Economic Policy Coordination in an Integrating Europe

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Foreword

Economic integration in Europe is now progressing at an unprecedented and accelerating pace. The agreement to establish economic and monetary union (EMU) in the European Community (EC) reflects an explicit commitment by EC member states to monetary integration. It is a logical complement to the integration of European economies that was given added momentum by the Community's single market programme.

The primary purpose of EMU is to facilitate the pursuit of common economic objectives within the Community. Hence, there will be a single monetary policy aimed at price stability and tight coordination of other sound macroeconomic policies. This convergence and coordination of policies *de facto* applies also to the states now seeking EC membership, as well as to other European countries.

This volume contains a selection of papers presented at a workshop on economic policy coordination hosted by the Bank of Finland. The workshop, which was held in Helsinki on 12–14 January 1992, was jointly organized by the Bank of Finland and the European Economics and Financial Centre in London. The papers now being published have been edited by Dr Christian C. Starck of the Bank of Finland and Dr Homa Motamen-Scobie of the European Economics and Financial Centre.

The analysis of international aspects of economic policy has long traditions at the Bank of Finland. In 1962, the current series was launched with the publication of "The EEC Agreement". In 1969, this tradition was continued against the background of deepening European economic integration with the volume "The EEC". The Bank of Finland hopes that the present publication will stimulate discussion on matters of policy coordination as European economic integration deepens even further.

Sirkka Hämäläinen
Governor
Helsinki, August 1992

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1 Introduction

This book emerges from a workshop that was jointly organised by the Bank of Finland and the European Economics and Financial Centre and took place in Helsinki during 12—14 January 1992. The workshop, entitled "Economic Policy Coordination", was hosted by the Bank of Finland and was the first of a series. A second workshop will be hosted by the Central Bank of The Netherlands during 4—6 November 1992 and a third will be held at the Bank of Austria in early 1993.

At this inaugural workshop some fifteen central banks from across Europe participated. In addition, there were papers from various government ministries, research institutes, the private sector, and academics from different universities in Europe and the US. In total some twenty-seven papers were presented. Alas, it was not possible to include every paper in this book. So a selection had to be compiled.

The guiding principle behind the selection of papers was that they should represent a fair cross-section between the policymakers (eg central bankers) within the public sector and the private sector. However, copies of the papers that were presented but not included in this volume and further information about this workshop and future workshops can be obtained from the European Economics and Financial Centre, P.O. Box 2498, London W2 4LE, UK.

Traditionally, policy coordination efforts have been channelled primarily towards external factors and have been focussed mainly on the trade side and exchange rate management. In the current climate of European integration, however, external considerations go way beyond the issues concerning current account surpluses and deficits.

Indeed, policy coordination is called for in almost every sphere of economic activity across this continent — and in particular for the member countries of the European Community. Checks and balances have to be imposed on all the diverging pressures across the participating countries. While effective coordination can prevent such tensions, the risk remains that these tensions could resurface.

This is not to say coordination on the external side can be overlooked. Indeed the coordination of exchange market operations remains a key objective among major countries. Many papers in this area were presented at the workshop.

With the above in mind, the aims and objectives of the workshop were specified as follows: i) to portray the nature and variation in economic research conducted within different central banks and government circles, ii) to bring into light the new thinking, new findings, developments and advances within these institutions (it was

intended to portray their outlook, focus and direction towards policy-making and interaction with each other without infringing confidentiality rules), and iii) to highlight and capture attempts at policy coordination.

Clearly domestic policies are formulated in the light of economic developments internationally and account is taken of such events. In this respect the workshop contained papers (some of which are published here) that focus on a specific domestic issue within a given country while giving insights into the degree of policy coordination. It was the intention of the meeting to keep its focus fairly broad, providing an overview of the direction of the research and determination of its course.

Perhaps some further words should be added about the objectives outlined above. Firstly, on the issue of variation in economic research that is carried out in different central banks, one of us speaking as the editor of the journal Economic Modelling, papers produced by central banks are continually presented to this journal. What is really striking is the variation in subjects covered by different central banks even though prima facie these banks tend to perform the same task in different countries. The emphasis and orientation of the research varies markedly from one bank to the next.

Not all the papers and material produced by these institutions are of course submitted to different journals. So it is important to bring to light the differences that exist and portray the new directions and to what extent account is taken of such valuable research when formulating policies.

Many of the papers and research documents are in their native language and are not easily accessible to the reader not familiar with the language concerned. That is why it is useful to gain an overview of the overall direction and new developments. One central banker, who shall remain nameless, pointed out recently that they do not do any applied work and their economic research is purely theoretical which is a rather interesting development.

A step towards manifestation of the type of research that has been carried out in a central bank is one that has been produced by the Centre that is the book published by Chapman and Hall entitled "Economic Modelling at the Bank of England".

The paper from the European Commission addresses the question of financial integration within the Community. Broadly speaking, financial integration within Europe has three dimensions: (a) free mobility of capital across borders, (b) removal of any barriers for the provision of financial services by institutions in other member states

(ie outside their home countries without being established in the other member states), and (c) a single currency.

The conditions under which the international financial markets seem to be operating today appear to be one of more risk and less profit. Yet a united Europe is likely to possess certain strengths that surpass that of the US and Japanese markets. Firstly, as an indicator of the financial strength of a single market, the European banks put together provide an aggregate balance sheet much greater than that of the United States or Japan. Secondly, the degree of their internationalization is much higher and allows them to compete favourably with the rest. Thirdly, the European saving rate is double that of the US — aggregate saving rising by a factor of USD 500 per capita per annum.

In short, a more integrated and united Europe with a single currency and a harmonised economic policy should provide the basis for the future dominance of "the European market" in the international financial arena.

Suffice it to say that one of the important variables within the integrating Europe is the absorption of the developments of Eastern Europe post liberalization. What is of immediate relevance to the Community is the evolution of the German economy following their unification.

The paper by Karl-Heinz Toedter (of the German Bundesbank) brings to light the following: a) the economic changes in Germany post unification and the difficulties in capturing these colossal changes in a structured framework that can be used by the Bundesbank for economic analysis and policy formulation; b) the way in which the original West German model had to be revised to incorporate the East German economy.

Previously, the macroeconometric model of the Deutsche Bundesbank had been applied for the purpose of forecasting the economy of West Germany. However, the lack of similarity between the East and the West prevented the formulation of an aggregate model for the two sides. For not only is there an absence of integrated data, the statistics for East Germany are unreliable.

Toedter's paper portrays the way in which the macromodel of the Bundesbank has evolved into two blocks — one for the West and one for the East. It describes the calibration and estimation procedure applied and, hence, reveals the progress of the political and economic harmonization in the two parts of Germany.

Indeed major obstacles against smooth integration remain, such as regional differences, obsolete capital stock in the East, etc. Accordingly, for the purpose of economic projection, there is a need

for a differing economic analysis that distinguishes and isolates the two sides.

This paper draws attention to the significance of this for the Bundesbank which has to conduct a "homogeneous all-German monetary policy". While East Germany accounts for only 10 per cent of the German economy, the interaction of the two sides of the model should increase over time to the point of a smooth merger of the two to capture unification fully.

In the paper by August Leppä (of the Finnish Ministry of Finance) causes for the world record high Finnish consumer price level, and the prospects for the price level to converge to the EC level, are documented. The high GDP per capita of Finland, of course, explains some part of the high price level, but, according to Leppä, other factors are important, too. Such are the taxation of alcoholic beverages (which influences the prices of restaurant and hotel services), the prices of books (influencing education costs), and food prices, to name just a few factors.

Leppä goes on showing that while some convergence of Finnish consumer prices to the EC level reasonably can be expected, the magnitude and speed of such convergence depend in a complex way on a multitude of factors. In fact, little more than educated guesses or scenarios based on strong assumptions can be offered in this case. Much seems to depend on the credibility of Finland's fixed exchange rate regime, on increased flexibility in the labor market, and on the extent to which trade barriers can be reduced. According to the calculations reviewed by Leppä, Finnish consumer prices would, in any case, moderate more were Finland to join the EC as opposed to the EES.

A real-life example of the benefits of policy coordination is presented in the paper by Heinz Glück and Dieter Proske (both of the Austrian National Bank) and John A. Tatom (of the Federal Reserve Bank of St. Louis). The authors study the Austrian fixed exchange rate policy paying particular attention to the coordination of Austrian economic policy with that of Germany. The authors provide a succinct qualitative and quantitative documentation of the Austrian "success story" thereby giving other countries a blueprint for and encouragement to successful economic policy coordination.

Glück et al. deal primarily with monetary policy, and show how important it is for the central bank to stabilize economic agents' expectations by reducing uncertainties about the future exchange rate. In fact, the Austrian central bank is required to ensure "that the value of the Austrian currency is maintained with regard both to its domestic

purchasing power and to its relationship with stable foreign currencies".

The authors stress the importance of economic policy credibility and the reputation of the policy making body. Credibility is defined as the extent to which beliefs concerning policy conform to the official announcements about policy. It is also stressed that, in the long-run, economic fundamentals must converge towards the announced goals. Reputation is defined by the authors as the probability which the public assigns to the consistent pursuit of policy. An important point is to note that the probability is derived by learning over time from the actual behaviour of policy makers. The Austrian case demonstrates that temporary departures from policy commitments can have high real costs; because the departures affect reputation, the costs are very persistent.

The paper by Már Gudmundsson (of the Central Bank of Iceland) studies the relationship between export supply and the exchange rate in a small open economy with a natural resource based export sector. The author presents a model of an economy which produces one single export good by harvesting a renewable natural resource which has no alternative demand on the domestic market.

Gudmundsson makes the interesting point that in such an economy, the Marshall–Lerner–Robinson condition is irrelevant. The well-known condition states that a devaluation improves the current account when the sum of the price elasticities of demand for exports and imports is larger than unity. However, in an economy of the type studied by Gudmundsson, the supply of exports will be limited by natural conditions. Hence, export supply will be far from infinitely elastic as it is usually assumed. It will be nearer to zero, and could in some cases be negative in the long-run. Exports will thus be determined by the supply side and not by the demand side as in most traditional, Keynesian textbook models.

In Gudmundsson's model, the current account will improve with a devaluation, if both export prices in terms of foreign currency and the quantity of exports are given independently of the exchange rate, and provided real wage resistance is not perfect and the price elasticity of the demand for imports is not zero. The devaluation in this model works through reducing real incomes and imports, but not by stimulating exports.

The interdependency of various countries' interest rates is an area much explored in the economic literature. The paper by U. Cherubini, M. Ciampolini, R. Hamaui and R. Sironi examines domestic and foreign determinants of interest rates in different EMS (European Monetary System) countries. For this purpose, the authors develop a

theoretical framework and apply it to Italy and France. Their model formulation embodies an impulse response function within an integrated VAR setting.

France and Italy were chosen for comparison for the reason that public perception is that these two EMS economies have similar problems. However, the results presented in Cherubini et al bring out some of the major differences between the two countries in their response to external economic variables.

While a rise in German interest rate is transmitted to both the French and the Italian system and brings about a major rise in both countries' interest rates, it is evident that Italian interest rates respond additionally to other external shocks, eg to sharp variations in the ITL/DEM exchange rate. In other words, the dependency of the French domestic interest rate on the German interest rate appears to be significantly more than that of Italy. Italian interest rates behave more independently and are more influenced by their own exchange rate policies.

Several factors are responsible for the divergence of response between the two countries: i) the high public debt in Italy and, hence, the difficulty in managing interest rates; ii) the broader band of 6% within the European Exchange Rate Mechanism (ERM) for Italy (as opposed to the narrow band of 2.25% within ERM for France) and, thus, the enhanced flexibility for Italy; and, iii) the considerably less restrictive financial system in France as compared to Italy.

The paper on timing of entry into the European economic system by H. M. Scobie draws attention to the considerations that are relevant for selecting the appropriate time for implementing such actions. It highlights the significance of the appropriate levels at which different economic variables such as inflation, interest rate, etc., have to be at the time of entry into the European Economic System.

The global term European Economic System is chosen in the paper because it embraces many stages of entry. For a country may join one part of the system and not be part of some of the other agreements. To join each stage of the European Economic System or each aspect of the agreement requires fulfilling certain obligations. If the country's economic conditions are not in tune with the obligations it has to fulfil after entry, the costs could be colossal and heavy economic penalties may have to be paid by the citizens. It has to be closely examined to what extent those costs may outweigh the benefits. On the other hand, the correct timing of entering when all the conditions are right could avoid huge costs that might otherwise be incurred.

The paper demonstrates a case of ill-timing of entry into one facet of the European Economic System, namely the case of the United Kingdom when it entered the ERM, and reveals the consequences of political quibbling and indecisiveness.

In short, the paper points to some of the key factors and some of the indicators to watch at the time of joining, and stresses the need to examine in detail what the requirements are once the country is in the system, and what the net gains and net losses may be.

The interactions between some major European market interest rates on one hand, and with the US federal founds rate on the other hand, are studied in the paper by Franz Ettlin and Michael Bernegger (both of the Swiss National Bank). In particular, the determination of 3-month deposit rates in the eurocurrency markets for Swiss francs, German marks and US-dollars is analyzed empirically, distinguishing between the effects of monetary policy and currency substitution.

The empirical results conform to reasonable *a priori* beliefs concerning the direction and strength of causal relationships between nominal interest rates, and the prevalence of currency substitution effects. The US interest rate is causally prior to the German rate which, in turn, is causally prior to the Swiss interest rate. Interestingly enough, the covariance of the German and US interest rates is found to be strong, as is the importance of the German rate for the Swiss rate. Furthermore, the estimated currency substitution effects are large in the case of Switzerland, they matter to some extent in the case of Germany, and, as expected, are nonexistent in the US case. All in all, the results do not support the view that German and Swiss money supply policies are highly autonomous.

Economic interdependence and the gains from policy coordination are analyzed within a game theoretical framework by Juan Carlos Martinez Oliva (of Banca d'Italia). His basic point is that enhancing the similarity of inflation unemployment trade-offs in different countries is desirable from the point of view of welfare improving economic integration between the countries. In other words, interdependence *per se* is not sufficient to assure that advantages will be forthcoming from cooperation between countries.

The model by Martinez Oliva nicely goes beyond the standard model in which higher interdependence and hence higher spillover effects are associated with higher potential gains from coordination. The author demonstrates that the scope for welfare improvements depends on, *inter alia*, whether policy is transmitted negatively or positively from one country to the other, and on policy makers, preferences with respect to inflation and unemployment. Using numerical simulations, Martinez Oliva demonstrates cases in which

increased coordination actually is welfare reducing. His results state an important caveat to the all too common, naive faith in the merits of higher interdependence between economies.

In the last paper of this volume, Hasse Ekstedt and Lars Westberg (both of the Gothenburg University) take a look at steady state equilibrium growth integrating the short-run with the long-run. The authors do this by means of a full-fledged dynamic general equilibrium model with appropriate micro foundations. In addition, the role of rigid institutional settings that create inertia in the price-system is emphasized. Together with a less than perfectly foreseen future, this inertia creates binding restrictions. The main contribution of Ekstedt and Westberg is to show how these restrictions affect both the short- and long-run stability conditions of the model. In effect, long-run growth is affected, as well as the conditions for economic policy.

All in all, the papers collected in this volume — albeit representing only a cross-section of those presented at the workshop — attest to the diversity, yet depth, of the research carried out at central banks and other governmental institutions. In particular, the papers bear on the increasingly important topic of economic policy coordination. It is hoped that this volume will stimulate thinking and further research on this fascinating issue.

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London, August 1992

Christian Starck
Helsinki, August 1992

2 Financial Integration in Europe

by
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2 Financial Integration in Europe

2.1 Introduction

In recent years, financial markets have undergone a radical process of transformation, prompted by international competition and made possible by technological development. The nature of financial intermediation has remained the same, however, and the risks associated with it — those of intermediation and transformation — have merely changed in degree.

Disintermediation, despecialization, securitization, internationalization, innovation and the current techniques of financial engineering are among the most familiar manifestations of the change that has occurred in financial markets. Markets have become more efficient and riskier, with the result that the financial intermediary finds himself today on a less favourable indifference curve than before: his risk has increased whilst his profit rate has declined.

This is the general environment in which European markets are operating today and in which the large Community market tomorrow till emerge.

2.2 Financial Europe today

The financial strength of the old continent is unrivalled in the world. For instance:

- European saving expands by about $500 billion a year, which is double the annual increase in saving in the United States; Japanese saving is also much lower than European in absolute terms;
- European financial intermediaries compared favourably in terms of experience, professionalism, internationalism and know-how, etc. with those in the United States and Japan;
- the aggregate balance sheet total of European banks is larger than that of their American rivals and the internationalization of their activities much greater.

Yet the American market continues to dominate European markets; the movement of European domestic interest rates is frequently determined more by stimuli from the other side of the Atlantic than by strictly

domestic factors. And the American market continues to attract European capital. Where the climate on the stock market is concerned, the wind always blows from the other side of the ocean. The consequences for Europeans of this dependence are anything but positive.

The reason for this paradox — the smaller market dominating the larger — is obviously that European markets are fragmented: compared to the monolithic American market (single currency, single economic and monetary policy, single political authority, uniform tax and institutional environment, etc., the European one is a mosaic of small, juxtaposed markets which often work in contradictory fashion.

There is clearly a need, therefore, for the Member States capital and money markets to be unified and integrated.

2.3 European financial integration

There are three main components of European financial integration: liberalization of capital movements, freedom to supply financial services, and monetary unification.

2.3.1 Liberalization of capital movements: an assessment

The Commission's directive will make it possible for all capital to move freely within the Community. Individuals and firms will be able to choose the financial institutions and instruments they wish for their deposits, financial investments and borrowing operations, without discrimination on the grounds of nationality or place of residence.

The net effects of liberalization of capital movements will clearly be very favourable. Of course not everything will be a bed of roses. As the saying goes, you can't have your cake and eat it. If something is worth having, you have to pay for it.

But there is no reason for panic. We are already well advanced on the road to liberalization and a group of high-level academics, after rigorous analysis, has given us something like a scientific and moral endorsement. We are, as it were, taking calculated risks but have prepared suitable defences.

The favourable effects expected from liberalized capital movements are as follows:

- resources will be allocated more efficiently, since capital which can move freely will tend to flow where the return is expected to be highest;
- competition is increased, raising consumer welfare. The average level of interest rates in the Community may even fall a little;
- the European market will become more independent of the American one. For this reason, there will perhaps be a greater tendency for European saving to stay in Europe;
- In particular, there will be significant progress towards unification of the old continent, including political union; the market for capital will become as liberalized as that for goods and services.

The unfavourable effects or possible risks are that:

- the EMS may be subject at times to greater strain than before. To cope with this, it is planned to increase the amounts of money available to the national monetary authorities for intervening on exchange markets where necessary. Such intervention will also have to be coordinated and more dynamic;
- national monetary policies will be less autonomous, and monetary targets will be more difficult to meet. National authorities will therefore have to coordinate their policies in a bid to recycle capital and "sterilize" unwanted funds. For emergencies a temporary safeguard clause restricted to short-term capital is envisaged;
- the interest rate differentials between the various currencies will probably widen. There is no defence against this, since it is an inevitable consequence of maintaining the EMS when there is complete freedom of movement for capital. Much more than in the past, interest rate differentials will have to exert a stabilizing influence on the flow of funds. Given the twin objectives mentioned above — free movement of capital and stability of exchange rates (EMS) — interest rate differentials will be the key variable in adjustment;
- tax avoidance may increase considerably. Capital flight could accelerate, and for two reasons: first because current banking technology makes it incredibly easy to transfer capital very quickly (on October 19, 1990, for instance, the computers on the New York Stock Exchange were able to execute no less than 2.5 billion orders); second, in 1992 the clients of financial intermediaries will be extremely well informed and will therefore tend to move their savings much more frequently than today.

This is a very difficult problem, which we are studying very closely. The eventual solution will, at all events, be a Community one, and it could take the form of taxing capital in the country where it is held, without discrimination on the grounds of nationality;

- finally, completely free outflows of capital may deprive certain countries or regions with a low return on capital of sufficient savings to finance their economies. This is a risk which is more apparent than real because in an integrated capital market financial intermediaries (and firms) in those regions or countries will be able to raise funds where they are located. Nevertheless, we have devised a twofold response: the policy to ensure cohesion will be strengthened considerably (through the doubling of the size of the structural funds) and will provide the finance; there will also be specific safeguard clauses and, in particular, an instrument of considerable importance — namely medium-term financial assistance.

One final observation: we are very close today to the free movement of capital, with, perhaps three-quarters of capital movements in the Community fully liberalized. It can therefore be safely said that the risks incurred through liberalization are not excessive. I would add that integration of the Community capital market will benefit small and medium-sized firms in particular, since large firms already have access to the large international markets (the Euromarkets).

2.3.2 Liberalization of financial services

A credit institution can provide financial services across borders either by opening a subsidiary or a branch (i.e. by becoming established) or by offering those services direct (without becoming established).

Under the proposals for Directives put forward by the Commission, any financial institution operating lawfully in its home country may, in future, supply financial services in the other Member States, without having to apply to the authorities of those States for prior authorization (principle of mutual recognition). In addition, the transactions carried out by such an institution outside its own country will be supervised only by the authorities in its home country (principle of home country control). These two fundamental aspects clearly show that in the single European capital market financial institutions will operate in other Member States under the same

conditions as they do in their own countries. This is what is meant by a unified financial area.

This is an important decision. It would seem essential, a priori, to harmonize operating rules (prudential, tax and others) throughout the Community. Such harmonization should not be regarded as a precondition, however, even though, in our view, it must be achieved in parallel with the process of financial integration. This determined approach adopted by the Commission is:

- based on fact. The lack of harmonization between countries which have liberalized their capital markets (the United States, certain European countries) has not given rise to speculative movements of funds;
- realistic. If one had to wait for such harmonization, European markets would not be integrated for many years; and
- conducive to convergence and the desired harmonization.

An important point to note is that a distinction must be drawn between *harmonization* of rules and *discrimination* between resident and non-resident financial institutions; according to the Commission's philosophy, the former is not, up to a certain point at least, a precondition of freedom to provide services nor of free capital movements; discrimination on the other hand would be completely prohibited.

The main advantages of a large European market for banking services are obvious: better service for customers, economies of scale and, last but not least, a unified financial market similar to that for goods and other services (ending an inconsistency).

It is to be hoped that, long before 1992, we shall see a major wage of mergers and acquisitions, which could have highly favourable consequences for the Community.

In short, the Community financial market, thanks to telecommunications and the special nature of the product traded (money), will be a fully integrated market — in sharp contrast to what is happening in the market for goods, where integration runs into major difficulties such as distance, non-substitutability of products, lack of transport infrastructures, and so on.

2.3.3 Single currency

The third component of financial integration is the creation of a single currency. With that aim in mind one can distinguish three parallel processes: economic convergence, monetary convergence and political convergence.

Concerning the latter we can say that this process is more advanced *de facto* than *de jure*. In fact domains such as budgetary, monetary and economic decisions are political in nature. Concerning the monetary union there are three steps to be followed: the first one began on 1 July 1990 and it's general aim is that all currencies should participate in the EMS with as reduced a margin as possible. The second step will begin in 1994 with the creation of the EMI, and the third step, consisting of the creation of the European system of central banks and the single currency, will begin in the final years of this century (after 1997).

Further elaboration on the previous points is not needed as they are common knowledge. With regard to the scheme followed so far in this exposé, advantages and inconveniences of the introduction of a single currency are addressed as follows:

With regard to the advantages, they are in three categories: from a microeconomic point of view single currency implies that most of the cost of cover will disappear. This is very important, because in the case, for example, of Portugal and importer of German goods should pay around 8 % or 10 % for cover of the borrowed capital and this percentage is sometimes higher than the profitability margin of his firm. From a macroeconomic point of view, some economists have calculated that the increase of the GDP, because we have a single currency, will be around 5 %. There are also institutional advantages: It is difficult to imagine a single market without a single currency.

Of course there are also problems with this single currency. The first is the question of macroeconomic policy: with the disappearance of the exchange rate within European countries, a major economic policy instrument disappears also. In fact we are moving to a situation where the national authorities are lacking financial instruments. The second problems is that of sovereignty. In this regard, it should be noted that nowadays our nations are neither politically nor economically nor monetarily sovereign or independent. All European countries are completely interpenetrated, and the so-called laws of sovereignty are something which, in many respects, are meaningless.

2.4 Conclusions

European financial integration is proceeding well. The liberalization of capital movements within the Community is practically completed. The liberalization of financial services will be total by the end of this year. The progress toward a single European currency was fostered substantially through the Maastricht treaty. Possible problems and risks notwithstanding, the outlook is very promising.

3 Economic Interdependence, Integration and the Scope for Coordination

by
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Banca d'Italia*

Contents

Paper presented at the Workshop on Economic Policy Coordination jointly organized by the Bank of Finland and the European Economics and Financial Centre of London, Helsinki, 14–16 January 1992

* The views expressed are the author's alone and do not represent the views of the Banca d'Italia.

3 Economic Interdependence, Integration and the Scope for Coordination

Abstract

The present paper shows that, despite its intuitively obvious connection with the gains from coordination, interdependence is not in itself sufficient to assure that advantages will stem from a cooperative process, and suggests a different interpretation of the gains from coordination, which can be regarded as indicators of an undesirable and welfare-reducing situation of international conflict among economic policies.

3.1 Introduction

It is a well established principle that in an interdependent world, economic policy actions by one country may give origin to significant spillover effects or "externalities" for the others. In the game theory approach to international policy coordination[1] in such a situation the attainment of a global optimum in the Pareto sense requires that those externalities be taken into account by the authorities in each country.

On the grounds of this "optimizing" view of the coordination process[2] many economists are implicitly or explicitly convinced that the higher the degree of interdependence, the larger the externalities descending from a unilateral process of policy-making and therefore the potential gains from coordination.

The idea that the size of spillovers may affect the spread between cooperative and non-cooperative outcomes is found, for example, in Oudiz (1985), Canzoneri and Minford (1986), Fisher (1988). The

[1] The view that in an interdependent world national policy-making has game-theoretic aspects and that uncoordinated macroeconomic policies lead to Pareto-suboptimal strategies has been the ground for the pioneering contributions of Niehans (1968) and Hamada (1974, 1976). The list of contributions on this topic has become incredibly long in recent years.

[2] A comparison among different views is found in Martinez Oliva and Sinn (1988).

present paper is an empirical counterpart of previous research[3] where I tried to demonstrate that, despite its intuitively obvious connection with the gains from coordination, interdependence is not in itself sufficient to assure that advantages will stem from a cooperative process.

In Section II the theoretical connection between spillovers and gains from coordination is briefly sketched with the help of a simple two-country interdependent model with money supply as policy tool. Section III numerically simulates the effects of different degrees of interdependence on monetary policy responses under cooperative and non-cooperative regimes and the associated welfare gains in the two cases of positive or negative policy transmission. In Section IV the assumption of symmetry is dropped and an asymmetric world, in which spillover effects are positive in one country and negative in the other, is considered. This is a somewhat more complicate situation, which requires the use of a bargaining model, and gives rise to a peculiar set of results. Section V draws a series of conclusions from the above results, stressing their practical relevance for the assessment of a process of economic integration.

3.2 The model and its internal and external trade-offs

A standard two-country (Country 1 and Country 2) interdependent world is here assumed to exist, in which national target variables depend on both domestic and foreign policy instruments. The relations between targets and instruments can be represented as follows:

$$\bar{Q}_1 = \frac{\partial Q_1}{\partial M_1} M_1 + \frac{\partial Q_1}{\partial M_2} M_2 \tag{1}$$

$$\bar{\pi}_1 = \frac{\partial \pi_1}{\partial M_1} M_1 + \frac{\partial \pi_1}{\partial M_2} M_2 \tag{2}$$

[3] See Martinez Oliva (1991a).

$$\bar{Q}_2 = \frac{\partial Q_2}{\partial M_1} M_1 + \frac{\partial Q_2}{\partial M_2} M_2 \tag{3}$$

$$\bar{\pi}_2 = \frac{\partial \pi_2}{\partial M_1} M_1 + \frac{\partial \pi_2}{\partial M_2} M_2 \tag{4}$$

where $\bar{Q}$ and $\bar{\pi}$ are the deviations of output and inflation from their baseline values Q^B and π^B respectively; M_1 and M_2 are the deviations of money supply growth rates in the two countries from their baseline values. Needless to say, for $M_1 = M_2 = 0$ target variables coincide with their baseline values.

An assessment of the policy implications descending from (1)–(4) requires some assumptions about the signs of partial derivatives. In a standard two-country framework à la Dornbusch, a domestic monetary expansion is supposed to raise home output and inflation and to reduce foreign inflation. The transmission of domestic monetary impulses to foreign output depends on the basic assumptions underlying the structural model.[4] In presence of fixed domestic costs and prices and full capital mobility, monetary policy is transmitted negatively across countries: a domestic monetary expansion causes the exchange rate to decline, thus shifting demand from the foreign to the domestic market.[5] Allowing for wage indexation abroad may reverse, for appropriate levels of indexation, the sign of the spillover effects of domestic monetary policy and vice-versa.[6] In the following analysis both cases of positive and negative transmission are taken into account.

In accordance with standard literature, we assume that the monetary authorities of each country aim at optimizing the objective function:

$$U_1 = U_1 (Q_1, \pi_1) \tag{5}$$

$$U_2 = U_2 (Q_2, \pi_2) \tag{6}$$

---

[4] A complete description of the structural model and the possible cases obtained from changing the basic assumptions is found in Oudiz and Sachs (1984). See also Canzoneri and Gray (1985) and Cooper (1985). For an extension to a fiscal policy context with current account targets see Martinez Oliva (199lb).

[5] This is the "beggar-thy-neighbour" world described in Canzoneri and Gray (1985).

[6] The so-called "locomotive" world; see Canzoneri and Gray (1983).

Let us now consider, for the sake of simplicity, only the case of Country 1.

Rearranging equations (1) and (2) we get:

$$M_1 = \left(Q_1 - \frac{\partial Q_1}{\partial M_2} M_2 \right) / \frac{\partial Q_1}{\partial M_2} \tag{7}$$

$$M_2 = \left(\pi_1 - \frac{\partial \pi_1}{\partial M_2} M_2 \right) / \frac{\partial \pi_1}{\partial M_2} \tag{8}$$

Solving (7) and (8) simultaneously we obtain:

$$Q_1 = \pi_1 K + H M_2 \tag{9}$$

where:

$$K = \frac{\partial Q_1}{\partial M_1} / \frac{\partial \pi_1}{\partial M_1} \tag{10}$$

$$H = \frac{\partial Q_1}{\partial M_2} - K \frac{\partial \pi_1}{\partial M_2} \tag{11}$$

The term K is the trade-off between output and inflation after a domestic monetary policy change. The term H represents the effect of an external monetary policy shock on the domestic trade-off between output and inflation.[7]

It can be demonstrated that under Nash equilibrium H is equal to $\partial U_1/\partial M_2$, ie the home welfare effect of a foreign monetary impulse.[8] Accordingly, expression H can be interpreted as a measure of the scope for a country's welfare improvement by means of external monetary policy. In fact, if H is equal to zero, the internal trade-off between target variables (output and inflation) cannot be improved by external policy actions.

It is worth noting that for H = 0 we get:

---

[7] It can be represented in the space (Q_1, π_1) as a shift in the domestic trade-off line.

[8] The demonstration is given in Martinez Oliva (1991).

$$\frac{\partial Q_1}{\partial M_2} / \frac{\partial \pi_1}{\partial M_2} = \frac{\partial Q_1}{\partial M_1} / \frac{\partial \pi_1}{\partial M_1} \tag{12}$$

Expression (12) shows a situation where, despite a very high interdependence ($\partial Q_1/\partial M_2$ and/or $\partial \pi_1/\partial M_2$ are large, implying strong spillover effects on domestic output and/or inflation from monetary actions abroad) the effect of a change in M_2 is negligible for Country 1's welfare.

This suggests that, at least under some conditions, the cross-gains, and more generally the gains from coordination, stem from some type of "comparative advantage" of each country's instrument with respect to the other's targets.[9]

In particular, the basic condition (12) can hold only if the signs of the cross-effects are the same, namely negative (since $\partial \pi_1/\partial M_2$ is negative by assumption), implying that, at least in the case of negative spillover effects ("beggar-thy-neighbour" world), the existence of strong interdependence is not in itself sufficient to assure large gains from coordination. On the contrary, given positive transmission condition (12) cannot be satisfied.[10]

A more general assessment of the results of changing sign and size of monetary transmission appears a difficult task, with the sole use of the above framework. For this reason the following sections will further investigate the welfare implications of changing spillovers with the help of numerical simulations.

3.3 The effects of changing spillovers: the symmetric case

For the purpose of numerical simulation the relationships between targets and instruments are assumed to be:

$$Q_1 = 1.000M_1 - 0.500M_2 + 100 \tag{1'}$$

$$\pi_1 = 0.250M_1 - 0.125M_2 + 3 \tag{2'}$$

---

[9] Following Hughes Hallett (1986) "Coordination enables governments to extend the range of comparative policy advantage, and hence the policy *specializations*, which they can exploit".

[10] Unless we assume that also $\partial \pi_1/\partial M_2$ (and $\partial \pi_2/\partial M_1$) is positive.

$$Q_2 = -0.500M_1 + 1.000M_2 + 100 \tag{3'}$$

$$\pi_2 = -0.125M_1 + 0.250M_2 + 3 \tag{4'}$$

The above system can also be represented in a more suitable form:

$$T = C\Gamma + T^B$$

where:

$$T = (Q_1, \pi_1, Q_2, \pi_2)$$

is the vector of targets, T^B is the value of T at the baseline,

$$C = (M_1, M_2)$$

is the vector of deviations of monetary policy from the baseline, and

$$\Gamma = \begin{pmatrix} \frac{\partial Q_1}{\partial M_1} & \frac{\partial \pi_1}{\partial \pi_1} & \frac{\partial Q_2}{\partial M_1} & \frac{\partial \pi_2}{\partial M_1} \\ \frac{\partial Q_1}{\partial M_2} & \frac{\partial \pi_1}{\partial M_2} & \frac{\partial Q_2}{\partial M_2} & \frac{\partial \pi_2}{\partial M_2} \end{pmatrix}$$

is the matrix of policy multipliers.

Equations (1')-(4') represent a symmetric "beggar-thy-neighbour" world, where domestic money expansion causes foreign output contraction. Domestic monetary policy has a stronger effect on domestic variables than foreign monetary policy. Baseline values are supposed to be 100 for the output level and 3 per cent for inflation.

Objective functions (5') and (6') are quadratic functions of the deviations of target variables from their target values:

$$U_1 = -\tfrac{1}{2}\,[(Q_1 - 100)^2 + \psi\,(\pi_1)^2] \tag{5'}$$

$$U_2 = -\tfrac{1}{2}\,[(Q_2 - 100)^2 + \psi\,(\pi_2)^2] \tag{6'}$$

where the inflation weights ψ are assumed to be equal to 2.[11]

[11] Alternative exercises with different values of ψ have given results very similar to those presented in this work, confirming that the gains from cooperation are sufficiently robust vis-à-vis changes in preferences.

Equations (5') and (6') show that the authorities aim at reducing the inflation rate to zero while keeping output unchanged at the baseline level.

It is worth noting that on the grounds of previous analysis (see expressions (11) and (12)) the parameters of equations (1')–(4') do not allow for gains from coordination, despite the large spillover effects implied by Γ.

The non-cooperative (cooperative) equilibrium can be easily computed from the first order conditions for minimizing (5') and (6') separately (jointly), subject to the home (home and foreign) policy instruments (See Appendix). Concerning the distribution of gains under the cooperative regime, the bargaining weights are assumed to be (½, ½), consistently with the assumption of symmetry. Table 1 shows the optimization results associated with the assumed parameters of Γ.

Table 1. **Nash and Cooperative outcomes under the assumption**

$$\Gamma = \begin{pmatrix} 1.000 & 0.250 & -0.500 & -0.125 \\ -0.500 & -0.125 & 1.000 & 0.250 \end{pmatrix}$$

	Country 1	Country 2
Nash:		
Money supply	–2.7	–2.7
Output	98.7	98.7
Inflation	2.7	2.7
U_N	–8.0	–8.0
Cooperative:		
Money supply	–2.7	–2.7
Output	98.7	98.7
Inflation	2.7	2.7
U_C	–8.0	–8.0
$U_C - U_N$	–	–

It can be seen that the target and policy values coincide in the two regimes: the money supply contraction is 2.7 points below the baseline, diminishing output and inflation by 1.3 and 0.3 points respectively. Correspondingly, the values of U_c and U_n are identical, implying no gains from coordination.

A grid of values is now considered, representing the size of spillover effects from domestic monetary policy to foreign output in both countries ($\partial Q_1/\partial M_2$ and $\partial Q_2/\partial M_1$). The grid range from –0.5 to 0.5 corresponds to 101 alternative values of spillovers. Moving from –0.5 to 0 the impact on output is progressively reduced. The negative values of the grid represent a "beggar-thy-neighbour" world, where monetary impulses are transmitted negatively. Value 0 is the point of transition towards a "locomotive" world, with positive transmission of monetary impulses. Moving from there to 0.50, the output effect starts to increase, implying a gradual increase in interdependence. It is worth noting that if we use the grid values in the following expression

$$\frac{\partial Q_1}{\partial M_2} / \frac{\partial \pi_1}{\partial M_2} - \frac{\partial Q_1}{\partial M_1} / \frac{\partial \pi_1}{\partial M_1} \tag{13}$$

we observe that the starting point 0.5 involves the absence of gains from coordination (Table 1). The progressive increase of the (absolute) value of expression (13) denotes that the potential gains from coordination also increase, in accordance with the analysis of previous section. Indeed, the gains from coordination tend to become larger, from the starting value 0 to 0.45, corresponding to assumption No. 101. It can be observed (Figure 1) that with negative transmission increasing gains from coordination are associated with decreasing interdependence; the contrary holds with positive transmission, in accordance with traditional beliefs. Figure 2 shows the well-known result that cooperative equilibria require in general milder monetary actions than non-cooperative equilibria.

Figure 3 shows the objective function values under the two regimes. The two utility outcomes, which are equal at the beginning (–8.00) implying no gains from coordination, tend to diverge, with a more rapid worsening of Nash than cooperative outcomes. At the same time in both regimes the utility outcome tends to decrease, as compared with the starting point. In other words the increasing gains from coordination are associated with a rapid decrease in the absolute welfare gains of both regimes. This result suggests that a situation like that depicted in Table 1 seems much more preferable in terms of welfare than that depicted in the Table 2, despite the greater scope for coordination implicit in the latter.

Figure 1. **Gains from coordination**

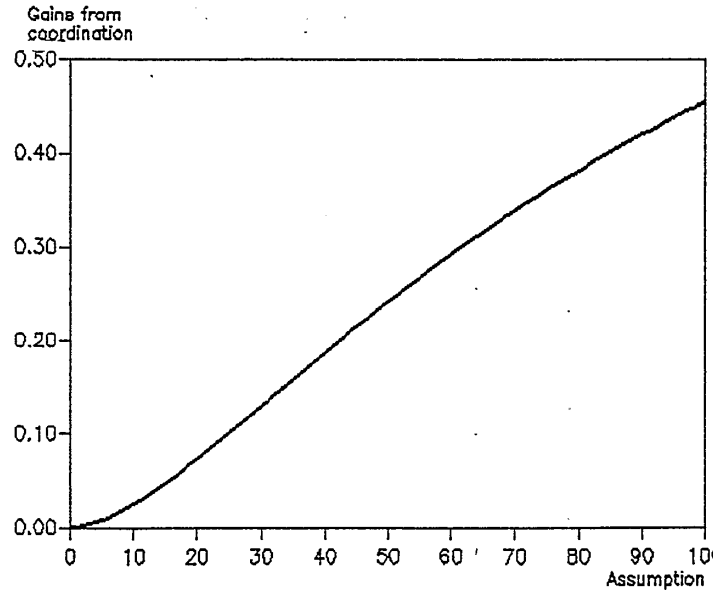


Figure 2. **Deviations of money supply growth from the baseline**

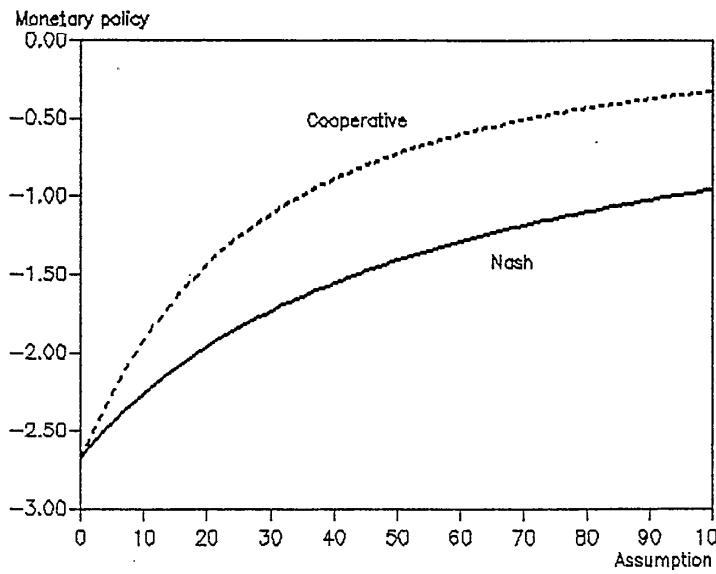


Figure 3. **Objective function values: Nash and Cooperative**

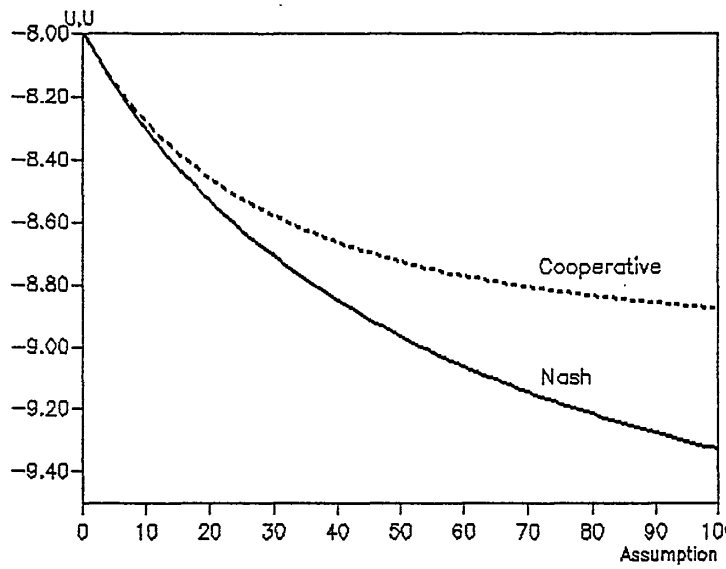


Table 2. **Nash and Cooperative outcomes under the assumption**

$$\Gamma = \begin{pmatrix} 1.000 & 0.250 & 0.500 & -0.125 \\ 0.500 & -0.125 & 1.000 & 0.250 \end{pmatrix}$$

	Country 1	Country 2
Nash:		
Money supply	-1.0	-1.0
Output	98.6	98.6
Inflation	2.9	2.9
U_n	-9.3	-9.3
Cooperative:		
Money supply	-0.3	-0.3
Output	99.5	99.5
Inflation	3.0	3.0
U_c	-8.9	-8.9
$U_c - U_n$	0.4	0.4

3.4 The effects of changing spillovers: the asymmetric case

In the present section the assumption of symmetry is abandoned. Accordingly, the relationships between targets and instruments are the same as in equations (1'), (2') and (4'), except for equation (3') which is now:

$$Q_2 = 0.500M_1 + 1.000M_2 + 100 \qquad (3'')$$

In this asymmetric world monetary spillovers from Country 2 are still of the "beggar-thy-neighbour" type while monetary spillovers from Country 1 are now of the "locomotive" type.

Table 3 illustrates the Nash and Cooperative outcomes in the new situation:

Table 3. **Nash and Cooperative outcomes under the assumption**

$$\Gamma = \begin{pmatrix} 1.000 & 0.250 & -0.500 & -0.125 \\ 0.500 & -0.125 & 1.000 & 0.250 \end{pmatrix}$$

	Country 1	Country 2
Nash:		
Money supply	–0.7	–1.7
Output	98.5	98.7
Inflation	3.0	2.7
U_n	–10.4	–8.0
Cooperative:		
Money supply	–0.2	–1.4
Output	99.1	98.7
Inflation	3.1	2.7
U_c	–10.2	–8.0
$U_c - U_n$	0.2	–

Two grids of spillover values are now computed. The grid of spillovers from Country 1 to Country 2 is the same as in previous section (from –0.5 to 0.5). The grid of spillover values from Country 2 to Country 1 ranges from (0.5 to –0.5)

In the central assumption (No. 50) both spillovers are zero.[12] As in the previous section, if we use the values of the two grids in expression (13), we get the differentials between external and internal trade-off in the two countries (expression (13)), which show that, as in the symmetric case, a reduction (increase) of interdependence increases (reduces) the potential gains from coordination in presence of negative transmission of monetary policy. The contrary holds with positive transmission of monetary impulses.

Figure 4 shows the gains from coordination in the two countries. The path of gains is consistent with the grid values depicted above. The gains are zero when expression (13) vanishes in both countries. When the trade-off differentials increase, the gains from coordination tend also to increase but not monotonically, reflecting the bargaining scheme followed for distributing the gains from coordination between the two countries.[13] As in the symmetric case, more favourable trade-off differentials require less restrictive monetary stances in both regimes (Figure 5). Nonetheless, since we are in an asymmetric world, global welfare optimization requires tighter monetary policies in the country where the spillovers from abroad are weaker and vice versa. Again, larger gains from coordination are associated in both countries with a poorer welfare performance both under Nash and Cooperation (Figure 6). Zero output effects from Country 2 (Country 1) maximizes welfare gains of Country 1 (Country 2). The best compromise in this highly asymmetric environment is found when spillovers are both zero (assumption No. 50), as depicted in Table 4.

[12] It can be verified that in this particular case the model is symmetric. Accordingly, this situation is identical to that depicted in previous section.

[13] Ie the Nash cooperative solution. See Appendix.

Table 4. **Nash and Cooperative outcomes under the assumption**

$$\Gamma = \begin{pmatrix} 1.000 & 0.250 & 0.000 & -0.125 \\ 0.000 & -0.125 & 1.000 & 0.250 \end{pmatrix}$$

	Country 1	Country 2
Nash:		
Money supply	–1.4	–1.4
Output	98.6	98.6
Inflation	2.8	2.8
U_n	–9.0	–9.0
Cooperative:		
Money supply	–0.7	–0.7
Output	99.3	99.3
Inflation	2.9	2.9
U_c	–8.7	–8.7
$U_c - U_n$	0.3	0.3

Figure 4. **Gains from coordination**

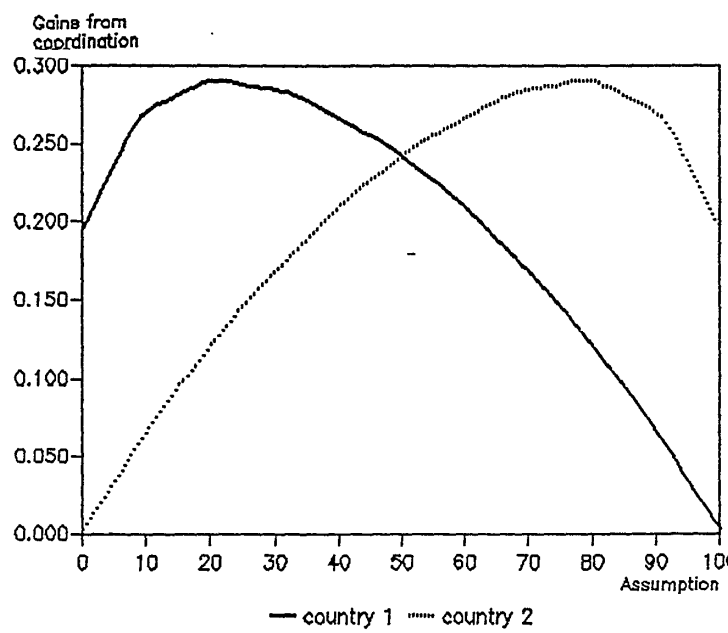


Figure 5. **Deviations of money supply growth from the baseline**

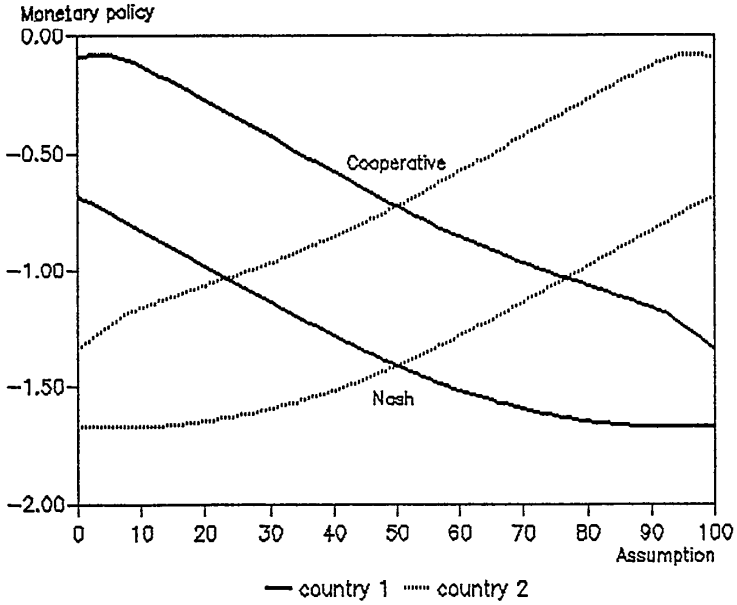


Figure 6. **Objective function values: Nash and Cooperative**

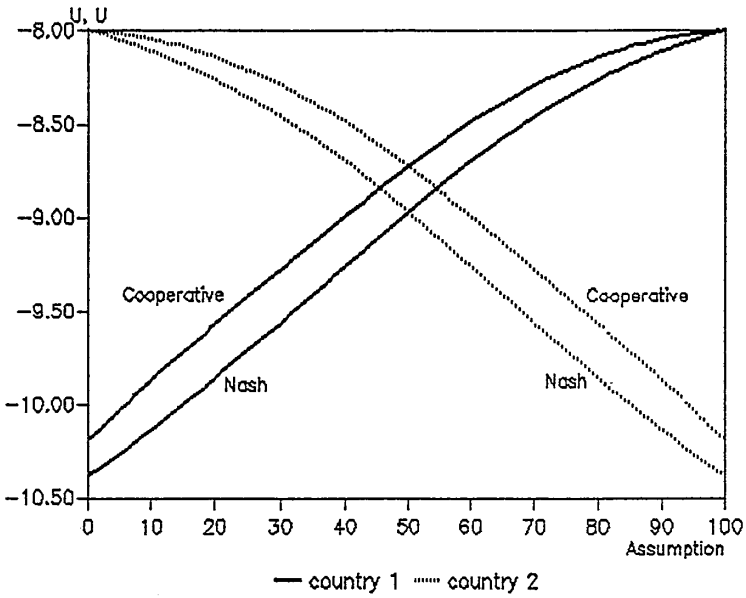
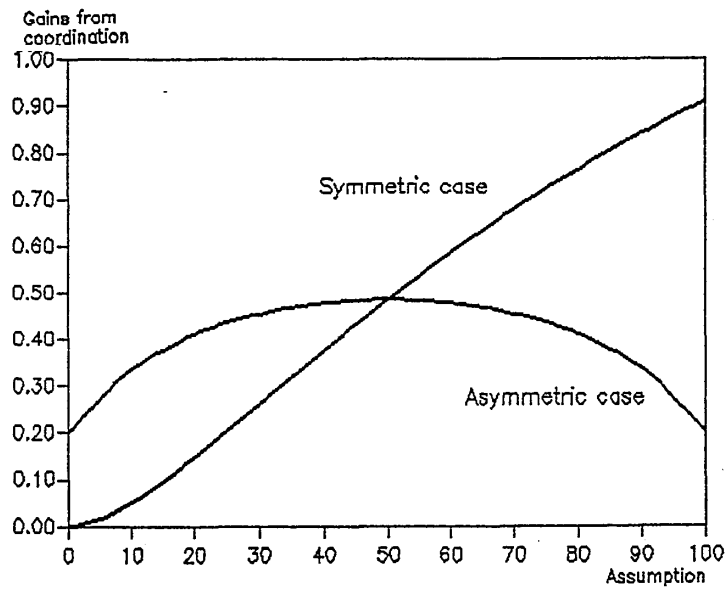


Figure 7 compares the global cooperative gains in the symmetric and asymmetric cases. It is there shown that under assumption No. 50 (no spillovers) the two lines coincide. In the asymmetric case the curve of global gains is symmetric, because one country's improvement is offset by the other country's deterioration. The case with no spillovers appears to be the most desirable in terms of distribution of gains and total welfare. In the symmetric case positive transmission of monetary impulses makes the gains from coordination larger than negative transmission. Moreover with positive transmission the increase in spillover size increases the size of cooperative gains. The contrary holds with negative transmission.

Nonetheless, in both symmetric and asymmetric spillovers large gains from coordination are associated with a poor welfare performance also with cooperation, suggesting that similar output/inflation trade-offs in the two countries are desirable.

Figure 7. **Sum of gains from coordination in both countries**



3.5 Conclusions

The numerical results of previous sections can be resumed as follows:

In a symmetric two-country model:

1) negative spillover effects from monetary policy on output imply that with stronger interdependence the potential gains from coordination are reduced; on the contrary, positive spillover effects imply that increasing interdependence increases the scope for coordination;

2) a situation of large gains from coordination is associated with a relatively poorer welfare performance than a situation with little or no gains from coordination;

In an asymmetric two-country model:

1) positive (negative) and increasing spillover effects imply increasing (decreasing) scope for coordination; following a standard model of bargaining, the gains are evenly distributed between the two countries;

2) as in the symmetric case, large gains from coordination are associated with a poor welfare performance.

The counterintuitive result appears to be that a world with no gains from coordination seems desirable, in case of symmetry; in an asymmetric world, total welfare is enhanced by poor or no spillovers.

The general conclusion is that in a symmetric world similarities in structure (expressed by the relationships between targets and instruments) are highly desirable, reducing the policy conflicts and therefore the potential gains from coordination, and bringing Pareto optimality.

The asymmetric model is the picture of a world in which the conflicting structures of countries make interdependence undesirable. In such a world the best outcome (from the points of view of efficiency and equality) is associated with a situation where linkages are negligible.

These findings suggest that an efficient process of economic integration requires enhancing structural similarities among countries in order to get optimal outcomes without explicit coordination. In the phase of transition coordination may help to reach Pareto-optimal outcomes.[14]

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[14] The role of policies aimed at enhancing structural similarities is stressed in the Report on economic and monetary union in the European Community. See Committee for the Study of Economic and Monetary Union (1989), paragraph 29.

Appendix Numerical solution of Nash and Cooperative equilibria

For the purposes of the present analysis we consider an n-country interdependent world. Country i has two targets, output (Q_i) and the rate of inflation (π_i), and one policy instrument, monetary policy (M_i).

The relations between instruments and targets of the two (or more) countries involved in the model of Section II are expressed by:

$$T = C\,\Gamma + T^B \tag{1}$$

where:

$$T = (Q_1, \pi_1, \ldots, Q_n, \pi_n)$$

is the vector of targets,

$$T^B = (Q_1, \pi_1, \ldots, Q_n, \pi_n)$$

is the value of T at the baseline,

$$C = (M_1, \ldots, M_n)$$

is the vector of deviations of the i-th country money supply from its baseline value.

Γ is the matrix of monetary policy multipliers. Since we have assumed an interdependent world, all elements of Γ are different from zero. It should be noted that, in absence of changes in monetary policies from the baseline, the values of the target variables coincide with those of the baseline.

In Sections III and IV we have assumed that each country aims at reducing domestic inflation, while keeping the output target unchanged. Since each country has one instrument and two targets, there will be a policy conflict between countries, giving origin to a Nash (or non-cooperative) equilibrium. Following the standard literature such an equilibrium is sub-optimal. Cooperation can improve the situation, leading to a Pareto-optimum.

In order to derive the Nash equilibrium we assume that authorities in Country i aim at maximizing a quadratic objective function:

$$U_i = -\tfrac{1}{2}\, T_i\, R_i\, T'_i \tag{2}$$

where

$$R_i = \begin{bmatrix} 1 & 0 \\ 0 & \psi_i \end{bmatrix}$$

is the matrix of welfare weights, ie the weights policy-makers attach to the different targets in the objective function (namely, 1 to output and ψ to inflation). The Nash solution is obtained by maximizing U_i subject to the home country policy instrument:

$$\max_{C_i} \; U_i \tag{3}$$

The first-order condition for Country i is:

$$\frac{\partial U_i}{\partial C_i} = -T_i R_i \Gamma'_{ii}) = 0 \tag{4}$$

The monetary policy changes corresponding to the Nash equilibrium are:

$$C^N = -T^B R \Gamma'_{ii} (\Gamma R \Gamma'_{ii})^{-1} \tag{5}$$

where:

$$R = \begin{bmatrix} R1 & & & \\ & \cdot & & \\ & & \cdot & \\ & & & \cdot \; R_n \end{bmatrix}$$

and the target variables values are at Nash:

$$T^N = C^N \Gamma + T^B \tag{6}$$

The cooperative equilibrium can be derived by the joint maximization of a weighted average of each country's objective functions:

$$\max_{C} \; U^C w \tag{7}$$

where:

$U^C = (U_1,...,U_n)$

are the single-country objective functions, and

$w = (w_1,...,w_n)$

are the bargaining weights, ie the weights attached to each country in the cooperative process.

For each given set of R and w we have a cooperative solution:

$$C^C = -T^B w R \Gamma' (\Gamma w R \Gamma')^{-1} \tag{8}$$

and the corresponding target values:

$$T^C = C^C \Gamma + T^B \tag{9}$$

The determination of w is derived from the Nash cooperative solution, based on maximization of the product

$$(U_1^C - U_1^N) \; ... \; (U_n^C - U_n^N)$$

subject to w.

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4 Modelling the German Economy after Unification

by
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Contents

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Abstract

German economic unification fundamentally changed the terms for model-based economic analysis. The adjustment process in east Germany and the integration process between both parts of Germany called for a re-orientation of the Bundesbank's approach to forecasting and policy analysis. The paper focuses on an empirically calibrated model for east Germany. This model attempts to capture the main characteristics of the structural adjustment problems facing the east German economy from a macroeconomic perspective. Key behavioural equations include conditional partial adjustment dynamics to account for the structural transition process.

Keywords: Econometric Bundesbank Model, German Unification, Structural Transition Process.

1. Introduction[1]

Within a relatively stable environment and under conditions of a fairly smooth economic development the macro-econometric model of the Deutsche Bundesbank has been continuously used in the past decade for economic forecasting and policy analysis.

The unification of the two parts of Germany in 1990 fundamentally changed the terms for quantitative economic analysis. On July 1, 1990, the State Treaty between the Federal Republic of Germany and the German Democratic Republic established a monetary, economic and social union. The East German Mark was replaced by the Deutsche Mark as legal tender, medium of exchange, unit of account and store of value. Simultaneously, the former GDR adopted the major economic laws of the Federal Republic of Germany or changed its own legislation accordingly. Moreover, it introduced a social security system along western lines. The monetary, economic and social union was a major step towards the political unification of Germany which took place on October 3, 1990.[2]

Economic unification led to a free flow of goods, labour and capital across the former border. Although the German monetary union was implemented without major difficulties, the transition from a centrally planned system to a market economy confronted the east German economy with deep-seated adjustment problems. **Table 1** provides an overview of the main characteristics of the east German economy in the first half of 1990 compared to annual data of west Germany.[3] The former GDR accounted for 43 per cent of the area of west Germany, for 26 per cent of the population but only for about 10 per cent of

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[1] The views expressed in this paper are solely the responsibility of the author and should not be interpreted as reflecting those of the Deutsche Bundesbank or members of its staff. For helpful discussions, suggestions and critique I am grateful to M. Arzbach, H.-J. Dudler (+), H. Hansen, O. Issing, W. Jahnke, R. König, H.-E. Reimers, M. Wewel and the participants of the Economics Workshop of the Deutsche Bundesbank and of the Helsinki-Workshop on Economic Policy Coordination of the European Economics and Financial Centre, London, and the Bank of Finland. They are not, however, responsible for any errors or omissions.

[2] A detailed account of the German monetary union and its technical and organizational aspects is provided by Deutsche Bundesbank ([9], [10]).

[3] The data in Table 1 broadly reflect current information about the economic situation in east Germany before the monetary union entered into force. Therefore, they differ from the base data used mid-1990 when the east German block originally was developed.

Table 1:

Gross National Product in East and West Germany (1990)

	East G.	West G.	East : West
Area (1000 sq.km)	108.	249.	.43
Population Density (inh./sq.km)	151.	253.	.60
Population (mill.)	16.3	63.1	.26
Labour Force Participation Rate (%)	56.4	48.0	1.18
Labour Force (mill.)	9.2	30.3	.30
Unemployment (mill.)	.1	1.9	
Employment (mill.)	9.1	28.4	.32
Working Time (hrs./Yr.)	1835.	1677.	1.09
Total Hours Worked (bill. Hrs.)	16.7	47.7	.35
At Current Prices (DM bill.)			
Private Consumption	167.	1299.	.13
Government Consumption	66.	500.	.13
Investment	47.	472.	.10
Exports	56.	873.	.06
./. Imports	–70.	–719.	.10
Gross National Product	266.	2425.	.11
./. Net Indirect Taxes	–3.	–254.	.01
Gross National Product at Factor Costs	263.	2171.	.12
./. Depreciation	–30.	–300.	.10
National Income	233.	1871.	.12
of which: Gross Wages and Salaries	178.	1314.	.14
of which: Gross Entrepreneurial Income	55.	557.	.10

Sources: East Germany: annualized data for the first and second quarter of 1990 from DIW (16). West Germany: annual data from the statistical data base of the Deutsche Bundesbank.

production.[4]

In west Germany the economic and political unification stimulated economic growth and quickly eliminated the current account surplusses. In the forefield of the monetary union the Bundesbank model was used to estimate the impact of the expected additional demand from east German citizens on west German output, prices and the trade balance.[5] Deutsche Bundesbank [13] provides an analysis of the impact of German unification of the west German economy.

From the outset, however, it was clear that the treatment of the east German economy as an external factor in the econometric model for west Germany would be inadequate after the establishment of a currency union. Both, the transition process in east Germany and the integration process between the two parts of Germany called for a re-orientation of the Bundesbank's approach to forecasting and policy analysis. The enormous structural differences between the East and the West did not allow to construct an aggregate model for Germany as a whole. An integrated statistical data base does not yet exist anyway. Moreover, the lack of meaningful historical data for east Germany prevented the construction and estimation of an econometric model for east Germany along conventional lines. Rather, it was decided to take a dual approach and to amend the west German model by an empirically calibrated theoretical system for east Germany. This model attempts to capture the main characteristics of the structural problems facing the east German economy from a macroeconomic perspective. As in the west German block, the long-term equilibrium relationships are guided by neoclassical economic theory. Dynamic adjustment processes are often modelled as error correction mechanisms. To account for the structural transition process in east Germany, key behavioural equations include conditional partial adjustment dynamics which drive important structural coefficients towards their west German counterparts.

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4 Economic decline in east Germany following economic unification came not unexpected as Tietmeyer ([27], p 2) pointed out: "The strategy envisaged by the German authorities is that, through restructuring, the capital stock per worker in the area of the GDR will reach the West German level and the economic structure will tend to equalize. But this restructuring and transformation needs time. The process can be viewed as a J-curve process for output and employment."

5 On the international level similar investigations using multi-country models have been conducted, for example, by the Federal Reserve Board (Alexander and Gagnon [4]), the International Monetary Fund (Masson and Meredith [28]) and the German Institute for Economic Research (DIW) using the model QUEST of the EC commission (Horn, Scheremet and Zwiener [23]).

The paper is concerned with the structure of the Bundesbank model after German unification. Section 2 briefly describes the west German block. The paper then focuses on the east German part of the new Bundesbank model in section 3. The main characteristics of this model are explained and discussed the light of available empirical evidence. In sections 4 and 5 the methods for estimation and calibration of the model are described. Subsequently, forecasting and simulation procedures applied to the Bundesbank model are outlined in section 6. Finally, some conclusions are drawn.

2. Structure of the west German block

The Bundesbank model is a quarterly model for the German economy. The present version of the west German block consists of 227 variables, 91 of which are explained by behavioural equations.[6] The model includes nearly 80 exogenous variables, representing monetary and fiscal policy instruments, demographic variables and foreign determined variables. For baseline projections and for simulation purposes the model includes a block of equations describing 34 stochastic exogenous variables by simple stochastic processes. **Table 2** gives an overview of the block structure of the model.

The west German model is organized in seven interdependent blocks (denoted by A to G) which refer to different sectors or activities of the economy. Blocks A to E are usually referred to as ***real sector*** and blocks F and G as ***financial sector*** of the economy. From a behavioural point of view, block A represents the aggregate economic activities of private households, block B of private enterprises, block D of the government, and block E of the external sector. (Block C explains wages and prices resulting from these market activities.) In each of these four blocks, the financial surplus or deficit of the respective sector is derived by definition and serves to update the sectors' net financial wealth position.

In the Bundesbank model instantaneous market clearing is not assumed. Rather, markets are characterized by temporary disequilibria due to sluggish adjustment of wages and prices. Consequently, the demand side and the supply

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[6] Earlier versions of the model are described in Deutsche Bundesbank [7], Jahnke [25], Toedter [39]. A recent model documentation is Deutsche Bundesbank [11], it can be obtained from the author upon request.

Table 2: Block Structure of the Bundesbank Model

	Behav. Eqns.		Identities		Total
	East	West	East	West	
A. Aggregate Demand	6	5	9	26	46
B. Aggregate Supply	11	13	5	32	61
C. Costs and Prices	3	14	10	20	47
D. Distr. of Income	9	18	1	15	43
E. Foreign Trade	2	7	5	19	33
F. Portfolio Demand	2	20	1	19	42
G. Interest Rates		14		5	19
X. Exog. Variables		34			34
Total	33	125	31	136	325

side of the aggregate goods and labour markets are modelled separately. Despite the disequilibrium approach adopted in the modelling of market interactions, the specification of core behavioural equations in the model is based on neoclassical long-term optimizing behaviour on the part of private households, firms and banks. Economic agents, however, are assumed to form expectations adaptively. The supply side of the economy is represented relatively detailed in the model. This includes an aggregate CES-production function for potential output and corresponding factor demand equations for investment, imports, working time and employment. Effective wages, import prices and capital costs are combined to a CES-weighted index of unit costs which explains price dynamics. The p-star approach is adopted to tie long-term price movements to monetary developments.

In the financial part the sectoral breakdown is somewhat different: the central bank, private banks, private non-banks (private households and private production firms), government, and the foreign sector are distinguished. Block F models the portfolio-demand behaviour of the private non-bank sector and explains the distribution of private wealth among different financial assets and liabilities. Finally, block G explains structure and development of interest rates resulting from supply behaviour of the banking sector and financial market interactions. A highly stylized version of the model is presented in **Table 3**.

Table 3: Stylized Version of the West German Block

(1)	Private Consumption	C =	C(YV, r-Dln p)
(2)	Labour Supply	E =	E(wH/p) POP
(3)	Population	POP =	(1+h)(POP(-1) + MIG)
(4)	Real Final Demand	Y =	C + D(K) + G/p + X
(5)	Real GNP	GNP =	Y – M
(6)	Real Disposable Income	YV =	GNP – d K(-1) – TN/p
(7)	Potential Production	GNPP =	GNPP(E H, K(-1))
(8)	Capital Stock	K =	K(Y, q/p)
(9)	Labour Demand (Hours)	A =	A(Y, w/p)
(10)	Real Imports	M =	M(Y, m/p)
(11)	Capacity Utilization Rate	GAP =	GNP/GNPP
(12)	Rate of Unemployment	ALQ =	(E – A/H)/E
(13)	Wage Rate per Hour	w =	w(p, H, ALQ)
(14)	User Costs of Capital	q =	p(r + d – Dlnp)
(15)	Unit Cost Index	k =	k(w, q, m)
(16)	Final Demand Deflator	p =	p(k, GAP, M3/GNPP)
(17)	Net Taxes	TN =	t p Y
(18)	Government Budget Balance	FS =	TN – G – TRE
(19)	Real Exports	X =	X(p e/pf , Yf)
(20)	Import Prices	m =	m(pf /e)
(21)	Money Demand	M3 =	M3(GNP, r) p
(22)	Long-Term Interest Rate	r =	r(i)
(23)	Exchange Rate	e =	e(if – i , pf/p)

D denotes the difference operator.
The exogenous variables of this stylized version are:

d = Depreciation rate
G = Government expenditure
h = Net birth rate
H = Average working time
i = Short-term interest rate
if = Foreign short-term interest rate
MIG = Migration from east Germany
pf = Foreign price level
t = Average net tax rate
TRE = Transfers to east Germany
Yf = Level of foreign production

A: Aggregate Demand

The most important economic activities of private households explained in the aggregate demand block are private consumption and labour supply. The consumption function is specified in real per capita terms, dynamic adjustment is modelled as an error correction process. Private consumption is determined by real disposable income, net financial wealth of private households and the real rate of return of the private portfolio. Labour supply is derived from optimizing the trade-off between working time and leisure time. Thus, the labour force participation rate depends on real net per capita wages, the real non-wage income per capita, and on the age structure of the population. The demand block includes the definition of aggregate final demand, gross national product (GNP), disposable income of private households and household savings.

B: Aggregate Supply

Block B treats the economic activities of firms in the goods and labour market. Together with block C it forms the core of the model's supply side. Potential output is derived from an estimated CES-production function. It depends on labour supply at standard working hours and the installed capital stock. Demand for labour, investment goods and imports is derived from an intertemporal optimization approach. The factor demand equations depend on gross output (real final demand) and 'real' factor prices, i.e., the effective wage rate, import prices and user costs of capital, respectively, deflated by the price index of final demand and corrected for indirect taxes. Imports are disaggregated into four categories: energy, raw materials and semi-manufactured goods, manufactured products and food, and services. Labour demand, defined as total hours worked, is disaggregated into employment and average working time per employee. The split of total hours into employment and average working time is explained by minimization of fixed and variable labour costs, including overtime compensation. Important identities of the supply block include the definition of capital stock, gross entrepreneurial income and the financial balance of firms. Moreover, the output gap (rate of capacity utilization) and the rate of unemployment are defined in this block. These measures of disequilibrium in the aggregate goods and labour markets, respectively, help to explain wage and price developments.

C: Factor costs and prices

Standard wages in the Bundesbankmodel are explained in an augmented Phillips approach by consumer prices, standard working time and the difference between the actual and the normal rate of unemployment. The latter variable is incorporated in an error correction term to ensure a long-term tendency of wages to restore equilibrium in the labour market. Standard working time catches the wage effect of reduced working hours. A wage-drift variable in the model is driven by overtime effects, i.e. the ratio of actual to standard working time. Combining standard wages, the wage-drift and fixed labour costs per hour worked completes the derivation of the effective hourly wage rate.[7] User costs of capital are defined in the usual way as a function of the price index for investment goods, a real long-term interest rate, the depreciation rate and tax - specific factors. From the effective wage rate, user costs of capital and import prices a CES-weighted index of unit production costs is defined. The weights are taken from the estimated production function.

The index of production costs helps to track the dynamics of the final demand deflators. Final demand is decomposed into eleven different components; final demand at constant prices is correspondingly disaggregated. Depending on empirical performance, in the long-run prices are determined by either the output gap or the price gap in an error correction formulation. The price gap is the ratio of actual to equilibrium price level. The equilibrium price level is defined as money stock (M3) per unit of potential output at 'normal' velocity.[8] The price gap can be decomposed into the output gap and a 'velocity gap', i.e., the deviation of money velocity from its long-term trend. Hence, the price gap comprises realized and potential demand for goods. The price gap is seen as an important factor driving inflation. It establishes an important link between the financial and the real sector of the model.

D: Distribution of income

In this block the redistribution of factor incomes through transfers, taxes and the social security system is modelled. Indirect taxes are disaggregated into value added tax, mineral oil tax, trade tax, and others. Direct taxes are decomposed

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7 Toedter [38] provides more details on this approach of wage and employment determination.

8 The price gap in the Bundesbank model is a generalization of a concept which was developed recently at the Federal Reserve Board, Washington; see Hallman, Porter and Small ([20], [21]).

into wage tax, assessed income tax, corporation tax, and others. Taxes and (employers' and employees') social security contributions generally are modelled as functions of the respective tax base, or an approximation thereof, and an exogenous tax rate variable. The equations for wage- and income taxes take into account their interdependence and the progressive structure of the tax schedule. As regards public transfer payments, unemployment benefits, old age pensions and other transfers are distinguished. Unemployment benefits are determined by net wages and the number of unemployed persons, whereas pensions depend on gross wages and the population above 65 years. Finally, the government budget balance is derived by definition.

E: Foreign trade and payments

Real imports and export prices, largely depending on domestic conditions, are modelled in blocks B and C, respectively. In block E real exports and import prices are explained, essentially by foreign-determined factors. Real exports are disaggregated into goods and services. Both components depend on a trade-weighted index of economic activity abroad and the real exchange rate. The explanatory variables of import prices (disaggregated into four components) are world market prices of energy and other raw materials as well as foreign deflators of final demand, all converted to DM. Identity equations for net-exports and the current balance close this block.

F: Portfolio demand

Portfolio wealth of the private sector is defined as cumulated financial surplus or deficit of private households and firms plus bank lending to the private sector. The core of the financial part of the model consists of a structural system of asset demand equations describing portfolio selection of the private sector. Portfolio selection is assumed to be separable between monetary and non-monetary assets. Real demand for monetary assets (M3 balances) is estimated as a dynamic function of real GNP and the difference between the rate of return of monetary and non-monetary wealth. Monetary assets (disaggregated into currency in circulation, demand deposits, short-term time deposits, and savings deposits at statutory notice) and non-monetary assets (decomposed into saving deposits at agreed notice, savings bonds, bank bonds and long-term time deposits, government debt to the private sector, time deposits of non-banks at the Euro-DM-market, other private net foreign assets) are modelled as systems of portfolio-demand equations and estimated under the usual homogeneity and

adding-up restrictions. The portfolio-shares are functions of a transaction variable, the own interest rate and a portfolio yield variable which is defined as a weighted average of the individual interest rates. This approach effectively reduces the problem of multicollinearity among interest rates but preserves a complete reaction pattern, i.e., the change of any single interest rate leads to adjustments of all asset shares.[9] The block is completed with equations describing financial activities of the government and a number of identities resulting from the accounting framework.

G: Interest rates and exchange rates

The central variable in this block is the money market interest rate. It depends on the Bundesbank rates (discount rate, lombard rate and the rate for the Bundesbank's open market transactions in securities under repurchase agreements), the equivalent Euro-dollar rate, the inflation rate and a pressure variable reflecting the difference between demand for central bank money and permanent provision of base money. Determination of the other interest rates, especially those corresponding to the assets in the portfolio-system, are based on a simple profit maximization approach on the part of the banking firms. Basically, these rates are modelled as dynamic functions of the money market rate, corrected for reserve requirements. The external value of the D-Mark against the 18 most important currencies is disaggregated into the external value of the D-Mark against EMS-currencies, the US-Dollar and the other non-EMS-currencies. Whereas the former is treated as an exogenous policy variable, the latter are explained by the respective price and interest rate differentials, drawing on the open interest parity condition and long-term purchasing power parity. The block is closed with various definitions of average portfolio yield variables.

Monetary impulses are transmitted to the real sector of the economy, either directly or through interest rates and wealth variables, primarily to investment, consumption and prices. Exchange rate movements have multiple effects on the current account and the real economy. **Chart 1** compares government expenditure multipliers for the west German block with those of the NIESR model and the OECD model for Germany, both being part of a multi-country system.

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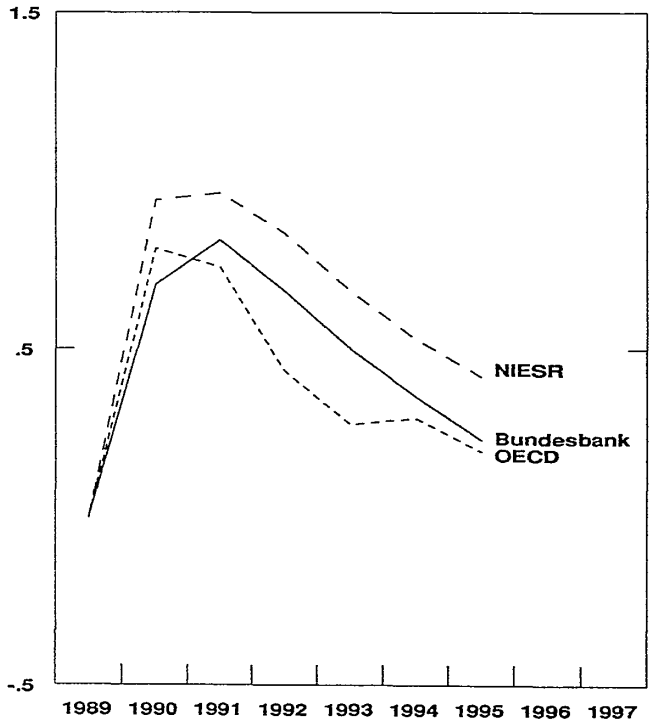
[9] For details on the portfolio-demand system and the associated interest rate system, see Toedter and Wewel [43]. Jahnke [27] discusses monetary policy and the monetary transmission process in the Bundesbank model.

Chart 1:

Effects on GNP of an increase in real government expenditure by 1 % of real GNP (unlinked mode, nominal short-term interest and exchange rates fixed)

deviation from base line in %



Sources: Richardson (31), Barrell and Gurney (5), Jahnke (26)

3. Structure of the east German block

Modelling the east German economy was confronted with an almost complete lack of adequate data. Historical data published by the Statistical Office of the GDR seemed of little value. The monetary, economic and social union over night replaced the non-convertible GDR Mark by the Deutsche Mark, established a decentralized market economy with private property rights and voluntary trade and exposed the east German industry to external competition. This fundamental institutional shift has completely changed the technology applicable in the production process and the preference structure of the economic agents in the east. To compensate for the lack of data, more theory was needed. Fortunately, it was the east German population itself that suggested a powerful working hypothesis. As it is well known, the Monday demonstrations in the City of Leipzig and elsewhere, voiced "Wir sind das Volk". But soon after it became clear that the old system was crumbling, the wording changed into "Wir sind ein Volk", suggesting that convergency of behavioural patterns might be a reasonable assumption, at least in the long run. The desire to 'make up with the Schmidt's in the West' was all too clear. Despite more than 40 years of enforced separation, the population in both parts of Germany shares the same cultural background and speaks the same language. Moreover, equalization of living conditions in both parts of Germany was proclaimed as a political goal by the major political parties. Hence, structural convergence is an important concept in the construction of the east German block.

The east German block has 33 behavioural equations and 31 definitions. Specification of long-run equilibrium relationships in the east German block is guided by neoclassical economic theory. Dynamic adjustment is often modelled by error correction mechanisms. In addition, key behavioural equations of the model include conditional partial adjustment processes which drive important structural coefficients towards their west German counterparts, provided the standard of living converges to western levels. The length of the transition period is an endogenous outcome of the model as a whole. Accession of the former GDR to the Federal Republic of Germany is reflected in the east German block at several other instances as well: the government sector in the east German block reacts passively to economic developments, one central bank issues a single currency; no exchange rate differential separates the valuation

of stocks and flows in both regions.[10] Morevoer, money and capital markets are integrated, there is no distinction between east and west German nominal interest rates. However, goods and labour markets are segmented and the model does allow for transitional differences of goods prices and wage rates. A stylized version of the east German block is provided in **Table 4.**

A: Aggregate Demand

Real private consumption (C) is assumed to develop proportional to real disposable income (YV) in the long run:

$$C = \beta\, YV\,. \tag{1}$$

The dynamic adjustment process of the actual level of consumption to its long-run level is modelled as an error correction mechanism (ECM) as was proposed by Davidson, Hendry, Srba and Yeo [6]:

$$\Delta \ln C = a_1\, \Delta \ln C(-1) + a_2\, \Delta \ln YV - a_3\, [\ln C(-1) - \ln \beta\, YV(-1)]\,. \tag{2}$$

Prior to unification the average propensity to consume in east Germany (ß) was well above the west German ratio (ß*). The convergency hypothesis suggests that these ratios will be equalized in the long-run. It seems implausible, however, to expect the propensity to consume falling to the west German level as long as there is a substantial gap in the standard of living between both parts of the country. Rather, it is assumed that ß approaches ß* conditional on the relative standards of living being equalized. (In this and in the following sections starred parameters or variables indicate west German entities.) The conditional partial adjustment process for ß is specified as:

$$\beta = b\, \beta(-1) + (1-b)\, [\beta^* - c \ln L/L^*]\,. \tag{3}$$

If c=0 equation (3) is a simple (unconditional) partial adjustment process. However, if c is chosen appropriately, equation (3) describes a partial adjustment

[10] "In the light of pure economics, it might have been preferable to retain the exchange rate as an important instrument of adjustment between the two Germany's, promote the East German currency gradually to full convertibility status and implement an intra-German currency union as a 'culminating' act" (Dudler [17], p. 6).

Table 4: Stylized Version of the East German Block

(1)	Private Consumption	C =	C(L/L*) YV
(2)	Labour Supply	E =	E(L/L*) POP
(3)	Population	POP =	(1+h)(POP(-1) – MIG(L/L*))
(4)	Final Demand	Y =	C + D(K) + G/p + X
(5)	Real Disposable Income	YV =	GNP – d K(-1) – TN/p
(6)	Standard of Living	L =	(w(1-t)H/p)((1-ALQ)+v ALQ)
(7)	Real GNP	GNP =	GNP(A, K(-1))
(8)	Real Imports	M =	Y – GNP
(9)	Real Capital Stock	K =	K(GNP, q/p)
(10)	Labour Demand	A =	A(GNP, w/p)
(11)	Rate of Unemployment	ALQ =	(E – A/H)/E
(12)	Wage Rate per Hour	w =	w(p, H, ALQ/ALQ*, w/w*)
(13)	User Costs of Capital	q =	p (r* + d – Dlnp)
(14)	GNP Deflator	p =	p(w, q, p*)
(15)	Government Expenditure	G =	G(G*/p*Y*) Y
(16)	Net Taxes	TN =	t(t*) p Y
(17)	Government Budget Balance	FS =	TN – G + TRE
(18)	Real Exports	X =	X(p/p*, p e/pf, Y*, Yf)
(19)	Money Demand	M3 =	M3(GNP, r*) p

D denotes the difference operator.
The exogenous variables of this stylized version are:

ALQ* = Rate of unemployment in west Germany
d = Depreciation rate
e = Exchange rate
G* = Government expenditure in west Germany
h = Net birth rate
H = Average working time
L* = Standard of living in west Germany
p* = Price level in west Germany
pf = Foreign price level
r* = Long-term interest rate in west Germany
t* = Net tax rate in west Germany
TRE = Transfer payments from west Germany
v = Ratio of unemployment benefits to net wages
w* = Wage rate in west Germany
Y* = West German output
Yf = Foreign output

process of ß towards ß* conditional on the relative standard of living: if L/L* increases, ß gradually approaches ß* from above.[11] The average standard of living of an economically active person (L) is defined as a weighted average of the real net earnings of an employed and an unemployed worker:

$$L = W\,(1 - ALQ) + v\,W\,ALQ\,. \tag{4}$$

Here, W is the real after tax monthly compensation of an employed worker, v is the ratio of unemployment benefits to net wages, and ALQ is the rate of unemployment. L (L*) may be interpreted as a measure of the expected income per period of an east (west) German worker facing the risk of unemployment.

Mainly due to the high labour force participation of women, the labour force participation ratio in the former GDR was substantially above the west German level (see Table 1). Here again it is assumed that conditional on the relative standard of living the east German participation ratio gradually approaches the west German level:

$$E/POP = a\,E(-1)/POP(-1) + (1 - a)\,[(E/POP)^{*} - c \ln L/L^{*}]\,, \tag{5}$$

where E denotes labour force and POP is population. From October 1989 to January 1990 alone, more than 300 000 people emigrated from the GDR to the Federal Republic of Germany. "If this migration had continued unabated, the political, economic and social implications for the two parts of Germany would have been incalculable" (Deutsche Bundesbank [9], p. 13). The establishment of a monetary union between both German states mid-1990 contained the movement to the West but did not stop it completely. In the model, an attempt has been made to account for migration flows. It is assumed that the decision of an economically active person in east Germany to move to west Germany or to stay depends on the relative standard of living and effectively ceases at L = 0.75 L*.[12] Assuming that migration (MIG) conditionally converges to zero, the process for the development of the east German population can be written as

$$POP = (1 + h)\,[POP(-1) - MIG(L/0.75L^{*})]\,, \tag{6}$$

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[11] More details about the empirical calibration of c and other parameters are given in section 6.

[12] There is a third alternative, namely to live in east Germany and to work in west Germany. The number of east German residents working in west Germany was around 500 thsd. in November 1991.

where h is the net birth rate and $MIG = a\,MIG(-1) + (1 - a)\,[0 - c \ln L/0.75L^*]$ The demand block is closed with some equations defining final demand, disposable income of private households, and private savings.

B: Aggregate Supply

Supply conditions in the new Länder are characterized by the poor state of the capital stock, ownership problems and environmental pollution. Analyzing the weaknesses of the industry in the former GDR, Siebert and Schmieding ([33], p. 5) conclude: "As a consequence of these shortcomings, the existing capital stock in the GDR industry is mostly technologically outdated, to a considerable extent physically run down and largely economically and ecologically obsolete."

After the currency union was established the east German population turned to Western goods. It is not the quality of Western products alone that attracted demand but also the "desire of the majority to radically dissociate themselves from everything created under the communist regime" (Dietz [15], p. 3). As a consequence of these developments, demand in east Germany widely exceeds domestic production, the gap being filled by imports. Eastern Germany practically faces no external payments restrictions. Moreover, external supply seems sufficiently elastic to warrant imports (M) being determined residually as difference between final demand (Y) and production (GNP):

$$M = Y - GNP\,. \tag{7}$$

Note, that this treatment of imports substantially differs from import determination in the west German block, where an explicit import demand function is specified.

Output in the east German block is determined by a homogenous CES-production function,

$$GNP = GNP(A, K)\,, \tag{8}$$

where A denotes total hours worked and K is capital stock. K should be interpreted as the economically usable part of the capital stock that remained after writing off most of the existing pre-unification equipment.[13]

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[13] Section 6 contains more about calibration of the coefficients of the production function.

Demand for labour and desired capital stock are derived from a profit maximization approach, resulting in the structural demand equations

$$A = A(GNP, w/p) \tag{9}$$

$$K = K(GNP, q/p)\,, \tag{10}$$

where w/p is the real wage rate and q/p is real user costs of capital. Adjustment of the actual levels of labour input and capital stock to their desired levels is modelled by error correction dynamics. Average working time unconditionally adjusts to west German level and employment is derived by definition.

The assumptions made above imply that a regional equilibrium requires the following relationship between the labour to capital ratio (labour intensity (u)), and relative factor prices:

$$A/K = u = [(a/1 - a)\,(q/w)]^{s}\,, \tag{11}$$

where q denotes user costs of capital, w is the wage rate, a is the distribution parameter and s is the elasticity of substitution of the CES-function. Under the restriction that the distribution parameter and the elasticity of substitution in the east and the west German production functions accord, a national production equilibrium requires

$$u/u^{*} = [(w^{*}/w)\,(q/q^{*})]^{s}\,. \tag{12}$$

Hence, the high labour intensity of east German production could only be maintained when the wage rate remained low or capital costs were high. Eventually, market forces and/or union pressure will equalize both factor prices such that a long-run production equilibrium is characterized by

$$u = u^{*}\,. \tag{13}$$

Assume, that the adjustment process exclusively takes place in the form of capital moving to the east such that u* keeps constant and u reduces to u*. Under these conditions, what would be the investment requirements to restore full employment in east Germany? An answer to this question depends on the definition of full employment. If it is assumed that the participation ratio and working time in east Germany will be the same as in the western part of the country in the long-run, an annual labour demand of 13.1 bill hrs. results. Allowing for 5 per cent unemployment, demand requirement reduces to 12.5 bill. hrs., compared to 16.7 bill. hrs. before unification. Applying the west German labour to

capital ratio of $u^* = 7.93$ hrs/DM thsd. (see Table 6) yields a required capital stock at 1985 prices of

$$K = A / u^* = \text{DM } 1570 \text{ bill.} \tag{14}$$

According to our estimates the usable capital stock (excluding housing) in east Germany at the time of the monetary union may have been around DM 580 bill. Hence, this simple calculation suggests investment needs of almost DM 1000 bill.[14]

To turn to the current situation, the transition from the rigid system of central planning to a social market economy was accompanied by a sharp downturn in production and employment. Downward adjustment of the labour market, which already started before unification, accelerated after the introduction of the monetary union and continued in 1991. In November 1991 more than 1 million east German workers were registered as unemployed, another 1.1 million were on 'short time' work and almost 0.8 million were absorbed by public labour market measures such as work- and education programs and premature pension schemes (Deutsche Bundesbank ([14], p. 37). Employment correspondingly fell to 6.3 million in the third quarter of 1991 (see table 5). In terms of total hours worked current employment is only half of the level before unification. Correspondingly, GNP at constant prices declined by 30 per cent compared to the first semester of 1990. The pre-unification -, current - and long-run - activity level is depicted in the isoquant scheme of **Chart 2.**

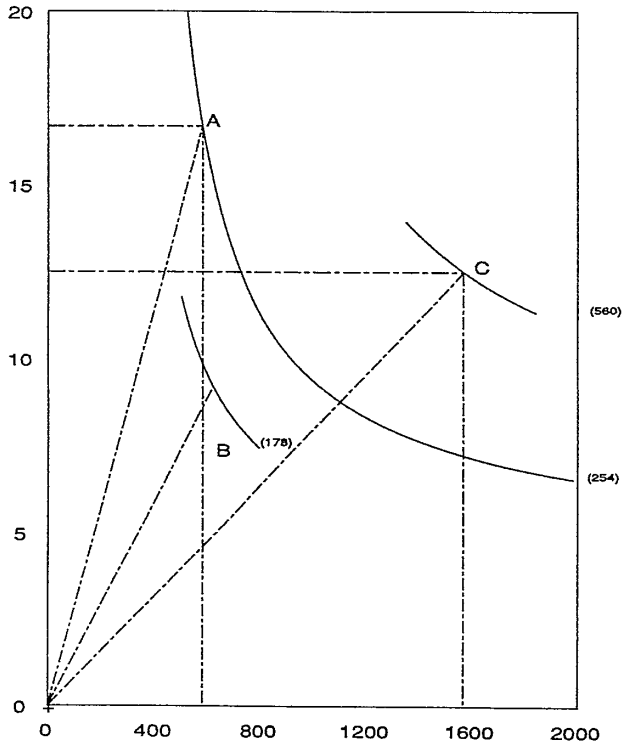
These considerations suggest that employment adjustment already overshooted its sustainable long-term level. While employment cutback started early and took place at a considerable speed, the investment process got under way only slowly. It is precisely this differential adjustment speed of employment and capital stock that produces a J-shaped time path of east German output in the

[14] Similar calculations have been made by Siebert [32], by Sinn [34], Sinn and Sinn [36], McDonald and Thumann [30]. Also note that DM 1000 bill. is an instantaneous rate of investment. If reconstruction of the capital stock takes place within a prolonged time, one decade (or two decades) say, the annual investment requirement would not be DM 100 (50) bill. but rather DM 150 (105) bill., assuming a depreciation rate of 5 per cent p.a.

Chart 2:

CES-Isoquants for real GNP at annual rates

Vertical scale: total hours worked (bill. hrs.)
Horizontal scale: capital stock (DM bill.)



A: Pre-Unification point (1990, Q1 and Q2)
B: Current activity level (1991, Q3)
C: Long-run equilibrium point

model simulations. In the first year of the monetary union, setting-up of new enterprises and restructuring existing ones have been hindered by diverse obstacles to investment. Unresolved ownership claims to land and buildings led to a shortage of industrial sites. In many cases heavy environmental pollution, associated with uncertainties as to the costs of its removal, discouraged investment. Inadequate public infrastructure, notably in communication and transport, and often poor public administration enlarged the investment barrier. All this contributed to a sluggish investment process in the new Länder. Recently, several measures have been taken to dismantle the investment barriers. The policy of the government trustee agency responsible for administering and privatizing of formerly nationally owned firms in the east (Treuhandanstalt) is analyzed by Sinn [35]; see also Akerlof, Rose, Yellen and Hessenius [1]. Empirical evidence at the turn of the year 1991 suggests that the east German economy approaches the bottom of its 'valley of tears', although a broadly based, self-sustaining upswing is not yet in sight. **Table 5** provides quarterly employment and output figures for east Germany.

Table 5: Employment and Output in East Germany

	1990				1991		
	1	2	3	4	1	2	3
Employment (mill.)	9.4	8.8	8.3	7.6	7.1	6.7	6.3
Tot.Hours (bill.)	4.3	4.0	3.3	2.5	2.6	2.3	2.3
Real GNP (DM bil.)	64.0	63.0	49.5	46.8	42.3	44.0	44.5
Lab.Prod. (DM/hr)	14.8	15.7	14.9	16.0	16.4	18.9	20.7
At current prices							
Domestic absorpt.	71.9	68.3	67.0	79.7	85.5	87.5	92.6
Net exports	–1.2	–5.8	–16.3	–25.1	–34.6	–36.7	–36.2
GNP	70.7	62.5	50.7	54.6	50.9	52.9	56.4

Sources: DIW (16) and own estimates

C: Factor Costs and Prices

The nominal wage rate is modelled as a modified Phillips relation. Hence, wage inflation depends on (expected) price inflation and the rate of unemployment. This approach reflects the distributional conflict in the wage bargaining process between labour and capital on one hand and between employed and unemployed workers on the other hand. In the case of east Germany a third distributional conflict is present: the conflict between the East and the West. Maintaining grossly different wage levels in a single country over a prolonged time period is difficult. To achieve a comparable standard of living in east Germany is a consensus view among the major political parties. "Since the accession of the former GDR to the Federal Republic of Germany it has more and more become the objective of wage policy to bring east German income up to the west German level as quickly as possible (although the very different conditions of scarcity between labour and capital have been lost sight of)." Deutsche Bundesbank [12], p. 26). In some industrial sectors unions have already settled to eliminate the existing east-west wage differentials within a few years. One of the reasons why such demands have been met is that otherwise a further migration of labour to the West would have to be feared. The following wage equation in the east German block attempts to capture these considerations:

$$\begin{aligned}\Delta \ln w &= a_1 \Delta \ln w(-1) + a_2 \Delta \ln H + a_3 \Delta \ln p \\ &\quad + a_4 \ln[(1 - ALQ(-1)/(1 - ALQ^*(-1))] - a_5 \ln w(-1)/w^*(-1) .\end{aligned} \tag{15}$$

Here, p is the price level , ALQ and ALQ* are the rates of unemployment in east and west Germany, respectively, and w and w* are the respective wage rates. Wages respond to prices, the relative employment rate and the wage rate differential. As noted above, current evidence suggests that the final term plays the dominating part in this process. The variable H (average working time per employee) catches effects of reduced working time on wage settlements.

Price dynamics in the east German block depends on production costs. However, an error correction specification ensures that prices in the long-run converge to the west German price level:

$$\Delta \ln p = a_1 \Delta \ln p(-1) + a_2 \Delta \ln w + a_3 \Delta \ln q - a_4 \ln p(-1)/p^*(-1) . \tag{16}$$

D: Distribution of Income

The restructuring problems faced by the east German economy have called for massive fiscal policy support. As a consequence, the deficit of the German public authorities increased from 0.4 % of GNP in 1989 to 3.1 % in 1990 and is estimated to exceed 4 % in 1991.

Active fiscal policy is conducted by the central government in the west German block, whereas the government sector in the east German block passively reacts to economic developments. The model assumes that conditionally on relative GNP per capita the ratio of government expenditures to GNP adjusts to the corresponding west German rate in the long-run. In contrast, the ratio of public investments to GNP unconditionally converges to the west German level.

Due to sizeable west German transfers, the decline in output and employment in the new Länder was not accompanied by a reduction of aggregate demand (see table 5). Since mid-1990 essentially the same social security system prevails in both parts of Germany. This does not imply, however, that the level of payments per head is the same. Outlays largely depend on the lower eastern wage level. In the model, unemployment benefits per head depend on lagged net wages, whereas old-age pension payments react to lagged gross wages. In principle, all tax laws equally apply to east Germany. In the model indirect taxes (VAT and others) are proportional to final demand components. It is assumed that the presently low average indirect tax rate gradually (and unconditionally) approaches the west German level. The direct taxes (wage tax, income tax, and corporation tax) linearly depend on the level of national income. Since the tax base is low, progression plays a minor role yet.

The income distribution block is closed with a definition of the government budget balance. Low tax revenues due to the depressed level of economic activity in east Germany, combined with sharply increasing transfer payments lead to a huge deficit of the public sector in east Germany, which largely has to be covered by transfers from the west. For 1991 a transfer of public funds of the order of DM 140 bill. is envisaged.

E: External trade

The unification of Germany and the political changes in Eastern Europe have altered Germany's external position fundamentally. Upon the introduction of the Deutsche Mark east German residents gained free access to western products. At the same time demand for east German products dropped sharply. Germany's persistent high current account surplusses have been eliminated quickly. Germany's trading partners benefitted from substantial German import demand, amounting to about 1/2 % of the GNP in the EC countries in 1990 (Deutsche Bundesbank [12], p. 26).[15] The reversal of the current account took place mainly through a rise of west German imports largely resulting from east German demand for Western products. At the same time, imports of east Germany from Eastern Europe, which had originally accounted for two thirds of GDR imports, decreased dramatically. Albeit with a time lag, east German exports also dropped sharply after the transferable rouble system of export subsidies to CMEA-countries agreed upon in the Unification Treaty expired at the end of 1990.

As it has been pointed out already, east German imports are derived residually as difference between final demand and domestic production. Total exports are described as a function of external (i.e. west German and foreign) demand and relative prices. Given the weak statistical foundation of intra-German trade data after unification, no attempt has been made to disaggregate east German trade regionally. Hence, separate east and west German trade and current balances cannot be deduced from the model.

F: Financial sector

Establishment of the German monetary union transferred the responsibility for monetary policy to the Deutsche Bundesbank. Simultaneously a two-tier banking system in east Germany with a separation between the central bank and the commercial banks was created. Fixing the conversion rate of the 'Mark' and thereby fixing the endowment of the east German population with west German 'DM' was a controversial issue in the preparation of the monetary union. "In view of the lack or incompleteness of the data on the real economic and monetary status of the GDR, the large number of different official exchange rates and a strongly fluctuating free currency market, hardly any reliable benchmarks were

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[15] An analysis of the impact of unification on the west German economy is provided by Deutsche Bundesbank [13].

availabe for the 'correct' conversion rates from GDR Mark to Deutsche Mark when preparing the monetary union with the GDR" (Deutsche Bundesbank [9], p. 14). Economic, social and political decision criteria had to be taken into account. It was important to prevent inflationary risks of the currency conversion, to preserve the competitiveness of GDR enterprises as far as possible, to contain budgetary problems and to find a solution which was acceptable to the residents of both the GDR and the Federal Republic from a social point of view. To strike a balance between these partly conflicting goals was extremely difficult. According to the regulations in the State Treaty almost all money claims and liabilities denominated in GDR Mark were converted at the rate of 2:1, while private savings were subject to a preferential rate of 1:1 within certain age-depended limits. Currency conversion raised the Deutsche Mark money stock by DM 180 bill., or almost 15% of M3, "... although, according to our estimates at the time, the real production potential would have warranted an increase of only about 10 %." (Issing [24]).[16]

As it was described above, the real sector of the east German economy is modelled separately with its own segmented labour and goods markets. In the full Bundesbank model these markets interact through migration, trade and transfers, wages and prices. Real economic integration is a protracted process. In contrast, it is assumed that financial integration has been completed more or less institutionally with the establisment of a monetary union mid-1990. Consequently, the east German block lacks a separate money market. Money supply and interest rates are determined in the west German block.

Chart 3 provides the results of a baseline projection with the full Bundesbank model from 1991.3 up to the year 2000. While a surplus in the current account re-appears after a few years, the government budget shows a substantial deficit for the rest of the decade. As a consequence of the ongoing adjustment process, labor intensity in east Germany decreases and labor productivity gradually rises. The simulations suggest, however, that the productivity gap will not be eliminated within this decade.

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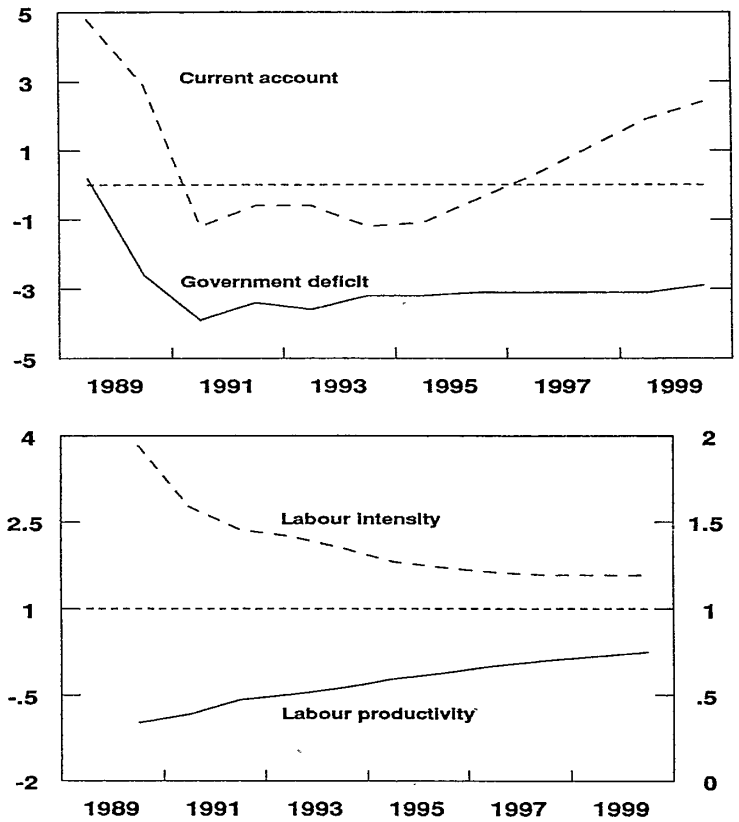
[16] For further information on the currency conversion issue see also Deutsche Bundesbank [8], de Grauwe [19].

Chart 3:

Government Deficit and Current Account in % of GNP

Baseline Projection for Germany with the Bundesbank Model



Relative (East G. : West G.) Labour Intensity (left scale) and Labour Productivity (right scale)

4. Estimation procedure

The estimation period for the west German block of the Bundesbank model begins with the first quarter of 1975 and ends with the latest available complete set of quarterly data. Generation of an econometric data base, estimation and simulation of the model are performed with the econometric software package TROLL [43].

Let the stochastic, interdependent, nonlinear and dynamic system described in section 2 be represented as

$$f(\, y(t),\ y(t-1),\ x(t)\ ;\ d) = u(t)\,, \qquad t = 1 \ldots T\,. \tag{17}$$

where f is a vector of functional operators, y is a vector of endogenous variables, x is a vector of exogenous variables, u is a vector of stochastic error terms with zero mean and constant covariance structure; d is a vector of unknown coefficients. Under certain conditions the reduced form of the system (17) can be written as

$$y(t) = g(\, y(t-1),\ x(t),\ u(t)\ ;\ d)\,. \tag{18}$$

For linear models a number of estimation techniques exists. The conventional techniques break down, however, if the number of predetermined variables exceeds the sample size. In the Bundesbank model for west Germany the predetermined variables by far outnumber the observations. Apart from this undersized sample problem, in nonlinear models additional difficulties arise because the reduced form cannot be expressed in closed form. However, classical procedures like Two-Stage-Least-Squares (2SLS) rely on estimation of the reduced form at the first stage (Amemiya [3]). As a consequence of these difficulties, often OLS is used to estimate large systems (see Edison, Marquez and Tryon [18]).

Nonlinearities in econometric models mainly arise from nonlinear transformations of variables and from nonlinear identities, while the stochastic equations themselves usually are linear in the parameters. For such systems Hatanaka [22] investigated a two-stage instrumental variables procedure that circumvents the undersized sample problem and avoids the need to obtain the reduced form analytically. This structural instrumental variables (SIV) procedure applies OLS to the structural eqations at the first stage. Let a typical equation of the system (17) be

$$y_i = Z_i d_i + u_i , \quad i = 1...G , \tag{19}$$

where the data matrix Z_i collects the observations of the endogenous and the predetermined variables appearing in equation i. OLS is used to obtain (inconsistent) estimates of the structural coefficients ($\tilde{d}$). With these coefficients a static simulation over the whole estimation period is performed, yielding numerically calculated solution vectors for the endogenous variables

$$\tilde{y}(t) = g(y(t-1),\ x(t),\ 0\ ;\ \tilde{d}) . \tag{20}$$

Re-estimation of the structural equations by instrumental variables using the simulated time series of the endogenous variables as instruments yields the consistent SIV-estimates

$$\hat{d}_i = (\hat{Z}_i' Z_i)^{-1} \hat{Z}_i' y_i . \tag{21}$$

The matrix $\hat{Z}_i$ is obtained from Z_i from replacing the current endogenous variables by their simulated counterparts. Note that SIV reduces to 2SLS in linear models for exactly identified equations. In the Bundesbank model it was found that the SIV-estimated coefficients often substantially depart from the corresponding OLS coefficients. Except for a few constant terms, sign changes did not occur. Quasi ex-ante dynamic forecasts over a rolling horizon ranging from 1984 to 1989 with the Bundesbank model reported in Toedter [40] have shown that SIV-based forecasts almost uniformly outperformed forecasts based on OLS estimates in terms of forecast accuracy.[17]

To take into account cross-equation restrictions, the system of portfolio-demand equations in the financial block is estimated by Zellner's restricted joint generalized least squares (RJGLS) procedure.

5. Empirical calibration

As outlined before, the coefficients of the east German block have been fixed on a priori grounds or calibrated with respect to empirical base data. Three types of coefficients may be distinguished: structural parameters, dynamic adjustment coefficients, and the c - coefficients in the conditional adjustment processes. Important structural coefficients were taken from west German data or estimates. The parameters controlling dynamic adjustment speeds of actual

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[17] Ahlstedt [2] also reports results in favour of the SIV-procedure.

variables towards their desired or optimal levels were fixed according to experiences with corresponding equations in the west German block, some amount of experimentation not withstanding. Finally, the c - parameters in the conditional adjustment processes are empirically calibrated using data for east Germany in a base period, originally the second quarter of 1990.

The consumption function may serve to explain this procedure. Let β^* be the estimated long-run propensity to consume in west Germany and $\beta(o)$ the ratio of consumption to disposable income in east Germany in the base period. Moreover, let $L(o)$ and $L^*(o)$ be empirical values of the standard of living in east and in west Germany, respectively, in the base period. The parameter c in equation (3) is then calculated as solution of the equation

$$\beta^* - c \ln L(o)/L^*(o) = \beta(o) . \tag{22}$$

The c - parameters are automatically adjusted if a new set of quarterly data is available. The complete consumption function is specified as follows:

$$\begin{aligned} \Delta \ln C = {} & 0.8\Delta \ln C(-1) + 0.2\Delta \ln YV + 0.01\Delta \ln M3/p \\ & - 0.05[\ln C(-1) - \ln \beta YV(-1)] , \end{aligned} \tag{23}$$

with $\beta = 0.8\,\beta(-1) + 0.2\,[\beta^* - c_o \ \ln L/L^*]$.[18] A slightly different approach has been used, for example, to determine labour force participation. In the west German model the participation rate is a function of several variables. The east German block assumes conditional adjustment to the west German participation rate:

$$E/POP = 0.95\,E(-1)/POP(-1) + 0.05\,[(E/POP)^* - c_o \ \ln L/L^*] . \tag{24}$$

Hence, the conditional adjustment process is targeting a variable rather than a constant. In the east German block the west German participation ratio is exogenous, in the full model it becomes an endogenously determined variable.

Aggregate output of the east German economy is described by a CES-production function:

$$GNP = GNP(A,K) = Q\,[a\,A^{-r} + (1-a)\,K^{-r}]^{-1/r} . \tag{25}$$

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[18] Note, that conditional upon $L/L^* = 1$, the level of consumption converges to $C = \beta^*\ YV$. Therefore, in the long-run the two regional consumption functions aggregate to $(C+C^*) = \beta^*\ (YV+YV^*)$.

The production function is parameterized to make it consistent with supply conditions in west Germany. The following parameter values have been chosen: $r = 0.666$, $a = 0.0574$, $Q = 0.85$. The substitution parameter was taken from the estimated CES-function for west Germany; the implied elasticity of substitution is $s = 0.6$. Assuming equilibrium in the west German labour market in the sense that the marginal product of labour is equal to the real wage rate allows to fix the distribution parameter by equating the production elasticity of labour to the 1990 share of wages in GNP at factor costs. Finally, total factor productivity in east Germany was calculated from the production function shown above. (The same calculation for west Germany results in $Q^* = 1.31$). In the model, using 0.85 as a starting value, Q increases at an annual rate of technical progress of 3 per cent.[19]

It is interesting to point out some implications of these figures. From the specified production function and the pre-unification data/estimates the marginal productivity of labour is estimated as 6.0 DM/hr, compared to a real wage rate of DM 10.30 DM/hr. On the other hand, the marginal productivity of capital widely exceeds real capital costs (see **Table 6**). These large discrepancies suggest the existence of a considerable potential for restructuring the production process in east Germany. Even at the low pre-unification real wage level of about 38 per cent of west German wages, under the new market economy conditions the existing capital stock supported labour demand of merely 8.2 mill. hrs. or 50 per cent the amount in the first semester of 1990.[20]

6. Simulation and forecasting procedures

The Bundesbank model is regularly applied for economic forecasting and policy analysis. Given a structural model as (17) and data (y, x) up to the period T, the information set needed to calculate model forecasts up to the period T+H consists of three components: a vector of forecasts of the exogenous variables ($\hat{x}(h)$), a vector of residuals ($\hat{u}(h)$), and a vector of coefficients ($\hat{d}$), where h runs from T+1 to T+H.

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[19] The estimated rate of technical progress for west Germany is 0.9 per cent p.a. Hence, it takes about two decades for total factor productivities to equalize. In the long-run, conditional upon $Q = Q^*$ and $u = u^*$, the relative production level solely depends on the ratio of capital installed in production plants located in east Germany: $GNP/GNP^* = K/K^*$

[20] Calculated from equation (12), assuming an elasticity of substitution $s = 0.6$ and $q = q^*$.

Table 6:

Decomposition of GNP in East and West Germany (1990)

	East G.	West G.	East : West
Total hours worked (bill.hrs.)	16.7	47.7	.35
Capital stock excl. housing (DM bill.)	580.	6014.	.10
Labour intensity (hrs./DM thsd.)	28.8	7.9	3.65
GNP (DM bill. at 1985 prices)	254.	2139.	.12
Av. labour productivity (DM/hr)	15.2	44.8	.34
Av. capital productivity	.44	.36	1.22
Total factor productivity	.85	1.31	.65
Real wage rate (DM/hr.)	10.3	27.1	.38
Real capital costs (% p.a.)	14.1	14.0	1.01
Marg. productivity of labour (DM/hr)	6.0	27.1	.22
Marg. productivity of capital (% p.a.)	26.6	14.0	1.90

Sources: West Germany: statistical data base of the Deutsche Bundesbank. East Germany: annualized figures for the first and second quarter of 1990: Total hours worked are from Table 1, labour productivity and capital stock are own estimates, real wage rate and real capital costs are calculated from Table 1, total factor productivity and marginal productivity of labour and capital are calculated from a CES-production function with distribution parameter a (0.0574) and elasticity of substitution s (0.6).

Usually, forecasts of the exogenous variables are obtained by some informal or judgemental procedure. For stochastic simulation purposes, the Bundesbank model contains a block of equations which describe the evolution of the stochastic exogenous variables by trend or difference stationary processes. For the stochastic error terms in the forecasting period their theoretical means (zero) or sometimes other judgemental values are chosen. The coefficients are obtained by the estimation and calibration procedures described in the previous sections. Deterministic dynamic simulation of the system described by (17) yields the forecasts

$$\hat{y}(h) = g(\hat{y}(h-1), \hat{x}(h), \hat{u}(h); \hat{d}), \quad h = T+1 \ldots T+H, \tag{26}$$

where $\hat{y}(T) = y(T)$. Depending on the question investigated, economic policy analysis can be performed ex ante, based on (26) as a baseline projection, or as counterfactual ex post simulation, based on a perfect tracking solution of the model.

In nonlinear models deterministic forecasts (and policy effects) are biased and inconsistent (simulation bias). Moreover, deterministic predictions provide no information on forecast uncertainty. To avoid the simulation bias and to estimate forecast uncertainty stochastic simulation techniques can be applied. The information set used to run a forecast is subject to errors. Hence, apart from possible specification and measurement errors, there are three sources of forecast uncertainty: exogenous variables uncertainty, residual uncertainty, and coefficient uncertainty. Stochastic simulation procedures which require explicit estimates of the covariance matrices of the residuals, the coefficients and the exogenous variables forecasts are either impracticable in large models or restrictive assumptions (like zero covariances) have to be made. The stochastic simulation and coefficients re-estimation procedure (SSCR) applied to the Bundesbank model completely avoids the calculation of covariances.

Trial m (m = 1 ... M) of the SSCR-procedure may be summarized as follows: Pseudo-N(0,1)-variables are randomly drawn and transformed according to McCarthy's (1972) procedure. Using the generated residuals a static simulation over the entire estimation period yields simulated time series of the endogenous variables. Subsequently the behavioural equations are re-estimated by application of the SIV-procedure to obtain a new set of structural coefficients. Now, random N(0,1)-variables are generated for the forecast period and transformed

according to McCarthy's formula. Finally, a dynamic simulation yields the forecasts

$$\hat{y}(h,m) = g(\hat{y}(h-1,m),\ \hat{x}(h),\ \hat{u}(h,m)\ ;\ \hat{d}(m)), \qquad h = T+1 \ldots T+H, \quad (27)$$

By omitting the re-estimation step coefficients can also be treated as given. To take into account exogenous variables uncertainty, a block of equations can be introduced into the model which describes the evolution of the stochastic exogenous variables by some stochastic processes. The expanded model is then treated in the same way as described above. Hence, the SSCR-procedure easily allows to decompose forecast uncertainty into its components. Toedter [41] describes the SSCR-procedure in more detail and reports empirical results for the Bundesbank model.

The stochastic simulation procedure described above can only be applied to the west German block of the Bundesbank model. Since the coefficients of the east German block have not been estimated empirically, there is no firm basis for evaluating forecast uncertainty. Generally, forecast variances associated with east German aggregates may be several times as large as those of corresponding west German entities. Nevertheless, since east Germany accounts for only about 10 per cent of the German economy, forecast uncertainty associated with national aggregates may well be contained.[21]

7. Summary and conclusions

The German unification in 1990 called for a re-orientation of quantitative, model based economic analysis at the Deutsche Bundesbank. To construct a macroeconomic model of the German economy after unification a dual approach was taken. The econometric Bundesbank model of the west German economy was adjusted and extended by an empirically calibrated theoretical system for east Germany.

The west German block explains aggregate supply and demand in the markets for goods, labour and several financial assets. Important characteristics of the model are its detailed representation of the supply side of the economy (including aggregate production, factor demand, factor costs and prices) and of the financial sector (including sub-systems for portfolio-demand and interest rates).

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[21] For example, if the prediction standard error of west (east) German GNP is 1 (10) per cent and if both forecasts are uncorrelated, the prediction standard error of total output raises to 1.4 per cent.

As in the west German block, long-term equilibrium relationships in the east German block are guided by neoclassical theory. Disequilibrium dynamics are often specified as error correction mechanisms. Additionally, conditional partial adjustment mechanisms have been formulated to model the structural transition process in eastern Germany. Conditionally upon the relative standard of living in the two parts of the economy and other conditioning variables, key structural coefficients are assumed to converge to western levels in the long-run. Moreover, wages and prices in the east German block depend on their west German counterparts. The goods and the labour markets are further related through trade, migration and public transfers. In contrast to the real economy, complete integration of the financial markets is assumed and money supply and interest rates are determined in the west German block.

The west German block is consistently estimated by the structural instrumental variables (SIV) procedure, whereas the coefficients of the east German block are fixed on a priori grounds and calibrated with respect to empirical base data. The Bundesbank model is regularly applied for econometric forecasting and policy analysis. For the west German block both applications can be run in deterministic or in stochastic mode, either ex-ante or ex-post. The structural instrumental variables (SIV) estimation procedure and the stochastic simulation and coefficient re-estimation (SSCR) technique proved powerful tools to estimate coefficient and forecast uncertainty in large nonlinear systems.

To sum up, considerable progress has been made in harmonizing the living conditions in both parts of Germany, although largely owing to massive transfers of public funds from western Germany. Markets for goods, services and labour are progressively integrating. Despite obvious progress, major problems remain. This holds particularly with respect to unemployment, aggregate output and the rate of investment, which falls behind the level needed for re-construction of the run-down capital stock. For the time being, the differing trends in east and in west Germany still require a separate economic analysis. The Bundesbank model provides a framework for quantitative economic analysis of the ongoing transition process in Germany. Its combination of two interdependent regional blocks allows to exploit the available empirical data und to integrate the accumulating new information. However, the present dual approach to modelling the German economy after unification will eventually give way to a single aggregated system for the whole economy.

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5 Interest Rate Determination in the Eurocurrency Market

by
Franz Ettlin and Michael Bernegger
Swiss National Bank

Contents

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1. Introduction

This paper represents an attempt to explain some important aspects of the covariation and interaction between interest rates on money market assets in different currencies since the mid-1970s. For that purpose it concentrates on the determination of three-month deposit rates in the Eurocurrency markets for Swiss francs, German marks and US-dollars. Our econometric study of the developement and the interactions between these rates is based on an apparently new model, which distinguishes between the effects of domestic monetary policy and international currency substitution.

2. Theoretical Considerations

The money market rates are placed at the starting point of the transmission process of monetary policy. They are, according to standard economic theory, the result of the supply of 'money' by the central bank and the aggregate demand for 'money', which is determined largely by real income (or wealth), the price level and 'the' interest rate. We consider this view to be valid mainly at the very first stage of monetary transmission, where in the interbank market the demand for and the supply of bank reserves determine the call-money or one-day rates. This, e.g. is, as a first approximation, the case in Switzerland. The very short-term rate is, however, to be viewed as exogenous, if the central bank — as in the United States during most of the period considered — follows an interest rate approach in conducting its monetary policy. In that case bank reserves are endogenously determined by demand.

The money market rates beyond the short end of the maturity structure can be viewed as reflecting the markets expectations concerning the developement of the interbank rate for call money within the time span of the respective contracts and thus the demand for and the supply of bank reserves within the relevant horizons. In an open economy with high international capital mobility these money market rates are also influenced by foreign interest rates. The relative

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strength of this influence from international currency substitution may depend on expected exchange rate changes and perceived exchange rate risks as well as on the relative size of the respective on-shore and off-shore money markets.

The interrelation between interest rates pertaining to different currencies has been modelled in the literature primarly as one of real interest parity. We consider this, however, as an inadequate hypothesis for the international money markets, in particular with regard to maturities of up to 12 months. It is based upon the presumed validity of three ex ante relationships — the Fisher hypothesis, uncovered nominal interest parity and purchasing power parity. The first two of these imply a neglect of the powerful direct or indirect influence of monetary policy through the interbank call money rates. Furthermore, the results of empirical tests in the literature do not seem to provide satisfactory evidence for any of these three hypothesis in the relevant short-run time context. The application of the composite real interest parity hypothesis to money markets clearly lacks empirical support (e.g. Mishkin 1984). However the existence of linkages between short-term interest rates on assets in different currencies is usually presumed.

In this spirit a modified simple version of uncovered nominal interest parity has shown to have strong empirical suppport. This applies in particular to a very interesting series of papers by Kirchgässner and Wolters (e.g. 1985, 1987) on the mutual interactions between corresponding domestic and foreign nominal interest rates not only in a bilateral, but also in a multilateral context. Unfortunately, their model specifications do not allow to separate between the effects of monetary policy and international currency substitution. We therefore offer an alternative approach for modelling the interdependence of international money market rates. According to our view the three-month deposit rate for a given Eurocurrency depends in principle on two sets of forces: the expected call money rate for that currency during the next three month and the expected rate of return on three-month Eurodeposits for other currencies. The empirical implementation, which is summarized below, makes use of the cointegration and error-correction methodology. The results indicate in particular a strong and stable dependence of the Eurofranc rate on the Euromark rate. The latter, in turn, shows a considerably smaller but significant dependence on the Swiss franc and US-dollar rate. Finally, the Eurodollar rate appears to depend only on the federal funds overnight rate, as no significant additional effects for foreign interest rates were found. The international currency substitution effects isolated in Tables 1 and 2, however, reveal only part of the story concerning the international covariation of interest rate changes. Another source of international linkage among interest rates is, in our model, hidden in the one-day interbank rate and refers to central bank behavior. A more complete understanding should emerge after studying the systematic reaction patterns of central banks either directly to foreign interest rates or indirectly by responding to other macroeconomic phenomena such as exchange-rate movements, international inflation shocks or synchronized business fluctuations.

3. Empirical Results on Interest Rate Determination for Three-month Eurodeposit Rates

In the presentation of the empirical results we first provide a relatively detailed account of our model for the Eurofranc rate and then report only briefly on the corresponding findings for the D-mark and US-dollar rates. The data used are quarterly averages of interest rates expressed as percent per annum. The estimation results for the Euro Swissfranc rate are summarized in Table 1. All the stochastic variables used in the model have first been checked for nonstationarity. On the basis of univariate ADF-test criteria (Dickey and Fuller 1979, Fuller 1976) the level variables are to be considered as nonstationary and their first differences as stationary, i.e. the former are integrated of order one and the latter integrated of order zero. We therefore estimated the model with the two-step OLS procedure proposed by Engle and Granger (1987).

The first column of numbers shown in Table 1 refers to the cointegration equation for the level variables. The dependent variable ist the three-month Euro Swissfranc deposit rate Z_{3M-CH}. The first explanatory variable listed is Z_{3M-DM}, the three-month Eurodeposit rate for D-marks. Its estimated coefficient of 0.43 (t-value 13.2) points to a highly significant and strong influence on the Eurofranc rate. The impact of domestic monetary policy is clearly manifested by a coefficient of 0.67 (t-value 18.9) of Z_{T-CH} , the one-day Swiss franc deposit rate. D_{1978} stands for a one-zero dummy variable, which is set to one from 1978 Q4 to 1979 Q4, when the Swiss National Bank had dropped its money supply target in favor of a policy of reducing the foreign exchange value of an overly strong Swiss franc. The liquidity overhang which was thereby created was only partially reflected in a drop of the one-day rate to the vicinity of zero. The coefficient of -1.25 (t-value 5.5) indicates that the Eurofranc rate was then 1.3 percentage points below the normal level indicated by Z_{3M-DM} and Z_{T-CH}. In the absence of a more careful economic specification of that exchange rate policy phase, the use of the additive D_{1978} variable seems to be justified by the improved stability it provides for the domestic and foreign interest rate coefficients. The cointegration properties between the three interest rate variables, however, are clearly established also without the dummy variable. For instance the Durbin-Watson statistic of the level variable would only drop to 1.04 from the 1.15 given for the level equation in Table 1. In both cases the null hypothesis of a zero Durbin-Watson statistic (if the model variables were not cointegrated) is clearly rejected. Cointegration in either case is confirmed also by ADF-tests on the residuals of the respective level equations with the appropriate critical values provided by Engle and Yoo (1987). The fit of the cointegration equation with an unadjusted R^2 of 0.969 (0.967 adjusted) and an estimated standard error σ of 0.46 percentage points is satisfactory. The F-value of the equation is 582.

The second equation shown in Table 1 refers primarly to the first differences of the model variables. The coefficient of Z_{3M-DM} of 0.44 (t-value 6.1) is almost identical with the respective value in the cointegration equation. Thus the currency substitution effect works without lag.

The coefficient of 0.64 (t-value 13.5) for the change in the Swiss one-day rate Z_{T-CH} is also little different from the corresponding level coefficient of 0.67. Thus, there is basically no indication of a lag either with regard to that variable. There is, however, a short lag implied in the additional variable for the change in the difference between the one-day rates at the end of the previous month and the end of the current month. Because of the importance the ultimo rate, i.e. the month-end rate, has had in Swiss monetary policy, particularly in the years 1981-87, the mean and variance of this variable is extremely high. Therefore, in spite of the small coefficient of 0.008 (t-value 3.9), the short-run dynamics are significantly affected by unforeseen large changes in the ultimo rate. For a detailed account regarding the Ultimo-application system, see Bernegger and Ettlin (1991).

The error-correction equation contains also a coefficient of 0.095 (t-value 2.6) for the change in the Eurodollar-rate Z_{3M-US}. Accordingly, the Eurofranc reacted to, say, a one percentage point increase of the Eurodollar rate with a rise of 9.5 basis points. This is to be considered as a transitory phenomenon only, since no significant role was found for the Eurodollar rate in the level equation. Stronger transitory and permanent effects of US-interest rates are, however, exerted through the Swiss one-day rate. A brief discussion of such reaction function effects via monetary policy will follow towards the end of the paper. The variable D_{1978} shows the same estimated coefficient of -1.25 in the error-correction equation as in the cointegration equation. The difference equation contains also a small seasonal effect of -0.22 (t-value 5.2) for a shift of 22 basis points from the first to the fourth quarter. The error-correction term $\varepsilon(t-1)$ is the estimated residual for the preceding quarter from the level equation. Its coefficient of –0.43 (t-value 4.2) indicates that 43% of a deviation between the actual and long-run equilibrium values of the Eurofranc rate are corrected within one quarter. The magnitude and t-values of this estimated coefficient also provides additional confirmation for the cointegration of the I(1)-level variables. The error-correction equation has an R^2 of 0.90 and a standard error of 0.33 percentage points. The F-value of 81.3 points to a highly significant relationship for the changes in the Eurofranc rate. The Durbin-Watson statistic of 1.88 indicates no significant first-order autocorrelation of the residuals. The reliability of the model specification is confirmed also by an out-of sample multiperiod prediction exercise. The model was reestimated for the shorter sample period 1976 Q1 - 1985 Q4. This provided 39 observations for the error-correction equation, which was then used for making predictions for the 20 quarters from 1986 Q1 to 1990 Q1. As the residual components of the cointegration equation were set at their expected value of zero for the entire prediction horizon, no feedback beyond 1986Q1 was allowed for in the error-correction term. The root-mean-squared error for the predicted change of the Eurofranc rate was 0.31, which is the same as the standard error of estimate for the shortened sample period.

Similar models, also with the Engle and Granger two-step procedure, were estimated for the D-mark and US-dollar three-month Eurodeposit rates. The results are presented in Tables 2 and 3. The summary statistics for both currencies show a relatively tight and well specified

relationship. Cointegration of the I(1) level variables is indicated by a Durbin-Watson statistic of approximately unity in either level equation. This conclusion is confirmed by ADF-tests of the cointegration equations as well as by the significant coefficients of -0.50 for the error-correction term in the difference equations. The influence of monetary policy via the domestic one-day deposit rate is in both cases stronger than for the Eurofranc rate. In fact, for the Eurodollar rate the coefficients of the federal funds rate are very close to 1.0, both in the cointegration and error-correction equations, and no additional influence could be traced to foreign three-months Eurocurrency rates. For the Euromark rate the corresponding estimated parameter of the domestic one-day rate is approximately 0.75. Here, a significant foreign influence is indicated. The Euro Swissfranc rate has an estimated coefficient of 0.19 (t-value 6.3) in the cointegration equation and one of 0.18 (t-value 3.8) in the error-correction equation. The estimated impact of a percentage point change of the Eurodollar rate is 0.06 (t-value 2.6) in the long run and 0.09 (t-value 3.1) in the short run.

Perhaps the most surprising feature of our findings is the only weak effect of the three-month Eurodollar rate on the German and Swiss three-month Euromarket rates. Thus, currency substitution by money market participants between the US-dollar on the one side and European currencies on the other affects interest rates in both regions only weakly and thus cannot explain the strong covariation in general of those interest rates.

4. Summary and Research Agenda

This paper presents a model of how interest rates on money market assets in the Eurocurrency markets are determined. The model tries to incorporate two major forces. First, it takes account of the influence of monetary policy. That effect manifests itself primarily through the one-day or call money rate in the interbank market for the domestic currency. Second, the model attempts to determine the effects of international currency substitution by including interest rates on corresponding assets in other currencies.

The empirical application of the model deals with the three-month Eurodeposit rates for Swiss francs, German marks and US dollars. There is evidence in terms of current statistical criteria that the level variables of the respective models are cointegrated. Moreover the error correction approach is succesful in closely tracking the first difference movements of the three-month rates. Whereas domestic monetary policy seems to determine the Eurodollar deposit rate almost entirely and the Euromark rate to a major extent, currency substitution appears to be very important for the Euro-Swissfranc rate. No significant time delay could be detected in the transmission of the effects of monetary policy and currency substitution to the three-month deposit rates.

These results will be extended in various directions. First, the present model shall be applied to a wider sample of currencies. Second, the process of currency substitution shall be modelled more accurately by incorporating operational measures of expected exchange rate

changes and risk premia. Third, the model shall be extended towards covering the entire maturity spectrum of assets. And fourth, the modelling of international interest rate linkages shall be complemented by estimating reaction functions of the response patterns of the monetary authorities in a number of countries.

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List of Variables

Z_{3M-CH} Interest rate on three-month Euromarket deposits in Swiss francs, quarterly average of daily figures.

Z_{T-CH} Interest rate on one-day (tomorrow-next) deposits in Swiss francs, quarterly average of daily figures.

Z_{3M-DM} Interest rate on three-month Euromarket deposits in D-marks, quarterly average of daily figures.

Z_{T-DM} Interest rate on one-day deposits in D-marks, quarterly average of daily figures.

Z_{U-CH} Interest rate on one-day deposits in Swiss francs at the last business day of the month ('ultimo rate'). Quarterly average.

D_{1978} Dummy variable equal to 1 in the period 1978 Q4 – 1979 Q4 (exchange rate policy by the Swiss National Bank), and 0 during other quarters.

Z_{3M-US} Interest rate on three-month Euromarket deposits in US-dollars, quarterly average of daily figures.

Z_{T-US} Interest rate on one-day deposits in US-dollars (Fed funds rate), quarterly average of daily figures.

$SD14$ Saisonal dummy variable equal to 1 in the first quarter and –1 in the fourth quarter of the year.

$SD24$	Saisonal dummy variable equal to 1 in the second quarter and –1 in the fourth quarter of the year.
ε	Residual of the estimated level equation.
R^2	Coefficient of determination.
$F(\cdot, \cdot)$	F-statistic.
DW	Durbin-Watson statistic.
σ	Standard error of estimate.

Table 1: Estimated Equations for the Three-month Euro-Swissfranc Rate.

Sample period:	1976 Q1 – 1990Q4	1976 Q2 – 1990Q4
Explanatory variables:	Level equation:	Difference equation:
$Z_{3M-DM}(t)$	0,432 (13,2)	0,401 (4,5)
$Z_{T-CH}(t)$	0,666 (18,9)	0,613 (7,8)
$Z_{U-CH}(t)$		–0,008 (3,9)
$D_{1978}(t)$	–1,249 (5,5)	–1,252 (4,2)
constant	–0,581 (3,4)	–0,015 (0,3)
$Z_{U-CH}(t-1/3)$		0,008 (3,9)
$Z_{3M-US}(t)$		0,095 (2,6)
$SD14\ (t)$		–0,219 (3,2)
$\varepsilon(t-1)$		–0,428 (4,2)
Summary statistics:		
R^2	0,969	0,904
σ	0,456	0,327
$F(.,..)$	(3,56) 581,6	(6,52) 81,3
DW	1,155	1,878

Table 2: Estimated Equations for the Three-month Euromark Rate.

Sample period:	1974 Q1 – 1990 Q4	1974 Q2 – 1990 Q4
Explanatory variables:	Level equation:	Difference equation:
$Z_{T\text{-}DM}(t)$	0,787 (15,1)	0,748 (12,5)
$Z_{3M\text{-}CH}(t)$	0,192 (6,3)	0,179 (3,8)
$Z_{3M\text{-}US}(t)$	0,061 (2,6)	0,090 (3,1)
$SD24(t)$		–0,115 (2,0)
$\varepsilon(t\text{–}1)$		–0,501 (4,0)
Summary statistics:		
R^2	0,975	0,862
σ	0,390	0,321
$F(.,.)$	(2, 65) 1295,3	(4, 62) 97,1
DW	1,009	2,007

Table 3: Estimated Equations for the Three-month Eurodollar Rate.

Sample period:	1975 Q1 – 1990 Q4	1975 Q2– 1990 Q4
Explanatory variables:	Level equation:	Difference equation:
$Z_{T\text{-}US}(t)$	1,005 (62,0)	0,995 (30,4)
constant	0,309 (2,0)	
$\varepsilon(t\text{–}1)$		–0,499 (4,6)
Summary statistics:		
R^2	0,984	0,938
σ	0,413	0,348
$F(.,..)$	(1, 62) 3843,6	(1, 61) 929,6
DW	0,946	2,248

6 Domestic and Foreign Determinants of Interest Rates in EMS Economies: the Case of France and Italy

by
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Contents

DOMESTIC AND FOREIGN DETERMINANTS OF INTEREST RATES IN EMS ECONOMIES: THE CASE OF FRANCE AND ITALY

Umberto Cherubini
Massimo Ciampolini
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Abstract. In this paper we use the impulse response functions of a cointegrated VAR in order to assess the relevance of foreign and domestic determinants of interest rates in two EMS economies: France and Italy. We find that foreign variables play a major role in both countries; unlike what happens in France, however, in Italy domestic interest rates *(i)* are significantly affected by exchange rate innovations, *(ii)* are to a greater degree self-determined and *(iii)* a shock in them persists entirely in the German-Italian interest rate differential. Three factors are deemed responsible for this evidence: the wider fluctuation band granted to the Italian currency in the EMS, the greater degree of openness of the French financial system and the presence of important "country specific" factors, such as a huge public debt, in the Italian system. Consistently with the asymmetric view of the EMS, French and Italian variables, except the FF-DM exchange rate, play no role in determining the German interest rate.

1 Introduction

During the eighties several EEC countries have gradually abandoned administrative instruments to manage monetary policy and have used interest rates as a major tool in conducting their economic policy. Meanwhile, they have released foreign exchange controls and increased their commitment inside the Exchange Rate Mechanism (ERM) to stabilize their exchange rate with respect to the other European currencies. So, the degree of independence of their monetary policies has promptly decreased and foreign factors have probably assumed a key role in determining domestic interest rates.

As for the independence issue, Germany represents an exception according to a widespread opinion. The idea is that this country has continued to determine its monetary policy autonomously, while the other countries have been more and more engaged in managing their exchange rate *vis à vis* the Deutsche Mark. In other words, the European Monetary System seems to have worked in an asymmetric way[1].

Much of the recent empirical work on interest rate determination in the EMS aims at testing the asymmetry hypothesis. Working on "off-shore" rates, Giavazzi-Giovannini (1989) show that tensions on foreign exchange markets within the EMS affect mainly weak currency interest rates. Using cointegration analysis Karfakis-Moschos (1990) find no systematic long run linkage between domestic interest rates in Germany and in other EMS countries, but unidirectional short run causality from the German interest rates to the others. Weber (1990) using Granger causality tests provides clear evidence in favour of the "German dominance" hypothesis. Fratianni-Von Hagen (1990) and De Grauwe (1989) on the other hand, find the relationship among interest rates to be more symmetric than it is usually thought, even though their time series analysis shows that Germany plays a major role in the system. Cohen-Wyplosz (1989) attain similar results using a VAR model including interest rates and monetary base growth rates.

A feature that is common to the whole of this literature is to investigate just the causality links among interest rates of different countries. In contrast, our purpose is to evaluate the relative weight of several explanatory variables in determining interest rates in two large EMS economies, i.e. Italy and France, that are commonly thought to share similar problems. In particular, we are going to look at the dynamics brought to interest rates by innovations in domestic and foreign variables. To this aim, we will proceed by studying the long and short run properties of two multivariate settings, one for each country, using the impulse response functions of a cointegrated VAR model.

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1. *This monetary discipline, designed to achieve credibility by high inflation countries, obviously contrasts with the spirit of the original agreement and the earlier analysis of the EMS; the latter, in fact, had emphasized the advantage of cooperation in containing the negative externality induced by the high degree of integration of the European countries. On the advantage of cooperation in Europe see Melitz (1985) and Begg-Wyplosz (1987); on the monetary discipline argument see Giavazzi Pagano (1985). A synthesis of the two approaches is in Melitz (1988).*

We choose to estimate our systems on a sample period ranging from March 1983 through December 1990. There is some agreement in fact that during the first years of the EMS the French and Italian authorities have not stuck to the exchange rate agreement with sufficient firmness. The turning point to stabilization can be traced back to 1983 when the French Government completely changed its target, gradually dismantling the *encadrement du credit* [Melitz (1991), Goodhart (1990)]. That year was also crucial for Italy, since the *massimale sui prestiti bancari*, i.e. a credit ceiling on bank loans, was disposed of and for the first time a target on M2 was announced [Angeloni-Giucca (1991)].

The plan of the paper is as follows. In section 2 the theoretical framework is introduced, yielding the foreign and domestic variables to be used in the empirical analysis. In section 3 the econometric methodology is described, along with some preliminary results. In section 4, the dynamics of the two VAR systems is presented, by means of impulse response functions. Concluding remarks are reported in section 5.

2 The Theoretical Framework

We start by sketching a model, originally developed by Giavazzi-Giovannini (1889), that represents just a simplified example of an international money market equilibrium between two similar countries. The model shows how intervention rules on the foreign exchange market and sterilization policies are crucial in determining the monetary stance and the relative role played by domestic and foreign variables in affecting the domestic interest rate. It also gives a flavor of how asymmetries in the EMS affect interest rates behavior.

Money demand [M] in the home and foreign country (whose variables are starred) is assumed to depend, as usual, on prices [P], income [Y] and interest rates [i], leading to the money market equilibria:

$$M = P + \gamma Y - \beta i \qquad M^* = P^* + \gamma Y^* - \beta i^*$$

The central banks' balance sheets are:

$$M = D + R \qquad M^* = D^* + R^*$$

where R are foreign exchange reserves and D is domestic credit. The latter is assumed to be determined by the sum of an exogenous component and an endogenous one that is proportional to foreign exchange reserves:

$$D = \overline{D} - bR \quad D^* = \overline{D}^* - b^* R^* \quad 0 \leq b, b^* \leq 1$$

where b is the sterilization coefficient. The equilibrium on the international capital market implies:

$$i = i^* + E(\hat{e}) + \rho$$

where $E(\hat{e})$ is the expected percentage variation of the exchange rate, ρ is the risk premium between domestic and foreign assets, that will be equal to zero in the case of perfect substitutability. The latter variable is assumed to be exogenous, so that it does not depend on monetary policy or other fundamental variables.

To close the model we need to introduce an equation that specifies the intervention rule on the foreign exchange market and allows to solve the problem of the $N-1$ currencies. So we assume:

$$R = g(R - R^*) \qquad 0 \leq g \leq 1;$$

in other words when $g = 0$ all the adjustment burden is borne by the foreign country, while, when $g = 1$ the domestic country has to adjust[2].

The model can be solved for the domestic interest rate, yielding the following equation:

$$i = (1 - \varnothing)\beta^{-1}[-\overline{D} + P + \gamma Y] + \varnothing[\beta^{-1}(1 - b^*)R^* + i^* + E(\hat{e}) + \rho] \tag{1}$$

$$\varnothing = \frac{g(1-b)}{g(1-b) + (1-g)(1-b^*)}$$

2. *Implicitly we assume that the exchange rate is equal to 1.*

This equation shows that interest rates depend on two components, the first being constituted by a set of home variables (domestic credit, prices and national income) and the second by a set of foreign variables (foreign interest rates, expected rate of depreciation and the risk premium).

The weight of these components crucially depends on the parameter $\varnothing$, i.e. on the sterilization coefficient b and on the intervention rules on the foreign exchange market g. If for, example, the foreign monetary authorities completely sterilize their interventions on the foreign exchange market $[b^* = 1]$ or do not intervene at all $[g = 1]$, $\varnothing$ will be equal to one and domestic interest rates will completely depend on foreign variables (foreign interest rates, expected rate of devaluation and the risk premium). The foreign country will lead the system and manage its monetary policy in a completely autonomous way. The opposite will happen if the domestic authorities fully sterilize their intervention on the exchange market $[b = 1]$ or do not intervene at all $[g = 0]$. Here, in fact, $\varnothing$ will be equal to zero and domestic interest rates will entirely depend on domestic variables.

In the following sections, we will estimate a multivariate system including all the variables of equation (1), except the risk premium, that cannot be observed, and foreign exchange market interventions that play a minor role in the model[3] and for which the total amount of reserves is a poor proxy.

Two final comments are worth. First, while here we discussed a static model, it would not be difficult to build some dynamics into it, so that equation (1) could be considered as an equilibrium relationship that has to be included as a long run target in an intertemporal loss function, yielding an error correction model (ECM) representation, as shown by Nickell (1985) and Domowitz-Hakkio (1990). Moreover, the same result could have been obtained using other theoretical equilibrium frameworks that may turn out to be "observationally equivalent": in fact, asymmetry can be generated by quite different factors, as for example different magnitude or openness of the financial system.

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3. *In fact, it is useful to note that international foreign reserves could not play any role in either of the two extreme cases previously described. In fact if* $g = 0 \Rightarrow \varnothing = 0$, *while if* $b^* = 1$ *the coefficient of* R^* *is equal zero.*

3 Econometric Methodology and Preliminary Results

In order to verify the theoretical hypotheses previously described, we specify both for Italy and France a multivariate model including, besides a representative domestic interest rate (r)[4], the following internal and external variables: money supply M2 (m), consumer prices (p), industrial production (y) as a *proxy* for domestic income, a German interest rate (r^*)[5], the exchange rate with the mark (e). Apart from interest rates, all variables are expressed in logarithms. Monthly data have been used.

As a first step, we study the trend properties of each series individually. The key question is whether a series is trend stationary or difference stationary. In the former case, the series exhibits trend reversion characteristics , i. e., in the long run the effects of the shocks that hit the series wipe out completely and the series goes back to its deterministic trend. In the presence of a unit root (the latter case), trend reversion is absent and shocks have permanent effects on the series.

The trend properties of the individual variables are going to provide useful information for the multivariate analysis which follows. Should the variables turn out to be trend stationary, we could simply specify the VAR model in levels and include a deterministic trend (or use the detrended variables): in this model, the effects of the shocks will be temporary. If the variables exhibit a stochastic trend (i.e., a unit root), the multivariate model will have to take into account the fact that stationary linear combinations of the variables might exist, i.e., that the variables might share common trends (the problem will be dealt with shortly); in any case, the model will be basically specified in the first differences of the variables and the effects of the shocks will be allowed to be permanent.

In order to ascertain the presence of a unit root we apply, instead of the standard Dickey-Fuller type tests[6], a more recent test proposed by Schmidt and Phillips (1989). Denoting the variable of interest by x_t, the test is based on the parametrization

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4. *For Italy we used the 3-month T-bill rate and for France the 3-month Pibor.*
5. *3-month Fibor.*
6. *Dickey and Fuller (1979, 1981), Phillips (1987), Phillips and Perron (1988).*

$$x_t = \psi + \xi t + u_t, \quad u_t = \beta u_{t-1} + \varepsilon_t \tag{2}$$

where the zero mean innovation ε_t satisfies the already well known regularity conditions assumed by Phillips and Perron (1988, p.336)[7]. The null hypothesis is $\beta = 1$ and it corresponds to the unit root hypothesis[8]. A valuable property of the two LM statistics $Z(\rho)$ and $Z(\tau)$ proposed by Schmidt and Phillips is that their (asymptotic) distributions under the null hypothesis are independent of the level parameter ψ and the trend parameter ξ[9]. Moreover, there is some Monte Carlo evidence that these statistics are more powerful than the Dickey-Fuller ρ_τ and τ_τ against trend stationary alternatives.

Table 1 shows the outcome of the Schmidt and Phillips test applied to each of our series. Before performing the test, money, prices and production were deseasonalised using dummy variables. In order to compute the statistics $Z(\rho)$ and $Z(\tau)$, a certain lag truncation parameter must be (arbitrarily) specified *a priori*[10]: the values given in the table were obtained setting this parameter equal to one, but repetitions of the test with different lag truncations led to essentially the same results for all the variables.

For no variable, except Italian production, the null hypothesis of a unit root can be rejected at a 2% level; in most cases, it is accepted at 5% (or even at 10%). Italian production turns out to be trend stationary. As most variables are integrated of order one, a multivariate framework which can deal with the possible existence of common trends (i.e., of cointegration) will have to be used in the following analysis. As to the trend stationarity of the Italian production, one could cope with it in two ways: detrending this variable before continuing

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7. *These conditions put some limits on the degree of heterogeneity and autocorrelation allowed in the ε_t sequence, but are otherwise very general. They are satisfied by all Gaussian and many other stationary finite order ARMA models under very general conditions on the underlying errors.*

8. *This correspondence is not difficult to see. When $\beta = 1$, in fact, from equation [2] we have $\Delta x_t = \xi + \varepsilon_t$: if, e.g., ε_t is a stationary ARMA process described by $a(L)\varepsilon_t = b(L)\eta_t$, we obtain $a(L)\Delta x_t = a(L)\xi + b(L)\eta_t$, so that Δx_t turns out to be a stationary ARMA process and x_t has a unit root.*

9. *As a consequence, "the difficulties for the Dickey-Fuller tests caused by nuisance parameters representing deterministic trend do not arise here" (Schmidt and Phillips, 1989, p.3).*

10. *See Schmidt and Phillips (1989, p.9) and, for more details, Perron (1988, pp.310-3).*

the analysis, or ignoring the problem and acting *as if* all variables were difference stationary. It turns out that the two strategies lead to very similar results and, in the exposition that follows, we assume that *all* variables are integrated of order one and show the results obtained adopting the second strategy.

As a second step, then, we set up the model for the multivariate analysis and perform the first part of this analysis, studying the (possible) cointegration relationships among the variables. We assume that the dynamic behavior of our six variables for France, as well as for Italy, is correctly described by a VAR model of the type

$$Y_t = \sum_{j=1}^{k} A_j Y_{t-j} + \mu + \Phi D_t + \varepsilon_t \qquad \varepsilon_t = I.I.N.(0,\Sigma) \tag{3}$$

where Y_t is the (p x 1) vector of the variables (in our case, p=6), the A_j's are coefficient matrices, μ is a vector of constants, D_t is a matrix of seasonal dummies and Φ is the matrix of the corresponding coefficients, ε_t is a vector of stochastic disturbances with the indicated properties.
This model can be *rewritten* in the following way:

$$\Delta Y_t = \sum_{j=1}^{k-1} \Gamma_j \Delta Y_{t-j} + \Pi Y_{t-k} + \mu + \Phi D_t + \varepsilon_t \tag{4}$$

where

$$\Gamma_j = -(I - A_1 - \ldots. - A_j) \qquad j = 1,2,\ldots k-1$$

and

$$\Pi = -(I - A_1 - \ldots\ldots - A_k).$$

The coefficient matrix Π contains crucial information about the long-run relationships among the variables in Y_t [11]. If the rank of Π - which we denote by r -

11. *See Johansen(1988, 1989) and Johansen and Juselius (1990a, 1990b).*

is zero, no linear combination of the variables in Y_t is stationary, i.e., no cointegrating vector exists. If on the other hand $0<r<p$, r stationary linear (and linearly independent) combinations of the variables in Y_t exist, i. e., there are r cointegrating vectors[12]. In the latter case, more precisely, there are (p x r) matrices α and β such that $\Pi = \alpha\beta'$, so that the model can be further rewritten

$$\Delta Y_t = \sum_{j=1}^{k-1} \Gamma_j \Delta Y_{t-j} + \alpha(\beta' Y_{t-k}) + \mu + \Phi D_t + \varepsilon_t \tag{5}$$

This expression is easily interpretable as an *error correction model* (ECM). The columns of β are the r existing cointegrating vectors and, correspondingly, $\beta' Y_t$ is an r-dimensional vector of stationary variables, whose mean we denote by $E(\beta' Y_t)$. The equality $\beta' Y_t - E(\beta' Y_t) = 0$ defines the long run equilibrium (cointegrating) relationships among the variables in Y_t. In the short run, the cointegrating residuals $\beta' Y_t$ may differ from their mean $E(\beta' Y_t)$, i. e., the variables in Y_t may be in a disequilibrium position. The ij-th element of α represents the weight that the j-th cointegrating residual has in the i-th equation. If this weight is different from zero, the j-th cointegrating residual influences the dynamics of the i-th variable in Y_t (hence, the *error correction* interpretation).

Johansen(1989a, 1989b) proposes two *likelihood ratio tests* for the rank of Π, i.e., for the number of cointegrating vectors. Before performing the tests, however, one must choose the order k of the autoregressive model to be used. Among the methods commonly employed in the literature, Akaike's criterion suggests, as usual, a quite high value of k for both Italy and France, while Schwarz's and Hannan-Quinn's criteria would lead to very low k's for both countries. Intermediate values for k are obtained applying the Ljung-Box autocorrelation test to the residuals of each equation in the model and choosing the lowest k for which the residuals of all equations turn out to be white noise. This method has led to k=2 for Italy and k=5 for France: these are the values of k that we adopted for Johansen's analysis.

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12. *The intuition is that, as on the left hand side of [4] the variables in ΔY_t are stationary, on the right hand side of [4] we must have stationary variables, too. The variables in Y_t, however, are integrated of order one (by our assumptions stemming from the unit root tests): any linear combination of these variables possibly contained in the right hand side term ΠY_t must be stationary and, therefore, must be a cointegrating relationship.*

Table 2 reports the values of the two Johansen's statistics for both Italy and France. The first column shows the "maximum eigenvalue statistic" $-T\ln(1-\lambda_i)$, for which the null hypothesis is rank(Π)$\leq r^*$ and the alternative is rank(Π)$= r^*+1$; the second column reports the critical values of the test at the 10% level. In the third column, the "trace statistic" $-T\Sigma\ln(1-\lambda_i)$ is shown: it tests the same null hypothesis against the alternative rank(Π) $> r^*$; 10% critical values of the test are reported in the last column.

For Italy, the evidence from the tests is clear-cut: both statistics suggest the existence of three cointegrating vectors. Evidence for France is less univocal: according to the "trace statistic", five cointegrating vectors would exist; the presence of the fourth and fifth of these vectors, however, is questioned by the "maximum eigenvalue statistic": as only three cointegrating vectors are certainly present, we assume for France the same number of cointegrating relationships as for Italy.

For completeness, the cointegrating vectors are given in table 3. As it is usual when there are more than two or three variables, however, the interpretation of these vectors is not an easy task. An instrument which is commonly used to better understand and summarize the economic implications (including, in this case, the long run properties linked to cointegration) of estimated autoregressive systems is the impulse response function analysis. We are going to introduce and perform this analysis presently, as our third and last step. Our cointegration analysis, however, was far from being useless: instead of employing a traditional VAR model in the levels with a time trend in it (constraining the effects of the shocks to be temporary), we have properly estimated an ECM which correctly embeds the long run relationships among the variables (allowing for permanent effects of the shocks). It is now this model which is the basis for our analysis.

As usual, the impulse response function analysis is based on the backward solution of the initial VAR model (3):

$$Y_t = \sum_{n=0}^{\infty} \Psi_n \varepsilon_{t-n} \tag{6}$$

where

$$\Psi_n = \sum_{m=1}^{n} \Psi_{n-m} A_m, \qquad n = 1, 2, \ldots \tag{7}$$

with $\Psi_0 = I_k$ (identity matrix) and $A_m = 0$ for $m > k$. The elements $\psi_{ij,n}$ of the matrices Ψ_n represent the response of variable i to the shocks in variable j after n periods.

In our case, obviously, the A_m matrices needed to build up the Ψ_n's are not obtained by direct estimation of the model in form (3): they are derived from the matrices Π and Γ_j obtained by estimating the model in its ECM form, under the proper rank restrictions for Π. As a consequence, they embed all the long-run restrictions related to the presence of three cointegrating vectors. Moreover, in such a way the long-run properties of the ECM are preserved in the impulse response function: in particular, the effects of the shocks are allowed to be permanent. Operationally, in order to derive the A_m's from Π and the Γ_j's we have used the algorithm proposed by Lutkepohl and Reimers (1990)[13].

A common practice suggests to orthogonalize the errors in ε_t. For this purpose we have rewritten (6) in the form

$$Y_t = \sum_{n=0}^{\infty} \Theta_n u_{t-n} \tag{8}$$

where $\Theta_n = \Psi_n P$, $u_t = P^{-1}\varepsilon_t$ and P represents a matrix such that $PP' = \Sigma_\varepsilon$. As it is well known, a shortcoming of this approach is that the orthogonalization (i. e., The P matrix) is not unique and that the results may depend on the way the variables are ordered. In our case, however, the impulse response profiles have turned out to be robust to changes in this ordering.

In the following paragraph we show the impulse response profiles obtained assuming the following ordering: r^*, y, p, e, m, r. In order to assess the significance of the responses of the variables to the various shocks, we have computed the 95% confidence intervals for these responses. In calculating these intervals we have followed the methodology proposed by Lutkepohl (1989,1990) for VAR models and, afterwards, by Lutkepohl and Reimers (1990) for cointegrated VAR models. This methodology exploits the asymptotic theory to analytically obtain the probability distributions of the impulse response functions and, in this way,

13. *Computations were performed using Speakeasy.*

it requires much lighter computational efforts and is more efficient than those associated to *bootstrap* and Monte Carlo methods, which are sometimes used as alternatives.

4 Impulse Response Results and Economic Interpretation

As previously said, the first purpose of our simulations is to understand the relative importance of internal and external determinants of domestic interest rates in Italy and France. In this respect we start by analyzing the effect on these rates of an innovation in each one of the considered variables.

Figures 1 and 2 show how shocks in the foreign interest rate or in the exchange rate bring about a positive and significant effect on the domestic interest rate both in Italy and France. Moreover it is interesting to observe that the significance and persistence of the responses to a shock in the German interest rate is stronger in France, while the response to an innovation in the exchange rate is more marked in Italy, whereas this effect tends to lose significance in the French case.

These results could be explained by the fact that for almost the whole sample period the fluctuation band of the Lira inside the Exchange Rate Mechanism was 6% instead of the 2.25% for the Franc. So, a large part of shocks in the German interest rate had to be absorbed by interest rate movements in France, while in Italy they also could turn into changes in the exchange rate. Furthermore, the huge budget deficit of Italy may have somehow hobbled the use of monetary instruments, forcing Italian authorities to strike a balance between exchange rate stability and the need to finance public deficits.

The domestic variables of the system (money supply, prices and output) turn out to play a minor role in determining domestic interest rates in both countries, but particularly in Italy. A partial exception is perhaps given by French output, whose innovations seem to have a significant effect on interest rates: this evidence can be consistent both with general equilibrium and with monetary authorities reaction to the business cycle. It is on the other hand more difficult to interpret the interest rate responses to money and prices innovations, as they appear to have the wrong sign, even though they are not significant.

It is also interesting to note that the response of the domestic interest rate to its own innovation turns out to be positive and significant only in Italy. This means that the Italian interest rates have been more "exogenous", probably because the financial openness of this country was lower and the huge public debt in Italy on one hand imposed a constraint to the use of monetary tools, while on the other affected interest rates directly; this linkage is not explicitly accounted for in our model.

In summary, so far our evidence confirms the fact that foreign variables have played a crucial role in determining interest rates in Italy and France. This result is consistent with an asymmetric view of the EMS, where Germany autonomously chooses its monetary policy, while the other countries are compelled to implement consistent policies, in order to support their exchange rate parity with the DM.

This view is not contradicted by the responses of German rates to shocks in the other variables of the model, that are not reported here. It is however interesting to point out that in the two VAR considered the only variable that seems to play a role in determining the interest rate in Germany, apart from the German rate itself, is represented by the exchange rate with the French Franc. It is interesting that no significant reaction was found in response to innovations in the Lira-DM exchange rate. In other terms, while the monetary policy implemented by the Bundesbank can be deemed by and large autonomous, it does not seem to be able to overlook completely shocks in the Franc-DM parity, that is often considered the pivot parity of the EMS.

Figures 3 highlights another aspect of domestic interest rates determination in the EMS, that, as far as we know, has not been tackled by the literature on EMS asymmetry. We show the response of the differential between the foreign and the domestic interest rate to a 1% shock respectively in the German rate and in the French (Italian) rate.

Our simulations show that in France the effect of a shock in the German rate is quite similar to that of a shock in the domestic rate: in fact, in both cases the differential tends to shrink considerably within few months. On the contrary, the effects do not turn out to be so symmetric in the Italian case, where a shock in the domestic interest rate tends to persist almost entirely in the differential, while the effect of an innovation in the German rate on the differential is about half the initial shock and do not turn out to be significant

(even though confidence intervals were not reported). This evidence strongly confirms the fact that the Italian financial system was much less integrated in the European economy and was subject to "country specific" shocks.

Even though the purpose of the model was mainly to assess the relevance of domestic and foreign variables for interest rates determination, it can give useful hints as to the stochastic behavior of the other variables, i.e. output, prices, money supply and the exchange rate.

As far as output is concerned, which we measured by the industrial production index, our estimates highlight the limited role played by monetary policy variables on the business cycle: in fact, output turns out to be basically self-determined, pointing at the fact that many relevant explanatory variables such as, in example, international business cycle and fiscal policy are not present in the model.

As far as consumer prices are concerned, they seem to be affected by mainly two variables: money supply and the foreign interest rate. While the first evidence is no surprise in a model that accounts for long run relationships, the second one calls for an explanation, because of its magnitude and sign (in fact, an increase in the foreign interest brings about an increase in domestic prices). This result is probably due to the fact that in the long run German interest rates end up representing international inflation, a variable that is not explicitly accounted for in the model[14].

Other evidence in the model is consistent with this explanation, as reported in figure 4. In both countries, in fact, a positive shock in German interest rates brings about an appreciation of the exchange rate and an increase in money supply. While the first evidence is clearly in line with the long run implications

14. *This hypothesis is also consistent with evidence reported by Neusser (1991) and Kunst-Neusser (1990), that in several countries, Germany included, nominal interest rates and inflation rates turn out to follow a common stochastic trend, so that real interest rates are stationary. An important implication of this finding is though that nominal interest rates and inflation embody the same low-frequency information.*

of the monetary approach to the exchange rate[15], the second seems to show that the capital inflows caused by currency appreciation are not completely sterilized by Italian and French monetary authorities.

5 Conclusion

In this paper we relate the dynamics of Italian and French domestic interest rates to the dynamics of other five variables: some internal and two external variables (a representative German interest rate and the exchange rate with the Deutsche Mark). The choice of these variables has been suggested by a simple model explaining the relative weight of internal and external determinant and to embed the hypothesis that the EMS works asymmetrically.

Methodologically, after having ascertained that almost all variables have a unit root, we have performed a cointegration analysis and estimated an ECM for both countries, following Johansen(1989). Then, we have developed an impulse response function analysis, using the Lutkepohl-Reimers (1990) algorithm.

In spite of the novelty of the technology used and the need to have a longer sample period to obtain more reliable results, our estimates show quite clearly that the external variables have played a crucial role in determining interest rates in both countries. An increase in German interest rates causes a significant increase in both Italian and French interest rates; Italian rates appear to respond to shocks in the Lira/DM exchange rate, too. The role played by the internal variables (money, prices and production) seems to be minor.

This evidence, together with the fact that German interest rates appear to be significantly determined only by themselves, is consistent with the hypothesis that the EMS works asymmetrically. From our simulations, however, it turns out that innovations in the Franc/DM exchange rate have some effect on German interest rates: while German monetary policy can be deemed as largely autonomous, it does not seem to be able to completely overlook the behavior of what is often considered the pivot parity in the EMS.

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15. *In the Italian case, the monetary interpretation is also supported by the fact that an increase in output and a decrease in money supply cause, at least in the long run, an appreciation of the exchange rate. These effects do not show up in the French case, probably because of the narrower fluctuation band allowed by the EMS agreement.*

French and Italian experiences do not turn out to be perfectly identical for other respects either. In particular, the link of domestic interest rates to German interest rates appears to be much tighter in France than in Italy. French rates respond to shocks in German rates much more significantly and lastingly; Italian rates are more "exogenous" in the sense that they are more influenced by their own innovations; finally, while in both countries the effects of a shock in German rates on the domestic-German rate differential tend to wipe out, a shock in domestic rates tends to persist almost entirely in the differential as far as Italy is concerned and dies out only in the French case.

Three factors seem to be responsible for this greater "freedom" of Italian interest rates: the wider fluctuation band granted to the Lira in the EMS for most of the period under consideration; the greater degree of openness of the French financial system; the difficulties in managing interest rates in Italy due to the high public debt in that country.

While the first two factors have recently disappeared or lost relevance, raising the expectation that Italian interest rates behavior will converge to the French pattern, the persistent problem of Italian public debt could inhibit this convergence process.

Table 1 - Schmidt-Phillips unit root tests				
	Italy		France	
	$Z(\rho)$	$Z(\tau)$	$Z(\rho)$	$Z(\tau)$
m	-16.92 ***	-3.01 ***	-19.01 **	-3.24 **
p	-11.68 ***	-2.47 ***	-7.92 ***	-2.01 ***
y	-52.73	-6.07	-16.73 ***	-3.05 ***
r^*	-2.32 **	-1.06 *	--	--
r	-7.25 ***	-1.90 ***	-3.23 ***	-1.26 ***
e	-4.18 ***	-1.43 ***	-5.39 ***	-1.63 ***

One, two or three asterisks indicate failure to reject the null hypothesis of a unit root at 10, 5 and 2 percent significance level, respectively.

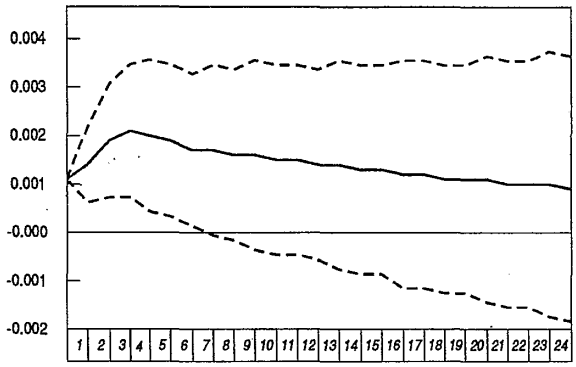
Table 2 - Cointegration tests				
Italy				
r^*	$-T\ln(1-\lambda_i)$	$\lambda_{max}(.90)$	$-T\Sigma\ln(1-\lambda_i)$	$\lambda_{trace}(.90)$
5	0.351	6.503	0.351	6.503
4	9.876	12.912	10.227	15.663
3	14.473	18.904	24.701	28.709
2	25.170	24.783	49.871	45.229
1	29.253	30.841	79.124	66.486
0	48.088	36.346	127.212	90.392
France				
r^*	$-T\ln(1-\lambda_i)$	$\lambda_{max}(.90)$	$-T\Sigma\ln(1-\lambda_i)$	$\lambda_{trace}(.90)$
5	6.291	6.503	6.291	6.503
4	9.397	12.912	15.689	15.663
3	18.267	18.904	33.955	28.709
2	28.549	24.783	62.504	45.229
1	35.502	30.841	98.006	66.486
0	47.306	36.346	145.312	90.392

Table 3 - Cointegration vectors						
	Italy			France		
m	1.000	1.000	1.000	1.000	1.000	1.000
p	-1.055	-0.095	0.065	-2.322	-1.723	-1.924
y	-0.241	-1.219	0.636	0.240	-0.372	2.422
r^*	-0.626	-2.703	-6.494	1.658	0.268	-4.016
r	0.360	0.641	2.591	-2.564	0.075	-0.116
e	-0.943	-1.019	-2.317	0.086	-0.259	-1.876

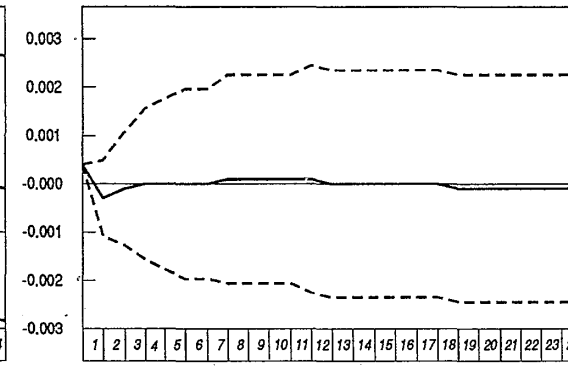
FIG. 1 - DOMESTIC INTEREST RATE RESPONSE TO AN INNOVATION IN THE OTHER VARIABLES OF THE SYSTEM

ITALY

$r^* \rightarrow r$

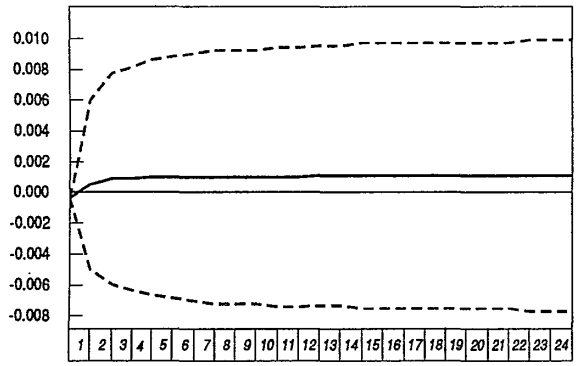


$y \rightarrow r$

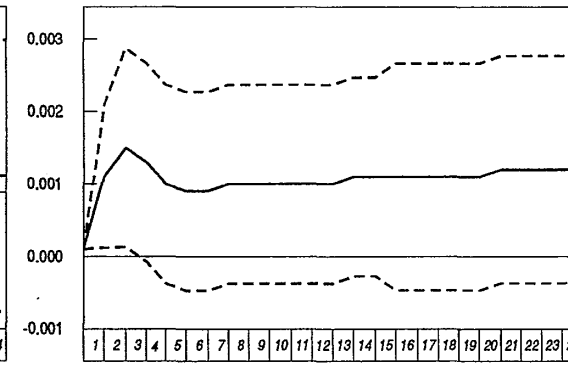


The picture with heading $r^* \rightarrow r$ shows the change in r in response to a shock in r^* equal to a standard error, up to 24 time periods after the shock; similarly for the other figures.

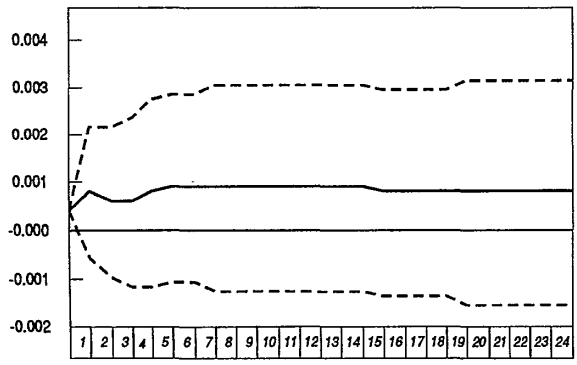
$p \rightarrow r$



$e \rightarrow r$



$m \rightarrow r$



$r \rightarrow r$

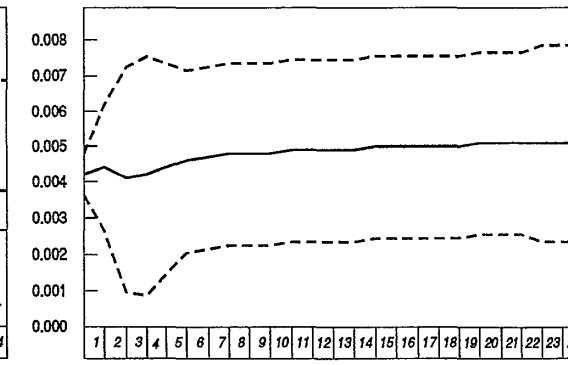
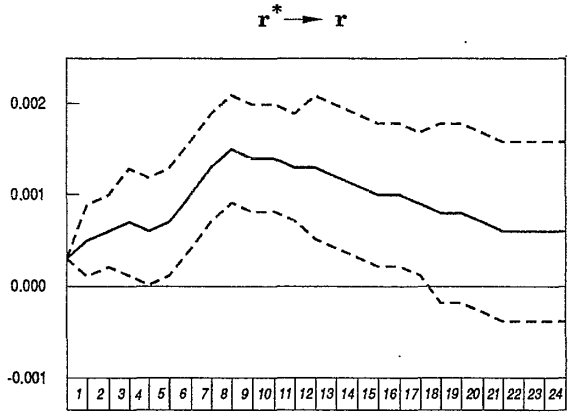
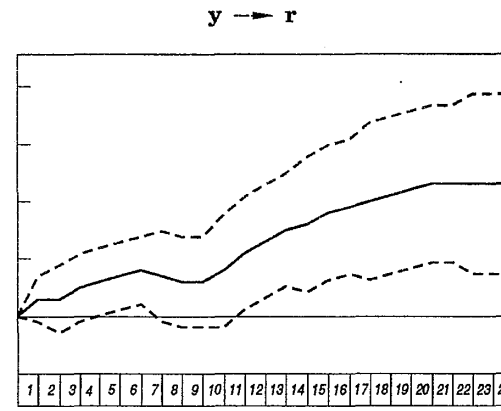


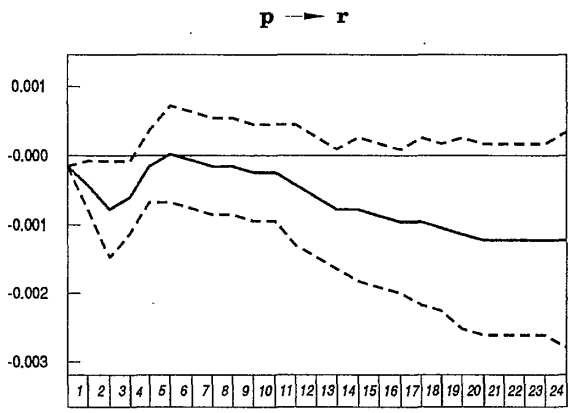
FIG. 2 - DOMESTIC INTEREST RATE RESPONSE TO AN INNOVATION IN THE OTHER VARIABLES OF THE SYSTEM

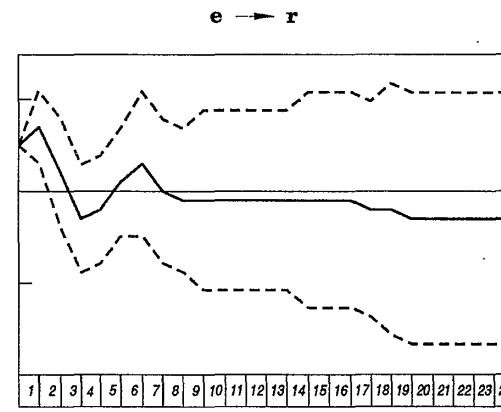
FRANCE

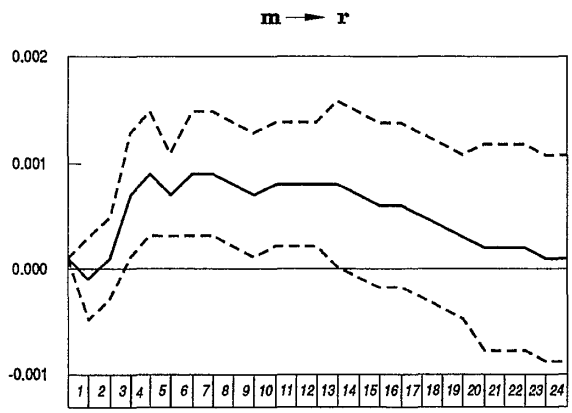




The picture with heading r* → r shows the change in r in response to a shock in r* equal to a standard error, up to 24 time periods after the shock; similarly for the other figures.







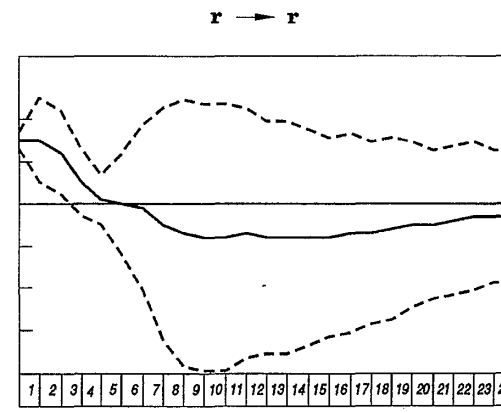
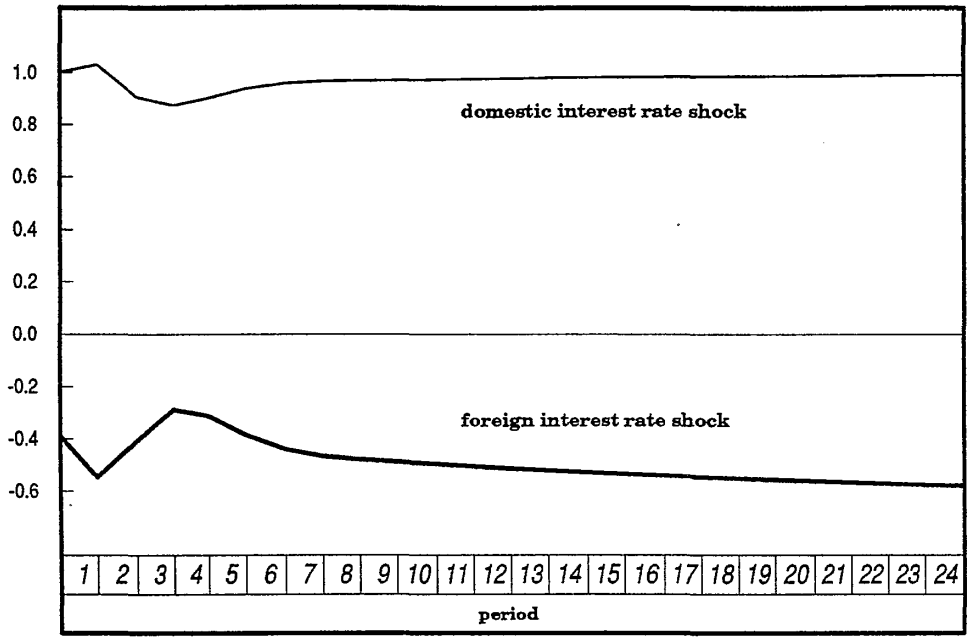


FIG. 3 - RESPONSE OF INTEREST RATE DIFFERENTIAL TO A SHOCK IN DOMESTIC AND FOREIGN INTEREST RATES

ITALY



The figure shows the change in the interest rate differential r–r* in response to a 1 percentage point shock in r and r*, respectively.

FRANCE

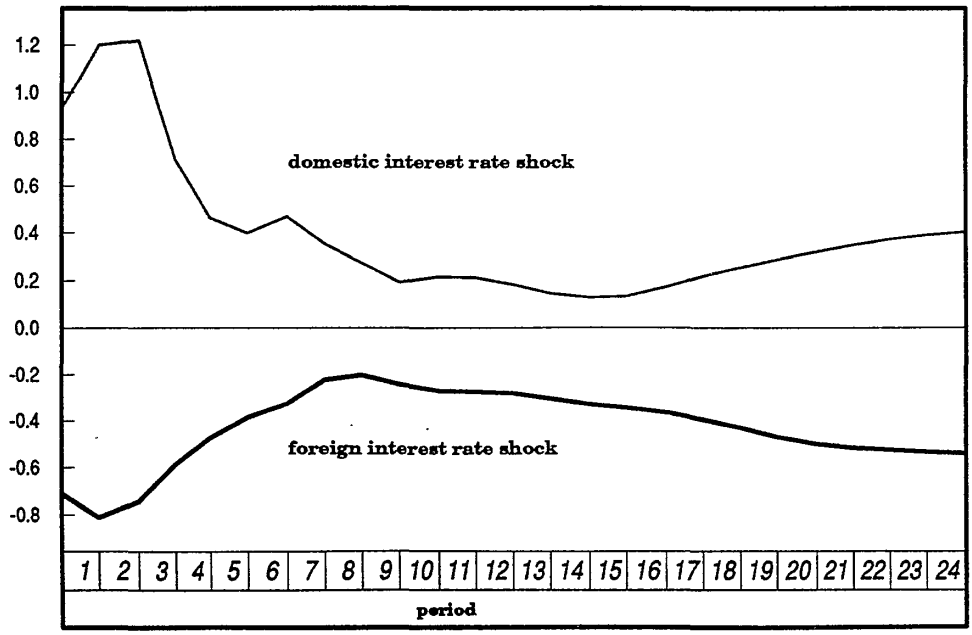
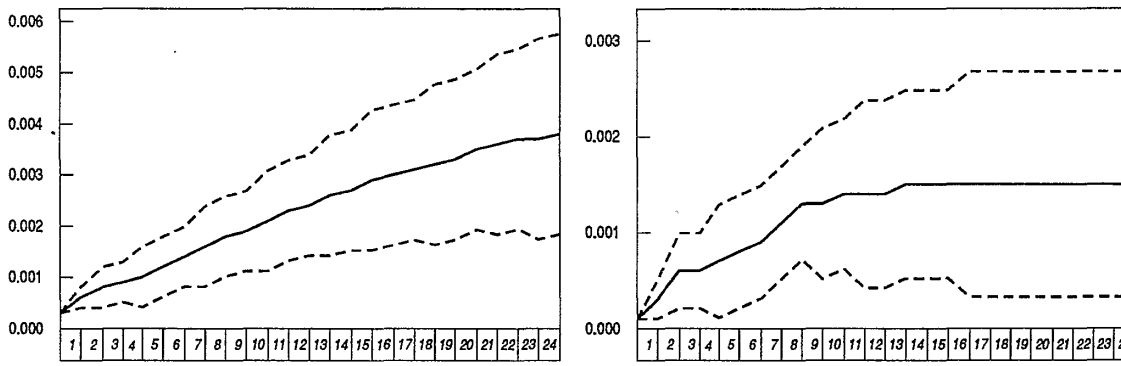


FIG. 4 - EFFECTS OF A FOREIGN INTEREST RATE TO AN INNOVATION ON PRICES, MONEY AND ECHANGE RATE

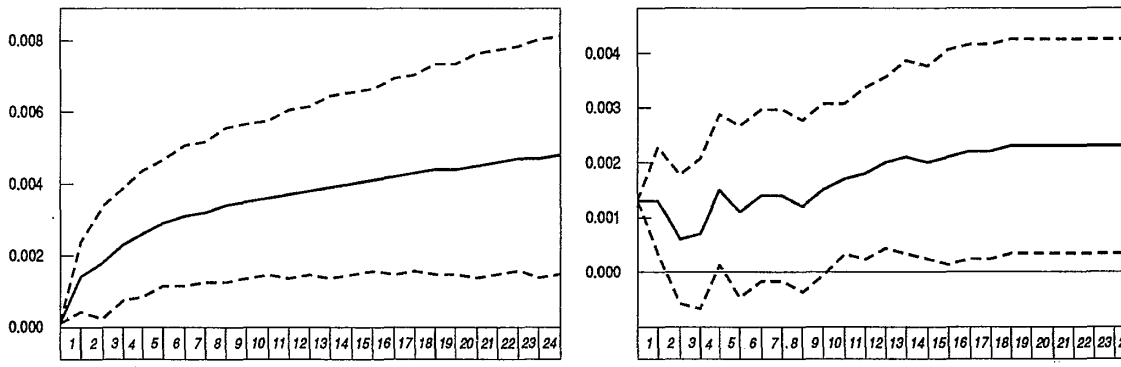
ITALY **FRANCE**

$r^* \rightarrow p$

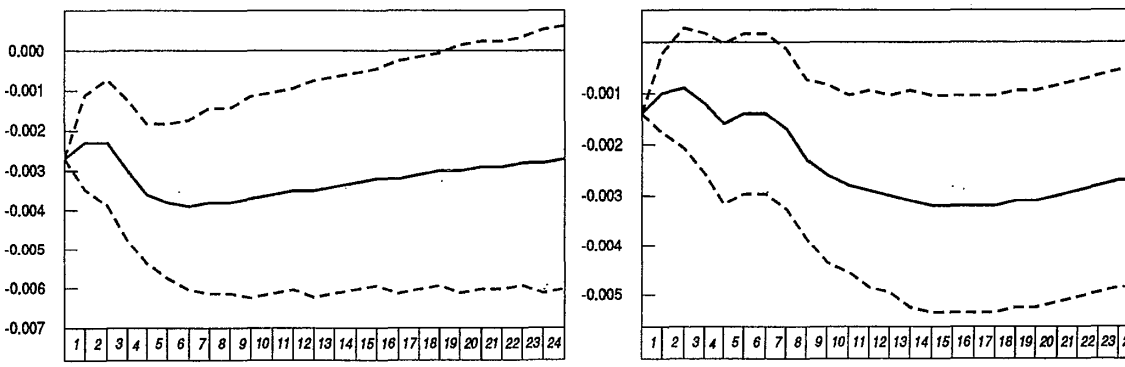


The picture with heading $r^* \rightarrow p$ shows the change in p in response to a shock in r^* equal to a standard error, up to 24 time periods after the shock; similarly for the other figures.

$r^* \rightarrow m$



$r^* \rightarrow e$



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7 Timing of Entry into the European Economic System: Economic versus Political Influences

by
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The European Economics and Financial Centre

7 Timing of Entry into the European Economic System: Economic versus Political Influences

This paper focuses on the timing of entry and the consideration of the different economic variables that need to be at the correct level for a country at the time of entry into the European Economic System. In that sense close interaction between the decision-makers and the economists has to exist.

The global term European Economic System is chosen here because it embraces many stages of entry. For a country may join one part of the system and not be part of some of the other agreements. Indeed, not all the EC members have joined all aspects of the Community agreements in one go. For example, in the case of the European Exchange Rate Mechanism, the countries Belgium, Denmark, France, Germany, Ireland, Luxembourg and the Netherlands were the first-round members of EC who entered into the initial agreement. Italy, Spain and the UK joined the system subsequently. Portugal so far is the last member to join the ERM — entering the system in 1992. Greece at present is the only EC member country operating outside the system.

To join each stage of the European Economic System or each aspect of the agreement requires fulfilling certain obligations. If the country's economic conditions are not in tune with the obligations it has to fulfil after entry, the costs could be colossal and heavy economic penalties may have to be paid by the citizens. It has to be closely examined to what extent those costs may outweigh the benefits. On the other hand, the correct timing of entering when all the conditions are right could avoid huge costs that might otherwise be incurred.

In particular it is of importance to demonstrate a case of illtiming of entry into one facet of the European Economic System, namely the case of the United Kingdom when it entered the European Exchange Rate Mechanism, and bring to light the consequences of political quibbling and indecisiveness.

The object of this paper is to draw attention to some of the key factors and some of the indicators to watch at the time of joining, i.e. examine in detail what the requirements are once the country is in the system, and what the net gains and net losses are.

The presence of a gap between the practitioner (both in the private and the public sector) and the economist has been an issue upon which I have been reflecting for a long time. The problem became more crystalized in my mind while on the one hand acting as editor of the *Journal Economic Modelling* and, thus, receiving manuscripts daily from academics who submitted to it, and on the other hand, working as an advisor to the US Legislature. This has involved working both with many Senators and Representatives from the House. It appears that economic policies are introduced regardless of their correct timing and/or consequences. The timing seems to be more related to the success of the party concerned or the politicians' careers which indirectly ensures their success in the next round of elections.

Let me examine more closely the interaction of the practitioners in the public sector — namely the politicians with economists. In particular I would like to focus on how the advice given by economists may be put into action.

Perhaps the best example of interaction of politicians with economists relevant for this analysis is the one that pertains to the European economy. I shall give you some background as to some of the economic developments among certain member countries of the European Community — namely Britain, Germany and France. This should help bring to the fore some of the points I wish to demonstrate, if one takes a closer look at some of the economic events.

What is purported to be demonstrated here is how as a result of political decisions Britain postponed its entry into the Exchange Rate Mechanism when all the economic conditions were favourable and ripe for entry. That is, in 1986 when inflation was only a bit more than three percent and the interest rate was low, etc.

The pressure for entry was brought to bear by industry and the nation and instead Britain entered the Exchange Rate Mechanism in 1990 with all the adverse conditions for entry. Again it was a political decision and I shall expound on this below. Both the delay in 1986 and the ill timing of entry in 1990 were costly and the consequences colossal.

Britain joined the European Exchange Rate Mechanism (ERM) in the first week of October 1990 at the central rate of DEM 2.95 (to pound sterling) within the 6% band. This means if sterling falls below its floor, the Bank of England is obliged to support it (by buying back sterling). It entered the ERM with a high rate of interest and high inflation, i.e. with all the adverse conditions for entry. One of the requirements of ERM is that there has to be a convergence of wage inflation (i.e. the rate at which average earnings rise) among the member states. Perhaps one way of demonstrating the economic sense

before and after joining the ERM is through closer inspection of the levels of manufacturing activity in the UK. Fig. 1 depicts the rate of capacity utilisation in the UK manufacturing sector prior to joining the ERM in 1989. This is to be constructed with Fig. 2 which shows the manufacturing sector capacity utilisation in 1992.

After the euphoria of joining the ERM was over and the dust had settled, the reality became more apparent. Gradually full membership of the ERM began to deliver a shock to various segments of the economy, in particular to the British trade unions who were asked to cut wage rises. Average *real* wages in the UK had been rising by 2.5% per year prior to that. During 1989/90 alone, average UK earnings had risen at an underlying nominal rate of 10%. This rose from an average nominal rate of 7.5% during the 1980's. But the rate had to fall to 4% to be compatible with the average rate of wage inflation within the European Monetary System. The longer it took to reach this target of 4%, the further below it had it to fall. Suffice it to say, the actual nominal rise in Britain's average earnings has not been below 5%.

At the point of entry into ERM it was forecast that on the basis of the trade-off between the level of unemployment and the level of wage inflation, in order to achieve the target of 4% inflation rate, the number of unemployed had to rise by 800,000 in Britain — bringing the unemployment rate to 8.5%. This is reflected in Fig. 2.

Alternatively on the basis of the trade-off between the proportional change in the rate of wage inflation and the proportional change in unemployment rate, the level of unemployed would have to rise by some 11.5% to achieve the target rate of 4% wage inflation.

In fact a year later, the figures released for December 1991 showed that the unemployment rate rose to 9%, while the annual wage rises were still stuck at 7.5% for the whole economy.

The Confederation of British Industry called for productivity bargaining at firm level. Unions, on the other hand, insisted on being compensated for the previous year's inflation. Nevertheless, it should be emphasized that although Britain has a high rate of unemployment, skilled labour remains in relative short supply — which goes back to the problem of the declining standards of education in the UK.

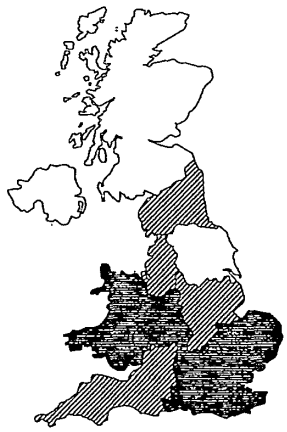
Figure 1. **Capacity utilisation in the UK economy January 1989**

% working below capacity

- 18 to 29
- 29 to 36
- 36 to 43

Source: Confederation of British Industry, London, 1992.

Figure 2. **Capacity utilisation in the UK economy January 1992**



% working below capacity

- 33 to 69
- 69 to 75
- 75 to 81

Source: Confederation of British Industry, London, 1992.

As pointed out earlier, from 1988 to 1991 Britain had been maintaining a policy of a high rate of interest to curb inflation (see Figs. 3 and 4). However, the move by the UK government to enter the ERM in October 1990 was seen as a purely political move, for with a high exchange rate and high interest rate, it had little room to help an already depressed British industry (see Fig. 5).

In fact the IMF cautioned Britain against entry into the ERM until its inflation was substantially narrowed against the other EC member nations. The organisation did not expect that to happen for some time and stated in its 1990 World Economic Outlook that the UK underlying rate of inflation could still be rising.

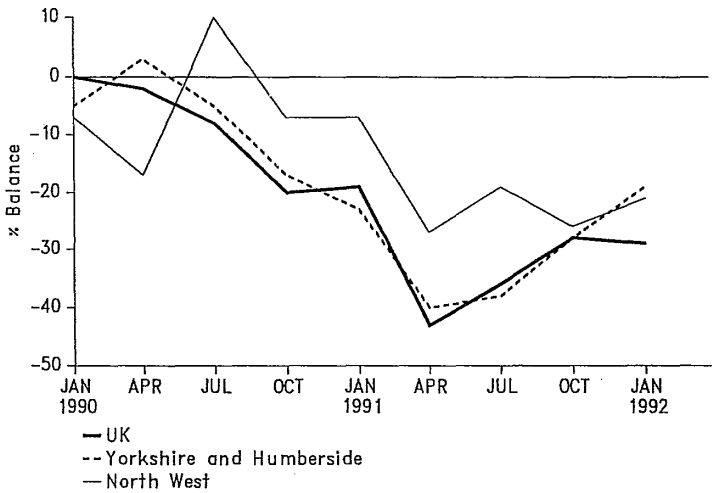
Furthermore, from the perspective of its European partners, the British entry into the ERM at that time was not viewed very favourably. Germany, for instance, expressed concern that there existed a gap between Britain's inflation and that of the other major EC member states. Karl Otto Pöhl, the then Head of the German Bundesbank referred to it "as another elephant in the boat", and said it would not make it any easier to create financial stability in Europe.

Britain entered regardless of the reservations expressed at the time by many economists. The argument used by the politicians for British entry into the Exchange Rate Mechanism was on the following lines: they expected that the prospective UK inflation rate would be lower than that of the previous twelve months. Membership of ERM would guarantee that this had to be the case. If wage bargaining could be settled on the basis of prospective inflation, it should be possible to achieve the disinflation required by ERM membership.

As explained above, wage inflation remained quite robust and a year after joining the ERM, it did not show any signs of weakening. So how did price inflation fall in the UK during 1991? Let us review the process by which price inflation was brought down. In other words how were the expectations of the politicians made to materialise? How did the government manage to create a falling inflation index which *prima facie* appeared to the public that the rate of inflation was falling?

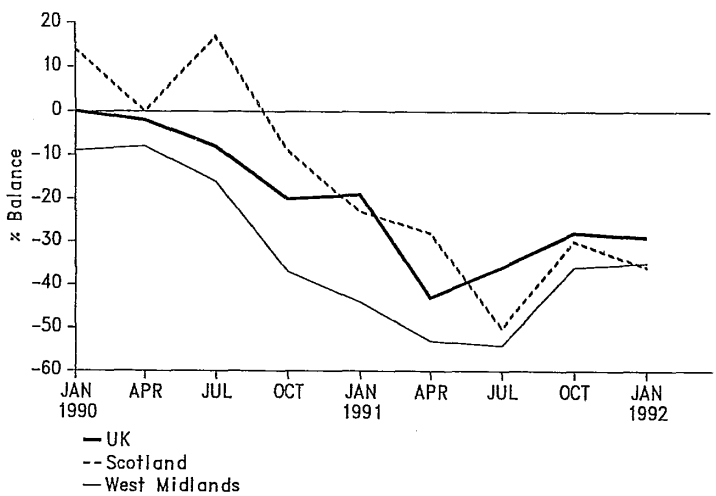
It is imperative to note here an important relationship — that is, in the UK interest payment is a component of the Retail Price Index which manifests the 'headline inflation'. Therefore, any change in the level of interest rate is reflected in the Retail Price Index with a lag of one or two months.

Figure 3. **Volume of output — % balance, past four months**



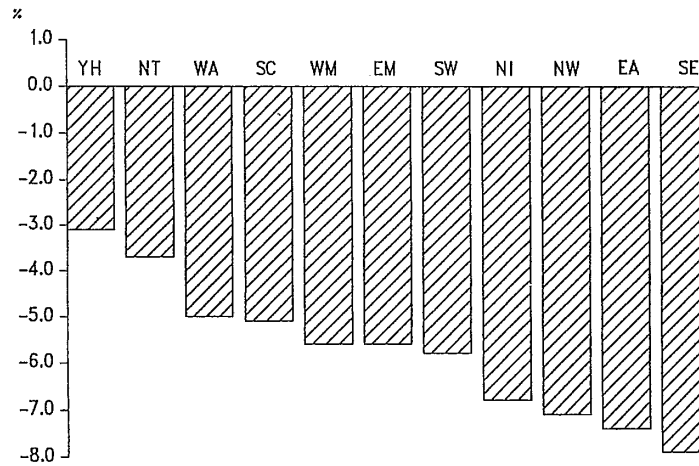
Source: Confederation of British Industry, London, 1992

Figure 4. **Volume of output — % balance, past four months**



Source: Confederation of British Industry, London, 1992

Figure 5. **Manufacturing employment year-on-year percentage change — January 1992**



YH = Yorkshire & Humberside
NT = North
WA = Wales
SC = Scotland
WM = West Midlands
EM = East Midlands
SW = South West
NI = Nothern Ireland
EA = East Anglia
SE = South East

Source: Confederation of British Industry, London, 1992

Immediately prior to joining this system, the Chancellor of the Exchequer reduced the UK interest rate from 15% to 14% thereby ensuring a reduction in the inflation index in the succeeding month. For, as a result of this cut in the interest rate which happened on 7 October 1991, the Retail Price Index fell in November and December 1991. Moreover, this process continued from the beginning of 1991 till the summer of 1991, when a series of very small cuts in interest rate (in total seven times) were introduced which translated themselves into a small drop in the Retail Price Index in the ensuing months.

These cuts were of the order of a quarter per cent to half a per cent and took place at monthly intervals. The process, thus, attracted

maximum media attention whenever the falls took place, be it the fall in interest rate or the resulting drop in Retail Price Index in the following month — scoring a political victory for the ruling party. But once the interest rate could not fall any further due to the constraints imposed by ERM the index of inflation levelled out. For the level of interest rate could not fall below that of Germany (see Table 1).

While the UK rate of interest has been falling, there have been rises in Germany's interest rate. Germany has two key interest rates, the Lombard and the discount rate, both of which rose. The Lombard rate, which is used by banks for emergency funding, was raised by the Bundesbank because the government did not want to burden capital markets with excessive calls for funding following German reunification.

Table 1. **Macroeconomic variables in the European Community in 1991**

	annual rates of interest %	consumer price inflation %
Belgium	9.3	3.2
Denmark	9.3	2.4
France	9.0	3.0
Germany	8.4	3.5
Greece	22.5	18.3
Ireland	9.4	3.0
Italy	11.3	6.4
Luxembourg	9.3	3.4
The Netherlands	8.8	3.2
Portugal	14.6	11.7
Spain	12.5	5.8
United Kingdom	10.3	6.5

Source: European Economy, No. 50, EC Commission, December, 1991.

The German interest rate rose, however, despite a fall in the German trade surplus. The fall in the surplus also reflects the acceleration of import demand after the opening up of East Germany. Moreover, the shift in sales efforts by West German companies from exports into East Germany has also been partly responsible for the fall in the surplus. But the Bundesbank has found the fall in the surplus healthy even though the high D-mark has eroded profits of manufacturing firms.

In the UK it is highly questionable how much the inflation index during 1991 would have come down, without those cuts in the interest rate. For after all, the exact definition of the inflation rate is the rate at which prices increase from one period to the next. So if there is a fall in one of its large components, the index would fall. But that is a one-off fall and as soon as it is absorbed the rises begin to show. As stated above the Retail Price Index levelled out from the autumn of 1991. A meaningful drop in inflation rate could have been achieved only if the index had fallen without the reduction in the interest rate. Indeed, as soon as the falls in the interest rate were halted, the index flattened out.

In short, Britain's entry into the ERM occurred at the worst time, namely at the point of the highest sterling exchange rate. Not only did this force the country to maintain a high interest rate, but the high exchange rate made UK exports uncompetitive and hurt the industrial sector. It should be noted that exports show a lag of seven quarters to respond to exchange rate movements. During 1991 alone over 4000 businesses went into receivership — a 50% increase over the previous year. This was around 1000 receiverships a quarter. By November 1991 sterling managed to hit the floor of its band and became the weakest member of the European Monetary system, reaching 2 pfennigs below the contract rate. By December 1991 the narrower definition of money supply, i.e. M0, was growing significantly below that of the previous September which indicates the force of the recession. No doubt the lower interest rate should work its way through the economic system and reduce production costs in the longer term. Moreover, the fact remains that the real interest rate during 1991/92 stayed high as a result of the constraints imposed by the ERM.

In fact Britain should have entered the European Exchange Rate Mechanism in 1986 when the inflation was around 3.5% — similar to some of its partners such as France. Whereas over the subsequent years in Britain the rate of price inflation climbed to 10.5 per cent, in France it barely crept up over 3 per cent.

Resisting the entry in 1986 was again a political decision and was not for economic reasons. Within the constraints of ERM, the options open to Britain when the pound sterling stays weak are: i) to raise interest rate to support the pound, ii) to devalue, which would be inflationary, and iii) to withdraw from the ERM. None of these options are easy options to implement. Moreover, they would not be viable for a ruling party just before an election for they would be politically sensitive. Indeed Britain used a large amount of its foreign reserves to support the pound sterling in November and December 1991.

The question facing any potential new member is what are the advantages of joining the European Community, and in answering that one has to question what are the prime objectives of the Community. Clearly these are the liberalization of the flow of services and goods. To go one step further, the prime goal of the 1987 Act for a Single Europe has been "harmonization of rules to facilitate the flow of services, goods and labour and removal of any barriers for the free movement of capital."

It is widely believed within the Community that over the life of 1970's and 80's there have been welfare gains though this has not been easy to quantify. For any new member contemplating entry into the European Community in the future two additional structural changes have to be considered which are in the process of being introduced in the future years: 1) the creation of a single currency, 2) the establishment of a European Central Bank, which together form the proposal known as European Monetary Union or EMU. These developments should add a dimension to the Community that ought to enhance economic growth in the region.

To reinforce the argument, one should perhaps compare the growth rate of the United States (which has one central bank and fifty states with their own elected independent legislatures) with that of the aggregate growth rate for the European Community over the period 1970–1991. Setting the two rates side by side over the seventies and the eighties decades, it is evident that the two closely resemble one another from which one can perhaps arrive at the following deduction. If Europe has achieved the same economic growth rate as that of the US without a single currency and in the absence of a single central bank, then the Community's growth rate should surpass that of the United States once it achieves monetary union and creates a single currency.

In conclusion, whether it concerns a potential new member or an existing member the authorities have to examine closely key macroeconomic variables before entering any part of the European Economic System or for an existing member before joining an existing agreement within the Community. Once the overall decision regarding the entry has been made the next salient decision is the correct timing of entry — i.e. whether to join the system in question as soon as the country is allowed in or whether to postpone it until the economic conditions are favourable for such an undertaking. Accordingly, the practitioner, in this case the decision maker in the public sector, has to be made aware of the adverse economic consequences of ill timing of entry.

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8 The Convergence of Finnish Consumer Prices to the EC Level

by
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Contents

The paper is partially based on research done in The Government Institute for Economic Research during a research leave from the Ministry. Some results have been published as a part of the research "Suomi Euroopan yhteisön jäseneksi? Taloudelliset vaikutukset", Government Institute for Economic Research, Helsinki 1992.

8 The Convergence of Finnish Consumer Prices to the EC Level

8.1 European record in consumer prices in 1990

In the autumn 1991 the Government Institute for Economic Research (GIER) was given a specific research task from the Government. The institute was asked to compare two possible alternatives for the Finnish economy, i.e. membership in the EC, European Community, and in the EEA, European Economic Area. Some results were incorporated into a memorandum which the Government brought to the Parliament in January 1992. The final study of GIER was published on the 9th of January, too. In the macroeconomic model calculations which were incorporated in the study one of the basic assumptions was an intensified downward adjustment in consumer prices due to membership in the EC as compared to the alternative EEA scenario. The present writer participated the study because of the model calculations, which were made by using the Ministry of Finance KESSU IV model. The purpose of this study is to elaborate on the assumptions used in the light of new information received after the calculations were accomplished.

Another starting point of this paper is the European record in consumer prices which was reached in Finland in 1990. This position has been lost since the last devaluation in November 1991 but the leading Scandinavian countries are not very far ahead. The relatively high price level has been noticed both at home and abroad, the OECD used a lot of pages because of it in its latest country report in 1991 and due to the intensified discussion about European integration the problem of prices has been tackled several times in the domestic discussion, too. Quite a common opinion is that there should be some explanations for the Finnish consumer price level besides the northern faraway location. The high living standard measured by per capita GDP is only a partial explanation. Subsequently, the highest relative prices can be found in commodities delivered for the domestic consumption. This is not surprising taking into account the income level but anyhow there are some reasons to suspect that some Finnish consumer prices are still unreasonably high also compared to other Scandinavian countries.

Among one common paradigms there is the law of one price which says that, excluding transport and similar costs, only one market price should prevail at least when border control and other trade barriers are abolished due to integration. Subsequently, border control is abolished only in the EC alternative. But to what extent and how quickly there might be any price convergence and how the difference in resulting price levels can be measured in hypothetic alternatives several years and regimes ahead might remain an open question also after having read this paper. Some approximations of true effects can be derived using the current differentials in prices, on the other hand any results with the correct sign are better than no results. The cornerstone of this study is the assumption and the to some extent proved hypothesis of a certain convergence of consumer prices which is accelerated by membership in the EC.

The difference between EEA and EC alternatives can be based on different pricing principles on the micro level but the difference can be a result of differences in economic policy, too, and in this way the difference is easier to explain. As a member of the EC the scope for economic policy is at least to some extent restricted and the crucial question is if this has any effects on inflation, too. One possible assumption is that the EEA alternative allows the continuation of inflation above the European average including the devaluation cycle.

The assumption concerning price convergence which was used in the integration study is only a potential outcome and the corresponding results are conditional, too. This means that the main results about the possible EC membership are based on a hypothesis of price convergence. This is at least one good reason to study in detail the current price differentials, their causes, and further development in alternative scenarios.

When comparing several scenarios of faraway future, personal opinions cannot be avoided while there are a lot of suitable and even contradictory assumptions which could be used. Maybe pure opinions have not been avoided in this paper either, but the amount of them probably does not exceed the average amount used when the pros and cons of an EC membership are discussed. The effects of the membership on the Finnish economy do not all have the same sign on all components of welfare and up to now no explicite welfare function has been presented for approval.

Further chapters are organized as follows. In chapter two the current price differentials according to demand categories are presented. In the following two chapters these price differentials are projected into the future and transformed into price differentials by producing branches. This description is followed by a list of causes for

the differentials. Implicitly, these causes also suggest the ways to abolish them if that is possible in the first place. The next step in the paper presents the membership effects published by the GIER including the effects of price differentials due to agricultural protection, domestic pricing and other producer price differentials and indirect taxation. The calculations presented include an explicitely defined assumption about the convergence of producer prices and prices of demand categories, respectively. At the end there is a short discussion concerning one prerequisite of price convergence, i.e. changes in the production factor markets, especially in the labour market. The convergence would be easier if wage costs would converge, too. It is only necessary to assume one price for homogenous labour in the European labour market.

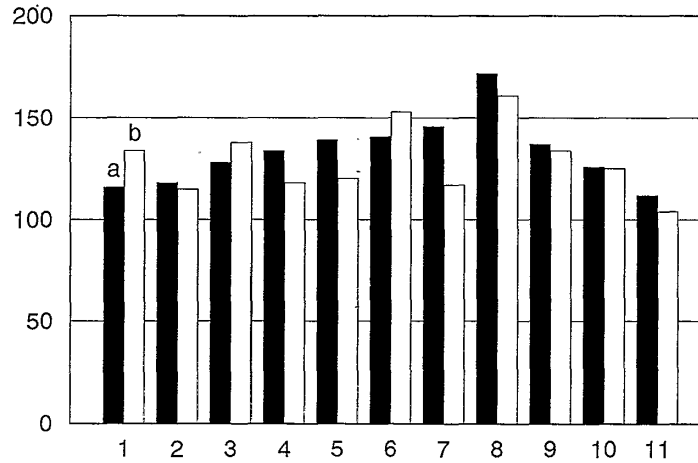
8.2 Estimates of current price differentials

In January 1992 the latest research on international price levels was the OECD purchasing power calculations for the year 1985. These can be updated by using national inflation rates and exchange rates but preliminary results can be derived from the forthcoming 1990 purchasing power calculations, too. In the diagram 1. both the old 1985 price levels and the new ones based on the 1990 study are presented.

Because of the devaluation in November 1991 the new figures are derived using the figures for 1990 so that they are updated by the currency rates prevailing at the beginning of January 1992. Hence, inflation rate differentials for 1991 are not taken into account. The latest estimate for the private consumption deflator last year in Finland is over 5 per cent which means that the figures presented may underestimate the current relative Finnish price level by 1—2 per cents. Subsequently, when exchange rates after the devaluation are used, one could use consumer prices where the normal cost push due to higher import prices is included, too. According to historical behaviour the current price level should be raised by 3—4 per cents due to this not yet noticed but maybe forthcoming effect. The situation in 1990 is easily obtained by multiplying the Finnish prices by a factor of 1.12. The effect of the devaluation is discussed in more detail in later chapters, here the main emphasis is on the structure of price differentials.

Diagram 1. **Consumer price levels in Finland in 1985 and in 1990**

(using 1992 exchange rates), EC = 100, preliminary figures for 1990



a 1985 b 1990

1 Medical and health care
2 Rent, fuel, power
3 Education, recreation
4 Household equipment
5 Transport, communication
6 Miscellaneous
7 Clothing, footwear
8 Food, beverages, tobacco
9 Total private consumption
10 Government consumption
11 Gross capital formation

OECD purchasing power calculations

Using the exchanges rates at the beginning of January the most expensive country in Europe is Norway, just because of the devaluation, otherwise Finland would be the "champion". Even Denmark is a bit more expensive but taking into account inflation forecasts for 1991 would reverse the situation. One could also insist that the effect of the devaluation could be completely eliminated before the earliest possible date for a Finnish EC membership.

The five Nordic countries in table 1. are clearly in a class of their own. Previously competent Switzerland has dropped downwards in the list. The result invites the question whether high consumer prices are due to the Nordic way of life, to the Scandinavian economic model which has to some extent been the ideal for some formerly socialist countries.

Table 1. **Consumer price levels in 1990, with exchange rates as of January 1992,**
EC = 100

	private consumption	alcoholic beverages
Norway	1.46	2.83
Sweden	1.38	2.54
Denmark	1.36	1.67
Iceland	1.35	3.10
Finland	1.34	3.11
Switzerland	1.31	1.76
Germany	1.09	0.84
Austria	1.07	1.11

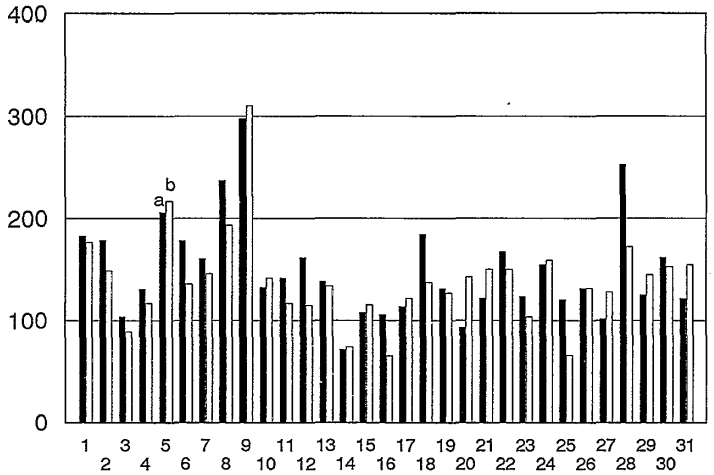
OECD purchasing power calculations

Another natural explanation is the high taxation of alcoholic beverages, noted already by Wieser (1989). High prices for alcohol and other beverages, too, certainly influences the high price level of restaurant and hotel services. In any case the average EC consumer price level is one third or one fourth beneath the Nordic level and the difference to the German price level is more than 20 per cent on average. Using per capita income as a measure and excluding the former East-Germany (not included in the figures) it can be argued that it is not only the income level and alcohol that determines the price differentials. Food prices due to agricultural policy can be added to the list of explanations but there still remains certain other items which quite clearly point to market imperfections. The effects of market imperfections are easier to see in single disaggregated commodity categories, see diagram 2.

Clear changes in the Finnish price structure in five years can be noticed. One could claim that branches and commodities without import or domestic competition have become relatively more expensive. In three main categories the relative price level in Finland has risen compared to the 1985 situation also when the devalued exchange rate is used. Medical and health care include domestic drugs, the production of which is licensed. In five years wages seem to have risen so that drugs compared to medical services are no more so remarkably expensive in Finland. One possible explanation is that the Finnish producers are preparing themselves for free competition by increased research for new products and the Finnish consumer is now paying for this investment.

Diagram 2. **Consumption subcategories, relative price level in 1985 and in 1990,**

EC = 100 both in 1985 and 1990



a 1985 b 1990

1 Bread and cereals
2 Meat
3 Fish
4 Milk, cheese and eggs
5 Oils and fats
6 Fruits, vegetables, potatoes
7 Other food
8 Non-alcoholic beverages
9 Alcoholic beverages
10 Tobacco
11 Clothing
12 Footwear
13 Gross rent, water charges
14 Fuel and power
15 Furniture, floor covering
16 Household textiles
17 Household appliances
18 Other household good and services
19 Medicals and pharmaceuticals
20 Medical and health services
21 Public services (1990–)
22 Personal transport equipment
23 Operation of transport equipment
24 Purchased transport services
25 Communication
26 Recreation equipment
27 Recreation and cultural services
28 Books, magazines, newspapers
29 Education
30 Restaurants, cafes, hotels
31 Other goods and services

The other main group where the relative price level compared to the EC level has risen in five years is education where the most striking example is books. This is nothing new for Finnish readers and the downward trend in the subgroup books and magazines would seem promising had it not been accompanied by several bankrupt newspapers last year. The standard explanation is that in a small country with an unique and difficult language the editions printed are so small that unit prices must be high. The other explanation is that there is no import competition. Although books may be printed abroad they are nevertheless sold only in the domestic market. The results of Wieser refer also to this exceptional phenomen, only alcohol exceeded the relative price of books in Finland compared to EC prices.

Also the third group which has gained in relative expensiveness has no actual competition, at least no direct import competition. Miscellaneous services include restaurants, hotels and cafes, the service prices of which are affected by alcohol taxation. These services are licensed to some extent and ethnic restaurants, if owned by foreigners, need more permissions.

Two main groups, clothing and transport, would be below the estimate of 1985 also without the devaluation. For textiles the most probable explanation is the collapsed share of domestic production in this category. In the category of transport there seems to have happened structural changes which are indicative of the effects (with both signs) of competition, trade barriers, tax competition and economies of scale.

Transport equipment and their use have become a bit cheaper indicating that it is not possible to widen the gap forever by taxing cars. Transport services are locally produced without imported competition with the exception of air traffic and they are still licensed, a certain needstesting is necessary, thus they have become relatively more expensive compared to the EC average. The most important example might be communication services where the relative price level in Finland has practically collapsed in five years to the Swedish level, see Wieser (1989). Again the reason can be increased competition or the knowledge of allowed competition in telecommunication. Postal services are not produced by a government office anymore but by a unit striving for profit.

The changes in disaggregated consumption categories in five years seem sometimes striking although the development could have been noticed earlier by following disaggregated inflation rates. A general hypothesis supported by the figures, both levels and changes in five years, is that notwithstanding the higher general inflation rate there is a certain convergence also in domestically sold tradables. On the other

hand more scope for convergence can be found in the previously sheltered sectors where competition is gradually allowed. Thirdly, indirect taxation cannot be used unlimitedly, high differentials of accises for e.g. alcohol become more and more difficult in a world where border controls are diminishing. The fourth point is that still clearly sheltered services have become relatively more expensive. This is not only due to wages as e.g. government consumption has the same relative price level compared to the EC in 1985 and in 1990.

One fact that supports the hypothesis of high prices due to lacking competition is the lack of a price differential in gross fixed capital formation. On average the estimate for 1990 refers to an almost same price level and taking the forthcoming changes due to import prices changes into account there might remain a 10 per cent price differential which is easily explained by transport costs etc. The difference between consumer price and investment price differentials also supports the hypothesis of price segmentation, i.e. higher prices for the same commodities intended for the domestic market compared to those exported.

According to the figures there is in 1992 still a clear price differential, especially in consumer prices, which cannot completely be explained by Finland's remoteness or by higher per capita income. A more detailed analysis will be attempted in subsequent chapters, now it is time to forecast the differential up to the next decade.

8.3 Continuation of the devaluation cycle?

The leading position in consumer prices in Europe was lost due to the devaluation last November. The ranking of expensive countries in 1990 or just before the devaluation has changed somewhat. One might ask if the current price differentials will prevail or whether the same differences in inflation rates as earlier will prevail. The reason for posing this question is that the effects of an EC membership on the Finnish economy should be estimated using future and not by using the current price differentials. If the law of one price is adopted more likely because of EC directives than because of EEA free trade, one should estimate the probable price differential in the new equilibrium after all membership effects have been realized.

The way to proceed in order to find the potential effects of the EC membership as an alternative to the EEA solution is to define probable inflation projections in both alternatives. In the near past, the very latest development excluded, the Finnish inflation rate has exceeded the European average. On the other hand that means lost price

competitiveness while consumer prices do not change separately from other prices. In historical terms the Finnish consumer price level which in the 70's was still comparable to that of other European countries has clearly diverged, to some extent together with other Nordic countries. The divergence is partly due to relatively increased per capita income, but the increase in productivity which has also been higher than the European average has not been enough to dampen the price development to European average. The tendency in the past has been a higher inflation which in due course has been corrected for by devaluations. When making projections for any alternative, the crucial question is the possible continuation of this historical habit.

The basic assumption concerning the EC alternative is a fixed exchange rate in the European Monetary Union, before and after joining. Another precondition is the upper limit for inflation, i.e. 1.5 percentage points over the three lowest rates. One possible basis for comparisons might be the German target rate of inflation, i.e. 2.5 per cent annually. But taking into account the law of one price, a succesful convergence necessitates a lower inflation than the average be it the German 2.5 per cent or something else. This convergence may not be only voluntary and a result of market forces while restricting inflation will gain in importance. The target inflation in Finland may also be a result of economic policy.

The EEA alternative as it was construed in the GIER study leaves open the question of the exchange rate. There is no necessity nor any possibility to keep it fixed if the past inflationary tendencies do not change. The alternative could to some extent be described as a continuation of past trends. Price convergence in tradables and in some services is possible while strictly sheltered branches use the old pricing principles. One further reason for different inflation rates might be differences in the markets for production factors. No proof is available, but one could presume more efficient factor markets in the EC compared to the EEA alternative especially if the number of countries in EEA but outside EC is small. The degree of price convergence in the EEA compared to that of EC membership is the crucial assumption which influences all the results of the study cited.

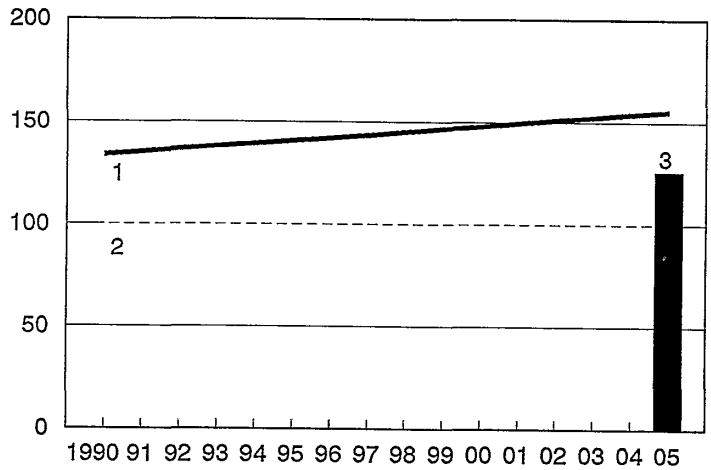
The solution used in the GIER study was two alternative inflation rates for the EEA scenario, the historical one with 1 per cent higher inflation, i.e. 4 per cent annually, and the rate of a new inflation regime in which the price differential in consumer prices remains the same as in 1991. One could further enlarge the number of alternatives by varying the possible outcome of the 1991 devaluation. To make it more simple the respective costs push can be included in the historical rate of inflation. These alternatives are described in the diagram 3.

where the "historical" gap of the first alternative grows from 25 or 34 per cent up to 36 or 56 per cent respectively when the difference in 1990 is taken as the starting point.

The historical projection clearly includes pressures for a next devaluation, which might well happen before the terminal year 2005. Taking successive devaluations into account the average inflation in the long run would be higher than the European average and hence the comparison between it and the EC reference path can be made using the diagram 3. The only problem that remains is to decide on the probable outcome, the probable remaining price differential when the economy has reached the new equilibrium.

Diagram 3. **Consumer price projection up to 2005**

in the hypothetical EEA scenario when the reference path in the EC is scaled so that EC = 100 every year. The projection in the GIER study uses the end of November 1991 as a starting point, so the figures differ a bit.



1 EEA Finland
2 EC base
3 EC Finland

It was assumed that the tendency for higher inflation is more probable in the EEA alternative and that the degree of convergence due to EC membership might with rigid real wages be about 13 per cent when the effects of indirect taxation were excluded and up to 19 per cent when their harmonization was included. Compared to the more stringent EEA price regime, the resulting new equilibrium price level would be about the same as in Germany, whereas subtracting those 19 per cents from the historical inflation in the year 2005 would imply a

price level of 126 as compared to the EC average of 100. That would be the same level where the current inflation in Denmark, i.e. half a percentage point below the EC average, would lead the Danish consumer price level by 2005. Some convergence in Denmark is still possible although the country has alreaby been a member for years. According to Wieser the price differentials are smaller between the original EC members also if alcohol prices are taken into account.

8.4 Price differentials by industries

Price differentials have been published for end use categories, only Kajaste (1992) gives estimates for production branches. Also in that case the estimates refer to aggregates, i.e. to open and sheltered sectors. The solution used in the GIER study was to fix the degree of price adjustment on the basis on consumer prices and transform them into producer prices using a priori information about different sectors and input-output connections between final demand categories and producing sectors. The main hypothesis is that in the open sector world market prices, i.e. the law of one price, are accepted and that integration can bring competition also to the sheltered economy producing for the domestic market. But this is only a simplistic picture of the real world.

A more realistic way to classify industries is that of Kajaste (1990) where two extreme groups of producers are not directly affected by the integration at all. Indirect effects include e.g. input prices and investment decisions. For example, the paper industry and its price level is independent of integration alternatives and on the other extreme e.g. retail trade is to a large extent again directly unaffected by integration. Between them there remain sectors which might be affected already by the EEA effects and those which would be affected by the EC membership.

The conclusion of Kajaste can still be elaborated upon. Firstly, a change in the general price level will change the profitability also in the open and already integrated sector both via input prices and wage costs. On the other hand membership decisions will almost certainly influence future investment decision especially with respect to their location. One extreme alternative is that the only country in EEA but outside EC is Finland and that all new capital formation by Finnish firms will be inside the EC. The same reasoning can be used for the strictly sheltered economy where the general price level will change both the price and through purchasing power also respective demand.

Table 2. **Price levels in different manufacturing sectors and their potential effect with respect to GDP,** EC = 100

	affected by EEA	affected by EC	completely sheltered
Price level in Finland	110	155	180
Effect as a share of GDP %	0.5	3.5	5.6

Source: Kajaste (1992), estimates based on OECD purchasing power calculations of 1985. The effect with respect to GDP has been estimated as the difference of production valued in current and EC prices.

The distinction between different integration alternatives has to be derived from two sources. In the EEA alternative border control will remain and thus all those barriers of trade which are based on the existence of borders might remain. Subsequently, the effects in the EC depend at least partially on the tariff barrier against third countries. The main hypothesis of Kajaste is that the already strong industries would gain of the EEA alternative but with full EC membership also less competitive industries have to adjust. That would imply difficulties e.g. for the textile industry if the EC alternative is adopted while metal manufacturing would benefit in both alternatives. With respect to prices this classification used by Kajaste does not give very clear results. Instead of discussing open and sheltered economies one should rather elaborate on the possible channels of integration effects or starting from the causes for price differentials.

8.5 Causes for price differentials and their relative importance

A lot of causes have been presented by several writers, Kajaste (1990) has been cited already and Wieser (1990), too. Similar reasoning can be found in OECD (1991) and ETLA et al. (1990). All writers seem to believe to some extent in the law of one price which is affected in the Nordic countries also by the high per capita income. The ways to abolish unnecessary price differentials include at least:

- abolishing barriers of trade and entry both over the border and domestically
- economies of scale
- increasing competition, both import competition and domestic competition
- increasing efficiency in various markets
- diminishing market segmentation
- specialization according to comparative advantage

In Finland the consensus society of negotiating interest groups has sometimes been mentioned as a reason for lacking competition, too. In the Norwegian study, Revidert nasjonalbudsjett 1990, the effect of government purchases are mentioned separately. Indirect taxation could be handled separately but also as a factor allowed by existing border control.

Existing border control is one prerequisite for differentials in tax rates and monopolies, thus the EC membership would increase the necessity for tax harmonization. Existing experiments in the EC and e.g. in the US seem to allow differing tax rates to some extent. Total harmonization of indirect taxation with the exception of value added tax would ceteris paribus imply about a 3 per cent cut in the consumer price level in Finland, a bit less than the effect of adopting EC producer prices in agriculture. These two effects would already with constant real wage costs account for about 40 per cent of the price convergence proposed earlier. Actual tariffs and restrictions on the border are already meagre with the exception of agriculture. Domestical barriers of entry are probably more efficient and numerous and more difficult to abolish. Competition policy has been renewed at the end of the 80's but there are still obstacles enough. Referring to the tables above, licensed production in pharmaceuticals is only one example; licenses are necessary for restaurants, market stores cannot be located freely, and the language itself is a kind of technical barrier. A detailed description of detailed trade barriers can be found in OECD (1991).

According to theory, production should be distributed according to comparative advantage. Forest reserves and a qualified labour force can be considered as Finnish natural resources hence no big changes should occur. On the contrary, major changes due to integration would result from the natural disadvantage for agricultural production. For other branches the effects of this factor might be small and no actual difference between the EEA and the EC can be distinguished.

The question of economies of scale is of importance for Finland. Firms of suitable size for the European market can be located also far

in the north but quite obviously that probability will depend on the EC membership. Diminished costs will be the result but there is no certainty that the increased production would be located in Finland unless there are competitive resources and a suitable athmosphere for investments. Referring to the price levels and their changes above, the development in communication is at least to some extent due to this factor.

Increased import competition can be fostered also by abolishing barriers of trade. There might be an overall price effect on consumer prices through wholesale activities, i.e. direct imports by independent retailers may cut consumer prices. Market segmentation implies higher prices for domestic supplies also in the case of tradables produced by a domestic exporter. The clearcut hypothesis of world market prices in all tradables is not supported by consumer price level data although the relative expensiveness can be at least partly due to domestic delivery marginals. Another way to express these causes for price differentials is to express them in the form of market inefficiency, the law of one price is not the actual guideline.

Market imperfections can be found also in factor markets. The widening price differentials in Finland in the 80's were exacerbated by restricted labour supply. Free movement of production factors is one cornerstone of integration but as with prices wage differentials they are not abolished overnight, the convergence might be even slower compared to that of prices. It is often assumed that there are not very many EC citizens who would be eager to move voluntarily to Finland. Still the effect on the labour market is real and in labour intensive service production the effect might even be bigger. One effect that should not be understated is the possible labour supply originating from the economies in transition if they would be integrated to a greater extent to the EC.

In the GIER study on integration the increased efficiency in the production factor markets is of importance. The convergence of prices to a relatively lower level although through lower inflation rates implies at least a possibility for nominal wages to adjust respectively. Otherwise, the typical Nordic phenomenon of high service prices together with world market prices in other sectors is still highlighted. There are no differences assumed in labour mobility in the EC and EEA alternatives, the main methodological change in calculations is to assume that there is increased labour mobility and respectively increased adjustment in nominal wages in both alternatives compared to the current situation. In model calculations nominal wages only react to different price changes.

8.6 The effects of EC membership

The macroeconomic calculations concerning the effects of the possible EC membership as compared to the EEA alternative were made using the Ministry of Finance marcoeconomic model KESSU IV. The model is an econometric model with 30 production sectors, about 20 consumer categories and a fairly disaggregated public sector including indirect taxation. The exposed export sector is modelled in the long run as a supply driven classical economy whereas the sheltered economy consists of Keynesian demand driven industries. The model is a dynamic one which in normal simulation applications will reach a new equilibrium. In the EC calculations the new equilibrium was approximated by the situation in the seventh year after full membership without transition periods.

Calculations were made and reported separately concerning four main assumptions; EC producer prices for agriculture, other producer price adjustment, harmonization of indirect taxation and EMU effects on interest rate differentials. The effect of third parties was not included and neither was the effect of possible changes in investments abroad. Because of the supposed change in labour market behaviour wage reactions were exogenized in the simulations. The effects of membership in the European Monetary Union implying a convergence of interest rates to the German rates is not discussed here while its price effects were negligible. Interest on invested capital is a cost element but the price effects according to the model are small.

The assumption used for wages was to fix the real wage in each successive simulation in order to find the potential gain due to each separate assumption. If consumers would benefit from all price cuts without nominal wage reactions the final effect of increased consumption in a supply driven model in the long run would be restricted to the effects of the reduced interest rate differential. The assumption of a given real wage could be acceptable if the assumed free mobility of production factors has real effects and if the behaviour in wage formation differs from the historical incomes policy solution.

In practice the assumed 13 or 19 per cent price cuts in consumer prices were taken as the starting point, producer prices and indirect taxes were adjusted exogenously using an assumption of changes by industries. The exogenous changes in producer prices were adjusted upward to the point when the assumed change in aggregate consumer prices was reached. All the time nominal wages were adjusted in order to fix the real wages. The a priori set of changes in producer prices was maintained in agriculture and food production, prices of exposed

export industries were left untouched and the rest was determined mainly using the estimated price differentials in end use categories.

The assumed change of 19 per cent in consumer prices as the total change could be devided into three effects of almost equal size, 7 per cent due to EC agricultural policy, 6 per cent to harmonization of accises and the rest of the 6 per cent to other producer price adjustment. On the other hand about half of this total effect and half of each separate effect is due to the assumed fixed real wage. With fixed nominal wages the total price cut would be reduced to 10 per cent and with endogenous wages using old wage equations the result would be even smaller.

Aggregate economic effects of lower producer prices in agriculture are mainly positive. EC producer prices at the moment would be one half of current Finnish producer prices which with constant input prices outside agriculture and food processing would lead to a substantial drop in entrepreneurial income in agriculture. EC membership would also include abolished barriers on agricultural trade. The assumed drop in food prices including beverages was 30 per cent which still leaves scope for some price segmentation. With fixed nominal wages and indirect taxes the effect on food prices would be around 15—25 per cent depending on pricing behaviour and productivity changes in food processing. Using the current equations in the KESSU IV model the effect would be 17 per cent for food prices and 23 per cent for producer prices in food processing, ceteris paribus. The current price differential according to table 1. is almost 40 per cent. In the successive steps the goverment balance has not been restored in every step, reduced agricultural subsidies if used e.g. for reducing taxes would make the positive effects a bit higher.

In a dynamic econometric model where wages are endogenized in the same way as in KESSU IV, i.e. in a kind of Scandinavian EFO model, released resources from agriculture do not necessarily find further use in the economy. Labour intensive production is diminished, reduced costs in the rest of the economy will partially increase wages in manufacturing and thus increased exports do not cover the increased food imports. The total effects are less impressive compared to results which would emerge from a general equilibrium model without barriers for production factors between sectors and without borders. This is the solution which is approximated in the model simulations by using exogenously fixed real wages. With a flexible exchange rate the current account deficit could be removed and the positive effects accentuated if inflation expectations are assumed away.

In the presented model simulations monopoly profits in food processing are reduced to some extent but production volumes

increase rather than decrease due to increased consumption. Old import functions estimated during the period of import restrictions might easily miss the real changes in a new regime, but this is only one critical point in the calculations.

The effects of the more general price adjustment in step 3 are also positive. The main channel for positive results is the change in relative producer prices. With given world market prices for the export sector, decreased prices in the domestic market due to increased competition and reduced costs should increase the profitability of export production. The potential price adjustments would be greater in a country where the price differentials have been higher. The assumed reaction of nominal wages accelerates the positive effects. If wages were assumed endogenous and old historical equations were used, production and price effects would at least be halved.

The results by industries in model simulations reflect the ideas presented by Kajaste. The already integrated export industries may gain more if nominal wages react to lower living costs. The result of manufacturing industries where prices go down depends on the profitability in the new regime, it also depends on deliveries to the domestic market whereas pure domestic industries with decreased costs may increase their deliveries because of increased demand. That also should increase the supply of commodities and it may be possible that new ethnic restaurants produce the new supply or foreign retail chains catch the increased demand.

The effects of lower producer prices would actually be still higher if the government balance is restored already in this phase. That could be done by harmonizing accises according to EC plans, step and column 4 in table 3. This would lead almost completely to the same balance as in the reference path, i.e. the EEA alternative. The important result is that only the increased activity and reduced wage costs in the government allows the harmonization. Otherwise there might be extra problems with the EMU's upper limit for government deficit.

The model results concerning the potential effects of EC integration can be compared to the approximate effect given by Kajaste in table 2. The magnitude is about the same, but both results are conditional, too. According to common wisdom the effects of integration ought to be more intensive when the convergence is started from a faraway position.

Table 3. **Potential macroeconomic effects of possible EC membership through various channels**

Scenarios	1	2	3	4
GDP, volume %	0.6	1.0	2.5	7.7
Private consumption, %	3.6	–	1.1	8.8
Imports, %	3.3	–	2.4	5.6
Exports, %	–0.5	–	7.7	11.4
Investment, %	–0.2	–	2.6	7.8
Consumer prices, %	–4.1	–7.0	–12.5	–19.3
Employment, %	–0.4	–	1.5	4.3
Current account, % of GDP	–0.8	–	2.0	1.4

1 EC producer prices for agriculture, food prices react respectively, endogenous wages
2 As in 1 but fixed real wages
3 Producer price adjustment in other industries added to 2, fixed real wages
4 Interest rate differential reduced by 2 percentage points and all accises are harmonized, fixed real wage The figures are differences after 7 years compared to the EEA alternative without any transition periods.

8.7 Integration effects in the labour market

The potential results presented are conditional on the assumed fixed real wage, fixed in the sense that it remains the same in both alternatives although it grows following the labour productivity development. Fixed nominal wages would reduce the positive effects in prices and production at least to one half and free wage drift might reduce it further. Thus the assumption of free movement of production factors and a new regime following the traditional incomes policy is crucial.

In the EEA alternative unemployment will remain at over 7 per cent of the labour force. The forecasted growth rate of almost 3 per cent annually for GDP depends on a fairly rapid growth in labour productivity. On the other hand the level of wages is close to the European average, when only western market economies are included. For highly skilled labour the probable outcome is a net emigration whereas for service sectors there might be net immigration from the South and East. Demographic factors do not favour large scale emigration and on the other hand cultural factors may hinder net immigration from the EC.

Anyhow no remarkable labour shortages are included in the EEA alternative. Historically, a high level of unemployment may to some extent reduce the problem of inflation. On the other hand the growth in export industries is fairly high. The result could be a diversification in wages according to productivity differentials. Centralized income agreements might be replaced by wage negotiations by unions and firms. Immigrated low wage labour in the service sector suits the proposed price convergence already in the EEA alternative and in the sheltered domestic industries, too.

The situation may change radically when the calculated increase in employment would be realized. An increase in demand about the size of over four per cent of the labour force and more than half of the unemployed in the EEA alternative surely is a danger to the assumed price convergence if there are limits to labour supply. It is also possible that slow adjustment in the labour market, slow if compared to possible adjustment in the goods market, will diminish the share of domestic supply. In that case some convergence in prices can be noticed but then it is due to increased imports only.

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9 Monetary and Exchange Rate Policy in Austria: an Early Example of Policy Coordination

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Contents

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9 Monetary and Exchange Rate Policy in Austria: an Early Example of Policy Coordination

9.1 Introduction

The evolution of Austrian exchange rate and monetary policy illustrates the benefits of policy coordination and credibility.[1] The emergence of Austria's hard currency policy followed from policymakers' recognition of the benefits from coordination of economic policy with other countries, especially with Germany. The importance of making credible both the feasibility of this policy and Austria's commitment to it emerged very soon.

Austria is a small open economy with high capital mobility; its exchange rate policy currently pegs its currency to that of a low inflation anchor currency, i.e. the Deutsche mark. Since the breakdown of the Bretton Woods Agreement, twenty years ago, however, there have been two distinct periods or regimes for Austrian monetary and exchange rate policies:

i) In the 1970s, exchange rate policy was discussed in terms of price stabilization, the ability to import stability, and the role of the real appreciation of the schilling in this process. A limited float against each currency aimed at pursuing the domestic inflation goal. Monetary measures were more discretionary during this period.

ii) At the end of the 1970s and in the 1980s, the necessary harmonization of fundamentals between the anchor country and Austria was emphasized; the idea of stabilizing expectations also became central to policy discussions. Since then, Austria's monetary policy has been characterized as a 'hard currency option'.

Policy developments in the recent period can be viewed as attempts to achieve policy coordination and to foster the credibility and reputation of the monetary authorities. A growing literature points to the significant role of credibility and reputation in economic policy in

[1] Kahn (1987) provides a useful description of the benefits and the costs of policy coordination.

individual countries, and these issues also bear great importance in the context of the European Monetary System and the European Monetary Union. Thus, the focus of discussion in Austria has also shifted to these issues. The credibility of Austria's exchange rate policy was widely achieved at the beginning of the 1980s, but challenges to this credibility, or to Austria's commitment to its policy, have occurred subsequently and are inevitable in the future. Such challenges have clarified the real economic significance of credibility and reputation and strenghtened the understanding of their role in the successful implementation of the hard currency policy.

The evolution of the Austrian exchange rate policy has been presented elsewhere (Handler 1989, Hochreiter and Knöbl 1991, and others), so only a short historical outline is presented in the next section. Then we examine some evidence on the effects of changes in Austrian policy coordination.

9.2 The evolution of the hard currency policy

When the Bretton Woods System came to an end and the United States closed the gold window in August 1971, Austria had to reconsider the anchor for its exchange rate and monetary policy. A free float was not seriously considered because of the supposed uncertainties connected with it, and especially the impact of these uncertainties on contracts. It was widely believed that these uncertainties would permanently lower economic activity and make it more volatile. As a result, Austria was one of the first countries to monitor an effective exchange rate and to use it as an 'indicator' for policy.

The indicator comprised the currencies of nine important trading partners (German mark, Swiss franc, Dutch guilder, Belgian franc, Swedish, Norwegian and Danish krona, Lira and Pound Sterling). These were not exactly the most important trading partners. The French franc, for instance, was not included, nor was the dollar. The nine currencies were weighted into a basket according to their trade weights (only trade in goods was taken into account, not trade in services or capital transactions).

The adoption of such a basket as an indicator for policy was based on Austria's National Bank Act which defines price stability as the primary task and responsibility of the Austrian National Bank. Article 3 of paragraph 2 explicitly says that the Bank "...has to ensure with all the means at its disposal that the value of the Austrian currency is

maintained with regard both to its domestic purchasing power and to its relationship with stable foreign currencies."[2]

Following the breakdown of the Bretton Woods Agreement this task was interpreted as requiring that the value of the schilling be stabilized relative to currencies with relatively stable domestic prices, that is, currencies whose external value had been rising relative to other countries with higher inflation rates. This was expected to keep the rise of Austrian import prices relatively low. In a small open economy with a high import content in production and consumption, with a fast pass-through of world market prices to domestic prices, which, in turn, are passed through to wages and costs, such a policy is expected to restrain the domestic price level to a correspondingly high extent. Thus, the currencies of those countries that, under floating, had inflated their economies (i.e., the Pound Sterling and the Lira) or that were devalued for reasons of competitiveness (Swedish Krona) were eliminated from the basket in the course of the following years.

In 1973, Austria unilaterally declared its adherence to the European snake, though not becoming an official member of this arrangement. Thus, between this time and 1976 there were two parallel guidelines, the snake and the indicator, but they never seriously conflicted. However, the observed depreciation of other snake currencies against the German mark implied, given attempts to stabilize the indicator, a concomitant weakening of the schilling against the Deutsche mark, as long as the snake's fluctuation limits (+/- 2 1/4 %) were adhered to. This problem was resolved first by doubling the band acceptable to Austria and then by dropping the snake orientation altogether and pegging the schilling exclusively to the German mark.

This change in the orientation of the exchange rate regime was also a consequence of another related Austrian innovation, the role of real appreciations in the 'hard currency policy'. In 1974, inflation had surged world-wide in the wake of the first oil price shock. In Austria the rate of inflation approached 10 per cent. Because of the pass-through effects that were inherent in the Austrian system of social partnership, the schilling was revalued by 4 1/2 per cent to bring inflation down.

It was clear that this hard currency policy would result in a real appreciation and in a worsening of the current account. Both effects, however, were accepted by the policymakers as they were confident

[2] This dual stability objective is only consistent if the value of the schilling is pegged to currencies which enjoy a stable purchasing power. The subsequent evolution of exchange rate policy can perhaps best be understood in terms of these twin objectives.

that the domestic economy would adjust to the new exchange rate level in due course. There was also the conviction that an alternative exchange rate policy that focused on competitiveness or employment would not succeed because wage earners would react to devaluation-induced price increases and a 'vicious circle' would result. Experience in 'soft currency' countries had made this very clear (Hochreiter — Knöbl 1991).

Thus, three considerations were decisive for the development of the hard currency policy. First, price stability can be imported via the pass-through from the prices of imported goods to consumer prices or to the prices of production inputs. In some periods even real appreciations were accepted despite adverse effects on the current account. Second, appreciations cause a profit squeeze in the exposed sector that leads to rationalization, innovation, rising productivity, and improved structure. It also prevents excessive wage increases. Third, by these mechanisms — a lower inflation rate as a precondition for the incomes policy and a profit squeeze in the exposed sector limiting the possibilities for wage increases — some 'virtuous circle' effects are brought into play, validating the appreciated exchange rate in the longer run.

9.2.1 Stabilizing expectations

At the beginning of the 1980s, the Austrian economy faced a series of national and international problems which had effects similar to those of a negative supply shock. Again, the option of devaluation was not chosen — on the one hand because of the long held conviction that this would not produce lasting positive effects, but also because the credibility of the hard currency policy already had to be defended.

The authorities also recognized that in a world of high and rising capital mobility a devaluation would raise the variability of exchange rates and that this effect would alter the public's expectations about future exchange rates. Once a devaluation was effected — and reputation lost — these expectations would change. More volatile capital flows and movements in the interest rate differential could result. Policymakers believed that an important role of the central bank was to stabilize the market participants' expectations by reducing, as much as possible, the uncertainties about the future exchange rate.

In the short term, this is done by limiting exchange rate fluctuations to an absolute minimum through the permanent presence of the Bank in the foreign exchange market and by the adjustment of interest rates. Austrian exchange market intervention goes beyond the scope of conventional intervention. For example, it encompasses

measures to coordinate the timing of the federal government's capital imports with intervention policy (see, for instance, Tichy 1986).

In the long run, however, stabilization of exchange rate expectations can only be achieved if underlying macroeconomic aggregates, or economic fundamentals, are also stabilized. Thus, economic policy had to be coordinated with Germany if the feasibility of the hard currency option was to become and remain credible. In this respect, successful economic policy coordination was a precondition for credibility.

9.2.2 'Monopolistic coordination'

The modern focus on international policy coordination was initiated by Hamada (1976), and has largely been promoted by discussions such as the 'Group of Three (Five, Seven)' meetings about cooperation in macroeconomic policymaking and the analyses of the costs and benefits of joining the European Monetary System. The principal issue concerns the question of externalities in the choice of macroeconomic policies by individual governments due to international spill-over effects. A coordinated policy internalizes these externalities by maximizing a weighted sum of the governments' objectives.

Concern for these externalities was preeminent following the breakdown of Bretton Woods and was central to the adoption of the exchange rate management system in the 1970s and to early support for the snake arrangement. In Austria, the volatility of the foreign exchange market and the uncertainties related to it were reduced, and the advantages of fixed exchange rates regained, to a degree, by the evolution of close coordination with German monetary policy. Such coordination, in effect, extends reputational advantages (or disadvantages) of the Bundesbank to Austrian policy so long as the Austrian and German policy is credible. This policy also leads to an asymmetric convergence of fundamentals, as Austrian economic developments and policy adjust to innovations in German policy or fundamentals, but German policy and fundamental developments are independent of Austrian innovations. In effect, the German Bundesbank independently chooses its monetary policy, while Austria — taking into account its institutional and market-oriented peculiarities — 'ties its hands' on exchange rate policy and adjusts its monetary policy to international developments, transmitted essentially from the anchor currency country.

A constellation like this has been labelled 'monopolistic coordination' (Spahn 1991) and is characterised, first, by the

hegemonic position of the leading currency which is fully acknowledged by the following country. Second, this type of policy coordination can be reached without an institutional process of joint decision-making in economic policy. The basic agreement is possible because this constellation is in accordance with the interests of the partners. Austria imports monetary stability and reputation, while Germany need not take care of any adverse monetary influences coming in the opposite direction, though they should be small in view of Austria's size. Another advantage that has been shown to be valid for EMS-countries (Giavazzi and Pagano 1988) may also apply to Austria, namely that it was able to 'export' its responsibility for restrictive policies to Frankfurt, by attributing the consequences of restrictive policy to the Bundesbank.

Monopolistic coordination finds its justification in its stabilizing function. As Spahn (1991) argues: "Every monetary production economy needs an institution providing an anchor of stability for prices and price expectations. In a closed economy this job is — and should be — done by the central bank. In an open system one country has to take over the stabilising function. We should bear in mind that the Bretton-Woods system finally broke down precisely because countries with a stable monetary system were forced to import inflationary pressures from abroad."[3]

9.2.3 Monetary policy

The development of the hard currency policy required alterations of monetary policy. Generally speaking, the room for manoeuvre for monetary policy was reduced and subordinated under the exchange rate target.

From the breakdown of Bretton Woods until 1979, monetary policy tried to keep nominal long-term interest rates stable while pursuing the exchange rate objective for the indicator. The domestic interest rate level, it was believed, should be protected as far as possible from exogenous influences in order to stabilize it as a cost factor. No balance of payments problems were expected to result because of foreign exchange restrictions, market segmentation and investors' preferences (see Winckler 1977 and Glück 1977).

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[3] Belongia and Chrystal (1990) discuss some of the disadvantages of exchange rate targeting. They focus particular attention to the costs of a real exchange rate shock associated with setting the nominal rate at an initial disequilibrium level.

This interest rate component of policy was maintained until 1979, when it could no longer be defended against a sharp rise in international interest rates. After one-third of Austria's international reserves was lost, interest rate policy was redesigned from its domestic orientation towards an instrument supporting the exchange rate target. This change also reflected the view that the weakening of financial market segmentation due to liberalisation and globalisation of world capital markets, meant that domestic interest rates would have to become more closely linked to international interest rates. In Austria's case, given the exchange rate regime, this link was more narrowly to Germany, so the differential between Austrian and German rates became a target for the exchange rate policy. Especially the short-term interest rate is to be considered as an intermediate target which is controlled by means of direct interest rate policy (key interest rates, open market interest rates) or liquidity policy measures (use of the domestic or foreign source components of money supply creation).

9.2.4 The loss of monetary autonomy

The constraint on monetary policy that is imposed by a fixed nominal exchange rate and free capital movements can be illustrated by a simple (monetary) model of exchange rate determination (see, for example, Branson 1991 and Dornbusch 1980).

In the monetary approach to price determination domestic prices are a function of domestic nominal money supply and real money demand. With real money demand depending on real income and the nominal interest rate the price equation reads as follows:

(1) $p = m - ay + bi - x,$

where:

m = logarithm of the nominal stock of domestic money
p = logarithm of the domestic price level
y = logarithm of the real GDP
i = domestic interest rate
x = represents any other factor that shifts portfolio preferences
a = income elasticity of the demand for money
b = semi-elasticity of the demand for real money balances with respect to the interest rate.

The same relationship holds for the anchor country:

(2) $p^* = m^* - ay^* + bi^* - x^*$

where coefficients a and b are assumed to be equal for both countries. With open goods markets and similar consumption baskets across countries, the domestic price level is tied to the center's by

(3) $p = e + p^*$, (purchasing power parity)

e denoting the logarithm of the price of the home currency in terms of the anchor currency.

This equation can be considered as goods market arbitrage condition. (It holds less strictly, of course, the larger the share of non-traded goods.)

Under the assumption of purchasing power parity, equations (1) and (2) can be combined to an equation for the exchange rate of these two countries:

(4) $e = (m - m^*) - a (y - y^*) + b (i - i^*) - (x - x^*)$.

The model establishes that relative changes in money supply, interest rate and real income affect the exchange rate. An increase in the money supply at home leads to an equiproportionate depreciation. Because an increase in domestic real income raises the demand for real balances and thus leads to a fall in domestic prices it induces an offsetting exchange rate appreciation. Relatively higher domestic interest rates, by contrast, reduce the demand for real balances, raise prices, and therefore bring about an exchange depreciation.

With free capital movements, the domestic interest rate is tied to the center's by the financial market arbitrage condition

(5) $i = i^* + \Delta e' + rp$,

where $\Delta e'$ is the expected change of the exchange rate and rp is the risk premium.

With a nominal exchange rate peg and sufficient credibility of this policy, $\Delta e'$ would be zero.

Combining equations (4) and (5) and solving for m, the constraint on domestic monetary policy is:

(6) $m = e + m^* + a (y - y^*) - b (\Delta e' + rp) + (x - x^*)$

With e fixed, $\Delta e'$ is zero; given that rp, which is minimized when e is fixed, as well as x and x* are constants, the following first-difference (Δ) relationship holds:

$$(7) \qquad \Delta m \; s \; \Delta m^* + a_1 (\Delta y - \Delta y^*)$$

Domestic nominal money growth is therefore determined by the anchor country's money supply growth and the real economic growth differential between these two countries. As a result, inflation rates and nominal interest rates are also closely tied together when e is fixed by the domestic monetary authority. In such an economy, the central bank is restricted to influence only the sources of money creation, i.e. domestic or foreign component, but not its magnitude.

9.2.5 Credibility and reputation

Issues of credibility and reputation and their benefits have been central to the transformation of exchange rate and monetary policy in Austria over the past 20 years.[4]

Credibility refers to the extent to which beliefs concerning a certain policy conform to official announcements about this policy. To achieve credibility, the authorities must precommit themselves to a particular policy rule. Credibility may thus also be viewed as a measure of the degree to which policymakers tie their hands on future policies to their public policy announcements. Reputation, on the other hand, is the probability which the public assigns to the consistent pursuit of a certain policy. It is derived by learning over time from the actual behavior of the monetary authorities (Weber 1991).

In order to obtain credibility, two elements are needed: First, an economic program must be feasible, stand the test of professional scrutiny, and reflect the experience of, and lessons from, other episodes. Second, policy commitments must not be susceptible to the time inconsistency problem, providing incentives to change the policy direction in mid-course. Policymakers must demonstrate that they are willing to continue an announced policy. For example, the adoption of a rule-based policy framework can reduce discretion and the

[4] The role of credibility and reputation was first modeled by Kydland and Prescott (1977) and further developed by Barro and Gordon (1983). The distinguishing feature of this work is that government is not exogenous in the analysis. Policy is made endogenous by specifying a government objective function and assuming that the government maximizes its objective under the constraints imposed by private equilibrium behavior (Persson 1988).

perception of arbitrariness and, thereby, strengthen confidence in the policy-making process (Calvo and Frenkel 1991).

In the beginning, the hard currency policy was not widely perceived to be feasible (see Hochreiter and Winckler 1991 for more detail). The measures taken in 1974 were followed by a massive deterioration of the current account deficit which reached 4,4 % of GDP in 1977. The strategy became increasingly criticized and confidence that it could be maintained was low. Industry opposed this policy and favoured a real exchange rate rule instead of pegging to the German mark. There was also criticism in academic circles and international organisations.

In this period, however, the central bank did not leave any doubt that it would maintain its exchange rate objectives, and if necessary, intervene and adjust the interest rate differential to whatever level required. Key policymakers had come to the conclusion that it was the economy which had to adjust to the exchange rate and not the other way around. A deviation from the course would leave central bank, budget, and unions worse off.

Later, in October 1978, in order to placate critics of the policy, a realignment in the snake was handled in such a way that the schilling lost about 1 % against the German mark. Obviously, this change was inconsistent, so that credibility and reputation were damaged.

In 1979, however, when oil prices rose guickly in the wake of the Iranian revolution, the idea of appreciating the nominal exchange rate to keep inflationary pressures low was again brought into discussion, and in September of that year the schilling was revalued against the German mark by 1 1/2 per cent, followed by gradual appreciations until late 1981 amounting finally to 4 1/2 per cent. Since then, the schilling/mark relation remained nearly constant.

Subsequently, credibility and also reputation were rebuilt. Official and press statements increasingly supported the policy. Also industry finally dropped its opposition. Thus, the public attached increasingly high probability to the consistent pursuit of the announced policy. The argument which nowadays is often used in connection with the EMS, that by a policy of this kind a country is enabled to borrow anti-inflationary reputation from the Bundesbank by credibly fixing the exchange rate to the German mark, was first adopted, credibly maintained and validated in the Austrian case.

9.2.6 Measuring credibility

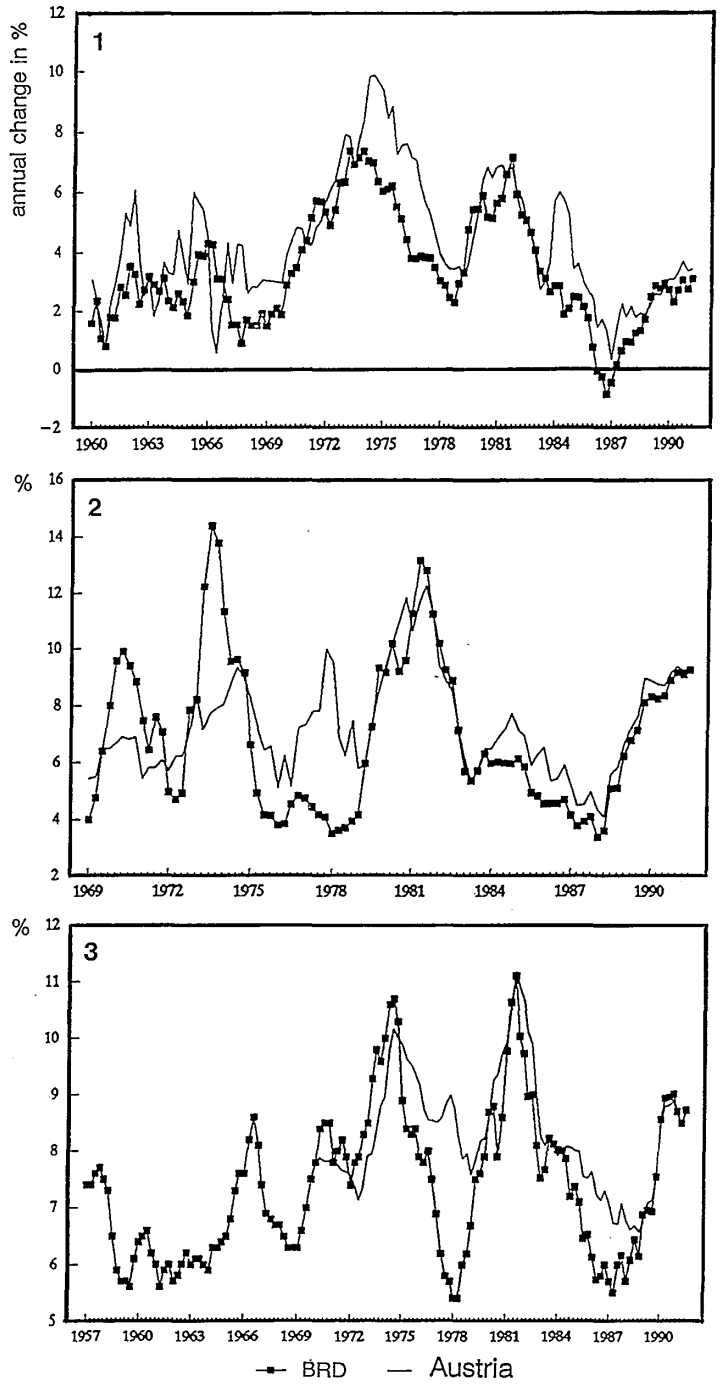
The credibility of a currency peg is often measured by the interest rate differential. A low interest rate is usually considered as the reward for a successful buildup of credibility. If the pegging country achieves better fundamentals, interest rates can even be lower than in the anchor country. This will, however, be the exceptional case. Usually the country pegging to a stable anchor currency has a positive risk premium, or interest rates are in general a bit higher than those of the reference currency. In Austria the 'necessary' interest rate differential to Germany was considered to be up to one percentage point in the early eighties, but has decreased in the wake of ever increasing capital mobility and rising credibility of Austrian exchange rate policy.

When credibility is endangered the interest rate differential may temporarily rise considerably, however. This was the experience of the Netherlands: In March 1983 an unexpected, though small, devaluation of the Dutch guilder against the Deutsche mark led to a remarkable change in market sentiment. Interest rates, which had been about three-quarters of a percentage point below German rates in the first quarter of the year, rose to about one percentage point above German rates after the devaluation. It took quite a long time until confidence was restored sufficiently to allow interest rate differentials to return to pre-devaluation levels. The Dutch central bank has interpreted this as an indication for the need to evaluate each policy measure more carefully with regard to its effects on credibility.

Similarily, Virén (1989) finds little sensitivity of interest rates in Finland, Iceland and Norway to interest rates abroad in his study on interest rates, capital movements and monetary autonomy in the EFTA countries. He concludes that relatively high domestic interest rates in these countries do not indicate a lack of capital mobility, but rather the problems these countries have experienced in terms of the credibility of the official exchange rate policy rule.[5]

[5] There may be imperfect substitutability of these assets due to tax treatment, tax or other sources of sovereign risk which mediate against this interpretation, however. Kool and Tatom (1988) provide evidence that short-term interest rates are not closely correlated across G-5 countries in the 1977–87 period. Nevertheless, long-term rates are significantly linked, so that, if real rates are arbitraged across countries, then long-run inflation rares are expected to be similar as well.

Chart 1.



1 Inflation rates (12 month percentage change in consumer prices)
2 3 month interest rates
3 Government bond yields

In Austria, credibility of exchange rate policies might have suffered between 1984 and 1987 because of a surge in domestic inflation, a deterioration in the current account and a negative growth differential. Just as in the Dutch case the rise in the interest rate differential can be considered as an indicator of this credibility loss.[6]

The inflation rate (as measured by the change in the consumer price index) surged in Austria in 1984 (chart 1) to a large part because of an increase in the value added tax (VAT) and a considerable rise in administered prices. In 1984, the 5,6 per cent Austrian inflation rate was about 2 points higher than a year earlier and about 3 points higher than in Germany; Austrian inflation (and interest rates) remained high relative to Germany until the second half of 1988.[7] Episodes like this should reinforce or enhance credibility, although it is premature to assert that this really also occurred. Nevertheless, this example of a temporary widening in the interest rate spread suggests that it is a useful measure of credibility.

9.3 Empirical evidence on convergence and coordination

The alterations in Austrian policy coordination since 1970 suggest that there should be evidence of convergence between Austrian and German economic developments, especially for nominal aggregates. The outcome for growth of output, current account, fiscal deficits, and unemployment may not be so clear on a priori grounds. Some casual evidence of convergence can be obtained by examining the data in Table 1. More direct evidence based on causality tests also is provided below.

Since the early 1970s, Austria succeeded in reducing its inflation rate by more than the reduction in Germany; generally, however, its inflation has been higher than in Germany. Chart 1 shows the rate of increase of consumer prices and the levels of nominal short and long-term interest rates. The chart also suggests that inflation and interest rates have exhibited some tendency to converge in the 1980s. Another nominal measure, unit labor costs in manufacturing, is a widely used measure for price performance and competitiveness

[6] This view is not generally held in Austria but it makes sense when looking at the data.

[7] A withholding tax on interest receipts was introduced at the same time and kept in force until mid-1986. But the tax rate was too low (7 1/2 % in 1984 and 5 % thereafter) to fully explain the rise in the interest differential.

because it largely excludes the sheltered sector. This measure also shows a tendency to converge (see table 1) because faster growth in Austrian productivity has offset faster wage growth in Austria.

According to table 1, there also has been some convergence in the growth rate of real GDP since the early 1970s, although this has been associated with slower growth for Austria. Austria's external position moved toward balance over the three periods shown in the table, but it has consistently been in deficit compared with Germany's persistent surpluses. Moreover, both the direction of movement in the middle period and the relative size of the movement toward surplus in the last period diverge in the two countries.

The fiscal deficits shown in table 1 have not exhibited convergence; the fiscal deficit worsened in the early and late 1980s in Austria, but worsened by a smaller amount in Germany in the early 1980s and improved in the late 1980s. Since 1989, of course, the German deficit has moved up (to 2,1 per cent of GDP in 1991) while that in Austria has declined (to 3,3 per cent in 1991), so that the two have converged to a degree. Finally the unemployment rate in the two countries, like real GDP growth, has moved in the same direction in each period, but the rise, especially in the early 1980s, has been smaller in Austria than in Germany. This relative success is typically attributed to Austria's specific policy mix, occasionally referred to as "Austrokeynesianism".

Generally speaking, the convergence of economic fundamentals with those of the center country has been realised to a relatively high extent. In Austria's case, the disciplinary effects of coordination to Germany were earned, but this fact did not entail tying every aspect of the real economy to the German one. The experience suggests that pegging the exchange rate does not necessarily imply that, for instance, the inflation-unemployment trade-off of the anchor country had to be fully accepted — at least not in the longer run, when the structural characteristics of the labor markets (comparatively high real wage flexibility in Austria) dominate (Hochreiter — Knöbl 1991). Also, a much less favourable current account balance was sustained in Austria over a long period.

9.3.1 Some evidence on coordination

Economic theory indicates that monetary authorities can only achieve an exchange rate objective by surrendering other objectives of monetary policy. For example, the independent use of monetary policy to achieve a domestic inflation objective requires that the exchange rate be free to reflect monetary developments abroad. Thus, in the first

of the three distinct Austrian monetary regimes identified above, the Bretton-Woods period, Austrian monetary aggregates, price level and other nominal measures were determined by the commitment to maintain a fixed price of the U.S. Dollar and other currencies. In the second regime, limited floating was allowed against each currency with the aim of pursuing a domestic inflation goal. During this period (from the breakdown of the Bretton Woods agreement (III/1971) to the breakdown of the limited-floating regime), monetary measures were more discretionary. Finally, since III/1979 Austrian monetary policy has been characterized as a "hard currency option" and has been narrowly focused on efforts to fix the DM/AS exchange rate. During this period, Austrian monetary and other nominal measures should be determined by German economic developments.

To test whether these characterizations are supported by the data, Granger causality tests are conducted for each period for the relationship between Austrian and German money stocks (Ml and M3), consumer prices, industrial production, and interest rates. If the coordination hypotheses above are correct, then in the latest period (III/1979 to IV/1989), German money, prices and interest rates should cause, in a Granger sense, their Austrian counterparts and, due to the asymmetry of the coordination, the Austria measures should have no influence on German developments.[8] That is, causality should be unidirectional. If German monetary policy becomes more causally significant for Austrian nominal developments and if monetary factors play a major role in the German cyclical experience, the cyclical experience of the two countries should also become more closely linked. To test this linkage, each country's industrial production growth is also examined.

During the previous period (III/1971 to II/1979), Austrian economic developments are expected to be less systematically influenced by developments abroad. In particular, since both Austria and Germany had floating rates between themselves and other countries, there is no *a priori* reason for a causal relation in either direction for the nominal variables. Finally, in the earliest period for which data are available (generally I/1960 to II/1971), both Germany and Austria were participants in the Bretton Woods arrangements, so

[8] The period ends in 1989 to avoid the distortionary influence of the temporary abandonment of the price stability goal by the Bundesbank when they implemented a fixed convertibility peg to the East German Mark as part of the unification process. As a result, there was a monetary shock to West Germany and countries pegging to the DM as the adjustment to this transition progressed. While the results described here should not be altered by these developments in any qualitative way, the size of the shifts,in several of the variables are large enough so that this brief experience could bias the results.

that their domestic nominal economic measures were related to a degree; in this period Granger causality could arise and in either direction.

The Granger causality test was conducted for each variable in each period using the same procedure. First, the univariate time series process of the growth rate (first-difference in the logarithm) was determined for the Austrian and German measure, then up to eight quarterly lagged values of the countèrpart variable for the other country were tested to determine if the past behavior of the measure in Germany (Austria) had statistically significant explanatory power for the same variable in Austria (Germany).[9] A five per cent significance level is used as the test criterion. For interest rates, simple first-differences of the variables are used. First-differences (▲) are used because all of the measures are nonstationary. The numbers in parantheses in table 2 to 8 are computed as t-statistics.

9.3.2 Money stock (M1)

Table 2 gives the causality tests for money stock (M1) growth in each country. The M1 data are not seasonally adjusted, so seasonal dummies are included for the first (Sl), second (S2) and third quarters (S3). The same test was conducted without the seasonal dummy variables and the results were identical. In the first period, Austrian M1 growth (M1A) is AR2, but there is evidence of causality by German M1 growth over the previous two quarters. This causality is unidirectional, as no lag of Austrian M1 growth significantly influences German M1 growth. During the second period, M1 growth is independent in each country, as hypothesized. During the latest period of coordination, there is also evidence of unidirectional causality from German M1 growth to Austrian Ml growth.

[9] The Q-statistics reported in tables 2 to 7 are Box-Pierce statistics to test for white-noise residuals with 12 lags. None of these statistics are statistically significant, indicating that the residuals for the test equations are white-noise.The test equations were also estimated using first-order moving average error processes. There is some evidence that MA1 error processes are significant for industrial production and German long-term interest rates when they substitute for autoregressive processes that are otherwise significant. The autoregressive processes used below fit the data better for the univariate and causality test equations than when the MA terms are included and insignificant AR terms are deleted. In addition, no causality test result is altered when MA terms are used.

9.3.3 Monetary aggregate M3

Table 3 presents similar results for M3 growth. During the initial period, no evidence was found for causality for M3 growth in one country by M3 growth in the other. The closest result to statistical significance is when one lag of German M3 growth is added to the reported Austrian equation; in this case, the t-statistic for this term is 1.80, which is not significant at a 5 per cent level. In the second period, there is again no causality from German M3 growth to Austrian M3 growth, but the test yields evidence of causality from Austrian M3 growth. This result is unexpected and is not consistent with the other results for this period. In the final period, German M3 growth causes Austrian M3 growth and reverse causality is rejected. The latter supports the coordination hypothesis.[10]

9.3.4 Consumer prices

Table 4 presents causality results for the consumer price index. These results are somewhat more mixed than for the other variables. In particular, in the first period, when both country's inflation rates are expected to depend more on reserve currency growth outside the two countries, there is some evidence of causality from Austrian inflation to German inflation. This result is dubious, however, because it only arises with an unusually long pure time delay of 4 to 6 quarters. In the second period, there is causality from the German rate of price increase to that in Austria. In the coordination period, the results again show that German developments play a causal role in Austria, but Austrian nominal developments, like inflation, do not cause their German counterpart.

[10] Causality tests for monetary base measures reveal an absence of causality in all three periods (the first begins in 1962 due to data availability). Both country's measures are white noise, except for the German base in the coordination period, which is AR1. This absence of causality, given the results for M1 and M3, suggests that the existing measures of the base are inadequate for capturing monetary policy actions. For example, neither measure includes excess reserves. Also, unusual movements in the currency ratio affect the base associated with a given level of the money stock. For this reason, the targeting and measurement of the monetary base was abandoned in Germany in 1990.

9.3.5 Industrial production

Table 5 shows the causality results for the growth rate of industrial production in each country. In all three periods the growth of German industrial production causes growth of industrial production in Austria. Only in the last period is there any evidence of causality from Austrian industrial production growth to German industrial production growth. This may not reflect any influence of the exchange rate regime, however, because the overall effect is zero (the sum of the lagged growth rates equals 0.2750,t = 0.92). Nevertheless the evidence is consistent with a tightening in the relationship between the real sectors of the two economy.

9.3.6 Long-term interest rates

Table 6 shows the causality results for long-term interest rates. Only the 1971–79 and 1979–89 periods are reported because of data availability. The quarterly average of monthly bond yields on 10-year government bonds are used for each country. During the limited-floating rate period, long rates show unidirectional causality from Germany and Austria, while there is bidirectional causality in the 1980s. The former result, like the CPI results above for 1971–79, suggests that monetary authorities in Austria were influenced by external developments in Germany, despite the limited floating that took place. The causality from German to Austrian long rates in the 1980s is insensitive to whether three lags, only the significant third lag, or no lags of the change in the Austrian rate are included. The bidirectional causality for long rates in the coordination period is not typical of the other results, but it suggests that adjustments in financial markets are not as asymmetric for long rates under such coordination.[11]

[11] Note that the equation for the German long rate in the 1980s indicate a *negative* effect of Austrian rates on German rates. When the two past Austrian changes are constrained to have no total effect on the German rate, however, the constraint cannot be rejected (t = – 1.09). The constrained effect is – 0.6787 (t= – 2.54) in the first quarter and 0.6787 in the next quarter. Thus, the curious-suggested causality from Austrian to German rates is a transitory result, at best.

9.3.7 Short-term interest rates

The results for short-term rates in table 7 are more consistent with the hypotheses. The short-term rate in Austria and Germany are the quarterly averages of monthly interest rates on 3-month government securities. During the latest period, the hypothesis of unidirectional causality from Germany to Austria is not rejected. During the limited-floating period, changes in short-term rates in each country are independent of changes in short-term rates in the other country. Finally, in the earliest period, there is unidirectional causality from Germany to Austria: this may reflect the dominance of the larger German economy in inducing real economic changes in Austria under fixed exchange rates.[12]

9.3.8 Cointegration of short-term interest rates

The strong, close connection between German and Austrian short-term interest rates since 1979 and its attribution to Austrian economic policy actions is supported by the causality results. Stronger evidence of this relation is found in cointegration tests.[13] For the coordination period, the cointegration vector is:

$$(8) \qquad ISA_t = \underset{(5.92)}{1.7145} + \underset{(20.79)}{0.8256}\, ISG_t + R_t$$

$$R^2 = 0.913 \qquad S.E. = 0.6522 \qquad D.W. = 1.07$$

The residual, R_t, is stationary according to the Dickey-Fuller test recommended by Engle and Granger (1987). In particular,

$$(9) \qquad \Delta Rt = \underset{(-\,3.82)}{-\,0.\,5394}\, R_{t-1}$$

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[12] In the fixed rate period, only the fifth lag of the change in the German rate is statistically significant and only when it is included alone instead of along with the first four lags. When the causality test is conducted with no lagged dependent variables, Austrian rates still have no statistically significant effect on German rates.

[13] If variables are cointegrated, then causality tests involving their first-differences can be biased against rejecting the absence of causality by omitting a significant lagged residual from the cointegrating vector from the causality test equation. In both of the causality equations for Austrian short-rates and for Austrian inflation such a consideration has no effect on the reported causality test results.

and no lags of the dependent variable are significant. The t-statistic is much larger in absolute value than the critical value (5 per cent) of 3.37 given in Engle and Granger, table 2.[14]

Such a strong long-run relationship between these short rates does not hold in either of the earlier periods, even though the same unidirectional causality from German to Austrian rates holds in the fixed rate period. In the floating rate period, ISG is not significant in the cointegrating vector (t = 1.88); moreover, the t-statistic on the lagged residual in testing its stationarity is only – 2.79, which is small enough in absolute value to reject stationarity.

In the fixed rate period, the cointegrating vector is:

$$\text{(10)} \quad \underset{}{ISA} = \underset{(-1.22)}{-\,0.7837} + \underset{(4.69)}{0.5897}\, ISG$$

$$R^2 = 0.319 \qquad S.E. = 2.2802 \qquad D.W. = 0.181$$

and the stationarity test results are:

$$\text{(11)} \quad \blacktriangle Rt = \underset{(-1.20)}{-\,0.\,0773}\, R_{t-1}$$

$$R^2 = 0.03 \qquad S.E. = 0.9554 \qquad D.W. = 2.10 \qquad Q(12) = 9.08$$

$$\text{(12)} \quad \blacktriangle R_t = \underset{(-1.78)}{-\,0.1161}\, R_{t-1} + \underset{(2.57)}{0.3929}\, \blacktriangle R_{t-4}$$

$$R^2 = 0.149 \qquad S.E. = 0.9382 \qquad D.W. = 2.03 \qquad Q(11) = 4.18$$

In both cases stationarity of the residual, and hence cointegration, are rejected.

Since arbitrage should tie expected real rates of return across countries together, expected inflation should also be cointegrated when nominal rates are. A check of the time series properties of consumer prices in Austria and Germany over the three regime periods indicates that they are I(2) in all three periods. Inflation is cointegrated in at

[14] The reverse cointegrating vector yields the same statistically significant evidence of cointegration in the coordination period of the 1980s and not in the other two periods.

least the second and third periods, however.[15] The cointegrating vectors and residual tests for each of the three periods are given in table 8. The coefficient on German inflation in the first period is not statistically significant at a 5 per cent level, although it is close (6.7 per cent). In the subsequent periods, the coefficient on German inflation is statistically significant and the residual is stationary, according to the significant t-values on the lagged residuals in the respective cointegration tests. Thus, inflation in Germany and Austria are cointegrated, at least since the breakdown of the Bretton Woods agreement. It is not surprising, then, that nominal interest rates have been cointegrated since 1979; indeed, it is more surprising that these interest rates were not cointegrated earlier.

9.3.9 Summary

The evidence presented in this section is strongly supportive of the hypotheses above, especially the coordination hypotheses. Money growth, inflation, industrial production growth and short-term interest rates all exhibit strong unidirectional causality from Germany to Austria in the 1980s. There is causality in long rates too, but it appears to be bidirectional. In the previous floating rate period, short-term rates, and monetary growth for both Ml and M3 are independent in each country, as would be expected with floating rates and independent monetary policies. Consumer prices show bidirectional causality during this period, however, but this may reflect the relative importance of common external price shocks on both countries. Finally, in the first period when policy in each country was constrained to a fixed exchange rate regime, the results are mixed. M3 growth in each country shows complete independence from the other, but Ml growth and short-term interest rate changes show unidirectional causality from Germany to Austria, while inflation shows a peculiar reversal of this unidirectional causality.

[15] The augmented Dickey-Fuller test for cointegration indicates that the levels of consumer prices in Germany and Austria are cointegrated in only the last period, III/1979 to II/1991. This result is marginal, however, and only marginally better than in the first period. In particular, in the latest period the t-statistic on the lagged residual (when a significant fourth and eight lagged dependent variable are included) is –3.23, only slightly larger in absolute value than the critical value of –3.17, or the –3.16 value obtained for the first period. In the first period, the first four lagged dependent variables are statistically significant and included.

9.4 Conclusions

Austrian monetary and exchange rate policy have evolved quite successfully into a coordinated policy that has improved the performance of the Central Bank in achieving its twin objectives of stabilizing the internal and external value of the currency. In this process, policymakers have sought to exploit the advantages of credibility by building a reputation for sticking to their policy. The evidence presented suggests they have succeeded. These accomplishments have not been without a few major departures that temporarily cost reputation, however.

Austrian coordination is one-sided or monopolistic by choice, but also by necessity. A more discretionary Austrian exchange rate policy would have created only minor external costs abroad, so that foreign policymakers would have had little incentive to forceably impose or negotiate a coordinated policy with Austria. On the other hand, the relative importance of international trade to Austria and its commitment to price stability require that foreign externalities be minimized. The movement from the Bretton Woods arrangement, which, in principle at least, provided a degree of trade, exchange rate and domestic price stability until it broke down, through the limited floating regime to the current hard currency policy offers interesting contrasts in efforts to secure the Central Bank goals and their outcomes.

The discussion and evidence show that by passively coordinating domestic monetary policy to German monetary policy decisions through the active enforcement of the fixed exchange rate, Austria has successfully tied its nominal economic performance — its inflation rate, interest rates and nominal income growth — to Germany's. These outcomes were the deliberate choice of policymakers who saw these nominal outcomes to be superior to the alternatives available through other policies and who recognized the independent benefits for the economy of building (by importing) credibility and reputation for commitment to the hard currency policy. These accomplishments have apparently not required tying the real performance of the Austrian economy to any adverse permanent real consequences of German monetary policy, in particular, to its inflation-unemployment trade off.

The principal risk of Austrian-style coordination, which now has spread to several other countries, is that the center country will temporarily abandon its commitment to price stability. In this event, like the breakdown of Bretton Woods, the small open economies would unexpectedly and passively confront the same implicit choice. The twin goals of stabilizing the external and internal value of the

currency will not be met without finding a new anchor. The unprecedented pressures on German monetary authorities created by unification and their response to it suggest that such concerns are easily overstated.

Periodic challenges to policymakers' commitments, like those examined in the paper, show that temporary departures from policy commitments can have relatively high real costs to the economy. Because such departures have reputational effects, these costs persist. Thus, the case for stability in policy rules, even in the face of perceived short-term inefficiencies in these policies, appears, from the Austrian perspective, to be as strong, or stronger, than proponents of the critical role of reputation have suggested.

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Table 1. **Convergence of fundamentals**
Mean (standard deviation)

	Austria	Germany
Inflation (%)		
1971–78	6.6 (1.97)	5.2 (1.51)
1979–84	5.2 (1.42)	4.5 (1.49)
1985–89	2.2 (0.71)	1.3 (1.25)
Unit Labor Cost (%)		
1971–78	6.1 (5.21)	5.6 (3.87)
1979–84	2.0 (3.38)	3.1 (3.77)
1985–89	0.1 (2.83)	1.5 (1.71)
Real GDP Growth (%)		
1971–78	3.6 (2.42)	2.7 (2.33)
1979–84	2.0 (1.71)	1.6 (1.73)
1985–89	2.6 (1.22)	2.7 (0.98)
Current Account Balance (% of GDP)		
1971–78	-1.5 (1.35)	1.2 (0.77)
1979–84	-0.8 (1.32)	0.1 (1.22)
1985–89	-0.1 (0.25)	4.0 (0.98)
Fiscal Deficit (% of GDP)		
1971–78	-2.6 (1.85)	-1.4 (1.08)
1979–84	-3.9 (1.08)	-2.0 (0.34)
1985–89	-4.5 (0.48)	-1.2 (0.36)
Unemployment Rate (% of Labor Force)		
1971–78	-1.9 (0.23)	3.0 (1.71)
1979–84	3.2 (1.19)	6.6 (2.48)
1985–89	5.2 (0.30)	8.7 (0.52)

Table 2. **Some causality results for money growth (M1) in Austria and Germany**

Period 1 (I/1960 – II/1971)

$$\dot{M}1A_t = -\underset{(-0.82)}{0.0078} + \underset{(1.42)}{0.2166}\,\dot{M}1A_{t-1} - \underset{(-3.72)}{0.5467}\,\dot{M}1A_{t-2}$$

$$+\underset{(1.10)}{0.1675}\,\dot{M}1G_{t-1} + \underset{(2.51)}{0.3855}\,\dot{M}1G_{t-2}$$

$$+\underset{(0.94)}{0.0088}S1 + \underset{(3.18)}{0.0408}S2 + \underset{(3.61)}{0.0473}S3$$

$R^2 = 0.89$ S.E. = 0.0093 D.W. = 2.00 Q(10) = 3.70

<u>M1G causes M1A</u>: $F_{2,35} = 4.44$; critical value = 3.26

$$\dot{M1G}_t = \underset{(13.44)}{0.0435} - \underset{(-16.39)}{0.0750}\,S1 - \underset{(-1.07)}{0.0048}\,S2 - \underset{(4.36)}{0.0200}\,S3$$

$R^2 = 0.885$ S.E. = 0.0107 D.W. = 1.42 Q(12) = 9.69

<u>M1A does not cause M1G</u>

Period 2 (II/1971 – III/1979)

$$\dot{M1A} = \underset{(0.72)}{0.0086} - \underset{(-0.82)}{0.0139}\,S1 + \underset{(1.11)}{0.0189}\,S2 + \underset{(2.48)}{0.0422}\,S3$$

$R^2 = 0.231$ S.E. = 0.0339 D.W. = 1.62 Q(12) = 4.97

<u>M1G does not cause M1A</u>

$$M1G = \underset{(6.19)}{0.0437} - \underset{(-11.24)}{0.0966}\,S1 + \underset{(1.02)}{0.0130}\,S2 - \underset{(-4.31)}{0.0354}\,S3$$

$$+\underset{(2.18)}{0.3918}\,\dot{M1G}_{t-1}$$

$R^2 = 0.851$ S.E. = 0.0142 D.W. = 2.00 Q(11) = 8.30

<u>M1A does not cause M1G</u>

Period 3 (III/1979–IV/1989)

$$\dot{M1A} = \underset{(0.07)}{0.0003} - \underset{(-5.25)}{0.0636\ S1} + \underset{(6.93)}{0.0809\ S2} - \underset{(-0.37)}{0.0027\ S3}$$

$$+ \underset{(3.48)}{0.6937\ \dot{M1G}_{t-1}}$$

$R^2 = 0.760$ S.E. = 0.0158 D.W = 1.53 Q(12) = 8.13

<u>M1G causes M1A</u>

$$\dot{M1G} = \underset{(14.35)}{0.0554} - \underset{(-13.11)}{0.1184\ S1} - \underset{(-1.82)}{0.0159\ S2} - \underset{(-10.25)}{0.0554\ S3}$$

$$+ \underset{(2.90)}{0.4305\ \dot{M1G}_{t-1}}$$

$R^2 = 0.899$ S.E. = 0.0118 D.W. = 1.99 Q(11) = 8.29

<u>M1A does not cause M1G</u>

Table 3. **Some causality results for M3 growth in Austria and Germany**

Period 1

$$\dot{M3}A = \underset{(0.52)}{0.0030} + \underset{(3.89)}{0.0140}\,S1 + \underset{(5.34)}{0.015}\,S2 + \underset{(8.06)}{0.0213}\,S3$$

$$+ \underset{(2.70)}{0.4179}\,\dot{M3}A_{t-1}$$

$R^2 = 0.607$ S.E. = 0.0054 D.W. = 1.79 Q(11) = 9.22

<u>M3G does not cause M3A</u>

$$\dot{M3}G = \underset{(10.92)}{0.0444} - \underset{(-3.12)}{0.0125}\,S1 - \underset{(-2.98)}{0.0097}\,S2 - \underset{(-2.94)}{0.0100}\,S3$$

$$-\underset{(-2.74)}{0.4592}\,\dot{M3}G_{t-5}$$

$R^2 = 0.541$ S.E. = 0.0070 D.W. = 1.82 Q(11) = 8.54

<u>M3A does not cause M3G</u>

Period 2

$$M3A = \underset{(6.68)}{0.0401} + \underset{(2.21)}{0.0118}\,S1 + \underset{(0.47)}{0.0024}\,S2 + \underset{(2.51)}{0.0136}\,S3$$

$$- \underset{(-2.75)}{0.5065}\,M3A_{t-8}$$

$R^2 = 0.203$ S.E. = 0.0102 D.W. = 1.80 Q(11) = 5.12

<u>M3G does not cause M3A</u>

$$\dot{M3}G = \underset{(14.32)}{0.0458} - \underset{(-7.49)}{0.0339}\,S1 - \underset{(-6.40)}{0.0290}\,S2 - \underset{(-5.49)}{0.0249}\,S3$$

$R^2 = 0.672$ S.E. = 0.0091 D.W. = 1.75 Q(12) = 9.50

<u>M3A does not cause M3G</u>

Period 3

$$\dot{M3A} = \underset{(6.12)}{0.0151} + \underset{(2.18)}{0.2838}\ \dot{M3G}_{t-1}$$

$R^2 = 0.08$ S.E. = 0.0102 D.W. = 1.58 Q(12) = 11.44

<u>M3G causes M3A</u>

$$\dot{M3G} = \underset{(20.28)}{0.0335} - \underset{(-10.08)}{0.0241}\ S1 - \underset{(-11.81)}{0.0283}\ S2 - \underset{(-9.90)}{0.0232}\ S3$$

$R^2 = 0.810$ S.E. = 0.0055 D.W. = 1.70 Q(12) = 13.30

<u>M3A does not cause M3G</u>

Table 4. **Causality results for the rate of increase of consumer prices in Austria and Germany**

Period 1

$$\dot{P}A_t = \underset{(7.60)}{0.0150} - \underset{(-0.46)}{0.0541}\ \dot{P}A_{t-1} - \underset{(-5.48)}{0.6487}\ PA_{t-2}$$

$R^2 = 0.401$ S.E. = 0.0085 D.W. = 2.10 Q(12) = 9.43

<u>$\dot{P}G$ does not cause $\dot{P}A$</u>

$$\dot{P}G_t = \underset{(0.33)}{0.0012} + \underset{(1.01)}{0.1570}\ \dot{P}G_{t-1} - \underset{(-3.45)}{0.5868}\ \dot{P}G_{t-2} + \underset{(0.05)}{0.0060}\ \dot{P}A_{t-1}$$

$$+ \underset{(1.56)}{0.1715}\ \dot{P}A_{t-2} + \underset{(1.55)}{0.1968}\ \dot{P}A_{t-3} + \underset{(2.81)}{0.3536}\ \dot{P}A_{t-4}$$

$$+ \underset{(0.01)}{0.0012}\ \dot{P}A_{t-5} + \underset{(2.30)}{0.2463}\ \dot{P}A_{t-6}$$

$R^2 = 0.423$ S.E. = 0.0053 D.W. = 1.84 Q(9) = 7.93

<u>$\dot{P}A$ causes $\dot{P}G$</u>: F6,34 = 2.92, critical value = 2.49

Period 2

$$\dot{P}A_t = \underset{(-1.93)}{-0.0064} - \underset{(-2.97)}{0.6190}\ \dot{P}A_{t-1} - \underset{(-2.33)}{0.4074}\ \dot{P}A_{t-2} - \underset{(-3.30)}{0.5549}\ \dot{P}A_{t-3}$$

$$+ \underset{(1.62)}{0.4247}\ \dot{P}G_{t-1} + \underset{(0.79)}{0.1919}\ \dot{P}G_{t-2} + \underset{(0.90)}{0.2200}\ \dot{P}G_{t-3}$$

$$+ \underset{(4.42)}{0.9315}\ \dot{P}G_{t-4} + \underset{(2.52)}{0.6664}\ \dot{P}G_{t-5} + \underset{(2.09)}{0.4901}\ \dot{P}G_{t-6}$$

$$+ \underset{(3.00)}{0.8077}\ \dot{P}G_{t-7}$$

$R^2 = 0.649$ S.E. = 0.0042 D.W. = 1.87 Q(9) = 5.96

<u>$\dot{P}G$ causes $\dot{P}A$</u>: $F_{7,21}$ – 7.87; critical value = 2.49

$$\dot{P}G_t = \underset{(0.35)}{0.0009} + \underset{(2.02)}{0.3177}\ \dot{P}G_{t-1} - \underset{(-1.52)}{0.2481}\ \dot{P}G_{t-2} + \underset{(1.42)}{0.2334}\ \dot{P}G_{t-3}$$

$$+ \underset{(3.65)}{0.5897}\ \dot{P}G_{t-4}$$

$R^2 = 0.598$ S.E. = 0.0040 D.W. = 1.84 Q(8) = 5.16

<u>$\dot{P}A$ does not cause PG</u>

Period 3

$$\dot{P}A_t = \underset{(1.42)}{0.0030} - \underset{(-1.05)}{0.1621}\,\dot{P}A_{t-1} + \underset{(0.37)}{0.0475}\,\dot{P}A_{t-2} - \underset{(-0.94)}{0.1183}\,\dot{P}A_{t-3}$$

$$+ \underset{(3.48)}{0.4713}\,\dot{P}A_{t-4} + \underset{(2.77)}{0.5570}\,\dot{P}G_{t-1}$$

$R^2 = 0.457$ S.E. = 0.0060 D.W. = 1.72 Q(8) = 8.51

<u>$\dot{P}G$ causes $\dot{P}A$</u>

$$\dot{P}G_t = \underset{(1.04)}{0.0012} + \underset{(5.13)}{0.7010}\,\dot{P}G_{t-1} - \underset{(-2.54)}{0.4016}\,\dot{P}G_{t-2} + \underset{(4.00)}{0.5155}\,\dot{P}G_{t-3}$$

$R^2 = 0.540$ S.E. = 0.0044 D.W. = 2.18 Q(9) = 2.63

<u>$\dot{P}A$ does not cause $\dot{P}G$</u>

Table 5. **Causality results for industrial production growth in Austria and Germany**

Period 1

$$\Delta LIPA = \underset{(2.52)}{0.0120} - \underset{(-3.47)}{0.4884}\,\Delta LIPA_{t-1} + \underset{(2.40)}{0.4135}\,\Delta LIPG_{t-1}$$

$$+ \underset{(1.15)}{0.1879}\,\Delta LIPG_{t-2} + \underset{(2.17)}{0.3570}\,\Delta LIPG_{t-3}$$

$R^2 = 0.261$ S.E. = 0.0214 D.W. = 1.68 Q(11) = 7.94

<u>IPG causes IPA</u>

$$\Delta LIPG = \underset{(4.11)}{0.0124}$$

$R^2 = 0.0$ S.E. = 0.0203 D.W. = 1.75 Q(12) = 13.41

<u>IPA does not cause IPG</u>

Period 2

$$\Delta LIPA = \underset{(1.57)}{0.0055} + \underset{(1.42)}{0.2875}\,\Delta LIPG_{t-1} + \underset{(2.15)}{0.4390}\,\Delta LIPG_{t-2}$$

$R^2 = 0.217$ S.E. = 0.0192 D.W. = 2.54 Q(12) = 6.67

<u>IPG causes IPA</u>: $F_{5,26} = 3.53$; critical value = 2.64

$$\Delta LIPG = \underset{(1.70)}{0.0053} + \underset{(2.11)}{0.3747}\,\Delta LIPG_{t-1} - \underset{(-0.66)}{0.1287}\,\Delta LIPG_{t-2}$$

$$+ \underset{(1.10)}{0.2105}\,\Delta LIPG_{t-3} + \underset{(0.72)}{0.1419}\,\Delta LIPG_{t-4} - \underset{(-3.21)}{0.5779}\,\Delta LIPG_{t-5}$$

$R^2 = 0.290$ S.E. = 0.0165 D.W. = 1.68 Q(7) = 4.33

<u>IPA does not cause IPG</u>

Period 3

$$\Delta LIPA_t = \underset{(2.31)}{0.0056} + \underset{(2.36)}{0.3164}\ \Delta LIPG_{t-1}$$

$R^2 = 0.10$ S.E. = 0.0153 D.W. = 2.07 Q(12) = 15.03

$$\Delta LIPA_t = \underset{(1.24)}{0.0031} + \underset{(2.42)}{0.3377}\ \Delta LIPA_{t-5} + \underset{(2.82)}{0.3617}\ \Delta LIPG_{t-1}$$

$R^2 = 0.197$ S.E. = 0.0145 D.W. = 2.02 Q(11) = 9.10

<u>IPG causes IPA</u>

$$\Delta LIPG = \underset{(0.40)}{0.0012} + \underset{(0.89)}{0.1280}\ \Delta LIPA_{t-1} + \underset{(2.78)}{0.3974}\ \Delta LIPA_{t-2}$$

$$- \underset{(-2.19)}{0.3098}\ \Delta LIPA_{t-3} - \underset{(-1.63)}{0.231}\ \Delta LIPA_{t-4} + \underset{(2.07)}{0.2906}\ \Delta LIPA_{t-5}$$

$R^2 = 0.250$ S.E. = 0.0146 D.W. = 2.25 Q(12) = 7.42

<u>IPA causes IPG</u>: $F_{5,36} = 3.72$; critical value = 2.48

Table 6. **Causality results for long-term interest rates in Austria and Germany**

Period 2

$$\Delta ILA = \underset{(0.27)}{0.0124} + \underset{(2.48)}{0.3864}\ \Delta ILA_{t-1} + \underset{(2.40)}{0.2384}\ \Delta ILG_{t-1}$$

$R^2 = 0.292$ S.E. = 0.2566 D.W. = 1.81 Q(11) = 3.37

<u>ILG causes ILA</u>

$$\Delta ILG = \underset{(0.03)}{0.0022} + \underset{(3.13)}{0.5183}\ \Delta ILG_{t-1}$$

$R^2 = 0.221$ S.E. = 0.4353 D.W. = 1.85 Q(12) = 7.58

<u>ILA does not cause ILG</u>

Period 3

$$\Delta ILA = \underset{(-0.02)}{-\ 0.0011} + \underset{(2.09)}{0.2746}\ \Delta ILA_{t-3} + \underset{(3.84)}{0.3298}\ \Delta ILG_{t-1}$$

$R^2 = 0.316$ S.E. = 0.2858 D.W. = 2.06 Q(11) = 8.26

<u>ILG causes ILA</u>

$$\Delta ILG_t = \underset{(0.01)}{0.0007} + \underset{(2.92)}{0.6367}\ \Delta ILG_{t-1} - \underset{(-2.61)}{0.9463}\ \Delta ILA_{t-1}$$

$$+\ \underset{(2.31)}{0.625}\ \Delta ILA_{t-2}$$

$R^2 = 0.138$ S.E. = 0.478 D.W. = 1.90 Q(11) = 7.97

<u>ILA causes ILG</u>

Table 7. **Causality results for short-term interest rates in Austria and Germany**

Period 1

$$\Delta ISA_t = \underset{(2.25)}{0.2798} + \underset{(0.28)}{0.0307}\,\Delta ISG_{t-1} - \underset{(-0.50)}{0.0563}\,\Delta ISG_{t-2}$$

$$- \underset{(-1.72)}{0.1951}\,\Delta ISG_{t-3} - \underset{(-3.02)}{0.3496}\,\Delta ISG_{t-4}$$

$R^2 = 0.182$ S.E. = 0.7227 D.W. = 2.43 Q(8) = 12.17

<u>ISG causes ISA</u>: $F_{4,36} = 3.23$, critical value = 2.63

$$\Delta ISG_t = \underset{(0.94)}{0.1431}$$

$R^2 = 0.00$ S.E. = 1.0176 D.W. = 1.87 Q(12) = 17.01

$$\Delta ISG = \underset{(1.46)}{0.2448} - \underset{(-3.26)}{0.3503}\,\Delta ISG_{t-5}$$

$R^2 = 0.086$ S.E. = 1.0319 D.W. = 1.89 Q(11) = 9.40

<u>ISA does not cause ISG</u>

Period 2

$$\Delta ISA = \underset{(-0.19)}{-0.0417}$$

$R^2 = 0.00$ S.E. = 1.1411 D.W. = 2.36 Q(12) = 6.36

<u>ISG does not cause ISA</u>

$$\Delta ISG = \underset{(0.12)}{0.0277} + \underset{(2.40)}{0.4094}\,\Delta ISG_{t-1}$$

$R^2 = 0.133$ S.E. = 1.2929 D.W. = 1.79 Q(11) = 7.05

<u>ISA does not cause ISG</u>

Period 3

$$\Delta ISA = 0.0335 + 0.5507\ \Delta ISG_{t-1}$$
$$(0.32) \quad (4.72)$$

$R^2 = 0.341$ S.E. = 0.6806 D.W. = 2.17 Q(12) = 6.49

<u>ISG causes ISA</u>

$$\Delta ISG = 0.0203 + 0.4365\ \Delta ISG_{t-1}$$
$$(0.16) \quad (3.20)$$

$R^2 = 0.184$ S.E. = 0.7958 D.W. = 2.06 Q(11) = 7.97

<u>ISA does not cause ISG</u>

Table 8. **Cointegration vectors for inflation**

I/1960 – II/1971

$$\Delta LPA = \underset{(2.61)}{0.006} + \underset{(1.89)}{0.451}\ \Delta LPG + R1$$

$R^2 = 0.05$ S.E. = 0.0106 D.W. = 2.05

$$\Delta R1 = \underset{(-10.00)}{-1.711}\ R1_{t-1} + \underset{(5.47)}{0.651}\ \Delta R1_{t-1}$$

$R^2 = 0.709$ S.E. = 0.0082 D.W. = 2.14

III/1971 – II/1979:

$$\Delta LPA = \underset{(3.16)}{0.007} + \underset{(4.94)}{0.757}\ \Delta LPG + R2$$

$R^2 = 0.43$ S.E. = 0.0054 D.W. = 1.61

$$\Delta R2 = \underset{(-4.87)}{-0.931}\ R2_{t-1}$$

$R^2 = 0.43$ S.E. = 0.0053 D.W. = 1.76

III/1979 – II/1991:

$$\Delta LPA = \underset{(2.84)}{0.0043} + \underset{(4.30)}{0.688}\ \Delta LPG + R3$$

$R^2 = 0.27$ S.E. = 0.0067 D.W. = 2.63

$$\Delta R3 = \underset{(-9.41)}{-0.864}\ R3_{t-1} + \underset{(2.52)}{0.278}\ \Delta R3_{t-4} + \underset{(2.39)}{0.286}\ \Delta R3_{t-8}$$

$R^2 = 0.79$ S.E. = 0.0053 D.W. = 2.17

10 Export Supply and the Exchange Rate

by
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Contents

10 Export Supply and the Exchange Rate

The case of a small open economy with a natural resource based export sector

Most traditional textbook models of balance and payments adjustment assume explicitly or implicitly a perfectly elastic supply of exports and imports. This is the basis for the famous Marshall-Lerner-Robinson condition, that a devaluation improves the current account when the sum of the price elasticities of *demand* for exports and imports is larger than unity. This is also the basis for the Mundell-Flemming model and its offshoots.[1]

The assumption that import supply is perfectly elastic is probably a good enough approximation in normal circumstances for industrial countries, especially small ones. The assumption that exports are determined only by the demand side is more critical. For big industrial countries where exports are dominated by the products of a large and a diversified manufacturing industry, the supply elasticity can though be expected to be high. Output that has been used to meet demand on the domestic market can be redirected to exports and it is possible to hire more labour and invest in plant and machinery and thus increase supply in the short and long run. But for a small economy with a very specialized export production, especially if it is based on the use of a limited natural resource, this might not be the case. It might not be possible in that case to increase export production in the long run on the basis of the existing export industries. The supply of exports will be limited by natural conditions. Export supply will be far from infinitely elastic. It will be nearer to zero and could in some cases be negative in the long run, as the following model demonstrates. Exports will thus be determined by the supply side and not the demand side.

The model below demonstrates this case. A small economy, that faces given prices in terms of foreign currency for its exports and imports, is assumed. It produces one export good by harvesting a renewable natural resource. The export good has no alternative demand on the domestic market.

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[1] See for instance Kenen (1985) and Krugman (1991). Krugman calls the expectations augmented Mundell-Fleming model, the "Mass. Ave." model. He states: "The first element of the canonical model is the Keynesian view that output is demand-determined at any point in time".

10.1 The resource

Given is a renewable resource. The growth of the resource stock or the biomass[2] is given by equation (1):

$$dx/dt = \dot{x} = F(x) - h(t), \tag{1}$$

where x is the size of the resource stock at time t, F(x) gives the natural growth rate of the resource and h(t) represents harvesting or extraction. It will be assumed that harvesting is equal to exports, i.e. there is no storage or processing.

The resource stock will be in equilibrium when $\dot{x} = 0$, i.e. $h(t) = F(x)$. The natural growth rate thus equals the sustainable yield at a given level of the resource stock.

It will be assumed that F(x) has certain properties, that will exclude problems which can make populations collapse if they are reduced below a certain level.[3] These problems are interesting in themselves, but are not important for the problems at hand, and would make the analysis more complicated. F(x) will thus be smooth and have the following properties:

$F(0) = F(x_m) = 0,$

$F_x(x_0) = 0$, where $0 \leq x_0 \leq x_m$

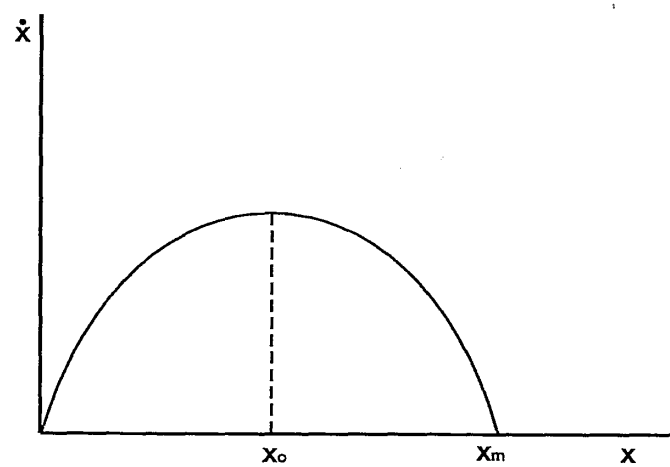
$F_{xx}(x) \leq 0$, all $x \geq 0$.

The graph of such a function could look like figure 1.

[2] The biomass should be measured in the same units as are relevant for harvesting. In the case of fish the relevant units are total weight. The size of the resource stock is then composed of the population size and the average weight of members of the population.

[3] See Clark (1976).

Figure 1. **The natural growth rate of a renewable resource**



x_m is the environmental carrying capacity. At x_0 the natural growth rate of the resource is maximized, which also gives the maximum sustainable yield of the resource.

10.2 Harvesting

Harvesting depends on effort and the resource stock. This relationship is given by equation 2.

$$h = H(f, x) \tag{2}$$

$H_f > 0$, $H_{ff} < 0$, $H_x > 0$, $H_{fx} = H_{xf} > 0$

f = production effort (e.g. number of days at sea, trawling hours etc.)

A given level of effort requires a certain amount of labour, intermediary goods and fixed capital. Substitution between these factors could be allowed for, i.e. effort could be modelled as a production function. A distinction could also be made between factors that are variable in the short run (labour and intermediary goods) and in the long run (fixed capital). By assuming irreversibility of investment decisions, a multiperiod optimization problem would be introduced. But this line of enquiry will not pursued here. Instead the following simplifying assumptions are made:

a) There is only one available technology.
b) There is a free competitive access to the resource.
c) Adjustment of effort to the profit maximizing level takes place gradually due to adjustment costs.

The first assumption means that labour, intermediary goods and fixed capital will be used in fixed proportions. Constant returns to scale are assumed, which will simplify the analysis considerably. Not much will be lost, as the interest at this stage is not in substitution between inputs, but in what happens to effort and the scale of the industry as the ratio between output and input prices is altered by changes in the exchange rate. This assumption will make it possible to concentrate on the weighted input price, which is the unit cost of effort. Formally we can write:

$$f = \min\{\beta_l * l,\ \beta_k * k,\ \beta_n * n\} \tag{3}$$

$$q = \beta_l * W + \beta_k * R + \beta_n * P_n \tag{4}$$

where

β_l, β_k and β_n are the fixed effort — labour, fixed capital and intermediate goods ratios respectively, and sum to one.
l = labour used
k = fixed capital
n = intermediate goods
W = wages
R = rental price of capital goods
P_n = price of intermediate goods
q = unit price of effort.

There are of course the usual problems with units here, the definition of the rental price of fixed capital and the fact that capital goods are long lived and usually owned by the industry. But these problems are left aside, by assuming that there is no fixed capital used.

10.3 Equilibrium

Assumption b) means that desired effort will be set at a level were total revenue equals total cost. The shadow price of the resource is not included in total cost in this case. This conclusion can be derived in two ways. The traditional one is to base the argument on free entry.[4] The same result can also be derived if the number of firms in the industry is large enough for each firm to disregard the effect of its own harvesting on the resource stock.[5] In both cases the economic rent from the resource will be completely dissipated in overexpansion of the industry. The equilibrium will then have to satisfy the following two equations:

$$\dot{x} = F(x) - H(f,x) = 0 \tag{5}$$

$$pH(f,x) - qf = 0 \tag{6}$$

$$\Rightarrow pF(x) = qf \Rightarrow f^* = p/q * F(x) = \pi F(x) \tag{7}$$

where
f^* = desired or equilibrium effort level
π = p/q = output-input price ratio in the export industry.

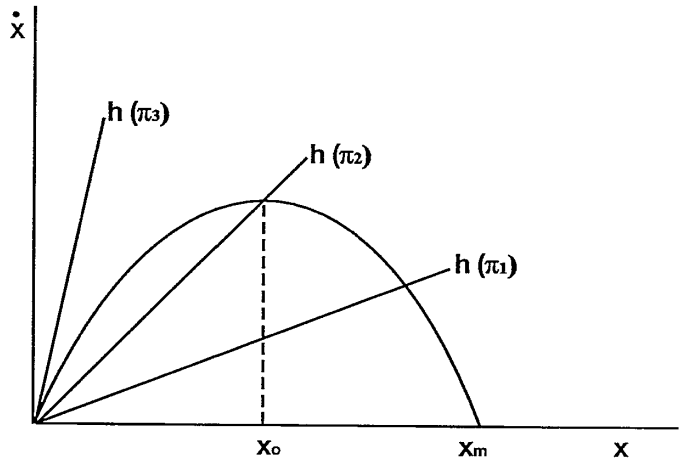
The higher π becomes, the higher the desired level of effort. Given our assumptions, π will rise with a devaluation. The exchange rate, measured by the domestic currency price of foreign currency, is denoted by e. $d\pi/de$ is the higher the lower is the response of wages to increases in import prices and the higher is the elasticity of substitution between domestic and imported goods.

The equilibrium implied by equation (7) can be demonstrated graphically as in figure 2.

[4] Gordon (1954) and Clark (1976).

[5] Arnason (1977).

Figure 2. **Equilibrium between the resource stock and harvesting**



A linear relation between the resource stock and harvesting is assumed for simplicity. It is clear that $\pi_3 > \pi_2 > \pi_1$. At π_3 the relation between ouput and input prices is such that the resource is harvested to near extinction. If the output-input price ratio is sufficiently high the resource will be completely depleted. At π_2 harvesting takes place at the level, where the resource gives a maximum sustainable yield. Although this could be interpreted as a biological equilibrium in some sense, it need not be the economic optimum. That optimum can only be derived by taking full account of the shadow price of the resource. But figure 2 shows clearly that harvesting depends on the exchange rate.[6]

The optimization problem turns out to be completely static as far as the resource is concerned. This is due to the fact that individual firms do not attach any value to the future level of the resource. If the multiperiod optimization problem would be set up formally, it would emerge that the dynamic equilibrium conditions of the firms would turn out to be the same as the static ones. This conclusion does not hold any longer, if firms take the resource stock externality into account, or there is a sole owner. The firms, of course, still face multiperiod optimization problems in their investment decisions if there are adjustment costs or some form of an irreversability.

[6] If the natural growth rate is constant over an interval, equilibrium harvesting is independent of effort and the exchange rate. The exchange rate only determines the size of the industry in this case.

10.4 Adjustment and stability

Formally, assumption c) could be expressed:

$$\dot{f} = \alpha(f^* - f) \quad 0 < \alpha < \infty \tag{8}$$

where α is the adjustment coefficient. Substituting into (8) from (5) and (6) gives:

$$\dot{f} = \alpha(\pi H(f,x) - f) \tag{9}$$

i.e. when economic rent is positive, effort is increasing as new firms are entering the industry and/or existing firms are expanding their operations, and vice versa when rent is negative.[7]

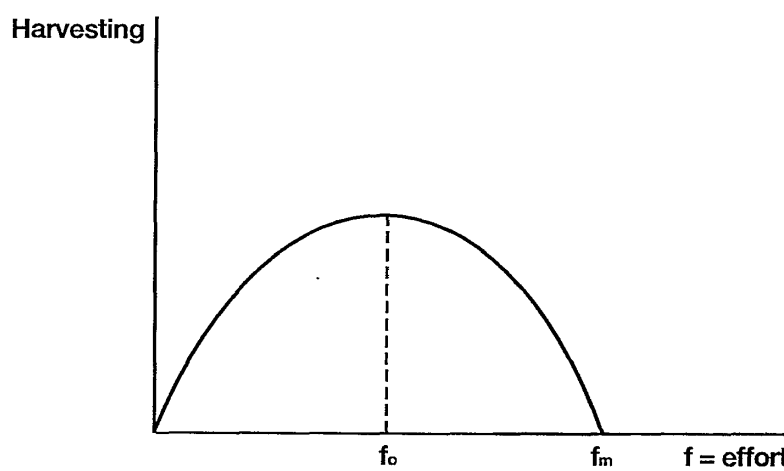
The export industry is now described by the equation for the growth of the resource and equation (9). Given that h(f,x) is increasing in both f and x and F(x) is the smooth continuous function we have assumed it to be, the system

$$\dot{x} = F(x) - H(f,x)$$

$$\dot{f} = \alpha(\pi H(f,x) - f),$$

will not have more than two equilibrium solutions. Only one of those will be stable. The case of two equilibria is demonstrated in figure 3.

Figure 3. **Stability of equilibria**



[7] The adjustment cost is here rather ad hoc. To be realistic one should assume that adjustment costs are mainly due to costs of making investments and their irreversability. But in this paper problems whith fixed capital will be ignored.

The low stock equilibrium A is unstable and the high stock equilibrium B is stable. This is demonstrated by the arrows in figure 3. This result will apply in general, when there are two equilibriums. This is shown below, were the stability of the system is investigated algebraically.

The system is linearized around equilibrium, giving:

$$\begin{vmatrix} \dot{x} \\ \dot{f} \end{vmatrix} = \begin{vmatrix} F_x - H_x & -H_f \\ \alpha\pi H_x & \alpha\pi(H_f - 1) \end{vmatrix} \begin{vmatrix} X - X^* \\ f - f^* \end{vmatrix}$$

Necessary and sufficient conditions for the stability of this system are:[8]

$F_x - H_x + \alpha\pi(H_f - 1) < 0$ and

$H_x - F_x + F_x H_f > 0.$

The following conditions are both necessary and sufficient for the conditions above to hold:

$H_x - F_x > 0$ and $H_f \geq 1.$

The first condition is always satisfied at a high stock equilibrium, as $F_x < 0$. It is also satisfied for all intervals were the growth rate of the stock is independent of the stock level. But unstability is a possibility at low stock equilibriums. In that case the natural growth rate of the stock would be higher in the neighbourhood of the equilibrium than the derivative of harvesting with respect to the stock.

10.5 Equilibrium export supply

It has been derived, that the export industry can be described by the following two differential equations.

$$\dot{x} = F(x) - H(f, x) \tag{10}$$

$$\dot{f} = \alpha(\pi H(f, x) - f). \tag{11}$$

[8] See Takayama (1985).

These two equations determine the equilibrium solutions for harvesting and the resource stock given the price-cost ratio (π). It will be interesting to analyse further the effects of changing the price-cost ratio, for example by a devaluation. That analysis will be simplified by introducing the sustainable yield curve, which gives those combinations of effort and harvesting where the growth of the resource is zero at the stable high stock equilibrium.

The sustainable yield curve is derived by solving the following system for h in terms of f:

$$F(x) - h = 0$$
$$H(f,x) - h = 0$$

The sustainable yield curve is denoted by G, i.e.:

$$h = G(f) \tag{12}$$

Differentiating the system above totally gives:

$$\begin{vmatrix} F_x & -1 \\ H_x & -1 \end{vmatrix} \begin{vmatrix} dx \\ dh \end{vmatrix} = \begin{vmatrix} 0 \\ -H_f df \end{vmatrix}$$

Using Cramers rule to solve for dh/df gives:

$$dh/df = \frac{-F_x H_f}{H_x - F_x} = G_f$$

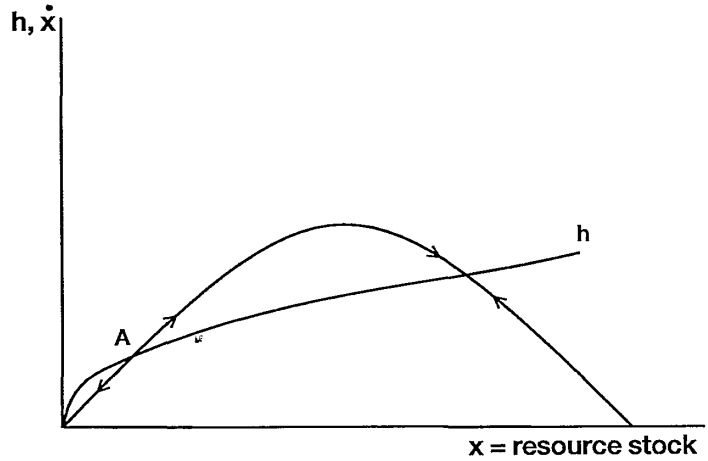
The following cases can be distinguished:

$$F_x < 0 \Rightarrow G_f > 0,$$
$$F_x = 0 \Rightarrow G_f = 0,$$
$$H_x > F_x > 0 \Rightarrow G_f < 0,$$
$$F_x \to H_x \Rightarrow G_f \to \infty.$$

If F(x) is a smooth function of the type drawn in figure 1., then G(f) will also be smooth, and look like figure 4.[9]

[9] When effort is increasing from zero to maximum in figure 4, the stock is falling from x_m, the maximum stock, to zero.

Figure 4. **Sustainable yield**



It must be noted that if the natural growth rate of the resource is constant over some interval, then the sustainable yield will also be constant over that interval.

Once the sustainable yield function has been derived, the system 10 and 11 is reduced to a single equation:

$$\pi G(f) - f = 0 \tag{13}$$

Differentiating 13 totally and rearranging gives:

$$df/d\pi = G/(1 - \pi G_f)$$

From 12 we get $dh/d\pi = G_f df/d\pi \Rightarrow$

$$dh/d\pi = G_f G/(1 - \pi G_f) \tag{14}$$

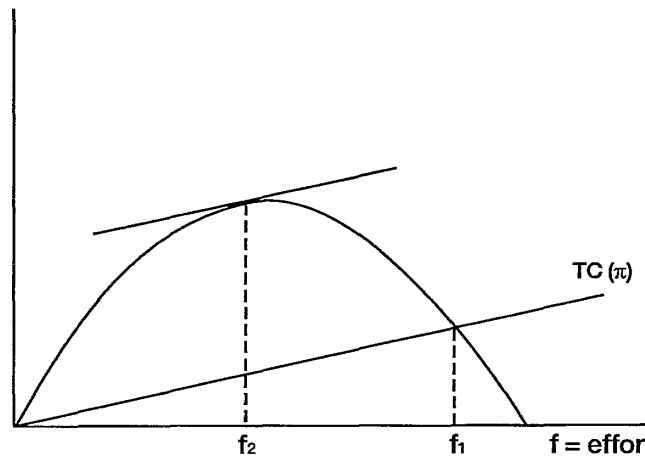
In general, G_f will change signs from being positive to being negative as effort is increased. $dh/d\pi$ can therefore be positive, zero or negative, depending on the initial level of effort. If the level of effort is high enough (and the size of the stock low enough), it is possible that a devaluation has none or a negative effect on the long run supply of exports. In this case an appreciation could be beneficial![10]

[10] This result applies only in the long-run. A devaluation will always increase export supply in the short run, provided increases in nominal wages do not wipe out the effect of the devaluation. A devaluation increases profitability in the export sector immediately. Effort increases gradually and harvesting with it. But if we are at the downward sloping part of the yield curve, stocks will begin to fall and, eventually, so will harvesting.

10.6 Optimum

Long-run equilibrium is characterised by the full dissipation of the economic rent from the resource. This result derives from free access to the resource. This situation is demonstrated in figure 5., which shows the sustainable yield curve and a total cost curve (TC).

Figure 5. **Long-run equilibrium**



The TC curve gives total cost, measured in units of exports, as a function of effort. Its slope is given by $1/\pi$ or q/P_h, the ratio between input and output prices. The sustainable yield function can also be thought of as a total revenue function.

Equilibrium occurs at effort level f_1, where total revenue equals total cost. But effort level f_1 is clearly not optimal. In the static framework that has been adopted here, effort level f_2 would be optimal, for this given π. At f_2 marginal revenue and and marginal cost are equalized and the economic rent from the resource maximized. But there is no way to enforce effort level f_2 without some kind of a resource policy. Changes in the exchange rate on its own will not enforce the optimum, as the optimum itself changes as π changes. If the exchange rate appreciates sufficiently for f_2 to become the new long run equilibrium, the optimum would move to some still lower effort level. Point f_2 might still be better in some sense than f_1, depending on the exact functional form of the sustainable yield function. If harvesting will not be lower than at f_1, then f_2 will clearly be better. Real income will be higher.

The discusssion above demonstrates that there is no simple optimum, when π becomes endogenous and/or the exchange is an active policy instrument. Overall optimum will depend on some objective function and its enforcement requires the introduction of resource policies.

10.7 Consequences and conclusions

In the model that has been presented here, the supply conditions in the export sector are such that the long run supply response to a permanent change in the real exchange rate is most likely to be close to zero or negative. This raises the question of the relevance of this result. It has to be born in mind that the model is simple and based on strong assumptions, i.e. there is only one export industry, there is no processing and there is no use for the export product on the domestic market.

Even in the case that comes first to mind, i.e. Icelandic fisheries, these assumptions are far from being met. There are other export sectors and a developed fish processing industry. Even though a devaluation can not increase fish catches, either because they are limited by natural conditions or controlled by an effective fish stock management policy, it could stimulate exports by increasing profitability and/or demand in other export sectors and through making a higher degree of processing more profitable in the fish sector. Icelandic conditions are still the same closer to the model in this paper than the traditional textbook demand determined model. It is for instance the case that the exports of marine products is usually exogenous in macroeconometric models of the Icelandic economy.

The Marshall-Lerner-Robinson condition is irrelevant in a model where the export sector is of the type presented in this paper. If both export prices in terms of foreign currency and the quantity of exports are given independently of the exchange rate, then the current account will improve with a devaluation, provided real wage resistance is not perfect and the price elasticity of demand for imports is not zero. The devaluation therefore works through reducing real incomes and imports, but not by stimulating exports. This will of course have consequences for the overall assessment of the relative merits of different exchange rate policies.

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11 Financial Development and Economic Stability

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Contents

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11 Financial Development and Economic Stability

11.1 The concept of bankruptcy

There is a fundamental difference between the Keynesian and the standard Neo-classical view on the danger of bankruptcy. In the neoclassical tradition the problem of bankruptcy disappears with the help of the assumption of future markets and perfect and uniform information among the agents. Arrow & Hahn discuss the matter in General Competitive Analysis.[1]

The essencial aspect of their proof of the existence of a *compensated equilibrium with bankruptcy* is that the deficits of the bankrupts must be balanced by surpluses of other agents in such a way that the bankruptcy have no effects on the demand. The simplest way to interpret this is, which Arrow & Hahn also mention, to think of some form of transfer system which maintain some kind of minimum guaranteed utility level. In fact it means some form of social security system. Whether or not this will be essentially the same kind of equilibrium as a competitive equilibrium is not clear.[2]

In the Keynesian theory the risk of bankruptcy has a very central position. Money payments and receipts occur in a sequential time setting and unexpected changes in demand may prevent the fulfilment of financial commitments and lead to insolvency if there are not sufficient liquid reserves.

Our analysis is attached to such a Keynesian tradition, and we regard the institutional devices of the financial system as intended to reduce the risk of economic planning during an uncertain future.

The institutional system on the credit markets also implies that it is impossible to regard the financial system as a perfect market system. There will always be information differences between insiders and outsiders.

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[1] K.J. Arrow & F.H. Hahn (1971) "General Competitive Analysis" Holden-Day, Inc. San Francisco, USA. The two main parts of the book where they discuss the problem of bankruptcy are ch. 5.5 "Equilibrium with Debt and Bankruptcy" and ch. 14 "The Keynesian Model". There is also an important remark in ch. 6 on page 151, remark 2 which should be read in relation to remarks 3 and 4 on the same page.

[2] In remark 2 on page 121 they write: "The conditions under which this compensated equilibrium is a compensated equilibrium and, indeed, the exact definition of a competitive equilibrium with bankruptcy remain open questions".

Our analysis is an intent to find out how the sudden and violent changes which according to Keynes characterizes the marginal efficiency of capital, as it is dependent on the expectations of future yields and as the basis for such expectations are very precarious, yet is part of an economic system which is not violently unstable, according to Keynes' own words.

Can the financial system explain such a contrast? Has the financial development stabilizing effects on the real economy?

Stability may, however, have two different meanings in relation to a general equilibrium framework. On one hand we could define stabilizing forces in the financial sector as such forces which counteract changes in the expectations caused by exogenous factors in such a way that the original equilibrium will maintain. On the other way we could define stabilizing forces as such forces on the financial markets which make the economy to converge more quickly to an equilibrium corresponding to a new set of expectations. In the latter case the new equilibrium will obvious be different from the original if the converging process will imply revaluations of assets which are non-flexible. If the society has some form of political goals which are fulfilled in the first equilibrium but not in the latter, the financial sector will make the economy unstable from a political point of view. In economic texts these two views on stability are often confused. Both interpretations are obviously acceptable from a theoretical point of view, but they refer to different problems. From a political point of view the first interpretation should be the most interesting.

If we discuss stability in a relation to a growth process the financial development could help to limit the changes of the actual growth and make actual and warranted rate of growth to converge.[3] Another approach is according to Minsky when the financial sector increases the instability of the economy in such a respect that an insignificant weakening of the real growth rate develops into a deep crises.[4]

Concerning the problem of stability the difference between a general crisis and local disturbances should be stressed. In a centrally planned economy the authorities must intervene in both types of crisis, as bottle necks in production or employment cannot be accepted. In a market economy the authorities need not bother about sales difficulties

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[3] Harrod, R.F. (1963), Themes in Dynamic Theory. The Economic Journal, Sept., vol 73, pp. 401–421.

[4] Minsky, H. Financial Crises, financial systems and the performance of the economy. In Private Capital Markets (eds) I. Friend, H. Minsky and V. Andrews, Prentice Hall, Englewood Cliffs, N.J.

in individual enterprises if the market process is reasonably efficient. But if there is a general crise concerning the whole economy the central bank is obliged to act as lender of the last resort. That means that the banking system will get all the credit it needs from the central bank. But the central bank can enforce its conditions for giving this credit and by a restrictive interest rate policy it may force the banking system and business to change their policy.

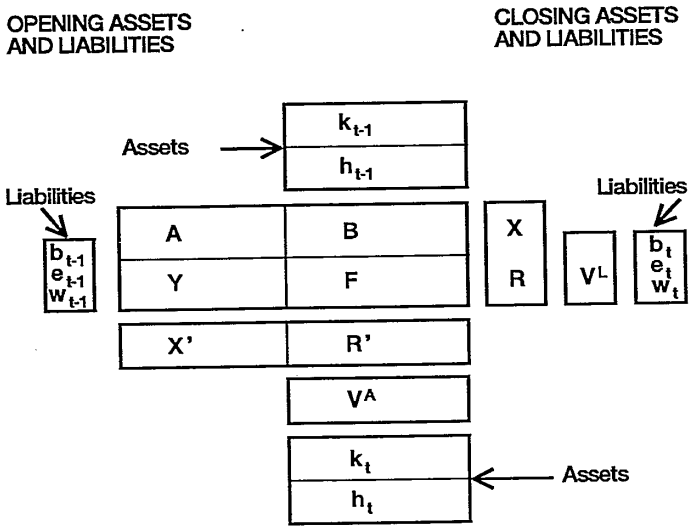
11.2 The financial structure

An institutional sectorization of the economy, which may be described with the help of the transactions table in fig. 1, makes it possible register the different sectors' types of assets, which are an inheritance from the past. But the current valuations of these assets, and the will to increase them by investments, is determined by the expectations of future profits. These future gross profits represent a series of planned cash flows, which may be completed by loans and new issued capital, if the expected future profits are satisfactory and expected to lead to increasing capital values.

In order to assure a future production growth the business must not only increase the production capital by net investment. It may also be necessary to make financial investments in shares to control competing firms, or in order to get capital incomes during cyclical recessions in its own production field. It may also have to build up reserves of liquid assets in form of bonds and cash, if the future credit possibilities are uncertain.

To these commitments in the form of increased assets should be added the contracted transfers as for instance taxes, interests and dividend. The financing analysis will show how these commitments are met by cash, either as a result of current net profits, by issues of loans or new equity capital or by selling of assets. The structure of the firms' liabilities is dependent on the relative importance of these sources of finance. Particularly the relation between debts and equities is considered of importance for the growth process. The study of these relations may start from a flow of funds analysis in order to find conditions for the future survival of the firm. It may also go directly to the structure of assets and liabilities and study how the changes in this structure influence the income development. We shall consider how Minsky has used a flow analysis and Malinvaud a stock analysis in order to clarify the importance of the financial conditions for the development of the real growth.

Figure 1. **Transactions' table for period t**



The transactions' table in figure 1 shows an enlarged input-output system. The following matricies are included in the system:

A intermediary products
B finished products
Y imports and factor servicies
X gross products
F matrix showing financial transactions including transfers and credits
R current financial resources

Around the system of current transactions are indicated opening and closing assets and liabilities. The assets include:

k real capital
h financial assets

The liabilities include:

b debt
e equities
w wealth

To these matrices a vector is added indicating assets and liabilities revaluations, V^A and V^L respectively.

11.3 Financial conditions for economic growth

The firms' assets create a flow of cash by the firms' participation in the production process. The cash flow is its anticipated sales revenues minus anticipated costs for inputs. In the transactions table a set of anticipated gross profits have been denoted $P_{1e},...,P_{ne}$. Besides gross profits, firms may have transfer income from financial assets and from government subsidies etc. which increases the cash flow. We will for the moment exclude such income. For planned investment it is a necessary condition that:

$$\sum_{i=1}^{n} P_i^e > 0 \tag{1}$$

$$\sum_{i=1}^{n} P_i^e > \sum_{i=1}^{n} T_i \tag{2}$$

Where T denotes the anticipated payment commitments which are created by liabilities.

The value of the firm, called E, is the capitalized value of the net cash flows:

$$E = \sum_{i=1}^{n} k_i(P_i^e - T_i) \tag{3}$$

k takes into account the Keynesian uncertainty factor and depends on the market interest rates on different risk or uncertainty classes of assets. The relation is variable over the business cycle.

There are different types of financing with different demand on the condition that anticipated gross profit must exceed anticipated payment commitments. If this relation is planned for each future period the investments are financed by "sinking fund finance" (SFF or "hedge finance"). As long as expectations of future cash inflows are not disappointed, future contractual payments are assured and neither the holder nor the lender need fear insolvency.

For many types of firms such strong financial conditions are not possible. During some periods payment commitments exceed gross profits. It is first during later periods that the gross profit exceeds payment commitments. This financing is called floating fund finance (FFF) and can be written:

$$P_i^e < T_i^e \quad (i = 1,...,m;\ m \text{ small})$$
$$P_i^e > T_i^e \quad (i = m + 1,...,n;) \tag{4}$$

This type of finance is also called "speculative finance" and may be the result of speculation in falling interest rates of the long market.

But as Minsky notes (p. 22), it is also the normal financial situation in some types of firms as a result of institutional rules. Banks and other financial institutions, which receive short credit from the public and has to accept that their portfolio to a great extent includes securities which are in reality of long character, must use floating fund finance.

There exists an extreme form of floating fund finance for which the payment commitments exceed the gross profits up to the last period of the investment project. Minsky calls this type "Ponzi finance" and it can be written:

$$P_i^e < T_i^e \quad (i = 1,...,n-1)$$
$$P_n^e > T_n^e \tag{5}$$

This type of finance is also of great practical importance, as many big investment projects may last several years and yield no revenue until the projects are finished.

Floating fund finance, including Ponzi-finance, is of course specially sensitive to change in economic policy, involving monetary restrictions and rising interest rates, as the firms are then obliged to constant refinancing of their positions.

During a general cyclical stagnation this refinancing may be curtailed and firms using floating fund finance may go bankrupt. The resulting short cut in payments will affect firms which normally have sinking fund finance. They may also develop floating fund finance and get refinancing problems.

This development will lead to increasing demand for liquidity and money and therefore produce falling prices on equity and bond markets.

Minsky notes (p. 26) that the stability of a financial system depends on the weight of sinking fund finance in the total private financial structure. The smaller the weight of sinking fund finance, the greater the possibility of a financial crisis, because the greater the likelihood that rising interest rates will lead to present-value reversals. Present-value reversals may result in the abandonment of investment projects that are under way and a decrease in new investment

undertakings. Minsky points out that, if there is no possibility to refinance positions, the upper turning point in the business cycle is completely endogenous (p.32).

Malinvaud starts his analysis of firms' risk of insolvency.[5] This is a consequence of the uncertainty about the future development and the fact that an important part of the firms' assets immobilized, as they represent productions means which can only be used for specific production processes. In this way the liquidity of the firms' assets are reduced, as the value of these assets will be very much diminished if the firms have to stop their activity.

Malinvaud's analysis has been simplified by O. De Bandt and P. Jacquinot.[6] The necessary condition in an overdraft economy for firms not going bankrupt is that the firms' income covers their financial charges. The income is defined as the rate of return (x) on total capital. The total capital includes equity capital ($\mathbf{e}_e$) and debt ($\mathbf{d}_e$). The interest rate is denoted r. The necessary condition for firms' income covering their financial charges can be written:

$$(\mathbf{e}_e + \mathbf{d}_e)x - r\mathbf{d}_e > 0$$
$$\text{or} \qquad (6)$$
$$x/(r-x) > \mathbf{d}_e/\mathbf{e}_e$$

This expression indicates that the debt/equity ratio may increase with firms' profitability without endanger their financial stability.

The risk that this condition will not be realized is denoted a and the corresponding rate of return is x*. Thus the probability that x > x* is (1–a) and the condition for the debt/equity ratio:

$$(1-a)x/[r-(1-a)x] > \mathbf{d}_e/\mathbf{e}_e \qquad (7)$$

Summing up, the debt/equity ratio is dependent on the rate of return, the interest rate on debt and the risk of not reaching acceptable rate of return. This relation can be written:

$$\mathbf{d}_e/\mathbf{e}_e = f(x,r,\mathbf{d})$$
$$\text{or} \qquad (8)$$
$$\mathbf{d}_e/\mathbf{e}_e = (1-a)x/[r-(1-a)x]$$

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[5] E. Malinvaud, (1981), "Théorie Macroéconomique", Paris, pp. 185.

[6] O. de Bandt and P. Jacquinot, (1991), "The Financing of Corporate Firms in France: An Econometric Model", Banque de France.

Derivating with regard to the three variables, x, r and a, we get:

$$\partial/\partial x\ (\mathbf{d}_e/\mathbf{e}_e) = (1-a)(1+ar)/[r-(1-a)x]^2$$

$$\partial/\partial r\ (\mathbf{d}_e/\mathbf{e}_e) = (1-a)x/[r-(1-a)x]^2 \qquad (9)$$

$$\partial/\partial a\ (\mathbf{d}_e/\mathbf{e}_e) = rx/[r-(1-a)x]^2$$

The debt/equity ratio shows that the capital structure of the firms is not independent. The financial markets are not perfect. The management may have to finance the deficit in particular institutes and the possibility of refinancing bank credits are often dependent on the banks willingness to take over securities which have not been sold.

According to this analysis the financial conditions concern the managements dispositions of the firms' liabilities. As they are valued in nominal terms it is only indirectly that the restriction on the debt/equity ratio is influenced by the market value of securities, by the possibilities of issuing new equities.

The financial conditions have however also to be considered from the point of view of the owners' asset preferences. The profit anticipations may be different among asset owners compared to firms' managements because of incomplete information.

We assume that the relative importance of the managements' preferences in relation to the preferences of the owners concerning investment and financing variates in accordance with the cyclical variations in factor income and in investment expenditure. In the early part of the cyclical upturn with a high profit share and a low investment propensity as a result of a relatively low capacity utilisation, the firms may have a surplus which makes loan financing unnecessary. The liquidity preference may also be insignificant. The firms' investment policy may resemble the situation which is assumed to exist according to the portfolio selection theory.[7]

This result can be explained by the fact of the firms' surplus position. The income expansion reduces the debt constraint to a minimum and increases profit expectations. These expectations will lead to rising equity prices.

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[7] There are empirical investigations which show that during such cyclical phases investment in industry develops in accordance to the Tobin Q (See G.Calganini, Market valuations, financial policies and investment decisions, Urbino 1991, pp 11—14.) It should however be noted that these empirical results can not be taken as evidence of Tobin's Q's ability to explain firms' investment demand, as the conditions in the form of perfect financial markets, completely uniform information, assimed in Tobin's theory, did not exist in the actual world during this period as Calganini notes.

There may develop an accelerated rise in equity prices because of lack of inside information on the market or because speculators become more influenced by expectations about how market will estimate the future equity price development rather than the future development of profits.

When profit share has culminated and the high capacity utilization leads to a high investment propensity, the firms will have a deficit position. The continuing growth process will be characterized by an increasing need for credit. Such a development need not produce a lack of liquidity as long as a stable growth in the demand leads to a stable growth in the asset prices. The banks will be able to continue the steady growth in credit and the households' high factor income share will result in an increasing demand for shares and bonds in households, insurance companies and pension funds.

It is particulary important for the banks that the tendency to stable or increasing prices for securities is not interrupted. Banks are in principle using floating fund finance and have therefore a vulnerable position, as they can not secure their flow of funds by time agreements. A rise in the interest rate will both hit the value of their portfolios and their liquidity positions. The profit development will deteriorate and a financial crises will develop if they are not forced to sell assets to save their liquidity position.

Minsky has analysed the interrelation between real and financial growth in a long run perspective.[8]

A stable growth rate is supposed to have existed during a fairly long time in the economy. As the expectations that growth will take place becomes more widely and more firmly held as the sustained boom continues this growth rate will influence equity and real estate prices, so they will rise relatively to debt prices, and this will occur in the absence of any rise of the price level or income.

Minsky shows the influence of growth expectations on the present value of a perpetuity \$1 per year, which is \$1/r, where r is the rate of discount appropriate to perpetuities of this particular risk and uncertainty class. Assume that instead of \$1 per year in perpetuity the expectation is that the return will grow at the rate of g % per year and that \$1 is the expected return next year. The present value of such a growing perpetuity will become \$1/(r–g). As the expectations of economic growth becomes progressively stronger — as the sustained

[8] 'Financial Crises, Financial Systems and the Performance of the Economy', in 'Private Capital Markets', (1964), Eds. I. Friends, H. Minsky and V. Andrews, Prentice -Hall, Englewood Cliffs, NJ

boom continues — the asset values which are expected to participate in the growth process will increase from $1/r to $1/(r−g).

The longer the growth process is, the higher will be the debt/equity ratio. When finally the growth process is interrupted and the expected growth rate is not realized, there will be a fall in the equity prices. The financial difficulties associated with a downturn of a given severity will tend to become progressively worse the longer the boom continues.

Financial distress exists when firms' decisions are dominated by the need to meet financial commitments. Widespread financial distress will lead to financial crises. A financial crisis has two dimensions. One is the liquidity aspect, which depends upon whether or not the financial system remains liquid and solvent. The other is the revaluation of equities and real assets, which depends upon a change in the expectations with regard to growth. It is possible for either aspect of a financial crisis to occur without the other.

The financial crisis, according to Minsky, involves a different kind of risk compared to the risk present in portfolio analysis. While risk in portfolio analysis is concerned with the expected variations in asset prices, the risk in Minsky's analysis of financial crisis depends upon the firms' possibilities to have sufficient liquidity for the discharge of contracted payments during future periods.

11.4 Some theoretical aspects on the concepts of growth, risk and uncertainty

Before we enter the discussion of growth in an economy, where we have rigidities and uncertainty, we have to discuss some essential points in dynamic theory and its consequenses for modelling economic growth. We base this discussion on Paul Samuelson's work.

Paul Samuelson discusses some fundamentals in dynamic theory in Foundation of Economic Analysis.[9] He cathegorizes dynamic systems with respect to two main characteristics, logical and historical. These two categories may then be stochastical or not.

A logical dynamic system is defined from a mathematical point of view by:

$$x_t = f[t-t^0;x_0(t^0)] \tag{10}$$

[9] P. Samuelson, (1971), "Foundation in Economic Analysis", Atheneum, New York, Fifth printing, p. 315.

This means that the development of the system is fully defined by the values of the state variables at t^0 and the distance in time between current state and t^0 This is what we may call a complete deterministic system. The agents have complete information of the relevant variables at the beginning and are all rational with constant preferences. If we introduce a stochastical element into this approach we will end up in von Newman's expected utility approach, where the agents are fully informed about the complete space of outcomes and have identical subjective probability distributions over this space, this is also the basic rational expectation model.

Another approach which also will end up in this particular specification is an intertemporal consumption choice solved by dynamic programming technique. This technique implies that we settle some terminal conditions which restrict the choice of earlier periods. The problem above could then be written:

$$x_t = g[t-t^0;x_0(t^0,B_T)] \tag{11}$$

where B_T is the terminal condition at the end of the planning period, T.

Historical time is expressed mathematically by Samuelsson:

$$x_t = f[t,t^0;x_0(t^0)] \tag{12}$$

In this system it is essential to know at what specific time the initial conditions are specified. This system will be explicitly dependent on time. The difference between logical time systems and historical systems does not need to imply any new theoretical insight into economics. If we maintain the assumption of rational agents with full information of the environment or at least a symmetric distribution of information we will arrive at more or less the same conclusions as in logical time models. The system as a whole will still be deterministic or stochastic in the same sense as the former system.

To realize the difference between the two types of systems we must focus our interest, not on the general mathematical specification of the systems but on the economic and pshychological content of our assumptions of the structure of the problem.

There are in principle two ways to vitalize the historical time model and make it qualitatively different from the logical time model.

On one hand we may attack the concept of rational behaviour in the elementary theory of preferences. In the theory of preferences we assume that the individual has complete preference ordering of goods. Furthermore we assume that this preference ordering is specified

according to the specific social, political and economic environment precisely at the time of preference formation. In a static analysis where we concentrate on the problem of existence of equilibrium we may accept the rationality concept as a reasonable simplification, if we try to avoid the more obscure methaphysical problem of the implications of the free will.[10] If we however set on for a dynamic analysis the assumption of constancy of preferences would not be equally easy to accept. In theory of production we accept that the individuals have a capacity to learn and thereby create productivity increases. We may in the same way think of learning with respect to different goods in the consumer baskets. It is well known that the social role of some goods changes over time. During the times of late King Gustav V of Sweden, who was a great tennis habitué, the social message of carrying a tennis racket was distinctly different from what it is nowadays when almost every child in Sweden at an age of more than five plays tennis on some public tennis court. What we mean here is that preferences are created not only according to physical survival but also to social survival. If we then accept a social learning process this will in itself create dynamic changes in the preference structures. By definition the specific content of learning cannot be foreseen at an earlier moment and therefore the historical time model will be qualitatively different from the logical time model.

On the other hand we may attack the assumptions of the environment of economic process. In general equilibrium theory we may either assume perfect knowledge about the future or that the agent has full information of the space of outcomes of different states of nature and has a subjective probability distribution over this space. Given this and assuming perfect future markets we may have stochastic logical time model.

If however the agents have incomplete knowledge about the space of outcomes there will be genuine uncertainty in the economic system. This means that actions based on information at one particular moment of time and which is rational relative this information could imply severe restrictions at a later time when outcomes not known to the agents have appeared. In Ekstedt & Westberg (1991) we separate four different situations in an economy with respect to risk and uncertainty:[11]

[10] G.L.S. Schackle discusses these problems in his essay "Time, Nature and Decision".

[11] Ekstedt, H., Westberg, L., (1991), "Dynamic models for the interrelations of real and financial growth". Chapman & Hall, London, p. 6.

1. The agents at the market have identical subjective probability distributions over the objective space of possible outcomes. In this case the market will be perfect and the economy will certainly converge to an equilibrium.

2. All agents concieve the same space of possible outcomes but have different subjective probability distributions. If the price system works efficiently the market process will make the probability distributions to converge. The economy will in this case converge to an equilibrium path and we will have a stochastic logical time model.

3. The agents have different conceptions of the space of possible outcomes. The union of all individually percieved spaces of outcomes will however be equal to the objective space of possible outcomes. In this case it is also possible to imagine a convergence process to some kind of equilibrium path. The information structure will be vital to the agents, but according to Radner add information to the vector of endowments and the equilibrium will then be dependent on information as well as physical endowments and preference structure.[12] In the long run it is also in this case possible to think of a dynamic model for the economy converging to a stochastical logical time model. Locally during the converging process it is possible however that a historical time model will be different to a logical time model specification.

4. The last case is when the union of the individually percieved spaces of outcomes is a strict subspace of the objective space of possible outcomes. This is the case when we have what we may call *genuine uncertainty*. If all productive resources were perfectly homogenous or all preference relation were identical it would still be possible to work with logical time models. If however there are insufficient flexibility among productive resources and the agents have different preferences, we will in this case always have the possibility of events which will change the distribution of endowments, irrespective of the information structure, and will by then create changes in relative prices. If an economy is best described by this case there are certainly no possibilities to represent its dynamic properties by any logical time model. We have to work with historical time models and the choice of starting time will be essential to the shape of the time path.

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[12] Radner, R., (1968), "Market equilibrium under uncertainty". Econometrica, 36, 31–58.

The fundamental reason why the time path in historical time models will be affected by the choice of starting time is fundamental to general equilibrium theory. In a market economy an agent could be represented by a preference relation and a vector of endowments, which could include an information structure. An equilibrium is then a unique price vector which entirely depends on the specific preference structure and the distribution of endowments. This price vector is the basic norm for indexing a dynamic development. If this norm is unchanged, which basicly means constant preferences and constant distribution of resources, the time path is unaffected by the choice of starting time. If however the economy passes through different equilibria during a time period or most of all if we accept *false trading*, that is trading at nonequilibrium prices, the choice of starting time will affect the shape of the time path.

In principle we will in such a case recieve a unique time path relative to each choice of starting time, provided that the economy has moved to different equilibria during time.

11.5 Rigidities in the economy and uncertainty

We discussed above different attitudes towards risk and uncertainty in general equilibrium theory. It was also suggested that the effects on equilibrium of the four different cases were dependent on the flexibility of the endowments. It is obvious that if all kinds of resourses are perfectly homogenous an exogenous event changing the preferences would not affect the relative valuation of the agents endowments. The only case when exogenous events affect the agents are when they are actually deprived of resources. In this case we could still save the equilibrium if we assume identical preferences among the agents.

In a production economy two steps, first forwards and then backwards, must be taken to attain general equilibrium. The first step is that the agents use their productive resources in the production process given a certain production technique. The second step is when the final goods are distributed among the agents according to their preferences and their relative participation in the production process. This is the forward direction in the physical production. To valuate the production resources however we must take the steps backwards. The valuation of the productive resources depends on the valuation of the final goods and the production technique. That implies that the pricing on the factor market is set in relation to the market for final goods. We could say that the fundamental problem in general equilibrium theory is created by the fact that the valuation process is opposite in

the time dimension compared to the physical production and consumption process. To ensure equilibrium we have therefore to impose certain conditions on both the production process and the consumption process which must be fulfilled. These conditions are in principle of two types although they are nested; conditions necessary to ensure the existence of equilibrium and conditions necessary to guarantee at least stability if prices are pertuberated in a neighbourhood of the equilibrium.

In a real economy however there are different kinds of obstacles preventing the price system to work in such a way that equilibrium is restored when there are exogenous events which induce momentous changes to the relative prices on the market. The obstacles are of course different kinds of resrictions imposed on the agents behaviour in such a way that substitution is prevented. There are two types of restrictions, on the consumption behaviour and on the production behaviour. Both these types are discussed by Keynes and we have mentioned them above.

With respect to the consumption behaviour the most fundamental type of restrictions is what we may call lexicographic preferences.[13] That means that the consumer is forced to have a certain amount of some goods irrespective of the prices. In a monetary economy these lexicographic preferences will take the form of binding liquidity restrictions. It is very important to realize that liquidity demand basicly has nothing to do with money in itself but is attached to the fact that people in order to survive in the long run certainly have to survive the presence and the near future.[14] In a real economy the demand from liquidity is not only attached to basic consumption needs but also to contractual commitments particularly on the credit market. The latter aspect is probably the most important to a production economy where producers have to decide relative to their expectations of the outcomes. We will return to this point later on.

On the production side the most important restriction is the deficient flexibility of factors of production. It is obvious that the rigidities of techniques which use production capital is the main risk creating factor to the entrepreneur. The deficient flexibility of production together with current liquidity restrictions will induce revaluations of capital assets and thereby change the distribution of incomes and wealths to change.

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[13] A more elaborate discussion about lexicographic preferences is found in Ekstedt & Westberg (1991), pp. 112–115.

[14] This should be the correct interpretion of Keynes famous remark: "In the long run we are all dead."

To build a theory of growth we have to take these to types of restrictions into consideration. To do this we will depend on the discussions in Ekstedt & Westberg (1991), chapter 2. We will omit the mathematics and proceed the discussion with the help of diagrams.

11.6 Growth when there are short-run restrictions

Assume a potential investor at a specific moment of time. The investment decision will be built on expectations of future prices of the final good and the inputs given possible production techniques. The discounted value of the expected net cash flow will then be compared to relevant alternatives and the investor arrives at a decision of the optimal volume of capital. Before the decision is taken the investor may consider various combinations of factor inputs and relations of labour and capital but once the decision is taken it will imply severe restrictions on future short-run behaviour.

It is also important to realize that the investment decision not only applies to quantities of different factors of production but also in general to actual organizations which are more or less fixed at least in the short run.

If we summarize this discussion we might say that given the state of expectations of the future the investor decides on an optimal quantity of production and given this quantity he chooses the cost-minimizing technique.

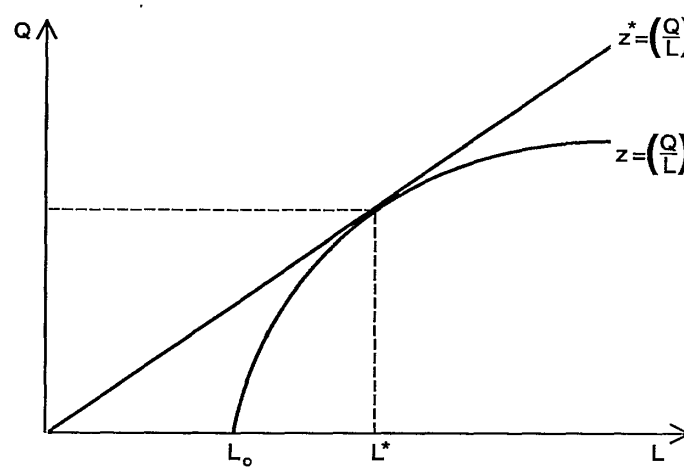
When the investment goods are installed we will have a cost-minimizing combination of labour and capital in the optimal quantity given the actual stock of invested capital.

If we now turn to the flexibility of the labour force, we have to realize that there are different kinds of labour. One type of labour is directly linked to the actual volume of production. Another type of labour is however not linked to the short run variations of production. Examples of this kind of labour are those employed in sales organizations, research departments and administrative departments. This type of labour is more attached to the production target and therefore we might see it as complementary to the capital stock.

We may now illustrate the relations between the volume of labour and the volume of production in the short run in the following figure:[15]

[15] Ekstedt & Westberg (1991), p. 44.

Fig. 2



The curve Z* represents the cost-minimizing relation between labour and production given the capital-stock, this is the maximum labour-productivity, which will be attained at the planned production volume Q*. The curve Z represents the actual labour-productivity given short-run variations in production dependent on variations in demand. The volume L_0 is the volume of labour which is not linked to the production volume in the short run.[16]

Technical growth in this model will in general have two effects. On one hand the maximum labour-productivity will be increased and on the other the ratio L_0/L^* will increase. That means that the volume of labour which is not dependent on short-run variations in production will increase in relation to the cost-minimizing volume of labour. A useful concept to discuss the development of the Z-curve in relation to the Z*-curve is the elasticity of labour-productivity with respect to changes in the production volume:

$$s = (\partial z/z)/(\partial Q/Q) \tag{13}$$

It can be shown that s varies from a positive number between 0 and 1 in the neigbourhood of L_0 to 0 in an environment of L* and then to the negative infinity along the Z-curve. It can also be shown that

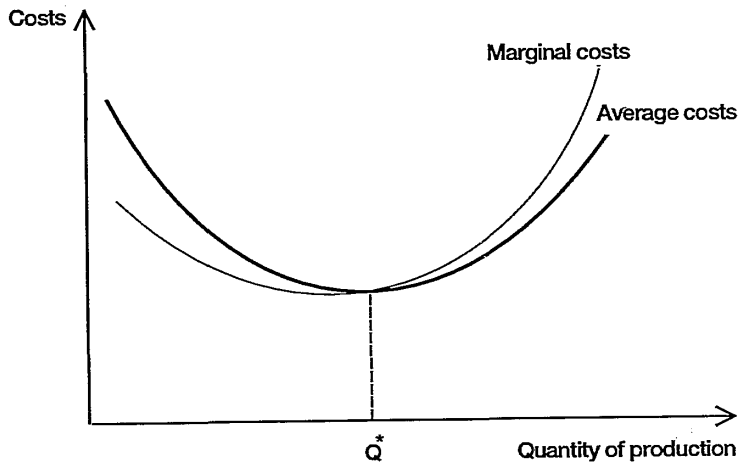
[16] Observe that we have to measure production volume in physical terms, otherwise we will not be able to analyse disequilibrium situations.The aggregation and measurement problems are discussed in chapter 2 in Ekstedt & Westberg 1991.

when the relation L_0/L^* approach 1, s will also approach 1 in a neigbourhood of L_0. It is by then possible to create a measure of the degree of the curvature of the Z-curve by the help this elasticity concept.

As is seen the locus of the short-run productivity is strictly quasi-concave. If production falls below the planned production, productivity will decrease because of the technical rigidities. On the other hand if production rise above the optimal production, productivity will also decrease because of the usual diminishing labour-productivity when the capital stock is fixed. The strict quasi-concavity is very useful in aggregation. We may think of an envelope to a set of quasiconcave functions which is quasi-concave. This implies that an aggregate short-run labour productivity function will display the same characteristics as the individual functions.

The corresponding cost-functions to the productivity curve will become:

Fig. 3



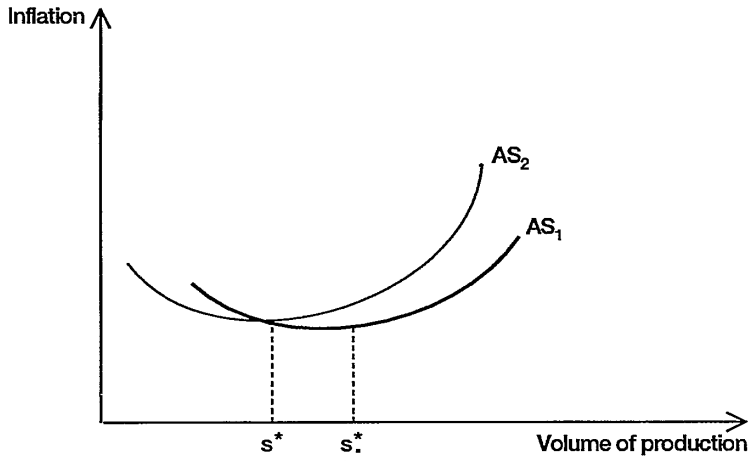
In Ekstedt & Westberg ch. 2 and 7, we give a detailed stability analysis of a closed as well as an open economy displaying production conditions indicated above. We show that in a closed economy there will be stable stagflation equilibria while the equilibria above cost-minimizing equilibria are always unstable. In an open economy there are no stable equilibria in the model which is highly simplified but catches some essential features of a real economy.

Let us look a bit closer at what happens if we have short-run variations of demand in an economy with the characteristics indicated above.

If actual demand falls below the expected the firms are not able to reduce the labour force in the same proportion as the reduction in production. The result is that the firm will face diminishing yield on capital as well as dimishing profit-share. The latter effect will obviously deteriorate the liquidity position of the firm. When demand increases from a position below the optimal production, the labour-productivity will increase and we would expect average costs to decrease. This is in the line of the empirical findings of pro-cyclical productivity and the so called Verdoorns law. In such a case the firms will experience both increasing profits and increasing profit rate, which will rapidly strengthen the liquidity position of the firms. This process will continue until demand is equal to the expected.

If actual demand rise above the expected firms have to increase their labour demand proportionally more than the increase in demand. The result of this could be that profit increases in absolute terms but the profit rate decreases. This will also imply that the liquidity position of the firm will deteriorate and the firm will experience a higher risk. The key factor in this process is the relation of price-increase to wage-increase. The concavity of the short-run productivity function makes it natural to assume that there exists an envelope which is concave. If this is the case there exists a specific volume of labour utilization which maximizes the over-all labour productivity. This volume, let us call it L*, could now be compared to the total supply of labour. If we are in the pleasant situation that L* is equal to the total supply of labour, we will have an equilibrium where the inflationary forces will be minimized. If, on the other hand, L* is below the supply of labour, an expansion of the production would result in accelerating inflation long before full employment is achieved. In some sense it is possible to define the concept of *natural rate of unemployment* within this approach, as the distance in labour utilization between L* and the potential labour force. We could also discuss two types of stagflation. One type of stagflation when the utilization of the labour force is below L* and one type of stagflation when the utilization of the labour force is between L* and the potential supply. Figure 4 below illustrates the arguments with the help of traditional Aggregate Demand-Aggregate Supply analysis:

Fig 4.



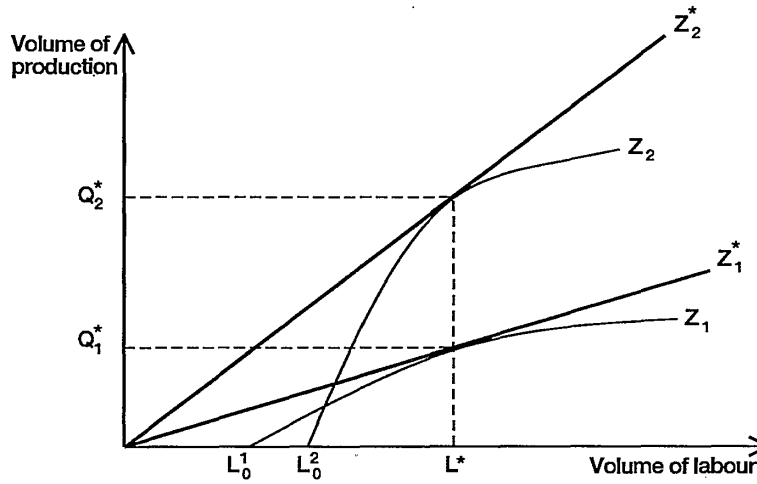
The supply curve AS_1, represents the case when optimal utilization of labour coincides with full employment while AS_2 is the case when the growth of the capital stock has been insufficient.

We may now enter the discussion of economic growth and stability of growth within this approach.

Economic growth is an interactive process between growth of demand and growth of production capacity. As we have indicated above neither of the both sides of the process is likely to behave in a simple straightforward way. Both sides are subject to short-run restrictions which makes the process vulnerable with respect to exogenous events. This is rather evident if we look at the real development of an economy. If we go back to the transactions tables in part two of this paper we realize that the short run rigidities on one hand changes the proportions between factor incomes, which will affect the inflow of liquid funds to the financial market, and on the other hand they will change the financial coefficients, that is the investment preferences, on the financial market. The important aspect is then the changes in the demand for liquidity.

Let us assume a specific moment of time with a given capital stock and given technology. The short-run productivity conditions are given by the curve Z in fig 5.

Fig 5.



The cost-minimizing production is given by Q*, with the corresponding labour volume, L*. Let the potential labour force be L_p. In Ekstedt & Westberg 1991, we show that in a *closed* economy we will attain stable equilibria if actual effective demand is below Q*, but equilibria are unstable if effective demand is above Q*. If wages follows the marginal productivity we will maintain a constant profit share. This condition could be fulfilled in the stable unemployment equilibria if wages are perfectly flexible, in an economy where we have some form of wage contracts the profit-rate and profits will decrease.[17] In the other case when effective demand is above Q* it will in general not be fulfilled in any circumstances. This means that when effective demand is low, the profit share will be at best constant but probably lower than in Q*, the demand is however insufficient relative to the capital stock. When the effective demand is above Q* profit share will deteriorate which will change the financial flows although the demand is high. In both cases we will probably have changes in the behaviour relative to the existent situation. In an open economy, as shown in Ekstedt & Westberg chapter 7, there will be an unstable situation in both. The only point where we will have no incentives to change the behaviour is when effective demand is equal to Q*.

Let us now think of a period of technological growth which on one hand increase the labour productivity and on the other changes the

[17] We could of course define the distance $L_p - L^*$ as the natural unemployment.

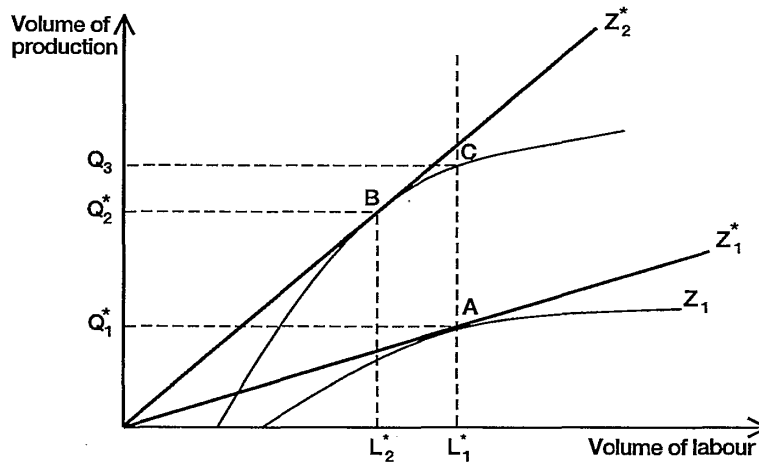
increase the ratio L_0/L^* of the short-run productivity curve. An *equilibrium growth* is then when L^* is unchanged as in figure 5. The stability of the equilibrium is however changed. The variations in the profit share will increase relative to given variations in demand. The firms perception of the experienced growth is that it implies a higher risk of capital and they will change their asset demand in order to increase liquidity. This will decrease the rate of growth of the production capital. In its turn this will cause the optimal cost-minimizing production to become less than what is regarded from social point of view as full employment. This will mean that an employment policy developed during a period when the distance $L^* - L_p$ is small will be inefficient in the respect that it creates inflationary equilibria wich will be unstable.

We will stress here that even if we experience an equilibrium growth relative to some initial price-vectors on the goods and factor markets but the technology changes in such a way that the short-run rigidities will increase, this will initiate changes in the investment behaviour of the agents as a result of binding liquidity restrictions. What happens is that the firms will experience an increased relative risk on production capital.

In the example above, fig. 5, we chose a very simple example of economic growth when L^* was constant. This implies that the growth of demand of the particular goods, which are produced by the specific production capital in question, will be equal to the technical growth rate.

If this is not the case as we exemplify in fig 6, the growth of the capital stock will decrease and the optimal level of production will in this case become point B in the figure. This example shows how the "economic-policy environment" will change dependent on the technological growth. With respect to the analysis in Ekstedt & Westberg (1990) the stability conditions will change completely if we try to achieve full-employment. If we have production less than Q^*_2 we will still have the "Keynesian case" but this will only last until we reach the optimal production Q^*_2. This production level is however not equal to full employment, which we have defined as L^*_1. Following the analysis in Ekstedt & Westberg (1990) ch. 2, the prospects for any kind of short-run policy to achieve and remain at a full-employment production level Q3 are not very encouraging since all short-run equilibria above Q*2 will be unstable. We might say that we have an increased "natural unemployment". In this situation the Phillips-curve, if we construct one according to the productivity curve z^*_2 will be steeper than the one we may construct with respect to z^*_1.

Fig. 6



11.7 Concluding remarks

In this paper we have tried to sketch out some ideas how to integrate short and long run in a dynamic context. We are not able yet to give a precise mathematical statement of the ideas but there are certain points we wish to emphazise which follows from our discussion.

First of all it is necessary to accept in all intertemporal studies, what is fundamental in general eguilibrium theory, that the only base for measuring economic development *both* from a positive *and* a normative point of view is the individual preference relations.

Secondly we have to realize that a production economy consists of rigid organizations which creates a certain degree of *inerria* in the price-system. This means that in the short-run the prices will not necessary display a market equilibrium price-vector. There exists the possibility of false trading.

The third point which we think is important is that inertia in the economy together with uncertainty of the future create instantaneously binding restrictions, particularly liquidity restrictions, which the agents must counteract in different ways. This will, as we have sketched out, change the conditions of the long-run growth as well as the short-run stability conditions and the conditions for economic policy.

It is fatal for the economic science to separate a theory of the long-run from a theory of the short-run. The history has created a certain degree of inertia in the system. The present events create the

environment of the economic process in which the valuations of the endowments are to be made. From this interaction between the past and the present it is always possible to calculate an unique general eguilibrium. If however the present valuation of the production system in different from the past valuation we will have a redistribution of endowments. Because of the inertia of the system these redistributions will not necessarily affect the price-vector of the real goods in the same degree as it will affect the price-vector of the financial market. This disequilibrium will in its turn create redistribution of endowments.

In general equilibrium, in addition to the uniqueness of the price vector, there is also a unique relation between the price vector and the distribution of endowments at the time of exchange. This implies that among other things that if we assume the economy has embarked some steady state equilibrium growth path we can expect the asset-prices to be stable relative to each other. If however there is a general increase in the risk of production of some reason, for example the reason given in this paper, the price of liquid assets will change as money and equally liquid assets are independent of the distribution of preferences in the future. This revaluation will cause redistribution of the wealth in the economy.

From these considerations it is hard to see the relevance of the recommendations that the government or other public authorities should intervene in the market process. If the society undergoes non-marginal revaluations of endowments the individual can not be expected to act according to the theoretical rules of perfect markets. It can be expected that a rational policy from the government is to maintain social stability and this will hardly be done by non-intervention policies if the market is out of equilibrium.

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