Loring Allen. Furthermore, he owed much to a sketch of Fisher's life by one of his colleagues at the Nederlandsche Bank, professor Martin Fase, who had also based himself on Allen's book.*

### References

- Allen, Robert Loring, 1993, *Irving Fisher, A Biography*, Blackwell, Cambridge MA & Oxford UK, 1993.
- Solow, Robert M., 1997, *One Little Piece of Irving Fisher*, AEA Papers and Proceedings, May 1997.
- Tobin, James, 1996, *Essays in Economics*, Vol. 4 National and International, MIT, 1996.
- Tobin, James, 1997, *Irving Fisher (1867-1947) in Retrospect*, AEA Papers and Proceedings, May 1997.
- Vogt, A., 1997, *Cinquantenaire du décès d'un grand économiste américain Irving Fisher (1867-1947)*, Cahier de Questions Conjoncturelles, 1/97, Office fédéral des Questions Conjoncturelles, Berne.

# The Significance of Fisher's Ideas for National Accounts

*Zoltan Kenessey*

*In 1997 is the 50th anniversary of the death of the American economist Irving Fisher. Among statisticians Fisher's book on The Making of index Numbers is his best known contribution. His role in laying some of the conceptual foundations of modern national accounting is practically unknown.*

The establishment of modern national accounts in the 1940s, essentially as a part of the war effort, was preceded by intensive work on national income estimates in the 1930s in the United States by Simon Kuznets and other researchers.

The post-war history of national accounting at the broader international level started in 1945 on a meeting held in Princeton, USA. The prelude to this meeting occurred in April 1939, when the League of Nations Committee of Experts decided to include the statistical measurement of national income into its program. Following the interruption caused by the war the Sub-Committee on National Income Statistics was set up to study the matter under the chairmanship of Richard Stone. George Jaszi represented the US at the League of Nations expert group meeting where Stone's seminal report was discussed. (The final report, in 1947, was already issued under the imprint of the United Nations.) [Stone (1947)] Jaszi's own summarizing reference to the early developments, offered at the time of his retirement in his famous *An Economic Accountant's Audit* was the following: "The very idea of income and product accounting, which emerged in the early 1940s, grew out of the practical needs of economic mobilization for World War II and made its debut almost simultaneously in the statistical offices here and in Canada and England. A great deal of responsive listening was taking place, and it continued." [Jaszi (1986) p. 412]

Usually it is implied that the American acceptance of the double-entry national accounting format was under the influence of the international consultations and the work of Stone. [Carson (1975)] I accept that the direct influence very well may have come from Stone. However, the role of Irving Fisher and Morris Copeland may be expanded in order to round out the story.

First it is useful to recall, that Stone's famous League of Nations study includes the following important reference: "... This report approaches the study of national income from the point of view of social accounting." The footnote attached by Stone to the term "social accounting" reads as follows: "It is believed that this term was first used by J.R. Hicks in his book *The Social Framework: An Introduction to Economics* (1942). For an explicit recognition of the accounting aspect of national income work see the following articles by M.A. Copeland: *National Wealth and Income – an Interpretation* in *Journal of the American Statistical Association*, Vol. XXX, No 190, 1935, pp. 377-386 and esp. 379 and 386, and *Concepts of National Income* in *Studies in Income and Wealth*, Vol. I (1937), pp 3-63 and esp. p. 63." [Stone (1947) p.23]

Copeland's (1935) article, which was referred to by Stone, includes extremely clear suggestions on the matter such as these: "Although the process of measurement of these basic concepts is partly a statistical one, it is also in an important sense an accounting process, an attempt to portray the economic condition and operation of a society in terms of double-entry bookkeeping, in terms of a set of controlling accounts ... (p 378). It seems probable that we are on the threshold of a much fuller use of national balance sheets and income statements and their detailed breakdowns, a use which may take a direction for the accounts of our national economic system, analogous to the progress from general accounting to cost accounting for the individual business." (p. 386).

Copeland's (1937) article, also referred to by Stone, includes a quotation from a letter he wrote in January 1936: "May I offer some suggestions regarding possible lines of inquiry which I believe would be profitable? Several of these emphasize the need for studying wealth and income together, setting up what amounts to a consistent scheme of social capital and income accounts for each major industrial grouping in our economic system ... This should be an experimental study for sample

years, which would attempt to work over available data into the form of a double-entry system of accounts on a rough accrual basis appropriate for use in national income and wealth measurements. Such a study should throw light on a number of problems – the handling of government interest, relief payments, government budget deficits, etc. in national income estimates ... (p 63).” Undoubtedly Copeland knew what he was talking about and for what purposes he wanted such accounts to be utilized. Indeed, his 1937 article concludes – after the quotation from his 1936 letter – with the following statement: “I now wish to urge this proposal again.” (p. 63).

Robert F. Martin was earlier involved in work on national income at the US Department and later joined the research staff of the National Industrial Conference Board in New York. In 1936 Martin published a study there with the title *National Income and its Elements*. [Martin (1936)] This study, in its first chapter, contains statements such as the following: “In an accounting system for the national economy, the balance sheets would list the national resources as assets and the claims of owners as liabilities. Its income account would show on the income side receipts for goods and services and on the outgo side payments to contributors to production.” Further Martin talks about “... a consolidation of the accounts of economic enterprises to obtain a master statement for the national economy ...”. Also, he states that “In a consolidated income account of the economic system ... receipts would correspond to the expenditures of individuals buying the goods and services, while the disbursements for capital, labor, and management services would represent the income of all individuals, or national income.” (These quotes are from p.1 in Martin, 1936.)

On the second page of the study Martin expresses the view that “The complete setting up of such a comprehensive bookkeeping system is impossible at present because of the limited state of available information ... The best that can be done is to establish a simple framework for the system and to expand it and fill in requisite data as they become available.” [Martin (1936) p. 20] In the footnote attached to the word “system” in the above sentence, Martin mentions that “For a preliminary suggestion of this nature see Morris A. Copeland, *Some Problems in the Theory of National Income*, Journal of Political Economy, Vol. XL, February, 1932.” [Martin (1936) p. 2, fn.]

Martin’s own suggestion is the following: “The basic framework of the aggregate income accounts of the individuals in its simplest form might be summarized as follows:

Receipts	Expenditures
Salaries and wages	Shelter
Entrepreneurial income	Food
Dividends, interest, net rent	Clothing
Other items	Other items.

... It is obvious that the national income statements simply represent a tentative and only partially complete accounting of our economic operations.” [Martin (1936) p. 2]

Martin was clearly aware of the work of Irving Fisher, and of course of Simon Kuznets. Regarding Fisher he refers to his 1906 book *The Nature of Capital and Income*, while for Kuznets he cites his *National Income* article in the Encyclopaedia of the Social sciences in 1933.

Morris Copeland joined the Division of Research and Statistics at the Federal Reserve Board in 1927. At the Federal Reserve Copeland’s first monetary analysis was a statistical study concerning Irving Fisher’s “equation of exchange”. [Copeland (1929)] Later, in his 1935 article, he again returned to Fisher and stated: “Statistical determinations of national – or broadly of social – wealth and income offer economists the chance to make their basic concepts accord with scientific method. Irving Fisher perceived this clearly a quarter of century ago ...” (p. 377). In his footnote to this statement Copeland cites Fisher’s famous work of 1906 about capital and income. We also know of the attention of Erik Lindahl to Fisher’s accounting thoughts. Thus both via Copeland (as seen in Stone’s quote of 1947) and possibly via Lindahl and Hicks (the latter also figuring in the same footnote by Stone) we can surmise the “seeping in” of the Fisherian thoughts into the conceptual arsenal of Stone.

It would carry us too far if we entered into an analysis of the complexities of Irving Fisher’s thought about the use of accounting in treating capital and income. In order to show, that he meant to extend the accounting treatment from individuals and single businesses to society at large, we restrict ourselves to a single quote from his book *The Nature of Capital and Income*: “If, then, we suppose balance sheets so constructed as to include the whole world of real and fictitious persons, with entries in them for every asset and liability, even public parks and streets, household furniture, persons themselves, and other possessions not ordinarily accounted for in practice, it is evident that we shall obtain ... a complete account of the distribution of capital value among real persons; and a

complete list of the articles of actual wealth thus owned.” [Fisher (1919) p. 96] And he continues in the chapter entitled “Income summation”: “By combining the net incomes of all persons, the net income of society may be obtained.” [Fisher (1919) p. 141] In his time Fisher was very widely read, not only in English but in German as well. Therefore his admonishment in his article entitled *The Income Concept in the Light of Experience* (first published in German) in the section about “Income accounting” must have reached a wide audience: “The student of income can scarcely go astray if he will take the trouble to learn the ordinary bookkeeper’s art of crediting and debiting ... This is simple ‘double entry bookkeeping’.” [Fisher (1928) pp. 4-5]

## Summary

Perhaps as a reaction to the relative oblivion Irving Fisher has fallen among most contemporary economists, sometimes exaggerated claims are made about his contribution to national accounting. In Fisher’s new biography Robert L. Allen (1993) flatly suggested that “He created the national accounting systems of the United States and other countries” (p.13). In respect of Fisher’s *Nature of Capital and Income*, published in 1906, however, Allen’s formulation is more careful and balanced, yet still somewhat hyperbolic: “Economic statistics and accounts, including the national accounting arrangements used by every country in the world ... rely on it ... Fisher was the originator and founding father of all national accounting systems.” (p. 95). I believe that Fisher’s originality and impact on other thinkers (including Copeland in the US and Lindahl in Sweden, who in turn influenced still others in the US, the UK, and Norway) is beyond doubt. But the creation of the national accounts themselves ought not to be attributed to him.

## Bibliography

- Allen, Robert L., 1993, *Irving Fisher. A Biography*. Blackwell.
- Carson, Carol S., 1975, *The History of the United States National Income and Product Accounts: The Development of an Analytical Tool*. The Review of Income and Wealth, pp. 153-181.
- Copeland, M.A., 1929, *Special Purpose Indexes for the Equation of Exchange for the United States, 1919-1927*. Journal of the American Statistical Association, June 1929.
- Copeland, M.A., 1932, *Some Problems in the Theory of National Income*. Journal of Political Economy, Vol. XL, February 1932.
- Copeland, M.A., 1935, *National Wealth and Income – an Interpretation*. Journal of the ASA, Vol. XXX, No. 190.
- Copeland, M.A., 1937, *Concepts of National Income. Studies in Income and Wealth*, Volume One, NBER, New York.
- Fisher, Irving, 1919; first ed. 1906, *The Nature of Capital and Income*, Macmillan, New York-London.
- Jaszi, George, 1986, *An Economic Accountant’s Audit Lecture on Economics in Government*. AEA Papers and Proceedings. American Economic Review, Vol. 76. No. 2.
- Martin, Robert F., 1936, *National Income and its Elements*. National Industrial Conference Board. New York.
- Stone, Richard, 1947, *Definition and Measurement of the National Income and Related Totals*. Appendix to the Report of the Sub-Committee on National Income Statistics of the League of Nations Committee of Statistical Experts, entitled: Measurement of National income and the Construction of Social Accounts. Studies and Reports on Statistical methods, No. 7, United Nations, Geneva, 1947. (Stone’s study – a revised version of his 1945 paper for the famous Princeton meeting – is the largest part of the UN publication).

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# On the Construction of European Area-wide Aggregates – a review of the issues and empirical evidence

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## 1 Introduction

The introduction of the euro as the common European currency in 1999 will lead to radical changes in a large number of areas. From the viewpoint of a central bank one may for instance note changes in payment systems, administrative and registrational alterations, and last but not least, monetary policy. With respect to the latter both the monetary strategy pursued and the monetary instruments used will be affected by the introduction of the euro. It goes without saying that a sound monetary policy relies heavily on thorough economic analyses. In this respect, quantitative analyses are nowadays the rule rather than the exception. Econometric analyses, however, make use of time series data on economic variables and obviously, reliable data are a prerequisite for solid empirical investigations. In this regard, the introduction of a common European currency poses specific problems. A natural question that arises is for instance how to construct area-wide data for the period before the introduction of the euro. This issue will be addressed in this paper.

The next section reviews the various options available to construct area-wide data and discusses methodological aspects of the procedures. The conditions under which the options considered will lead to identical results will be derived, and it will be argued that these conditions are not satisfied in practice. As a consequence, the resulting series will depend on the specific procedure chosen. In order to assess these differences we will give in section 3 some empirical evidence, using data for the countries of the European Union. Some recommendations are given in the concluding section 4.

## 2 Methodological aspects

One research area that as a result of the progressing European integration has become the focus of growing attention during the last ten years concerns the demand for money in the European Union.<sup>(1)</sup> The studies in question explicitly deal with the issue how to construct area-wide data. The studies show that several options are available and in this section these options will be reviewed. The discussion focuses on constructing data for area-wide output, both in nominal and real terms, and the implications for the output deflator and, thus, the area-wide inflation rate. A discussion and assessment of the various options for constructing area-wide data on nominal and real output suffices to illustrate the procedures available for other economic variables. For money demand analyses, for instance, one needs area-wide data on the money stock, wealth and interest rates as well. With respect to monetary aggregates and wealth, it is logical to use the same procedure as the one which will be applied to nominal output, since all these variables read in terms of numbers of national currency. Because of the relationship between the inflation rate and the interest rates and the fact that both variables read in terms of percentage points, the results found for the area-wide inflation rate can be used to choose a procedure to construct area-wide interest rates.

Data on area-wide output are calculated using the information on this variable for the individual countries. In the sequel we use the following notation:

$Y_t^i$  = output country i at current prices (nominal output)

$y_t^i$  = output country i at constant prices (say 1985-prices, real output)

$PI_t^i$  = price index country i, base-year 1985. Hence,  $PI_{85}^i = 1$  and  $Y_{85}^i = y_{85}^i$ .

With  $P_t^i$  the price level in country i, we have  $PI_t^i = P_t^i / P_{85}^i$ .

In order to aggregate the output data of the individual countries, it is necessary to convert the national currencies' data into a common currency. In this paper we will use the Deutsche Mark as the common currency. Two alternatives are available for converting the national currencies in DM: the exchange rates and the purchasing power rates vis à vis the DM. Define

$e_t^i$  = exchange rate of currency country i with respect to DM (for example Dutch guilders per DM)

$PPP_t^i$  = purchasing power of currency country i with respect to DM

For the purchasing power rates we have  $PPP_t^i = \frac{P_t^i}{P_t^G} = PPP_{85}^i \frac{PI_t^i}{PI_t^G}$ ,

with  $P_t^G$  and  $PI_t^G$  the price level and price index in Germany, respectively. Obviously, the purchasing power rate of the currency of country i vis à vis the DM is constant if  $P_t^i / P_t^G = \text{constant}$  over time, or, alternatively,  $PI_t^i / PI_t^G = 1$  for all t. Hence, a necessary and sufficient condition for constancy of the purchasing power rates is that the inflation rates in country i and Germany are identical.

Four options are available to express nominal and real output of country i in DM: current exchange rate ( $e_t^i$ ), fixed base-period exchange rate (say 1985 as base-year,  $e_{85}^i$ ), current purchasing power rate ( $PPP_t^i$ ) and fixed base-period purchasing power rate ( $PPP_{85}^i$ ).

In order to express real output of country i  $y_t^i$  in DM, it is appropriate to use fixed base-period rates. If we convert  $y_t^i$  into DM with current exchange rates or current PPP rates, viz.  $y_t^i / e_t^i$  or  $y_t^i / PPP_t^i$ , real output growth of country i in DM will also depend on changes of the exchange rates or changes of the PPP rates:

$$\Delta \ln(y_t^i / e_t^i) = \Delta \ln y_t^i - \Delta \ln e_t^i$$

or

$$\Delta \ln(y_t^i / PPP_t^i) = \Delta \ln y_t^i - \Delta \ln PPP_t^i = \Delta \ln y_t^i - \Delta \ln(PI_t^i / PI_t^G)$$

Conversion of individual countries' real output data into DM with current rates introduces therefore a price component in the volume series for the individual countries, leading to a hybrid variable which is difficult to interpret. These interpretation problems are avoided if real output data are converted into DM with fixed base-period rates  $e_{85}^i$  or  $PPP_{85}^i$ . When the countries' real output data are expressed in a common currency, the area-wide real output data can be calculated by aggregating the data for the individual countries. With 1985 DM exchange rates we obtain

$$y_t^{EU} = \sum \frac{y_t^i}{e_{85}^i}$$

and hence, using  $\frac{d \ln x}{dx} = \frac{1}{x}$  for an arbitrary variable x,

$$\Delta \ln y_t^{EU} = \sum \frac{y_t^i / e_{85}^i}{y_t^{EU}} \Delta \ln y_t^i$$

since  $\Delta \ln(y_t^i / e_{85}^i) = \Delta \ln y_t^i$ .

A similar expression follows with  $PPP_{85}^i$  as conversion factor. We see that with fixed base-period

rates to express the countries' real output in DM, the growth of real area-wide output is a weighted average of the individual countries' growth rates of real output, the weights being equal to the countries' shares in real area-wide output. Moreover, the growth rate of real area-wide output is not affected by the specific choice of the common currency. If we define  $\tilde{e}_t^i$  as the exchange rate of currency country  $i$  with respect to, say, Italian liras, we have

$$\tilde{e}_t^i = \frac{e_t^i}{e_t^{IT}}, \quad e_t^{IT} \text{ being the exchange rate of the Italian lira vis à vis the DM.}$$

The above expression for the growth rate of real area-wide output shows that the effect of a change of the common currency on the numerator and denominator of the countries' shares in real area-wide output cancels out. This independence from the choice of the specific common currency is lost if we use current exchange rates or current PPP rates to convert the countries' real output into a common unit. Because of these arguments it is recommendable to apply fixed base-period rates in constructing area-wide data on real output.

In order to construct area-wide data on nominal output the above-mentioned four options to express countries' nominal output in DM are available. Since it does not make sense to use e.g. current or fixed base-period exchange rates to construct data on area-wide nominal output and 1985 PPP rates for calculating area-wide data on real output, we have a total of four options:

- Case A1: current exchange rates for converting nominal output, 1985 exchange rates for real output
- Case A2: 1985 exchange rates for both nominal and real output
- Case A3: current PPP rates for converting nominal output, 1985 PPP rates for real output
- Case A4: 1985 PPP rates for both nominal and real output

Once the countries' data on nominal and real output are expressed in a common currency, the corresponding area-wide data can be calculated by aggregating the individual countries' data. The results for output, both in nominal and real terms, and the implied output deflator can easily be derived. For the four different cases we obtain the following results.

**Case A1:**

$$Y_t^{EU} (A1) = \sum \frac{Y_t^i}{e_t^i}, \quad y_t^{EU} (A1) = \sum \frac{y_t^i}{e_{85}^i}$$

$$\text{And so } PI_t^{EU} (A1) = \frac{Y_t^{EU} (A1)}{y_t^{EU} (A1)} = \sum \frac{e_{85}^i}{e_t^i} \frac{y_t^i / e_{85}^i}{\sum y_t^j / e_{85}^j} PI_t^i$$

**Case A2:**

$$Y_t^{EU} (A2) = \sum \frac{Y_t^i}{e_{85}^i}, \quad y_t^{EU} (A2) = \sum \frac{y_t^i}{e_{85}^i}$$

$$\text{and so } PI_t^{EU} (A2) = \frac{Y_t^{EU} (A2)}{y_t^{EU} (A2)} = \sum \frac{y_t^i / e_{85}^i}{\sum y_t^j / e_{85}^j} PI_t^i$$

**Case A3:**

$$Y_t^{EU} (A3) = \sum \frac{Y_t^i}{PPP_t^i}, \quad y_t^{EU} (A3) = \sum \frac{y_t^i}{PPP_{85}^i},$$

$$\text{and so } PI_t^{EU} (A3) = \frac{Y_t^{EU} (A3)}{y_t^{EU} (A3)} = \sum \frac{PPP_{85}^i}{PPP_t^i} \frac{y_t^i / PPP_{85}^i}{\sum y_t^j / PPP_{85}^j} PI_t^i = PI_t^G$$

$$\text{since } PPP_{85}^i / PPP_t^i = PI_t^G / PI_t^i$$

**Case A4:**

$$Y_t^{EU} (A4) = \sum \frac{Y_t^i}{PPP_{85}^i}, \quad y_t^{EU} (A4) = \sum \frac{y_t^i}{PPP_{85}^i}$$

$$\text{And so } PI_t^{EU} (A4) = \frac{Y_t^{EU} (A4)}{y_t^{EU} (A4)} = \sum \frac{y_t^i / PPP_{85}^i}{\sum y_t^j / PPP_{85}^j} PI_t^i$$

Given the above expressions, the conditions under which the various options yield identical results can easily be derived:

A1 = A2 if  $e_t^i = e_{85}^i$ , i.e. exchange rates are constant

A1 = A3 if  $e_t^i = PPP_t^i$ , i.e. exchange rates maintained consistent with purchasing power parity on a continuous basis

A1 = A4 if  $e_t^i = PPP_{85}^i$ , i.e. exchange rates are constant at  $PPP_{85}^i$ -level

A2 = A3 if  $PPP_t^i = e_{85}^i$ , i.e. PPP rates constant at  $e_{85}^i$ -level

A2 = A4 if  $PPP_{85}^i = e_{85}^i$ , i.e. exchange rates in 1985 consistent with PPP

A3 = A4 if  $PPP_t^i = PPP_{85}^i$ , i.e. PPP rates are constant

Obviously, the above conditions are not satisfied in practice. The various options will therefore lead to different series for area-wide nominal and real output. In the next section we will give some empirical evidence using data for the European Union. The remainder of this section will be devoted to a discussion of some methodological aspects. We will not discuss the results in detail but only address some salient features.

The most curious result concerns Case A3. The use of current PPP rates to express nominal output of country *i* in DM leads to an area-wide price index which is equal to the German price index. As a consequence area-wide inflation will also be equal to the German inflation. The reason of this result is that the PPP rates enforce the inflation in country *i* *in terms of DM* to be equal to the German inflation rate:

$$\Delta \ln(Y_t^i / PPP_t^i) = \Delta \ln y_t^i + \Delta \ln PI_t^i - \Delta \ln PPP_t^i = \Delta \ln y_t^i + \Delta \ln PI_t^G$$

$$\text{since } \Delta \ln PPP_t^i = \Delta \ln PI_t^i - \Delta \ln PI_t^G$$

In all countries, inflation in terms of DM will therefore be equal to the German inflation. The area-wide inflation rate will therefore also be equal to the inflation rate in Germany. Obviously, this is an undesirable property in for instance demand for money analyses on a European level, since one of the objectives of these studies is to specify a demand for money relationship that might be useful for monetary policy to be conducted by the future European central bank. The European central bank will of course be concerned with the inflation rate throughout the European Union, not just in Germany (see also Kremers and Lane, 1992). Moreover, the question arises what the relevant area-wide inflation rate actually is. The above results illustrate that the use of current PPP rates in converting nominal output of country *i* into a common currency introduces an arbitrary element in the series. If we had expressed nominal output in the individual countries in terms of, say, Italian liras, the resulting EU price index would have been equal to the Italian price index. Obviously, in case A3 the choice of the specific common currency is of importance. This feature of current PPP rates is shared by the use of current exchange rates. The price index in case A1 depends on  $e_t^i$  and hence the choice of the specific common currency will have an impact on the results. Since the growth rate of real area-wide output is not affected by the specific choice of the common currency, it follows that with the use of current exchange rates or current PPP rates the growth rate of the resulting nominal area-wide output will be dependent on the choice of the specific common currency.

The feature that the choice of the specific common currency has an impact on the growth rate of area-wide nominal output is absent if fixed base-period rates are used to convert countries' nominal output into a common currency. This is clearly an advantage, since it implies that the growth rate of area-wide nominal output is a weighted average of the countries' growth rates of nominal output. With fixed base-period exchange rates we have for instance

$$\Delta \ln Y_t^{EU} (A2) = \frac{Y_t^i / e_{85}^i}{\sum Y_t^j / e_{85}^j} \Delta \ln Y_t^i,$$

showing that the weights are equal to the countries' shares in area-wide nominal output. With  $PPP_{85}^i$  rates as conversion method we obtain a similar expression. The fact that the choice of a specific common currency has no influence on the growth rates of real and nominal output clearly facilitates the interpretation of the area-wide series. The independence with respect to the specific common currency does not imply, however, that the results in case of  $e_{85}^i$  or  $PPP_{85}^i$  are identical. It is only stated that the choice of unit, say German marks or Italian liras, has no impact.

The above findings reflect that both in case A2 and case A4 the price index on an area-wide level is a weighted average of the price indices for the individual countries, the weights being the shares of the countries' real output in area-wide real output. This implies that area-wide inflation can be approximated as a weighted average of the inflation rates in the individual countries. The weights are in this case, however, the shares of the countries' nominal output in area-wide nominal output. With fixed base-period exchange rates we have for instance

$$\Delta \ln(PI_t^{EU} (A2)) = \sum \frac{y_t^i / e_{85}^i}{\sum y_t^j / e_{85}^j} \frac{PI_t^i}{PI_t^{EU} (A2)} \Delta \ln PI_t^i = \sum \frac{PI_t^i y_t^i / e_{85}^i}{\sum PI_t^j y_t^j / e_{85}^j} \Delta \ln PI_t^i$$

assuming that the shares  $(y_t^i / e_{85}^i) / (\sum y_t^j / e_{85}^j)$  are approximately constant.

At this stage it is useful to dwell for a moment on the construction of area-wide interest rates. In demand for money analyses for the European Union as a whole the area-wide interest rates are always constructed as a weighted average of the individual countries' interest rates.<sup>(2)</sup> Because of the relationship between the inflation rate and the interest rates and the fact that both variables read in terms of percentage points, the procedure generally applied to the interest rates is consistent with those using fixed base-period exchange rates or fixed base-period purchasing power parities to express countries' nominal output in a common currency, since in case A2 and A4 the area-wide inflation rate will also be a weighted average of the individual countries' inflation rates. This consistency is lost when current exchange rates or current PPP rates are applied in the calculation of area-wide nominal output. If one opts for current rates as conversion method, consistency can of course be restored by calculating area-wide interest rates in an alternative way, e.g. by using the weighting scheme for the area-wide interest rates that corresponds with that for the area-wide inflation rate. In case of current PPP rates this would imply that the area-wide interest rate is the German interest rate, since in this procedure area-wide inflation will be equal to the German inflation rate. In case of current exchange rates this would imply a weighting scheme which will reflect the changes of the exchange rate against the DM. Hence, the choice of the specific common currency will have an impact on the resulting series for the area-wide interest rates. Obviously, this may lead to a series which is somewhat difficult to interpret. Because of these interpretation problems, these options for constructing area-wide interest rates are not very attractive and this is an argument in favour of using fixed base-period exchange rates or fixed base-period PPP rates for calculating area-wide nominal output.

In conclusion, using fixed base-period exchange rates or fixed base-period PPP rates to express both nominal and real output in the individual countries in a common currency has the attractive feature that on an area-wide level the growth rates of real and nominal output, the price level and the inflation rate are all weighted averages of the corresponding variables of the individual countries. Moreover, these series will not depend on the specific common currency which will be chosen.

### 3 Some empirical evidence

The former section addressed methodological aspects of the various options to construct area-wide data on nominal and real output. In order to illustrate the impact of a choice of one specific option

for the resulting area-wide series, we will present here some empirical evidence, using the database used in Fase and Winder (1997), containing data for all present member states of the European Union. The sample period is 1971:I-1995:IV. We will not consider the series according to all conversion methods available, but confine ourselves to some representative series. The series to be discussed are depicted in Chart 1.

Chart 1A gives the series for nominal EU-output using fixed base-period exchange rates and current exchange rates to express the countries' nominal output in a common currency. In section 2 it was argued that both procedures would lead to identical results if the exchange rates would have been constant over time. In practice, this condition has of course not been satisfied, leading to a different development of the series involved. Chart 1A shows that the growth of EU-output with the use of current exchange rates has been lower than that according to fixed base-period exchange rates. For the growth rates of area-wide nominal output we have

$$\Delta \ln(Y_t^{EU} (A1)) = \sum \frac{Y_t^i / e_t^i}{\sum Y_t^j / e_t^j} \Delta \ln \frac{Y_t^i}{e_t^i}$$

and

$$\Delta \ln(Y_t^{EU} (A2)) = \sum \frac{Y_t^i / e_{85}^i}{\sum Y_t^j / e_{85}^j} \Delta \ln Y_t^i$$

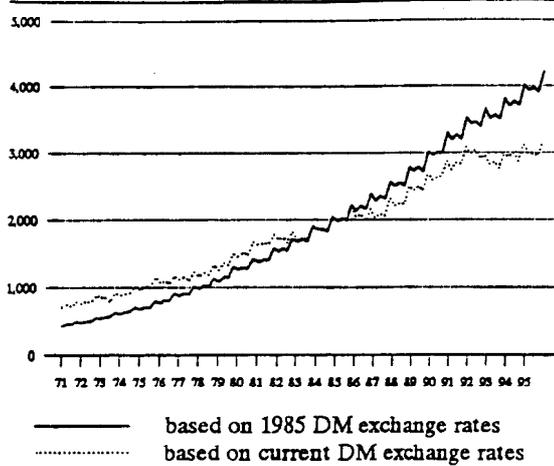
Obviously, with fixed base-period exchange rates (case A2) the growth of nominal EU-output is not influenced by changes of the exchange rate of the countries' currencies vis à vis the DM. These exchange rate changes do have an impact on the growth rate of nominal EU-output if one uses current exchange rates to convert the countries' nominal output into a common currency. Since the currencies of the European countries have depreciated against the DM over time, the growth rates of nominal output in terms of DM is lower, leading to a relatively modest growth of EU-output in nominal terms. This effect will dominate the impact of the changes of the shares of the countries' nominal output in nominal EU-output.<sup>(3)</sup> The influence of exchange rate changes is clearly illustrated by Chart 1A for the last years of the sample period considered. The depreciation of notably the Italian lira and English Pound after the EMS-turbulence in 1992 has depressed nominal output in the European Union.

Chart 1B depicts the area-wide inflation rates over the sample period, using 1985 DM exchange rate (case A2) and current DM exchange rates (case A1) to convert the countries' nominal output into DM. The differences between the two resulting inflation series reflect the different development of nominal EU-output in Chart 1A, since in case A1 and A2 the series for real EU-output are identical. The use of current exchange rates as conversion method leads to a very volatile inflation series, clearly illustrating the interpretation problems with this procedure mentioned before. The volatility in the area-wide inflation rate reflects the volatility of the currencies' exchange rates vis à vis the DM, as the only difference between case A2 and A1 concerns the use of the exchange rate. Chart 1B clearly illustrates the effect of the depreciations of the European currencies against the DM – during the EMS period especially the comprehensive realignments in 1983, 1986 and 1992 –, which have led to a downward adjustment of the EU-inflation in terms of DM. In section 2 it was argued that the use of current PPP rates against the DM as conversion method leads to an area-wide inflation rate which is identical with the German inflation rate. This latter variable has evolved more or less in line with the solid line in Chart 1B. As a consequence, the PPP rates have displayed a much less volatile behaviour over time than the exchange rates have.

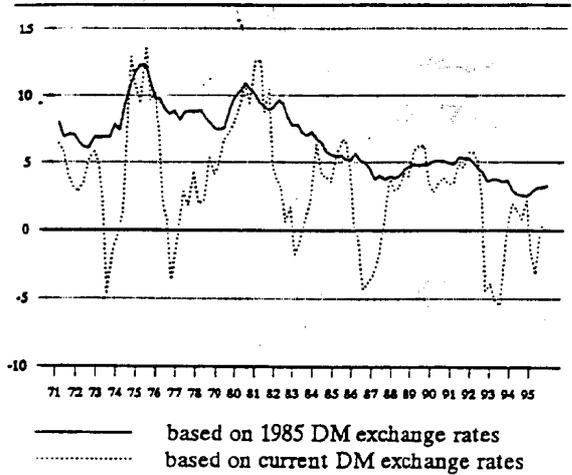
Because of the interpretation problems related to the use of current conversion rates, it is preferable to use either fixed base-period exchange rates or fixed base-period PPP rates to convert countries' nominal and real output into a common currency. In order to investigate whether the choice of exchange rates or PPP rates against DM makes much difference, Chart 1C and 1D give the series for real output and inflation on a EU-level, using the 1985-level of the rates against the DM. The area-wide real output series according to the 1985 PPP rates is slightly higher than the one resulting from the use of 1985 exchange rates. This reflects the differential between the exchange rates and the PPP rates prevailing in 1985. We mentioned before that the PPP rates have evolved more smoothly over time than the exchange rates. Using another base-year than 1985 may therefore lead to larger differences. These differences, however, concern notably the level of the series. The effects on the growth rate of area-wide real output are much smaller, as different values for the base-year exchange rates and PPP rates affect only the weighting scheme in the expression for the area-wide real output growth. These weights are much less affected. The same argument applies to the

Chart 1 Output and inflation in European Union

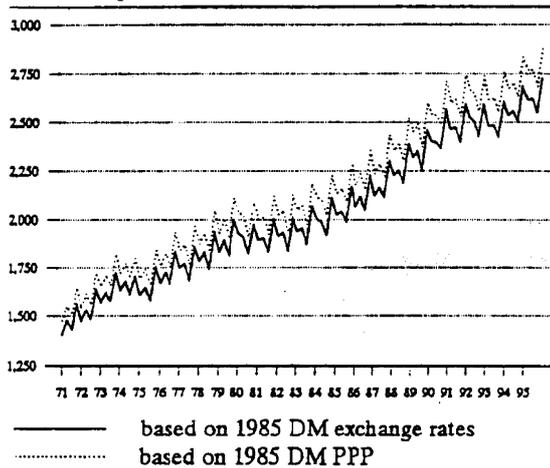
**A Nominal output**



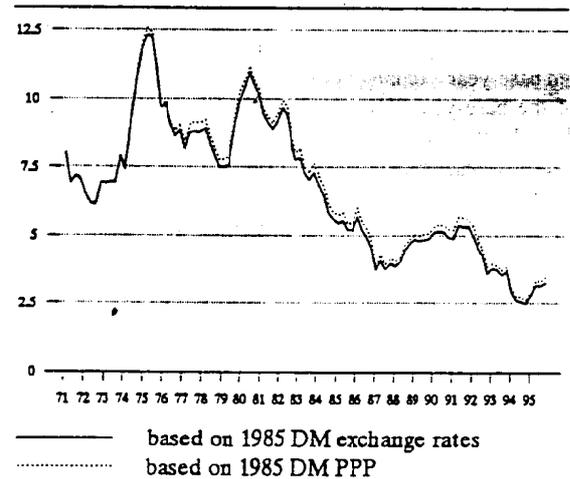
**B Inflation**



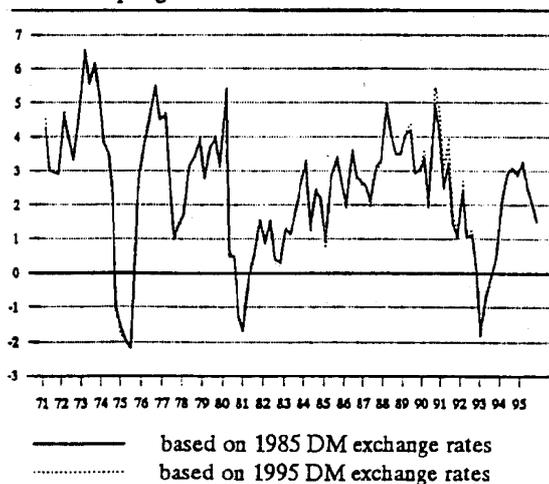
**C Real output**



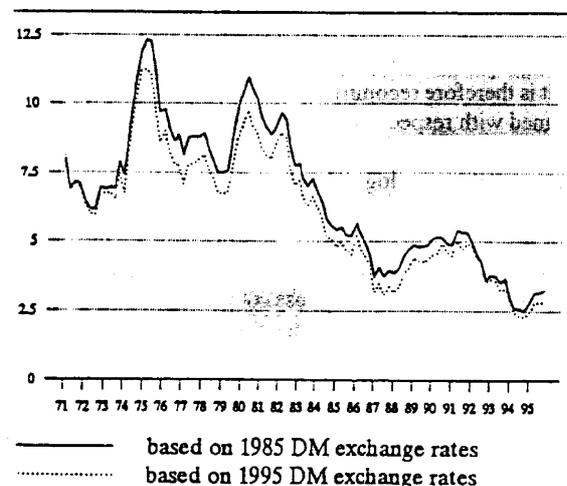
**D Inflation**



**E Real output growth**



**F Inflation**



area-wide inflation rates, since these variables are growth rates of the price index, and explains why the inflation rates according to both conversion procedures in Chart 1D are almost identical.<sup>(4)</sup>

The use of fixed base-period rates to express the countries' data on real and nominal output in a common currency entails a choice of a base-period. This choice has an impact on the resulting series, but, as before, this influence concerns notably the level of the series, not the growth rates. In case of fixed base-period PPP rates, the choice of the specific base-year does not have an influence on the growth rate of area-wide real output. Using 1985 as base-year we have

$$\Delta \ln y_t^{EU} (A4) = \sum \frac{y_t^i / PPP_{85}^i}{\sum y_t^j / PPP_{85}^j} \Delta \ln y_t^i$$

In case, say, 1995 is chosen as the base-year it follows

$$\Delta \ln \tilde{y}_t^{EU} (A4) = \sum \frac{\tilde{y}_t^i / PPP_{95}^i}{\sum \tilde{y}_t^j / PPP_{95}^j} \Delta \ln \tilde{y}_t^i = \sum \frac{PI_{95}^i y_t^i / PPP_{95}^i}{\sum PI_{95}^j y_t^j / PPP_{95}^j} \Delta \ln y_t^i$$

with  $\tilde{y}_t^i$  real output of country i in 1995-prices and thus  $\tilde{y}_t^i = y_t^i PI_{95}^i$ .

Since  $PPP_t^i = PPP_{85}^i \frac{PI_t^i}{PI_{85}^i}$ , we have

$$\frac{PI_{95}^i}{PPP_{95}^i} = \frac{PI_{95}^i}{PPP_{85}^i} \cdot \frac{PI_{85}^i}{PI_{95}^i}$$

Thus it follows that  $\Delta \ln \tilde{y}_t^{EU} (A4) = \Delta \ln y_t^{EU} (A4)$ .

With fixed base-year exchange rates as conversion method this independency with respect to the choice of the base-year does not hold, but the differences for the resulting growth rates of area-wide real output are very small, as witnessed by Chart 1E. The differences for the resulting inflation rates are also very modest, though somewhat larger than those for real output growth (Chart 1F). Tentative calculations using several base-years lead to similar plots as Chart 1E and 1F. These results warrant the conclusion that the impact of the specific base-year to be chosen, is very limited.

#### 4 Concluding remarks

In this paper we discussed and assessed various options to aggregate data on output, both in nominal and real terms, across different countries. We considered four options to express nominal and real output of the countries in a common currency: current exchange rates, fixed base-period exchange rates, current purchasing power rates and fixed base-period purchasing power rates. We derived the conditions under which the various options lead to identical results and argued that these conditions are not satisfied in practice. The various options will therefore lead to alternative results. Any choice will be more or less arbitrary, reflecting the fundamental problem that only from 1999 onwards we will have one common currency. The data for the period before the introduction of the euro concern in this respect a hypothetical situation. Given these reflections it is therefore recommendable to assess in econometric analyses the sensitivity of the results obtained with respect to aggregation procedure chosen.

The discussion of methodological aspects of aggregation and the empirical evidence using data for the European Union lead to the following observations:

- In case of using current exchange rates or current PPP rates to express countries' data in a common unit, the choice of the specific common currency will have an impact on the results. In aggregating real output data across countries, this will introduce a price component in series that are aimed to reflect volume developments, which is an unattractive feature. In case of current PPP rates the area-wide inflation rate will be equal to the inflation rate in the country with the common currency. This is an undesirable property of current PPP rates as the European central bank will of course be concerned with the inflation rate throughout the European Union, not just in, say, Germany.

- The use of fixed base-period exchange rates or fixed base-period PPP rates to express both nominal and real output in the individual countries in a common currency has the attractive feature that on an area-wide level the growth rates of real and nominal output, the price level and the inflation rate are all weighted averages of the corresponding variables of the individual countries. Moreover, these series will not depend on the specific common currency which will be chosen. Tentative calculations show that the effects of choosing an alternative base-year – and thus different values for the base-year exchange rates and PPP rates – are relatively modest, since only the weighting scheme is affected. These features clearly facilitate the interpretation of the resulting series and are arguments in favour of applying fixed base-period conversion rates.

## Notes

1) See for instance, Bekx and Tullio (1989), Kremers and Lane (1990), Monticelli and Strauss-Kahn (1993), Fase and Winder (1994, 1997), Falk and Funke (1995), Artis (1995) and Monticelli (1996). For a survey, see Fase and Winder (1994) and Artis (1995).

2) Sometimes ecu-weights are used for the construction of interest rates for the European Union as a whole. A problem with this procedure may be that these weights are now and then adjusted and that not all present EU member states participated in the EMS from 1979 onwards. An alternative is to use the shares of the individual countries' output in EU output. One can opt for the shares of nominal output of the individual countries in EU nominal output or the shares of countries' real output in EU real output. Because of the findings for the area-wide inflation rate, it is recommendable to choose the first option.

3) For the currencies participating in the ERM the exchange rate changes have not occurred smoothly. Between two realignments the exchange rates have been approximately constant, but at the time of a realignment a discrete jump appeared. With current DM exchange rates as conversion method, the share of high inflation countries' nominal output in nominal EU-output increases between two realignments and discretely falls at the time of a realignment. For the case of fixed base-period DM exchange rates these shares will continuously increase over time. This effect may lead to a distortion of the nominal EU-output series. This possible disadvantage of using fixed base-period exchange rates is, however, outweighed by the advantages of this procedure.

4) The resemblance of the series in Chart 1C and 1D provides further support to, and in some sense explains, the conclusion in Fase and Winder (1994) that the choice between 1985 exchange rates or 1985 PPP rates as conversion method has not a significant effect on the empirical results of their demand for money analysis for the European Union.

## References

- Artis, M.J., 1995, *Currency substitution in European financial markets*, European University Institute Working Paper 95/34.
- Bekx, P. and G. Tullio, 1989, *A note on the European Monetary System and the determination of the DM-dollar exchange rate*, Cahiers économiques de Bruxelles, 123, 329-343.
- Falk, M. and N. Funke, 1995, *The stability of money demand in Germany and in the EMS: Impact of German unification*, Weltwirtschaftliches Archiv, 131, 470-488.
- Fase, M.M.G. and C.C.A. Winder, 1994, *Money demand within EMU – an analysis with the Divisia measure*, De Nederlandsche Bank Quarterly Bulletin September 1994, 25-55.
- Fase, M.M.G. and C.C.A. Winder, 1997, *Wealth and the demand for money in the European Union*, DNB-Staff Reports no 6/1997.
- Kremers, J.J.M. and T.D. Lane, 1990, *Economic and monetary integration and the aggregate demand for money in the EMS*, IMF Staff Papers, 37, 777-805.
- Kremers, J.J.M. and T.D. Lane, 1992, *The derivation of the liquidity ratio in the EMS – Reply to Arnold*, IMF Staff Papers, 39, 203-207.
- Monticelli, C., 1996, *EU-wide money and cross-border holdings*, Weltwirtschaftliches Archiv, 132, 215-235.
- Monticelli, C. and M.O. Strauss-Kahn, 1993, *European integration and the demand for broad money*, Manchester School of Economic and Social Studies, 61, 345-366.

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# The Back-calculation of Nominal Historical Series after the Introduction of the European Currency – an application to the GDP

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## 1 Introduction

Monetary union in Europe raises the problem of converting into euros historical nominal series calculated in the respective national currencies. Using the conversion rates between the national currencies and the euro may appear to be the simplest and most sensible solution, since the series could be immediately linked into the future and their original dynamics (i.e. growth rates) would be preserved intact. However, when applying this procedure to multicountry comparisons or aggregations within the single currency area, an additional concern emerges which is absent in individual country studies: given the divergent inflationary past of the countries entering EMU, conversion rates would provide overly low (high) values for the nominal series of those countries with higher (lower) inflation rates, so that their individual weights in the aggregate would be distorted. Consequently, the need arises to search for alternative conversion procedures.

This paper is organised as follows. The next section deals more formally with the problems associated with selecting appropriate convertors for nominal series denominated in national currency into euros and presents the criteria for ranking possible candidates, including historical market exchange rate series and PPS series. Section 3 sets out the results of applying the criteria, while section 4 addresses their interpretation. Finally, the concluding section is devoted to three aims: to summarize the previous reflections, to develop the main proposals and to highlight the limitations of the exercise.

## 2 The description of the problem

Formally, assume without loss of generality that EMU will be composed of just two countries. A nominal series in national currency (say, nominal GDP) for country  $i$  is represented by  $Y_{i,t} = p_{i,t} \cdot y_{i,t}$ , where  $p_{i,t}$  is the price deflator,  $y_{i,t}$  the real magnitude, and  $t \leq t_N$ , any time period prior to monetary union (which takes place at  $t = t_N$ ). The (inverse of the) conversion rate against the euro fixed in period  $t_N$  is given by  $\bar{e}^{euro,i}$  ( $i = 1,2$ ).

Now, building the whole series in euros backwards using  $\bar{e}^{euro,i}$ , amounts simply to a rescaling of the original series without any impact on the growth rates. However, under such a transformation, the change in the weight of country  $i$  within the aggregate ( $w_i$ ) between any period  $t \leq t_N$  and  $t = t_N$  will be given by

$$w_{i,t_N} - w_{i,t} = \frac{\bar{e}^{euro,i} \cdot p_{i,t_N} \cdot y_{i,t_N}}{\sum_{j=1,2} \bar{e}^{euro,j} \cdot p_{j,t_N} \cdot y_{j,t_N}} - \frac{\bar{e}^{euro,i} \cdot p_{i,t} \cdot y_{i,t}}{\sum_{j=1,2} \bar{e}^{euro,j} \cdot p_{j,t} \cdot y_{j,t}}$$

Using the implicit fixed parity between the currencies of the two countries derived from  $\bar{e}^{euro,1}$  and  $\bar{e}^{euro,2}$  ( $\bar{e}^{2,1} = \bar{e}^{euro,1} / \bar{e}^{euro,2}$ )

and rearranging, we obtain for country 1:

$$w_{1,t_N} - w_{1,t} = \frac{y_{1,t_N}}{y_{1,t_N} + \frac{p_{2,t_N}}{\bar{e}^{2,1}} \cdot y_{2,t_N}} - \frac{y_{1,t}}{y_{1,t} + \frac{p_{2,t}}{\bar{e}^{2,1}} \cdot y_{2,t}} \quad [1]$$

where it can be easily checked that if country 1 recorded higher (lower) cumulative inflation between periods t and t<sub>N</sub>, then its weight is being artificially lowered (increased) back in the past.

Assume now that the conversion is done using market exchange rates instead. Let B be any possible currency or basket of currencies and  $e_t^{B,i}$  its historical exchange rate series against the currency of country i (i=1,2). Then, the nominal series in euros for country i can be expressed as:

$$Y_{i,t}^{euro,B} = \bar{e}^{euro,B} \cdot e_t^{B,i} \cdot p_{i,t} \cdot y_{i,t} \quad \text{for } t \leq N$$

where  $\bar{e}^{euro,B}$  is the exchange rate between the euro and B at the start of Stage Three, when parities for EU currencies entering EMU are fixed.

The change in the weight of country 1 in the aggregate between periods t and t<sub>N</sub> will be given by:

$$w_{1,t_N} - w_{1,t} = \frac{\bar{e}^{euro,B} \cdot \bar{e}^{B,1} \cdot p_{1,t_N} \cdot y_{1,t_N}}{\sum_{j=1,2} \bar{e}^{euro,B} \cdot \bar{e}^{B,j} \cdot p_{j,t_N} \cdot y_{j,t_N}} - \frac{\bar{e}^{euro,B} \cdot e^{B,1} \cdot p_{1,t} \cdot y_{1,t}}{\sum_{j=1,2} \bar{e}^{euro,B} \cdot e^{B,j} \cdot p_{j,t} \cdot y_{j,t}} \quad (1)$$

Using  $e_t^{2,1} = \frac{e_t^{B,1}}{e_t^{B,2}}$  and  $\bar{e}_t^{2,1} = \frac{\bar{e}^{B,1}}{\bar{e}^{B,2}}$ , simplifying and rearranging:

$$w_{1,t_N} - w_{1,t} = \frac{y_{1,t_N}}{y_{1,t_N} + \frac{p_{2,t_N}}{\bar{e}^{2,1}} \cdot y_{2,t_N}} - \frac{y_{1,t}}{y_{1,t} + \frac{p_{2,t}}{e_t^{2,1}} \cdot y_{2,t}} \quad [2]$$

If, for any period t, PPP were to hold in its absolute version,

$$\bar{e}_t^{2,1} \cdot p_{1,t} = p_{2,t}$$

then [2] equals:

$$\frac{y_{1,t_N}}{y_{1,t_N} + y_{2,t_N}} - \frac{y_{1,t}}{y_{1,t} + y_{2,t}} \quad [3]$$

so that the change in the weight of country 1 would equal the change in real terms.

Were PPP to hold in its relative – rather than its absolute – version,

$$\frac{p_{2,t_1}}{e_{t_1}^{2,1} \cdot p_{1,t_1}} = \frac{p_{2,t_2}}{e_{t_2}^{2,1} \cdot p_{1,t_2}} = h \quad t_1, t_2 \leq t_N$$

then [2] could be rewritten as:

$$\frac{y_{1,t_N}}{y_{1,t_N} + h \cdot y_{2,t_N}} - \frac{y_{1,t}}{y_{1,t} + h \cdot y_{2,t}} \quad [4]$$

so that some distortion would still exist, although unlike in [1], this would not be induced by cumulative inflation differentials, but rather by the fact that market exchange rates possibly do not equalize price levels across countries. <sup>(2)</sup>

In any case, using market exchange rates in the conversion does not provide a conclusive answer to the problem. First, empirical evidence rejects the absolute PPP hypothesis that national price levels are equal in any period when converted to a common currency. However, a certain consensus has been reached that long-run convergence to relative PPP takes place, although deviations from it tend to be corrected very slowly (Rogoff, 1996).

Besides, PPP compliance does not guarantee that the dynamics of the original series (in terms of growth rates) are preserved. Let  $\hat{Y}_{i,t}$  and  $\hat{Y}_{i,t}^{euro,B}$  be, respectively, the growth rates of country  $i$ 's nominal series in national currency and in euros, where

$$\hat{Y}_{i,t} = \frac{P_{i,t} \cdot Y_{i,t}}{P_{i,t-1} \cdot Y_{i,t-1}} - 1$$

and

$$\hat{Y}_{i,t}^{euro,B} = \frac{e_t^{B,i} \cdot P_{i,t} \cdot Y_{i,t}}{e_{t-1}^{B,i} \cdot P_{i,t-1} \cdot Y_{i,t-1}} - 1$$

Both rates will only coincide when  $e_t^{B,i} = e_{t-1}^{B,i}$  as in the case where the conversion parities are used to calculate the series from the conversion period backwards. Moreover, if PPP (absolute or relative) holds, then

$$\hat{Y}_{i,t}^{euro,B} = \frac{P_{B,t} \cdot Y_{i,t}}{P_{B,t-1} \cdot Y_{i,t-1}} - 1$$

so that real magnitudes are expressed in the prices of the B area. <sup>(3)</sup>

Still, since retaining the original weights is to be seen as a desirable outcome of the chosen conversion procedure and this appears to be worse accomplished by the fixed parities than by historical exchange rate series, it seems justified to reject the use of the former and to search among any possible B (currency or basket of currencies) for those which minimise the deviations between  $\hat{Y}_{i,t}^{euro,B}$  and  $\hat{Y}_{i,t}$ . Thus, to evaluate basket performance, similarity between the dynamics of the original and converted series is the main criterion used. More precisely, consider country  $i$ 's nominal GDP series in euros built using a given basket B as:

$$Y_{i,t}^{euro,B} = \bar{e}^{euro,B} \cdot e_t^{B,i} \cdot Y_{i,t}$$

where  $i$  is now any EU Member State.

The rate of growth of  $Y_{i,t}^{euro,B}$  can be expressed as:

$$\hat{Y}_{i,t}^{euro,B} = \hat{e}_t^{B,i} + \hat{Y}_{i,t} + \hat{e}_t^{B,i} \cdot \hat{Y}_{i,t}$$

where  $\hat{e}_t^{B,i}$  is the rate at which currency  $i$  appreciated or depreciated against B between periods  $t-1$  and  $t$ .

Thus,

$$\hat{Y}_{i,t}^B - \hat{Y}_{i,t} = \hat{e}_t^{B,i} (1 + \hat{Y}_{i,t}) \tag{5}$$

A measure of the appropriateness of basket B as a conversion factor for  $i$ 's nominal GDP can be provided by the standard deviation of [5],  $std_i^B$ .<sup>(4)</sup> Consequently the overall performance of basket B is evaluated by computing the unweighted sum of the  $std_i^B$  for  $i = 1, 2, \dots, 15$  (i.e., for all 15 EU Member States),

$$std^B = \sum_{i \in EU-15} std_i^B$$

The best performing basket B\* can be chosen as the one for which  $std^{B^*} = \min_B std^B$ .<sup>(5)</sup>

In this paper, the Bs for which  $std^B$  is computed are either currencies or baskets of currencies. Among currencies,  $std^B$  has been computed for each of the 14 currencies of the EU Member States and for the US dollar. Baskets are any combination of two or more EU currencies in which the

weights are given by the relative shares of the issuing countries' GDP in the GDP of the whole basket area.<sup>(6)</sup> Results obtained with an already existing basket – the ecu – are also provided. Ecu recompositions in the past addressed the fact that appreciating (depreciating) currencies tended to become overweighted (underweighted) between any two recompositions. As a result, between recompositions the weights in the ecu tended to depart from the criteria used to define them. In order to avoid this problem, the  $std^B$  measure is obtained for any basket B – other than the ecu – with the national currency amounts in B being recalculated every year (“yearly decomposition”).<sup>(7)</sup>

Finally, as has been pointed out, it can hardly be believed that, in practice, market exchange rates truly equalize price levels among countries (so that absolute PPP does not hold and the real weights are not preserved as in [3]). Besides, short-term market exchange rate movements do not respond just to inflation differentials (so that relative PPP does not hold either in the short-run). For these reasons, series converted through purchasing power standards (PPS) are also considered. PPS are constructed exchange rates which equalize the price levels for a given nominal aggregate in all countries considered and thus, unlike actual exchange rates, do not move in response to factors independent of relative price variations. Consequently, nominal series converted through PPS are able to preserve the real weights of every country as in [3].

### 3 Comparison between different currencies and baskets

The data used in the exercise relate to the period 1970-96 and stem from Eurostat's AMECO database. The results obtained for the different currencies and baskets are presented in table 1. The basket which provides the lowest sum of standard deviations (B\*) contains the same currencies irrespective of whether the currency amounts are allowed to change every year (“yearly recomposition”) or only when the ecu composition was revised (“ecu recomposition”). These currencies are the FBL, DKR, IEP, HFL, ÖS and SKR, which jointly account for only around 15% of total EU GDP. Indeed, one would probably have expected a larger number of currencies in the basket, as well as a higher share of those currencies in the GDP of EU-15. Both basket recomposition procedures offer very similar results.

The basket in which all fourteen currencies are included (the “all currencies” basket) has a somewhat larger sum of standard deviations.<sup>(8)</sup> However, this total sum is more evenly split among the different Member States, so that the goodness of the fit of the nominal GDP growth rates is more similar – according to the  $std_h^B$  criterion – when the “all currencies” basket is employed as compared to the B\*. Losers under the former include Germany, Greece and all countries whose currencies are included in B\* (except Ireland and Sweden), while for the latter two countries, Spain, France, Italy, Portugal and the UK the “all currencies” basket is preferable.

Compared to the all currencies basket, the ecu provides aggregate results which are similar or even a bit better (if the “ecu recomposition” version of the former is considered). Taking instead for comparison the all currencies basket where currency amounts are determined in every period, the ecu is seen to produce somewhat more “unfair” results in the sense that differences tend to sharpen among those countries for which the differences between the rates of growth of nominal GDP expressed in terms of the all currencies basket and in national currencies tend to be, respectively, more and less volatile.

Among individual currencies, the lowest sum of standard deviations is obtained for the Dutch guilder, which is not very useful however for capturing the dynamics of nominal GDP in national currency for such countries as Spain, Italy, the United Kingdom, Sweden, Finland and even France or Ireland, although it performs very well for Germany and Austria. Of course, this must be reflecting the much lower stability over the past two and a half decades of the exchange rate of the guilder against the first group of currencies as compared to the second, which translates into the volatility of the rates of appreciation or depreciation. Conversion through the German mark shares many features with conversion through the guilder.

For comparison purposes, the worst performing EU currency is also included in table 1. This proves to be the Portuguese escudo, which is unable to capture the dynamics of the nominal GDP growth rates of any country (except Portugal, of course) better than any other of the previously mentioned measures.

**Table 1 – Performance of alternative baskets and currencies**

Basket	std <sup>B</sup>	std <sub>h</sub> <sup>B</sup>														
		B	DK	D	G	E	F	IRL	I	L	NL	P	UK	Ö	SV	SF
B*																
"yearly recomposition"	0.684	0.021	0.021	0.023	0.060	0.064	0.034	0.053	0.061	0.024	0.020	0.092	0.069	0.022	0.056	0.062
"ecu recomposition"	0.683	0.022	0.021	0.024	0.060	0.064	0.034	0.052	0.060	0.024	0.020	0.092	0.069	0.023	0.056	0.062
All currencies included																
"yearly recomposition"	0.706	0.034	0.033	0.038	0.062	0.055	0.033	0.040	0.046	0.037	0.034	0.088	0.055	0.037	0.053	0.062
"ecu recomposition"	0.727	0.038	0.036	0.042	0.065	0.056	0.035	0.035	0.043	0.041	0.037	0.089	0.052	0.041	0.055	0.062
Ecu	0.710	0.028	0.029	0.030	0.064	0.065	0.033	0.041	0.051	0.033	0.026	0.095	0.059	0.030	0.061	0.065
PPS	0.460	0.019	0.019	0.024	0.053	0.037	0.018	0.046	0.035	0.028	0.019	0.064	0.032	0.020	0.021	0.027
Dutch guilder (best performing currency)	0.746	0.030	0.028	0.012	0.065	0.075	0.045	0.058	0.069	0.032	0	0.102	0.077	0.010	0.072	0.071
German mark	0.773	0.031	0.030	0	0.066	0.077	0.048	0.063	0.073	0.033	0.012	0.105	0.079	0.009	0.074	0.073
Portuguese escudo (wordt performing currency)	1.452	0.106	0.100	0.115	0.102	0.086	0.092	0.111	0.110	0.105	0.111	0	0.114	0.114	0.086	0.099
US dollar	1.815	0.126	0.121	0.120	0.104	0.133	0.127	0.119	0.132	0.130	0.117	0.144	0.101	0.119	0.111	0.110

Note: For all single currency baskets, "yearly recomposition" is used.

The performance of the US dollar is also very poor. Indeed, the variability of the difference between the growth rates of nominal GDP expressed in dollars and in national currency is greater than the variability of the corresponding difference between growth rates in escudos and national currency for all countries other than the United Kingdom.

Finally, PPS exchange rates clearly outperform any other B, although results are somewhat worse for Ireland's and Luxembourg's nominal GDP than under some other possible conversion series.

Table 2 contains the best performing basket for any individual country's GDP ( $B_h^*$ ), when the currency amounts in the basket are allowed to change every year and the currency from that country itself is excluded from the calculations. The results in this table provide an indication as to which currencies are best able to capture the movements in the growth rates of the original series.

Some points are noteworthy. First, there is a certain degree of "transitivity", in the sense that whenever the currency of country i belongs to the optimal basket for h ( $B_h^*$ ), the currency of h tends also to be included in  $B_i^*$ . However, this is not true in quite a large number of cases. Second, it is also not always true that the optimal basket for a country with a history of low inflation is composed only of currencies with an analogous past (and vice versa). It is somewhat surprising that the escudo belongs to five of the optimal baskets  $B_h^*$ , while Portugal's GDP dynamics themselves tend to be the worst tracked by any basket B.

Finally, and most importantly,  $B_h^*$  performs worse than PPS for two thirds of the countries' nominal GDPs. So, even if for a nominal series denominated in a given national currency, those currencies are taken with the lowest bilateral volatility against it, it is still preferable to use exchange rates which only take price developments into account in their calculation (PPS).

What about the weight of the converted series of a given country within the aggregate for a given basket B ( $w_{i,t}^B$ )? We assume that the weights when B is the PPS series are the "true" real weights of every country. To see this, note that the conversion through PPS amounts, for every single year, to valuing the nominal GDP of each country at the same prices. Consequently, for each year, a cross-section comparison between the resulting aggregates is equivalent to a comparison between real values (recall also [3]).<sup>(9)</sup>

For any other basket B composed of one or more currencies, the resulting weights differ from the ones obtained under the PPS conversion. However, they are the same regardless of the composition of the basket (see footnote 1). Table 3 presents for selected years the weights corresponding to PPS and to any other basket. Differences in the weights of some countries under both conversion procedures are in some cases rather large, but what is more relevant is the greater volatility of the weights for baskets constructed through market exchange rates, reflecting the volatility of the latter.

Finally, some calculations were done computing weighted  $std^B$ s, with results which point crudely towards the resulting trade-off: better treatment of the country with the higher weight amounts to worse treatment of nearly every other country.<sup>(10)</sup>

#### 4 Interpretation of the results

How should these results be interpreted? Note first, from [5] that  $std^B_h$  is lower, the less volatile  $\hat{e}_t^{B,h}$  has been historically.<sup>(11)</sup> For instance, assume that  $\hat{e}_t^{B,h} = -0,02$  in every period (that is, the national currency of country h has been depreciating against basket B at the constant annual rate of 2%). Then  $std^B_h$  would be equal to zero, so that one would conclude that B is indeed a very good convertor for  $Y_t^h$ .<sup>(12)</sup>

Of course, no market bilateral or multilateral nominal exchange rate changes at a constant pace in the real world. Take for instance  $e_t^{DM,USD}$  for the period considered here. In the last 25 years, the US dollar has tended to depreciate against the DM in a long-run perspective. However, from period to period,  $e_t^{DM,USD}$  variations have been far from uniform. A sharp US dollar appreciation between 1981 and 1985 was followed by an equally sharp depreciation until 1988. Now, the question is what factors explain such nominal exchange rate dynamics. The long-run US dollar depreciation can be satisfactorily explained by developments in the inflation differential between the two coun-

**Table 2 - Best Performing Basket ("Yearly recombination") for each Country's Nominal GDP Series ( $B_h^*$ )**

Country	std <sub>h</sub>	Component currencies of the basket $B_h^*$													
		BLF	DKR	DM	DRA	PTA	FFR	IEP	LIT	HFL	ESC	GBP	ÖS	SKR	FIM
Belgium	0.023		X	X			X			X				X	
Denmark	0.019	X		X			X			X	X			X	
Germany	0.009												X		
Greece	0.055									X	X			X	
Spain	0.049		X					X			X			X	X
France	0.029	X	X					X			X				
Ireland	0.027	X	X						X	X		X			
Italy	0.044							X							
Luxembourg	0.026		X	X	X		X			X				X	
Netherlands	0.010												X		
Portugal	0.076				X	X								X	
UK	0.046							X							
Austria	0.008			X						X					X
Sweden	0.046	X			X	X					X				X
Finland	0.052												X	X	

**Table 3 - Weights of the converted Nominal GDP Series within the aggregates for selected years (% of total)**

Country	Conversion series					
	PPS			B other than PPS		
	1975	1985	1995	1975	1985	1995
Belgium	3.13	3.00	3.07	3.68	2.92	3.20
Denmark	1.64	1.69	1.60	2.23	2.10	2.06
Germany	21.09	20.97	23.96	24.67	22.42	28.65
Greece	1.71	1.81	1.81	1.49	1.46	1.36
Spain	8.30	7.83	8.02	6.21	5.99	6.64
France	17.79	17.91	16.70	20.23	18.94	18.26
Ireland	0.60	0.68	0.92	0.52	0.72	0.76
Italy	15.84	16.98	16.12	12.54	15.33	12.91
Luxembourg	0.16	0.15	0.18	0.15	0.14	0.20
Netherlands	4.51	4.36	4.32	5.24	4.64	4.70
Portugal	1.44	1.54	1.81	1.00	0.86	1.21
UK	17.12	16.49	15.48	13.82	16.56	13.09
Austria	2.34	2.36	2.43	2.23	2.36	2.77
Sweden	2.98	2.77	2.32	4.33	3.64	2.72
Finland	1.38	1.46	1.27	1.66	1.94	1.48

tries, so that it is acceptable to think of relative PPP as being fulfilled in the long-run. However, to explain the behaviour of this particular bilateral exchange rate in the 80s and, in general, the behaviour of market exchange rates over a horizon of a few years, one must rely upon economic policies applied, agents' reaction to such policies, market bubbles and so on. Such behaviour is often unrelated to inflation differentials. <sup>(13)</sup>

Consequently,  $std_D^{USD}$  has a high value in this exercise, which leads us to conclude that the US dollar is not a good choice to convert German nominal GDP into euros. Had the market exchange rate moved more smoothly, then it would have been found more appropriate for the conversion. This would have been so if  $\hat{e}_t^{USD,DM}$  had moved in line with the bilateral inflation differential, but even in this case,  $std_D^{USD}$  would have been positive, since although inflation rates were higher in the US than in Germany throughout the period (except after German reunification), the differential was not constant. Indeed,  $std_D^{USD}$  would have been still lower if  $\hat{e}_t^{USD,DM}$  had shown less volatility than the inflation differential. However, this would have been rather unusual.

The US dollar overshooting in the 80s helps to explain why the US dollar performance in converting the nominal GDP series of the EU Member States into a common currency is so poor for all of those series. At the other extreme, the best overall performance according to the criterion established in the current exercise is provided by PPS exchange rates. This is consistent with the way PPS are calculated. By eliminating that part of nominal exchange rate variability which is not due to inflation differentials, PPS are much less volatile. However, the performance of PPS is uneven across Member States. This reflects the fact that, while for some countries – for instance, Belgium or France – inflation differentials against the other 14 Member States have shown little departure from their average, for some others – especially Portugal – such deviations have been large.

Consequently, PPP fulfilment serves as a guide to provide for an adequate choice of B, but only imperfectly captures the dynamic behaviour of the original series (in the sense that original growth rates are preserved, albeit possibly augmented or diminished by a constant amount).

An alternative in order to select B\* would have been to compute the sum of squared deviations between the growth rates of the converted and original series  $ssd_i^B$

$$\text{(where } ssd_i^B = \sum_{t=1}^T (\hat{Y}_{i,t}^B - \hat{Y}_{i,t})^2 \text{)}$$

instead of  $std_i^B$ . Intuitively, for a given basket B and a given country i, both options would provide similar results in the case in which inflation differentials between country i and the countries whose currencies compose B have been historically reduced. However, if this were not the case, results could be substantially different and, more importantly, it would not be so obvious which measure would be more suitable. If inflation differentials had remained high, but more or less constant, the  $std_i^B$  measure would remain adequate, since there would exist a well-defined average difference between  $\hat{Y}_{i,t}^B$  and  $\hat{Y}_{i,t}$ . On the contrary, such an average would be less meaningful under high and volatile inflation differentials, so that possibly  $ssd_i^B$  could be preferable. Indeed, this issue deserves to be further investigated.

## 5 Conclusions

In this paper, exchange rate series have been sought which allow for an appropriate conversion of nominal series in national currency into euros when the aim is to aggregate or compare series across countries. While the problem has no obvious solution, the two criteria employed for selecting the conversion exchange rate series have been, trying to preserve as accurately as possible, on the one hand, the relative real weight of each country in the aggregate and, on the other hand, the original dynamics of the series (in the sense that the resulting growth rates tend to maintain the profile of the original rates, although possibly shifted by a fixed amount). The focus is on nominal GDP series, although the results obtained for them need not hold for other series.

PPS appear to be the best choice according to both criteria. Let us start with the second one. PPS are non-market exchange rates which equalise the price levels in different countries when expressed in a common currency. Thus, by their very construction, PPS comply with absolute (and relative) PPP. Matters are different for market exchange rates which empirically have been found to fulfil PPP only in its relative version and only in the long-run.

Consequently, PPS rates of growth reflect inflation differentials. If these have kept constant between the country whose nominal series is converted and the reference group of countries, the rates of growth of the converted series will differ from those of the original one by a constant amount (equal to the inflation differential). If, more realistically, inflation differentials diverge over different periods, the conversion will amount, approximately, to adding (or subtracting) from the original rate the inflation differential in every period.

Market exchange rate movements do not track inflation differentials very well in the short-run. Rather, they show a markedly higher volatility, and thus perform rather worse for conversion purposes, since converted rates of growth will tend to differ to a greater extent from the original ones.

As to the first criterion, PPS are also preferable, since it can easily be shown that PPP fulfilment guarantees that the weight in the aggregate after conversion through PPS coincides with the weight in real terms.

The use of PPS has further advantages. There already exist available PPS series, they are intuitively simple (although their calculation is complicated) and they do not tend to fit some countries' series better at the expense of others'. The main disadvantage is that PPS are specific for every aggregate. For the sake of simplicity, it would probably be preferable to employ the same PPS series for conversion of all nominal series. This would be clearly wrong if the main interest were to lie in volume comparisons for a given period. However, this is not the aim of the current exercise. The obvious candidate then PPS would be computed for GDP.<sup>(14)</sup>

If, in spite of these considerations, it is regarded as more suitable to convert nominal series using market exchange rates, the B\* basket (that which provides the lowest overall volatility of the deviations between the rates of growth of the transformed and original series for all countries) should be discarded. The reason lies in the difficulty in justifying the selection of the currencies composing the basket, which might appear artificial and arbitrary.

A basket including all EU currencies or the ecu basket offer aggregate results (in terms of the measure of volatility) which are only marginally worse. However, compared to B\*, usage of such baskets is easier to justify and treats different countries more evenly. Were the all currencies basket chosen, some issues would remain to be solved. First, whether the national currency amounts should change each period (which seems reasonable); second, whether other criteria – besides the country shares in the area GDP or GNP – should be used to determine the currency weights in the basket (which might also appear warranted, but might heavily complicate the calculations). Finally, whether the all currencies basket should contain just the currencies of the countries entering the first wave of EMU or those of all Member States instead. The latter option seems more justified in order to avoid the problem of having to decide a few years afterwards between recalculating the series or permanently leaving out of the basket the currencies of the countries initially remaining outside.

As to the ecu, there exist good arguments for selecting it. First, broader criteria are taken into account in determining the weights from which national currency amounts are derived (even if a certain degree of arbitrariness exists). Second, it is an already existing basket for which series are available – so that there would be no need to calculate a new basket – and, finally, it has a symbolic value in the process to monetary union .

Conversions through any single currency should also be ruled out, since they either show an overall bad performance or are particularly unsuitable for certain countries' GDP.

Finally, it is important to note that these proposals do not constitute an optimal solution in terms of the proposed selection criteria, but just second best solutions. Besides, the criteria themselves might be called into question. First, the definition of the maintenance of the original dynamics is rather narrow and, second, it is even possibly not so obvious why the dynamics of the transformed series should approach those of the original series.

## Annex: Construction of the Currency Baskets

Baskets are constructed using an analogous procedure to the ecu methodology. However, two main differences arise. First, the weights of the different currencies in the ecu were determined according to the share of the respective countries in total EU GNP, in intra-EU trade and in the EU financial support mechanisms.<sup>(15)</sup> In this exercise, weights are solely determined by the shares of the different countries' GDP in the total GDP of all countries whose currencies belong to the basket (both measured in – current – PPS).

Second, new currencies were included in the ecu basket when the weights were revised in 1984 and 1989. Here, the currencies belonging to any basket B remain the same during the whole period.

Let  $t_0$  be the period in which the composition of the basket is initially fixed;  $i$ , a country whose currency belongs to the basket B (denoted  $i \in B$ ); and  $w_{i,t_0}$ , the share in period  $t_0$  of country  $i$ 's GDP in the GDP of the basket area so that  $\sum_{j \in B} w_{j,t_0} = 1$ .

These shares are taken as the equivalent value in US dollars of the national currency quantities in the basket. Note then, first, that consequently, the exchange rate between the basket and the USD when the basket composition is determined for the first time is given by

$$e_{t_0}^{B,USD} = \sum_{j \in B} w_{j,t_0} = 1$$

(a normalization without any impact on the growth rates) .

Second, from  $t_0$  until the next change in the composition of the basket in period  $t_1$ , the fixed amounts of the currencies belonging to the basket are:

$$N_{i,t}^B = e_{t_0}^{i,USD} \cdot w_{i,t_0} = N_{i,t_0}^B \quad \text{for } t_0 \leq t < t_1 \quad (16)$$

and the exchange rates of the USD dollar and currency  $i$  against the basket are given, respectively, by

$$e_t^{USD,B} = \sum_{j \in B} \frac{e_{t_0}^{j,USD} \cdot w_{j,t_0}}{e_t^{j,USD}} = \sum_{j \in B} \frac{N_{j,t}^B}{e_t^{j,USD}}$$

$$e_t^{i,B} = e_t^{i,USD} \cdot \sum_{j \in B} \frac{e_{t_0}^{j,USD} \cdot w_{j,t_0}}{e_t^{j,USD}} = e_t^{i,USD} \cdot \sum_{j \in B} \frac{N_{j,t}^B}{e_t^{j,USD}}$$

regardless of whether or not currency  $i$  is included in the basket (i.e.,  $i \in \text{EU-15}$ , although possibly  $i \notin B$ ).

At  $t_1$ , the amounts of the national currencies in the basket B are changed, according to the new shares of their GDP in the basket area GDP ( $w_{i,t_1}$ ). More precisely, since the  $e^{USD,B}$  obtained using the old basket composition must be the same under the new basket composition, the equivalent value in US dollars of the national currency quantities must now be

$$w_{i,t_1} \cdot \sum_{j \in B} \frac{e_{t_0}^{j,USD} \cdot w_{j,t_0}}{e_{t_1}^{j,USD}}$$

and the national currency amounts in the basket themselves will be given, until the next change in the composition, by

$$N_{i,t}^B = e_{t_1}^{i,USD} \cdot w_{i,t_1} \cdot \sum_{j \in B} \frac{e_{t_0}^{j,USD} \cdot w_{j,t_0}}{e_{t_1}^{j,USD}} = N_{i,t_1}^B \quad \text{for } t_1 \leq t < t_2$$

Finally, also for  $t \in [t_1, t_2]$ :

$$e_t^{USD,B} = \sum_{i \in B} \frac{N_{i,t_1}^B}{e_t^{i,USD}}$$

$$e_t^{h,B} = e_t^{h,USD} \cdot \sum_{i \in B} \frac{N_{i,t_1}^B}{e_i^{i,USD}} \quad h \in \text{EU-15}$$

In general, for  $t \in [t_{n-1}, t_n]$ , where  $t_{n-1}$  and  $t_n$  are recomposition periods

$$N_{h,t}^B = e_{t_{n-1}}^{h,USD} \cdot w_{h,t_{n-1}} \cdot \sum_{i \in B} \frac{N_{i,t_{n-2}}^B}{e_i^{i,USD}}$$

$$e_t^{h,B} = e_t^{h,USD} \cdot \sum_{i \in B} \frac{N_{i,t_{n-1}}^B}{e_i^{i,B}}$$

Inverting the resulting  $e_t^{h,B}$  series, nominal series in euros can be constructed as

$$Y_{h,t}^{euro,B} = \bar{e}^{euro,B} \cdot e_t^{B,h} \cdot Y_{h,t}$$

### Notes

\*) I wish to thank J.L. Díaz del Hoyo, A. Estrada, S. Fernández de Lis, D. López Salido, A. Maravall, M. Navascués and J. Salaverria for their comments.

1) Note that the weights are the same regardless of the B used. In fact, using B' instead of B would amount to substituting

$$\bar{e}^{euro,B'} \cdot e_i^{B',B} \cdot e_i^{B,i} \quad \text{and} \quad \bar{e}^{euro,B'} \cdot \bar{e}^{B',B} \cdot \bar{e}^{B,i} \quad \text{for} \quad \bar{e}^{euro,B} \cdot e_i^{B,i} \quad \text{and} \quad \bar{e}^{euro,B} \cdot \bar{e}^{B,i},$$

respectively, so that numerators and denominators would be multiplied by the same factor.

2) Note that neither absolute nor relative PPP would be of any help in preserving the original weights in [1].

3) Consequently,  $\hat{Y}_{i,t}^{euro}$  will tend to be more similar to  $\hat{Y}_{i,t}$  the closer the price dynamics of the basket area are to those of country i. In fact, a bit of algebra shows that, under PPP,  $\hat{Y}_{i,t}^{euro,B} - \hat{Y}_{i,t}$  is zero if  $\hat{p}_{i,t} = \hat{p}_{B,t}$ , where hats denote rates of growth of the respective price indices.

4) An alternative would have been to compute, for a given i, the sum of the squared deviations in [5] for all t. However, computing  $std_i^B$  has been preferred for reasons which are explained later.

5) It is debatable whether the  $std_i^B$ s should be weighted or not. For a given B, it might appear warranted to weight the respective  $std_h^B$  on the grounds that a bad adjustment distorts the aggregate more if it affects a large rather than a small country. However, it has been preferred here to treat all countries equally irrespective of their size.

6) Details on the construction of the baskets are provided in the annex.

7) Results are also obtained for every basket revising national currency amounts only when the ecu composition was changed – i.e., 1979, 1984 and 1989 – (“ecu recomposition”).

8) It is very difficult to derive statistical tests which are able to check whether the  $std^B$ s obtained with different Bs are statistically different from each other.

9) However, note that time-series of PPS aggregates are purely nominal series in which real magnitudes are valued at each year's prices.

10) Specifically, the Dutch guilder was substituted as the best performing currency by the German mark, with the result that  $std^{DM} (weighted)$  was reduced a bit to 0,722017 (as compared to  $std^{HFI} (unweighted) = 0,746047$ ). However,  $std_h^{DM} (weighted)$  was lower than  $std_h^{HFI} (unweighted)$  only for the nominal GDP of Austria and – obviously – Germany, and higher for those of the Netherlands – also obviously – and the remaining countries.

11) This interpretation is ignoring the term  $\hat{e}_t^{B,h} \cdot \hat{y}_t^h$  in  $\hat{Y}_t^{h,euro} - \hat{Y}_t^h$ . Although somewhat large for certain periods and countries (for instance, for B = DM, h = Italy and t = 1992, 1993), this term is in general of a second order of magnitude compared to  $\hat{e}_t^{B,h}$ .

12) Note, however, that this does not mean that the resulting growth rates for h's nominal GDP in terms of B (or equivalently in euros) would coincide with those in national currency, but rather that the latter would be lowered uniformly by 2% in any period.

13) Precisely, what inflation differentials can be useful for, is to say whether nominal exchange rates are misaligned and the size of the required adjustment.

14) In fact Eurostat uses the PPS for GDP in international comparisons of various aggregates (Eurostat, 1995, page 28).

15) An additional criterion was the importance of the country's financial markets.

16) In fact, these are also the national currency amounts used to extend the  $e^{i,B}_t$  series back to periods prior to the establishment of the basket ( $t < t_0$ ).

## References

Eurostat, 1995, *National accounts ESA. Aggregates 1970-1993*, European Commission, Office des publications officielles des Communautés européennes, Luxembourg.

Rogoff, K., 1996, *The purchasing power parity puzzle*, *Journal of Economic Literature*, vol. XXXIV (June 1996), pp. 647-668.

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# Eurostat's Strategy in Harmonising Statistics in the Euro Environment

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## Introduction

The Economic and Monetary Union (EMU) is scheduled to begin on 1 January 1999. At the moment, mid-1997, we still do not know which countries will form this union, as the relevant decision will not be taken until Spring 1998. What we *do* know, is that the creation of a huge area in which a single currency – the euro – is used, will affect the organization and production of statistics in the European Union, in the rest of Europe, and very probably around the globe.

Our objective here is to analyse the situation in Europe after 1999 as we see it in the statistical field. This paper sets out the main strategic thrust of the work that Eurostat, the Statistical Office of the European Communities, together with the future European Central Bank and the national statistical bodies must do in order to meet this challenge. These systemic adjustments also provide golden opportunities for making advances in statistics against the backdrop of the economic globalisation.

The development of the European Statistical System has always been closely related to the deepening and enlargement of the European Community, now European Union. In fact, the statistical activities at the European level have been progressively responding to the growing information requirements emerging from the increasing number of policy tasks to be pursued in the Community framework. Although the extension of statistical achievements was quite gradual, some major development stages deserve to be mentioned. In 1957, through the Treaty of Rome, the European Economic Community was founded to give post-war Europe an ambitious economic and political perspective of integration. Subsequently, a Statistical Division was created to support the, at that time, rather limited range of EU policies aiming both at the progressive opening of national markets for goods, and at implementing a common agricultural policy. According to these objectives, modest, first attempts were made to gather national data and to produce European aggregates for the major fields of macro-economic policies, whereas for the agricultural sector, comprehensive and genuine Community statistics were developed. After the completion of the customs union during the sixties and in view of the first attempt to create a monetary union at the turn between the sixties and the seventies, great efforts were made to enhance the comprehensiveness and harmonization of integrated economic accounts and foreign trade statistics. Common standards, classifications and methodologies became important references for the development of national statistics within the European Community. The European System of Economic Accounts: ESA, the general industrial classification of economic activities within the European Communities: NACE and NIMEXE, the nomenclatures of goods for the external trade statistics of the Community are salient examples by which international standards were further developed for their use within the European Community. The period between 1973 and 1986 was first characterized by several enlargements of the European Communities from 6 to 12 countries and secondly by a progressive liberalization of national foreign exchange transactions for some Community countries. Whereas the first aspect generally increased the pressure for a higher degree of harmonisation of statistics within the Community, the second one required the countries which dismantled their foreign exchange controls to adapt the collection system for their balance of payments statistics. Statistical information gained through foreign exchange controls, mostly banking records, had to be replaced by specific statistical reporting. It was also during this period, at the beginning of the eighties, that harmonised business tendency surveys were introduced throughout the Community. A totally new challenge emerged with the Single European Act in 1987 aiming at the completion of the internal Market by the end of 1992. Free circulation of people, goods, services and capital set a milestone in European integration and likewise had considerable repercussions for statistics. A sharply increased demand for more comparable economic, business and also social statistics had again to be met in spite of the loss of essential administrative data sources. The latter particularly refers to the loss of customs

statistics for trade between Member Countries. It had to be replaced by a new system collecting directly from enterprises and is partly linked to the administrative system of value added tax returns (INTRASTAT).

### The impact of EMU on statistics

Now, due to the adoption of the Maastricht Treaty in 1993, European monetary unification has become a constitutional objective set up within a fixed time frame. In consequence, a common monetary policy for EU countries (at least for those participating in the single currency) will be defined and implemented by the future European Central Bank. By the same token, with a view to avoiding excessive government deficits, national fiscal policies have become subject to a fairly tight surveillance mechanism at the EU level. Upper limits for both the fiscal deficit and the stock of government debt have been fixed in relation to the GDP. Before Maastricht, it is true, Member States also had to pursue economic policies ensuring the equilibrium of their overall balance of payments and maintaining confidence in their currencies. A co-ordination mechanism at EU level was also set in motion. However, the final responsibility and authority for the stance of monetary and fiscal policy remained with the national governments and in the case of insufficient convergence of economic performance of a Member State as compared to the other Member States, the system of fixed exchange rates allowed for exchange rate adjustments, which indeed occurred on several occasions. During the pre-Maastricht era, the essentially nationally oriented monetary, financial and balance of payments statistics were, as a rule, sufficient for pursuing the respective policy and surveillance tasks by national and Community authorities. Due to the EMU, however, this has changed and the impact on the statistical field will be considerable in several respects.

Firstly, on the **demand** side, management of economic and monetary policy at national and EU level will highlight new needs in terms of relevant comprehensive, genuinely consolidated, harmonised and timely data for the different decision levels. However, given the multidimensional objectives of the EU, in the event, the need for genuine EU statistics will comprise virtually all aspects of economic and social life which, according to the treaties, are dealt with in the EU framework.

Due to the creation of the single market in 1992 a number of statistical sources of an administrative nature were abolished; EMU will exacerbate this effect, and statisticians must review and adapt their methodologies and collection systems. This impact on the **production** conditions of statistics will be particularly felt for the bulk of monetary, financial and balance of payments statistics. Until now, these statistics hinged to a large extent on the notion of national territories and borders, and even more importantly, on the differentiation according to national currencies. In consequence, through the creation of a Single Currency area, a number of statistical sources will simply get lost. This mainly concerns transactions between residents of different EMU Member States.

Thirdly, there will be an impact on the **organisation** of the European statistical system. Provision is made under the Treaty on European Union (the Maastricht Treaty) for the European Central Bank, with the assistance of the central banks of the Member States, to collect and compile all the statistics it needs to do its job. That means that alongside with Eurostat there will be another major institution contributing to the development of the European Statistical System. The creation of a single-currency area will quickly push decision-making in the field of economic and monetary policy to a supranational level, and decisions will have to be based on statistical data compiled at the level of the Union and EMU respectively, rather than at Member State level as before. In the light of these developments, Eurostat's role will change: from a body basically responsible for co-ordinating and harmonising national statistics, it will increasingly have to play a role as producer of statistics at the level of the European Union.

Last, but not least, EMU will effect the **quality** of the statistics that the European statistical system will be led to produce. Like it or not, statistical information will be increasingly used for major policy and administrative decisions. Within the EMU, statistics will become a major tool for the Member States' surveillance mechanisms, and will form a basis for decisions that will affect the whole of the Union. The recent debate on measuring the cost of living in the United States, for instance, should encourage European statisticians to step up their efforts to improve the quality of their statistics, particularly those that will be used as a basis for sensitive political decisions.

### The demand for statistical information

The transition to a fully fledged Economic and Monetary Union will affect the framework and the efficiency of EU policies to an extent which goes far beyond a strengthened co-ordination of monetary and fiscal policies as previously mentioned. A look at the general economic EU tasks to be achieved within the Economic and Monetary Union presents good indications of the policy areas to be followed up within the EU framework and consequently, covered by EU statistics. According to the treaties, *common policies shall promote throughout the Community a harmonious and balanced development of economic activities, sustainable and non-inflationary growth respecting the environment, a high degree of convergence of economic performance, a high level of employment and of social protection, the raising of the standards of living and quality of life; and economic and social cohesion and solidarity among Member States.* This concise statement strongly illustrates that the future requirements asked from the European Statistical System in terms of economic, social and environmental statistics will be similar to what constitutes the conventional statistical information of a modern, industrialised economy.

It is worth noting that the respective institutions which have to contribute their due part to the achievements of the common European policy goals are not necessarily institutions acting at the EU level. In accordance with the principle of subsidiarity, only if and in so far as the objectives of the proposed action cannot be sufficiently achieved by the Member States, a Community institution shall take action. Nevertheless, irrespective of the level of the acting institutions – European, national or regional – coherent and comparable statistical information for European policy goals will be needed throughout the whole EU.

As far as transition to EMU is concerned, we cannot talk of demand for really new statistics to cover areas not covered hitherto. However, through the introduction of a single currency, in addition to the internal market, the degree of economic integration will reach a new quality. Therefore, there is a need for much greater comparability, harmonisation and consolidation of existing statistics in order to provide the appropriate information for all decision levels, national and EMU. Both will be an essential feature of the next big decision in Europe. I use the words “in Europe” for good reason, as this requirement will obviously affect not just the Member States of EMU, but also the countries known as the “pre-ins”, which, whilst not forming part of the first wave of EMU, might subsequently join, together with countries that wish to become members of the European Union and that will subsequently form part of monetary union. I will give some examples of where harmonisation work will need to be done, and specific data produced more regularly.

The management of monetary policy by the Central Bank will need to be based on a set of short-term indicators produced by each country using the same definitions at very precise and regular intervals. Examples include indicators for supply and demand, production and consumption, the labour market, money supply, etc. Responsibility for producing these indicators will lie with the European System of Central Banks on the one hand and Eurostat with the national statistical institutes (NSIs) on the other. It is significant that the international Monetary Fund recently devised a system of statistical indicators for monitoring the economic and monetary policies of all countries at world level. Eurostat’s and the future Central Bank’s programme of short-term indicators will go well beyond IMF requirements.

The multilateral surveillance reinforced by what is known as a “growth and stability pact”, will call for very accurate statistical monitoring country by country. There will be a particular call for harmonisation of quarterly accounts at constant prices, and for the expansion of quarterly harmonised accounts for the general government sector, at least for the main aggregates. The results of the qualitative business tendency surveys will certainly also be an important complement to the quantitative indicators.

On the fiscal level, there is currently provision underway to change over to a common VAT system for using economic accounts, input-output tables and other statistical sources when reallocating VAT receipts between countries. Obviously, this can only be done once fully comparable reference indicators have been established. This will call for specific household consumption surveys on the one hand and harmonisation of final consumption aggregates from the national accounts on the other.

### The production of statistical data

When the single European market was created in 1992 by eliminating a wide range of barriers to the free movement of people, goods, services and capital between Member States, statisticians had to cope with the disappearance of administrative information that had hitherto been the source of various statistics. EMU will have to deal with a further blow to administrative sources, particularly in the banking sector. This concerns a whole range of balance of payments transactions mainly between different EMU countries such as trade in services, tourism and certain transfers. It is also certain that the banking community is applying strong pressure to limit the burden of statistical declarations needed for the intra-EMU balance of payments.

It is obviously a manageable task to produce balance of payments statistics:

- (1) for the EU, as a whole, focusing on the current account and direct investment flows;
- (2) for the EMU, as a whole, to comprise all transactions, in the short term, and;
- (3) for individual non-EMU countries to be monitored in the pre-in phase to EMU.

However, a conflicting situation occurs if balance of payments statements are, at least partly, to be produced for the individual EMU countries in order to establish their national economic accounts including trade in goods and services, etc.

Due to the General Agreement on Trade of Services (GATS), subsequent to the Uruguay Round, the international trade in services will deserve particular attention. Statistics will have to comprehend both "cross-border trade" and trade through "commercial presence" in the foreign country. In consequence, for all cross-border affairs, the coming years will probably see statisticians having to collect data directly from enterprises, rather than use administrative sources, at least for intra-Union trade.

### Organisation of statistics

As previously mentioned, provision is made under the Maastricht Treaty for the European Central Bank, with the help of national central banks, to collect and compile all the statistics it needs to do its job. This means that, for the first time in the history of European statistics, a supranational body, the ECB, will have the right to directly produce statistics, the national central banks (NCBs) acting as executives for ECB decisions. No such provision is made for the bulk of other statistics that are not the responsibility of the ECB.

Until now, the relations between Eurostat, a directorate general of the European Commission, and the national statistical institutes have been of a different legal nature as in the case of Central Banks. Eurostat's relationship with the national statistical institutes has grown in the long process of statistical co-operation. Nevertheless, it is obvious that the transition to EMU enforces the need for a strong central statistical institution acting at EU level which will assume the responsibility of meeting the statistical requirements of the EMU as a whole. This is the natural vocation of Eurostat. On an organizational level, however, Eurostat will have to ensure that it is capable of producing EMU statistics which should be more than a simple aggregation of national numbers produced by Member States. Certainly, this task can only be achieved in close co-operation with the national statistical institutes, which have the *in situ* infrastructure and organizational capacity for collecting data.

Comparability, i.e. the strict harmonisation of Member States' statistics will become even more important than in the past. In the event, policy decisions affecting all EU countries will be contingent upon this data. A few examples will show how a new organisation of the European Statistical System will occur in the new EMU environment.

*Firstly*, for national accounts, it is one thing to combine the financial and non-financial accounts of the Member States to produce accounts for the Union, but it would be quite another to produce them directly (or indirectly via the NSIs and the central banks as collecting bodies). The results of the latter would, in our opinion, be more reliable, more consistent and would be available more rapidly. This would meet a real need, given the importance of national accounts for monitoring the Union's economic and monetary policy. In view of this, it seems obvious to us that the European Central Bank will play the same role in compiling financial accounts as is currently played by most

of the national central banks, even if accounts are subsequently revised, supplemented and brought into line with non-financial accounts by the statistical institutes.

The *second* example is similar; it concerns the Economic and Monetary Union's consumer price index. To some extent, account has already been taken of this in the Union's decisions regarding the harmonisation of consumer price indices. Partially aggregated national data is forwarded to Eurostat by the NSIs, and Eurostat calculates the EMU aggregate. This information for example is relevant for the EMU participation of countries to be decided in Spring 1998.

The *third* example is of a more general nature. It concerns all surveys or production of indicators whose results are required primarily at EMU level. In our opinion, it is essential for Eurostat to be able to collect the data needed to produce these statistics directly (or indirectly) on its own initiative.

The *last* example does not concern just Eurostat. It is a topic that must form the subject of close co-ordination with the European Central Bank: the balance of payments. This data is useful for both trade negotiations and bilateral agreements (the responsibility of Eurostat) and monetary policy (responsibility of the ECB). In all likelihood, and notwithstanding the conflicting situation referred to above, monetary union will mean that, in the long term, we shall no longer need balance of payments figures for individual Member States – all we shall need is the EMU balance of payments. The ECB and Eurostat, with the assistance of the national institutes (NCBs and NSIs) will play a central role in compiling this data.

### **Data quality**

The quality of statistical information must be guaranteed by a high degree of relevance, reliability; timeliness, objectivity and professional independence. These criteria have always been a central concern of European statisticians. We are convinced that this will become even more important with the transition to EMU. There are two reasons for this:

*Firstly*, major economic and political decisions will be made at EMU level on the basis of statistics. The quality of these statistics will therefore be crucial for the analysis and the exertion of political pressure. This should not become a subject for political bickering but, like Caesar's wife, must be above suspicion. National and European statistical authorities should thus become guarantors of this quality.

The *second* reason stems from the novelty of statistics produced directly by Eurostat and the ECB for the EMU. The challenge will be considerable: these statistics will be scrutinised by institutional users and shrewd observers of EMU affairs; economists, research institutes, politicians, etc. Therefore, continued investments must be made in statistical research, and political authorities should be immediately alerted to the grave risks they run if the qualitative bases of their decision-making instruments is inadequate. We are convinced of the need to provide for closer co-operation between the world of official statistics and research establishments. In terms of the quality of statistics, there is everything to be gained from pooling the ideas and experiences of NSIs, central banks, universities and research centres. To refuse communication between these institutions under the pretext of statistical independence would be unwise and dangerous. EMU represents a golden opportunity to stimulate and deepen this debate.

### **Economic globalisation**

In parallel with the European integration, the process of global integration has gained a strong momentum. Their origins and consequences for the statistics, namely deregulation of international transactions and loss of administrative information, are of a very similar nature. But this time, the problems apply not to transactions between residents of different EU countries, but more generally to transactions between EU countries and the rest of the world. However, the problems are not confined solely to the loss of statistical sources, which in principle could be replaced by developing alternative compiling systems. In addition, the meaning of former concepts of international transactions – transactions between nations – is increasingly put into question by the process of globalisation. We do not really have an "internal" global market, but we have much more than just trade be-

tween nations. Trade between affiliated and non-affiliated firms, subcontracting and processing trade are only a few words behind the conventional notion of international trade in goods. This list can easily be extended by the increasing importance of international trade in services, which can take place through very different channels, in addition to the intricate subject of direct investment activities. Reflections have started on what should and could be the subject of statistical records in order to catch the most relevant features of the globalisation process. However, there are a host of conceptual issues, including economic paradigmatae, as well as the ensuing statistical problems to be cleared. These problems are and can only be tackled by the world community within the appropriate forums – the most important of which are the UN, WTO, IMF, World Bank and the OECD. Eurostat always was and will be a particularly active contributor in these forums attempting to find appropriate statistical solutions. Results coming out of this co-operation concerning for example the statistical methodologies for international trade flows in goods and services, direct investment and other capital flows, have been and will be duly taken into account together with the statistical adjustments with regard to EMU.

### Conclusions

We have entered a crucial period for statistics in Europe. The strengths and weaknesses, pitfalls and opportunities of European statistics have been systematically analysed during recent congresses and meetings organised by various institutions, as for instance at the 1994 Voorburg conference on the “Long-term Perspectives of International Statistics”.

The creation of EMU, for all its intrinsic risks in terms of institutional relations between the Member States, is a golden opportunity to advance statistical knowledge, produce quality data, and make from statistics a reliable, decision-making instrument for political authorities and economic and social operators alike.

More and more tasks were put to the EU level, whilst the framework in which economic activities are to be undertaken approaches a single market and a currency area which is open to meet the international competition in a more and more globalised world.

The current European system must meet these challenges if it is not to fall behind the pace of change of the realities those statistics purport to present. However, as Duncan-Gross put it in their recent book on Statistics in the 21st Century, *“truly effective change can only come about if it is informed by a larger vision: a vision that is clear-sighted in its understanding of the current statistical system, bold in its projections of what a more adequate system will look like, and aggressive in its determination to move all affected and interested parties toward making that vision a reality.”*

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# Les problèmes pratiques pour la collecte, le traitement et la diffusion des statistiques publiques après l'entrée en vigueur de l'euro dans l'Union Monétaire Européenne

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*L'adoption de l'Euro comme monnaie unique par plusieurs pays membres de l'Union Européenne à partir du 1er janvier 1999 va nécessiter de l'ensemble des acteurs de la vie économique et sociale de ces pays ainsi qu'à l'ensemble de leurs citoyens un effort d'adaptation sans précédent. Les INS (Instituts Nationaux de Statistique), qui recueillent un grand nombre de données exprimées en termes monétaires n'échapperont pas à l'effort technique nécessaire<sup>(1)</sup> pour adapter les méthodes de collecte ou les outils de traitement informatique des données collectées. L'objectif de cet article est de présenter l'analyse du travail à effectuer qu'a réalisée, en France, l'INSEE (Institut National de la Statistique et des Etudes Economiques). Auparavant seront rappelées quelques-unes des caractéristiques de cette opération, du moins celles qui ont une influence directe sur les travaux que vont devoir accomplir les INS.*

## 1 Le calendrier

C'est le Conseil Européen tenu à Madrid les 14 et 15 décembre 1995 qui a arrêté les principales étapes de la mise en place de la monnaie unique:

- a) Le plus tôt possible en 1998, la liste des pays qui participeront à la troisième phase de l'Union Monétaire (c'est-à-dire ceux qui le souhaiteront et qui satisferont aux critères de convergence fixés par le Traité de Maastricht en se fondant sur "les données les plus récentes et les plus fiables pour 1997") sera fixée par le Conseil Européen; la Banque Centrale Européenne (BCE) se substituera à l'actuel Institut Monétaire Européen (IME) avant le 1er janvier 1999.
- b) La troisième phase commencera le 1er janvier 1999 avec la fixation de taux de conversion fermes et irrévocables entre les monnaies nationales de ces pays et entre leurs monnaies nationales et la monnaie unique (qui prendra le nom d'Euro, lui-même subdivisé en 100 Cent). L'Euro sera substitué aux monnaies nationales sur les marchés des changes et pour certaines opérations financières (émission des titres de la dette publique négociable par exemple); les opérateurs économiques privés pourront, s'ils le désirent, utiliser l'Euro pour leurs transactions, sans pour autant y être contraints; l'Euro se substituera à l'actuel ECU-panier sur la base de 1 pour 1; la continuité des contrats sera assurée.
- c) Le 1er janvier 2002 au plus tard, l'Euro entrera en vigueur comme seule monnaie: il se substituera de plein droit aux monnaies nationales des pays fixés pour l'entrée en vigueur de la troisième phase; les billets et les pièces libellés en Euro commenceront à circuler dès le 1er janvier 2002; les billets et pièces libellés en monnaies nationales devront avoir été retirés de la circulation au plus tard dans un délai de six mois.

Comme prévu par les décisions du Conseil de Madrid, les conditions d'utilisation de l'Euro ont été précisées avant la fin de 1996 par deux propositions de règlements du Conseil. On ne citera ci-après que les dispositions de ces textes susceptibles d'avoir une répercussion sur le traitement de l'information statistique:

- Le premier texte, pris sur la base de l'article 235 du Traité, entre immédiatement en vigueur: les taux de conversion fixeront la valeur d'un Euro dans chacune des monnaies nationales avec six chiffres significatifs après la virgule (par exemple, 1 E. = 6,513222 F.<sup>(2)</sup>); ces taux sont utilisés pour toute conversion entre Euro et monnaies nationales et les conversions entre monnaies nationales doivent utiliser la conversion en Euro comme intermédiaire de calcul; les montants monétaires à régler ou à comptabiliser sont arrondis au cent le plus proche, ou avec deux chiffres après la virgule pour ce qui concerne les montants en monnaie nationale.
- Le second texte a fait l'objet d'un "accord politique" au Sommet de Dublin en décembre 1996 et devra être formellement adopté après qu'aura été fixée la liste des pays participants. Il prévoit pour l'essentiel les mesures juridiques nécessaires pour que l'Euro devienne effectivement la monnaie des Etats membres participants et remplace les monnaies nationales de ces Etats.

## 2 Les conséquences pratiques pour le traitement de l'information statistique par les INS

Il apparaît aujourd'hui que l'Euro ne sera pas utilisé par la plupart de nos fournisseurs d'information (ménages, entreprises, commerce et services) avant le 1er janvier 2002, ne serait-ce que les moyens de paiement usuels resteront libellés en monnaies nationales jusqu'à cette date. En particulier, pour les ménages, les petites et moyennes entreprises,<sup>(3)</sup> les commerçants de détail, continueront à utiliser les monnaies nationales pour l'essentiel de leurs transactions. Il n'en sera pas de même pour certaines grandes entreprises, au moins pour leurs opérations financières et pour leurs opérations de gestion de trésorerie et de commerce international ainsi que, bien entendu, pour les banques, qui souhaiteront utiliser dès le 1er janvier 1999, ou en tout cas bien avant le 1er janvier 2002, la possibilité qui leur a été offerte par les conclusions du Conseil Européen de Madrid.

Bien entendu, la seule date vraiment impérative pour avoir achevé les maintenances nécessaires sur les chaînes de traitement est la 1er janvier 2002, mais les INS ne peuvent "faire l'impasse" sur l'éventualité de recevoir de certaines grandes entreprises des données en Euro bien avant cette date. Les INS devront donc accepter des déclarations en Euro dès le 1er janvier 1999.

Une période critique se situera au premier semestre de l'année 2002: les chaînes de traitement devront "basculer" en Euro au 1er janvier, date à laquelle l'Euro deviendra la seule monnaie ayant cours légal, mais la coexistence pendant six mois de billets et pièces libellés en Euro et en monnaies nationales rendra nécessaire d'accepter encore des déclarations en monnaies nationales pendant cette période.

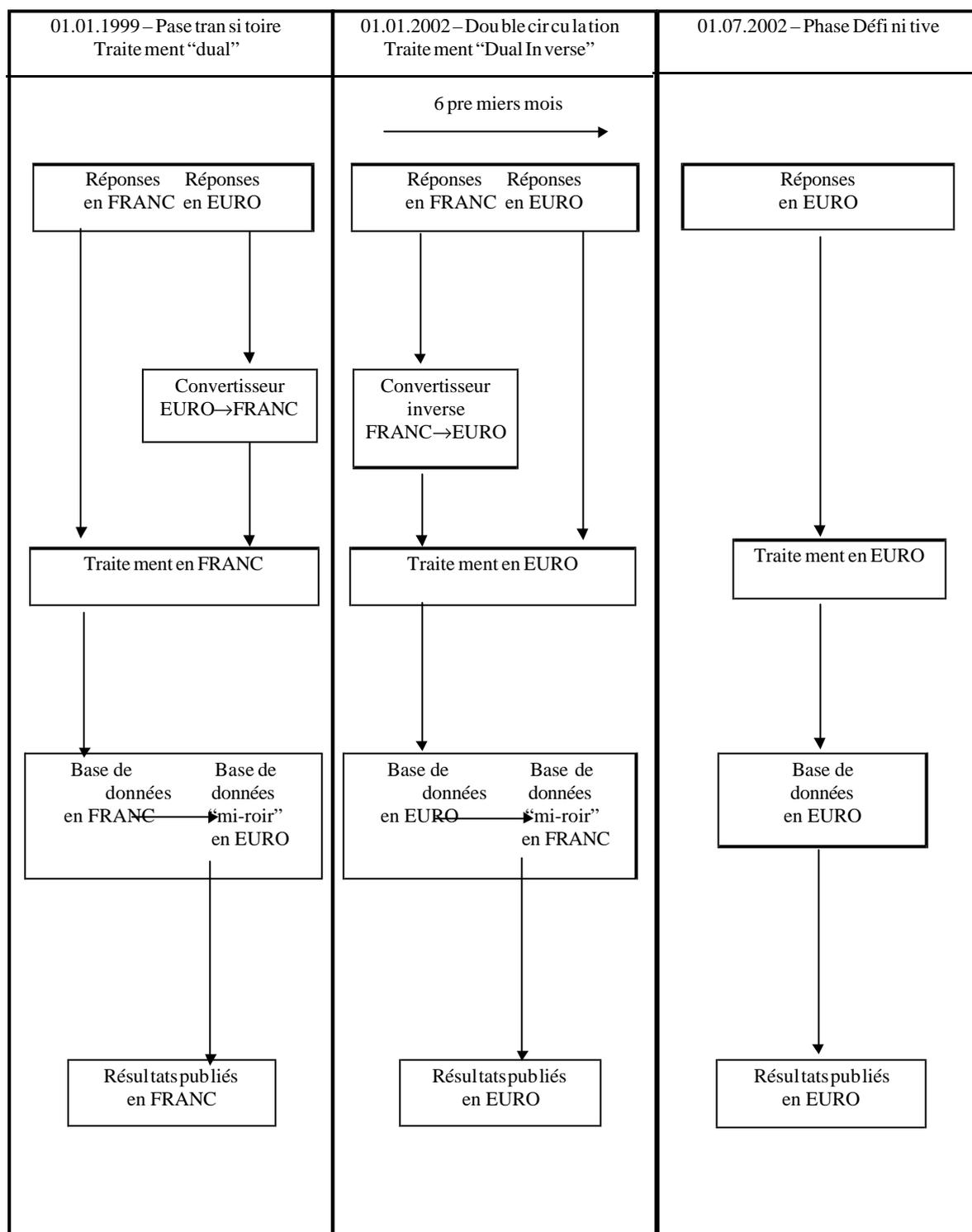
Les choix effectués par l'INSEE sont ceux qui ont été retenus par l'ensemble des directions du Ministère français de l'Economie et des Finances. Au demeurant, l'importance de l'utilisation de données administratives, en particulier celles en provenance de la Direction Générale des Impôts, aurait interdit à l'INSEE de faire "cavalier seul". Deux préoccupations ont guidé ces choix: faire au plus simple pour gérer la période transitoire (1999-2002), préparer minutieusement le basculement définitif (après le 1er janvier 2002).

Le schéma ci-après illustre le principe du traitement retenu.

### 2.1 La période transitoire (du 1 janvier 1999 au 31 décembre 2001)

Pendant cette période, seules seront affectées pour l'essentiel les enquêtes menées auprès des entreprises, les ménages n'étant pas en mesure d'utiliser réellement l'Euro dans leur vie courante. Le principe de base est de continuer à publier, pendant toute la période transitoire, les résultats en Franc et donc à gérer en Franc l'ensemble des fichiers. Toutefois, afin de permettre aux opérateurs qui le souhaiteraient de faire leurs réponses aux enquêtes statistiques en Euro dès 1999, des "convertisseurs" externes aux applications seront créés pour transformer les Euro en Franc en périphérie des diverses applications. De ce fait, le coeur des chaînes de traitement n'aura pas à être modifié avant 2002. Par ailleurs, les gestionnaires d'enquête auront à leur disposition des "miroirs" qui leur permettront d'afficher en Euro les données enregistrées en Franc dans les fichiers, afin notamment de permettre les vérifications ou les retours vers le déclarant lorsque celui-ci aura choisi l'Euro comme monnaie de déclaration. Le choix retenu par le Conseil de fixer les taux de conversion avec six chiffres après la virgule garantit contre toute erreur dans l'utilisation de ces "miroirs" et

## Scenario de Traitement des Réponses aux enquêtes (Phase III de l'Union Monétaire)



← Taux de conversion FRANC ↔ EURO fixe →

garantit une permanence à peu près parfaite<sup>(4)</sup> dans l’affichage qui, lui, ne sera réalisé qu’en “cent” (deux chiffres seulement après la virgule).

Il serait souhaitable que les réponses d’une même unité statistique à une enquête soient homogènes, c’est-à-dire que l’unité soumise à l’enquête choisisse de répondre à sa guise en Franc ou en Euro, mais qu’au sein du même questionnaire, il exprime ses réponses dans une seule unité monétaire (Franc ou Euro). Dans ce cas, il suffirait de réaliser une maintenance légère des applications de manière à conserver l’unité choisie pour la réponse. Il sera important de conserver cette information car le taux de conversion Franc ↔ Euro ne sera pas suffisamment important pour permettre une détection automatique fiable, notamment dans le cas des petites et moyennes entreprises. On ne peut toutefois pas totalement exclure que les entreprises ne répondent, au sein d’un même questionnaire, de façon hétérogène en Franc pour certaines variables, en Euro pour d’autres; dans ce cas, le principe de l’externalisation de la conversion à l’entrée des données évitera de refondre les chaînes de traitement, mais n’évitera pas de reconcevoir les questionnaires pour qu’aucune erreur ne soit commise à l’entrée des données.

## **2.2 La période de basculement (1er janvier 2002 – 30 juin 2002)**

Pour le traitement des enquêtes auprès des entreprises, le traitement effectuera sera un traitement “dual” du traitement effectué pendant la phase provisoire (Cf. schéma) et les problèmes techniques rencontrés, compte-tenu des principes d’externalisation retenus, seront donc de même nature.

Les problèmes les plus complexes à résoudre seront ceux des enquêtes de consommation, de budgets des ménages, ou encore l’observation des prix. En effet, pendant toute cette période, les prix feront très certainement l’objet d’un “double affichage”,<sup>(5)</sup> ce qui nécessitera à la fois l’adaptation des bordereaux de relevé des prix, une formation spécifique des enquêteurs et une adaptation des chaînes de traitement si l’on souhaite garder une trace de l’unité monétaire utilisée.<sup>(6)</sup> Les budgets d’enquête des INS pendant cette période devront donc être très sensiblement augmentés.

## **2.3 La période “de croisière” – phase définitive (après le 1er juillet 2002)**

À l’issue de la période de basculement, tout devrait normalement rentrer dans l’ordre. Le remplacement du Franc par l’Euro, sans aucune ambiguïté puisque, dans cette dernière phase, il n’y aura plus de risques d’emploi simultané de deux unités monétaires, permettra d’une certaine manière que les traitements (collecte, saisie des données, traitements informatiques) d’avant la troisième phase soient repris tels quels, ce que le principe d’externalisation retenu pour les deux périodes précédentes devrait permettre sans difficulté majeure.

Un certain nombre de difficultés surgiront toutefois tout au long de ce processus du fait que le calendrier effectif de traitement des données ne coïncide que partiellement avec le calendrier “juridique” de passage à l’Euro. 2002 sera à cet égard l’année la plus difficile: en particulier, les résultats de l’année 2001 qui seront encore pour la plupart collectés en Franc devront être publiés en Euro, ce qui complique le schéma proposé. De plus, les périodes délicates sont de durée plus ou moins longues en fonction de la périodicité des enquêtes. Les traitements des enquêtes annuelles réalisés sur l’année 2001 se poursuivront tout au long de l’année 2002 alors qu’on sera déjà passé à la phase définitive pour le traitement des enquêtes mensuelles, voire des enquêtes trimestrielles.

## **3 L’archivage et la diffusion des séries chronologiques**

Il sera souhaitable que tous les INS des pays membres de l’Union Monétaire adoptent des solutions harmonisées pour répondre aux questions suivantes: dans quelle unités monétaires convient-il de stocker et d’archiver les bases de données de séries chronologiques? dans quelles unités monétaires convient-il de publier les résultats?

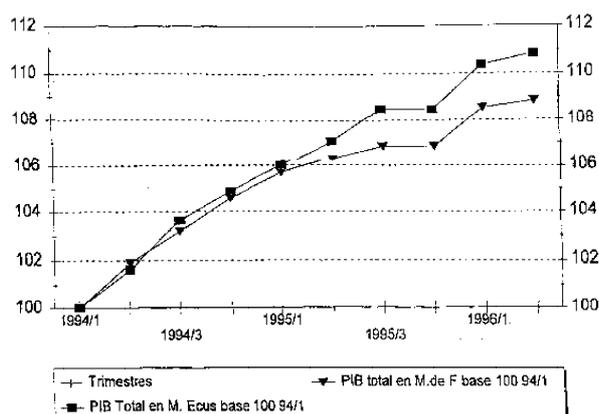
Pour ce qui concerne l’archivage et le stockage des bases de données de séries chronologiques, la seule solution raisonnable semble être d’archiver les données en Franc jusqu’au 31 décembre 2001, puis en Euro ensuite.

En revanche, en ce qui concerne la diffusion et la communication des données, il conviendra que, dès l'entrée en vigueur de l'Euro comme monnaie unique des pays membres de l'Union monétaire, c'est-à-dire à partir du 1er janvier 1999, un certain nombre de données soient présentées et publiées à la fois en Franc et en Euro, afin de préparer les utilisateurs à l'échéance du 1er janvier 2002 et de faire rentrer dans les mœurs les nouveaux ordres de grandeur. Cela suppose que les séries chronologiques correspondantes soient "rétopolées" avant le 1er janvier 1999 sur la base du taux de conversion ferme et irrévocable adopté à cette date en suivant les règles définies par le règlement du Conseil (taux de conversion avec six chiffres après la virgule et arrondi au Cent le plus proche). De même, certaines séries pourront encore être présentées en Franc pendant quelques mois après le 1er janvier 2002; mais cette ultime phase gagnera sans doute à être raccourcie au maximum.

Un problème plus délicat qui n'a pas trouvé de réponse à ce jour est lié au fait qu'EUROSTAT et l'Institut Monétaire Européen publient dès à présent des séries chronologiques en ECU-panier; du fait du caractère fluctuant de l'ECU-panier, ces séries ne sont évidemment pas identiques à celles qui résulteraient d'une rétopolation sur la base du taux de conversion Franc ⇔ Euro. Les économistes spécialistes des comparaisons internationales connaissent bien ce problème: l'histoire de l'inflation n'est pas la même dans la monnaie nationale d'un pays et dans une autre monnaie, le dollar par exemple. Si l'on prend par exemple la base des données des séries de comptabilité nationale, on aurait en théorie deux solutions:

- une première solution consisterait à rétopoler les séries en adoptant l'ECU-panier comme unité monétaire avant le 31 décembre 1998, c'est-à-dire en recalculant tous les chiffres antérieurs sur la base du taux de change Franc ⇔ ECU-panier à chacune des dates concernées; mais, outre que ce travail serait extrêmement lourd à réaliser, les séries qui font l'objet de publications par EUROSTAT ou l'IME ne seraient pas identiques à celles qui seraient ainsi recalculées par les INS pour de multiples raisons, théoriques ou pratiques (variation du taux de change de l'ECU-panier au jour le jour alors que les séries ont une périodicité au moins mensuelles, harmonisation ex-post réalisée au niveau européen, etc.); l'utilisateur aurait ainsi à sa disposition trois séries censées mesurer le même phénomène: celle d'EUROSTAT ou de l'IME, celle rétopolée par l'INSEE. De plus, la coexistence d'une série en ECU-panier et d'une série en Franc pourrait conduire à des erreurs d'analyse (Cf. graphique joint)<sup>(7)</sup> bien connus de ceux qui sont conduits à comparer successivement l'évolution d'une économie en monnaie nationale et dans une autre monnaie;

Graphique 1



- une deuxième solution consiste à ne rétopoler qu'un certain nombre de séries comme il a été indiqué plus haut à propos de la diffusion des données; certes, là aussi, les séries ainsi rétopolées seraient différentes des séries publiées par EUROSTAT et l'IME, mais l'utilisateur devrait en être moins gêné car il s'agira bien alors clairement de deux univers monétaires différents; les modélisateurs pourraient, quant à eux, se voir proposer, dans le cadre des bases de données auxquels ils ont accès pour leurs travaux, des séries donnant, depuis la date de création de l'ECU-panier, la valeur du taux de change Franc ⇔ ECU-panier (au jour le jour, mensuellement, trimestriellement, annuellement) afin de pouvoir, sous leur propre responsabilité procéder aux rétopolations qu'ils estiment nécessaires.

**Résumé:** *L'adoption de l'Euro comme monnaie unique par plusieurs pays membres de l'Union Européenne à partir du 1er janvier 1999 va nécessiter de l'ensemble des acteurs de la vie économique et sociale de ces pays ainsi qu' à l'ensemble de leurs citoyens un effort d'adaptation sans précédent. L'objectif de cet article est de présenter l'analyse du travail à effectuer qu'a réalisée, en France, l'INSEE (Institut National de la Statistique et des Etudes Economiques) pour adapter les méthodes de collecte ou les outils de traitement informatique des données collectées. Deux préoccupations ont guidé ses choix: faire au plus simple pour gérer le période transitoire (1999 – 2002), préparer minutieusement le basculement définitif (après le 1er janvier 2002). Enfin, il est rappelé que tous les INS des pays membres de l'Union Monétaire devront adopter des solutions harmonisées pour répondre aux questions suivantes: dans quelle unités monétaires convient-il de stocker et d'archiver les bases de données de séries chronologiques? dans quelles unités monétaires convient-il de publier les résultats?*

**Summary:** *For the adoption of the Euro as a single currency by several member countries of the European Union from January 1st, 1999, it is required for all the economic and social actors within those countries and for all their citizens to make an unprecedented adaptation effort. The purpose of this paper is to present the analysis of the work to be done, carried out by the French INSEE (Institut National de la Statistique et des Etudes Economiques) in order to adapt its methods for collecting and processing the data. Two preoccupations have lead those choices: being as simple as possible to manage the problem during the transitory period (1999 – 2002), carefully preparing the final swing after January, 1st, 2002. Finally, it is recalled that all the NSIs of member countries of the Monetary Union will have to adopt harmonised solutions to meet the following questions: In which monetary units should we store and archive the data banks containing time series? Which monetary units should be used for publishing the results?*

### Notes

1) Cet effort sera d'autant plus lourd que son calendrier va coïncider avec la maintenance liée au fameux problème "dit de l'an 2000".

2) Ce taux est évidemment donné comme exemple et ne saurait constituer une quelconque prévision!

3) Sauf, bien entendu, celles qui entretiennent des relations commerciales importantes avec ceux des autres pays qui auront rejoint l'Union Monétaire.

4) En tout cas compte-tenu de la nature de nos traitements; cela pourra poser des problèmes parfois un peu plus délicats, même s'ils n'ont qu'une incidence très marginale, pour les gestionnaires de titres, d'obligations en particulier.

5) Il est même à peu près certain (et d'ailleurs souhaitable!) que le "double affichage" commencera avant le 1er janvier 2002.

6) Ce qui peut se révéler utile si l'on souhaite, par exemple, étudier l'inflation spécifique induite par le changement d'unité monétaire.

7) Ce graphique présente l'évolution du PIB de la France à la fois en Franc et en ECU-panier sur la base 100 au 1er trimestre 1994, le taux de change étant le taux trimestriel moyen publié par la Commission. Il montre que la rétropolation en ECU-panier conduit à surévaluer la croissance du PIB de façon importante (sauf au 2ème trimestre 1994).

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# Meeting the Statistical Requirements for Stage Three of Monetary Union – some Aggregation Issues

*Peter A. Bull*

*This paper considers two important aspects of the statistical preparations for Monetary Union, namely harmonisation and aggregation issues. It does so in respect of money and banking, balance of payments, and financial account statistics, which are the areas in which the EMI has main or shared responsibility at European level. The selection of these contexts does not imply that interesting questions for the production of area-wide statistics do not arise elsewhere; nor does this paper exhaust all the possibilities in the chosen area.*

## **Background**

The Treaty on European Union (Maastricht Treaty) sets a January 1999 date for those Member States which are judged ready to do so to proceed to Monetary Union.<sup>(1)</sup> A European Central Bank will be established, with the main responsibility of maintaining price stability. In pursuit of this objective, the ECB must define and conduct monetary policy and carry out foreign exchange operations for the single currency area. The Treaty empowers it to collect the statistical information necessary for the performance of these tasks. Meanwhile, the Treaty requires the EMI to make the preparations for the ECB to carry out its tasks, including specifically in the area of statistics. A statement of statistical requirements for Monetary Union was released by the EMI in July 1996.

The focus of the ECB's policy responsibility will be the single currency area.<sup>(2)</sup> Accordingly the statistics to enable it to carry out its tasks will primarily relate to the single currency area. All national central banks in EU Member States have similar responsibilities, and therefore similar statistical needs. But the statistics used at national level may not be suitable for aggregation across the countries forming Monetary Union, for the reasons explained below.

## **Harmonisation**

The Maastricht Treaty requires the EMI to “promote the harmonisation, where necessary, of the rules and practices governing the collection, compilation and distribution of statistics in the areas within its field of competence ”

All Member States have banking and monetary statistics and balance of payments statistics, and some of them compile financial accounts. But there are many differences of definition and coverage, and, as important, differences in the frequency and timeliness of statistics. The necessary degree of harmonisation varies, however, among areas of statistics; and the approach differs, for reasons explained below.

## **Money and banking statistics**

Because some measure of money stock may be targeted, and policy decisions in the ECB may accordingly be based on its growth in relation to the target, high quality statistics are very important in this area. Even if money stock is not targeted, it is certain to be monitored closely.

There are two rather separate issues. First, what group of institutions should have their liabilities included in money stock, and accordingly report their business for this purpose? Second, how should a standard reporting framework for these institutions be drawn up?

The difficulty with using national definitions of institutions forming the “monetary” sector is that they are very varied. In some countries, only deposit-taking institutions are included (though other of their liabilities, e.g. CDs or bonds, may then be included in money stock); in other countries, institutions which do not take deposits (but specialise in leasing business or export finance, for example) may be included. A particular difficulty arises with money-market funds, which are easily identified in some countries but not in others (although there may be institutions there which are functionally the same).

The approach is to establish a definition and include all institutions considered to meet it. The definition of so-called Monetary Financial Institutions is central banks and:

*“... resident Credit Institutions as defined in Community Law, and all other resident Financial Institutions whose business is to receive deposits and/or close substitutes for deposits from entities other than MFIs, and, for their own account (at least in economic terms), to grant credits and/or to make investments in securities.”*

Money-market funds are in principle included in the sector. They are defined as:

*“... Collective Investment Institutions which collect funds from the public by issuing marketable shares, other than equities, and whose investment policy is to provide a return close to that provided by money market instruments. This investment policy is achieved mainly by investing most of their resources in money market assets, in instruments indexed to the money market or in bank deposits, or by shadowing the money market performance through the use of financial derivatives.”*

All Credit Institutions as defined in Community law are included, because the definition in the Banking Co-ordination Directives is very similar<sup>(3)</sup> and because to exclude some of them would have been confusing. While the phrase “... close substitutes for deposits” clearly leaves an element of judgement in the choice, the definition – which is reproduced in the European System of National and Regional Accounts 1995, and is very similar to that incorporated in the world System of National Accounts 1993 – should in practice produce a closely homogeneous sector.

The second question concerns harmonisation of the data which these institutions should report. The approach here was to present a standard balance sheet format containing the essential items in monthly and quarterly statistics (with the monthly requirement focused on money stock and counterparts, and the quarterly requirement on sector and instrument detail). Standard boxes are not sufficient for harmonised data, however; the schematic balance sheet is (or will be) accompanied by detailed guidelines on what constitutes a particular class of deposit or loan, etc. One of the purposes of including limited breakdowns by original maturity in the scheme was to promote functional harmonisation, which proved difficult to achieve starting with instruments.

In important respects the adoption of ESA 95 promotes harmonisation. In addition to the MFI sector itself, all sector definitions in the ECB’s banking and monetary statistics will coincide with those in the ESA 95, which Member States must implement, regardless of the ECB’s needs, starting in 1999. As will be seen later, the ESA 95 is an important instrument for harmonisation and thus a big help to the EMI/ECB.

Even fully harmonised statistics would not however achieve acceptable MU aggregates. A monetary aggregate covering a group of countries is more than the sum of their national monetary aggregates because it must include cross-border holdings of deposits within the area. A consistent treatment of lending and other counterparts is also necessary. Achieving the right coverage and effecting the necessary consolidation requires a breakdown of all external business of MFIs into positions with residents of other countries participating in the single currency area (Monetary Union Member States, or MUMS for short) and positions with counterparties in other countries (non-MUMS), including EU Member States outside the single currency area. This breakdown is needed throughout the instrument and sectoral detail in the quarterly statistics, if MU aggregates are to be

produced which are conceptually equivalent to the aggregates at present compiled at national level.

This requirement presents a transitional problem. The ECB will require accurate monetary statistics covering the future single currency area for more than one year before the starting date of Stage Three. As reliable seasonal adjustments cannot be available then, monetary developments in 1999 could only be judged on the basis of the previous year comparison, which makes the monthly outturns for 1998 as important as those for 1999. Moreover, to formulate a target for monetary growth towards the end of 1998, in case one is required, will need for example an outturn in the fourth quarter of 1997 to provide a base. This requirement for monetary statistics covering the prospective single currency area in the so-called interim period and earlier relates to those data items that would be essential for the compilation of monetary aggregates and their counterparts. As the initial composition of the area will not be known until early 1998, this requirement for data in the interim period would imply that MFIs would have to label by country all positions with residents of EU countries back to end-September 1997 with the full set of breakdowns required to compile the monetary aggregates and counterparts. In practice, the compilation of data on this basis relating to the period before the composition of the single currency area is known would impose a heavy burden. To avoid this, data for this period may be compiled with some flexibility, perhaps from existing international banking data sources.

This problem will recur whenever Member States enter the Monetary Union after it has been set up, since it will be important, especially if money stock is targeted, to be able to produce back data on the enlarged MU basis. In principle, MFIs will need to retain the ability to analyse by country all positions with residents of the EU countries which remain outside the area after the start of Stage Three. To reduce the potentially heavy reporting burden, it is proposed that any back data covering the period before a change in the composition of the single currency area is known could be produced with some scope for flexibility.

It is also clear that longer runs of back data covering monetary aggregates and at least the main other items in the MFI balance sheet approximating to a Monetary Union basis will be required for purposes of comparison through time. The likely starting point here is a partially harmonised broad monetary aggregate, M3H, used for some years in making cross-EU comparisons. M3H is a national measure of money stock; M3H data could be supplemented by the quarterly international banking statistics, as a proxy for cross-border positions within the MU.

### **Balance of payments statistics**

Issues of harmonisation arise also in balance of payments statistics. Implementation of the 5th edition of the IMF's Balance of Payments Manual (BPM5) will resolve many of these. The ECB's statistical requirements will conform to international conventions, in this area principally BPM5, so far as possible; departures from them will arise only for practical reasons, where, for example, conventions cannot be followed to the letter in monthly statistics compiled to a short deadline. In some cases the international conventions give scope for interpretation; here practices will be followed which make the best sense for Monetary Union applications.

Instead of harmonisation work, this paper considers the aggregation problems that arise in compiling the combined balance of payments for a group of countries. Here the combined bop means a statement of transactions of the MUMS area as a whole with the rest of the world; it excludes their cross-border transactions with each other.

Aggregating the net balance of payments of the MUMS provides a net balance of payments for the area as a whole, since cross-border transactions within the area in principle cancel out. This is indeed the approach that will be adopted in 1998 and, at least for portfolio investment (see below) for some time thereafter. But the ECB's requirement is for credits and debits, assets and liabilities, separately; aggregating net balances does not meet this need.

Consequently, reporting agents in MUMS will be required to distinguish in their external transactions between cross-border transactions within the MU and transactions outside the MU. The balance of payments of the MU is the sum of the latter.

A difficult aggregation issue arises in connection with portfolio investment. BPM5 recommends that a purchase by an institution in country A of shares issued by an enterprise in country B should

be recorded as an acquisition by A of a financial claim on B. Similarly, BPM5 recommends that an acquisition by a resident of country A from a resident of country B of securities issued by an entity in country C should appear in country C's accounts as an increased financial liability to A and a reduced liability to B. This is called the debtor/creditor approach and is generally accepted as an aim. But most Member States are unable to implement the debtor/creditor approach at present for practical reasons and instead classify transactions according to the country of residence of the counterparty with whom the transaction is done. This is known as the transactor approach. Hybrids between the two approaches are possible. Any approach applied consistently can produce a *national* balance of payments. Therefore aggregating across the MU net national balances on portfolio investment can produce a net balance in this category for the MU as a whole. But aggregating assets and liabilities separately for MUMS transactions with the outside world may produce errors where the MUMS follow different practices.

A simple example may help to explain this point. Suppose that country A follows the debtor/creditor principle, and country B follows the transactor principle. They are both MUMS. A resident of A sells to a resident of B a security issued by an entity in country C, which is outside the Monetary Union. It is evident that, for the Monetary Union as a whole, there is no balance of payments transaction because both parties are residents of the Monetary Union. But A will regard this transaction as a disinvestment in C, whereas B will regard it as an acquisition of a claim on A. Aggregating the data from A and B shows a net sale of securities by the Monetary Union as a whole, which is wrong.

The example given concerns assets for the Monetary Union. For liabilities of the Monetary Union the difficulties are even greater. These difficulties are related to the practicalities of reporting systems and cannot be solved quickly.

A solution devised for the portfolio investment account for the Monetary Union runs along these lines. Member States will be required to distinguish between net transactions in Monetary Union assets and net transactions in Monetary Union liabilities. For Member States of the single currency area, this would imply a split of portfolio transactions between MU securities (that is, securities issued by residents of the MUMS), and non-MU securities – that is, securities issued by non-residents of the Monetary Union. The sum of their transactions in securities issued by non-residents is then the net change in the Monetary Union portfolio assets – that is, outward portfolio investment by residents of the Monetary Union. The sum of transactions by residents of the Monetary Union in securities issued by residents of the Monetary Union represents the net change in Monetary Union liabilities – that is, inward portfolio investment in the Monetary Union. At the reporting level it is necessary to identify the residence of the issuer of the security in order to establish whether the issuer is a resident or non-resident of the Monetary Union. To this end, work is proceeding to develop a securities database using ISIN codes, to which balance of payments compilers can refer.

### **Financial accounts**

A detailed statement of financial transactions in the economy, broken down by sector and borrowing/lending instrument, together with a corresponding balance sheet, is a valuable complement to monetary analysis and policy research. The EMI is accordingly developing a financial account covering the future single currency area.

The money and banking and balance of payments statistics described above will provide the data for the MFI and external sectors. These will, in principle, be properly consolidated across the MU, and be available quarterly in some detail from ECB sources.

ESA 95 requires all EU Member States to compile financial accounts (transactions and balance sheets). The ESA financial accounts will be on a *national* basis, meaning that claims and liabilities within the national sector will cancel out but claims and liabilities against the same sector in another MUMS will show as external positions. It will thus not be possible to effect a full consolidation at MU level across the accounts.

In practice, this may not be a serious drawback, since partially consolidated accounts of, for example, the non-financial enterprise sector (being the sum of consolidated national statistics on the sector) may be of more interest than fully consolidated accounts across the MU. At all events, there is

no present intention to collect new information to compile MU financial accounts, but rather to use the ECB's money and banking and balance of payments statistics and the ESA 95 (national basis) financial accounts reported to the Commission (EUROSTAT). Other available data and estimations will be used to supplement these sources.

While, as noted earlier, the ECB sources will be quarterly (and indeed monthly, though with limited detail), the legal requirement under ESA 95 is an annual financial account. Although some Member States already have quarterly accounts and intend to continue them, others compile no financial account at present and are unlikely to exceed the minimum legal requirement. An intended second stage of the EMI/ECB work will be to consider how best to compile a quarterly MU account from the information available, since quarterly data, compiled in timely fashion, are much more useful for policy analysis than annual data.

This work is seen as an adjunct to the ECB's policy functions. As the above paragraphs have explained, it will not yield a definitive set of financial accounts in rivalry to those submitted to the Commission under ESA 95. Financial accounts at EU level are a shared responsibility between the EMI (and prospectively the ECB) and the Commission. The EMI is taking the lead in this project, because the ECB will be the institution with a policy interest in an MU financial account and the monetary and balance of payments data compiled by the ECB will have a prominent role in it. Nevertheless, EUROSTAT, as the recipients of the ESA 95 financial accounts, are actively involved.

### Notes

- 1) Denmark and the UK have a special position in this respect.
- 2) The ECB will also have certain responsibilities concerning EU Member States not participating in the single currency; these are not discussed in this paper.
- 3) The Banking Co-ordination Directives are concerned with prudential supervision and the definition in them is chosen accordingly: "[A Credit institution is an] undertaking whose business is to receive deposits or other repayable funds from the public and to grant credits for its own account."

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### I

*Rudi Acx*

This session dealing with the statistical problem related to the introduction of the Euro, the new currency for the European Monetary Union, has produced a set of very interesting papers. The papers of Mr. Mínguez and of Mr. Winder tackle a very practical and important problem on the conversion of ex ante monetary union time series expressed in national currencies into area-wide series expressed in a common currency unit. The papers of Mr. Bull and of Mr. Bodin deal with the new environment after the introduction of the Euro and the changeover to the Euro in the statistical procedures. The contribution of Messrs. De Michelis and Schönborn takes a special place, in that sense that it describes the important future impact of statistics and the challenges for the statisticians. That paper can serve as a basis for the outline of a charter over the coming years for the statistical agencies involved with official statistics. Upon request from the chairman I will concentrate on the two first mentioned contributions.

The Mínguez paper and the Winder paper have the same objective, but follow a different approach in the search for the best historical area-wide series. Let it be clear that the series are not that historical. Regardless of the intermediate variable to be handled by the European Central Bank (ECB) in the conduct of its monetary policy, the monetary and real economic aggregates for the monetary union will be of considerable importance from the outset of its activities. Both papers – and this is one of their strengths – present methods which are not uniquely linked to the European Monetary Union but may be transposed to any regrouping of national data into a larger geographical area. The Winder paper goes even further, given its more formal and theoretical approach, and points to the problems occurring in expressing different national data into one single currency regardless a geographical boundary.

The Mínguez paper states, correctly, that the absolute nor the relative purchasing power parity hold for market exchange rates in the short run. Therefore the selection criterion of the best fitting currency, or currency basket, consists in tracing, to the best extend possible, the original dynamics of the series expressed in national currency, together with the test on the relative weights of the respective countries in the area-wide aggregate. Both criteria are of importance; the maintenance of the original dynamics is a main concern for the countries involved and on the other hand the relative impact of each country on the area-wide data must be respected.

A first attempt in defining the best fitting currency or currency basket tries to minimize the standard deviation between the growth rate of the nominal output in the common currency and the growth rate of the nominal output in the original currency. The best basket for the European Union resulting from that exercise proves to be a basket containing 6 currencies which amount only to 15 % of the European Union output. This is not surprising, because the test is done against growth rates which are independent from the country size. This first exercise, which looks very attractive, is hardly defensible from an economic point of view because it is too mechanic. One example to illustrate this: let's take the case of Belgium and Luxembourg, countries which share already a common currency. Their growth rate in terms of a basket can be best kept in line with their respective original dynamics by a basket containing the same currencies, but one. In the case of Luxembourg the optimal basket contains in addition the Greek Drachma. The economic constellation remains silent on the reason why the Greek Drachma has to be included for Luxembourg. A more fundamental problem of this method lies in the fact that for each economic variable the best fitting basket will differ, as indicated by the author. These differences can be huge provided the exercise is based on growth rates. This method is not transparent for the user of the area-wide statistics and the com-

binations of area-wide statistics calculated that way may leave the decision maker puzzled with methodological paradoxes and inconsistencies in the values of related economic variables.

One of the alternatives put forward by Mr. Mínguez converts the national series through the purchasing power standards (PPS) produced by Eurostat. They coincide roughly spoken with the price parities between goods applied to the gross domestic product. They have the advantage to preserve the real weights of every country in the aggregate. These calculated exchange rates proof to meet best of all the retained criteria and should therefore be preferred. If this approach will be followed by the ECB for its monetary union figures, it will be faced with a question: will the PPS of Eurostat be retained or does the ECB need to recalculate PPS for the monetary union alone. This latter would imply the rescaling of the price parities to the GDP in ECU of the monetary union. Some sensitivity analysis should take place to check if these recalculations lead to significant differences with the actual Eurostat data. If this is not the case, the Eurostat PPS are to be preferred, to keep monetary union and economic union data consistent.

The Winder paper follows a different track. Regardless the search for a best fitting currency, the paper presents the conditions for different conversions methods, all of them using one single currency as the common denominator, to obtain the area-wide series. It follows that none of the conditions prevail in the real world and that the different methods will lead to different series.

However the main conclusion states that the conversion of both nominal and real output should use either fixed base exchange rates or fixed base purchasing power parities (PPP), to eliminate the influence of the chosen common denominator. Note that the proposition meets the first criterion of the Mínguez paper (not affecting the original dynamics). There remains however a problem in converting nominal output against e.g. the fixed base PPP. The weight of the country with higher inflation beyond the base year (calculated by the implicit deflator) will increase in the area-wide figure, which is not a desirable outcome. The result is only acceptable as far as the PPP remains constant, which is obviously not the case.

The two papers have both very much contributed to the stock taking of the possible methods and the description of their potential drawbacks. A common solution seems achievable using a kind of PPP. On the other hand, both the Mínguez and Winder paper conclude that “the” conversion method doesn’t exist and that therefore the choice of conversion method should be related to the aim of the economic analysis. And probably in that respect both authors support the proposition made by Mr. Bodin to limit the number of converted historical area-wide series in widely spread publications.

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## II

*René H.M. Smulders*

**The Introduction of the Euro – A contribution to best practices for NSIs**

This contribution presents the first results of the Steering Group “CBS and the euro” (SGE; StatNeth). The SGE published its preliminary report in July 1997. The report of the SGE is based on the work of four specialized project groups. We therefore hope that this report could contribute to determine “best practices” for NSIs.

These four project groups covered:

- Finance, management and administration;
- Input;
- Throughput/conversion;
- Output.

The general conclusion of the SGE is:

- The introduction of the euro will have a lot of consequences for CBS. Large and complex problems could arise if not in time an overview will exist of what CBS needs to do at which time, who will be responsible for it, and what budget (human capacity; material costs) will be needed.
- For reasons of control of the process and costs as well of the image of CBS, a number of expensive arrangements have to be made; not only internally, but also with data-providers and users of statistics. Internal and external information and communication will play an important role in this process.
- It is necessary to take a lot of decisions at this stage; based on these decisions a “general shooting script” (derived from plans and activities at the level of divisions/sectors) can be developed. Central direction, co-ordination and monitoring is indispensable.
- The costs of the total “operation euro” for the CBS will be around NFL 14,000,000 (= more than 6,5 million euros). It is necessary to look for the budgets needed for this operation.

The introduction of the euro will have many consequences for the statistical process of the CBS. Especially because it may be possible that the “real transition” (that is to say: the use of euros by data providers and by users of statistics) will start faster than expected now. The preparation of activities and some activities themselves cannot wait until the definite, political decision. Start now! A “euro test” will be introduced from now.

The formulation of a “CBS-euro-procedure” has two aims:

- to give an integral overview of the most important prepositions, starting points and decisions which are in force at StatNeth at the time of the introduction of the euro; so giving the possibility to decide on the short term that this procedure will be the uniform starting point for further elaboration and activities;
- to create an instrument that will be the guidance principle for clear and consistent information and communication, internally and externally.

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## Scheme of the CBS Euro Procedure

	Before 1-1-1999	From 1-1-1999 until 1-1-2002	From 1-1-2002 until 1-7-2002	From 1-7-2002
INPUT	<ul style="list-style-type: none"> <li>concerning reportperiods until 1999: <b>guilders</b></li> <li>concerning reportperiods from 1999: <b>guilders or euros</b> (recommendation: <b>guilders</b>)</li> </ul>	<ul style="list-style-type: none"> <li>concerning reportperiods until 1999: <b>guilders</b></li> <li>concerning reportperiods from 1999 to 2002: <b>guilders or euros</b> (recommendation: <b>guilders</b>)</li> <li>concerning reportperiods from 2002: <b>guilders or euros</b> (recommendation: <b>guilders</b>)</li> </ul>	<ul style="list-style-type: none"> <li>concerning reportperiods until 1999: <b>guilders</b></li> <li>concerning reportperiods from 1999 to 2002: <b>guilders or euros</b> (recommendation: <b>guilders</b>)</li> <li>concerning reportperiods from 2002: <b>guilders or euros</b> (recommendation: <b>euros</b>)</li> </ul>	<ul style="list-style-type: none"> <li>concerning reportperiods until 1999: <b>guilders</b></li> <li>concerning reportperiods from 1999 to 2002: <b>guilders or euros</b> (recommendation: <b>guilders</b>)</li> <li>concerning reportperiods from 2002: <b>euros</b></li> </ul>
THROUGHPUT/ CONVERSION facilitating input and output	<ul style="list-style-type: none"> <li>through put in: <b>guilders</b></li> </ul>	<ul style="list-style-type: none"> <li>gradual conversion or building up new systems based on priorities and available budgets</li> <li>storing of original data</li> </ul>	<ul style="list-style-type: none"> <li>through put in: <b>euros</b></li> <li>storing of original data</li> </ul>	<ul style="list-style-type: none"> <li>through put in: <b>euros</b></li> <li>storing of original data</li> </ul>
OUTPUT	<ul style="list-style-type: none"> <li>concerning reportperiods until 1999: <b>guilders</b></li> <li>concerning reportperiods from 1999: <b>guilders</b></li> </ul>	<p><i>availability:</i></p> <ul style="list-style-type: none"> <li>concerning reportperiods until 2002: as a standard <b>guilders</b>; gradually <b>euros</b></li> <li>concerning reportperiods from 2002: <b>guilders and euros</b></li> </ul> <p><i>publication:</i> <b>guilders</b></p>	<p><i>availability:</i></p> <ul style="list-style-type: none"> <li>concerning reportperiods until 2002: as a standard <b>guilders</b>; gradually <b>euros</b></li> <li>concerning reportperiods from 2002: <b>guilders and euros</b></li> </ul> <p><i>publication:</i> <b>euros</b></p>	<p><i>availability:</i></p> <ul style="list-style-type: none"> <li>concerning reportperiods until 2002: as a standard <b>guilders</b>; gradually <b>euros</b></li> <li>concerning reportperiods from 2002: <b>guilders and euros</b></li> </ul> <p><i>publication:</i> <b>euros</b></p>

## III

*Enrico Giovannini*

In my discussion, I will divide the papers into two groups. The first group, the political one, is comprised of Bull's and De Michelis' papers. The second, the technical and organizational one, takes into account others papers.

**The political papers**

In Bull's paper, the guidelines of EMI activity for the development of statistics in Stage Three of Monetary Union are described. Many problems are discussed from both organizational and methodological points of view. I have only one remark on this paper, referring to the problem of the construction of quarterly financial accounts. As Bull says, ESA95 regulation does not require quarterly financial accounts, but yearly accounts and EMI wants to take the lead of a project for the production of quarterly data. It is clear that the Maastricht treaty gives to ECB (or EMI) the faculty to collect and to produce the statistics necessary for its tasks, so there is not a "legal" problem for this activity, but my question is the following: when the ECB needs are close to those covered by a legal act of the Council or of the Commission (like in the case of in financial accounts), will the ECB prefer to produce directly the data or to promote changes in the legal acts in order to fulfil its needs following the "usual" channels and respecting national competencies? I think that this question is quite relevant for the correct development of statistics in the third stage of MU.

In De Michelis' paper many aspects related to the demand and supply of statistics in stage three are discussed. His approach is clearly "optimistic": he thinks that the importance of statistics will be increased because of MU and that the initial difficulties will be solved with an improvement of the quality in statistics. I agree with this view, even if I see many difficulties in convincing policy makers (and respondents) about the increasing importance of statistics and statisticians and about the financial support necessary for this purpose.

My question is related to the role of Eurostat in the production of statistics. The paper clearly indicates that Eurostat is ready to assume a direct role in the production of statistics requested primarily at the MU level. If these are a kind of "flash" estimates of data usually obtained, with a certain delay, by aggregation of national data, I don't see any problem. But if the intention is to have two sources for the same aggregate I see some difficulties, first of all for the users but also for National Statistics Offices (NSOs). This problems could be enhanced if the data have administrative effects, as in the case of GDP and public deficits in the "excessive deficit procedure" or for the "stability and growth pact".

**The technical and organizational papers**

Bodin's paper deals mainly with organizational problems of the introduction of the Euro. I agree with Bodin's view of the transition strategy and with his proposals, but the practical situation will be more complicated than described in the paper. For example, different groups of enterprises will follow different strategies in the transition period and relevant effects could occur on enterprises budgets which have transactions denominated in a currency participating in the Euro area, while other enterprises will not have changes in their budget, or the effects will be only due to the recalculation of fixed asset values registered at historical cost.

Otherwise, European directives impose that the enterprises obliged to publish their budgets must produce comparable data for at least two years. If an enterprise calculates its first budget in the Euro for the year 1999, it must produce figures also for 1998. Probably the enterprise will convert figures for 1998 expressed in the national currency invoking the so called "conversion for easy use procedure", using the fixed rate of 31 December 1998 (I would point on that this kind of conversion is already used by enterprises for the preparation of budgets in Ecu).

If the conversion will be made on macro data, this operation will not effect final results, but if the enterprise will convert micro data some effects on value added or on profits can be obtained. In this case two different sets of data for the same enterprise could be collected with reference to 1998.

Given these and others difficulties, I agree with Bodin's view about the need for an enlargement of financial resources for NSOs to conduct surveys during the transition period. These costs must be presented to the politicians as a cost of introducing the Euro, but if you read the documents prepared by the Commission or by other authors about this topic, statistical costs are never mentioned. A joint Eurostat-EMI initiative in this field, for example at the Monetary Committee and at the Council, could be very useful for the national statistical authorities.

The last problem described by Bodin, the recalculation of time series in Euro, is analysed in depth by the remaining papers. Winder's suggestion is to use fixed base-period exchange rates or fixed base-period PPP rates to express both nominal and real output of individual countries in a common currency. This choice permits obtaining growth rates of aggregates which are weighted averages of the corresponding variables of individual countries. Mínguez follows a different approach, trying to find a linear combination of individual currencies in order to preserve the dynamics of original series. His final suggestion is to use a basket of PPP rates, even if a basket of all EU currencies gives results which are only marginally worse.

First of all, I would point out that any econometric analysis based on time series from the pre-Euro period is strongly affected by Lucas' critique. In particular, I have many doubts about the possibility to correctly estimate an equation of monetary demand for the Euro. Secondly, I agree with Mínguez' remark that all methods of reconstruction of the series are artificial and arbitrary. Nevertheless, because it is necessary to have time series for the Euro area, a method must be chosen. In order to derive an "optimal solution" it is necessary to fix a priori the desired criteria and a sort of "loss function" to be minimized. To identify the method perhaps it is necessary to start looking at the real world, trying to understand how economic agents will treat the transition problems. National accounts, in fact, are theoretically (and practically) based on the aggregation of millions of micro data, reflecting mirco-behaviours.

Let me give an example. The main principle of the transition from the legal point of view is that all the contracts must remain in force. The intention of this principle is to avoid that the relative situation of an enterprise can change only for the transition to Euro. This principle could be used also for the relative position of a country with respect to the others. The consequence of this approach could be the choice of Mínguez' methodology applied to ratios between original series of GDP transformed through bilateral exchange rates.

To give another example of a statistical approach augmented by an analysis of the real world is the choice, in Winder's proposal, of the fixed base-period. As noted above, many enterprises will probably use the exchange rate between the Euro and national currencies to derive data for 1998. As a consequence of his choice, 1998 should be the base year of any reconstruction made using a fixed rate of conversion.

In conclusion, I don't have any final proposal for the reconstruction of the series. My suggestion is to link statistical approaches with the analysis of the real world, taking into account, among others, accountability rules followed by enterprises and legal aspects of the transition.

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# Irving Fisher and the Modern Theory of Indices

János Barta

*From the beginning and throughout my life (I have tried) to help build economics into a genuine science, comparable with the physical sciences, as well as to apply its principles to help solve certain practical economic problems pressing for solution.*

Fisher (1947)

## 1 Fisher between Mathematics and Economics

The above quotation comes from Fisher's manuscript called *My economic endeavours*, a work that Fisher planned to publish in 12 chapters as his scientific testament and summary of his research. The quotation expresses Fisher's deep scientific inclination, which accompanied his research in economics during his whole life.

Originally Fisher was a mathematician, therefore his view of economics was always deeply related to mathematical methods. At the time he entered the field of mathematical economics, "in the so-called gay nineties", Fisher was one of the first scientists in America coming from mathematics to economics. Remembering his early years Fisher (1941) wrote:

*One day I confided to William Sumner my growing perplexity as to how I was to write my doctor's dissertation, since only about half my time had been spent on mathematics, the other half having been mostly in economics. He immediately said: "Why not write on mathematical economics?" I replied, "I never heard of it."*

In this sense Fisher can be considered a pioneer in mathematical economics. It's remarkable that the systematic use of mathematical models in social sciences is more recent than in natural sciences, like physics for example.

An interesting question is, why this delay took place in the history of social sciences. The economist Mitchell (1938) wrote for the case of the measurement of price changes:

*It is a curious fact that men did not attempt to measure changes in the level of prices until after they had learned to measure such subtle things as the weight of the atmosphere, the velocity of sound... Their tardiness in attacking that problem is the more strange because price changes had frequently been a subject of acrimonious debate among publicists and a cause of popular agitation. Perhaps disinclination on the part of "natural philosophers" to soil their hands with such vulgar subjects as the prices of provision was partly responsible for the delay...*

As the title of this paper says, we will focus on price index theory. This was one of the main domains, where Fisher accomplished his program of explaining economical phenomena using mathematical models.

Fisher is therefore the father of the modern price index theory; indeed his work opened the way for a great mathematical development, which went on until nowadays. It is fascinating how the theory

behind price indices became more and more abstract involving surprisingly many domains of pure mathematics, like functional analysis, group theory, axiomatics and so on. This large use of sophisticated mathematical tools led to the so-called modern theory of index numbers.

## 2 The Price Index Problem

The economical concept of price index can be modelled mathematically as follows:

We consider function with 4 n-dimensional vectors as arguments:

$$P: R_{++}^{4n} \rightarrow R_{++}, \quad (\bar{q}^0, \bar{p}^0, \bar{q}^1, \bar{p}^1) \mapsto P(\bar{q}^0, \bar{p}^0, \bar{q}^1, \bar{p}^1)$$

$$\text{prices in the base situation} = (p_1^0, p_2^0, \dots, p_n^0) = \bar{p}^0,$$

$$\text{quantities in the base situation} = (q_1^0, q_2^0, \dots, q_n^0) = \bar{q}^0,$$

$$\text{prices in the observed situation} = (p_1^1, p_2^1, \dots, p_n^1) = \bar{p}^1 \quad \text{and}$$

$$\text{quantities in the observed situation} = (q_1^1, q_2^1, \dots, q_n^1) = \bar{q}^1$$

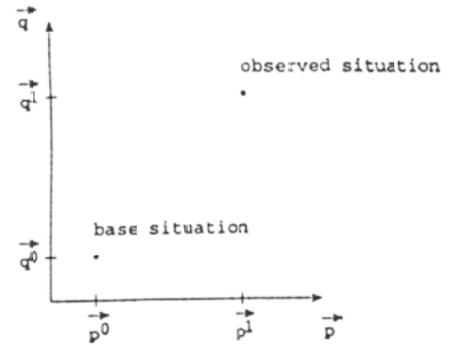


Fig 1

There is a base situation  $(\bar{p}^0, \bar{q}^0)$  and an observed situation  $(\bar{p}^1, \bar{q}^1)$ . The price index  $P(\bar{q}^0, \bar{p}^0, \bar{q}^1, \bar{p}^1)$  is a function which gives a positive real number expressing the comparison of these two situations. This number is called price index number.

The essence of the price index problem consists in finding for several commodities a suitable continuation of the price relative defined for one commodity into a higher dimension. The continuation has to be thought of as e.g. the continuation of a function defined on the real axis to a function defined in the complex plane. The price relative appears when one considers only one good. The price index then is simply the price in the observed situation  $p^1$  divided by the price in the base situation  $p^0$ . Generally spoken, the price index is the following function of the four real variables  $p^0, q^0, p^1, q^1$ , whereby  $q^0$  is the quantity in the base situation and  $q^1$  that of the observed situation:

$$P(q^0, p^0, q^1, p^1) = \frac{p^1}{p^0}.$$

## 3 Solutions of the Price index Problem

### 3.1 Laspeyres, Paasche Solutions and Their Arithmetic and Geometric Mean

There are many possible solutions of the price index problem. Maybe the most well-known ones are the Laspeyres index, the Paasche index:

$$P_{\text{Laspeyres}} = \frac{\bar{q}^0 \bar{p}^1}{\bar{q}^0 \bar{p}^0} = \frac{\sum_{i=1}^n q_i^0 p_i^1}{\sum_{i=1}^n q_i^0 p_i^0} \quad [3.1]$$

$$P_{\text{Paasche}} = \frac{\bar{q}^1 \bar{p}^1}{\bar{q}^1 \bar{p}^0} = \frac{\sum_{i=1}^n q_i^1 p_i^1}{\sum_{i=1}^n q_i^1 p_i^0} \quad [3.2]$$

The Drobisch arithmetical mean of the Laspeyres and Paasche index

$$P_{\text{Drobisch I}} = \frac{P_{\text{Laspeyres}} + P_{\text{Paasche}}}{2} \quad [3.3]$$

and Fisher's geometrical mean

$$P_{Fisher} = \sqrt{P_{Laspeyres} \cdot P_{Paasche}} \tag{3.4}$$

are other suitable solutions of the price index problem, Fisher called Laspeyres and Paasche indices “very good”, Drobisch index “superlative” and Fisher’s index “ideal”.

### 3.2 The Divisia Solution and Two Special Cases

#### 3.2.1 The index of Divisia

We regard the base point  $(\bar{q}^0, \bar{p}^0)$  and the observed point  $(\bar{q}^1, \bar{p}^1)$  as connected by a path  $\{\bar{q}(t), \bar{p}(t)\}$  parameterised by the “time parameter”  $t \in [t_0, t_1]$  with

$$\begin{aligned} \bar{q}(t_0) &= \bar{q}^0 & \bar{p}(t_0) &= \bar{p}^0 \\ \bar{q}(t_1) &= \bar{q}^1 & \bar{p}(t_1) &= \bar{p}^1 \end{aligned} \tag{3.5}$$

The whole path  $\{\bar{q}(t), \bar{p}(t)\}_{t \in [t_0, t_1]}$  will be denoted by C.

We treat all components  $q_i(t)$  and  $p_i(t)$  as differentiable with regard to t. We denote these derivatives by  $\dot{q}_i(t)$  and  $\dot{p}_i(t)$  respectively.

The resulting Divisia indices for quantities and prices

$$Q_{Divisia}^{(C)} = \exp \int_{t_0}^{t_1} \frac{\dot{\bar{q}}(\tau) \bar{p}(\tau)}{\bar{q}(\tau) \bar{p}(\tau)} d\tau \tag{3.6}$$

$$P_{Divisia}^{(C)} = \exp \int_{t_0}^{t_1} \frac{\bar{q}(\tau) \dot{\bar{p}}(\tau)}{\bar{q}(\tau) \bar{p}(\tau)} d\tau \tag{3.7}$$

are dependant on the path C from the base point to the observed point in the 2n-dimensional quantity-price space (Fig. 2).

One can conceive some of the traditional indices as Divisia line integrals on fictitious paths between the base point  $(\bar{q}^0, \bar{p}^0)$  and the observed point  $(\bar{q}^1, \bar{p}^1)$  in the 2n-dimensional quantity-price space. Namely Laspeyres’ price index, Paasche’s index and Edgeworth-Marshall’s (and Walsh’) index can be interpreted as Divisia indices (see Vogt and Barta (1997)) on the path 3.1, 3.2 and 3.3 respectively.

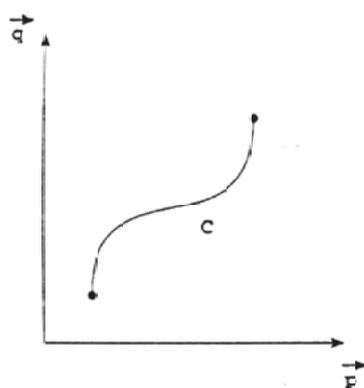


Fig 2

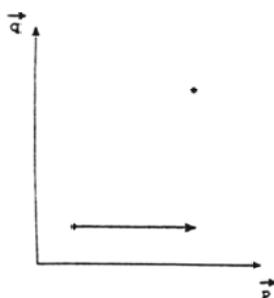


Fig 3.1

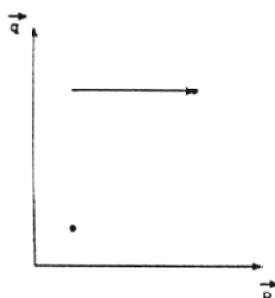


Fig 3.2

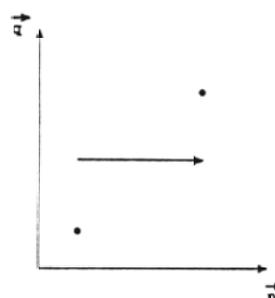


Fig 3.3

#### 3.2.2 The Divisia Index on the Straight Line

The straight line can be regarded as a special path between the base point and the observed point in the 2n-dimensional quantity-price space. It can be parameterised as follows:

$$q_i(t) = q_i^0 + t \cdot (q_i^1 - q_i^0) \quad i = 1, 2, \dots, n$$

$$p_i(t) = p_i^0 + t \cdot (p_i^1 - p_i^0) \quad t \in [0,1] \quad [3.8]$$

Analytically the evaluation of the Divisia price [3.7] index on the straight line leads to the following index:

$$P_{Vogt I}^{(C_{lin})} = \begin{cases} \sqrt{\frac{\bar{q}^1 \bar{p}^1}{\bar{q}^0 \bar{p}^0}} \left( \frac{\bar{q}^0 \bar{p}^1 + \bar{q}^1 \bar{p}^0 + \sqrt{D}}{\bar{q}^0 \bar{p}^1 + \bar{q}^1 \bar{p}^0 - \sqrt{D}} \right)^{\frac{\bar{q}^0 p^1 - \bar{q}^1 p^0}{2\sqrt{D}}} & D > 0 \\ \sqrt{\frac{\bar{q}^1 \bar{p}^1}{\bar{q}^0 \bar{p}^0}} \exp \frac{\bar{q}^0 \bar{p}^1 - \bar{q}^1 \bar{p}^0}{\bar{q}^0 \bar{p}^1 + \bar{q}^1 \bar{p}^0} & D = 0 \\ \sqrt{\frac{\bar{q}^1 \bar{p}^1}{\bar{q}^0 \bar{p}^0}} \exp \left( \frac{\bar{q}^0 \bar{p}^1 - \bar{q}^1 \bar{p}^0}{\sqrt{-D}} \arctan \frac{\sqrt{-D}}{\bar{q}^0 \bar{p}^1 + \bar{q}^1 \bar{p}^0} \right) & D < 0 \end{cases} \quad [3.9]$$

where

$$D = (\bar{q}^0 \bar{p}^1 + \bar{q}^1 \bar{p}^0)^2 - 4\bar{q}^0 \bar{p}^0 \cdot \bar{q}^1 \bar{p}^1. \quad [3.10]$$

### 3.2.3 The Divisia Index on the Exponential Path

One might prefer the exponential path  $C_{exp}$  displayed in figure 4 to the straight line  $C_{lin}$ . This exponential path can be parameterised as follows

$$q_i(t) = q_i^0 \cdot \left( \frac{q_i^1}{q_i^0} \right)^t \quad i = 1, 2, \dots, n \quad [3.11]$$

$$p_i(t) = p_i^0 \cdot \left( \frac{p_i^1}{p_i^0} \right)^t \quad t \in [0,1]$$

and the Divisia price index on this path is given by

$$P_{Vogt II}^{(C_{exp})} = \exp \int_0^1 \frac{\sum_{i=1}^n q_i^0 p_i^0 \left( \frac{q_i^1 p_i^1}{q_i^0 p_i^0} \right) \ln \left( \frac{p_i^1}{p_i^0} \right)}{\sum_{i=1}^n q_i^0 p_i^0 \left( \frac{q_i^1 p_i^1}{q_i^0 p_i^0} \right)} dt. \quad [3.12]$$

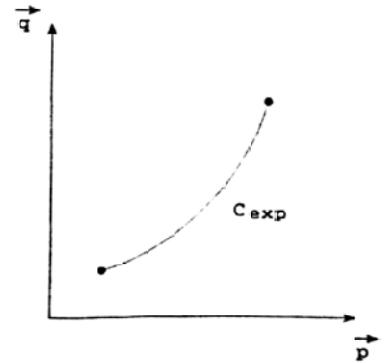


Fig 4

The analytic integration of [3.12] was evaluated, however only for the situation with two commodities:

$$P_{Vogt II}^{(C_{exp})2} = \left( \frac{P_1^1}{P_1^0} \right)^E \quad [3.13]$$

with

$$E = \left[ 1 + \frac{\ln \left( \frac{P_2^1}{P_2^0} \right) \left( \ln \left( \frac{q_2^1 P_2^1}{q_1^1 P_1^1} + 1 \right) - \ln \left( \frac{q_2^0 P_2^0}{q_1^0 P_1^0} + 1 \right) \right)}{\ln \left( \frac{P_1^1}{P_1^0} \right)} + \frac{\ln \left( \frac{q_2^0 P_2^0}{q_1^0 P_1^0} + 1 \right) - \ln \left( \frac{q_2^1 P_2^1}{q_1^1 P_1^1} + 1 \right)}{\ln \left( \frac{q_2^1 P_2^1}{q_1^1 P_1^1} \right)} \right] \quad [3.14]$$

It remains to investigate if such an evaluation is possible for  $n=3,4,\dots$ . From the above figures it is clear that the indices Vogt I and Vogt II are crossings of the indices of Laspeyres and Paasche, namely “geometric crossings”.

## 4 Tests for Price Indices: From Fisher Until Nowadays

### 4.1 Fisher's Great Reversal Tests

The words "suitable" and "good" for price indices should be clarified: a criterion is needed in order to distinguish good from bad functions.

In 1922 Fisher was aware of this problem. In his book *The Making of Index Numbers* we find that  
*The multiplicity of formulae for computing index numbers has given the impression that there must be a corresponding multiplicity in the results of these computations, with no clear choice between them. But this impression is due to a failure to discriminate between index numbers which are good, bad, and indifferent. By means of certain tests we can make this discrimination...*

Fisher (1911, 1922) is known for his test-theoretical approach in the statistical index theory. By test he understood a desired property of an index. The above quotation shows clearly his desire to have rational criteria in order to discriminate good from bad index numbers:

The use of tests is again a scientific method, typical in statistics or in other applied sciences. The two most important tests introduced by Fisher are the so-called "great reversal tests". The first one is the

#### *Time reversal test*

$$P(\bar{q}^0, \bar{p}^0, \bar{q}^1, \bar{p}^1) = \frac{1}{P(\bar{q}^1, \bar{p}^1, \bar{q}^0, \bar{p}^0)} \quad [4.1]$$

stating that when the two situations are interchanged the price index yields the reciprocal value. For instance, when the index is 2 with 1980 as the base and 1990 as the observed situation, it should be 1/2 when "the film runs backwards" with 1990 as the base and 1980 as the observed situation. The second great reversal test is the

#### *Factor reversal test*

$$P(\bar{q}^0 \cdot \bar{p}^0, \bar{q}^1, \bar{p}^1) = \frac{\bar{q}^1 \bar{p}^1 / \bar{q}^0 \bar{p}^0}{P(\bar{p}^0, \bar{q}^0, \bar{p}^1, \bar{q}^1)} \quad [4.2]$$

The factor reversal test states that a price index P multiplied with its analogous quantity index Q should yield the value ratio

$$V = \bar{q}^1 \bar{p}^1 / \bar{q}^0 \bar{p}^0 \quad [4.3]$$

Tests help us to classify indices; they give information about the quality of the chosen price index. For example it is remarkable that the well-known and most used indices of Laspeyres [3.1] and Paasche [3.2] don't satisfy neither the time reversal test, nor the factor reversal test, but the index of Drobisch [3.3] satisfies the time reversal and not the factor reversal test and finally Fisher's index [3.4] satisfies both of them. This fact supports the widely accepted conviction, that Fisher's index is the ideal price index. In the following we will give further arguments for calling it "ideal".

### 4.2 Fisher's Antitheses and Fisher's Group of 16 Elements

#### 4.2.1 The Group of 4 Antitheses

Fisher (1922) called the time and the factor reversal test "finders of new formulae" because to each price index  $P(\bar{q}^0, \bar{p}^0, \bar{q}^1, \bar{p}^1)$  exists its

#### *Time antithesis*

$$AT(P(\bar{q}^0, \bar{p}^0, \bar{q}^1, \bar{p}^1)) = \frac{1}{P(\bar{q}^1, \bar{p}^1, \bar{q}^0, \bar{p}^0)} \quad [4.4]$$

and its

**Factor antithesis**

$$AF(P(\bar{q}^0, \bar{p}^0, \bar{q}^1, \bar{p}^1)) = \frac{\bar{q}^1 \bar{p}^1 / \bar{q}^0 \bar{p}^0}{P(\bar{p}^0, \bar{q}^0, \bar{p}^1, \bar{q}^1)} \quad [4.5]$$

Fisher’s reversal tests [4.1] and [4.2] state that an index should be equal to the corresponding antithesis. From a mathematical point of view AT and AF are two functionals, which applied to an index function P generate a new index function, respectively AT(P) and AF(P). The composition of AT and AF yields the

**Simultaneous Time and Factor Antithesis**

$$AS(P) = AT(AF(P)) = AF(AT(P)) \quad [4.6]$$

If we consider also the

**Identity Antithesis**

$$AE(P) = P \quad [4.7]$$

we get a set of 4 antitheses (AE, AT, AF, AS). The interest of this set is that it has a group structure, which is a property that plays a central role in mathematics. We remember a sentence of Armstrong (1988) about the beauty of the group structure: “Groups measure symmetry as numbers measure size”.

**4.2.2 Fisher’s Group of 16 Antitheses**

Irving Fisher was the first to introduce time and factor antitheses in price index theory. but the intriguing connection between concrete economical objects and abstract mathematical structures was found out many years later by Vogt (1987). In chapter 3 of Vogt & Barta (1997) the main results obtained in this domain are shown. In 1993 Arthur Vogt extended to 16 antitheses the original set G of 4 elements (see Vogt (1993)):

$$F = \{AE, AQ, AP, AT, AF, AS, f7, f8, f9, f10, f11, f12, f13, f14, f15, f16\}$$

	AE	AQ	AP	AT	AF	AS	7	8	9	10	11	12	13	14	15	16
AE	AE	AQ	AP	AT	AF	AS	7	8	9	10	11	12	13	14	15	16
AQ	AQ	AE	AT	AP	10	9	11	12	AS	AF	7	8	16	15	14	13
AP	AP	AT	AE	AQ	9	10	12	11	AF	AS	8	7	15	16	13	14
AT	AT	AP	AQ	AE	AS	AF	8	7	10	9	12	11	14	13	16	15
AF	AF	7	8	AS	AE	AT	AQ	AP	13	14	15	16	9	10	11	12
AS	AS	8	7	AF	AT	AE	AP	AQ	14	13	16	15	10	9	12	11
7	7	AF	AS	8	14	13	15	16	AT	AE	AQ	AP	12	11	10	9
8	8	AS	AF	7	13	14	16	15	AE	AT	AP	AQ	11	12	9	10
9	9	12	11	10	AP	AQ	AT	AE	15	16	13	14	AF	AS	8	7
10	10	11	12	9	AQ	AP	AE	AT	16	15	14	13	AS	AF	7	8
11	11	10	9	12	15	16	14	13	AP	AQ	AE	AT	8	7	AF	AS
12	12	9	10	11	16	15	13	14	AQ	AP	AT	AE	7	8	AS	AF
13	13	16	15	14	8	7	AS	AF	11	12	9	10	AE	AT	AP	AQ
14	14	15	16	13	7	8	AF	AS	12	11	10	9	AT	AE	AQ	AP
15	15	14	13	16	11	12	10	9	8	7	AF	AS	AP	AQ	AE	AT
16	16	13	14	15	12	11	9	10	7	8	AS	AF	AQ	AP	AT	AE

The following group table was obtained using the computer program MATHEMATICA. We call this group F Fisher's group. Many interesting mathematical properties and symmetries are contained in the group F. But also from a practical point of view Fisher's index being known as ideal since 1922 passes all the sixteen reversal tests (obtained by the above 16 antitheses) and is the only possible index with this property! (cf. Vogt 1991). We think that this is a good mark for these sixteen reversal tests.

Finally Fisher's group could also be classified on the base of its algebraic structure: the result was that F is isomorphic to the group

$$D_4 \times Z /_{2Z} \tag{4.8}$$

where  $D_4$  is the dihedral group with 8 elements and  $Z /_{2Z}$  is the cyclic group with two elements. Then interesting information about this group was found, in particular the subgroup structure and the order of each element. For example we found that Fisher's group G has altogether 35 subgroups: 1 subgroup with 16 elements, 7 with 8 elements (4 of these are isomorphic to  $D_4$ ), 15 with 4 elements, 11 with 2 elements and finally 1 subgroup with 1 element. We remember that the dihedral group plays an important role in Euclidean geometry; in fact the 8 possible isometries of a square (that is 4 symmetries and 4 rotations) correspond to a dihedral group.

### 4.3 Antitheses of Properties of Indices

The research about antitheses went on with the introduction of a new idea: the antithesis of a property of price indices.

Let P be a given index and E any property of indices. Then let A(P) be a given antithesis of the index P. We want to answer the following question: which property has to hold for P, so that A(P) satisfies E? We call this property A(E), i.e. the antithesis of the property E.

**An example:** what is the factor antithesis of the

#### *Proportionality property*

$$P(\bar{q}^0, \bar{p}^0, \bar{q}^1, \lambda \bar{p}^0) = \lambda? \tag{4.9}$$

If proportionality holds for the factor antithesis of the index P, we have

$$\frac{\bar{q}^1 \cdot \lambda \bar{p}^0}{\bar{q}^0 \cdot \bar{p}^0} = \lambda \tag{4.10}$$

Then we can cancel the factor  $\lambda$  and we get

$$P(\bar{p}^0, \bar{q}^0, \lambda \bar{p}^0, \bar{q}^1) = \frac{\bar{q}^1 \bar{p}^0}{\bar{q}^0 \bar{p}^0} \tag{4.11}$$

Rewriting [4.11] with the usual sequence  $\bar{q}^0, \bar{p}^0, \bar{q}^1, \bar{p}^1$  in the price index P we get the well-known

#### *Strong value-index-preserving test*

$$P(\bar{q}^0, \bar{p}^0, \lambda \bar{q}^0, \bar{p}^1) = \frac{\bar{q}^0 \bar{p}^1}{\bar{q}^0 \bar{p}^0} \tag{4.12}$$

We say that the strong value-index-preserving test is the factor antithesis of the proportionality property.

The definition of antithesis of a property can be formalized in the following implication:

$$P \text{ satisfies } A(E) \Leftrightarrow A(P) \text{ satisfies } E. \quad [4.13]$$

Section 3.2 of Vogt & Barta (1997) treats this idea and shows several interesting properties following from the above definition.

## 5 Axiomatics

The use of tests represents Fisher's scientific approach to price index theory. The next natural question to ask is: what essential properties have to be satisfied by a function in order to be considered a price index? This is nothing else than looking for a suitable axiom system for price indices. The axiomatic approach of price indices is actually a modern evolution of Fisher's original program, that is treating economics with the same rationality as physical sciences; therefore we might say that axiomatics belong to the modern theory of index numbers. We give here a short overview of the axiomatic approach of price indices. One of the most known axiom systems is the one Eichhorn and Voeller proposed in 1978. It consists of the following 5 properties:

### *Monotonicity axiom*

$$\begin{aligned} P(\bar{q}^0, \bar{p}^0, \bar{q}^1, \bar{p}^1) &> P(\bar{q}^0, \bar{p}^0, \bar{q}^1, \hat{\bar{p}}^1) && \text{if } \bar{p}^1 > \hat{\bar{p}}^1 \\ P(\bar{q}^0, \bar{p}^0, \bar{q}^1, \bar{p}^1) &< P(\bar{q}^0, \hat{\bar{p}}^0, \bar{q}^1, \bar{p}^1) && \text{if } \bar{p}^0 > \hat{\bar{p}}^0 \end{aligned} \quad [5.1]$$

This axiom states that the function P is strictly increasing with respect to  $\bar{p}^1$  and strictly decreasing with respect to  $\bar{p}^0$ .

### *Dimensionality axiom:*

$$P(\bar{q}^0, \lambda \bar{p}^0, \bar{q}^1, \lambda \bar{p}^1) = P(\bar{q}^0, \bar{p}^0, \bar{q}^1, \bar{p}^1) \quad \text{for } \lambda \in R_{++} \quad [5.2]$$

This axiom states that a dimensional change in the unit of currency in which all prices are measured does not change the value of the function P.

### *Commensurability axiom*

$$P\left(\frac{q_1^0}{\lambda_1}, \dots, \frac{q_n^0}{\lambda_n}, \lambda_1 p_1^0, \dots, \lambda_n p_n^0, \frac{q_1^1}{\lambda_1}, \dots, \frac{q_n^1}{\lambda_n}, \lambda_1 p_1^1, \dots, \lambda_n p_n^1\right) = P(\bar{q}^0, \bar{p}^0, \bar{q}^1, \bar{p}^1) \quad [5.3]$$

for  $\lambda_1, \dots, \lambda_n \in R_{++}$

This axiom states that a change in the units of measurement of commodities does not change the value of the function P.

### *Identity theorem*

$$P(\bar{q}^0, \bar{p}^0, \bar{q}^1, \bar{p}^0) = 1 \quad [5.4]$$

According to this property the value of the function P equals one if all prices remain constant.

### *Linear homogeneity test*

$$P(\bar{q}^0, \bar{p}^0, \bar{q}^1, \lambda \bar{p}^1) = \lambda P(\bar{q}^0, \bar{p}^0, \bar{q}^1, \bar{p}^1) \quad \text{for } \lambda \in R_{++} \quad [5.5]$$

According to this property the value of the function P changes by the factor  $\lambda$  if all prices of the observed situation change  $\lambda$ -fold.

This can be considered as the basic axiom system for price indices, so that the later proposals of new systems are substantially attempts to correct or improve the original axiom system.

Olt (1995) proposed an axiom system consisting of the dimensionality axiom [5.2], the commensurability axiom [5.3], the

**Symmetry theorem**

$$P(\bar{q}^0, \bar{p}^0, \bar{q}^1, \bar{p}^1) = P(\tilde{q}^0, \tilde{p}^0, \tilde{q}^1, \tilde{p}^1) \quad [5.6]$$

W(stating that the same permutation of the components of the four vectors does not change the value of the index) and the

**Strong mean value theorem**

For every  $(\bar{q}^0, \bar{p}^0, \bar{q}^1, \bar{p}^1) \in R_{++}^{4n}$  there exists a  $\lambda = \lambda(\bar{q}^0, \bar{p}^0, \bar{q}^1, \bar{p}^1; P) \in (0,1)$  in order that the value of the price index can be represented as a convex combination of the smallest and the biggest price relative:

$$P(\bar{q}^0, \bar{p}^0, \bar{q}^1, \bar{p}^1) = \lambda \cdot \min_i \left\{ \frac{p_i^1}{p_i^0} \right\} + (1-\lambda) \cdot \max_i \left\{ \frac{p_i^1}{p_i^0} \right\} \quad [5.7]$$

The axiomatics of price indices produced many other axiom systems; each of them trying to represent the idea of price index or a specific aspect of it in the best possible way. Already Eichhorn and Pfingsten (1984) pointed out that actually price indices are not functions but sequences of functions  $\{P_n\}_{n \in \mathbb{N}}$ ; a price index function for any possible number of commodities n. However the idea of price index implies that this should behave “the same way” for any number of commodities n, therefore there must be a strong relation between  $P_n$  (the index for n commodities) and  $P_{n+1}$  (the index for (n+1) commodities), that is an extension rule is needed. This fact represents a difference to other classical mathematical measures like norms and metrics, which are usually defined in a fixed n-dimensional vector space. We think that it would be reasonable to define an analogous extension rule also for norms and metrics; in this way they would also become sequences of functions like price indices according to Eichhorn and Pfingsten (1984) (cf. section 2.5.3 of Vogt & Barta (1997)).

It is remarkable that the above two axiom systems would accept as a price index the following alternating sequence

$$P_n(\bar{q}^0, \bar{p}^0, \bar{q}^1, \bar{p}^1) = \begin{cases} P_{Laspeyres}(\bar{q}^0, \bar{p}^0, \bar{q}^1, \bar{p}^1), \text{ i.e. (1.18) for } n=2,4,6,\dots \\ P_{Paasche}(\bar{q}^0, \bar{p}^0, \bar{q}^1, \bar{p}^1), \text{ i.e. (1.19) for } n=1,3,5,\dots \end{cases} \quad [5.8]$$

However with this index the calculating authority could manipulate the value of the index by introducing an (n+1)th “phantom commodity” with  $q_{n+1}^0 = 0$  and  $q_{n+1}^1 = 0$ . That’s why in chapter 4 of Vogt & Barta (1997) the natural extension axiom for price indices is introduced. This extension rule permits to extend  $P_n$  to  $P_{n+1}$  and at the same time excludes undesired indices like the above alternating sequence.

**6 Automated Reasoning**

An axiom system is the essential core of a theory, that is a set of basic properties, which the whole theory is built on. With an axiom system the treated theory gets clear boundaries, since the truth of any statement can be checked on the base of the given axioms. This kind of formalization suggests to use the computer for proving theorems.

If we have a look to the evolution of mathematics we see that human beings are being more and more replaced by machines. The development of mathematics and the replacement of human beings by machines has been marked by several breakthroughs: the execution of *numerical calculations* by Pascal (addition and subtraction), Leibniz (multiplication and division), evaluation of more *complicated numerical algorithms* by programming languages like ALGOL, FORTRAN etc. and then the evaluation of *symbolical expressions* by programming languages like MAPLE, MATHEMATICA etc. Nowadays a lot of mathematical tasks are absolved by machines, but most mathematicians still believe that the core of mathematical thinking, that is theorem proving, will remain essentially human.

However in the last years artificial intelligence came to astonishing results. Under the first computer languages able to simulate logical thinking we mention PROLOG and LISP. Today we have new generations of computer languages able to prove mathematical theorems. One of them is called OTTER and it's a "real theorem proving assistant". To see how OTTER works we propose the following example about price indices:

**To prove:** The circular test

$$P(\bar{q}^0, \bar{p}^0, \bar{q}^2, \bar{p}^2) = P(\bar{q}^0, \bar{p}^0, \bar{q}^1, \bar{p}^1) \cdot P(\bar{q}^1, \bar{p}^1, \bar{q}^2, \bar{p}^2) \quad [6.1]$$

together with the proportionality property [4.9] imply the linear homogeneity test

$$P(\bar{q}^0, \bar{p}^0, \bar{q}^1, \lambda \bar{p}^1) = \lambda P(\bar{q}^0, \bar{p}^0, \bar{q}^1, \bar{p}^1) \quad \text{for } \lambda \in R_{++} \quad [6.2]$$

We will prove this for any n-dimensional situation.

**Defined objects:**

- We will use a price index function with 4 arguments:  $P(, , , )$ . The arguments won't be 2-dimensional vectors, but variables x,y,z, meaning general n-dimensional vectors.
- Then we define a multiplication of numbers  $..*..$  and the product  $\text{prod}(, )$  between a scalar and a vector.

The following input file contains the above stated theorem: the assumptions and the statement to prove (which appears in its negated form, since OTTER always tries a proof by contradiction):

**Input file**

```
1 set(auto).
2 list(usable).
3 P(xq0,xp0,xq2,xp2) = P(xq0,xp0,xq1,xp1) * P(xq1,xp1,xq2,xp2).
4 P(xq0,xp0,xq1,prod(xk,xp0)) = xk.
5 x*y=y*x.
6 P(q0,p0,q1,prod(k,pl))!= k * P(q0,p0,q1,pl).
7 end_of_list.
```

**Explanations**

- line 3: here we have the circular test. All the vectors are quantified with “ ”.
- line 4: this line contains the proportionality property.
- line 5: commutativity of the multiplication.
- line 6: this clause is the negated claim, i.e. the negated homogeneity test. Notice that all the quantities in this clause are constants and not variables.

**OTTER's proof**

————— PROOF —————

Length of proof is 4. Level of proof is 4.

————— PROOF —————

```
1 [] P(q0,p0,q1,prod(k,pl))!=k*P(q0,p0,q1,pl).
3 [] P(x,y,z,u)=P(x,y,v,w)*P(v,w,z,u).
```

4 [copy,3,flip.1]  $P(x,y,z,u)*P(z,u,v,w)=P(x,y,v,w)$ .  
 6 []  $P(x,y,z,prod(u,y))=u$ .  
 8 []  $x*y=y*x$ .  
 10 [para\_into,4. 1. 1.2,6.1.1]  $P(x,y,z,u)*v=P(x,y,w,prod(v,u))$ .  
 22 [para\_into,10.1.1,8.1.1]  $x*P(y,z,u,v)=P(y,z,w,prod(x,v))$ .  
 25 [copy,22,flip.1]  $P(x,y,z,prod(u,v))=u*P(x,y,w,v)$ .  
 26 [binary,25.1,1.1] \$F.

————— end of proof —————

### Explanations of the proof

**lines 1-8:** here are the statements coming from the input file. All the information in the input file has been used.

**line 10:** this line is the clue of the proof: OTTER uses the proportionality property (line 6) to do the needed non-trivial substitution in the circular test (line 4): at the place of  $\bar{q}_2$  OTTER puts  $k.\bar{q}_1$ . The obtained formula is actually already the wished homogeneity test, but OTTER hasn't seen it yet.

**line 22-25:** OTTER needs to apply commutativity of the multiplication and turn the statement from  $a=b$  to  $b=a$ . Only now the contradiction with the negated claim is reached.

The machine generated a correct proof, which is very similar to our traditional proof, because the example is rather simple. But it has to be underlined that in other cases OTTER could give surprising new proofs or sometimes could even prove theorems which were never proved before! In fact Wos, the main creator of OTTER, tells in Wos (1988) that in fields like logic and algebra there have been several hypotheses which could be proved only using OTTER.

Applying automated reasoning to price index theory was a challenge. It is fascinating to see how the machine solves the problems, sometimes very easily and sometimes with long and complicated attempts. It must be admitted that today theorem provers like OTTER are still quite limited, but they might become more powerful in the future. As a conclusion of this paper we consider two questions of philosophical nature, which arise at this point:

- 1) What is there in mathematics, that can't be done by a computer today?
- 2) Is it thinkable that in the future machines will completely replace mathematicians?

As an answer we propose saying that a chief aspect of mathematics is the art of conjecturing provable statements by intuition (*ars coniectandi*), something machines will never be able to do. Prof. E. Stiefel, the computer pioneer at the Federal Institute of Technology in Zürich (+1978), once said: "A mathematician only has the force of proving a statement which is already intelligible to him." ("...", *das ihm einleuchtet*."). A mathematician will not prove a formal statement randomly submitted to him. On the other side the proofs performed by a machine are based exclusively on formal, logical rules and don't consider the meaning (semantics) of the treated objects, nor the mathematical or scientific context in which the theorems lie. Since reality is more than a chess board, that is more than a closed system based on a few well-defined and formalizable rules, it seems us still very futuristic to imagine machines doing mathematics "in a human way", "thinking" about reality, about the meaning and the need of new conjectures.

### 7 Conclusion

Once more it must be underlined that the present state of price index theory, deeply connected with sophisticated mathematical structures, had its origin in Fisher's scientific efforts. Therefore, coming back to the initial quotation, we can say that Fisher was in fact able to "help build economics into a genuine science" as he desired.

### Bibliography

- Armstrong, M., 1988, *Groups and Symmetry*, Springer-Verlag, New York, etc.
- Barta, J., 1996, *Methods of Automated Theorem Proving Applied to Several Measures of Descriptive Statistics. An Approach to Axiomatics with a New Tool of Computer Logic*, Diploma Thesis at the Federal Institute of Technology, Zürich.
- Eichhorn, W. and Pfingsten, A., 1984, *Sequences of Mechanistic Price indices*, in Hauptman et al. (1984).
- Eichhorn, W. and Voeller, J., 1976, *Theory of the Price Index*. Lecture Notes in Economics and Mathematical Systems, Springer-Verlag, Berlin.
- Fisher, I., 1911, *The Purchasing Power of Money. Its Determination and Relation to Credit, Interest and Crises*. New and revised edition of 1913, Reprint of 1985 by Augustus M. Kelley. German translation of 1916 by Reimer-Verlag, Berlin. Vol.4 in Fisher (1997).
- Fisher, I., 1922, *The Making of Index Numbers. A Study of Their Varieties, Tests, and Reliability*. Reprint of 1967 by Augustus M. Kelley of the third edition of 1927. Vol.7 in Fisher (1997).
- Fisher, I., 1941, *Mathematical Method in Social Sciences*. *Econometrica*, Journal of the Econometric Society, Vol. 9, July-October, 1941, Chicago, U.S.A.
- Fisher, I., 1947, *My Economic Endeavours*. Manuscript, in the Fisher Papers, Series III, Box 26, Folder 414-417, Yale University Library.
- Fisher, I., 1997, *The Works of Irving Fisher*, General Editor W. Barber, Consulting Editor J. Tobin, Pickering & Chatto Publishers, Brookfield, U.S.A.
- Mitchell, 1938, *The Making and Using of Index Numbers*, Originally published in 1915 as part of Bulletin 173, Bureau of Labour Statistics, Reprints of Economic Classics, Augustus M. Kelley, New York 1965.
- McCune, W., 1994, *OTTER 3.0.0., Reference Manual Guide*, Mathematics and Computer Science Division, Argonne National Laboratory, Illinois.
- Olt, B., 1995, *Axiom und Struktur in der statistischen Preisindextheorie*, Dissertation an der Universität Karlsruhe, Referent: W. Eichhorn.
- Thomas, A.D., Wood, G.V., 1980, *Group Tables*, University College of Swansea, Shiva Publishing Ltd., United Kingdom.
- Vogt, A., 1980, *Der Zeitumkehr- and der Faktorumkehrtest als 'finders of tests'*: *Statistische Hefte*, 21,66-71.
- Vogt, A., 1981, *Die Zeit- and die Faktorantithesen von Eigenschaften von Indices*. *Statistische Hefte*, 22, 142-143.
- Vogt, A., 1987, *Some Suggestions Concerning an Axiom System for Statistical Price and Quantity Indices*, *Commun. Statist.-Theory Meth.*, 16(12), 3641-3663.
- Vogt, A., 1991, *The Making of Tests for Indices*, Discussion paper 91-2 of the University of Bern, Volkswirtschaftliches Institut.
- Vogt, A., 1993, *The Ghost and the Machine*, in: Diewert, W.E., Spremann, K. and Stehling, F. (eds.): *Mathematical Modelling in Economics, Essays in Honour of Wolfgang Eichhorn*, Springer-Verlag, Berlin etc.
- Vogt, A. and Barta, J., 1997, *The Making of Tests of Index Numbers, Mathematical Methods of Descriptive Statistics*, Published in Honour of the 50th Anniversary of the Death of Irving Fisher, Physica-Verlag, Heidelberg, etc.
- Wolfram, S., 1988, *Mathematica, a System for Doing Mathematics by Computer*, Addison-Wesley Publishing Company Inc., California.
- Wos, L., 1988, *Automated Reasoning*, Prentice Hall, New Jersey. Second edition: Wos, L., Overbeck, R., Lusk, E. and Boyle, J., 1992, McGraw-Hill, NY, etc.

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# Leading Indicators of Inflation in Turkey<sup>(\*)</sup>

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## I Introduction

As argued in Fischer (1996), there is now a widespread consensus among the policy-makers that the ultimate policy objective of a central bank should be price stability, defined as low inflation. A practical question remains, however, as to what sort of a model or approach should the policy-maker use, once an “inflation target” is established. Earlier work suggests that one could take two different approaches: the more conventional intermediate target (IT) approach or the relatively recent information variable (IV) approach.

The *IT approach* seeks to determine the money growth rate *ex ante* to be consistent with the central bank’s macroeconomic policy objective and then conducts monetary policy operations during some time interval as if achieving money growth along that path were itself the policy objective (Friedman and Kuttner (1992), Friedman (1994)). This approach requires the existence of a stable relationship between the relevant monetary aggregate and the final objective as well as a good understanding of the monetary transmission mechanism, that is, of what might be taking place inside the “black box”.

Difficulties in identifying the transmission mechanism and the absence of a stable relationship between a monetary aggregate and the basic policy objective, usually attributed to financial liberalization, have recently led many countries to adopt an alternative framework, the IV approach, made popular in the context of recent debate on “inflation targeting” as a new monetary policy framework.<sup>(1)</sup>

The *IV approach* has two key elements. First, it incorporates a broad set of information variables with strong predictive content into the policy-making process, principally aiming at high quality inflation forecasts; and, second, it updates the set of information variables by frequently reassessing the forecasting properties of each variable and in that sense, offers a fairly flexible monetary control framework to the policy-maker (Mühleisen, 1995). The key practical issue, of course, is to find an appropriate set of information variables or indicators which lead inflation over an operationally relevant time horizon. The IV approach addresses this issue through non-structural and atheoretical time series techniques.<sup>(2)</sup>

In Turkey, structural changes in the economy since the early 1980s, extensive financial liberalization culminating in the opening of the capital account in late 1989, as well as a highly unstable macroeconomic environment with high and chronic inflation seem to have broken the link between various monetary aggregates and inflation.<sup>(3)</sup> The lack of a sufficient understanding of the monetary transmission mechanism also seems to pose serious difficulties in the implementation of monetary policy by the Central Bank.<sup>(4)</sup> However, despite many practical problems, the Central Bank has given strong emphasis on “inflation control” in its monetary policy practice over the recent past. Taking into account these factors, in what follows, we attempt to derive a set of leading indicators of inflation for Turkey. We should add, however, that our objective of deriving these indicators should not be taken as an attempt to suggest “inflation targeting” in Turkey. High and chronic inflation which has become the central problem of the Turkish economy needs to be sharply reduced before such a framework can be suggested in any meaningful way. Instead, our main motivation is to offer guidance to the policy-makers in their daily operations and to gain preliminary insights on the monetary transmission mechanism as well as inflation dynamics in Turkey over the recent past.

The rest of the paper is organized as follows. In Section II, we provide a summary of monetary policy implementation in Turkey since 1986, a year that financial liberalization and developments in financial markets speeded up considerably. In Section III, we discuss the methodology and data issues, and in Section IV we explain the estimation results. In Section V, we surmise on the policy implications of our results and explain our future direction of research.

## II The Practice of Monetary Policy Since 1986

The environment of monetary policy implementation has changed substantially since 1986. Before 1986, the monetary policy of the Central Bank was characterized by direct interventions aimed at controlling the expenditure and portfolio structures of both the private and the public sectors; the loan demand of the private sector was met by the commercial banks and preferential credits were supplied through the rediscount window almost automatically. More importantly, the public sector's borrowing requirement was mainly met through the Central Bank resources which, in effect, fully subordinated monetary policy to fiscal policy (Kesriyeli, 1997). Starting in 1986, the Central Bank has modified its monetary policy environment substantially, the critical changes being a shift from direct to indirect monetary policy instruments as well as efforts to organize Central Bank policy-making around monetary programs aimed at, at least in principle, inflation reduction. The new policy centered around the control of the Turkish lira reserves of the banking system with the aim of increasing the effectiveness of interest rate policy and hence achieving an indirect control over broad money supply.

The change in policy required substantial modifications to the institutional structure. In order to prevent the somehow automatic financing of the budget deficit by the Central Bank resources, an auction market was established for the sale of treasury bills and government bonds in 1985. Moreover, an interbank money market was rendered operational in April 1986 in order to facilitate the reserve management by deposit money banks. The most important developments during the latter period were the introduction of open market operations in 1987 and the liberalization of interest rates on deposits in 1988.<sup>(5)</sup>

The Central Bank designed a monetary program for the first time in 1986 for internal purposes. The intermediate target of the program was broad money supply (M2) whereby its annual increase was tied to changes in key macroeconomic variables, such as the growth rate, real exchange rate and real interest rates. The program aimed at achieving the desired growth in M2 by controlling the growth in both net domestic and net foreign assets of the Central Bank. Similar programs were prepared in 1987 and 1988, but were also not announced to the public.

In 1989, the monetary policy strategy was modified slightly whereby the Central Bank aimed at controlling the growth of its own balance sheet while dropping the use of an intermediate broad money supply target. In the same year, the use of the short term advance facility by the Treasury, an important cause of monetary control problems, was limited and credit extended to banks was brought under control.<sup>(6)</sup> Furthermore, the growth in the Central Bank balance sheet began to be driven more through increases in net foreign assets rather than expansion in domestic currency components, except for the devaluation account;<sup>(7)</sup> a strategy to finance its assets by way of creating "central bank money" rather than increasing its foreign exchange liabilities to residents was adopted. The most important development in 1989 was the enactment of Decree No. 32 late in the year which fully liberalized the capital account. This has changed the policy making environment substantially ever since by exposing the economy to strong capital flows, but at the same time allowed the Central Bank to strengthen its reserve position substantially despite persistent deficits in the current account.<sup>(8)</sup>

In 1990, the Central Bank prepared a medium term monetary program which was announced to the public. The program has been set at the level of the Central Bank's balance sheet, as it was the case in the previous years, but following a somewhat unusual practice, the program set ceilings on domestic credit expansion by way of controlling the growth in four aggregates: the total balance sheet, total domestic liabilities, total domestic assets, and central bank money.<sup>(9)</sup> The program was broadly successful in terms of achieving the desired restructuring in the balance sheet.

In 1991, the Central Bank was not able to implement a monetary program because of two important developments: the outbreak of the Gulf Crisis and the announcement of early elections after a

short period of increased political uncertainty. In that context, the Central Bank moved toward providing stability in the financial markets with a view to preventing attacks on the domestic currency and excessive reserve losses, rather than controlling inflation.

A monetary program was announced in 1992, but the rapid expansion of public sector credit made it impossible for the Central Bank to comply with the program targets. Thus, the Central Bank, once again, turned into eliminating excessive fluctuations in the financial markets, most notably pressures in the foreign exchange market largely arising from excess liquidity; consequently, the central bank money, one of the key targets of the monetary program, grew excessively and exceeded the targeted level.

In 1993, the Central Bank did not announce a monetary program because of past difficulties in controlling the monetary aggregates, most notably those arising from the financing needs of the public sector, and again aimed at providing exchange rate and interest rate stability. The growing public deficit, combined with artificial means to keep interest rates on treasury bills and government bonds at low levels, led to the financial crisis of April 1994. After the crisis, the main objective of the monetary policy was again to ensure stability of the financial markets. One of the most important measures taken to achieve this end was the limitation of the short term advance facility of the Treasury in the context of a stand-by agreement with the IMF in 1995.<sup>(10)</sup> Within the framework of this agreement, the aim of the monetary program in 1995 was to substantially reduce inflation which had reached 150 percent in 1994. The program, which set a ceiling on the net domestic assets and a floor on net foreign assets, but around some sort of an exchange rate band, was put into practice for the first ten months of the year. Nevertheless, the program deviated from its target as political uncertainty increased after the announcement of early parliamentary elections in September 1995.

The period thereafter was marked by political instability. In this highly uncertain environment, the Central Bank put another monetary program into effect in the second quarter of 1996. Similar to the earlier programs, the 1996 program aimed at providing stability in the financial markets by controlling the growth in net domestic assets and by creating domestic liabilities, to the extent possible, in return for increases in foreign assets. The Central Bank also announced that it would follow a real exchange rate rule with a view to keeping the real exchange rate broadly constant.<sup>(11)</sup>

The above review suggests that the monetary policy practice of the Central Bank over the recent period has focused mainly on the restructuring of the Central Bank's balance sheet (1986-89) and on providing stability in the financial markets (1990-present) rather than on inflation reduction except, perhaps, for some very brief periods as in 1995. As it is shown in Section IV below, this observation is largely borne out by the data.

### III Methodology and Data

The methodology used in this paper consists of selecting leading indicators of inflation based on a battery of Granger-causality tests and a robustness criterion described in Baumgartner et al. (1997). They adopt the following robustness criterion based on simple Granger-causality tests: the null hypothesis of no-Granger causality is rejected only if the Granger causality tests applied *at both the levels and first differences of the series reject it for at least half the calculated lag orders.*<sup>(12)</sup>

To this end, we first perform the Granger-causality tests on a bivariate basis using the following formulation:

$$\Delta X_t = \alpha(L)\Delta X_{t-1} + \beta(L)Y_{t-1} + \varepsilon_t \quad [1]$$

In equation [1],  $X_t$  refers to the price variable at time (t) which we have chosen as the Consumer Price Index (CPI), whereas  $Y_t$  represents the variable which is a potential leading indicator of inflation.<sup>(13)</sup> We then proceed to test the robustness of the bivariate results in a multi-variate setting. In this exercise, we estimate the following equations:

$$\Delta X_t = \alpha(L)\Delta X_{t-1} + \beta(L)\Delta Z_{t-1} + \gamma(L)\Delta Y_{t-1} + \varepsilon_t \quad [3]$$

where  $Z_t$  represents the value of the variables that are likely to contain information on the dependent variable and account for the impact of aggregate demand shocks, both internal and external, on inflation. We define the first element of  $Z_t$  as the output gap obtained by using the monthly industrial production index (IPI) and the second as the export volume in dollar terms.<sup>(14)</sup>

The set of candidate indicators analyzed in this study mainly consist of various interest rates and monetary aggregates, several aggregates from the Central Bank balance sheet, foreign trade and fiscal variables, the output gap, and a monetary conditions index.<sup>(15)</sup> All data are monthly and cover the period from January 1987 through March 1997. The only exception is the deposit money bank loans series which starts from January 1990. Although we have experimented with the seasonally adjusted data, all of the results reported in this study refer to seasonally unadjusted data. The main reason for preferring the unadjusted series is to avoid any loss of information in the data. Furthermore, seasonally adjusted data are usually not reported in Turkey and do not seem yet to be a part of the regular decision making process of private agents. The definitions of variables as well as data transformations for all the variables are given in Table 1 in the Appendix.

In line with the usual practice, before applying the causality tests, we carry out the Augmented Dickey-Fuller unit root tests using the sequential procedure based on Dickey and Fuller (1981).

To test the order of integration, we start from the most general form of the model:

$$\Delta X_t = \alpha_0 + \alpha_1 t + \alpha_2 X_{t-1} + \sum_{i=1}^k \beta_i \Delta X_{t-i} + \sum_{i=1}^{11} \gamma_i CD_i + \varepsilon_t \quad [2]$$

where  $(t)$  is a linear time trend, and  $CD_i$  ( $i=1, \dots, 11$ ) are 11 centered seasonal dummies. In deciding the lag order of the lagged values of the dependent variable, we use the criterion of no serial correlation in residuals. Then, we test the significance of the trend term together with the unit root hypothesis by using the Dickey-Fuller likelihood ratio test,  $\phi_3$ . In cases where we reject the hypothesis based on  $\phi_3$  test, we continue with the Dickey-Fuller likelihood ratio test,  $\phi_2$ , to test the joint hypothesis of the insignificance of the drift and the trend terms along with the presence of a unit root. If we reject the maintained hypothesis from this test, we assume that the series follow a random walk with a drift. Otherwise, we keep the null of random walk without a drift hypothesis. We conduct the final tests on the existence of unit roots by using the forms suggested by the sequential testing procedure.

## IV Estimation Results

### IV.1 Unit Root Tests

The results of the unit root tests are presented in Tables 2, 3.1 and 3.2, with critical values based on Dickey and Fuller (1981). All series except the interest rates, output gap, monetary conditions index, cash balance of the consolidated budget, and the Turkish lira value of the total volume of foreign exchange deposits are I(1) processes. Among these variables interest rates, the output gap and the monetary conditions index were found to be I(0) processes, while the cash balance of the consolidated budget and the Turkish lira value of total foreign exchange deposits turned out to be I(2) processes.

### IV.2 Bivariate Granger Causality Tests and Variance Decompositions

In this section, we perform bivariate Granger causality tests and decide on the existence of Granger-causality following the above-mentioned criterion based on Baumgartner et al. (1997). We start the analysis with a lag order of 12 and sequentially reduce it to one-lag. As noted above, the null hypothesis of no-Granger causality is rejected only if the Granger causality tests applied at both the levels and first differences of the series reject it for at least half the calculated lag orders.<sup>(16)</sup>

Table 4.1 presents the results. The results reveal that among all indicators the nterbank interest rate, the money supply M1Y – M1 plus foreign exchange sight deposits – and the import volume are the strongest leading indicators of inflation.<sup>(17)</sup> The second row consists of the cash balance of the consolidated budget, the broad money supply M2Y and, a sub-component of M1Y, the Turkish

lira value of foreign exchange sight deposits (SFXDTL). The output gap, the export volume, the narrow money supply M1, the broad money supply M2Y in real terms (M2YR), and the personnel expenditures of the consolidated budget have also fairly high degree of predictive information on inflation. The broad money supply M2 and the deposit money bank loans as well as a number monetary aggregates, such as the foreign exchange sight deposits divided by the exchange rate basket (SFXDFX) and the Turkish lira value of total foreign exchange deposits (TFXDTL), are relatively modest indicators. Finally, the exchange rate basket, defined as the weighted average of the Deutsche mark and the US dollar rates, and of the two currencies that form the basket, the Deutsche mark individually contain some predictive information on inflation. The US dollar seems to be less significant than expected.

We have also looked at variance decompositions by running bivariate vector autoregressions and using the Choleski decomposition in orthogonalising the innovations. The VARs were all run with 12 lags with the candidate indicator placed last, and only for those variable that yielded good results from the Granger-tests. The results of the bivariate variance decompositions are reported in Table 5.1.

The variance decompositions are mostly supportive of the results obtained from the bivariate Granger causality tests. Nevertheless, the results indicate that some reordering of indicator variables is warranted taking into account their relative contributions to the forecast error variance of inflation. The interbank interest rate contains the strongest predictive information on inflation as was the case with the bivariate Granger causality tests. On the other hand, the import volume, the narrow money supply M1, the broad money supply M2Y in real terms (M2YR), the Deutsche mark, the exchange rate basket, the US dollar and the export volume are placed second this time. Moreover, all remaining monetary variables and the output gap seem to contain less predictive information on inflation than it was the case with bivariate Granger-causality tests.

### ***IV.3 Multivariate Granger Causality Tests and Variance Decompositions***

Following Baumgartner et al. (1997), we now carry out Granger causality tests in a multivariate context to test the robustness of results obtained in the bivariate set-up. The results are presented in Table 4.2.

The results are more or less in conformity with those of the bivariate tests. There exists strong Granger causality from the interbank interest rate to inflation. While the import volume and M1Y lose their predictive power slightly, compared to the bivariate case the deposit money bank loans perform better in the multivariate setting. The second row of indicators consists of the exchange rate basket, the Deutsche mark, and two sub-items of monetary aggregates: the Turkish lira value of the foreign exchange sight deposits (SFXDTL) and the Turkish lira value of total foreign exchange deposits (TFXDTL). While the predictive content of the cash balance of the consolidated budget on inflation somewhat declines, the US dollar performs better in the multivariate setting. Interestingly, the predictive power of the narrow money supply M1 as well as that of the broader concepts of money M2, M2Y, and the total foreign currency deposits divided by the exchange rate basket (TFXDFX) gets weaker. Finally, Granger causality from the personnel expenditures of the consolidated budget and the foreign exchange sight deposits divided by the exchange rate basket (SFXDFX) to inflation disappears in the multivariate context.

The variance decompositions obtained from the multivariate vector autoregressions are in Table 5.2 and are mostly similar to the above results, as in the bivariate case.

The interbank interest rate is still the most powerful indicator, although its predictive power appears to have somewhat decreased in the multivariate case. The exchange rate basket and the Deutsche mark are placed second in order while the predictive power of the US dollar remains broadly the same in the multivariate case. Finally, the predictive power of the deposit money bank loans increases while those of the narrow money supply M1 and the import volume decline significantly.

Table A – Summary of Test Results\*

	GRANGER TESTS		VARIANCE DECOMPOSITIONS RESULTS			
	Bivar.	Multi	6 <sup>th</sup> Bivar.	12 <sup>th</sup> Bivar.	6 <sup>th</sup> lag Multiva	12 <sup>th</sup> Multiv
<b>Real Sector Variables</b>						
<b>GAP</b>	10		6.3	8.4		
<b>GDP</b>	8					
<b>EXPP</b>	0					
<b>EXPV</b>	10		8.4	18.0		
<b>IMPP</b>	0					
<b>IMPV</b>	12	8	15.9	23.6	13.1	13.4
<b>TERMTR</b>	0					
<b>IPI</b>	8					
<b>Exchange Rates</b>						
<b>FXB</b>	5	8	13.7	19.5	20.0	21.1
<b>FXDM</b>	4	8	12.8	16.1	20.9	20.9
<b>FXUS</b>	2	6	10.7	19.1	11.1	14.6
<b>RER</b>	0					
<b>Monetary Variables</b>						
<b>NDA1</b>	0					
<b>NDA2</b>	0					
<b>NFAFX</b>	1					
<b>NFATL</b>	0					
<b>CBM</b>	0					
<b>CIS</b>	2					
<b>M1</b>	10	5	18.1	22.7	9.6	8.7
<b>M1Y</b>	11	7	10.9	15.1	10.0	16.9
<b>M2</b>	7	3	10.3	12.0	4.6	4.5
<b>M2Y</b>	10	2	14.1	14.4	5.1	9.0
<b>M2YR</b>	8	2	16.2	22.5	17.3	16.8
<b>SFXDFX</b>	6	0	4.7	6.4	0.9	1.8
<b>SFXDTL</b>	11	8	10.9	15.1	10.0	16.9
<b>TFXDFX</b>	4	2	11.5	15.6	6.9	7.9
<b>TFXDTL</b>	3	8	13.3	17.3	10.4	14.5
<b>CBCR</b>	0					
<b>DMBL</b>	6	12	3.5	11.9	14.6	21.2
<b>MCI</b>	0					
<b>INTERIR</b>	12	12	43.4	45.2	34.2	32.3
<b>SDIR</b>	0					
<b>TBILLIR</b>	0					
<b>TDIR1</b>	0					
<b>TDIR12</b>	3					
<b>TDIR3</b>	0					
<b>TDIR6</b>	5					
<b>CASHBAL</b>	10	7	5.5	10.1	9.5	11.4
<b>PUBPEREXP</b>	7	0	4.7	9.0	0.5	4.9
<b>STADV</b>	0					

\* The ordering of the variables in Sections IV.2. and IV.3 in terms of their performance as leading indicators of inflation is based on the number of Granger-causality tests that give significant results out of 12 regressions. For instance, for each chosen lag-length, that is from one- to 12-lags, there is Granger causality from the interbank interest rate to inflation almost with a marginal significance level close to zero percent. For M1, on the other hand, 10 Granger causality tests out of 12 indicate causality with a marginal significance level equal or smaller than 5 percent.

#### IV.4 Impulse Response Functions

We have also examined the impulse response functions to see how far into the future these variables give information on inflation, given its operational relevance. Chart 1 shows the impulse response functions for those variables that proved to be robust indicators of inflation. We take the horizons at which the impulse response function is statistically significant. As seen in the first panel of Chart 1, the interbank interest rate has an effect on inflation in the second and third months, but the sign is positive.<sup>(18)</sup> The second panel reveals that the exchange rate basket has a positive effect on inflation also in the second and the third months. For the deposit money bank loans and the cash balance of the consolidated budget, however, we were not able to find any statistically significant effect, based on the impulse response functions.

We have also examined Granger-causality and variance decompositions between the interbank interest rate and some other important indicators to gain some insight into the monetary transmission mechanism, as shown in Table (6.1) and (6.2). The strong positive unidirectional Granger-causality from the cash balance to the interbank interest rate and the two-way causality between the exchange rate basket and the interbank interest rate are noteworthy.

As to M1, although it has a positive effect on inflation in the fifth and sixth months, there is an unexpected negative effect during the first four months. When these results are combined with those from Granger causality tests and variance decompositions, we think that one must be very cautious in using M1 for monetary policy purposes. The money supply M1Y – M1 plus foreign currency sight deposits – has significant positive relationship with inflation that extends through the fifth month.

#### V Policy Implications and Research Agenda

Overall, the results indicate that the interbank interest rate and the exchange rate basket are the strongest leading indicators of inflation, whereas almost all Turkish lira denominated monetary aggregates do not seem to have as strong a predictive content. In this section, we elaborate on some of these findings and discuss their policy implications.

First, all test results uniformly indicate that the interbank interest rate is the strongest leading indicator of inflation although with an unexpected (positive) sign.<sup>(19)</sup> One could attribute this to cost-push or wealth effect type mechanisms. However, we have also experimented with the deposit and T-bill rates and found that the Granger causality runs only from inflation to interest rates, suggesting some sort of a Fisher-type effect and ruling out, in our view, the significance of any cost-push or wealth effect type mechanisms.

Another explanation may be offered along the following lines. The overnight interbank interest rate might play an important role in the formation of inflationary expectations, as market players seem to consider it as the most timely information available to form their expectations. This positive relationship might therefore simply reflect inflationary expectations rather than contractionary monetary policy. Alternatively, when there is upward pressure on the exchange rates, for speculative reasons or higher inflationary expectations, the central bank intervenes in the interbank market to ease the pressure on the exchange rate by raising the interbank rate. However, inflation continues, but at a level lower than it would otherwise be. This would be true for any shock to inflation that is foreseen by the Central Bank who tries to act preemptively but can not be fully effective.<sup>(20)</sup> This explanation is similar in spirit to what has been offered by Sims (1992) who also obtains this rather unconventional result for industrialized countries. He attributes this to information asymmetry whereby the monetary authority has better information about inflationary pressures than the public, and can thus act preemptively to dampen inflationary pressures. The prices still rise after the monetary contraction, though by less than they would have otherwise.

A final explanation concerns the degree of effectiveness of monetary policy in a dollarized economy with inertial inflation. The Central Bank responds to shocks to inflation with contractionary monetary policy, but may largely be ineffective owing to the decreasing importance of growth rates in Turkish lira aggregates on inflation.

Second, the exchange rate basket and the two foreign currencies included in the basket did not perform very well in the bivariate case. However, their predictive power increased significantly in the multivariate setting.<sup>(21)</sup> The opposite seems to hold for monetary aggregates. While most of the monetary aggregates turned out to be good leading indicators of inflation in a bivariate setting, after controlling for the impact of aggregate demand on inflation in a multivariate setting, only the narrow money supply M1Y and, to a much lesser extent, M1 performed well. We were not able to find any Granger-causality from other monetary aggregates, such as currency in circulation, reserve money, the central bank money and the net domestic assets of the Central Bank. We did, however, find strong Granger-causality from inflation to some of the monetary aggregates, such as M2, reserve money and the central bank money, indicating, perhaps, accommodative nature of monetary policy in Turkey.<sup>(22)</sup> In sum, except M1Y, the only monetary variable that seems to Granger-cause inflation is M1. However, given our robustness criterion, we were not able to reach a definite conclusion on M1 either. The unexpected signs obtained from the impulse response functions contribute further to our doubt on the usefulness of M1 as a good leading indicator of inflation. As to the impact of M1Y, one could argue that its impact may arise from the exchange rate rather than from “liquidity”, taking into account the lack of any Granger causality from money supplies converted to foreign exchange (SFXDFX and TFXDFX) to inflation.

When we include the various components of foreign currency denominated deposits in several definitions of money supply, we see that they have a higher predictive content on inflation than the traditionally defined money supplies. While the Central Bank has no direct control over M1Y, M2Y and other monetary variables that include foreign exchange deposits, all of these variables can be used as information variables. However, as to controlling inflation, an exchange rate-based strategy seems more appropriate compared to a money-based strategy. Furthermore, results from the multivariate setting seem to indicate that while money supplies (including FX deposits) lead inflation by way of creating aggregate demand pressures, exchange rate might have a more direct impact on inflation either through the price of tradables or expectations.

Third, the existence of Granger causality from the cash balance of the consolidated budget and personnel expenditures to inflation seems to be supportive of the view that one of the main driving forces of inflation in Turkey is public sector deficit and wage pressures arising in that context.<sup>(23)</sup> The lack of Granger causality from reserve money to inflation, however, seems to indicate that the link between the cash balance and inflation is more complex than suggested by a simple seignorage view.

Finally, the impulse responses reveal that the interaction between various variables and the inflation has a rather short-term nature, not extending beyond six months, indicating the highly responsive nature of interrelationships among nominal variables.

In the light of these findings, a further exploration of the monetary transmission mechanism in Turkey which imposes more structure on these findings constitutes the main item in our research agenda.

## APPENDIX

TABLE 1: Variable Definitions and Transformations

<b>CASHBAL</b>	Cash Balance of the Consolidated Budget	1987:1
<b>CBCR</b>	Central Bank Domestic Credits	1987:1
<b>CBM</b>	Central Bank Money	1987:1
<b>CIS</b>	Currency issued	1987:1
<b>CPI</b>	Consumer Price Index, base year 1987	1987:1
<b>DMBL</b>	Deposit money bank loans	1990:1
<b>EXPP</b>	Export Price Index, base year 1989	1987:1
<b>EXPV</b>	Export volume in US dollars	1987:1
<b>FXB</b>	Nominal exchange rate basket, composed of $0.4*USD + 0.6*DM$	1987:1
<b>FXDM</b>	TL/DM, average of Central Bank buying+ selling rates	1987:1
<b>FXUS</b>	TL/USD, average of Central Bank buying+ selling rates	1987:1
<b>GAP</b>	Output gap, percentage deviation from trend of monthly IPI measured by a Hodrick-Prescott filter (smoothing parameter= 14400)	1987:1
<b>GDP</b>	Real Gross Domestic Product, converted to monthly data by <del>Yalcin (1997)</del> Yalcin (1997) method, estimated by Yalcin (1997)	1987:1
<b>IMPP</b>	Import Price Index, base year 1989	1987:1
<b>IMPV</b>	Import volume in US dollars	1987:1
<b>INTERIR</b>	O/N Interbank interest rates, monthly average, weighted by total volume of daily transactions	1987:1
<b>IPI</b>	Industrial Production Index, base year 1986	
<b>M1</b>	Currency in circulation+ Sight deposits	1987:1
<b>M1Y</b>	M1+ Foreign exchange sight deposits	1987:1
<b>M2</b>	M1+ Time deposits	1987:1
<b>M2Y</b>	M2+ Foreign exchange time deposits	1987:1
<b>M2YR</b>	Real M2Y, M2Y divided by the exchange rate basket	1987:1
<b>MCI</b>	Monetary Conditions Index	1987:1
<b>NDA1</b>	Net Domestic Assets of the Central Bank (IMF definition)	1987:1
<b>NDA2</b>	Net Domestic Assets of the Central Bank (IMF definition minus foreign exchange liabilities of domestic banks)	1987:1
<b>NFAFX</b>	Net Foreign Assets of the Central Bank divided by exchange rate basket	1987:1
<b>NFATL</b>	Net Foreign Assets of the Central Bank in TL	1987:1
<b>PUBPERE</b>	Personnel Expenditures of the Consolidated Budget	1987:1
<b>XP</b>		
<b>RER</b>	Real exchange rate basket, composed of $0.4*USD + 0.6*DM$	1987:1
<b>RM</b>	Reserve Money	1987:1
<b>SDIR</b>	Interest rates on sight deposits	1987:1
<b>SFXDFX</b>	Foreign currency sight deposits divided by exchange rate basket	1987:1
<b>SFXDTL</b>	The Turkish lira value of foreign currency sight deposits	1987:1
<b>STADV</b>	Central Bank Short Term Advances to the Treasury	1987:1
<b>TBILLIR</b>	Average compound T-Bills rate, weighted by maturities and total sales	1987:1
<b>TDIR1</b>	Interest rates on 1-month deposits	1987:1
<b>TDIR12</b>	Interest rates on 12-months deposits	1987:1
<b>TDIR3</b>	Interest rates on 3-months deposits	1987:1
<b>TDIR6</b>	Interest rates on 6-months deposits	1987:1
<b>TERMTR</b>	Terms of Trade (log of export price index minus log of import price index)	1987:1
<b>TFXDFX</b>	Total foreign currency deposits divided by exchange rate basket	1987:1
<b>TFXDTL</b>	The Turkish lira value of total foreign currency deposits	1987:1
<b>WPI</b>	Wholesale Price Index, base year 1987	1987:1

All series except GAP, MCI, CASHBAL, NFA, NDA1, NDA2 and interest rates are in logs.

**TABLE 2: Results From Unit Root Tests**

<b>Variable</b>	<b>Unit Root Tests</b>
<b>CASHBAL</b>	I(2) with constant and trend
<b>CBCR</b>	I(1) without trend or constant
<b>CBM</b>	I(1) with constant
<b>CIS</b>	I(1) with constant
<b>CPI</b>	I(1) with constant
<b>DMBL</b>	I(1) with constant
<b>EXPP</b>	I(1) without trend or constant
<b>EXPV</b>	I(1) without trend or constant
<b>FXB</b>	I(1) with constant
<b>FXDM</b>	I(1) with constant
<b>FXUS</b>	I(1) with constant
<b>GAP</b>	I(0) without trend or constant
<b>GDP</b>	I(1) without trend or constant
<b>IMPP</b>	I(1) without trend or constant
<b>IMPV</b>	I(1) without trend or constant
<b>INTERIR</b>	I(0) with trend and constant
<b>IPI</b>	I(1) without trend or constant
<b>M1</b>	I(1) with constant
<b>M1Y</b>	I(1) with constant
<b>M2</b>	I(1) with constant
<b>M2Y</b>	I(1) with constant
<b>M2YR</b>	I(1) without trend or constant
<b>MCI</b>	I(0) without trend or constant
<b>NDA1</b>	I(1) without trend or constant
<b>NDA2</b>	I(1) without trend or constant
<b>NFAFX</b>	I(1) without trend or constant
<b>NFATL</b>	I(1) without trend or constant
<b>PUBPEREXP</b>	I(1) with constant
<b>RER</b>	I(1) without trend or constant
<b>RM</b>	I(1) with constant
<b>SDIR</b>	I(1) without trend or constant
<b>SFXDFX</b>	I(1) without trend or constant
<b>SFXDTL</b>	I(1) with constant
<b>STADV</b>	I(1) with constant
<b>TBILLIR</b>	I(0) with trend and constant
<b>TDIR1</b>	I(0) with trend and constant
<b>TDIR12</b>	I(0) without trend or constant
<b>TDIR3</b>	I(0) with trend and constant
<b>TDIR6</b>	I(0) with trend and constant
<b>TERMTR</b>	I(1) without trend or constant
<b>TFXDFX</b>	I(1) without trend or constant
<b>TFXDTL</b>	I(2) with constant
<b>WPI</b>	I(1) with constant

**Table 3.1: Augmented Dickey-Fuller Unit Root Tests- Levels**

	<b>Trend Includ ed k</b>	<b>(- 3.45)</b> $\tau_\tau$	<b>(4.88)</b> $\Phi_2$	<b>(6.49)</b> $\Phi_3$	<b>No Trend k</b>	<b>(- 2.89)</b> $\tau_\mu$	<b>No Const k</b>	<b>(- 1.95)</b> $\tau$
<b>CPI</b>	1	-1.67	7.189	0.766	1	1.58		
<b>WPI</b>	1	-1.42	6.236	0.418	1	1.16		
<b>CASHBAL</b>	3	8.78	28.875	42.023				
<b>CBCR</b>	1	-1.96	4.536	2.180			1	3.00
<b>CBM</b>	2	-3.67	6.363	2.793	2	0.16		
<b>CIS</b>	1	-1.99	46.099	3.140	1	1.38		
<b>DMBL</b>	1	-0.32	8.842	0.720	1	2.19		
<b>EXPP</b>	4	-2.97	2.982	4.473			1	-0.05
<b>EXPV</b>	2	-2.57	3.317	3.316			2	1.30
<b>FXB</b>	1	-1.68	4.159	0.509			1	5.12
<b>FXDM</b>	1	-1.87	3.871	0.564			1	4.83
<b>FXUS</b>	1	-1.57	4.199	0.498			1	5.20
<b>GAP</b>	1	-5.72	4.530	7.070				
<b>GDP</b>	1	-3.97	2.365	3.288			1	-1.91
<b>IMPP</b>	1	-2.82	2.907	4.100			1	0.65
<b>IMPV</b>	1	-2.52	2.966	3.189			1	1.50
<b>INTERIR</b>	2	-5.21	9.107	13.629				
<b>IPI</b>	1	-4.98	3.564	5.351			1	0.95
<b>M1</b>	1	-1.14	13.524	0.581	1	1.65		
<b>M1Y</b>	1	-0.85	6.529	0.662	1	1.82		
<b>M2</b>	3	-1.31	8.360	2.087			3	1.41
<b>M2Y</b>	3	-1.23	7.667	2.838			3	1.89
<b>M2YR</b>	1	-2.51	0.991	1.064			1	1.57
<b>MCI</b>	1	-3.04	1.089	1.877			1	-2.09
<b>NDA1</b>	1	-1.95	0.256	0.616			1	-1.85
<b>NDA2</b>	3	-1.61	0.669	0.563			3	1.47
<b>NFAFX</b>	1	-2.39	0.870	0.927			1	-0.97
<b>NFATL</b>	3	3.07	3.850	5.051			3	4.78
<b>PUBPERE</b>	1	-3.00	6.972	1.704	1	-0.39		
<b>XP</b>								
<b>RER</b>	1	-2.13	0.276	0.660			1	-0.08
<b>RM</b>	1	-1.03	47.620	2.688	1	1.99		
<b>SDIR</b>	1	-3.06	3.157	4.69			1	-0.84
<b>SFXDFX</b>	1	-1.36	1.140	0.176			1	2.73
<b>SFXDTL</b>	1	-0.85	6.530	0.663	1	1.82		
<b>STADV</b>	1	-2.31	5.784	2.953			1	0.15
<b>TBILLIR</b>	1	-4.61	7.132	10.496				
<b>TDIR1</b>	2	-5.31	9.496	14.098				
<b>TDIR12</b>	2	-3.41	4.029	5.823				
<b>TDIR3</b>	2	-5.31	9.519	14.150				
<b>TDIR6</b>	2	-4.58	7.196	10.525				
<b>TERMTR</b>	2	-2.62	2.403	3.554			2	-1.63
<b>TFXDFX</b>	1	-1.94	2.295	0.510			1	3.18
<b>TFXDTL</b>	1	-1.38	10.304	0.207	1	0.83		

**Table 3.2: Augmented Dickey-Fuller Unit Root Tests- First Differences**

	<b>Trend include</b>	<b>(- 3.45)</b>	<b>(4.88)</b>	<b>(6.49)</b>
	<b>d</b>	$\tau_\tau$	$\Phi_2$	$\Phi_3$
	<b>k</b>			
<b>CPI</b>	1	-7.20	7.267	11.164
<b>WPI</b>	1	-5.94	4.909	7.368
<b>CASHBAL*</b>	6	2.99	6.547	8.270
<b>CBCR</b>	1	-8.02	21.465	32.197
<b>CBM</b>	1	-10.65	14.836	22.600
<b>CIS</b>	1	-8.64	27.418	41.121
<b>DMBL</b>	1	-5.63	4.202	6.570
<b>EXPP</b>	2	-8.07	21.809	32.582
<b>EXPV</b>	1	-12.27	50.226	75.339
<b>FXB</b>	1	-6.11	5.201	8.076
<b>FXDM</b>	1	-6.09	5.175	8.037
<b>FXUS</b>	1	-6.29	5.522	8.560
<b>GDP</b>	1	-10.46	16.245	21.981
<b>IMPP</b>	1	-9.08	27.505	41.248
<b>IMPV</b>	1	-8.81	25.863	38.794
<b>IPI</b>	3	-8.67	10.173	15.574
<b>M1</b>	1	-7.915	8.654	13.282
<b>M1Y</b>	1	-5.66	4.427	6.915
<b>M2</b>	1	-5.26	9.694	14.540
<b>M2Y</b>	1	-7.42	7.584	11.360
<b>M2YR</b>	1	-6.51	5.959	9.222
<b>NDA1</b>	2	-7.53	7.833	12.048
<b>NDA2</b>	2	-6.79	6.472	9.994
<b>NFAFX</b>	1	-5.90	4.829	7.521
<b>NFATL</b>	1	-5.66	4.482	6.977
<b>PUBPERE</b>	3	-7.89	8.556	13.138
<b>XP</b>				
<b>RER</b>	1	-7.58	8.022	12.336
<b>RM</b>	1	-9.06	24.893	37.334
<b>SDIR</b>	1	-7.29	17.718	26.573
<b>SFXDFX</b>	1	-6.46	5.834	9.036
<b>SFXDTL</b>	1	-5.66	4.427	6.915
<b>STADV</b>	1	-7.65	19.510	29.264
<b>TERMTR</b>	1	-12.59	52.992	79.465
<b>TFXDFX</b>	1	-6.82	6.471	9.991
<b>TFXDTL**</b>	1	-8.30	9.430	14.485

\*CASHBAL has a second order unit root.

\*\* TFXDTL has a second order unit root.

**Table 4.1: Information Content of Monetary Indicators for Inflation  
( Granger Causality Tests)  
Bivariate Prediction Equations for Different Lag Lengths**

(Sample:1987:1 1997:3)

CPI	Lags											
	1	2	3	4	5	6	7	8	9	10	11	12
<b>CASHBAL</b>	0.38	0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.003	0.006	0.007	0.08
<b>CBCR</b>	0.83	0.74	0.71	0.74	0.90	0.93	0.71	0.73	0.81	0.81	0.82	0.47
<b>CBM</b>	0.83	0.44	0.20	0.36	0.46	0.40	0.54	0.66	0.71	0.80	0.87	0.57
<b>CIS</b>	0.94	0.58	0.17	0.24	0.53	0.15	0.09	0.06	0.07	0.01	0.04	0.19
<b>DMBL</b>	0.02	0.02	0.02	0.06	0.09	0.04	0.02	0.03	0.08	0.09	0.23	0.52
<b>EXPP</b>	0.78	0.77	0.73	0.88	0.99	0.57	0.65	0.56	0.48	0.09	0.07	0.18
<b>EXPV</b>	0.06	0.10	0.03	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004
<b>FXB</b>	0.01	0.07	0.15	0.19	0.37	0.28	0.26	0.14	0.05	0.02	0.03	0.03
<b>FXDM</b>	0.003	0.02	0.06	0.07	0.13	0.11	0.12	0.11	0.06	0.02	0.03	0.11
<b>FXUS</b>	0.09	0.27	0.40	0.47	0.73	0.61	0.59	0.27	0.09	0.05	0.08	0.03
<b>GAP</b>	0.28	0.13	0.03	0.005	0.02	0.02	0.01	0.002	0.002	0.000	0.002	0.02
<b>GDP</b>	0.03	0.04	0.08	0.13	0.06	0.09	0.03	0.04	0.05	0.01	0.03	0.05
<b>IMPP</b>	0.68	0.83	0.83	0.79	0.61	0.66	0.72	0.63	0.26	0.36	0.46	0.83
<b>IMPV</b>	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.002	0.005
<b>INTERIR</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>IPI</b>	0.08	0.07	0.11	0.05	0.07	0.03	0.003	0.01	0.005	0.005	0.01	0.05
<b>M1</b>	0.47	0.79	0.02	0.008	0.000	0.000	0.000	0.001	0.002	0.004	0.01	0.006
<b>M1Y</b>	0.000	0.000	0.002	0.002	0.002	0.003	0.003	0.004	0.006	0.008	0.02	0.06
<b>M2</b>	0.63	0.80	0.42	0.02	0.02	0.02	0.02	0.03	0.05	0.09	0.16	0.04
<b>M2Y</b>	0.02	0.04	0.05	0.002	0.002	0.005	0.008	0.01	0.02	0.04	0.09	0.06
<b>M2YR</b>	0.83	0.16	0.23	0.007	0.02	0.02	0.04	0.03	0.04	0.03	0.07	0.007
<b>MCI</b>	0.94	0.47	0.62	0.67	0.59	0.69	0.43	0.41	0.54	0.66	0.75	0.82
<b>NDA1</b>	0.44	0.74	0.84	0.87	0.90	0.95	0.95	0.94	0.92	0.97	0.98	0.97
<b>NDA2</b>	0.20	0.44	0.57	0.62	0.69	0.71	0.79	0.78	0.60	0.70	0.72	0.75
<b>NFAFX</b>	0.07	0.21	0.21	0.26	0.20	0.22	0.34	0.51	0.39	0.43	0.34	0.02
<b>NFATL</b>	0.48	0.77	0.84	0.88	0.84	0.91	0.92	0.97	0.96	0.98	0.99	0.99
<b>PUBPERE</b>	0.58	0.02	0.001	0.007	0.009	0.01	0.03	0.06	0.06	0.08	0.03	0.40
<b>XP</b>												
<b>RER</b>	0.71	0.98	0.89	0.83	0.88	0.62	0.60	0.55	0.60	0.56	0.60	0.58
<b>RM</b>	0.65	0.53	0.36	0.62	0.88	0.39	0.32	0.22	0.34	0.20	0.40	0.68
<b>SDIR</b>	0.13	0.08	0.17	0.20	0.10	0.18	0.28	0.42	0.48	0.48	0.35	0.40
<b>SFXDFX</b>	0.01	0.05	0.13	0.02	0.02	0.03	0.04	0.06	0.10	0.16	0.28	0.68
<b>SFXDTL</b>	0.000	0.000	0.002	0.002	0.002	0.003	0.003	0.004	0.006	0.008	0.002	0.06
<b>STADV</b>	0.82	0.91	0.57	0.75	0.82	0.89	0.65	0.67	0.71	0.76	0.79	0.31
<b>TBILLIR</b>	0.51	0.41	0.38	0.23	0.45	0.51	0.33	0.33	0.28	0.33	0.35	0.73
<b>TDIR1</b>	0.99	0.87	0.88	0.85	0.85	0.93	0.88	0.86	0.87	0.87	0.93	0.86
<b>TDIR12</b>	0.38	0.42	0.20	0.14	0.12	0.17	0.13	0.02	0.04	0.04	0.08	0.11
<b>TDIR3</b>	0.77	0.72	0.69	0.68	0.51	0.67	0.63	0.64	0.67	0.66	0.80	0.69
<b>TDIR6</b>	0.58	0.46	0.18	0.11	0.04	0.05	0.05	0.03	0.04	0.07	0.12	0.08
<b>TERMTR</b>	0.66	0.82	0.72	0.79	0.85	0.47	0.48	0.50	0.24	0.22	0.23	0.45
<b>TFXDFX</b>	0.15	0.12	0.02	0.03	0.04	0.05	0.10	0.17	0.11	0.17	0.29	0.11
<b>TFXDTL</b>	0.002	0.02	0.02	0.06	0.06	0.06	0.10	0.12	0.19	0.23	0.24	0.24

The numbers in the table are marginal significance levels (p-values) of F-tests for the  $H_0$  of non-Granger causality of candidate indicator. All series except GAP, INTERIR, TFXDTL (I(0)) and CASHBAL (I(2)) are in first differences.

**Table 4.2: Information Content of Monetary Indicators for  
Inflation  
( Granger Causality Tests)  
Four Variable Prediction Equations for Different Lag Lengths**

(Sample:1987:1 1997:3)

CPI	Lags											
	1	2	3	4	5	6	7	8	9	10	11	12
<b>CASHBAL</b>	0.130	0.000	0.028	0.005	0.016	0.052	0.022	0.139	0.133	0.074	0.005	0.115
<b>DMBL</b>	0.000	0.001	0.000	0.000	0.000	0.000	0.002	0.006	0.012	0.018	0.030	0.013
<b>FXB</b>	0.003	0.017	0.177	0.157	0.191	0.160	0.013	0.003	0.001	0.006	0.029	0.054
<b>FXDM</b>	0.002	0.017	0.092	0.152	0.214	0.170	0.028	0.011	0.007	0.017	0.041	0.054
<b>FXUSD</b>	0.011	0.042	0.374	0.226	0.253	0.247	0.022	0.007	0.006	0.044	0.142	0.211
<b>IMPV</b>	0.010	0.000	0.001	0.000	0.004	0.007	0.020	0.060	0.030	0.156	0.181	0.171
<b>INTERIR</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>M1</b>	0.145	0.297	0.306	0.067	0.000	0.001	0.024	0.023	0.027	0.065	0.135	0.149
<b>M1Y</b>	0.001	0.011	0.006	0.005	0.018	0.020	0.014	0.034	0.108	0.273	0.387	0.308
<b>M2</b>	0.006	0.046	0.787	0.120	0.053	0.167	0.521	0.627	0.599	0.689	0.707	0.562
<b>M2Y</b>	0.556	0.718	0.037	0.082	0.039	0.087	0.300	0.394	0.472	0.636	0.849	0.728
<b>M2YR</b>	0.014	0.013	0.130	0.070	0.171	0.325	0.129	0.117	0.146	0.318	0.423	0.150
<b>PUBPEREXP</b>	0.792	0.291	0.094	0.453	0.268	0.257	0.779	0.803	0.903	0.956	0.937	0.936
<b>SFXDFX</b>	0.192	0.536	0.138	0.109	0.233	0.287	0.353	0.479	0.547	0.887	0.966	0.843
<b>SFXDTL</b>	0.001	0.011	0.006	0.005	0.018	0.020	0.014	0.034	0.108	0.273	0.387	0.308
<b>TFXDFX</b>	0.787	0.112	0.032	0.070	0.068	0.142	0.029	0.074	0.096	0.141	0.311	0.240
<b>TFXDTL</b>	0.010	0.128	0.004	0.014	0.028	0.040	0.018	0.035	0.041	0.091	0.195	0.208

The numbers in the table are marginal significance levels (p-values) of F-tests for the  $H_0$  of non-Granger causality of candidate indicator. All series except INTERIR, TFXDTL (I(0)) and CASHBAL (I(2)) are in first differences.

**Table 5.1: Forecast Error Variance Explained Through Different Variables**

**Bivariate VAR model of Order 12**

(Sample:1987:1 1997:3)

**CPI**

<b>Step</b>	<b>GAP</b>	<b>EXPV</b>	<b>IMPV</b>	<b>FXDM</b>	<b>FXUSDFXB</b>	<b>M1</b>	<b>M1Y</b>	<b>M2</b>	<b>M2Y</b>	<b>M2Y</b>	<b>R</b>
<b>1</b>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>2</b>	0.3	1.4	1.2	8.1	6.8	9.0	1.8	4.5	1.3	0.9	2.1
<b>3</b>	0.8	2.6	6.4	13.4	10.3	13.9	6.1	7.2	4.3	4.0	10.9
<b>4</b>	3.4	5.4	10.3	13.4	10.7	14.0	9.2	8.4	7.9	4.0	12.1
<b>5</b>	6.0	7.1	10.7	12.8	10.5	13.6	12.8	10.6	8.7	11.3	14.7
<b>6</b>	6.3	8.4	15.9	12.8	10.7	13.7	18.1	10.9	10.3	14.1	16.2
<b>7</b>	6.4	9.0	16.6	12.8	10.7	13.6	19.2	10.7	10.7	13.9	16.0
<b>8</b>	6.4	9.1	17.5	13.2	10.7	13.9	19.1	11.1	10.6	14.0	16.9
<b>9</b>	6.7	14.8	21.4	14.5	12.3	15.4	20.6	11.3	10.8	14.2	19.7
<b>10</b>	7.9	16.7	23.4	14.5	14.3	16.0	21.7	12.8	10.9	14.4	20.2
<b>11</b>	8.4	16.9	23.4	15.5	18.4	18.8	22.6	15.1	11.6	14.3	22.5
<b>12</b>	8.4	18.0	23.6	16.1	19.1	19.5	22.7	15.1	12.0	14.4	22.5
<b>18</b>	9.8	21.9	27.7	14.7	18.8	18.5	25.4	18.2	16.0	18.6	21.5
<b>24</b>	10.0	24.7	29.6	14.9	18.9	18.7	26.6	20.6	16.1	18.6	22.1
<b>30</b>	10.1	26.3	31.5	14.7	19.0	18.6	27.6	21.8	16.9	19.3	22.0
<b>36</b>	10.2	27.6	32.0	14.7	19.1	18.7	27.8	22.6	16.9	19.3	22.1

**CPI**

<b>Steps</b>	<b>PUBPEREX</b>	<b>SFXDT</b>	<b>SFXDF</b>	<b>TFXDTL</b>	<b>TFXDF</b>	<b>DMB</b>	<b>INTERI</b>	<b>CASHBAL</b>
	<b>P</b>	<b>L</b>	<b>X</b>	<b>X</b>	<b>L</b>	<b>R</b>		
<b>1</b>		0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>2</b>		2.3	4.5	0.2	2.8	0.0	2.6	30.1
<b>3</b>		2.8	7.2	0.3	2.9	6.5	2.7	44.0
<b>4</b>		3.7	8.4	1.2	7.7	7.5	2.7	43.7
<b>5</b>		4.6	10.6	4.3	13.2	11.3	3.1	43.1
<b>6</b>		4.7	10.9	4.7	13.3	11.5	3.5	43.4
<b>7</b>		4.8	10.7	4.7	13.3	11.5	4.6	43.2
<b>8</b>		5.0	11.1	5.8	15.4	14.1	7.3	44.1
<b>9</b>		5.1	11.3	6.4	15.4	15.0	9.0	43.5
<b>10</b>		5.2	12.8	6.4	15.5	15.6	8.8	43.5
<b>11</b>		7.0	15.1	6.4	17.1	15.6	10.6	44.5
<b>12</b>		9.0	15.1	6.4	17.3	15.6	11.9	45.2
<b>18</b>		10.7	18.2	8.1	17.5	15.5	12.5	41.9
<b>24</b>		12.5	20.6	8.6	18.3	16.3	15.5	41.7
<b>30</b>		13.2	21.8	9.1	18.3	16.3	15.9	41.1
<b>36</b>		13.7	22.6	9.2	18.5	16.4	17.1	41.0

All series except GAP, INTERIR, TFXDTL (I(0)) and CASHBAL (I(2)) are in first differences.

**Table 5.2: Forecast Error Variance Explained Through Different Variables**  
**Four Variables VAR model of Order 12**

(Sample:1987:1 1997:3)

<b>CPI</b>											
<b>Steps</b>	<b>FXDMFXUS</b>		<b>FXB IMPV</b>		<b>M1</b>	<b>M1Y</b>	<b>M2</b>	<b>M2Y</b>	<b>M2YR</b>	<b>PUBPERE</b>	<b>XP</b>
	<b>D</b>										
<b>1</b>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
<b>2</b>	9.6	7.6	12.0	6.5	1.5	3.8	2.2	0.2	6.4	0.0	
<b>3</b>	17.5	10.6	18.8	8.9	4.8	7.4	2.8	1.2	16.5	0.2	
<b>4</b>	22.1	12.1	21.4	9.9	7.1	9.3	3.3	2.6	17.2	0.2	
<b>5</b>	21.0	11.2	20.1	9.5	8.3	10.1	4.4	5.1	16.6	0.3	
<b>6</b>	20.9	11.1	20.0	13.1	9.6	10.0	4.6	5.1	17.3	0.5	
<b>7</b>	20.5	10.9	19.5	12.2	9.5	9.5	4.7	5.9	16.7	1.3	
<b>8</b>	20.4	11.2	19.4	13.2	9.3	11.7	4.6	6.5	16.8	3.2	
<b>9</b>	21.2	11.4	20.2	12.8	8.9	11.8	4.4	7.3	16.5	3.4	
<b>10</b>	20.5	13.2	19.9	12.8	8.7	12.9	4.6	9.1	16.4	4.5	
<b>11</b>	20.7	13.3	20.9	13.4	8.6	15.9	4.6	9.1	17.1	4.2	
<b>12</b>	20.9	14.8	21.1	13.4	8.7	16.9	4.5	9.0	16.8	4.9	
<b>18</b>	20.5	16.5	22.3	14.7	9.6	24.0	6.9	13.5	15.6	6.1	
<b>24</b>	19.7	16.2	21.6	14.0	12.2	24.0	7.7	14.7	15.9	8.4	
<b>30</b>	21.0	16.5	22.7	14.8	12.0	25.3	8.1	15.0	16.2	9.4	
<b>36</b>	20.9	16.2	22.5	14.3	12.8	25.5	8.6	16.0	15.9	10.4	

<b>CPI</b>											
<b>Steps</b>	<b>SFXDT</b>		<b>SFXDF</b>		<b>TFXDT</b>		<b>TFXDF</b>		<b>DMB</b>	<b>INTERI</b>	<b>CASHBAL</b>
	<b>L</b>	<b>X</b>	<b>L</b>	<b>X</b>	<b>L</b>	<b>X</b>	<b>L</b>	<b>R</b>			
<b>1</b>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	
<b>2</b>	3.8	0.0	0.7	0.5	1.4	19.5	3.3				
<b>3</b>	7.4	0.1	0.7	5.9	1.4	42.2	3.7				
<b>4</b>	9.3	0.6	7.9	6.5	2.7	37.7	7.0				
<b>5</b>	10.1	0.9	9.9	6.9	9.9	34.5	9.6				
<b>6</b>	10.0	0.9	10.4	6.9	14.6	34.2	9.5				
<b>7</b>	9.5	0.9	10.3	6.9	13.8	33.8	10.2				
<b>8</b>	11.7	1.8	12.3	7.8	13.7	34.0	10.4				
<b>9</b>	11.8	1.8	13.5	7.6	14.1	32.8	10.3				
<b>10</b>	12.9	1.8	14.2	7.4	14.0	32.1	10.0				
<b>11</b>	15.9	1.8	14.6	7.6	16.3	32.3	10.4				
<b>12</b>	16.9	1.8	14.5	7.9	21.2	32.3	11.4				
<b>18</b>	24.0	3.1	16.9	8.3	23.4	29.9	15.9				
<b>24</b>	24.0	3.4	17.2	9.2	25.8	29.3	17.1				
<b>30</b>	25.3	3.6	17.8	9.3	24.4	28.2	23.9				
<b>36</b>	25.5	3.8	18.7	9.5	25.1	27.3	26.4				

All series except INTERI, TFXDTL (I(0)) and CASHBAL (I(2)) are in first differences.

**Table 6.1: Bivariate Granger Causality Tests and Variance Decomposition Results Between CASHBAL and INTERIR**

From INTERIR to CASHBAL	Granger Test	Var. Decomposition	From CASHBAL to INTERIR	Granger Test	Var. Decomposition
<b>1</b>	0.80	3.1	<b>1</b>	0.15	0.0
<b>2</b>	0.95	2.5	<b>2</b>	0.09	1.0
<b>3</b>	0.88	4.0	<b>3</b>	0.13	6.5
<b>4</b>	0.91	5.3	<b>4</b>	0.01	13.0
<b>5</b>	0.87	5.3	<b>5</b>	0.02	17.7
<b>6</b>	0.79	8.9	<b>6</b>	0.04	18.7
<b>7</b>	0.83	12.5	<b>7</b>	0.05	18.6
<b>8</b>	0.10	18.2	<b>8</b>	0.07	18.8
<b>9</b>	0.14	34.7	<b>9</b>	0.09	19.6
<b>10</b>	0.00	38.6	<b>10</b>	0.02	20.5
<b>11</b>	0.00	39.2	<b>11</b>	0.03	21.9
<b>12</b>	0.00	38.5	<b>12</b>	0.04	23.3
<b>18</b>		21.1	<b>18</b>		25.8
<b>24</b>		37.0	<b>24</b>		25.7
<b>30</b>		23.3	<b>30</b>		27.8
<b>36</b>		34.4	<b>36</b>		27.9

Granger test results show marginal significance levels of F-tests for  $H_0$  of non-Granger causality of INTERIR and CASHBAL. CASHBAL is in second difference and INTERIR is in level.

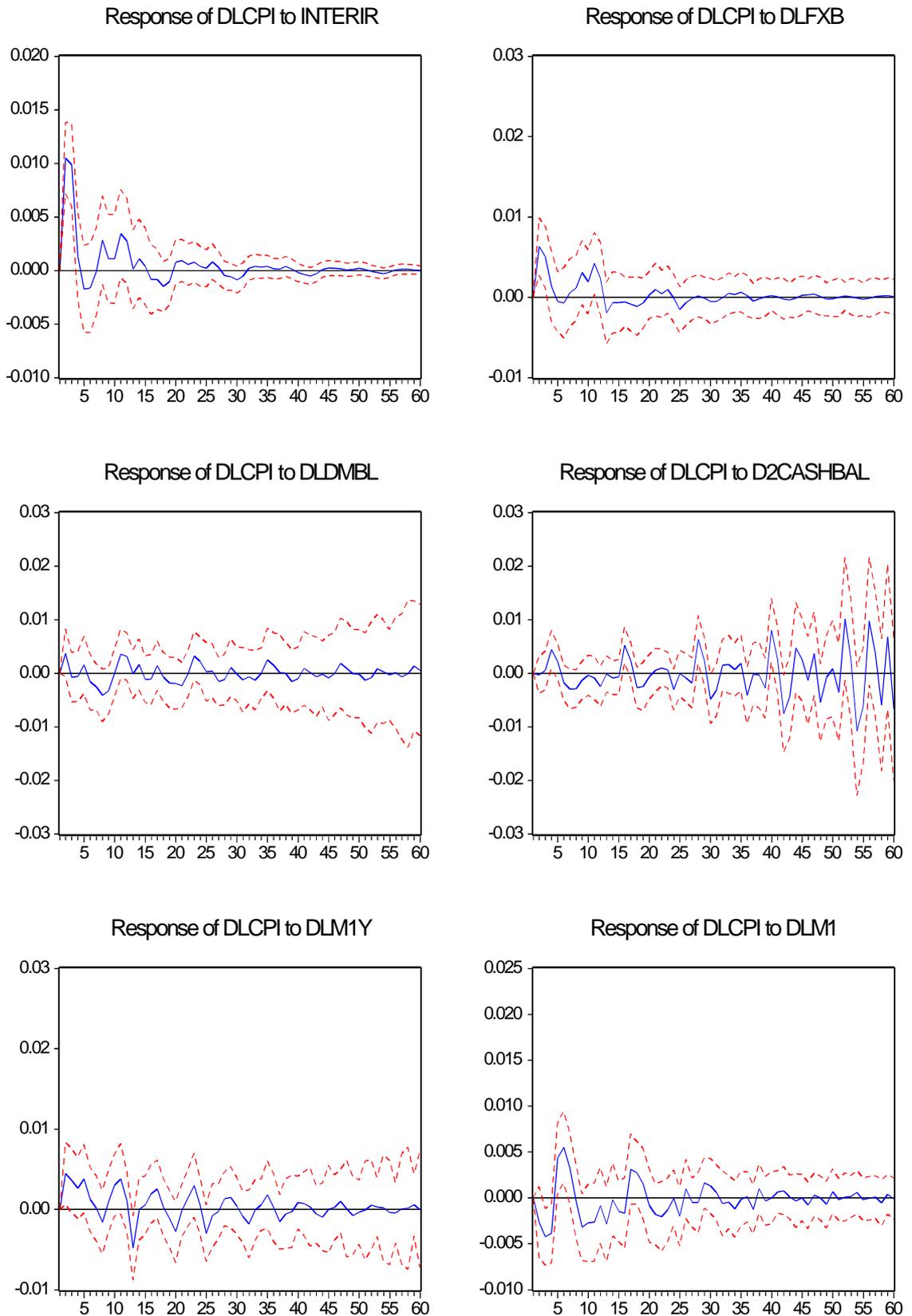
**Table 6.2: Bivariate Granger Causality Tests and Variance Decomposition Results Between FXB and INTERIR**

From INTERIR to FXB	Granger Test	Var. Decomposition	From FXB to INTERIR	Granger Test	Var. Decomposition
<b>1</b>	0.00	2.9	<b>1</b>	0.00	0.0
<b>2</b>	0.00	64.5	<b>2</b>	0.00	13.8
<b>3</b>	0.00	70.1	<b>3</b>	0.00	8.8
<b>4</b>	0.00	69.2	<b>4</b>	0.00	10.1
<b>5</b>	0.00	69.4	<b>5</b>	0.00	10.5
<b>6</b>	0.00	69.4	<b>6</b>	0.00	10.5
<b>7</b>	0.00	69.4	<b>7</b>	0.00	10.7
<b>8</b>	0.00	69.3	<b>8</b>	0.00	11.0
<b>9</b>	0.00	69.3	<b>9</b>	0.00	11.6
<b>10</b>	0.00	69.1	<b>10</b>	0.00	11.7
<b>11</b>	0.00	68.8	<b>11</b>	0.00	11.7
<b>12</b>	0.00	69.0	<b>12</b>	0.00	11.8
<b>18</b>		68.0	<b>18</b>		14.2
<b>24</b>		67.9	<b>24</b>		14.3
<b>30</b>		67.9	<b>30</b>		14.3

**Table 7: Cross Correlations of CPI with DMBL, CASHBAL, FXB, INTERIR**

<b>Lags</b>	<b>DMBL</b>	<b>CASHBAL</b>	<b>FXB</b>	<b>INTERIR</b>
<b>1</b>	0.241	-0.039	0.373	0.424
<b>2</b>	-0.096	-0.215	0.101	0.182
<b>3</b>	-0.051	0.160	-0.051	-0.065
<b>4</b>	0.105	0.160	-0.159	-0.061
<b>5</b>	-0.077	0.000	-0.029	0.031
<b>6</b>	-0.176	-0.021	0.120	0.126
<b>7</b>	-0.068	-0.116	0.127	0.156
<b>8</b>	-0.163	-0.012	0.093	0.158
<b>9</b>	-0.042	0.045	0.090	0.121
<b>10</b>	0.265	0.082	0.062	0.088
<b>11</b>	0.089	-0.076	0.040	0.081
<b>12</b>	-0.057	0.058	0.123	0.033
<b>24</b>	-0.046	0.043	0.130	0.044
<b>36</b>	-0.084	0.025	0.121	0.125

Chart 1: Impulse-Response Functions  
(Bivariate VAR Models with lag Order 12)



## Notes

\*) We would like to thank Mural Üçer for providing insightful comments during various stages of this study. The usual disclaimer applies. This study has been prepared as part of a broader research program, undertaken at the Central Bank of Turkey, to develop a better understanding of some key issues concerning a disinflation program in Turkey. The views expressed in this study belong to the authors and do not represent those of the Central Bank of the Republic of Turkey.

1) The most recent examples of countries who have begun to experiment with inflation targeting are Britain, New Zealand, Canada, Sweden and Finland. For the experiences of some of those, see Freedman (1994), Duquay (1994), Baumgartner et al. (1997), and Mühleisen (1995). For a recent review of inflation targeting as a monetary policy framework, see Bernanke and Mishkin (1997).

2) It should be added that the IV and IT approaches are not thoroughly mutually exclusive. As a number of studies on leading, the indicators of inflation concluded inclusion of leading indicator indices in structural models improves the forecasting ability of these models (Webb and Rowe, 1995). In other words, inflation indicators that emerge out of the IV approach, can be used to augment the predictive power of traditional inflation models.

3) See, for instance, Alper and Feyzioglu (1995), who had difficulty in finding stable demand functions for both narrow (M1) and broad (M2Y) money supplies during 1980-91, the latter including the foreign exchange deposits. They show that although the demand for M1 was stable through mid-1988, that is, about a year preceding the liberalization of the capital account, M2Y was not stable throughout. Kesriyeli and Yalçin (1997) show weak out-of-sample performance of an empirically sound recent money demand estimate for Turkey.

4) As it stands, this study does not explicitly address the monetary transmission mechanism, but provides some preliminary evidence on its nature which will be followed-up in future work (see Section V). As noted in Mishkin (1995), one could talk about three alternative views of the monetary transmission mechanism. The "interest rate channel" of the basic Keynesian textbook model whereby a contractionary monetary policy leads to an increase in the real interest rate, which in turn raises the cost of capital, causes a decline in investment spending, a reduction in aggregate demand, and a fall in output. The second view on the monetary transmission mechanism is the so-called "exchange rate channel" whereby a decrease in money supply raises the real interest rates, capital flows ensue in an open economy context with mobile capital and flexible exchange rates, leading to an appreciation of domestic currency and a decline in net exports, which in turn results in output loss. The third approach is known as the "credit view" which emphasizes how asymmetric information and costly enforcement of contracts create agency problems in the financial markets. According to the most common channel, a decrease in money supply leads to a decrease in bank reserves and deposits, and consequently in bank loans. This decline causes a fall in investment spending and a fall in output.

5) For a detailed analysis of the financial liberalization policies in Turkey, see Atiyas and Ersel (1992).

6) The rediscount facility of the Central Bank was limited to short term credits in 1989. Thus, the practice of using rediscount credits as a tool of selective credit policy came to an end.

7) The losses of the Central Bank arising from an open foreign exchange position against depreciation of the TL as well as losses associated with changes in cross-parities are recorded in the devaluation account.

8) See Agenor, McDermott, and Üçer (1997) on some aspects of the Turkish experience with capital flows.

9) The central bank money comprises reserve money, public deposits at the Central Bank, and liabilities arising from open market operations.

10) The Central Bank Act was revised in October 1995. As stated in the Act, short-term advances to the Treasury were not to exceed 12 percent of the excess of the current budgetary appropriations over those of the previous year in 1995. This rate was specified as 10 percent and 6 percent for 1996 and 1997, and 3 percent thereafter. Moreover, the sum of annual advances and discounts extended to the public enterprises was not to exceed half the limit for advances to the Treasury (Annual Report 1995, CBRT).

11) The real exchange rate rule which aims at maintaining a constant real value for an exchange rate basket comprising 1.5 Deutsche mark and 1 US dollar has been, either explicitly or implicitly, a central component of monetary and exchange rate policy framework since the beginning of the 1980s.

12) As argued in Baumgartner et al. (1997), the regressions do not control for the error correction term in cases where cointegrating vectors might exist based on the results of Toda and Phillips (1994), who show that in small samples Granger causality tests that explicitly take co-integration into account could not outperform conventional tests in levels and first differences.

13) In this study, we have also experimented with the Wholesale Price Index (WPI). The results, however, were mixed. We were not able to replicate some of the results that were obtained with the CPI. This phenomenon is likely to have arisen largely because of the role of the public sector prices in the composition of the WPI. The prices of public goods are usually adjusted on a discretionary basis and most of the time these adjustments are not related to current economic conditions. This discretion might have blurred the relation of the WPI to some potential indicator variables. We are currently exploring this issue further by using the private manufacturing industry prices.

14) The output gap is usually calculated by using the GDP series. However, as in many other countries, the GDP series is available only on a quarterly basis in Turkey. Though Yalçin (1997) converted the quarterly

GDP series into monthly frequency by using Fernandez method, the output gap obtained by using the monthly GDP data did not give significant results in our study. Therefore, we decided to use the monthly industrial production index as a proxy for GDP.

15) The monetary conditions index is calculated as a weighted average of the real interest rate and the deviations of the level of real exchange rate from some average or base value, following Freedman (1994).

16) We also applied the standard practice of performing the causality tests based on the lag order selected by the Schwarz criteria, this time starting from the lag order of 36. The resultant causalities were mostly similar to the ones we obtained by applying the above mentioned robustness criterion.

17) The ordering of the variables in Sections IV.2. and IV.3 in terms of their performance as leading indicators of inflation is based on the number of Granger-causality tests that give significant results out of 12 regressions. For instance, for each chosen lag-length, that is from one- to 12-lags, there is Granger causality from the interbank interest rate to inflation almost with a marginal significance level close to zero percent. For M1, on the other hand, 10 Granger causality tests out of 12 indicate causality with a marginal significance level equal or smaller than 5 percent. For a summary of all test results, see Table A.

18) This counterintuitive result is discussed in Section V.

19) It may be worthwhile to note some key operational aspects of the interbank money market in Turkey. There are two types of transactions: one takes place between commercial banks and the Central Bank and the other among commercial banks themselves. The Central Bank of Turkey often assumes a strong presence in the interbank market and leads the commercial banks by way of quoting ask-bid prices. It also imposes limits on the volume of funds that each bank can borrow from the Central Bank. No such limits on transactions among commercial banks are imposed.

20) The relationship between the interbank interest rate and the exchange rate basket is such that Granger causality runs in both directions while the variance decompositions indicate that the interbank rate explains more of the variations in the exchange rate basket than vice versa (see Table 6.2). It may be worthwhile to explore this issue further in a structural framework.

21) The anomaly, that among the currencies that form the basket the interaction between the Deutsche mark and inflation seems to be longer than that of between the US dollar and inflation, can perhaps be explained by the fact that while most trade contracts are in terms of Deutsche mark and hence is expected to have longer term effect on inflation, the US dollar holdings, based on anecdotal evidence, are mostly used for speculative reasons and may not have any lasting effect.

22) This seems to be typical for economies where inflation has assumed an inertial nature. Based on variance decompositions obtained in the multivariate setting, even in the presence of the strongest indicator, that is the interbank interest rate, almost 40 percent of the forecast error variance of inflation is explained by its past values.

23) However, as noted in Section IV.3, the Granger-causality from personnel expenditures to inflation disappears in a multivariate setting. Moreover, although cash balance performs well in the multivariate setting, impulse responses reveal that it has no statistically significant impact on inflation.

## References

- Alper C. E. and N. T. Feyzioglu, 1995, *Money Demand and Financial Liberalization: The Case of Turkey 1980-1991*, unpublished, Georgetown University.
- Atiyas I. and H. Ersel, 1992, *The Impact of the Financial Reform: The Turkish Experience*, World Bank, Industry and Energy Department Working Paper, Industries Series No: 65
- Baumgartner, J., R. Ramaswamy and G. Zettergren, 1997, *Monetary Policy and Leading Indicators of Inflation in Sweden*, IMF Working Paper (IMF-WP) No:34, April.
- Bernanke, B. S., 1986, *Alternative Explanations Of The Money-Income Correlation*, Carnegie-Rochester Conference Series on Public Policy 25, 49-100.
- Bernanke, B. S. and F. S. Mishkin, 1997, *Inflation Targeting: A New Framework for Monetary Policy?*, *Journal of Economic Perspectives*, Vol. 2, Spring, 97-116.
- Central Bank of the Republic of Turkey, Annual Report 1995.
- Dickey D. A. and W. A. Fuller, 1981, *Likelihood Ratio Statistics For Autoregressive Time Series With A Unit Root*, *Econometrica*, Vol. 49, No.4, July.
- Fisher, S., 1995, *Central Bank Independence Revisited*, *American Economic Review*, Papers and Proceedings, Vol. 85, No.2, May, 472-492.
- Freedman C., 1994, *The Use of Indicators and the Monetary Conditions Index in Canada*, in: *A Framework for Monetary Stability*, Balimo and Cutinelli (eds.)
- Friedman, B., 1994, *Intermediate Targets versus Information Variables as Operating Guides for Monetary Policy*, in: J.A.H. de Beaufort Wijnholds et al. (eds.), *A framework for Monetary Stability*, Papers and Proceedings of an international conference organized by De Nederlandsche Bank and the Center for Economic Research at Amsterdam, October. Kluwer Academic Publishers, Dordrecht.
- Friedman B. and K. N. Kuttner, 1992, *Money, Income, Prices and Interest Rates*, *American Economic Review* Vol. 82, July, 472-492.
- Fuller, W. A., 1976, *Introduction to Statistical Time Series*, Wiley Publication in Applied Statistics, New York.
- Kesriyeli, M., 1997, *Monetary Policy Developments since 1980*, in Turkish, Central Bank of the Republic of Turkey (CBRT) Working Paper, 97/4.
- Kesriyeli, M. and C. Yalçın, 1997, *The Behaviour of Monetary Aggregates and Its Implications for the Conduct of Monetary Policy*, CBRT Working Paper, forthcoming.
- McDermott, A. and M. Üçer, 1997, *Capital Flows and the Real Exchange Rate: The case of Turkey*, IMF-WP 97/1.
- Mishkin, F. S., 1995, *Symposium on the Monetary Transmission Mechanism*, *Journal of Economic Perspectives*, Vol. 9, No. 4.
- Mühleisen, M., 1995, *Monetary Policy and Inflation Indicators for Finland*, IMF-WP No:115, November.
- Sims, C.A., 1992, *Interpreting the Macroeconomic Time Series Facts: The Effects of Monetary Policy*, *European Economic Review*, May, 975-1000.
- P. C. B. Phillips and H. Toda, 1994, *Vector Autoregression and Causality: A Theoretical Overview and Simulation Study*, *Econometric Reviews*, Vol. 13, No. 2.
- Webb, R. H. and T. S. Rowe, 1995, *An Index of Leading Indicators for Inflation*, *FRB of Richmond Economic Quarterly*, Vol. 81, No.2, Spring, 75-96.
- Yalçın, C., 1997, *Estimation of Monthly GDP: Fernandez Method*, in Turkish, unpublished, CBRT Working Paper.

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# Price Compilation and Construction of Various Price Indices in Iran

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## **Introduction**

Three price indices, namely the Consumer Price Index (CPI), the Wholesale Price Index (WPI) and the Producer Price Index (PPI), are produced in the Islamic Republic of Iran. They all have a monthly frequency of compilation and publication. The current basic year for each index is 1369 (1990/91) = 100.<sup>(1)</sup> The series for the CPI and the WPI are available since 1936/37, and for the PPI since 1990/91. The General Directorate of Economic Statistics of the Central Bank of the Islamic Republic of Iran is responsible for price data collection and computation of the indices. The main purposes of these indices are: measuring the inflation and the purchasing power of the national currency, price, wage and salary adjustment and deflation of the national accounts.

## **The Consumer Price Index in Urban Areas in Iran**

The CPI was first computed in 1315 (1936/37). The index measures the changes in the prices of certain goods and services consumed or used by all urban households in Iran. It is used as an appropriate tool for measuring the inflation rate and the purchasing power of the national currency, and also as a deflator in the national accounts.

### ***Weighting system***

The weights and items were derived from a household expenditure survey, conducted in 1369 (1990/91), covering 13,000 households. A three-stage sampling procedure was used. At the first stage a sample of 82 cities was selected.<sup>(2)</sup> These cities covered 70% of the whole population of the urban areas. At the second stage, in each city a number of blocks was selected and, at the third stage, households were selected in each block. Systematic sampling design was used for selecting the blocks and households.

The consumption expenditure used for derivation of the weights consists of the money value of all goods and services purchased during the base year by households for consumption. It includes the total value of durable goods, credit purchases, the value of income-in-kind (not received from other households), contributions to social insurance funds, licence fees, health care, life insurance payments and expenditure of gifts. It excludes remittances, direct taxes, contributions to pension funds and the value of home-produced and consumed goods.

The classification scheme of the weights conforms to the SNA<sup>(3)</sup> classification of household final consumption expenditure.

Items were selected according to the relative importance and their availability in the future. In some cases, random sampling methods such as probability proportional to size were used. The weights of the items not selected in the basket were distributed among the items in the corresponding sub-group.<sup>(4)</sup>

Table 1 presents the number of households surveyed and the number of goods and services included in the CPI for each base year. Table 2 shows the current major groups, their weights and the number of items in each major group. In addition, approximate number of price quotations are also included.

### ***Selection of outlets***

In each city, the selection of outlets is on the basis of knowledge of the data collectors which is based on rough estimates of sales' volume of the outlets and their geographic distribution.

The total number of outlets is 34,000 (13,000 for food and 21,000 for non-food).

### **Price data**

For most items, detailed and tight specifications are provided which may be adjusted when necessary. Specifications describe the quality, make, brand, unit, etc. For any item for which is not possible to determine detailed and tight specification, in each city, data collectors may select the selling variety and brands of that item.

Prices for most items are collected during the first 25 days of each month from retail outlets, supermarkets and service establishments in 82 cities.

For most items, price data are collected by direct visits to outlets. Actual purchases take place for a few new items such as bread and meat. For medical care. Prices of the most important items are collected each month. For education, average tuition of private schools or universities are collected. Average taxi and bus fares are used for transportation.

Discount, sales prices and black-market prices, when they exist, are to be considered. Second-hand purchases and hire-purchases or credit terms are not considered. For items with both official and free-market prices, a weighted average of prices is computed, using weights derived from the latest household expenditure survey.<sup>(5)</sup>

When a seasonal item is absent from the market, its price is imputed by assuming that it has the same rate of change as the weighted average of the prices of other goods of the same group.

Attempts are made to obtain the prices of goods with the same quality each month. If this is not possible, the nearest quality is priced. If quality change is significant, quality adjustment or a linking method is used. When a given type of good disappears from the market, it will be substituted by a similar one.

Items included under rent are (1) rental dwellings and (2) the rental equivalence of owner occupied dwellings. Rent quotations are obtained each quarter from a sample of approximately 8,500 dwellings.

The weights of the rental equivalence of owner occupied dwellings are obtained from the household expenditure survey.

Table 3 gives a number of monthly quotations for Tehran, large cities and other cities.

### **Computation of the Index**

The index is computed according to the Laspeyres formula as a weighted arithmetic average with fixed base weights corresponding to the base year.<sup>(6)</sup>

The index is computed based on aggregation of 82 cities. A national basket is used, but each city has its own fixed base weights. The index is also computed on regional basis (25 provinces and large cities). Annual arithmetic averages of the general index and major group indices are computed by calculating the average index points of 12 months of the year for each index.

The results are published about two weeks after the end of the month under review in a special publication including aggregated and detailed indices.

### **The Wholesale Price Index in Iran**

The WPI has also been compiled since 1315 (1936/37). The index covers all home produced goods on the domestic wholesale market, imported goods sold on the wholesale market and all exported goods excluding petroleum.<sup>(7)</sup>

### **Price data**

The price under survey is the price corresponding to the first commercialization of a good on the wholesale market. This is tantamount to an ex-factory-gate price for home-produced manufactured goods sold to wholesalers. The price is rather the price received by wholesalers for agricultural goods. For imported goods, it is the price as sold by the importer (c.i.f. plus duties, inland transport and trade margin). For exported goods, it is the price f.o.b. at Iranian ports. For imports and exports, prices in foreign currency are expressed in rials using the official or the free-market rate depending on the exchange rate that is practically used.<sup>(8)</sup>

### **Computation of the index and weighting system**

The index comprises 4,300 price quotations obtained from manufacturers, wholesalers and/or import-export enterprises. The elementary price quotations are first grouped in 432 items using

simple non-weighted arithmetic averages.<sup>(9)</sup> These 432 are then aggregated, using the Laspeyres formula, in a set of three indices grouped by origin or destination (“Domestically produced and consumed goods”, “imported goods” and “exported goods”), and, in parallel, in a set of eight major indices by nature (Food, Beverage and Tobacco, etc.). An overall index covers these two sets of indices. The weight of an item is:

(1) for the domestically produced goods, equal to its volume of production sold to the wholesale market multiplied by its average wholesale price for the base year;

(2) for the imported goods sold on the wholesale market, equal to the volume of the imports multiplied by a price obtained as the c.i.f. price to which has been added duties, inland transportation and trade margin; and

(3) for the exported goods, equal to the value of export f.o.b.

The classification used is the Standard International Trade Classification (SITC). Prices include taxes on products.<sup>(10)</sup>

Elementary price quotations are collected on the location of the businesses in Tehran and 26 cities comprising major production sites or wholesale markets. More than 80% of the price quotations are obtained in Tehran and in the four other main cities. Price quotations in minor cities concern mainly agricultural goods. The survey is not mandatory but there are very few reluctant businesses. Several prices of the same good are collected when all sales are not made at the same price. This concerns cooking oil and sugar, of which prices to certain purchasers are subsidized (see footnote 5). For industrial goods, the sample of enterprises included in the survey represents nearly all produced goods. For agriculture products and carpets, only a sample of the major wholesalers are selected. On the whole, the coverage of the index is more than 70% in every segment of the market. The results are published around 10 days after the end of the month under review in a special publication including aggregated and detailed indices. Unless special problems occur, the items and the varieties do not change between two rebasements.

Table 4 presents the number of goods included in the WPI for each year. The current group, their weights and the number of items in each major group is presented in table 5.

### **The Producer Price Index in Iran**

The wholesale price indices have been discontinued in many countries and replaced by producer price indices because these latter price indices are conceptually closer to the framework of the national accounts and therefore more useful to economists and national account compilers. It has become clear that WPIs are subject to a major defect: The multiple counting of price changes. This problem is common among highly aggregated traditional commodity groupings because they are calculated from price changes of commodities at several stages of processing, where each individual price change is weighted by its total gross value of shipments in the weight base year. Therefore, less aggregated commodity grouping indexes that cover only a single stage of processing are not affected by this multiple counting defect and are more desirable. Thus, the PPI was developed in Iran, based on the Laspeyres formula, and was first published in early 1996. It is computed based on the “producers’ price”.<sup>(11)</sup> The PPI based on the “basic price” will also be computed in the near future.<sup>(12)</sup>

The PPI covers agriculture, manufacturing, and electricity, gas, water supply and telecommunications according to the International Standard Industrial Classification (ISIC), which is the recommended classification for the PPI.

### ***Weighting system and price data***

Items were selected according to their relative importance in total sales volume of goods and services in the base year (1990/91). This also includes part of the production which is not entered in the market. Production or consumption multiplied by the adequate price was used as a proxy for sales.<sup>(13)</sup>

The PPI major groups, their weights and the number of items in each group are presented in table 6. The consumer price of a considerable number of goods and services used in the CPI, and the wholesale price of a large number of goods used in the WPI, are close to the “producers’ price”. So, they are included in the PPI. As in many other countries, prices of business services were put aside because of the difficulties associated with the observation of the price of these services.

### ***Some differences between the PPI and the WPI***

1. The WPI covers the products exchanged in a wholesale market. It does not cover home-made products sold directly to retailers or consumers. The PPI is expanded to these flows.
2. The WPI mixes imported and home-made products. The PPI does not include imported products which should be treated in a separate import price index.
3. The WPI separates exports and home-made products which are sold on the domestic market. The PPI merges them in an index covering all production, whether home-consumed or exported.
4. Most of the branches organized in medium and large enterprises are covered by the WPI. Many of the industrial branches organized in small or even very small enterprises, such as the production of bread, furniture, the clothing industry, and the hand-made shoe industry, which are not covered by the WPI, are covered by the PPI.<sup>(14)</sup>

The PPI is published about two weeks after the end of the month under review in a special publication including aggregated and detailed prices.

### **Notes**

1) Previous basic years are 1338 (1959/60), 1348 (1969/70), 1353 (1974/75) and 1361 (1982/83). The indices are going to be rebased in the current Iranian year, 1376 (1997/98).

2) In this revision the number of cities was increased to 82, which were classified into large cities and other cities.

3) A System of National Accounts.

4) The number of goods and services increased to 313, among which 100 were food and 213 non-food items.

5) Sugar and cooking oil are among the commodities of which prices are subsidized. Other significant examples of openly or indirectly subsidized commodities are wheat, petroleum, and medicinal goods. There is a policy of controlling the producer, wholesale and retail prices of goods considered essential, among which: cheese, detergent, soap, metal raw materials, raw materials for clothing, raw chemical and petrochemical products, tires, cars, tractors and trucks, butter, bread, flour, and soft drinks. This control is operated through the Organisation for the Protection of Consumers and Producers (OPCP), chaired by the vice-minister of trade.

6) The average of matched prices is used for deriving prices relative in consecutive months. Missing prices are substituted by prices from other similar outlets or cities.

7) To be selected into the WPI a good must be sold by wholesalers. For example, bread will not be part of the WPI as it is sold directly from producers to consumers; in the same way, goods imported directly by manufacturers are not part of the import sub-index of the WPI. Hence, this import sub-index represents only 40% of imported goods. Exports concerns mainly carpets, dry fruits, and caviar.

8) Iran is using a system of multiple exchange rates. There is an official rate, which is 1.750 rials per US dollar, and an official export rate, which is 3.000 rials per US dollar.

9) However, (1) when price quotations for the same item are in several cities, an average price is compiled for each city and the national average price is obtained by a weighted average of the average city prices; (2) when the varieties included in the item are very different in price, prices of high varieties are multiplied by corrective coefficients in order to avoid assigning a large implicit weight in these high priced varieties.

10) Taxes on products are deductible.

11) The prices include taxes on products, but do not include subsidies received by producers.

12) The prices exclude taxes on products and include subsidies received by producers.

13) However, weights used to aggregate agricultural commodities do not include production for own use.

14) There are no wholesalers in these branches. The production is sold directly by the producers to the households in the case of bread, or to the retailers in the case of furniture, clothing, and shoes. However, in the case of bread, as the "producers' price" is close to the consumer price, the price observation from the consumer price index is used in the PPI as "producers' price".

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**Table 1 – Number of households and number of goods and services included in the CPI**

Basic year	Number of households	Number of items		
		Total	Food	Non-food
1936/37	617	31	14	17
1959/60	3600	170	50	120
1969/70	4783	300	80	220
1974/75	9346	313	91	222
1982/83	15000	302	92	210
1990/91	13000	313	100	213

**Table 2 – The CPI major groups and their weights; 1369 (1990/91) = 100**

Major groups	Number of items	Weights	Number of price quotations
General index	313	100.00	111900
1. Food, beverages and tobacco	103	37.34	56100
2. Clothing and footwear	41	11.14	9200
3. Housing, fuel and power	24	25.18	13900
4. House furnishings and household operations	44	7.16	9900
5. Medical care	39	3.94	8800
6. Transport and communications	25	7.93	5600
7. Recreation, education and reading	14	2.02	3200
8. Miscellaneous goods and services	23	5.30	5200

**Table 3 – Number of monthly quotations for food and non-food items**

	Tehran	Large cities	Other cities
Food	20	10	5
Non-food	10	5	3

**Table 4 – Number of goods included in the WPI**

Base year	Number of items			
	Total	Domestically produced	Imported	Exported
1936/37	66	26	14	26
1959/60	160	85	45	30
1969/70	366	180	132	54
1974/75	620	394	178	48
1982/83	395	323	58	14
1990/91	432	306	106	2

**Table 5 – The WPI major groups and their weights; 1369 (1990/91) = 100**

Major groups	Number of items				Weights
	Total	Domestic -ally produced	Imported	Exported	
General Index	432	306	106	20	100.00
1. Food	127	102	16	9	35.76
2. Beverages and tobacco	7	6	1	0	1.02
3. Industrial raw materials	22	11	3	8	4.41
4. Mineral fuels	9	9	0	0	3.21
5. Chemical and petrochemical	26	20	6	0	2.60
6. Manufactured in terms of raw materials	129	86	40	3	33.89
7. Machinery and transport equipment	96	63	33	0	17.63
8. Miscellaneous	16	9	7	0	1.48

**Table 6 – The PPI major groups and their weights; 1369 (1990/91) = 100**

Major groups	Number of items	Weights
General index	442	100.00
1. Agriculture, Hunting and Forestry	82	25.05
2. Mining and Quarrying	4	0.32
3. Manufacturing	298	45.14
4. Electricity, Gas and Water Supply	10	1.25
5. Hotels and Restaurants	9	1.04
6. Transport, Storage, Communications	17	2.53
7. Financial Intermediation	7	6.79
8. Real Estate, Renting, Business Activities	3	15.06
9. Education	3	0.28
10. Health and Social Work	9	2.54