Financial Markets and Macroeconomic Policy in the Flow-of-Funds Framework

Kari Alho

ETLA
The Research Institute of the Finnish Economy

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Preface

This book is, with minor changes and additions, my thesis accepted in 1988 at the University of Helsinki.

The general problem setting of this thesis deals with the functioning of the financial markets, the transmission mechanism of the monetary policies and the variety of links between the real and financial behaviour in the economy. It is based on the work involving the construction of the flow-of-funds matrices and, starting in the late 1970's, their integration with the forecasting activities of ETLA (The Research Institute of the Finnish Economy). The study thus has quite a long history, even though the bulk of the work was completed in 1986-88.

The formulation of the theoretical macro model, which tries to describe the essentials of the above issues, was started during my visit to the US in late 1984. This part of the study has gradually been enlarged to cover around half of the study. The main inspiration of this effort stems from professor Tobin's temporary general equilibrium macroeconomic analysis, and I am grateful to him for those early discussions on the framework of the analysis. The aim of the work is to expand upon this strand of analysis and to apply it to the Finnish

conditions.

I wish to express my deep feelings of gratitude to ETLA for sponsoring the project. I am particularly grateful to my superior and close friend Dr. Pentti Vartia for enduring inspiration and backing of the project in its many difficult phases. During the work I have benefitted from discussions and critiques by my teachers and colleagues. I especially want to thank professor Erkki Koskela from the University of Helsinki, who has read several versions of the study and who has made me acquainted with a large body of literature on various issues of the study. Professor Pentti J. K. Kouri directed my early research towards the lines of the Brainard-Tobin approach. The atmosphere of ETLA has also in many ways been conducive to the research work. Especially, I want to mention my colleague Jukka Lassila, with whom I have discussed the theoretical part of the study and its formulations.

My official examiners, Dr. Urho Lempinen and Dr. Olavi Rantala, have inspired me with their comments to revise the theoretical part and consider its applicability to the current situation in the financial market as well. Dr. Markku Rahiala has kindly helped me in the statistical problems of the empirical part of the study. I wish to also express my gratitude to many colleagues at the banks financing ETLA and elsewhere, without whose profound knowledge and previous research this study could not have succeeded in finding a proper basis for problem setting and analysis.

The staff of ETLA has assisted the work in many ways. Irmeli Hietamäki and Jari Mantsinen helped me a great deal by making the computer facilities readily accessible. Tuula Ratapalo has handled the preliminary typing work. Arja Virtanen has skillfully drawn the figures. John Rogers has checked and improved the language. The final text processing has been carried out by Simo and Tuomo Riihimäki from Skuutti Co.

Finally, I want to thank my wife Anna-Liisa and daughters Hanni and Laura for their patience and understanding during the work. I am also grateful to my parents for their warm support.

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Helsinki, August 1990
Kari Alho

1 Introduction

1.1 Overview of analysis of financial markets and monetary policy in the small open economy

It is a common practice in macroeconomic analysis that new ideas are first developed and applied in the context of the closed economy and then later on modified to suit the case of the open economy. Accordingly, macroeconomics based on the ideas of Keynes initially concentrated on the closed economy case. Keynes himself briefly discussed the potential differences between open and closed economies in his General Theory. One central dispute between Keynes and classical economists was whether a cut in wages is an efficient means of curing unemployment. Keynes maintained that, in contrast with a closed economy, a cut in wages in the open economy can in principle be an efficient way of increasing employment (see Keynes (1936, pp. 262-263)). Keynes, however, stated the reservation that the terms of trade could worsen as a consequence of a cut in wages and so there would be a reduction in real incomes which would reduce the potential positive effects on employment.

The standard view of the present open economy macroeconomics is that relatively little can be done by means of monetary policy in the small open economy if the exchange rate is kept fixed. This is a result of the assumption of free capital movements and a high degree of substitutability between the domestic and foreign assets in the portfolios of the asset holders, which rapidly or even instantaneously drives the domestic interest rate to the same level as the foreign rate.[1)]

Empirical evidence does not uniformly favour these propositions. It is a fact that the extent of the integration of many small economies into the international currency and capital markets has been limited and that they have been able to control effectively their nominal as well as real exchange rates for considerable lengths of time. This is one reason for the fact that in many small countries classical elements emphasizing adjustment through product wages have been more in the foreground in the policy making than the Keynesian demand management elements of larger countries.[2)] Also monetary policy has proved to be an effective means of promoting various kinds of stabilization goals. Monetary policy has operated with assets which are not at all, or are only on a limited scale, owned by the foreign agents. This and the exchange regulations have caused so low a substitutability between domestic and foreign financial assets that there has been room for effective monetary policy measures.

The standard means of analyzing macroeconomic problems and policy effects along Keynesian lines is the Hicks-Hansen IS-LM apparatus. It was only in the late 1950s that this model was initially adapted into the open economy context by adding the net exports to it as an additional term in the goods market equilibrium condition. At the same time the balance of payments was integrated into the model. (See the review article by Kenen (1985) concerning how the Keynesian model was transformed into an open economy after the Second World War.) The pioneers of this period were Mundell, Fleming and Meade.

The theoretical problem setting in that phase was especially concerned with the effectiveness of monetary versus fiscal policy and their relative effectiveness with respect to the two goals of employment and the balance of payments, and the problem to which goal each instrument should be assigned. The cases of freely floating and fully fixed exchange rates were polar cases in the analysis. Another main institutional feature in the model is the assumption concerning the elasticity of foreign capital movements with respect to interest rates. In the above-mentioned case, which is quite commonly made in the open economy literature, they are perfectly elastic, which - in the context of no uncertainty related to exchange rate changes - means that the interest rate in the home country and abroad are equal, in the fixed exchange rate case immediately, and in the flexible rate case after the exchange rate reaches its equilibrium value. In the former case monetary policy cannot stabilize total demand and employment but has effects only on the balance of payments and foreign reserves of the central bank.[3)]

According to Fleming (1962), Mundell (1968) and Whitman (1970) (see Shinkai (1975)) the standard results produced by the Keynesian open economy models regarding the effectiveness of various policies are:

1) The more flexible the exchange rate is, the more effective monetary policy is in stabilizing output and employment.
2) In the case of fixed exchange rates, as the capital flows become perfectly elastic with respect to the difference between domestic and foreign interest rates, monetary policy completely loses its effectiveness as a means of stabilization.
3) The effectiveness of fiscal policy crucially depends on the elasticity of capital flows. The fiscal policy becomes more effective than monetary policy in the case of fixed exchange rates as the elasticity of capital flows exceeds a certain limit. This is due to the fact that the effectiveness of fiscal policies depends on the slope of the LM curve. The flatter it is as a consequence of a more elastic supply of money through the capital movements, the more effective the fiscal policies are. Finally, capital movements are perfectly elastic and there is full monetary accommodation with respect to fiscal policy. The standard result is that in an open economy with fixed exchange rates fiscal policy should be guided to stabilize employment and monetary policy to stabilize the balance of payments.

In the 1970s the Keynesian models lost their dominant position as the sole framework for open economy macroeconomic analysis. Problems concerning the flexible exchange rates, rising rates of inflation and the various supply shocks shifted the emphasis also of open economy macroeconomics from traditional demand management and balance of payments problems to questions such as the volatility of the exchange rates, to problems of price rigidities and indexation of domestic costs and to the problem of whether to pursue accommodating or non-accommodating monetary policy towards adverse supply shocks arising in the international or domestic economy. Monetarism and the monetary approach to the balance of payments began to dominate the policy debate.

The theoretical focus shifted from pure demand management problems towards considering proper monetary policy management in the context of market clearing assumptions in the labour and goods market in the classical spirit, expectations being formed rationally and errors in expectations concerning policy being the only component which matters in policy making.[4)] The most far-reaching proposition of the 1970s was that of the policy ineffectiveness by Sargent and Wallace (1975), who showed that when the market clearing and rational expectations hypotheses are combined, any systematic (feedback) monetary policy is as good - that is, as powerless - as any other policy in stabilizing the economy. This controversial result has been disputed on several grounds, and especially the hypothesis of continuous market clearing, which is crucial here, is not much favoured by the empirical evidence. (See e.g. Tobin (1980) for a discussion on these issues.) It is anyway true that the effectiveness of monetary policies crucially depends on the true wage-price mechanism and the assumptions concerning the clearing of the factor and goods markets.[5)]

The above-mentioned shift of emphasis in the macroeconomic research also caused a reduction in the share devoted to empirical macroeconomic work-often based on large-scale Keynesian models-and an increase in the volume of theoretical work often operating with models consisting of only a few equations. Nonetheless, in the actual forecasting of short-run macroeconomic developments the Keynesian models have to a large extent preserved their status as the central apparatus.

Traditionally in Finland central bank policy - covering also the exchange rate policy - was able to control simultaneously the (effective) exchange rate with exchange regulations and interventions, the nominal interest rates through administrative controls, and bank lending and the money supply by controlling the terms of the central bank debt of the banks. This sort of effective control of prices and quantities at the same time easily leads to rationing of quantities, and so calls for another kind of approach in monetary analysis. This constitutes one dividing line between the traditional monetary policy analysis, which concentrates on freely changing interest rates and control of the money supply, and the Finnish case, where the analysis has mainly started from the notion that the financial markets function imperfectly, especially the bank loan market.[6)]

In the Finnish conditions the money and bank loan markets have been closely linked to the real expenditures of the private sector. One essential cause for this is the fact that financial markets have not been cleared through interest rates so that the demand for and supply of finance would have had their effects on the market rates. The relationship between the loan markets and the real expenditures may, because of quantitative rationing, be quite close even though the interest rate elasticity of real expenditures would be relatively small. In this case we can well imagine that an easing of the central bank policy can have a direct effect on spending decisions rather than on the offsetting capital flows.

The credit rationing phenomenon has clearly been the most dominating starting point in the Finnish monetary economics research carried out extensively in the 1970s and early 1980s. The financial markets have recently been in a rapid process of change towards becoming more market or interest rate oriented, i.e. less regulated and rationed. Furthermore, there is a higher degree of integration between domestic and international financial markets. In this study we do not aim to discuss these developments in detail (see the discussion and analysis in e.g. Alho et al. (1985)).[7] It is of course true that structural changes in the financial system also change the transmission mechanism of monetary policy, which in turn necessitates changes in the starting point of monetary research. In the following we analyze problems which the changes in "regimes" cause for analysis of financial markets. We are able to give a "correspondence" result which implies that the "old" and the "new" regime can be analyzed in a unified framework, which allows us to move from describing the "old" regime with credit rationing into the "new" situation in the theoretical part of the study.

Above we mentioned the critique directed by the new classical school against the Keynesian models. There has also been another kind of critique against the Keynesian short-term IS-LM model based on the fact that it has several weaknesses of a technical nature. First, it separates the saving and portfolio decisions, because there is no consistent tracking of the saving flow and the accumulation of various kinds of assets and liabilities. There is no coordination between the demand flows for assets arising on the basis of the behaviour of the private sector and the supply flows arising from real investment, the government deficit and the current account (for more on these issues see Tobin (1980)).

In the late 1960s a new framework for monetary analysis was suggested by Brainard and Tobin (1968) in their famous article "Pitfalls in Financial Model Building". They argued "for the importance of explicit recognition of the essential interdependences of markets in theoretical and empirical specification of financial models" (Brainard and Tobin (1968, p. 99)). They suggested a "general disequilibrium" framework for the dynamics of adjustment of a general equilibrium system. The financial market submodels in the econometric models of the 1960's were typically based on equations for money demand and money supply, whereby the short-term interest rate was determined. An equation for the term structure of interest rates was then constructed to explain changes in the long-term rate, considered to be the relevant financial variable through which the transmission mechanism operated from the financial side to the real expenditure decisions. The "Pitfalls" approach replaced this by applying portfolio theory to describe the desired assets and liabilities and by introducing a consistent framework for portfolio adjustment through explicitly incorporating budget constraints of the agents (sectors). Consistent demand and supply equations were specified for a wide(r) menu of assets rather than just for money (the short-term asset) and bonds and other long-term assets, typically aggregated with bonds into a single long-term asset.

The transactions in an economy during a unit period can be described in a consistent way in the flow-of-funds matrix of the economy (see table 2.1 on page 16). Each institutional sector has a column for its real transactions and changes in financial assets and liabilities, which are considered to be imperfect substitutes for each other. Each market has a row of its own where the market equilibrium condition that the excess demands sum to zero across sectors is presented. This approach enables us to construct a consistent macroeconomic model for both real expenditure and financial assets and liabilities, which can be modified to include as special cases both the Keynesian and classical models (see Tobin (1982)).

In Finland the flow-of-funds approach has also been quite widely used, initially merely as an accounting framework at the Bank of Finland and at ETLA, and then later on also as a framework in the construction of sectoral models.[8)]

The flow-of-funds matrix taken as such is only a consistent accounting framework. It is "the task of theory and estimation to bring the columns to life by functions relating sectoral portfolio and saving decisions to relevant variables, and to bring rows to life as a set of simultaneous market clearing conditions" (Tobin (1982, p. 175)).

A flow-of-funds model built along these lines can be called a temporary general equilibrium macroeconomic model with many linkages between the real economy and the financial markets. As such it is a general, but a rather loose hypothesis. Starting with the Brainard-Tobin paper, much theoretical and empirical work has been done in this spirit.[9)] The flow- of-funds approach gives a useful framework which allows us to describe the various ways of clearing of the financial markets, to integrate the financial markets and the real economy with each other, and to describe the transmission mechanism of monetary policy in a rich and detailed manner. As we shall see, it also allows us to discuss consistently the financial aspects of fiscal policies as the government budget constraint is included in the model and is integrated with the equilibrium in the financial markets.[10)]

1.2 Goals and structure of the study

The general goal setting behind this work has been to carry out consistent theoretical and empirical macroeconomic analysis in the Brainard-Tobin framework in the Finnish conditions. We seek to improve understanding concerning the operation of the financial markets and the various channels of the transmission mechanism of monetary policies and to introduce as well some novelties into the theoretical and empirical techniques used in connection with the Brainard-Tobin framework. The theoretical framework also seeks to be loose enough to be applicable to "a prototype" of a small open economy. The main idea in chapters 2 and 3 is to build a series of macroeconomic models and to stepwise enlarge the model to include more markets and relax some of the basic assumptions made in the earlier phases. We start chapter 2 by introducing a general accounting framework which we are going to use in our analysis. We show in section 2.2 that with adequate changes the framework covers both the "old" Finnish financial markets case where administrative interest controls set by the monetary authorities gave rise to credit rationing in the bank loan markets, and the "new" system with a developed short-term money market, suspension of direct control of bank loan rates and a shift in the monetary policy tools of the central bank from fixing its lending (discount) rates into having an indirect influence on them through open market operations. These operations by the central bank started in 1987.

In chapter 2 and 3 we mainly operate with financial markets where the rates in the bank loan and deposit markets are fixed during the unit period. This does not, however, mean that the model would be "outdated". In the bank loan markets we have here excess demand for loans as an equilibrating factor, but in the case of a competitive loan market we can consistently replace this variable with some minor changes in the model by a varying loan rate of interest. In chapter 2 we also make comparisons between the model in conditions of a fixed versus a freely floating loan rate of interest. We first analyze the economy in a framework of fixed prices in order to be able to discuss clearly the main ideas concerning the links between the various financial markets and their connection with the goods market. The model is specified in a Keynesian spirit where the market for goods primarily clears through output rather than through the price level. In chapter 3 we specify the model to include supply factors, a variable price level and endogenous inflationary expectations in the spirit of rational expectations.

With respect to the basic model of an economy with interest controls and credit rationing we are able to present a macroeconomic typology which brings the model to a close correspondence with the basic IS-LM model of macroeconomics. We are also able to find conditions under which monetary policy achieves its greatest possible effectiveness with respect to influencing the real economy - and the fiscal policy simultaneously has no effect at all. It is not surprising that this situation is analogous to the monetarist case in the standard IS-LM model. We are also able to derive the other polar case with full monetary accommodation and no effect at all from monetary policies and where the fiscal policy does not at all have a crowding out effect, i.e. the "pure" Keynesian case.

Irrespective of interest controls in the bank loan markets, within the financial markets in Finland there have been submarkets, the rates in which have not been controlled by the central bank. It is interesting to analyze in a theoretical model their potential role in the transmission mechanism of monetary policies and their influence on the effect of monetary policy measures. Their role has been much discarded in previous macroeconomic research in Finland which has been coping with the central issue of operation of the bank loan market and its relationship to the real economy. In a larger framework provided by the Brainard-Tobin approach with potentially a multitude of channels and links between financial markets and the real economy, it is natural to face this issue of flexible rate markets explicitly as an issue in macroeconomic analysis.

Our analysis in chapter 2 has links to previous theoretical macroeconomic analysis in Finland and abroad. Of the earlier Finnish studies we should mention Oksanen (1980), Willman (1981), Kähkönen (1982), and Åkerholm (1982). Oksanen presented the basic analysis of an economy under credit rationing. Willman extended the model further and used it for comparative statics analysis also in the case of flexible prices. Below we are basically operating in this same area, but as we are building the model more explicitly from the financial market elements, we are also able to derive some new results and interpretations of the functioning of an economy under interest controls. Kähkönen (1982) systematically penetrated into the area of various macroeconomic regimes of the short-run equilibrium, i.e. whether it is Keynesian or classical, in the context of an economy with credit rationing. We should also mention Tarkka (1986) as a recent synthesis of Finnish macroeconomic thinking and analysis. Of the international influences we must first of all mention Tobin (1982), whose analysis has been one of the main starting points and inspirations of our model. We should also mention Blinder (1987) and Greenwald and Stiglitz (1987a), who have emphasized the potentially important role which imperfections in the financial markets can play in the macroeconomic adjustment.

In chapter 3 we first carry out an analysis of some basic macroeconomic policies in the case of the fixed price version of the model. For example, we derive the condition under which a securities financed expansion in public demand is expansionary and when it is fully crowded out in financial markets. We then incorporate inflationary conditions into the model by changing the behaviour of the private sector and describe the determination of the various prices, inflation and inflationary expectations in the model. In the short run the prices are described solely in terms of cost push while inflationary expectations are based on rational expectations in a way which may be relevant in the wage-price dynamics of a small economy.

In chapter 3 we use our model to analyze the effects of a range of macroeconomic policy measures and the effects of various kinds of macroeconomic shocks. Due to the way in which the labour market is described in our model, we are able to combine some longer-run factors with our basically short-run model. We use extensively the technique of partitioned matrices to calculate the determinants in Cramer's rule. This technique in effect means that we shrink the size of the original system by reducing the number of endogenous variables - usually by one - and carry out an analysis utilizing this reduced system, i.e. the financial block.

Our chapter 4 is an enlargement of the model in chapter 3, where exchange rate expectations are fixed, to utilize the information embedded in the open interest parity which, at least in a longer run, should reveal devaluation expectations prevailing among the public. By this means we are also able to describe a relevant "middle range" between the polar cases of the fully fixed exchange rate with static expectations and the perfectly floating exchange rates. This point of view is relevant in countries such as Finland, Norway and Sweden with a fixed but discretely adjustable effective exchange rates system.

After this we turn to the empirical part of the study. Here we have two main goals. We seek to settle some of the issues raised in the theoretical part of the study, for example we try to find evidence on the nature of the spillover effects of credit rationing. Secondly, our aim is to build an integrated flow-of-funds model - covering both real expenditure and financial behaviour - for the households and firms. We also build a model for asset holdings of the banks in Finland.

Chapter 5 is a survey of the general specification and estimation of a flow-of-funds model where we have tried to present in a systematic way the building blocks of this kind of a model. We also try to introduce some novelties, especially when considering the behaviour under rationing and interest controls. We start from the standard results concerning optimal portfolio behaviour under uncertainty in the case of a single representative investor, and then consider behaviour under market imperfections. The adjustment model is discussed next and also the important problem of integration, or separation, of the real expenditure and financial portfolio decisions. We also devote one section to the estimation problems of the flow-of-funds model, including the estimation of the credit rationing effects in this kind of a model.

Chapter 6 is a general introduction to the structure of the empirical analysis of the study. In chapter 7 we start to build the sectoral flow- of-funds models, the first of which is the household sector model. A part of the chapter is devoted to considering the behaviour of a household under the credit constraint and to discussing the various effects of changes in the degree of credit rationing. The empirical model is based on the notion of a permanent credit constraint binding the behaviour of the household sector and considers the determination of the non-durable consumption expenditures, durable consumption, housing investment, deposit and the government bond holdings of the households. As regards the structure of the model we carry out some tests which are either new in general or have not been previously carried out in the Finnish conditions.

Chapter 8 presents the model for the firm sector. Here the most important element is the decision concerning the investment in the physical capital stock and its relationship with the financial decisions of the firm. The decisions of the firms which are modelled here regard investing in fixed capital and in inventories, raising foreign finance and holding demand deposits at the domestic banks.

In chapter 9 we build a flow-of-funds model for the banking sector in Finland. We first discuss more thoroughly than in chapter 5 the behaviour of the banks when their customers are divided into two categories: households and firms, which exhibit different characteristics from the banks' point of view. Another important point in this chapter is the potential interaction of loan demand and loan supply of the banks in the determination of the market solution in the bank loan markets. We find evidence that the demand factors have played a role in the determination of bank loans to the firm sector. Chapter 10 presents the conclusions of the study.

Notes

1) For more on this see e.g. Dornbusch (1980), chapter 10.
2) Theoretically, we can also show that there is a certain real exchange rate which should give the full employment level as an outcome if we can assume that there is a tradables sector in the economy, the output of which is supply determined. The other sector of the economy, the non-tradables sector, the output of which is demand determined, expands together with the tradables sector, so an overall improvement in employment is a consequence of an effective devaluation in real terms.
3) These results are a consequence of the behaviour of domestic and foreign asset holders with respect to yield differences between the domestic and foreign assets. In the first phase the demand-oriented open economy models did not include a satisfactory portfolio balance condition, because

with fixed exchange rates the balance of payments need not be in equilibrium and thus through this channel there may be big changes in the supply of the stock of base money. In order to achieve a stock equilibrium in this kind of a model we should suppose that the central bank obeys a policy of active sterilization so that the monetary impulses arising in the foreign sector will be neutralized from affecting the money supply. For more on these issues see Frenkel and Mussa (1985). On the other hand, even if the balance of payments were in balance, but the current account were not, the wealth of the domestic economy would change by the amount of the surplus in the current account. These points would call for an enlargement of the model into the intermediate run; see Kouri (1983).

4) However, Mishkin (1982) found clear evidence which contradicted the hypothesis that anticipated monetary policy does not have any effect on the real economy.

5) Blinder and Mankiw (1984) have shown that with respect to demand shocks (technically changes in the velocity of money) monetary policy is totally ineffective in the classical case where the real wage and the goods price adjust instantly to clear the goods and labour markets, and also when there is real wage rigidity and the price level adjusts to clear the goods market, because demand shocks have no effect on output and employment in these cases. In other cases with nominal wage or price rigidities demand shocks and accordingly monetary policy have an effect on the real variables, and so it is optimal for the monetary authorities to compensate fully for the anticipated changes in velocity. This leads to the rule of trying to stabilize nominal output. With respect to the supply shocks things are not so fortunate. In general a proper reaction to an adverse supply shock is a monetary contraction. This is not, however, a necessity in the short run. In the case of a fixed money wage the optimal policy may be accommodative. This depends on whether the actual output falls more than the natural rate, i.e. the Walrasian equilibrium level of output.

6) For earlier Finnish monetary research considering the role of banks see Puntila (1969), Koskela (1976), and Oksanen (1977).

7) See also Bank of Finland (1986) and articles published in the Finnish Economic Journal 1986/1.

8) See Huomo et al. (1976), Salo (1978), Alho (1980a), Kostiainen (1981), Luukkainen (1983), Jalamo (1986), Saarenheimo (1990) and Valkonen (1990).

9) See papers in Journal of Money, Credit and Banking, May 1980, Okker et al. (1983), Green (1984a), Keating (1984), and Owen (1986 a, B).

10) In the analysis of policy making we may discern two lines of approach. Traditional macro theory aims to find out the effects of isolated policy

measures to be adopted when the economy faces some internal or external shocks. The more recent theory concentrates on dynamic considerations related to the relationship between the policy makers and the private sector and studies concepts such as the time consistency and credibility of economic policies. In this study policy making is formulated in the first-mentioned way and we are mostly concerned with short-run policy measures. However, we also include some longer-run supply factors into our model, and in chapter 4 we consider also expectations concerning future policy measures as affecting current decisions of the private sector.

2 Basic macroeconomic analysis under fixed and freely floating interest rates

2.1 A general accounting framework of financial markets and the real economy

Our theoretical model deals with the following institutional sectors:

private non-bank sector (symbol p)
banks (b)
central bank (cb)
government (public sector) (g)
foreign sector (f).

The markets in which these sectors operate are the following:

goods (symbol Q)
factors of production: labour (N), interest and dividends (I)
cash (base money) (H)
bank deposits (D)
foreign financial claims, taken here as an asset (F) of the domestic economy
bank loans (L)
domestic short-term instruments, taken as central bank debt of the banks (CB) in the old Finnish financial system with no explicit short-term

money market or asset (M) from the point of view of the private sector in the new financial system (basically not operating until 1987 in Finland) securities (S).

As can be seen from this list we have aggregated both over agents and markets to form a fairly concise description of the economy. Disaggregation in both these directions is an important element in building of a macro model, especially that over assets in the general equilibrium tradition of Brainard and Tobin (1968), which in principle considers a spectrum of financial markets forming the transmission mechanism of monetary policy. Of course, in order to build the model in a meaningful way it should include markets which are essential in financial intermediation of funds from agents and sectors with a financial surplus to those with a deficit, it should describe the supply of base money and its link with the short-term money market, the determination of the long-term rate of interest and in an open economy present links between the domestic and foreign financial markets. Our model is built with the aim that it is able to capture the most essential features of financial processes in these respects.

We have aggregated the non-bank private sector into a single unit even though the breakdown of this sector into households and firms could bring us some new features, but at the cost of making our model still more extensive. We, however, do not need this distinction because we are mostly concerned with the links between real expenditures and financial markets without paying special attention to the potential differences within the private sector in this respect.

The markets in the above list can also be classified according to the assumptions concerning the way in which they are assumed to clear. The standard case is that a market clears through its own price. In the Keynesian model we are familiar with the notion that the market for goods may clear through its volume, i.e. output, rather than through the price of goods,[1)] and that in the labour market there is at the prevailing wage rate an excess supply of labour. As this excess supply does not have an effect on the goods market, we can treat it as a residual in the Keynesian model.[2)]

In this study we are also going to deal with a similar kind of a problem in the case of rationed loan markets where the loan rate is fixed below the market clearing levels either by design of the monetary authorities or as the result of a rational choice by the banks, which could be explained, for example, by the adverse selection and moral hazard behaviour in the loan markets.[3)] We can discern cases where this excess demand in the loan markets has spillover effects on the real economy but in some cases it does not. There are also financial markets which reach their equilibrium in the sense that the supply of the asset concerned is perfectly elastic at the going rate, while the demand for it depends positively on the rate in this market. Markets of this type do not constitute a part of the simultaneous system of market equilibrium conditions in the model. They are markets of a residual character and can in the solution of the model be substituted away into other equations where these rates and quantities appear. The most notable markets of this type are the market for bank deposits, where the banks are supposed to be rationed, and the market for foreign finance, where we assume that the private sector faces an infinitely elastic supply curve of foreign finance at the prevailing foreign interest rate.

One central - perhaps the most important - element distinguishing between the "old" and "new" financial markets in Finland is the change in the role of the short-term money market. We make the interpretation that in the "old" financial system the market for central bank debt of the banks was "the" short-term money market in Finland up to the early 1980's. This structure of the short end of the financial markets was quite exceptional in the sense that the supply of base money was based on a claim of the central bank on the private sector and that only the banks and the central bank participated in it - the non-bank private sector and the government were virtually totally outside this market. The government only had an indirect effect as did the non-bank private sector. The foreign capital flows carried out by the domestic private sector and the government had an effect on the foreign reserves of the central bank and thereby also on the liquidity position of the banks. The government deposited a part of its cash balances at the central bank, which had an effect on the liquidity position of the banks. Typically, the government did not borrow from the central bank; if it did, this was quite exceptional. In the primary framework presented in this chapter we can largely refrain from explicitly specifying the government and its finances. In chapter 3, however, government finances play an essential role in the short-run properties of the model.

Let us now present the basic accounting framework which we shall use in this chapter. To simplify matters, we omit the public sector here and do not explicitly present the factor markets, except interest income on foreign assets. The accounting matrix in table 2.1 is the framework to which we are gradually extending our macroeconomic model.

We are not going to discuss the set-up in detail until the next section, where we start to build the macroeconomic model systematically in successive stages. In the "new" framework the short-term money market consists of the market for domestic free rate funds in its various forms of claims issued by the central bank, banks, firms and the government and the forward market for foreign exchange which are all taken to be linked together through arbitrage between the markets.

Table 2.1
The basic flow-of-funds matrix*)

Market (symbol for asset)	Sectors: Non-bank private sector	Banks	Central bank	Rest of the world	Sum
Interest and dividends (I)	$-i_fF_{-1}$	0	0	i_fF_{-1}	0
Goods (Q)	$-y+c(.)+i(.)$	0	0	$x(.)-m(.)$	0
Cash (H)	$H^d(.)-H_{-1}$	0	$-(H^s(.)-H_{-1})$	0	0
Bank deposits (D)	$D^d(.)-D_{-1}$	$-(D^s=\infty)+D_{-1}$	0	0	0
-Bank loans (L)	$z-(L^d(.)-L_{-1})$	$L^s(.)-L_{-1}$	0	0	0
-Central bank debt (CB) /	0	$-(CB^d(.)-CB_{-1})$	$CB^s(.)-CB_{-1}$	0	0
Domestic short asset (M)	$M^p(.)-M^p_{-1}$	$M^b(.)-M^b_{-1}$	$M^{cb}(.)-M^{cb}_{-1}$	0	0
Securities (S)	$S^p(.)-S^p_{-1}$	$S^b(.)-S^b_{-1}$	0	0	0
Foreign asset	$F^p(.)-F^p_{-1}$	0	$(F^{cb,d}=\infty)-F^{cb}_{-1}$	-ca(.)	0
Sum	0	0	0	0	0

*) By the notations A^d, A^s we have denoted the stock demand for and supply of the instrument A respectively. The superscript p refers to the non-bank private sector, b to banks and cb to central bank. We use these symbols only so as to be able to distinguish the sector concerned and the asset/ liability nature of the instrument. Uses of funds from the point of view of the sector concerned are denoted as positive entities while sources of funds are negative. The notation (.) denotes that there is in general a vector of explanatory variables in the behavioural equation. The subscript -1 denotes the stock of the instrument in the beginning of period. The notation $A^s(A^d)=\infty$ implies that the supply of (demand for) the asset is perfectly elastic at the prevailing interest rate. The surplus in the current account is denoted by ca, output by y, consumption c and investment i, x is exports and m imports, i_f is the foreign interest rate and F the total foreign assets in the economy $F=F^p+F^{cb}$. Note that profits of the banks and the central bank are here assumed to be distributed to the non-bank private sector (see chapter 3). z is denoted the excess demand for credit prevailing in the bank loan market; see section 2.3 for more on this. If z = 0 we have the case where the loan market clears through a flexible loan rate of interest. The endogenous variables, of which there are one less than the number of markets, are from the second row (market): output (y), volume of bank deposits (D), either excess demand for loans (z) or the loan rate of interest (i_L), the marginal rate on central bank debt (i_m) or the domestic short-term rate, securities rate (i_s), and the foreign reserves of the central bank (F^{cb}) in the case of a fixed exchange rate (which is presented in the table), or the exchange rate (e) in the case of a flexible exchange rate. The sum of the two first rows is the balance of net lendings by sectors or the IS curve. As the first row is just an accounting identity, we can equivalently concentrate on either the goods market equilibrium or the IS curve.

2.2 Functioning of financial markets under interest controls

In this chapter our aim is to derive the basic macroeconomic model and the variety of macroeconomic outcomes which fixing the interest rate through administrative controls below the market clearing level and the resulting quantity constraints, i.e. credit rationing, give rise to. Primarily, we think that credit rationing has spillover effects on the behaviour of the private sector in the market for goods, i.e. on its investment and consumption decisions. But we must allow credit rationing to have effects in other parts of financial markets as well. These are based on the fact that controls and rationing in one market create incentives for the private sector to circumvent rationing by more intensive use of other parts of financial markets, i.e. to economize on holdings of assets and to acquire a greater portion of funds from those markets which are not controlled and which serve as substitutes for the rationed loans. Depending on the significance of these channels, we can derive something we call a typology of these various macroeconomic processes as well as a typology of the outcomes of various macroeconomic policies.

We start with a framework covering the key parts of the Finnish financial system with emphasis on the bank loan and deposit markets. Later on in section 2.5 we also introduce a market with free interest rate formation, which in an interesting way transforms our initial results. It should be kept in mind that throughout this chapter we concentrate on the case of fixed prices in the goods market, and similarly in the standard Keynesian manner we assume that there is excess supply in the labour market at the prevailing wage rate, which is also taken as fixed. The labour market is accordingly a residual in the system and is therefore omitted from the considerations in this chapter. In chapter 3 we introduce inflation and relative prices into the model.

We can well describe the basic setting in the closed economy framework. It is quite straightforward to transform the model into the case of an open economy, and we are going to do this in section 2.4 below.

We first introduce the simplest framework where we only consider the operation of the key elements of the financial markets, the markets for loans, deposits and the central bank debt of the banks. The goods market is added in the next section. The central bank supplies cash, denoted by H, which for simplicity is assumed to be held only by the non-bank private sector, through the central bank debt of the banks CB.[4)] The central bank sets a rising supply curve CB^s (i_m), where i_m is the marginal cost of this debt, for its lending to the banks. Alternatively, the supply curve is horizontal, i.e. the central bank pegs its lending rate to a fixed level ($\bar{i}_m$) (see page 44).

The balance sheet of the central bank is simply

$$(1) \qquad CB = H,$$

i.e. the supply function of base money is identical with that of the central bank debt of the banks. The banks have as their assets only loans L extended to the private sector. The loan rate is denoted by i_L. Bank lending is primarily financed by deposits D held by the private sector. The deposit rate (i_D) is set by a mutual agreement of the banks with reference to their loan rate and the regulations of the central bank. For simplicity, we take here the deposit rate as a fixed parameter. At this deposit rate the supply of bank deposits by the banks is perfectly elastic. The banks also resort to central bank debt CB in financing their loan stock. A necessary condition for this to happen is of course that it is profitable for the banks to borrow from the central bank. We assume that the situation is of this type.[5] The behaviour of the banks is constrained by their balance sheet as follows:

$$(2) \qquad \underset{(+)(+)(-)}{L^s(D, i_L, i_m)} = D + \underset{(-)(+)(-)}{CB^d(D, i_L, i_m)}.$$

In parentheses we have the signs of the partial effects in the behavioural equations. The supply of loans L^s depends positively on the volume of deposits the private sector wants to hold at the banks, and on the loan rate, and negatively on the cost of central bank finance. The demand for central bank debt CB^d by the banks is a mirror image of the desired loan supply of the banks.[6]

The private non-bank sector holds deposits and cash, financing these with its financial wealth and with bank loans. As the government debt has not been introduced so far, the net financial wealth of the private sector is zero. Loans as a negative asset and deposits are taken here as gross substitutes for each other. The only interest rate which we consider as an equilibrating variable and which is in this sense relevant for the private sector at this stage is the loan rate of interest i_L. So we have for the private sector behaviour,

$$(3) \qquad \underset{(-)}{L^d(i_L)} = \underset{(-)}{D^d(i_L)} + \underset{(-)}{H^d(i_L)}.$$

Now we have a system of three interrelated markets, two of which produce independent market clearing conditions. The third can be solved from these two and the budget (wealth) constraints.

loans $$L^d(i_L) = L^s(D, i_L, i_m)$$

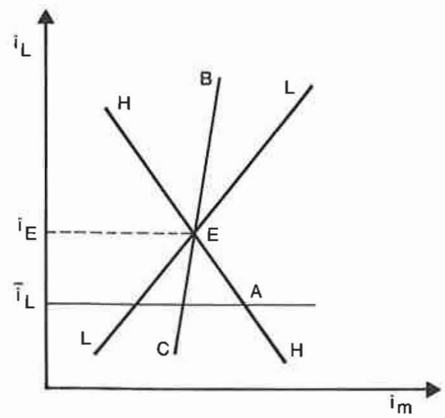
(4) central bank debt $$CB^s(i_m) = CB^d(D, i_L, i_m)$$

cash $$H^d(i_L) = CB^sD(i_m)$$

For simplicity, we have assumed here that output is a fixed parameter with respect to the operation of the financial markets. The market for deposits is always in equilibrium on the basis of the above assumptions and $D = D(i_L)$ can be substituted into the market clearing conditions in (4).

The equilibrium in the financial markets can be described with the aid of figure 2.1. The equilibrium curve for cash HH has a negative slope while those for central bank debt of the banks CB and the loan market LL have positive slopes. It can also be readily shown that the equilibrium curve for central bank debt is steeper than that for the loan market.[7] To the right of the CB curve there is excess supply of central bank debt and excess demand to the left of it. To the right of the LL curve there is excess demand for bank loans.

Credit rationing is now introduced as a situation where the equilibrium in the financial markets, i.e. point E in figure 1 cannot be reached because the loan rate is administratively set below the market clearing level at $\bar{i}_L$. As we "move" from the equilibrium interest rate i_E to its rationed level $\bar{i}_L$, financial markets basically adjust in such a way that the market for base money, or cash is in equilibrium. This is so primarily because the demand for cash by the



LL = equilibrium for the loan market

HH = equilibrium for base money (cash)

CB = equilibrium for central bank debt of the banks

Figure 2.1 The operation of financial markets in the basic framework private sector determines the volume of the central bank debt of the banks, and simultaneously also the (marginal) interest rate on this debt, rather than vice versa, since the public can at will change its bank deposits into cash balances and vice versa. So, the banks cannot through their demand for central bank debt directly determine its volume and the volume of cash balances of the public. Accordingly, at the loan rate of interest $\bar{i}_L$, the central bank rate is determined by point A in figure 2.1. But on the basis of what is stated above, we find that this point A lies to the right of the equilibrium curves for loans and central bank debt and so in A there is excess demand for loans and a simultaneous excess supply of central bank debt. The debt of the banks to the central bank is higher than they desire to have, given the deposits the private sector wants to hold at this loan rate of interest.

The reaction of the banks to this situation is to curb their lending in order to achieve a reduction in their central bank debt. And as there is excess demand for bank loans at point A, the banks can start this process. From equilibrium condition (4) we see that if the deposits of the public were smaller, the CB curve would shift to the right, finally to point A on the HH curve.[8)] This is just what happens as bank lending is reduced from its previous "equilibrium" level. According to (3), as loans are cut, deposits and cash balances of the public, taken together, are reduced. We assume that primarily banks reach their equilibrium through a contraction in deposits. If equilibrium would be reached through a reduction in the demand for cash by the public, then the HH curve would shift to the left and not the CB curve to the right.

It is interesting to note that in our imaginary process initially the banks were in a situation where, from their point of view, they had too much central bank debt, which they tried to get rid of by cutting down on their lending. Through cuts in their lending, however, they finally come to a situation where they anyway still hold the initial amount of central bank debt.[9)]

We have seen that under credit rationing the private sector has to change its deposits - or cash - holdings in such a way as is consistent with the rationed amount of loans and the controlled rate of interest. We come to the important conclusion, elaborated more thoroughly below, that the "effective" demand for financial assets may depend on the loan supply in the case of interest controls. As mentioned above, another major channel of credit rationing is naturally the goods market to which the adjustment in behaviour by the private sector is also reflected. We next turn to combine this with the analysis.

2.3 A macroeconomic model including the goods market

As we add the goods market to the model, we transform in the flow-of- funds tradition all the above equilibrium conditions into a flow specification, i.e. we consider the above asset demand functions to refer to the desired end-of-period situation. From this we can then determine the desired asset flows (denoted by the symbol Δ) during the unit period. In this way we are able to achieve a consistent set of temporary equilibrium conditions as relationships of the model.

Now we have the following markets:
goods (symbol Q)
loans (L)
central bank debt (CB)
cash (H).

This is a set of four markets, one of which on the basis of Walras' law is a residual automatically in equilibrium once the other three are. In this system of three independent market clearing equations we only have two endogenous market clearing variables: output y and the marginal rate i_m on the central bank debt of the banks, as the loan rate i_L is now fixed at level $\bar{i}_L$. To describe the situation in the bank loan market and the spillover effects of credit rationing in other markets, we define a new "market clearing" variable, the excess demand for credit, denoted by z, which in a pseudo sense equilibrates the loan market. So we specify the loan market in the following way:

(6) $$z - (\Delta L^d - \Delta L^s) = 0 .$$

An implicit assumption here is that the loan rate is fixed so low that there is excess demand for credit, $z > 0$, and so the actual amount of loans, which is the smaller of demand and supply, is equal to the supply of loans. A very essential question analyzed in more detail below is in which markets are the spillover effects from credit rationing felt. We must start here with a general specification allowing for credit rationing to influence behaviour both in the goods and financial markets. As is shown in the following, we can achieve either a pure Keynesian multiplier model or a monetarist model depending on the degree to which credit rationing affects these various markets. The real expenditures E are determined by the function

(7) $$E^d = \underset{(+)(-)(-)}{E(y, \bar{i}_L, z)} ,$$

where y is the level for output. We have also included the administrative loan rate in expressions (7), (8d), and (9) even though in a credit rationing case we should rather have the exogenous stock of credit as an explanatory variable. But as the credit constraint is here transformed to the form of excess demand for credit, the loan rate is also included in the behavioural equations (for more on this see section 5.5.3 below). The model can now be specified to be the following.

(8a) goods $$y - E\underset{(+)(-)(-)}{(y, \bar{i}_L, z)} = 0$$

(8b) loans $$z - \Delta L^d \underset{(+)(-)}{(y, \bar{i}_L)} + \Delta L^s \underset{(+)(+)(-)}{(D, \bar{i}_L, i_m)} = 0$$

(8c) central bank debt $$-\Delta CB^d \underset{(-)(+)(-)}{(D, \bar{i}_L, i_m)} + \Delta CB^s \underset{(+)}{(i_m)} = 0$$

(8d) cash $$\Delta H^d \underset{(+)(-)(-)}{(y, \bar{i}_L, z)} - \Delta CB^s \underset{(+)}{(i_m)} = 0$$

As previously, the market for deposits is taken to be always in equilibrium and the demand-for-deposits function is specified to be

(9) $$D^d = D\underset{(+)(-)(-)}{(y, \bar{i}_L, z)} .$$

The demand functions E, H and D in the model (8) are rationed effective demand functions in the sense that they describe behaviour under a binding credit constraint and therefore have to fulfill the adding-up constraints, which for the rate of rationing variable z is[10)]

(10) $$E_z + D_z + H_z = -1 .$$

It is often an open question how the behavioural equations in a macromodel are derived from microfoundations since different views have been expressed concerning how strictly macroequations should and could be derived from microeconomic foundations and aggregated from them (for a discussion on this see Tobin (1980, pp. x-xi)). Here we simply state that a tightening in credit rationing, i.e. a rise in z, causes a reduction in effective demand E in the goods market, which the agents try to mitigate by running down deposits and cash balances, i.e. by economizing on these in a similar manner as a rise in the interest rate changes the demand for money in the standard specification.[11)]

In (8) the goods market equilibrium condition is the sum of the three financial market equilibrium conditions, as can be readily checked using the budget constraints of the sectors, and so we can concentrate on the last three financial equations - i.e. the LM part of the model - which form a system of independent market equilibrium conditions.[12)]

Let us first describe graphically the determination of output y under rationing as compared to the case of a freely floating loan rate of interest, in which case we have z = 0 in the equations (7)-(9). In order to carry this out in a simple way, we assume that the central bank pegs its marginal lending rate to the banks by setting an infinitely elastic supply curve in the market for the central bank debt of the banks. So now we can reduce the system to consist of three markets, one of which is a residual.[13)] It is important to note that in general the properties of the supply function of the central bank debt have an effect on the loan supply behaviour of the banks. It can be shown that if this supply function is horizontal, the bank loan supply does not under certain conditions depend on the volume of deposits.[14)]

Let us first analyze the corresponding notional equilibrium curves in the (y, i_L) space (see figure 2.2). Here we have first assumed that $L_y^d - L_y^s > 0$, i.e. that an increase in activity tightens the loan market. Below we return to consider this assumption and its meaning for the operation of the model. The three notional equilibrium curves intersect each other at point E, which is the short-run macroeconomic equilibrium in the case of a free loan rate of interest. It is also quite easy to see that the equilibrium curve for cash is located between the equilibrium curves for the loan and goods market.[15)]

Let us now proceed to the case where the loan rate is fixed below the market clearing level at $\bar{i}_L$ and consider at which level of output the rationed short-run equilibrium could be. Point A on the goods market equilibrium curve represents a situation which would be realized only if the loan supply of the banks were perfectly elastic at this rate of interest, and the LL curve would then in fact be horizontal. But normally, as in figure 2.2, at point A there is excess demand for credit and simultaneously an excess demand for base money, i.e. the stock of cash is larger than the central bank debt the banks desire to have. So point A cannot be an equilibrium in the case of interest control and credit rationing. On the other hand, output need not contract so

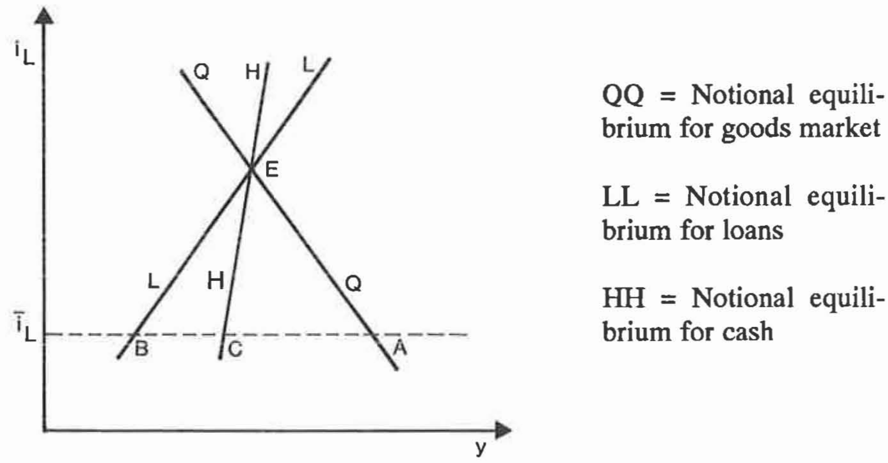


Figure 2.2 The short-run equilibrium in the goods and financial markets

much to produce a notional equilibrium in the bank loan market, i.e. point B on the LL curve is not an equilibrium point either.

The reason for this is that at point B, which lies to the left of the equilibrium curve for the market for cash, the central bank debt of the banks is smaller than they desire to have. So the banks are willing to supply a larger amount of credits than what they would supply at point B in the notional equilibrium in the loan markets. The public is also willing to absorb the increased supply of bank loans as there is excess demand for credit to the right of the LL curve. We are led to consider point C where the banks want to hold an amount of central bank debt that is the same as the public holds in cash.

Point C, however, is only one possible equilibrium, but it is quite an interesting one, as we shall see. We should now take into account the fact that interest controls and the consequent credit rationing change the behaviour of the non-bank private sector in the manner described above in (8) and (9), although they do not change the behaviour of the banks. The rationed equilibrium can be described by the following diagram 2.3, where, analogous to the IS-LM tradition, we have as market clearing variables output y and the excess demand for credit z. We still maintain the assumption of interest pegging by the central bank in the market for the central bank debt of the banks. The equilibrium curve for the goods market slopes downward as in the standard IS-LM framework and the excess demand for loans curve slopes upward if we assume $L_y^d - L_y^s > 0$. It is also important to note that the respective intersections of these two curves with the horizontal axis, both representing cases of no credit rationing, correspond to points A and B in figure 2.2 .

The equilibrium curve for the goods market is

(12) $$\left[\frac{dz}{dy}\right]_{QQ} = \frac{1-E_y}{E_z} < 0$$

and for the loan "market"

(13) $$\left[\frac{dz}{dy}\right]_{LL} = \frac{L_y^d - L_D^s D_y}{1 + L_D^s D_z} > 0 \quad \text{as, because of (10),} -1 \leq D_z \leq 0 .$$

As mentioned in note 13, the equilibrium curve for cash in this case is

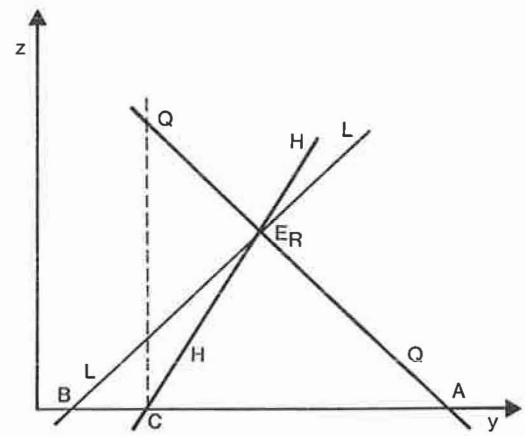
(14) $$H^d(y, z) - H_{-1} - CB^d(D(y, z), \bar{i}_m) + CB_{-1} = 0 .$$

In a differential form this can be presented as

(15) $$\left[\frac{dz}{dy}\right]_{HH} = \frac{-CB_D^d D_y + H_y}{CB_D^d D_z - H_z} > 0 .$$

The HH curve is sloping upward and is not vertical as long as the denominator is positive. We return to this below. As above, we can infer that the slope (13) is smaller than (15). So the equilibrium curve for base money lies between the equilibrium curves for loans and goods and intersects the z = 0 axis between B and A corresponding to point C in figure 2.2 . It is now quite easy to see that at the short-run equilibrium E_R there is excess demand for credit, i.e. z is positive. We can also infer that if the HH curve is not vertical, output at the short-run equilibrium is larger than at point C in figure 2.2 . In terms of figure 2.2 this means that output can be expanded to the right of the notional HH curve. The reason for this is just the above-mentioned change in financial behaviour, i.e. in the demand for monetary assets by the private sector as a result of credit rationing. If we compare output in the rationed and "free" solutions, we cannot a priori tell in which case it is higher.

If both D_z and H_z were zero, i.e. if credit rationing only had a spillover effect in the goods market, the HH curve would in figure 2.3 be vertical at the income level C of figure 2.2 above. The HH curve would assume the position of the dotted line in figure 2.3. In this case changes in total demand that are to be financed by borrowing from the banks will not be expansive. They only lead to a tightening of the bank loan market and are fully crowded out there. In terms of figure 2.3 such efforts would cause an upward shift in the equilibrium curve for goods and similarly in the LL curve, but the HH curve



QQ = Equilibrium for goods

HH = Equilibrium for cash

LL = Excess demand for credits

Figure 2.3 Macroeconomic equilibrium under credit rationing

would remain in its vertical position at income level C. Output is solved from the equilibrium condition between the demand for cash by the public and the demand by the banks for central bank debt only, and the goods market is a residual in this case. In terms of (14) this would mean that the demand functions for both deposits and cash by the public determine the short-run equilibrium as they now only depend on output and not at all on the tightness in the bank loan market. This case is what we can call a "monetarist" version of the short-run macroeconomic equilibrium under a fixed interest rate.

It is also interesting to consider the other polar case where all the spillover effects are reflected within the financial market. Now we have $E_Z = 0$ and $D_Z + H_Z = -1$. In this case the goods market equilibrium curve in figure 2.4 is vertical at the income level corresponding to point A in figure 2.2 . So in the short-run equilibrium there is excess demand for credit but this does not cause any repercussions for the real economy. The explanation for this kind of a situation is that credit rationing is now costlessly absorbed in deposits and cash holdings, and in this way the private sector can smoothly finance its desired expenditures by running down its deposit and cash balances to compensate for the lack of credits. Policy measures by the monetary authorities, i.e. changes in the interest rate on central bank debt of the banks, are futile in this case. This could perhaps be the situation if credit rationing is not severe and the private sector considers credit rationing to be a temporary phenomenon. If it is considered to be permanent, real expenditures are likely to be affected by it, too.

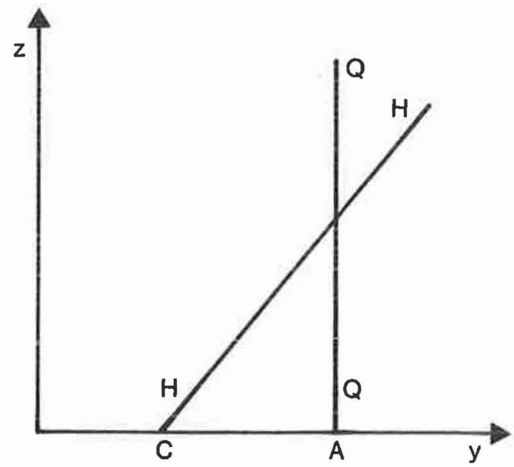
Let us also consider the special case where $D_Z = -1$, $H_Z = 0$. In this case changes in the credit supply are reflected fully in deposit holdings, i.e. we have

$$(16) \qquad \frac{dD}{dL^s} = 1 .$$

In effect this would mean that loans and deposits are perfect substitutes for each other from the point of view of the public. It is easy to understand that the banks, taken as a group, are now willing to satisfy all the demand for credit by the public, as they are not forced to run into a larger volume of central bank debt if they expand their credits. This means that the credit supply curve is horizontal at the interest rate $\bar{i}_L$ in figure 2.2 . These cases are analogous to the Keynesian liquidity trap case as monetary policy totally loses its power to affect the real economy.

Let us conclude this section by describing the operation of the bank loan market under rationing. In general, the situation in the bank loan market is depicted in the following manner (see figure 2.5). At the interest rate $\bar{i}_L$ there is z amount of excess notional demand for credit. The "effective" demand for loans, however, is equal to the actual supply of them, because if the other markets are in the rationed equilibrium, the loan market is too as a result of Walras' law. The situation can be described in such a way that the effective demand for credit (the dotted line) becomes vertical at the loan rate i_L^* because at rates lower than this the private sector will take the amount L_0 of loans actually supplied by the banks.[16)]

We have not yet paid any attention to the possibility that the loan rate of interest is fixed in such a way as to produce an excess supply of loans, which is of course entirely possible. It is important to note that in figure 2.2 we have drawn the curves in such a way that they intersect at a point E, where the equilibrium rate of interest is higher than the rationed level $\bar{i}_L$. It is, however, possible that the equilibrium curve for goods would be located so much to the left from its position in figure 2.2 that the intersection E would lie below the level $\bar{i}_L$. In this case the solution for output would be on the QQ curve and there would be excess supply of bank loans and excess supply of base money.



QQ = Equilibrium for goods
HH = Equilibrium for cash

Figure 2.4 The case with spillover effects of credit rationing only in the financial markets

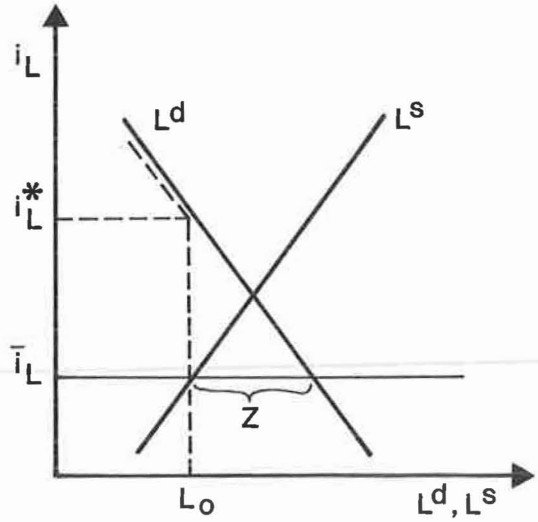


Figure 2.5 The bank loan market under rationing

2.4 The basic model in an open economy framework

It is quite straightforward to transform the model to the case of an open economy under fixed exchange rates. The money market equilibrium condition has to be transformed to include the foreign reserves F^{cb} of the central bank as one source of the base money supply (see table 2.1). Accordingly, the equilibrium condition for cash in (8) is now replaced by

$$(17) \qquad \Delta H^d - \Delta CB^s - \Delta F^{cb} = 0 .$$

The change in reserves is the sum of the surplus in the current account, denoted by ca, and the capital imports from abroad $-\Delta F^p$, where F^p is the (net) foreign assets of the private sector. We take the former to be simply a negative function of output y and foreign borrowing to depend negatively on domestic output and positively on the tightness in the domestic bank loan market. As mentioned above, we assume that the supply of foreign loans to the domestic private sector is perfectly elastic at the prevailing international interest rate i_f. The banks do not directly operate in the foreign financial market as they are required to have a closed currency position against the domestic currency (for more on this see section 9.1). So we have

$$(18) \qquad \Delta F^{cb} = \underset{(-)}{ca(y)} - \Delta F^p\underset{(+)(-)(-)(+)}{(y, \bar{i}_L, z, i_f)} .$$

The goods market equilibrium curve also has to be transformed so that net exports x-m, which like ca depends negatively on domestic output, is added as one item of total demand to (8a). Foreigners are not assumed to participate in the domestic financial markets as investors. Interest income on foreign assets is not explicitly treated here (see chapter 3 where this is done).

This change in the model to the open economy context does not change the signs of the slopes of the equilibrium curves considered above. The above considerations concerning the spillover effects of credit rationing can now be supplemented by the new element of foreign borrowing, which at least to some extent - possibly even completely - reduces the effectiveness of domestic monetary policies. If the credit rationing were to be completely offset by a change in foreign borrowing, we would have $F^p_z = -1$, $E_z = 0$, and we would again come to the case considered above in figure 2.4 where the goods market equilibrium curve is vertical and monetary policy is totally ineffective.

If there is a rising supply curve for the central bank debt of the banks, we have some sort of intermediate case between sterilization and accommodation of monetary shocks arising from fluctuations in export revenues or capital flows. If there is a capital outflow and deposits go down, the domestic component of the base money supply increases, see (17), but this leads to a higher interest rate on the central bank debt of the banks and efforts by them to reduce it. Normally these lead to a reduction in the debt after the following tightening in the bank loan markets, reduced absorption and increased capital inflows, and then finally also to a reduction in the domestic component of the base money supply.

Let us now turn to the model presented above in (8) transformed in the way stated above into the open economy context. As above, we analyze the working of the economy by concentrating on the "LM part" of it, i.e. on the equilibrium conditions for loans, central bank debt of the banks and cash. The market for goods is the residual one in the spirit of Tobin (1982). Now we return to the more general case where the supply curve of central bank finance is rising. The Jacobian of the system is now

	market:		market clearing variable:
(19)	loans	$\begin{bmatrix} + & - & +/- \\ - & + & + \\ - & - & + \end{bmatrix}$	z
	central bank debt		i_m
	cash		y

Let us denote this Jacobian by A and its elements by a_{ij}.

Above we have reached the idea concerning dynamics of an economy under credit constraints according to which excess supply of or demand for central bank debt by the banks is an important element in this, as simultaneously there is a notional excess demand for goods prevailing in the goods market. If the actual central bank debt is smaller than is optimal from the banks' point of view, there is an increase in bank lending. Simultaneously, as there is excess demand for bank loans, bank lending can be expanded and the demand for goods rises, i.e. output is expanded. This suggests that the dynamics of output can be specified in the following way

(20) $$\dot{y} = h\,(CB^d - CB^s),\ h > 0\,.$$

Let us further suppose that both the interest rates z and i_m adjust instantaneously to their equilibrium values. The single characteristic root of the dynamic system can be solved from the following characteristic equation

$$
(21) \qquad 0 = \begin{vmatrix} a_{11} & a_{12} & a_{13} \\ -ha_{21} & -ha_{22} & -ha_{23}-\lambda \\ a_{31} & a_{32} & a_{33} \end{vmatrix} .
$$

This can be further solved and written in the following form

$$
(22) \qquad 0 = d - (\lambda/h)\,(a_{11}a_{32}-a_{12}a_{31})\,,
$$

where d is the determinant of the Jacobian. In (22) the expression in the brackets is negative on the basis of the signs presented in (19). As λ is required to be negative in order to reach stability, we can derive from (22) the result that the determinant d of (19) should be positive. As can be seen from (19), the sign of $|A|$ is in general ambiguous, if a_{13} ($= -L^d_y + L^s_D D_y$) is negative.

Above we first made the assumption that the reaction of the loan demand to a change in output is stronger than that of the loan supply, i.e. that $L^d_y - L^s_y > 0$. If we make the reverse assumption that the loan demand reacts negatively to output which is also conceivable, we arrive at the important conclusion that the Jacobian A in (19) is a dominant diagonal matrix encountered often in a general equilibrium context (see e.g. Arrow and Hahn (1971)), and also in the temporary general equilibrium macroeconomic model by Tobin (1982). A dominant diagonal matrix has positive diagonal elements, negative off-diagonal elements and positive column sums. Its determinant is positive. This holds also if one of the columns, i.e. that related to income y, is replaced by nonnegative elements, at least one of them being positive (see Tobin and Brainard (1963) and Tobin (1982)).

In (19) we come to this situation if we make the above-mentioned reverse assumption concerning the dependence of excess demand for loans on output. The column sums refer to the effects of the interest rate variables and income on the QQ curve. The former should be positive, as they are normally in an outside money model with financial markets (see Tobin (1982)). In our case one of them is the effect of the central bank interest rate i_m, which in our system is not directly included in the expenditure function of the private sector. However, we can easily derive the result that the determinant of (19) is positive if a_{13} is positive.

Our initial assumption $L^d_y - L^s_y > 0$ means in terms of figure 2.2 that the private sector is able to move in an expansive manner into the credit rationing area, i.e. to the right of point B, and usually also to the right of point C towards higher income levels. The reverse assumption $L^d_y - L^s_y < 0$ means that the LL curve in figures 2.2 and 2.3 slopes downward and that output in the short-run equilibrium is smaller than what would be consistent with a notional equili-

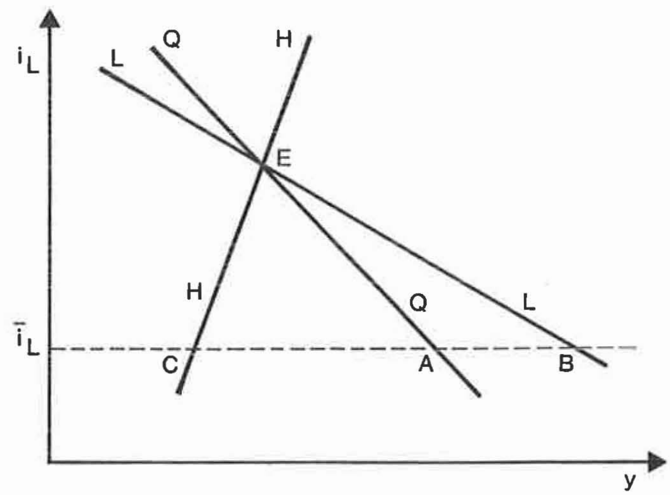


Figure 2.6 The short run equilibrium under a free loan rate of interest as the LL curve is downward sloping. For explanations, see figure 2.2 .

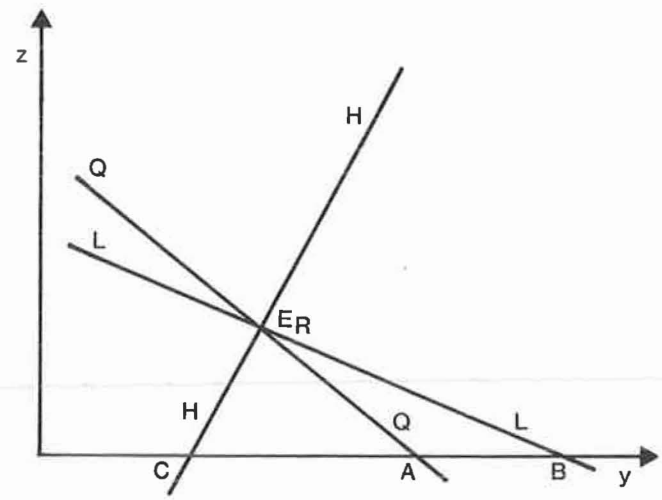


Figure 2.7 Macroeconomic equilibrium under rationing and a downward sloping LL curve. For explanations, see figure 2.3 .

brium in the loan market.[17] In this case the private sector is "forced" to step into the excess demand for credit area to the left of the LL curve. We have reproduced this situation in figures 2.6 and 2.7, which correspond to figures 2.2 and 2.3 above.

Let us make one comparative statics analysis with the aid of the model. As discussed above, the properties of the model with respect to the effects of policy measures crucially depend on whether an increase in expenditure which simultanously leads to an increase in the demand for bank loans is expansive or neutral with respect to output. Now it is quite easy to see that an increase in autonomous expenditure that the private sector tries to finance by an increase in their loans, is in the case of credit rationing expansionary if and only if the sum of D_z and $H_z + F_z^p$ differs from zero, i.e. is negative.[18] The intuition behind this result is that either through a reduction in deposits or cash or through increased foreign borrowing the private sector "can get the expansion started" once it "realizes" that there are no extra bank loans available. In the sequel we consistently assume that $L_y^d < 0$, i.e. that an increase in income leads to a reduction in the demand for credit.

2.5 Introduction of non-rationed parts of financial markets into the model

We now increase the realism of our model by allowing for the fact that, irrespective of the dominating position of the bank loan market in Finland, there have been submarkets within the financial markets where no interest controls are set by the monetary authorities. Let us call this market in general the securities market, or S market, and suppose that both the banks and the private sector can potentially invest funds in this market. We can imagine that this role is played, for instance, by the government bond or stock market. The introduction of this market of course "changes" the behaviour of the private sector and the banks in all other markets as well. Foreigners are not assumed to participate in this market. The equilibrium condition for this market is now,[19]

$$(23) \qquad \underset{(+)(-)(+)(-)}{\Delta S^p(y, \bar{i}_L, i_S, z)} + \underset{(+)(-)(+)(-)}{\Delta S^b(D, \bar{i}_L, i_S, i_m)} = 0,$$

where the first term is the net demand for the asset S by the non-bank private sector and the latter that by the banks, with i_S being the rate on the asset S.

Alternatively, we can assume that there is a fixed outside flow supply of S, e.g. through the government budget deficit, if S is identified to be the government bond market. If we now add equation (23) to the open economy version of the model (8) and transform the rest of the equilibrium conditions accordingly, we can then engage in a repeat analysis of the model along the lines above.[20)]

We seek to discuss here the S market from the point of view of the potential role of the securities market in the transmission of monetary policy. We may find a variety of outcomes in this respect depending on whether the banks invest in the S market or not, whether the non-bank private sector uses this market in order to reduce the effects of credit rationing, and how large this market is in volume as a ratio, say, to the financial wealth of the private sector. In a broader context rationing in the bank loan market creates incentives for the private sector to use and form other financial instruments and markets instead of the rationed one. Market developments are endogenous reactions i.a. to financial regulation by the monetary authorities, but we do not in this section delve any further into this interesting area. We simply assume the existence of an S market with a certain volume and only seek to make some simple comparisons concerning the role of a "free" securities market in a macro context.

The effectiveness of monetary policies quite clearly depends on the degree of substitutability between bank loans and the asset S just as it depends on the possibilities to raise foreign finance. Let us now turn to consider how the short-run equilibrium will change as we introduce the S market into the model. The model in this enlarged version is the following. Once again to make matters somewhat simpler we stick to the case of a fixed central bank rate in the market for central bank finance of the banks. Let us solely concentrate in the rest of this chapter and the next on the case where the banks do not participate in the S market, so we can omit the S^b function from (23) and denote S^p by S.

$$\underset{}{y} - E(\underset{(+)}{y}, \underset{(-)}{\bar{i}_L}, \underset{(-)}{i_S}, \underset{(-)}{z}) - x + m(\underset{(+)}{y}) = 0$$

$$\Delta S(\underset{(+)}{y}, \underset{(-)}{\bar{i}_L}, \underset{(+)}{i_S}, \underset{(-)}{z}) = 0$$

(24)

$$z - \Delta L^{d}(y, \bar{i}_L, i_S) + \Delta L^{s}(D, \bar{i}_L, \bar{i}_m) \quad = \quad 0$$

$$\qquad (-)(-)(+) \qquad\qquad (+)(-)(-)$$

$$\Delta H(y, \bar{i}_L, i_S, z) - \Delta F^{cb}(y, \bar{i}_L, i_S, z)$$

$$(+)(-)(-)(-) \qquad\qquad (-)(+)(+)(+)$$

$$-\Delta CB^{d}(D, \bar{i}_L, \bar{i}_m) \quad = \quad 0$$

$$(-)(+)(-)$$

The demand for deposits equation is now specified to be the following

(25) $$\Delta D = \Delta D^{d} = D(y, \bar{i}_L, i_S, z) - D_{-1} .$$

$$(+)(-)(-)(-)$$

We reduce the system to consist of the same equations as above in (8) by solving the securities rate i_S from the equilibrium condition for the S market and substituting it then into the equilibrium conditions for goods and cash. In order to economize on notations, let us simply denote the equilibrium curves for goods and cash in (24) by f and g respectively. So we have primarily on the basis of (24),

(26) $$f(y, i_S, z) = 0$$

$$(+)(+)(+)$$

for the QQ curve and

(27) $$g(y, i_S, z, \bar{i}_m) = 0$$

$$(+)(-)(-)(+)$$

for the HH curve. The QQ curve is transformed to the following differential form

(28) $$\left[\frac{dz}{dy}\right]_{QQ} = -\frac{f_y - S_y(f_{i_S}/S_{i_S})}{f_z - S_z(f_{i_S}/S_{i_S})} .$$

The slope of the equilibrium curve for the market for cash is now accordingly

$$(29) \qquad \left[\frac{dz}{dy}\right]_{HH} = - \frac{g_y - S_y(g_{is}/S_{is})}{g_z - S_z(g_{is}/S_{is})} .$$

From (26) and (27) we can derive the following expression for the effect of a change in monetary policy on output

$$(30) \qquad \frac{dy}{d\bar{i}_m} = \frac{g_{\bar{i}_m}}{\left(-\left[\frac{dz}{dy}\right]_{QQ} + \left[\frac{dz}{dy}\right]_{HH}\right) \bar{g}_z} ,$$

where $g_{\bar{i}_m} = - CB^d_{\bar{i}_m}$ and $\bar{g}_z$ is the denominator in (29). From this we can infer that the effectiveness of the monetary policy is reduced if the denominator in (30) increases in absolute value as the numerator remains unchanged when the S market is introduced. Definitely, the power of domestic monetary policies is reduced if the QQ curve becomes steeper. The effect of a change in the slope of the HH curve is more complex because $\bar{g}_z$ is also included in (29) as its denominator. If $\bar{g}_z$ increases in absolute terms, the slope of the HH curve becomes smaller and also (30) becomes smaller in absolute terms. Monetary policies become weaker. If, however, $\bar{g}_z$ remains unchanged and the numerator in (29) diminishes, we see that the monetary policy becomes more effective. The intuitive reasoning behind this result is the fact that as the demand for money and deposits and for foreign assets become less dependent on income, monetary impulses allow for greater changes in real activity. Normally, it is understood that effectiveness of monetary policies is reduced if we introduce new financial markets and financial intermediation (see e.g. Tobin and Brainard (1963)).[21] Monetary impulses are then more easily absorbed in the financial markets instead of the goods market.

The adding-up restrictions, which are an integral part of a flow-of-funds model, also have to be satisfied as a new market is introduced into the model. This usually means that the interest rate and income effects in the "old" markets have to change simultaneously. An intuitively obvious result from this kind of an enlargement of the model is that this new market to some extent bears the burden of credit rationing, i.e. that $S_z < 0$. As a consequence, the dependence of real expenditures on credit rationing is likely to be reduced. It is less clear how the demand for other financial assets, i.e. deposits and cash holdings and foreign borrowing, will change so let us keep them unchanged. The dependence of real expenditures on income, i.e. f_y, may also change as the S market is introduced and expenditures can be financed by asset holdings in this market. It is now quite clear that with the arsenal so far presented we can only make some loose statements on the possible changes in the locus of the equilibrium curves [22]. Let us therefore assume that the derivatives f_y and g_y remain unchanged in the transformation of the financial markets. Because of the adding-up constraints we then have $S_y = 0$. This roughly corresponds to the situation in the government bond market in Finland (see chapter 7 below).

As can be seen from (28), however, the power of the monetary policy is not automatically reduced in the sense that the QQ curve would become more vertical as the securities market is opened. As a countereffect to the likely reduction in the importance of the rationing channel we have now the interest rate in the S market as a new element within the monetary policy transmission mechanism.

The term appearing both in the numerator and denominator of (28) can written as

$$(31) \qquad \frac{f_{is}}{S_{is}} = -\frac{E_{is}}{S_{is}} > 0 .$$

If we make the assumption of gross substitutability between the assets, the absolute value of this ratio would be less than unity. In the case where $S_y = 0$, and if there is a shift in the spillover effects of credit rationing from the goods market to the securities market as a result of the introduction of the S market, we can derive the result that the QQ curve becomes steeper, the steeper the less elastic real expenditures are with respect to the securities rate i_S.

This is not the full story, as we must combine the change in the slope of the HH curve with that of the QQ curve. The term appearing both in the numerator and denominator in (29) can be written as

$$(32) \qquad \frac{g_{is}}{S_{is}} = \frac{(H + F^P - CB_D^d\, D)_{is}}{S_{is}} < 0 .$$

If $S_y = 0$, we come to the conclusion that, if the spillovers of credit rationing to the "old" financial markets remain unchanged, the HH curve will get flatter through a rise in the denominator in (29). The overall result would then be a reduction in the effectiveness of monetary policy. The HH curve will, for example, be all the flatter, the higher the substitutability between the foreign liability and the domestic S asset.

We have in this chapter presented a basic macroeconomic analysis of an economy under effective interest controls and credit rationing and compared it to the case of a freely floating interest rate in the loan market. We next turn in chapter 3 to analyze short-run macroeconomic policies systematiwith the aid of the model, first in the present version of fixed prices and then in the model incorporating inflationary conditions.

Notes

1) See a recent analysis of this by Patinkin (1987).
2) To be precise, this is also based on the assumption that the propensities to spend out of wage and non-wage incomes are the same. This assumption implies that only interest income and dividends on bank profits are considered as the factor revenues in our model.
3) See the analysis on this by Greenwald and Stiglitz (1987b) and Bester (1987). For a recent analysis of the IS-LM framework including the banking sector with free formation of interest rates see Bernanke and Blinder (1988).
4) Thus, throughout we abstract away cash balances held by the banks; their liquidity consists primarily of central bank financing.
5) This is not self-evident as normally the loan rate has been lower than the average and marginal rates on central bank debt. This imposes some constraints on the specification of the model for the banking sector, e.g. that there are other revenues than interest payments related to loans or that an expansion in lending increases also deposits which lowers the effective financing costs of marginal lending. See more closely section 9.2. on these issues.
6) From (2) we can derive the following adding-up constraints binding the behaviour of the banks, $L_D^s - CB_D^d = 1, L_{i_L}^s = CB_{i_L}^d$ and $L_{i_m}^s = CB_{i_m}^d$. The partial derivatives are here denoted by a subscript. The partial derivatives L_D^s and $-CB_D^d$ are taken to lie between zero and unity. Bank behaviour is derived in more detail in section 9.2.
7) The slope of the LL curve is

$$(5a)\quad \left.\frac{di_L}{di_m}\right|_{LL} = \frac{-L_{i_m}^s}{-L_{i_L}^d + L_D^s D_{i_L} + L_{i_L}^s} > 0, \text{ as } L_D^s \leq 1 \text{ and } \left|L_{i_L}^d\right| \geq \left|D_{i_L}^d\right|,$$

and that of the CB curve

$$\text{(5b)} \qquad \left.\frac{di_L}{di_m}\right|_{CB} = \frac{CB^s_{i_m} - CB^d_{i_m}}{CB^d_D D_{i_L} + CB^d_{i_L}} > 0 .$$

It can be easily shown on the basis of (2) that the numerator in (5a) is smaller than in (5b). The difference between the denominators is $-L^d_{iL} + D_{iL}$, which is positive on the basis of (3). So, altogether we can derive the property mentioned above that (5a) is smaller than (5b).

8) Note that the LL curve shifts to the left from its position in figure 2.1 as deposits are decreasing.

9) In a broader perspective we can think that the goals of the central bank are linked to the loan supply behaviour of the banks. So if the banks fulfill these by cutting their lending, they may also expect a reduction in the cost of their central bank finance later on.

10) The budget constraint is initially $E + \Delta H + \Delta D = y + \Delta L$, which can be transformed into the form $E(z) + \Delta H(z) + \Delta D(z) - \Delta L^d = y - z$, which produces the constraint (10). Note that in (8b) ΔL^d is the notional demand for credit by the public.

11) The signs of the partial effects of the loan rate in the rationed behavioural equations (7), (8d), and (9) of the non-bank private sector are the same as those of credit market tightness. The reason for this is that the loan rate, with z given, describes a notional element of behaviour present in the equations (on this see section 5.5.3).

12) Note that the profits of the banks and the central bank are omitted at this stage, and are implicitly assumed to be distributed back to the non-bank private sector.

13) In this case the equilibrium condition for the central bank debt is changed to be one of the residual markets as now this market is always in equilibrium at the rate pegged by the central bank. The volume of the central bank debt is determined by the demand for it, and this is substituted into the equilibrium condition for cash in (8) (see (14) below).

14) For more on this see sections 5.2 and 9.2 below.

15) The slope of the equilibrium curve for loans is

$$\text{(11 a)} \qquad \left[\frac{di_L}{dy}\right]_{LL} = \frac{L^d_y - L^s_D D_y}{-L^d_{iL} + L^s_D D_{iL} + L^s_{iL}} > 0 \quad \text{and for cash}$$

$$\text{(11b)} \qquad \left[\frac{di_L}{dy}\right]_{HH} = \frac{-CB^d_D D_y + H_y}{CB^d_D D_{i_L} + CB^d_{i_L} - H_{i_L}} > 0 .$$

The denominator in (11a) is the same as that in (5a) and is therefore positive. The difference between the numerators of (11a) and (11b) is $E_y - 1$, which is negative, and the difference between the denominators is $-E_{i_L}$, which is positive. So, by combining these we get the result stated in the text.

16) This interpretation is based on professor Patinkin's analysis of Walras' law and the labour market in the standard Keynesian model, see Patinkin (1987).

17) If the LL curve is downward sloping, we can quite easily show that it is less steep than the QQ curve.

18) This result can be derived with the aid of Cramer's rule; see note 7 on page 70. The numerator in the ratio of determinants in Cramer's rule is $CB^d_D D_z CB^s_{i_m} - (-CB^d_{i_m} + CB^s_{i_m})(H_z + F^p_z)$, from which the stated result can be derived.

19) Note that we specify here the flow demand for securities to depend positively on the flow of sources of funds (income) rather than negatively as in the standard stock specification, where income represents only the transactions motive.

20) In principle, we could think of the possibility that introduction of the S market does not enlarge the system but changes its character in the sense that one of the equations is in fact linearly dependent on the others, so that there are only three independent market clearing equations in the model. The most obvious candidate for this role is the securities market. If securities were perfect substitutes for bank loans, these two would in fact form one market.

21) Kanniainen (1976) reached the same conclusion if there are trade credit flows.

22) Alho (1989) presents an analysis of the consequenses of the liberalization of the credit market and the emergence of the short-term money market on the effectiveness of fiscal and monetary policies in an optimizing framework based on portfolio theory. The general outcome is that both monetary and fiscal policies, when the budget deficit is financed from abroad, are likely to lose in effectiveness, while the case is the reverse with capital income taxation.

3 Analysis of short-run macroeconomic policies

3.1 Policies under fixed prices

Let us now proceed to consider the effects of some policy measures in the framework presented in chapter 2. In order to be able to analyze fiscal policies as well, we introduce government expenditure, revenues and the government budget constraint. We now specify the S market to be the government bond market so that we can discuss the domestic financial aspects of fiscal policies.

Let us simply specify that nominal taxes T in period t are collected according to a proportional tax function

(1) $$T = \theta \breve{Y}, \quad 0 < \theta < 1,$$

where $\breve{Y}$ is the nominal taxable income of the private sector (non-banks and banks together), see (3) below. Alternatively, we could have a progressive tax system where the tax rate rises as income grows. This would complicate the derivations below quite a lot, and so we have decided to use here a conventional specification for the tax function.

The government has real expenditures g. The budget deficit of the government is financed either by borrowing from the S market, the share of which in financing of the deficit is α_s, or from the central bank (with share α_{cb}) or abroad (α_f). The government debt to the central bank is denoted by CB^g and the foreign assets of the government by F^g.

The interest income on financial assets, i.e. on bank deposits and government bonds, is tax exempt in the Finnish tradition, while interest expenses on domestic and foreign loans are tax deductible. Bank profits are simply assumed to be distributed back to their owners in the private sector during the unit period. This allows us to omit interest incomes and payments from the disposable income of the private sector; only their different treatment in taxation has to be taken into account.

Profits of the central bank are assumed to be distributed back to the government. These profits are

$$(2) \qquad \pi_{cb} = i_{cb}(CB_{-1}) + i_f e F^{cb}_{-1} + i^g_{cb} CB^g_{-1} \,,$$

where the first term represents interest payments by the banks on their central bank debt. In the second term e is the (effective) exchange rate, i.e. price of a unit of foreign currency in terms of home currency. All interest payments are assumed to be based on asset stocks at the end of the previous period, denoted by the subscript -1.
The government deficit in nominal terms is now the following:[1)]

$$(3) \quad Def_g = Pg + bS^g_{-1} - i_f e F^g_{-1} + i^g_{cb} CB^g_{-1} - \pi_{cb} - \theta(P^d y + i_f e F^p - i_{cb}(CB_{-1}))$$

Here P is the price of domestic expenditure and P^d that of domestic production (see section 3.3 below). By b is denoted the coupon on a perpetual bond, the number outstanding of which is S^g. There is assumed to be an inverse relationship between the market price q and the rate of return i_S on a bond. The rate of return i_S on a unit of securities held from a period to the next is the following

$$(4) \qquad i_S = (b + \Delta q^e)/q \,,$$

where $\Delta q^e = q_{+1} - q$ is the expected change in the price of a bond. We assume that $(\partial i_s/\partial q) < 0$, i.e. that the elasticity of the expected future price q^e_{+1} with respect to the present price is less than unity in order to be able to derive the "usual" properties of macroeconomic models.[2)]

The deficit is financed by government borrowing in the following manner:

$$q\Delta S^g = \alpha_s \, Def_g$$

$$(5) \qquad -e\Delta F^g = \alpha_f \, Def_g$$

$$\Delta CB^g = \alpha_{cb} \, Def_g \, ,$$

$$\alpha_s + \alpha_f + \alpha_{cb} = 1 \, .$$

For simplicity, we have omitted government borrowing from the banks and government deposit holdings at banks. These features could easily be handled in the model. In the specification of the equilibrium conditions in the model (2.24) (formula (24) in chapter 2) we have to add the government expenditure g to total demand for goods, the flow supply of the S asset to the equilibrium condition for this market, and government borrowing from abroad and from the central bank as sources of the base money supply. In this section we assume fixed prices and therefore set the price indices in (3) to unity.

The Jacobian of the system is now

Market					Variable
Goods	$-E_{is}$	$-E_z$	$-(E)_{y^{pd}} (y^{pd})_{im}$	$1 + m_y - E_y$	
Securities	S_{is}	S_z	$(S)_{y^{pd}}(y^{pd})_{im}$	$S_y + \alpha_s\theta$	is
Loans	$-L^d_{is} + L^s_D D_{is}$	$1 + L^s_D D_z$	$L^s_{im} + a$	$-L^d_y + L^s_D D_y$	z
Central bank debt	$-CB^d_D D_{is}$	$-CB^d_D D_z$	$(-CB^d_{im} + CB^s_{im}) + b$	$-CB^d_D D_y$	im
Cash	$H_{is}+F^p_{is}$	$H_z+F^p_z$	$-CB^s_{im}+c$	d	y

where y^{pd} is the disposable income of the private sector (see (14) and (16) below) and[3)]

$$a = ((-L^d)_{y^{pd}} + L^s_D(D)_{y^{pd}})(y^{pd})_{i_m} < 0,$$

$$b = -CB^d_D(D)_{y^{pd}}(y^{pd})_{i_m} < 0,$$

$$c = (H + F^p)_{y^{pd}}(y^{pd})_{i_m} < 0 \text{ and}$$

$$d = H_y + F^p_y - ca_y + (\alpha_{cb} + \alpha_f)\theta < 0.$$

The surplus ca in the current account is now $x - m(y) + i_{fe}(F^p + F^g + F^{cb})_{-1}$. The derivatives A_y of the asset demand functions with respect to output can be further written as $(1-\theta)(A)_{y^{pd}}$, see more closely (17) below.

The elements in the third column need some explanation. In general, we have described the flows of interest income and expenses so that they are based on the prior period's stocks but the current period's interest rate which means that the instrument concerned is of the variable interest rate type. The income effect of a change in the marginal rate i_m on the central bank debt CB is calculated as follows. On the basis of the supply function of central bank debt specified in (8) below we first integrate it to derive the average interest rate $\bar{i}_{cb} = h_0 + (h_1/2)CB$ during the unit period. The interest payment by the banks on their central bank debt can then derived to be

(6) $i_{cb}(CB_{-1}) = \bar{i}_{cb}CB_{-1} = h_0CB_{-1} + (h_1/2)CBCB_{-1} = \frac{1}{2}(h_0 + i_m)CB_{-1}$.

This gives us the result $(y^{pd})_{i_m} = -\frac{1}{2}(1-\theta)\,CB_{-1} < 0$. The sum of the four elements in the third column of the Jacobian is the corresponding partial derivative of the equilibrium for the goods market and is positive. Because the off-diagonal elements are negative, the diagonal element in this column has to be positive.

As above, we concentrate on the last four equations in the system and treat the goods market equilibrium condition as a residual. We can now specify the elements of the Jacobian, denoted as the A matrix, to be of the following sign

$$
(7)\qquad
\begin{array}{l}
\text{Goods} \\
\text{Securities} \\
\text{Loans} \\
\text{Cb debt} \\
\text{Cash}
\end{array}
\quad
\begin{array}{cccc}
+ & + & + & + \\
\end{array}
\quad
\begin{bmatrix}
+ & - & - & + \\
- & + & - & + \\
- & - & + & + \\
- & - & - & +
\end{bmatrix}
\begin{array}{c}
i_S \\ z \\ i_m \\ y
\end{array}
$$

The goods market equilibrium is the sum of the four financial market equilibrium conditions.[4] Referring now to what was said above, we impose on (7) the condition that it is a transformed dominant diagonal matrix with one column, i.e. that for output y, replaced by elements of a positive sign. All principal minors of the system are of the dominant diagonal type, i.e. their determinant is also positive. This ensures that the determinant of A is positive. This can be established by expanding the determinant by the fourth column. All cofactors in the expansion can be proved to be positive.

We now analyze the consequences of some basic policy measures on output with the aid of this fix-price model. Therefore, we specify the supply function for the central bank debt of the banks to be of the following kind:

(8) $$i_m = h_0 + h_1 CB,\ h_1 \geq 0\text{, i.e. } CB^s = h_1^{-1}(i_m - h_0)\,.$$

The measures to be considered are:

a) an upward shift by dh_0 in the marginal interest rate curve of the central bank debt of the banks (i.e. a downward shift in the supply curve of central bank debt). This reduces the disposable income of the private sector by $\frac{1}{2}(1-\theta)CB_{-1}$ and the government deficit by the same amount. For the moment let us abstract from these income effects (for more on this see p. 61 below).

b) an increase by dg in public spending financed by borrowing from abroad (symbol $dg|\,f$) or alternatively from the central bank ($dg\,|\,cb$).[5]

c) an increase in public spending financed by issuing bonds ($dg\,|\,S$).

d) an increase in public spending financed by an equivalent increase in taxation, i.e. $d\theta = dg / \hat{Y}$.

In addition to these we consider:

e) an increase in private expenditure financed by borrowing from the domestic banks ($dE|L$).

The system with the impact effects is now the following[6]:

$$(9)\quad \begin{bmatrix} A \end{bmatrix} \begin{bmatrix} di_s \\ dz \\ di_m \\ dy \end{bmatrix} = \begin{bmatrix} 0 & 0 & dg|S & b_1 & 0 \\ 0 & 0 & 0 & b_2 & dE|L \\ h_1^{-1}dh_0 & 0 & 0 & b_3 & 0 \\ -h_1^{-1}dh_0 & dg\,|\,f, cb & 0 & b_4 & 0 \end{bmatrix}$$

Here A is the Jacobian in (7).

In the analysis we use Cramer's rule and the technique of partitioned matrices.[7)] We can derive the following results concerning the impact effects of changes in monetary and fiscal policies:

$$(10a)\qquad \frac{dy}{dh_0} \leq 0$$

$$(10b)\qquad \frac{dy}{dg}\Big|_f = \frac{dy}{dg}\Big|_{cb} > 0$$

$$(10c)\qquad \frac{dy}{dg}\Big|_S \geq 0\,,\ (10b) > (10c)$$

$$(10d)\qquad \frac{dy}{dg}\Big|_{dT} = dg \geq 0\,,\ (10b) > (10d)$$

$$(10e)\qquad \frac{dy}{dE}\Big|_L \geq 0\,.$$

The result (10a) can be derived by first adding the fourth row to the third in the numerator matrix of Cramer's rule and then expanding the determinant by the fourth column. By a direct calculation it can also be shown that if the income effects related to the cost of central bank debt can be ignored, monetary policy is totally ineffective as a stabilization tool if $E_z = S_z = 0$, which is a generalization of the result stated in chapter 2 to the situation where we have introduced the securities market. Similarly an increase in government spending, if it is financed in an expansionary way from abroad, leads to an increase in output. This result (10b) follows from the fact that the upper left corner 3 by 3 matrix A_{11} is also a dominant diagonal matrix, as can be easily checked. The effect on output (even though naturally not on foreign reserves of the central bank) is identical whether the government instead takes recourse to borrowing from the central bank.

We are also able to derive the result that an increase in government spending financed by issuing securities (bonds) is expansive, a result reached in the standard case (see Tobin (1982)). This result can be derived by a direct expansion of the determinant in the numerator of Cramer's rule. From (9) we can derive the result that an increase in government expenditure financed by issuing securities is fully crowded out if credit rationing does not have spillover effects to the demand for deposits, base money and foreign assets and if a rise in the S rate does not lead to a monetary expansion e.g. through increased foreign borrowing, i.e. we have the result

$$(11)\ \text{If } S_Z = D_Z = H_Z + F_Z^p = 0 \text{ and } D_{i_S} = (H_{i_S} + F_{i_s}^p) = 0 \text{ then } \left.\frac{dy}{dg}\right|_S = 0.$$

An increase in public spending financed through an equivalent increase in taxation is also expansionary, which is a result of the fact that the corresponding right hand side vector in (9) consists of positive elements. When the fourth column of the Jacobian is replaced by this vector, the resulting matrix is again a transformed dominant diagonal matrix discussed in section 2.4. above with a positive determinant. An increase in private spending which is to be financed from the bank loan market is also expansive. This last result was discussed already above in section 2.4. An increase in real expenditures is totally crowded out in the financial markets if credit rationing does not have any spillover effect in the financial markets, i.e. we have the result

$$(12)\qquad \text{If } S_Z = D_Z = H_Z = F_Z^p = 0, \text{ then } \left.\frac{dy}{dE}\right|_L = 0.$$

We can also prove that the multiplier of government spending related to borrowing from abroad or from the central bank is higher than the multipliers related to the two other ways of financing government expenditure. These results are derived by first subtracting the corresponding right-hand side vectors in (9) from each other and then calculating with the aid of this the difference between the determinants in the numerator of Cramer's rule. The result that an increase in government spending financed from abroad or the central bank is more expansionary than a securities financed expenditure is then derived by adding the fourth row to the first and noting that resulting three by three upper left corner matrix is a dominant diagonal matrix with a positive determinant. The comparison between financing from abroad or the central bank and by taxes is carried out by noting that the difference between the right hand side vectors in (9) is a vector with a positive fourth element, other elements being negative and the column sum being positive. When this vector is substituted into the numerator matrix in Cramer's rule, we can derive the result that it is again a dominant diagonal matrix, the determinant of which is positive. This gives us the stated property between the multipliers.

3.2 The model with a variable price level and inflation

So far we have operated with a fixed price level and accordingly with no inflationary expectations. It is now time to transform the model in such a way as to allow for a variable price level and inflation. In order to carry this out we have to consider two major elements in the model. First, how does inflation affect financial portfolio behaviour, and secondly, how is it linked to the goods market equilibrium? Let us start with the former problem.

As before, we treat the private sector as a single unit, which makes the derivations below somewhat simpler. Of course, by doing so, we lose the chance to discuss the potential effects of changes in income distribution between firms and households on the results of the model. Modifications of the model to include also the sectoral division of the private sector would, however, complicate the analysis substantially. We have therefore decided to omit this issue here, but we shall return to it below in the empirical analysis in the subsequent chapters.

The real wealth of the non-bank private sector is

$$(13) \qquad w^p = W^p/P = (qS^g + PK + H + D + eF^p - L)/P\ .$$

Here K is the volume of the capital stock used in production and P the domestic price level, i.e. price of domestic expenditure (see section 3.3).

The flow of real income y^p of the non-bank private sector as bank profits are distributed back to the non-bank sector is (see section 3.1)

$$(14) \qquad y^p = \frac{Y^p}{P}\ \text{, where}$$

$$Y^p = P^d y + i_{fe}F^p_{-1} + bS^g_{-1} - i_{cb}(CB_{-1}) - \theta(P^d y + i_{fe}F^p_{-1} - i_D D_{-1} - i_{cb}(CB_{-1})).$$

The flow of real income of the private sector is the value of production plus the net interest income from abroad, the government and the central bank less taxes. The tax function was introduced above in section 3.1.

The budget constraint of the private sector requires that the value of all uses of funds equals the value of all sources of funds, including capital gains, during each period. This condition can be written as follows:

(15) $Pw^p + Pc = P_{-1}w^p_{-1} + Py^p + (\dot{p}(1-d)-d)P_{-1}K_{-1} + \dot{e}(eF^p)_{-1} + \dot{q}(qS^g)_{-1}$,

where w^p is real wealth at the end of period, c is the real flow of consumption and d the rate of depreciation of the capital stock, $\dot{p}$ is the rate of inflation in the period, $\dot{p} = P/P_{-1}-1$,and $\dot{e} = e/e_{-1} -1$ and $\dot{q} = q/q_{-1}-1$ are the rates of devaluation and appreciation of the S asset, respectively. We approximate $(1 + \dot{p})^{-1}$ by $1-\dot{p}$. We can now write (15) approximately as follows if we omit the second order terms

$$(16) \qquad (w^p - w^p_{-1}) + c = y^p - \dot{p}w^p_{-1} + (\dot{p} - d)K_{-1} + \dot{e}\,(\frac{eF^p}{P})_{-1} + \dot{q}\,(\frac{qS^g}{P})_{-1} .$$

It is appropriate to denote the right hand side of (16) as the real disposable income y^{pd} of the private sector, it is equal to the flow of real income y^p less the net loss in the real value of net wealth added to the capital gains on the productive capital stock and on foreign assets and long-term financial assets. In other words, the real disposable income is equal to the flow of real income added to the real capital gains on the various assets. Capital gains are taken to be totally tax exempt.[8)]

We now specify the desired financial asset stocks of the private sector which refer to the components of the end-of-period real wealth w^p (see our definition in (13)). The asset demand functions (17) are homogeneous of degree one in the price level P, and they can be expressed as a product of P and the real demand functions. The asset demands depend on the vector of nominal interest rates: i_S , z, i_D (deposit rate), i_f and i_L. The yield on cash H is zero, and the expected inflation rate is $\dot{p}_e$, which is the nominal yield on goods.[9)]

$$H^d/P = h(\underset{(+)}{w^p_{-1} + y^{pd}}, \underset{(-)}{i_S}, \underset{(-)}{z}, \underset{(-)}{i_D}, \underset{(-)}{i_f}, \underset{(-)}{i_L}, \underset{(-)}{\dot{p}_e})$$

$$D^d/P = d(\underset{(+)}{w^p_{-1} + y^{pd}}, \underset{(-)}{i_S}, \underset{(-)}{z}, \underset{(+)}{i_D}, \underset{(-)}{i_f}, \underset{(-)}{i_L}, \underset{(-)}{\dot{p}_e})$$

$$(17)\qquad qS^{gd}/p = s(w^{p}_{-1} + y^{pd},\ i_S,\ z,\ i_D,\ i_f,\ i_L,\ \dot{p}_e)$$
$$(+)\quad (+)(-)(-)(-)(-)(-)$$

$$eF^{pd}/P = f(w^{-1^{p}} + y^{pd},\ i_S,\ z,\ i_D,\ i_f,\ i_L,\ \dot{p}_e)$$
$$(+)\quad (-)(-)(-)(+)(-)(-)$$

$$K^{d} = k(w_{-1} + y^{pd},\ i_S,\ z,\ i_D,\ i_f,\ i_L,\ \dot{p}_e)$$
$$(+)\quad (-)(-)(-)(-)(-)(+)$$

$$-L^{d}/P = l(w^{p}_{-1} + y^{pd},\ i_S,\ i_D,\ i_f,\ i_L,\ \dot{p}_e)$$
$$(+)\quad (-)(-)(-)(+)(-)$$

This formulation of asset demands implies that here we do not consider adjustment towards the optimum, which is a key part of the empirical model. Note that the demand functions in (17) do not sum up to total wealth plus income, but to total wealth plus income less consumption less excess demand for credit z. The asset demand functions are assumed to have the property of gross substitutability between the assets.[10)]

The consumption function is now the following

$$(18)\qquad c = c(w^{p}_{-1} + y^{pd},\ i_S,\ z,\ i_D,\ i_f,\ i_L,\ \dot{p}_e)$$
$$(+)\quad (-)(-)(-)(-)(-)(+)$$

The sum of functions in (17) and (18) is $w^{p}_{-1} + y^{pd} - z$ which implies the adding-up constraints binding the model. We assume that all the partial derivatives in (17) and (18) with respect to $w^{p}_{-1} + y^{pd}$ lie between zero and unity.

The above asset demand functions are transformed into real flows, which constitute the equilibrium conditions in the model, in such a way that beginning-of-period asset stocks, valued as real market values at the end of the period, are subtracted from the desired real market-valued stocks presented in (17) (see our treatment of this in section 5.4).

The introduction of inflationary conditions into the behaviour of the banks and the central bank is quite straightforward and we need not engage in this. We may note that the decision-making of the banks is based on nominal interest rates rather than on real ones (see the appendix to this chapter).

Before turning to the determination of domestic prices, let us still note the following changes to be made in the foreign trade equations. The foreign sector supplies with perfect elasticity the import goods, the volume of which is m, demanded by the home economy. The real demand for import goods depends on the level of production and the relative price of the import goods in terms of the domestically produced good,

$$(19) \qquad m = m^d\left(\underset{(+)}{y}, \underset{(-)}{\frac{eP^f}{P^d}}\right),$$

where P^f is the price of the foreign goods.

The volume of exports x depends on the world demand (world output) y_w and on the relative price between world prices and the export prices P^{df} of the home economy. So we have

$$(20) \qquad x = x\left(\underset{(+)}{y_w}, \underset{(+)}{\frac{eP^f}{P^{df}}}\right).$$

3.3 Determination of domestic prices

With respect to the prices and the inflation rate we consider in our model the determination of the prices P^d of domestic production and the domestic price level P, and the expected inflation rate $\dot{p}_e$. The domestic inflation rate is $\dot{p} = P/P_{-1} - 1$. We assume that the nominal wage rate W in the temporary equilibrium is an exogenous variable in the Keynesian manner, an assumption made also by, for example, Halttunen and Korkman (1981).

The determination of domestic prices is in the short run specified to depend solely on cost push factors while in a longer run they are based on a kind of Phillips curve augmented with inflation expectations. In a flow-of-funds model we could also take a classical view which would imply that there is a flexible price level equilibrating the goods market within the unit period (see Tobin (1982) on the various possibilities in this respect). Here we specify inflation in the short run to depend on the tightness in the labour and goods markets, while in a longer run under fixed exchange rate it is fully determined by the foreign inflation rate, along with the ideas of the monetary approach to the balance of payments.

Domestic production is either sold to the foreign market or to the domestic market. We allow that the goods exported and sold to the home market are not identical, so that export prices P^{df} and home market prices P^{dh} do not have the same cost structure. The former is based partly on domestic production costs,[11)]

$$(21) \qquad P^{df} = (eP^f)^{\gamma} W^{1-\gamma}, 0 < \gamma \leq 1 .$$

The domestic production sold to the domestic market is accordingly based on the following price index,

$$(22) \qquad P^{dh} = (eP^f)^{\alpha} W^{1-\alpha}, 0 < \alpha \leq 1 .$$

The price of domestic production is specified by the following price index

$$(23) P^d = (P^{df})^{\delta}(P^{dh})^{1-\delta} = (eP^f)^{\gamma\delta + \alpha(1-\delta)} W^{(1-\gamma)\delta + (1-\alpha)(1-\delta)}, 0 < \delta < 1.$$

The domestic price level P is a combination of the prices of domestic production sold to the domestic market and the imported (final) goods:

$$(24) \qquad P = (P^{dh})^{\sigma}(eP^f)^{1-\sigma} = (eP^f)^{1-\sigma(1-\alpha)} W^{(1-\alpha)\sigma}, 0 < \sigma < 1 .$$

The relative price between the prices on domestic production and domestic expenditure is now

$$(25) \qquad \frac{P^d}{P} = \left(\frac{W}{eP^f}\right)^{\delta(1-\gamma) + (1-\alpha)(1-\delta-\sigma)} .$$

If γ were unity and the sum of δ and σ and also unity, the two price indices would be identical. In this case, where the domestic economy is a price taker in the world market ($\gamma = 1$) and the share of exports in domestic production is the same as that of imports in domestic expenditure, i.e. foreign trade is roughly in balance, a devaluation of the home currency does not lower real income, and on the other hand, a rise in nominal wages does not raise real income. If γ is less than unity and the sum of and is less than one, then definitely a devaluation will lower real income and a rise in wages will raise it, ceteris paribus.

We now derive the formation of inflation expectations. Often they are described by some form of the Phillips curve, or taken as exogenous (for more on this see Tobin (1982)). We aim to introduce them to be determined by both domestic and foreign factors and to be consistent with the long-run equilibrium where the domestic inflation rate is fully determined by the foreign rate of inflation.

We first specify the dynamics of the wage rate in the model. The change in the real wage rate depends on both labour demand and labour supply elements, on the gap between the actual real wage and the level consistent with equilibrium in the labour market, and on whether total demand in the goods market deviates from its "normal" level. We do not in this context delve more deeply into this area, but simply specify the following mechanism. The long-run demand for labour N^d by the firms is described by the following relationship based on a standard production function

(26) $$N^d = N^d(\underset{(-)}{\frac{W}{P^d}}, \underset{(-)}{r})$$, where r is the real long-term rate of interest.

The labour supply function N^s is simply specified to be

(27) $$N^s = N^s\left(\underset{(+)}{\frac{W}{P}(1-\theta)}\right).$$

From the labour market equilibrium condition $N^d = N^s$ we can solve the equilibrium real wage $(W/P)^*$ as in the long run the real rate of interest in a small economy is equal to the foreign, which is denoted by r_f,

(28) $$(\frac{W}{P})^* = (\frac{W}{P})^*(\underset{(-)}{r_f}, \underset{(+)}{\theta}).$$ [12)]

The gap between actual y and "normal" capacity levels of production y* has an effect on the speed of adjustment of real wages towards this equilibrium level. If output (total demand) is high relative to its normal capacity levels, adjustment of real wages towards the level which is consistent with full employment will speed up if the actual real wage is lower than the equilibrium level of real wages, and the case is the reverse if the actual real wage is higher than the equilibrium real wage. Transforming these ideas into the form of nominal wage change, we may write

(29) $$\dot{W} = \dot{p}_e + \lambda(\frac{W}{P} - (\frac{W}{P})^*) + g(y/y^*) , \lambda < 0, g' > 0 ,g(1) = 0 ,$$

where $\dot{p}_e$ is the expected inflation rate ($= P^e_{+1}/P - 1$) .

From (24) we get that actual inflation is

(30) $$\dot{p} = \beta\dot{W} + (1 - \beta)(\dot{e} + \dot{p}^f), \beta = \sigma(1 - \alpha) .$$

Assuming perfect foresight, i.e. $\dot{p} = \dot{p}_e$, in this wage-price block of the model, we get

(31) $$\dot{p}_e = \frac{\lambda\beta}{1 - \beta} (\frac{W}{P} - (\frac{W}{P})^*) + \frac{\beta}{1 - \beta}g(y/y^*) + \dot{e} + \dot{p}_f .$$

On the right hand side we have, in addition to the foreign inflation rate $\dot{p}_f$, in fact the expected change in the exchange rate ($\dot{e}$). To simplify matters on this point we have in this chapter just kept the regime to be a true and credible case of fixed exchange rates ($\dot{e} = 0$) . But as a reaction to an actual devaluation it would be quite meaningless to argue that the old parity would be believed to be restored once it has been given up. So, in the manipulation of the model and equation (31) we assume that in every situation the private sector thinks that the new situation is a fixed parity case.

The actual real wage can be written as

(32) $$\frac{W}{P} = (\frac{W}{eP^f})^{1 - \beta} .$$

From this we see that a discrete devaluation of the home currency reduces the real wage in the short run. From (31) we further see that this raises the expected inflation rate. In the long run the domestic inflation rate is fully determined by the foreign because then the two first terms in (31) vanish.

We now turn to consider the solution of the system with endogenous variables i_S(or q), z, i_m, y, P^d ,P and $\dot{p}_e$.

3.4 Analysis of effects of macroeconomic policies and shocks in the enlarged model

The model can now be put together from the parts presented above and analyzed as we did in section 3.1. The model is reproduced in the appendix to this chapter. At the same time we introduce a wider menu of policy measures and exogenous shocks to be inspected in this section. Before that we have to think about how a change in the domestic price level and in inflationary expectations changes the properties of the demand for and supply of various assets.

The price level variables P^d and P depend directly on exogenous variables. So, in fact, we can only consider inflationary expectations as a new endogenous variable in the model. The asset demands in (17) depend on the expected inflation rate. As indicated there, we assume that real expenditures react positively to a rise in expected inflation, while the demands for financial assets react negatively. In this way we are able to derive the Jacobian of the enlarged system to be the following,

$$(33) \qquad \begin{matrix} S \\ -L \\ -CB \\ H \\ \dot{p} \end{matrix} \begin{bmatrix} + & - & - & + & - \\ - & + & - & + & - \\ - & - & + & + & - \\ - & - & - & + & - \\ 0 & 0 & 0 & - & 1 \end{bmatrix} \begin{matrix} i_S \\ z \\ i_m \\ y \\ \dot{p}_e \end{matrix}$$

Let us next turn to analyze the determinant of the Jacobian in (33), denoted again by A. Using the rule to calculate the determinant of a partitioned matrix stated in note 7 on page 70, we can derive the following expression for the upper left corner four by four matrix appearing in the determinant formula

$$(34) \qquad \bar{A}_{11} = A_{11} - A_{12}A_{22}^{-1}A_{21} = A_{11} - A_{12}A_{21}$$

$$= A_{11} - \begin{bmatrix} 0 & 0 & 0 & + \\ 0 & 0 & 0 & + \\ 0 & 0 & 0 & + \\ 0 & 0 & 0 & - \end{bmatrix}$$

where A_{11} is the corresponding submatrix of A.

The elements in the last column in brackets in (35) are of the type

$$(35) \qquad -g'(A)_{\dot{p}_e} > 0,$$

where A denotes the respective excess demands in the four financial markets. So, when we subtract this matrix from the "original" Jacobian of the fixed price system, i.e. from the upper left corner matrix A_{11}, only the elements in the last column of A_{11}, i.e. those referring to the effect of output on the excess demand for the financial assets, are affected by the change in the model. Let us now assume that these elements do not change in sign in $\overline{A}_{11}$ in (34), i.e. that

$$(36) \qquad A_y + (A)_{\dot{p}_e} (\dot{p}_e)_y \geq 0 .$$

This means that an increase in output does not lead, through increased inflationary expectations, to such a large reduction in the excess demand for the various assets that it would outweigh the initial positive effect of output on the excess demand for them. If we can make this assumption, we can definitely once again derive the result that the determinant of the Jacobian of A is positive (the determinant of A_{22} is now simply unity). The determinant of $\overline{A}_{11}$ can be seen to be positive by expanding it by its fourth column.

Let us now turn to use the model to analyze impact effects over a range of policy measures and exogenous shocks. We consider the following items.

Monetary policy measures:
- an increase in the loan and deposit rates di_L, di_D respectively,
- a shift in the central bank interest rate schedule dh_0 and
- an open market operation which increases the supply of securities dS^g and reduces the supply of base money;

Fiscal policy measures:
- increase in public expenditure dg financed in different ways as above in section 3.1
- an increase in the tax rate $d\theta$;

A devaluation of the home currency de (exchange rate policy);
An exogenous shift in the wage rate dW (incomes policy);
Shocks arising in the international economy:
- an increase in the world output dy_w ,
- an upward shift in the foreign price level dP_f,
- a rise in the foreign inflation rate $d\dot{p}_f$ and
- an increase in the international interest rate di_f .

Some of the above measures potentially cause income effects which run counter to the substitution effects and cause ambiguities in the effects of policy measures. In particular, these are related to the changes in the administrative loan and deposit rates. These problems are, however, eliminated in the case of the loan rate if we make the assumption that bank profits are distributed back to the non-bank private sector during the unit period.

The system of simultaneous equations to be solved can now be derived to be the following:

$$
(37)\quad [A]\begin{bmatrix} di_S \\ dz \\ di_m \\ dy \\ d\dot{p}_e \end{bmatrix} = \begin{bmatrix} + & ?,+ & ? & 1 & a & ? & - & + & 0 & + & 0 & + \\ - & ? & + & 0 & 0 & + & - & + & 0 & + & 0 & + \\ + & - & + & 0 & 0 & + & ?,- & + & 0 & + & 0 & + \\ + & ?,+ & ? & -1 & b & ? & ?,- & + & + & ? & 0 & ?,- \\ 0 & 0 & 0 & 0 & 0 & + & - & c & 0 & 0 & + & - \end{bmatrix} \begin{bmatrix} di_L \\ di_D \\ dh_o \\ dS^g \\ dg \\ d\theta \\ dW \\ de \\ dy_w \\ dP^f \\ d\dot{p}_f \\ di_f \end{bmatrix}
$$

?=uncertain effect

? , +=uncertain, but likely to be positive

? , - =uncertain, but likely to be negative

$a=\alpha_S$

$b=(\alpha_{cb} + \alpha_f)$

$c=-\lambda\beta \left(\frac{W}{eP^f}\right)^{1-\beta} e^{-1}$.

Let us first comment on the impulse effects presented in (37). The loan rate has substitution effects on the various excess demands to be seen in the first column in (37). The income effects do not arise under the above-mentioned assumptions concerning the treatment of bank profits and a uniform tax function within the private sector, including the banks. A rise in the deposit rate has substitution effects on the demand for other assets of the kind presented above in (17). It also increases the disposable income of the private sector which combined with the substitution effects cause the ambiguities denoted in the second column of (37). Here we have assumed the total effect to be dominated by the substitution effects, which assumption leads to the "likely" effect denoted in the first element in this column in (37). The second element in this column is anyway uncertain in sign.[13)] The third element is unambiguously negative but the fourth is again ambiguous, although it is positive if the income effects are discarded.

The impulse effects of a shift in the supply function of the central bank debt of the banks would be identical to those above in (9) if we could discard the income effects of a downward shift in the supply function of the central bank debt of the banks and concentrate on the "pure" supply effects presented in (9) above. If we, however, allow for the income effects which are the consequence of the reduction in the income of the private sector and a respective reduction in the government deficit, we face some ambiguities presented in the third column of (37). These reflect the fact that, depending again on the way in which the government deficit is financed, the excess demands for securities and base money may increase or decrease. We return to these ambiguities below. The effects of an increase in public expenditure depend on the way in which the expansion is financed. We see that the endogenous variables in our model are not affected by the degree to which that part of the government deficit not financed by domestic securities is financed by borrowing from the central bank or from abroad.[14)] The effects of a rise of the tax rate also depend in an essential way on how the government uses its increased revenues in financial markets. The various possibilities here give rise to ambiguities in the impulse effects which are denoted by a question mark in this column in (37). If increased taxes are used to amortize government debt in domestic securities, the excess demand for S is likely to increase and that for cash to decrease. Then we have a minus in the first and a plus in the fourth element in the column concerned in (37). But if taxes are used to reduce government debt to the central bank or reduce government foreign debt, these signs are reversed. Note also that the tax rate has an effect on the equilibrium real wage in the economy on the basis of (28) above. If the tax rate rises, this reduces the labour supply and thereby raises the equilibrium real wage which is reflected in higher inflationary expectations.

An increase in the nominal wage rate has many kinds of effects. First we must decide how it affects, ceteris paribus, the real factor incomes of the home economy, as discussed above in section 3.3. Here we have assumed that they are raised (see (25) above). Further, a wage increase raises the domestic price level which increases the capital losses on the inherited financial wealth of the private sector. This can be taken to be negative if the net foreign debt of the private sector dominates the financial wealth, and so the real income of the private sector therefore increases. On the other hand, the real value of taxes is also raised and the budget deficit reduced as a result of a rise in real incomes. The excess demand for loans is reduced, as is also likely to be the case for central bank debt of the banks as the real deposit inflow increases. The demand for base money increases but the supply of it is likely to decrease if the surplus in the current account reacts negatively to a rise in wages and government borrowing from abroad and the central bank goes down. A rise in the nominal wage rate leads to an increase in the actual real wage rate and thereby it, in fact, reduces inflationary expectations in our model, as less inflation is to be expected in the sequel in order to reach an equality between the actual and equilibrium real wages.[15)] The latter is of course not affected by changes in the actual nominal wage. An increase in wages raises the current price level instead.

Also a devaluation of the home currency has effects running in various directions. First, we suppose that it reduces real domestic current income, consistent with the assumption made in connection with a rise in the wage rate (see (25) above). The real capital losses on the financial wealth included in (16) increase as the sector is a net debtor vis-à-vis the rest of the world. There is also a capital loss on the securities stock, while the gains and losses on bank assets and liabilities are likely to roughly balance each other. So, the real disposable income y^{pd} of the private sector diminishes as a result of a devaluation. Real taxes are also reduced and therefore the budget deficit of the government automatically increases. The positive signs presented in the column related to devaluation in (37) require some further assumptions. The first element indicates that the excess demand for securities decreases as a result of a devaluation. In spite of the above assumptions this is not self-evident because a rise in the price level also decreases the real value of the existing stock of securities, which increases the flow demand for them. The second element is uniformly positive, as a devaluation leads to an increase in the excess demand for loans. The third positive sign requires that the excess demand for central bank debt increases, which is a likely outcome as the real demand for deposits decreases. The fourth element is the most problematic one. As the economy is taken to be a net debtor vis-à-vis the rest of the world, a devaluation may well worsen the balance of payments if increased foreign borrowing by the private and public sector does not compensate for it. The balance of trade may also show some J curve effects in the short run, which we have, however, assumed away here. The more the export prices depend on world market prices, the less important this effect is. By reducing the actual real wage, a devaluation also raises the inflationary expectations and reduces the expected real rates of interest.

The effects of the foreign shocks are quite straightforward. A shift in the foreign price level has effects here which are similar to those of a devaluation. This is due to the assumption made in connection with (25) that a rise in the foreign prices reduces real domestic income. Also here quite much depends on what happens to the equilibrium in the market for base money. As the domestic price level rises and incomes are reduced, the need for foreign borrowing increases. The trade balance may either worsen or improve as a result of a terms of trade shock represented by a rise in the foreign price level. As we keep the world output unchanged, the volume of exports rises and that of imports decreases. If the trade balance improved, we would have a positive sign in the fourth element of this column. If, however, the trade surplus goes down, we have an ambiguous sign in this element.

It should be remarked here, as well as in the case of a devaluation, that if we have a positive sign in every of the four first elements of the corresponding column in (37), this also means that their sum is positive, i.e. that the excess demand for goods increases. This requires that the increased demand for goods caused by a reduction in real taxes, added to the increase in net exports, outweigh the reduction in the demand for goods resulting from a decrease in real factor incomes.

An acceleration in the foreign inflation rate initially has a direct one-to-one effect on the domestic expected inflation rate. At the same time it also leads to a reduction in the real foreign interest rate and thereby raises the equilibrium domestic real wage rate (see (28) above). Through this channel a rise in the foreign inflation has a magnifying effect on domestic inflation. Correspondingly, a rise in the foreign interest rate causes a cut in the equilibrium real wage that is reflected in inflation also through this channel. Furthermore, it has effects through reduced domestic disposable income if, as we assume here, the domestic private sector and the government are net debtors vis-à-vis the rest of the world. We also assume that foreign capital flows by the private sector are dominated by the interest differential between domestic and foreign interest rates rather than by the income effect which a rise in the foreign rate causes. This results in a negative fourth element of the last column in (37).

Now we are ready to examine the impact effects of the various policy measures and the shocks in the exogenous variables mentioned above. The results of the analysis are summarized in table 1 and then commented below. We have based the calculations on the likely signs in (37).

A rise in the administrative loan rate of interest has ambiguous results. The only clear-cut result is that the tightness in the bank loan market decreases. In a credit rationing context it is well-known that a rise in the controlled loan rate of interest can have an expansive effect on output, as bank lending is then expanded. Also in our model we reach this conclusion if we were to omit the initial easing of the loan market as a result of a rise in the administrative loan rate. In the special case where credit rationing only has a spillover effect on the goods market, we definitely reach the result that output is expanded as the loan rate rises. This can be verified by a direct expansion of the numerator matrix by the second column.

A rise in the deposit rate, in general, has ambiguous results. The effect on output is a combination of diverging impact effects. There is a contractive effect with respect to output as the demand for central bank debt diminishes,

Table 3.1

Effects of the various policy measures and exogenous factors (1) on endogenous variables (2)

(2)	(1) Effects of a change in [16]:													
on:	i_L	i_D	h_0	S^g	$g\|S$	$g\|0$	$\theta\|S$	$\theta\|0$	W	e	y_w	P^f	$\dot{p}_f$	i_f
i_S	?	?	+	+	+	-	?,-	?	?	?	-	?	?	?
z	-	?	+	?	?	-	?	?	?	?	-	?	?	?
i_m	?	?	+	+	?	-	?	?	?	?	-	?	?	?
y	?,+	?	-	-	+	+	?	?,-	-	+	+	+	+	?,-
$\dot{p}_e$	?,+	?	-	-	+	+	?	?,-	?,-	+	+	+	+	?

but along with the consequent strengthening in the balance of payments there is an expansive effect so the overall effect is ambiguous. Consequently, the effect on the inflation rate is also unclear.

The effects of a rise in the cost curve of the central bank finance of the banks, i.e. a downward shift in the supply curve of central bank finance, has quite clearcut effects on all the variables, if we could discard the reduction in private sector income and in the government deficit caused by a downward shift in the supply curve of central bank debt. It raises the rate on securities as well as the marginal rate on central bank debt, as is natural. The bank loan market tightens. It reduces output in the manner described above in section 3.1 and decelerates inflationary expectations. We have not explicitly specified in the model the cash reserve deposits of the banks at the central bank. A change in these can be handled analogously with a shift in the cost curve of central bank finance.

A tightening stance in central bank policy reduces the income of the private sector and the government deficit by the same amount (see page 45 above). This clearly has a dampening effect on the demand for goods. All income effects of monetary policies are not, however, contractionary in the model. A decrease in private sector income initially increases the tightness in the bank loan market and increases the demand for central bank debt by the banks. Both these, ceteris paribus, cause an increase in output.[17)]

However, depending on the way in which government surplus is used, either through the securities market or through the market for base money a contraction in output is caused, which is likely to outweigh the expansive impulse effects. We can definitely infer this in the case where government surplus is solely invested abroad or in the central bank. In this case in the numerator of Cramer's rule, which is related to the income effects of a rise in h_0, the fourth column of $\overline{A}_{11}$ would have a negative diagonal element and positive off-diagonal elements and their sum, i.e. the effect on the excess demand in the goods market, would be a negative entity. Changing the signs in this column means that the sign of the determinant changes and also that we come to the case of a dominant diagonal matrix, the determinant of which is positive. Thus the determinant of the original $\overline{A}_{11}$ is negative. So we can infer that in this case, where a reduction in the disposable income of the private sector leads to a monetary contraction, there is also unambiguously a contraction in output.

Let us assume that the financial behaviour of the private sector would not depend on inflation in the sense that the coefficients in the Jacobian (33) related to the effects of the financial rates of interest on the respective excess demands were the same under inflation as in the case of fixed prices. Now we could reach the conclusion that in the present version, i. e. under inflation, monetary policies are more effective. Technically this is due to the fact that the determinant of the denominator in Cramer's rule is now smaller (see (36) above) and the numerator is the same as in the case of fixed prices. The intuition behind this result is that, as a tightening in monetary policies leads to an initial contraction in output, this also reduces inflationary expectations and raises the real rates of interest which magnifies the initial contractive effect. We shall return to this issue once again in the next chapter.

An open market operation where securities are issued and the revenues deposited at the central bank or abroad definitely raises the securities rate and that on the central bank finance of the banks, reduces output and lowers inflationary expectations.

We have divided the effects of government spending and taxation into two cases depending on whether the deficit is financed from either the securities market or from abroad or the central bank. An increase in public expenditure financed by borrowing from the domestic securities market has quite obvious results. It raises the interest rate on securities, and increases or leaves domestic output unchanged on the conditions stated above in section 3.1. Its effect on the rate on central bank debt of the banks is unclear. If expansion in public demand is financed in an expansive way by borrowing from the central bank or from abroad, the effects are clearcut. All the rates in the financial markets are lowered, the real economy expands and inflationary expectations rise.

A rise in the tax rate has effects which essentially depend on the way in which these extra government revenues are invested in financial markets. If the government debt in domestic securities is reduced, the securities rate is likely to go down.[18)] A rise in taxes reduces the real disposable income of the private sector, which in our model reduces the demand for base money and the demand for deposits. These run against the normal contractive effects of a tightening in taxation. A rise in taxes also increases the equilibrium real wage, as it reduces the supply of labour. This accelerates inflation, which also gives a boost to the expenditures of the private sector as expected real interest rates are lowered.

Even in the case where a rise in taxation leads to a monetary contraction if tax revenues are deposited at the central bank or abroad, we face some ambiguity about the contractive effect on output. This is due to the acceleration in inflation through a tightening in the labour market. If we could discard this, we would now come to the conclusion that a rise in the tax rate in our model is contractive with respect to output. This is proved in a similar way as the contractive output effect of monetary policies in this pattern of government financing. So we are able to qualify the result presented by Mankiw and Summers (1986), who showed that if the demand for money depends on disposable income rather than on output, a rise in taxes may be expansive with respect to output.[19)]

A rise in the domestic wage level has quite many effects again. We have here used the assumption mentioned above that a rise in the wage rate, ceteris paribus, increases the real domestic factor incomes (see (25) above). The contractive effects of an increase in the wage rate on output come here i.a. through a worsening in the balance of payments, through a dampening of the inflationary expectations, and through a reduction in the demand for central bank debt as deposits rise in value. The effect on inflationary expectations remains ambiguous, but is negative in the case where inflationary expectations depend only slightly on the total demand in the goods market.

A devaluation of the home currency leads to a rise in the domestic price level and to a reduction in the real domestic incomes according to our basic starting point made above. A devaluation raises inflationary expectations, as we mentioned earlier, and this gives a boost to expenditures.[20)] The more the financial asset demands react to a change in inflationary expectations, the more pronounced this effect is. The counterpart of these negative partial effects (see (33) above) is a positive dependence of real expenditures on expected inflation. A devaluation reduces real income and increases the budget deficit also because interest payments to foreigners grow. Real income is also reduced as a result of a capital loss on foreign debts, as we assume that the private sector is a net debtor vis-à-vis the rest of the world. Also the domestic price level rises, which is likely to raise the capital losses on wealth. However, if a devaluation leads to an improvement in the balance of payments, we can anyway definitely derive the conclusion that it leads to an expansion in output irrespective of the mentioned contractive effects. The overall net result of these various effects is positive because in a diagonal dominant system impulses which initially lead to a rise in all the endogenous variables in the system lead to an expansion in output. The effects of a devaluation on the domestic interest rates are, however, ambiguous.

In Finland there has been a keen discussion on the exchange rate policies pursued since the late 1960's, and different views have been expressed whether they have been stabilizing or destabilizing, has the timing of the discrete exchange rate changes been suitable, etc. In academic circles views have been presented whether and on what conditions a devaluation is expansionary or even contractionary with respect to the real economy.

Let us consider more closely how in our model a discrete stepwise change in the effective exchange rate has effects on the real economy, especially how the impact effect dy/de, which may or may not be a constant in our model, behaves depending on the initial conditions which prevail in the situation before the change in the exchange rate. There are two major arguments which have been presented in this connection:

1) If the net foreign debt of the country is "large enough", this dampens the "normal" expansionary effects of a devaluation running through the trade balance.
2) The effects of a change in the exchange rate depend on the initial imbalance in the economy "at the moment" of the change in exchange rate policies. (See the discussion on this in Alho and Vartia (1983), Korkman (1984) and Pekkarinen and Sauramo (1985).)

The first point is of course valid also in our model, which we tackled already above, but it was taken not to fully "crowd out" the expansionary effects of a devaluation during the unit period covered by our model. Let us therefore turn to consider more closely the second issue. Because of the wage-price mechanism of the model, changes in the exchange rate potentially have an effect on the inflation rate depending on the gap between the initial real wage and the "long run" equilibrium real wage. The element c in (37) is higher, the higher the actual real wage is. As can be easily seen this causes an expansive effect on the overall output effect of a devaluation.

Intuitively, this can be interpreted in the following way. If a devaluation is made in a "wrong" situation where the real wage is below its equilibrium levels, in our model this causes only a slight increase in the inflation rate. As all the excess demands for financial assets react negatively to expected inflation, this implies that the real expenditure depends positively on it, as is plausible. So we have as an outcome that excess demand for goods is not raised much through this channel. If, on the other hand, the excess demands for financial assets do not at all react to expected inflation, we have the case that the effects of a discrete change in the exchange rate on output is a constant, positive in sign. In this quite implausible case the initial state of the real wage does not have an effect on the impact effect of exchange rate policies. We have illustrated the situation in figure 3.1.

The shocks arising in the international economy are quite easily analyzed. An increase in world output (export demand) has very clearcut consequences. It expands domestic production, it reduces the domestic rate on securities and on the central bank debt of the banks and the tightness in the bank loan market is eased. It raises inflationary expectations. An upward shift in the foreign price level has effects similar to those of a devaluation. We must bear in mind that a rise in the foreign price level at the same time reduces real taxes and increases the budget deficit. An acceleration in the world inflation rate is expansionary with respect to output and leads to higher inflationary expectations. The domestic rates of interest remain unchanged if the asset demands do not depend on inflationary expectations.

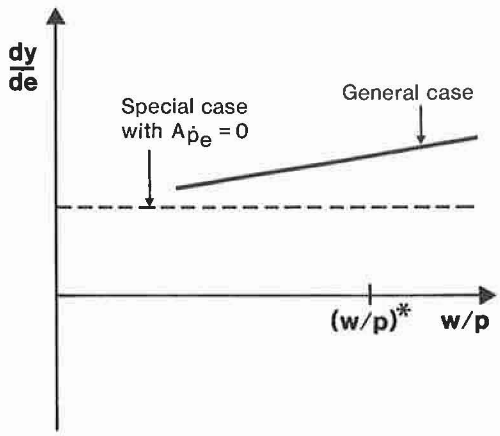


Figure 3.1 The output effect dy/de of a discrete devaluation and its dependence on the initial real wage rate

A rise in the foreign interest rate has ambiguous effects again. If it simultaneously leads to a rise in the real rate of interest, it also reduces the equilibrium domestic real wage as a kind of an adverse supply shock (see (28) above and Kouri (1983)). These are reflected in inflation and thereby in domestic output. We can reach the conclusion that the overall effect on output is contractive, if the balance of payments deteriorates as a result of a rise in the foreign rate of interest.[21)] The contraction in output is reinforced by the deceleration in domestic inflation caused by the rise in the foreign interest rate. It is interesting to find that in this model the effects on the domestic interest rates are ambiguous.[22)]

Models of the small open economy with flexible exchange rates provide for perfect insulation against disturbances in the foreign inflation rate in the short, as well as in the long run, if and only if the foreign nominal interest rate fully adjusts to the foreign inflation rate, i.e. if the foreign real interest rate is a constant (see Turnovsky (1984)). In our model the effective exchange rate is fixed, but it can be changed in a discretionary manner by a policy decision. Here the overall effect of a foreign inflationary shock, if the foreign real rate of interest remains unchanged, is ambiguous, because it feeds contractive monetary impulses through the balance of payments and expansive impulses through a reduction in the demand for deposits and accelerated inflationary expectations. So we cannot a priori tell what kind of exchange rate policies are required in our model to reach the insulation property.

We have so far operated under the assumption of credit rationing, which produced for us the z variable reflecting tightness in the bank loan markets.

Now it is quite an easy task to understand that the above analysis can be carried out, mutatis mutandis, also under the assumption of a freely floating loan rate of interest and a short-term money market where also the non-bank private sector is participating.

Of course, there may be major changes in behaviour "between" the different financial regimes, but the qualitative properties of the asset demand and supply functions with respect to the interest rates should remain the same as presented above. In our model, also the potentially different income effects of the loan rate i_L and the excess demand for credit z are eliminated on an aggregate level, which is a consequence of the assumption according to which bank profits are distributed back to the non-bank private sector during the unit period.[23)]

Removal of the interest controls does not in itself mean that there would be an automatic shift to a Walrasian loan market with perfect competition. There are typically imperfections in these markets, as adverse selection and model hazard (see argumentation concerning the operation of loan markets by Stiglitz and Weiss (1981) and Bester (1987), who analyzes the role of collateral policies in elimination of these market imperfections).

3.5 Some notes on longer-run effects of policies

The above flow-of-funds model is in itself a dynamic description of the economy. It consists of equations describing the changes in the capital stocks and in the stocks of financial assets and liabilities, and the growth of wealth. The model also describes the evolution of the inflationary process over time.

There are also other possibilities to introduce dynamics into the model. These are related to relaxing the assumption made above concerning the fixing of the expected prices of securities. This sort of dynamics with rational expectations in a much smaller Keynesian model with various assets being perfect substitutes for each other is presented by Blanchard (1981). In our much more complicated model, with assets which are not perfect substitutes for each other in the short run, introduction of this kind of dynamics would not be an easy task.

The analysis of a steady state of a model of the kind above has been presented by Tobin (1982), but he decided to concentrate solely on the closed economy case, because "... the whole concept of steady long-run growth fails for open economies unless their several natural rates of growth happen to be identical." (Tobin (1982, p. 196)).[24)]

We may make some brief notes on the operation of our model in an intermediate-run context where the domestic wealth may be changing as a result of an imbalance in the current account. First, we may note that as the elasticity of the capital flows with respect to the differential between the domestic and foreign rates of interest grows over time, the domestic securities rate and the bank loan rate have to be equal to the foreign interest rate. The central bank rate goes down to the level where there is no effective credit rationing. The dynamic force driving the economy towards this situation is the capital flows, which without this sort of adjustment in the domestic rates, would lead to continuous accumulation or decumulation of the foreign reserves of the central bank.

According to the model, the inflation rate is fully determined by the foreign inflation rate once the domestic economy is on the normal capacity level of production and the real wage corresponds to its equilibrium level. In order to achieve this, the adjustment through the real wage rate is in a key position. The lower the real wage rate is, the lower the product wage in the export sector and the higher the volume of exports.

The total demand has to be equal to the total supply of goods at the level of domestic production where the real interest rate is equal to the foreign real rate and the real wage rate is at the corresponding equilibrium level. The government has to adjust its expenditure and taxation in order to achieve this kind of a situation.

We have in this chapter presented a model for the Finnish economy in the spirit of the general equilibrium macroeconomic model applying the general ideas on macroeconomic modelling of Tobin and Brainard. By introducing the inside money and bank loan markets we faced a richness of macroeconomic effects, the overall balance of which is not every where clear.

The empirical justification of some of the solutions made in our model should also be briefly assessed. This is primarily related to the relevance of the securities market as a part of the transmission mechanism of monetary policy to the real economy. We examine this more closely in the empirical model for households, where securities are empirically identified as housing wealth and government bonds, and are able to find some support for this channel. The treatment of the securities market, if taken as the government bond market and as a market reaching a flow equilibrium within the unit period is also a solution which may be questioned, because the bond rate has been quite rigid.[25)] Our solution here has been made in order to be able to describe in a simple way the crowding out effects of government expansion through the domestic financial markets and that major changes in bond supply also require changes in the bond rate to induce the private sector to change its portfolio behaviour. Some evidence on this is found in Alho (1982), page 63 and in chapter 7 below.

Appendix. The model in the inflationary framework

$$s(.) - \frac{q}{P} S^g_{-1} - \alpha_s \frac{Def_g}{P} = 0 \text{ (securities)}$$

$$z - l^d(.) + \frac{L_{-1}}{P} + \frac{L^s(D, i_L, i_D, i_m)}{P} - \frac{L_{-1}}{P} = 0 \text{ (loans)}$$

$$\frac{-CB^d(D, i_L, i_D, i_m)}{P} + \frac{CB_{-1}}{P} + \frac{CB^s(i_m)}{P} - \frac{CB_{-1}}{P} = 0 \text{ (-central bank debt)}$$

$$h(.) - \frac{H_{-1}}{P} + f(.) - \frac{eF^P_{-1}}{P} - \frac{P^{df}x - eP^f m}{P}$$

$$-i_{fe} \frac{(F^p + F^g + F^{cb})_{-1}}{P} - CB^s(i_m) + \frac{CB_{-1}}{P} - (\alpha_{cb} + \alpha_f) \frac{Def_g}{P} = 0 \text{ (base money)}$$

$$\dot{p}_e - \frac{\lambda\beta}{1-\beta} \left(\frac{W}{P} - \left(\frac{W}{P}\right)^*\right) - (\dot{e} + \dot{p}_f) - g(y/y^*) = 0 \text{ (inflationary expectations)}$$

Here (.) refers to the arguments presented above in (17). Other variables are defined as in the text. The nominal demand for deposits is D=Pd(.). The bank lending also depends negatively on the administrative deposit rate i_D (see section 9.2 more closely on the specification of bank behaviour). The sum of the four first equilibrium conditions can be shown to be the equilibrium condition for the goods market,

$$\frac{P^d}{P} y - c - i - g - \frac{P^{df}}{P} x + \frac{eP^f}{P} m = 0,$$

where i is the investment in the fixed capital.

Notes

1) The taxable income is derived in the following way. Primarily it is based on factor income of the private sector, i.e. national income less capital income, net of the government (the sum of the second, third, and fourth term on the right-hand side of (3) multiplied by minus unity) and the profit of the central bank. Interest income on deposits and government bonds is tax exempt and the interest payments on bank loans and foreign loans are tax deductible in the taxation of the non-bank private sector. The banks pay taxes on their profit $i_L L_{-1} - i_D D_{-1} - i_{cb}(CB_{-1})$. Then the private sector, i.e. the banks and non-bank private sector, pays taxes in the manner presented in (3).
2) If this does not hold, then the S market would not behave in a stable way so that excess demand in this market would be eliminated through a rise in the price of S. (See Tobin (1982, p. 190)).
3) Note that the partial derivatives of the equilibrium conditions with respect to the securities rate i_S consist of the sum of its direct substitution effect and its effect through the disposable income of the private sector on the asset demands, see (16) and (4). In the securities market a rise in i_S, which is related to a reduction in the market price of a bond, also causes an increase in the flow demand for bonds as their real market value is lowered; see the flow specification of the model in the appendix to this chapter. For simplicity, we have in this section also set the prices of exports and imports in terms of domestic prices to unity. In chapter 2, where we did not consider exchange rate policies, by using F^p we denoted foreign assets directly in terms of domestic currency. In this chapter we consistently change the notation of F^p (and F^g and F^{cb}) to denote the stock of foreign assets in terms of foreign currency. In the Jacobian the partial derivatives of F^p are, however, calculated in terms of domestic currency.
4) The goods market equilibrium is now y-E-g-x+m = 0.
5) It should be noted that we assume here that the government has a credit facility of its own at the central bank and that it does not participate in the market for central bank debt of the banks.
6) The elements b_i are

   $b_1 = S_{y^{pd}}$, $b_2 = -L^d_{y^{pd}} + L^s_D D_{y^{pd}}$, $b_3 = -CB^d_D D_{y^{pd}}$, $b_4 = H_{y^{pd}} + F^p_{y^{pd}}$,

   where y^{pd} is the disposable income of the private sector and $dy^{pd}/dT = -dg = -1$. All the elements are positive and supposed to lie between zero and unity, see (17) below.

7) According to Cramer's rule, from the linear equation system A(dy)= B(dx), we can solve

$$\frac{dy_i}{dx_j} = \frac{|A_1, \ldots, A_{i-1}, B_j, A_{i+1}, \ldots, A_n|}{|A|}$$

, where the A_i and B_j denote the ith and jth column vectors of A and B, respectively.

The determinant of a partitioned matrix $A = \begin{vmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{vmatrix}$ can be calculated as $|A| = |A_{22}|\,|A_{11} - A_{12}A_{22}^{-1}A_{21}|$ See e.g. Rao (1965, p. 28). The latter matrix is denoted below by $\bar{A}_{11}$.

8) In this we have followed the treatment of inflation by Papademos and Modigliani (1983). This pooled definition of disposable income could in principle mean that there are well functioning capital markets so that increases in capital gains would lead to increased indebtedness. This is, however, contrary to our view on the operation of the Finnish credit market. We can well imagine that in the case of credit constraints the capital gains are directly invested back into the asset stock from which they are originating. So the specification of equations (17) is only a short-cut and could in principle be replaced by a disaggregated income concept with the various components having different effects on the portfolio behaviour. See more thoroughly section 5.4 below on the treatment of capital gains in a portfolio model. We also need some long-run constraints in order to be able to eliminate some perverse behaviour in the long run. We require that the discounted value of the net wealth w^p converges to a non-negative limit value (on this see d'Autume and Michel (1987)).

9) The real demand functions in (17) could be specified to be homogeneous of degree zero in this vector of (after-tax) nominal rates of return and the rate of inflation. The financial asset demands could then be written as functions of the expected real (after-tax) rates of interest, see Papademos and Modigliani (1983, p. 210). Note that on the basis of what was stated above, the partial derivatives in (17) with respect to the loan rate and the foreign rate of interest take into account that the relevant rates for behaviour are the after-tax rates of interest $(1-\theta)i_L$ and $(1-\theta)i_f$.

10) See Tobin (1982, pp. 184-185) on gross substitutability as an element of a flow-of-funds macroeconomic model.

11) The share γ reflects both the price-taking behaviour of exporters and the share of imported raw materials in export production. Of course, we should add here the capital costs and pure profits of the producers, but we have taken them to be identical mark-ups in the various prices and they are therefore omitted from the following expressions of price levels.

12) Here we have assumed that in the long run $P^d = P$.

13) This is due to the fact that the demand for deposits by the public increases and this increases bank lending but the funding costs of the banks also rise, which leads to a cut in lending (see section 9.2 on specification of bank behaviour)

14) We have not reiterated here the case where the budget is balanced with an identical increase in taxation.

15) Here we can see the role played by our specification of the inflationary expectations as rational expectations rather than, say, stationary or autoregressive.

16) $g|S$ = increase in government expenditure g financed through the securities market, $g | 0$ = g financed from abroad or the central bank, $\theta|S$ is an increase in the tax rate where the extra revenues are invested in the S market, and $\theta |0$ is the same except that the revenues are invested in the central bank or abroad. The meanings of the question marks, followed by plus and minus signs are the same as in the equation system (37).

17) These individual effects refer to the corresponding cofactors multiplied by the corresponding element in the expansion of the determinant $|A_{11}|$ by the fourth column.

18) It will certainly go down if the demand for securities does not depend on inflationary expectations or if we can discard the effect of a tighter taxation on inflationary expectations.

19) In addition to these effects, a rise in the tax rate also reduces the after-tax rate on loans and foreign assets which has substitution effects on the asset demands. The former is likely to cause a contraction in output (see above) and the latter causes an expansion.

20) It is an interesting empirical fact that in Finland after the devaluation in October 1982 a price freeze was put into effect, which had a marked expansive effect on consumer durable expenditures in late 1982.

21) In this case the fourth diagonal element in the numerator matrix A_{11} is negative and the off-diagonal elements in the fourth column are positive, the sum of them all being negative. This again leads to the result that the determinant $|\overline{A}_{11}|$ is negative.

22) In the special case where the foreign rate only has an effect on the demand for foreign assets and on real expenditure we, however, reach the conclusion that the domestic rates rise as a result of a rise in the foreign rate.

23) See Neary and Roberts (1980) on an analysis of consumer behaviour under quantitative rationing in the goods market.

24) See also Lassila (1983) for an analysis of long-run effects of macroeconomic policies in models based on the same approach.

25) See Stenius (1986) for a disequilibrium analysis of the Finnish bond market. For further discussion on the disequilibrium hypothesis in this connection see Kanniainen (1987) and Stenius (1987).

4 Monetary policies and integration of the domestic and foreign money markets

Basically, the above analysis in chapters 2 and 3 refers to the main features of a financial system that prevailed in Finland in the period extending from the late 1960's to the early 1980's. Since then there have been substantial institutional changes both in the structure and scope of the markets, behaviour of the market participants and the tools of monetary policies of the central bank. The short-term money market has grown to a substantial size, being first linked by arbitrage to the market for central bank finance of the banks, and then recently being transformed into a market of the standard type where the central bank indirectly through changing its position in this market influences the short-term rate. The central bank has abandoned its control over the lending rates of the banks. Markets which we have introduced above in the general form of the "S (securities) market" have grown in importance both in the form of the corporate bond and equity market. In terms of table 2.1 on page 16, we now turn to the case where we have a general short-term money market (symbol M) and the bank loan market is described by the equilibrium version, i.e. we have z=0 in the flow-of-funds matrix.

The domestic short-term money market consists of markets for various categories of the free rate funds, the market for covered foreign assets held by domestic economic agents and the domestic assets held by foreigners, e.g.

through the forward market. All these assets are taken to be linked by arbitrage as perfect substitutes for each other. The banks' liquidity reserve is now the domestic short-term money market. In a normal situation the foreigners also invest in domestic securities in the S market. We can open this cell in our accounting framework with a similar kind of demand for S function as the domestic private sector has. So, this change does not alter the qualitative properties of our system. Normally, we get the result that if foreigners can invest in domestic securities, then monetary autonomy is reduced (for more on this see Alho (1984a), where this conclusion is based on Kanniainen (1984)).[1)]

Our aim in this chapter is to carry out a brief analysis of these changes. The main point is that we take into account links between the domestic and foreign financial markets in the form of closer ties between the domestic short-term asset and the uncovered foreign asset. The new link to the model presented above in chapter 3 is that we add the open interest parity between the short rates to the model in the following form:

(1) $$i_m = i_f + E\dot{e},$$

where $E\dot{e}$ is the expected rate of devaluation of the domestic currency. This specification would strictly imply risk neutrality or no exchange risk but we could well add a constant risk factor to (1) depending on the total (lagged) portfolio of the wealth-holders and its composition.[2)]

This addition affects the model in the sense that the inflationary process in (3.31) is transformed with the aid of (1) so that now we have market data for the public's attitudes concerning the expected rate of devaluation of the home currency.[3)]

Accordingly, our equation for inflationary expectations (3.31) above is now transformed to the following form:

(2) $$\dot{p} = \dot{p}_e = \frac{\lambda\beta}{1-\beta}\left(\frac{W}{P} - \left(\frac{W}{P}\right)^*\right) + \frac{\beta}{1-\beta} g(y/y^*) + i_m - i_f + \dot{p}_f .$$

On the right hand side, we have the domestic interest rate and the negative of the foreign real rate of interest. An autonomous rise in the domestic interest rate now leads to accelerated inflationary expectations, as it gives rise to expectations of a future devaluation. In the long run we have the condition that the real rates of interest are identical in the home economy and abroad.

It is now interesting to analyze how this change in the model affects the effectiveness of domestic monetary policies. The Jacobian (3.33) is now transformed into the following[4)]

$$(3) \qquad |A^*| = \begin{bmatrix} + & - & - & + & - \\ - & + & - & + & - \\ - & - & + & + & - \\ - & - & - & + & - \\ 0 & 0 & -1 & - & 1 \end{bmatrix} .$$

As above, let us first calculate the sign of the determinant of this Jacobian. Again, we use the technique of partitioned matrices, which gives us the same condition as above in (3.35) concerning the signs of the fourth column in the Jacobian. Further, we now also have the situation that the elements of the third column in $\overline{A}^*_{11}$ are changed because the short-term rate i_m also appears in the inflation equation.

Let us first concentrate on the case where the excess demands for financial assets do not at all depend on inflationary expectations. In this case the elements in the third and fourth columns of the matrix A* are not affected when we substitute the equation for inflationary expectations into the four first equations, i.e. when we form the matrix $\overline{A}^*_{11}$. On the basis of what is stated above, the determinant of A* is then easily checked to be positive. The general situation is the following. The adding-up constraints also have to bind the partially reduced four by four system consisting of the first four endogenous variables in a similar way as they bind the original system once the equation for inflation is substituted away. The elements of the third column of $\overline{A}^*_{11}$ sum to the corresponding effect in the equilibrium in the market for goods, i.e. to

$$(4) \qquad -E_{i_m} - E_{\dot{p}_e}(\dot{p}_e)_{i_m} = -E_{i_m} - E_{\dot{p}_e} .$$

If real expenditures depend on the various real rates of interest, we have the homogeneity property

$$(5) \qquad E_{i_m} + E_{i_S} + E_{i_L} + E_{i_D} + E_{\dot{p}_e} = 0.$$

Now, we see that (4) is negative. So, the property related to the sum of the elements of a column vector in a dominant diagonal matrix, i.e. that it is positive, is violated in this column of $\overline{A}^*_{11}$. Therefore, the sign of the determinant A* is not any more unambiguously positive, even though we make the assumption (3.35) also here.

Let us now assume that domestic monetary policies are tightened (or eased, mutatis mutandis) and analyze whether they can affect output under these new conditions. It is relevant to face this question once again because in the present case a rise in the domestic short-term rate not only has those same contractive effects it had above under constant exchange rate expectations, but now it also leads to a rise in inflationary expectations on the basis of (2). This has expansive effects through intertemporal substitution in expenditures.

Leaving again aside the income effects of monetary policies, the numerator in Cramer's rule is now the following:

$$(6) \qquad |B| = \begin{vmatrix} + & - & - & 0 & - \\ - & + & - & 0 & - \\ - & - & + & 1 & - \\ - & - & - & -1 & - \\ 0 & 0 & -1 & 0 & 1 \end{vmatrix} .$$

The determinant of the four by four matrix $\overline{B}_{11}$ is calculated in the following way. To the elements in the third column of B we add the elements of the last column of B, i.e. the first four elements in the fifth column of A*. In the third column of $\overline{B}_{11}$ other elements are now negative but the diagonal element is uncertain. This may even lead to the case where monetary policies have a "perverse" effect on the real economy in the short run in a situation where we have a closer connection between the domestic and foreign financial markets. This would happen if the sum $\overline{B}_{11}(3,3) + \overline{B}_{11}(4,3)$ were negative and $|A^*|$ were positive, which can be seen as follows. The determinant $|\overline{B}_{11}|$ is calculated so that first its fourth row is added to its third row and then the determinant is expanded by its fourth column. The determinant of the upper left corner three by three submatrix of $\overline{B}_{11}$ is negative under the stated condition and the determinant of B would be positive. We come to the conclusion that the model is in fact too large for us to be able to firmly settle this problem.

Let us therefore reformulate the model in such a way that we are able to discuss more thoroughly the effect of monetary policies when it has a direct influence on the inflationary expectations. As mentioned above, we assume that the loan market now clears through a flexible loan rate of interest i_L. A second simplification is that we combine the securities market and the loan market into a single market for long-term financing. The third change is that we again assume that the central bank pegs the domestic short rate to $\overline{i}_m$ by means of its interventions in the short-term money market. These changes mean that now the model consists of only three endogenous variables, the loan rate i_L , output y and inflationary expectations $\dot{p}_e$. The two financial market equations of the model can now be written in the following form

$$-L^d(y^{pd}, \bar{i}, \dot{p}_e) + L^s(D, \bar{i}) - \alpha_s Def_g = 0$$

$$(7)\ H(y^{pd}, \bar{i}, \dot{p}_e) - H_{-1} + f(y^{pd}, \bar{i}, \dot{p}_e) - eF^p_{-1} + M^p(y^{pd}, \bar{i}, \dot{p}_e) - M^p_{-1}$$

$$+ M^b(D, \bar{i}) - M^b_{-1} - (\frac{P^{df}}{P} x - \frac{eP^f}{P} m) - i_f e(F^P + F^g + F^{cb})_{-1}$$

$$-(\alpha_{cb} + \alpha_f)Def_g = 0 ,$$

where the new symbols $M^p$and M^b refer to the nominal demand for the domestic short-term asset by the non-bank private sector and the banks, and $\bar{i}$ is the vector of interest rates, $\bar{i} = (i_L, \bar{i}_m, i_D)$. Other symbols are as above. The Jacobian A with elements a_{ij} of the model is now

$$(8)\qquad \begin{bmatrix} + & + & - \\ - & + & - \\ 0 & - & 1 \end{bmatrix} \begin{matrix} i_L \\ y \\ \dot{p}_e \end{matrix} .$$

Let us now consider a tightening stance in monetary policies so that i_m is raised. As we do not consider measures which cause a shift in the price level we have set P to unity in (7). Leaving aside again the income effects of monetary policies, the left hand side vector of the impulse effects of this change is

$$(9)\qquad \begin{bmatrix} -L^d_{i_m} & +L^s_D D_{i_m} & + & L^s_{i_m} & & \\ H_{i_m} & + \ F^p_{i_m} & + & M^p_{i_m} & + & M^b_D D_{i_m} \\ & & -1 & & & \end{bmatrix} .$$

Let us denote the two first elements in this vector by b_1 and b_2. As above, let us use the technique of partitioned matrices when we calculate the determinants of the matrices in Cramer's rule. We make again here a similar assumption as in connection with (3.35) above concerning how the excess demands in the financial markets depend on output when we take the link between output and inflationary expectations into account. This ensures that the determinant of the Jacobian (8) is positive as above. In calculating the determinant in the numerator of Cramer's rule we partition this matrix B so that $\overline{B}_{11}$ consists of the upper left corner two by two submatrix of B. The elements c_{ij} of this matrix $\overline{B}_{11}$ are

$$(10) \qquad \begin{bmatrix} a_{11} & -b_1 - A^1_{\dot{p}_e} \\ a_{21} & -b_2 - A^2_{\dot{p}_e} \end{bmatrix},$$

where by $A^i_{\dot{p}_e}$ is denoted the partial effect of inflationary expectations on the excess demands in the financial market i. The sum of the elements in the first column of $\overline{B}_{11}$ is the corresponding effect of the loan rate i_L on the equilibrium in the goods market, i.e. it is $-E_{i_L} > 0$. The sum of the elements in the second column of $\overline{B}_{11}$ is the corresponding effect of inflationary expectations on the excess demands in the financial market i. The sum of elements in the first column of $\overline{B}_{11}$ is the corresponding effect of the loan rate i_L on the equilibrium in the goods market, i.e. it is $-E_{i_L} > 0$. The sum of the elements in the second column of $\overline{B}_{11}$ is

$$(11) \qquad E_{i_m} + E_{\dot{p}_e} .$$

As above in (5) let us assume that the real expenditure E depend on the real rates of interest. Then (11) can be written as

$$(12) \qquad -E_{i_L} - E_{i_D} > 0 .$$

We are now able to prove that monetary policies can in the present framework lead to a perverse outcome in the sense that a tightening in policies may in fact expand output. A sufficient condition for the determinant $\overline{B}_{11}$ to be positive is that $c_{11} > c_{12}$, as can easily be proved on the basis of the above properties of the sum of the elements in the columns of $\overline{B}_{11}$.[5)] We can now derive the following expression

$$(13)\ c_{11} - c_{12} = (-L^d_{i_L} - L^d_{i_m} - L^d_{\dot{p}_e}) + (L^\$_{i_L} + L^\$_{i_m}) + L^\$_D(D_{i_L} + D_{i_m} + D_{\dot{p}_e}) .$$

If we assume that the demand for loans depends on real rates of interest only, the first term in brackets can easily be seen to be equal to $L^d_{i_D}$, which is positive. The second term on the right hand side of (13) is equal to $-L^\$_{i_D}$, which is again positive. This is based on the fact that we have (roughly) the following homogeneity property describing bank decision making, $L^\$_{i_L} + L^\$_{i_D} + L^\$_{i_m} = 0$ (see chapter 9 for more on this).

If deposits depend on real rates of interest, the term in brackets in the third term of (13) is equal to $-D_{i_D}$ which is negative. So on balance, (13) may be positive or negative. However, in this framework where the domestic short rate is pegged, we can show that under profit maximization by the banks, bank lending does not depend on deposits, i.e. that $L^S_D = 0$ (on this see section 9.2 below). So in this case we definitely reach the outcome that a rise in the level of interest rates in fact leads to an expansion in output.

The intuition behind this result is simply the following. A tightening in monetary policy immediately leads to a corresponding acceleration in inflationary expectations - if we assume that inflationary expectations are based on long-run factors in the consistent way specified above, which does not hold in practice in the very short run - other real rates of interest are reduced and the real short-term rate remains unchanged. These give rise to an expansionary effect on the demand for output in the goods market. The ambiguity of the result is related to the reaction of the loan rate to a rise in i_m. As the loan rate is likely to rise, this causes a reduction in expenditures. The interpretation of the condition $c_{11} > c_{12}$ is also straightforward. Let us consider the "initial" rise in the loan rate i_L based on the equilibrium condition in the loan market, when this market is taken in isolation from the other equations of the model, and allow for the one-to-one rise in the inflationary expectations as i_m is raised. The condition $c_{11} > c_{12}$ says that a sufficient condition for a perverse expansion in output is that this partial reaction of the loan rate to a rise in the short-term rate is less than proportional, i.e. that the corresponding real loan rate is initially expected to be lowered. The expression (13) is this condition written in terms of our model and we were able to derive the result that it is valid at least in a specific environment of bank behaviour.

Tobin (1982, p. 192) also refers to the possibility of a perverse outcome of monetary policy in the connection with a Phillips curve, i.e. in our model already in connection with assumption (3.35), and states that this possibility cannot be ruled out as an unstable equilibrium as no dynamics have yet been introduced into the model.

In our transformed model of this chapter we have added a new factor through which monetary policies lead to accelerated inflation and which can be a cause for a perverse outcome of monetary policies. It should be added that also in this reduced and transformed model the fiscal policy works in the manner described above. This holds also for monetary policies, if the open interest parity is removed from the model and we return to the basic assumption of chapter 3. This leads us to the conclusion that there exists an intermediate case with less dependence of inflationary expectations on direct measures by monetary policies which guarantees that there will no longer exist a possibility for an intuitively perverse outcome of monetary policies. It should be noted that monetary policy is neutral, i.e. there is no effect on output from a rise in the domestic interest rates, if the (administrative) deposit rate i_D is raised pari passu with the domestic short-term money market rate i_m . This result only requires the above stated homogeneity properties of private sector behaviour with respect to the nominal rates of interest and the inflation rate and that of bank lending behaviour with respect to the rates of interest i_L, i_D, i_m, and holds for any value of the parameter L_D^S .

Notes

1) For a debate concerning monetary autonomy and the deregulation of the domestic financial markets in Finland, see Tarkka (1987).
2) In fact we should have here a variable risk factor depending on the current portfolio shares of domestic and foreign assets held by the private sector. This would lead us again back to portfolio behaviour and therefore we take (1) to be approximately valid representing the assumed close tie between domestic and foreign short-term assets.
3) It should be noted that in the definition (3.16) of real disposable income we have the rate of devaluation as describing its realized rate while in (1) we have the expected rate of devaluation.
4) Now, a change in i_m also leads to a similar change in the expected cost of foreign finance, which is $i_f + E\dot{e}$ and is on the basis of (1) equal to the domestic rate i_m. So domestic monetary policy, if it is able in the short run to control the domestic rate, is in fact also able to influence the expected terms of foreign borrowing. This in effect means that here we do not have the foreign interest rate in the asset demand equations as a separate variable.
5) Let the column sums of the first and second column of $\bar{B}_{11}$ be c_1 and c_2 respectively and Δ the difference $c_2 - c_1 = -E_{i_D} \geq 0$. The determinant $\bar{B}_{11}$ can now be expressed as $c_1(c_{11} - c_{12}) + c_{11}\Delta \geq 0$ if $c_{11} \geq c_{12}$.

5 Specification and estimation of a flow-of-funds model

We now turn to the second part of the study, where our aim is to analyze some of the key issues raised above concerning the real expenditure and portfolio allocation decisions of the private sector. Our aim in this part of the study is to present evidence concerning the spillover effects of credit rationing and the effects of various interest rates on the different categories of uses of funds, as well as the adjustment by the private sector towards their desired portfolios. Here we concentrate on the period of quantitative rationing in the Finnish financial markets. We also outline the possibilities to make inferences concerning a period of free interest rate formation as well. It should be remarked here at the outset that we are not going to build a full-scale macro model but limit ourselves to building partial flow-of-funds models for the households, firms and banks in Finland.

The aim of this chapter is to present the general framework for the flow-of-funds models that will then be specified in more detail and estimated in later chapters. Here we discuss the theoretical basis of the flow-of-funds model in general, methods of its estimation, and problems encountered in empirical applications of the flow-of-funds approach. We also outline some of the main features and solutions made in our own models.[1)]

By a flow-of-funds model we can either mean a sectoral partial model for the real and financial flows of the sector concerned or a combination of sectoral models where they are linked through the market clearing conditions. Here we mostly discuss problems related to the construction of an individual flow-of-funds model.

We start the chapter with a discussion of optimal portfolio behaviour in the standard framework of perfect capital markets and then enlarge it to the case of imperfect capital markets with monopolistic elements and rationing in some markets. The next topic is adjustment towards the desired holdings of assets, which is an essential part of a flow- of-funds model where, because of adjustment costs, a distinction must be made between changes in the composition of the existing wealth and allocation of the new investable flow, for instance saving. An important question is whether decisions concerning consumption and investment expenditures can be separated from or should they be integrated with those concerning financial portfolio allocations. This problem is considered in section 5.4. We devote the last section of the chapter to the estimation problems related to the flow-of-funds model. Here we i.a. consider the problem of how to take into account credit rationing effects in a flow-of-funds model, which is quite an essential point in the subsequent models.

5.1 The portfolio allocation decision

The decisions with which we are here concerned are related to real expenditures and financial portfolio allocation (including liability management). We start with the latter and expand upon this topic in section 5.4 by also addressing the expenditure-portfolio allocation problem. The portfolio allocation decisions are usually divided into three phases: the determination of the desired or optimal allocation of a given stock of wealth, the determination of the actual holdings of assets in the case of adjustment costs, i.e. adjustment towards the optimal allocation, and thirdly, the determination and allocation of the increase in wealth.

A usual practice in a portfolio model is to specify the desired allocations of a given stock of wealth as being linear functions in expected asset yields and homogeneous of degree one in total wealth.[2)] Friedman and Roley (1980a) derive the following conditions to be sufficient to produce approximately asset demand functions of this type,

a) the utility function has the property of constant relative risk aversion, i.e. $-WU''(W)/U'(W)$ is a constant, where U is a utility function and W is wealth, and

b) asset returns are joint normally distributed.

Let W_t be the wealth considered fixed at the beginning of period t and let r_t be the nx1 column vector of stochastic nominal (real) asset returns in period t per dollar invested, i.e. interest rates. The investor maximizes the expected utility related to the stochastic end-of-period nominal (real) wealth W_{t+1} with his or her allocations in the beginning of the period,

$$(1) \qquad E(U(W_{t+1})) = EU\,(W_t\,(\alpha'_t\,(i + r_t))\,,$$

where α_t is the column vector of the portfolio shares to be selected summing to unity, i is a nx1 column vector of unities, and E the expectation operator. Furthermore, let S_t be the covariance matrix of the asset returns. Utilizing assumption b), the optimal portfolio shares can be derived to be

$$(2) \qquad \alpha_t = B_t\bar{r}_t^e + a_t,$$

where $\bar{r}_t^e$ is the vector of the means of the interest rates and

$$(3) \qquad B_t = \frac{-U'(E(W_{t+1}))}{W_tU''\,(E(W_{t+1}))}\,[S_t^{-1} - (i'S_t^{-1}i)^{-1}S_t^{-1}i\;i'S_t^{-1}] \text{ and}$$

$$(4) \qquad a_t = (i'S_t^{-1}i)^{-1}S_t^{-1}\,i\,.$$

By assuming constant relative risk aversion, the multiplier term in the expression of B_t is approximately constant, namely equal to the inverse of the coefficient of relative risk aversion, and we get the required result. The above expressions imply that the asset demand equations have the following properties:

a) They satisfy the adding-up constraints, i.e. the column sums of the matrix B_t are zero and the sum of the elements of the vector a_t is unity.
b) The diagonal elements of the B_t matrix are nonnegative.[3)]
c) Because of a) and b) the column sums of the off-diagonal elements in B_t are negative, but the off-diagonal elements do not all have to be negative. Therefore, the matrix B_t does not automatically satisfy the condition of gross substitutability.
d) The matrix B_t is symmetric (analogously with the properties of consumer demand theory).

We also see that in this case where risk-aversion is of the constant relative risk-aversion type, the budget shares do not depend on wealth.

If there is one safe (risk-free) asset in the model, the vector $\alpha_{(1)}$ of the optimal budget shares of the risky assets is

$$\alpha_{(1)t} = \frac{-U'(E(W_{t+1}))}{W_t U''(E(W_{t+1}))} S_{(1)}^{-1} \bar{r}_{(1)t}^{e}, \tag{4}$$

where $S_{(1)}$ and $\bar{r}_{(1)}^{e}$ refer to the covariance matrix and the vector of mean rates of return of the risky assets. The share of the safe asset is then determined as a residual (Friedman and Roley (1980a)).

In this type of a portfolio problem the outcome can be decomposed into two parts (see on this e.g. the survey on portfolio decision making by Branson and Henderson (1985)). The constant term a_t in the optimal portfolio (2) is the solution to a minimum variance portfolio problem. This is the portfolio the investor would like to hold if he were extremely risk averse (the constant term in the expression of the matrix B_t in (3) would then be zero). If there is a safe asset, e.g. money or short-term bonds (if inflation is considered as non-stochastic), the minimum variance portfolio would be allocated solely to the safe asset. The other component of the optimal portfolio, i.e. the term $B_t\bar{r}_t^e$, represents the speculative part of the portfolio where the portfolio shares sum to zero and where only the expected asset returns influence the behaviour of the investor, with allocations expanding or contracting depending on how risk averse he or she is.

The allocation problem as formulated above is a static problem, but we can in a similar way handle the multiperiod optimal allocation problem, the solution to which is a myopic one in the case of no transactions costs (see e.g. Fama (1970)).

So far we have considered the theory behind individual asset demand (and supply) decisions. We should also discuss how to aggregate them over agents to reach market demand and supply functions. In general this is a fairly difficult task which can clearly violate the often so nice properties of microrelations from being valid when microfunctions are aggregated to form a macrorelation (see Deaton and Muellbauer (1980), chapter 6).

In the special case of portfolio allocation presented above we may, however, reach some positive results concerning aggregation. Let us as a first case assume that all individuals share a common view concerning the expected returns and risks related to the investments (i.e. the mean and the covariance matrix of the uncertain asset yields are identical in each investor's beliefs), and that they all show the same constant relative risk aversion. On the basis of (2) we can now easily aggregate the microrelations to macro asset demand functions specified only in terms of macrovariables,

(5) $$A = \sum_j A^j = \sum_j W_j (B\bar{r}^e + a) = (\sum_j W_j)(B\bar{r}^e + a),$$

where the symbol j refers to individual j.

This result (5) would require, however, that all investors hold each asset in the same proportion of total wealth, which is clearly not the case in practice. So, in general, we must allow for differences in the matrix B, related to different attitudes towards risk and in the vector a between individuals, and thus we face a more difficult aggregation problem. Let w_j be the share of individual j in the total (market) wealth, $w_j = W_j/\Sigma W_j$. Now we can write

(6) $$A = \sum_j A^j = \sum_j W_j \left[(\sum_j w_j B^j)\bar{r}^e + \sum_j w_j a^j) \right] = (\sum_j W_j)(\tilde{B}\bar{r}^e + \tilde{a}) .$$

So, if we assume that the same mean $\bar{r}^e$ is expected by all agents, we can still achieve aggregate demand functions specified in terms of macrovariables where the adding-up constraints and other properties of B and a stated above are fulfilled by $\tilde{B}$ and $\tilde{a}$, as can be easily checked. If the shares w_j are constant over time, the matrix $\tilde{B}$ and the vector $\tilde{a}$ are also constant.[4)] Analogously, if the covariances (the risks) are perceived to be the same, but the means differ, we get macro functions where the properties a)-d) are fulfilled. In this case the mean vector of rates of return is replaced by a weighted average of the individual mean vectors. If both the mean and the covariance matrix vary, we can still achieve macro demand functions which satisfy the adding-up properties, but these macro relations are not based only on macrovariables (see Vartia (1979) for more details on this).

5.2 Behaviour under rationing and other market imperfections

A common feature of much of the theoretical analysis of financial markets and portfolio theory is the underlying assumption of perfect markets. In practice, however, various kinds of imperfections are a common phenomenon, which has also been recognized in the more recent theoretical analysis.

In the context of consumer behaviour the influence of credit rationing in the loan markets has long been recognized as an essential factor which changes the optimal path of consumption in a life-cycle behaviour model from wealth constrained to liquidity constrained (see chapter 7 below). In the case of bank loan markets, credit rationing has also long been a feature of analysis even in the conditions of "well developed" financial markets, e.g. in the USA (see the penetrating analysis in this field by Jaffee (1971) and Koskela (1976)).

In the portfolio theory framework, various kinds of market imperfections have, however, been virtually nonexistent. This is evidently a consequence of the fact that usually the capital markets have been assumed to resemble, or even be, very representative of the "perfect" market case.

In this section we now want to take market imperfections into consideration in the context of a portfolio allocation model. Our aim here is to carry out an analysis of portfolio decision-making in a more general framework than in the previous section by allowing for rationing and monopolistic elements in some markets. The analysis is formulated in such a way that it essentially describes the behaviour of the banks which typically operate in markets that clear in a variety of ways. Melton and Roley (1981) systematically considered this sort of decision-making and estimation of a more general portfolio model. Green (1984b) clarified and improved upon some of their results. Here we present a framework of portfolio analysis under market imperfections which slightly differs from that presented in these papers.

In the case of certainty it makes no difference whether an agent in a monopolistic position in a market chooses the quantity held by him or sets the price (rate of interest). In an uncertain environment, however, this makes a difference, as Green (1984b) has argued.

We want to distinguish between four types of markets where the agent operates by choosing the asset portfolio or alternatively by setting the interest rates:

1) Markets where the agent fixes interest rates and faces downward sloping demand curves for the quantities (in terms of liabilities of the counterpart of the agent). Let r_1 be the vector of interest rates in these markets so that the demand curves for these assets are

(7) $$A_1 = Z_0 + Z_1 r_1 + U_1 ,$$

where Z_0 and Z_1 are supposed to be known matrices and U_1 is a stochastic error-term with $EU_1 = 0$, $\text{cov}(U_1) = S_{11}$. So, the agent acts as a monopolist in these markets.

2) Markets with perfect competition, where the agent faces a perfectly elastic supply of assets A_2 with the interest rate (vector) r_2 , which is random,

(8) $$r_2 = \bar{r}_2 + U_2, \text{ where } EU_2 = 0 \text{ and } \text{cov}(U_2) = S_{22} .$$

3) Markets where the agent is rationed (the agent is on the short side of the market). Here we suppose that the vector of interest rates r_3 in these markets is known with certainty, $r_3 = \bar{r}_3$, but the quantities are random, so that

(9) $$A_3 = \bar{A}_3 + U_3 \text{ where } EU_3 = 0 \text{ and } \text{cov}(U_3) = S_{33} .$$

4) Markets where the agent chooses to hold A_4 quantity of assets in this category but he or she simultaneously influences the rate of interest in these markets. So we specify for the interest rate vector r_4

(10) $$r_4 = r_4^0 + RA_4 .$$

Observe that perfectly competitive markets 2) are a special case of type 4 markets.

Melton and Roley (1981) considered portfolio decision-making in the case where there are markets of type 1) and 2) above, i.e. monopolistic markets and perfectly competitive markets respectively. Green (1984b) also considered the case 3, but in a transformed version where rates of return are stochastic and quantities nonstochastic. We observe that rationed markets where the agent lies on the long side of the market can be treated as a special case of 2.

One essential problem with this kind of a more general decision-making is the "liquidity problem", i.e. how is the portfolio balanced in a situation where quantities of some assets are endogenous compared to the standard case discussed above where the quantities are selected by the agent. By introducing the type 4 markets we want to suggest a solution to this liquidity problem which is different from that presented by both Melton and Roley and by Green.

Markets in the above category 4 are what we can call the liquidity adjustment markets, where the agent adjusts his or her portfolio to meet the balance sheet constraint. So we have

(11) $$i'A_4 = W - i_1'A_1 - i_2'A_2 - i_3'A_3 ,$$

where W is total wealth and the i's are conformable vectors of unities. We now suppose that there is only one market of this category, i.e. that we have

(12) $$r_4 = \beta_0 + \beta_1 A_4, \ \beta_1 \leq 0 .$$

According to (12) the agent faces a rising "penalty" interest rate schedule, the parameters of which are supposed to be known, and linear, for his or her borrowing in this market.

The intuitive reasoning behind this construction is that this sort of liquidity adjustment is quite common. Typically, the agent in the first phase chooses the stocks of the (long-term) assets, the yields on which are uncertain, and fixes interest rates in monopolistic markets where demand is uncertain. After the outcome in these markets is revealed, the agent uses his or her liquidity reserve, in the simplest case cash balances, to the extent necessary to meet the wealth constraint. In the case of a banking firm we can well consider the liquidity channel A_4 to be borrowing from the central bank, which in many countries with "less than well developed financial markets" has been a common feature, as has been a system with some sort of extra cost for excess use of this liquidity reserve.

We suppose that the decision making of the agent takes place in a mean-variance framework where the agent maximizes the following function:

$$(13) \qquad EU(\pi) = E(\pi) - \frac{b}{2} V(\pi) ,$$

where π is the profit on the portfolio,

$$(14) \qquad \pi = r_1'A_1 + r_2'A_2 + r_3'A_3 + r_4A_4 .$$

Here E is the expectation and V the variance of the profit, and b is the Arrow-Pratt measure of absolute risk aversion $(b > 0)$.[5] Let us further suppose that the residual vectors U_1, U_2 and U_3 above are joint normally distributed and for simplicity that between groups 1,2, and 3 they are uncorrelated, but may be initially correlated within groups. We can now infer that the use of the liquidity reserve A_4 is normally distributed,

$$(15) \qquad A_4 \sim N(W - i_1'(Z_0 + Z_1r_1) - i_2'A_2 - i_3'\overline{A}_3 , i_1'S_{11}i_1 + i_3'S_{33}i_3).$$

We denote the mean of A_4 simply by μ and the variance of A_4 by σ^2 in (15). We can now derive the mean and variance of the profit π in (14) to be the following:

$$(16) E(\pi) = r_1'(Z_0 + Z_1r_1) + \overline{r}_2'A_2 + \overline{r}_3'A_3 + \beta_0\mu + \beta_1 (\mu^2 + \sigma^2) \text{ and}$$

(17) $V(\pi) = (r_1 - \beta_0 i_1)'S_{11}(r_1 - \beta_0 i_1) + A_2'S_{22}A_2 + (r_3 - \beta_0 i_3)'S_{33}(r_3 - \beta_0 i_3)$

$$+ \beta_1^2 E(A_4^2 - (EA_4^2))^2 + 2\beta_1 E(A_4^2 \cdot (\gamma' U_{(1)}))\ ,$$

where we have denoted by γ' the vector $(\gamma_1', \gamma_2', \gamma_3') = (r_1' - \beta_0 i_1', A_2', r_3' - \beta_0 i_3')$ and by $U_{(1)}' = (U_1', U_2', U_3')$. We can quite easily further derive that

(18) $$E(A_4^2 - (EA_4^2))^2 = 2\sigma^4 + 4\mu^2\sigma^2\ .$$

By further assuming that S_{11} and S_{33} are diagonal we can derive

(19) $$E\,[\,A_4^2 \cdot (\gamma' U_{(1)})\,] = -2\mu i_1' S_{11}\gamma_1 - 2\mu i_3' S_{33}\gamma_3\ .$$

We can see that the objective function (13) consists of terms where the mean μ is raised to the second power. The derivative of the objective function with respect to r_1 includes the term $\partial\mu/\partial r_1 = -Z_1'i_1$. An interesting special case is the following. If we suppose that the asset demand functions which our optimizing agent faces in the markets of category 1 are a result of an optimal portfolio allocation by agents who operate solely in these markets and who consider them to be perfectly competitive markets, this means that according to the adding-up constraints $Z_1'i_1 = 0$. (see property a) on page 83).[6] Because of property d) on page 83 the matrix Z_1 is also symmetric.

This assumption[7] simplifies the solution for r_1 to a great extent and we get

(20) $$r_1 = (bS_{11} - 2Z_1)^{-1}(Z_0 + b\beta_0 S_{11} i_1) \text{ and}$$

(21) $$A_2 = (bS_{22} + a i_2 i_2')^{-1}(\bar{r}_2 - \beta_0 i_2 - 2b\beta_1(i_1'S_{11}\gamma_1 + i_3'S_{33}\gamma_3)i_2 + aW_0 i_2),$$

where $a = -2\beta_1(1 - 2b\beta_1\sigma^2)$ and $W_0 = W - Z_0 - Z_1 r_1 - i_3'\bar{A}_3$.

We can first infer that in this solution the slope parameter β_1 does not at all affect the optimal setting of the interest rates r_1 in markets of category 1, but affects the optimal demands of assets A_2 in the perfectly competitive markets (or in rationed markets where our agent is on the long side of the markets (or in rationed markets where our agent is on the long side of the market). The transformed budget W_0 influences, as it should, the allocation of the type 2 assets. It is interesting to find that if there is no penalty cost in the liquidity adjustment, i.e. if β_1 is zero, the solution of A_2 is as follows

$$(22) \qquad A_2 = (bS_{22})^{-1} (\bar{r}_2 - \beta_0 i_2) .$$

This solution does not at all depend on the quantities or interest rates in the markets of type 1 and 3. This reflects the property of the mean-variance model according to which, if there is a safe asset, all increases in wealth will be allocated to it. In general, the choice of assets A_2 is fairly complex in (21) where the interest rates r_1 and r_3 affect the solution as well as the quantities A_3 .

5.3 Adjustment towards an optimal portfolio: the optimal marginal adjustment model

The second phase in the derivation of the asset demand functions is based on the fact that usually there are adjustment costs with respect to the reshuffling of the portfolio, and that a realistic asset demand model should allow for this. A "theory" of portfolio adjustment, i.e. asset flows, is called for. The Brainard-Tobin (1968) paper did not present any formal derivation of the adjustment model, but they presented in their "general disequilibrium" model an important idea related to portfolio adjustment with several assets. In their formulation every discrepancy between the desired and actual stock of an asset affects as a spillover also the adjustment of all other assets. In the partial adjustment model a discrepancy only has an effect on the adjustment of the asset concerned. When this is applied to a multiasset framework, we have as a logical outcome that the adjustments must be infinitely rapid.[8] This is clearly not what is usually realistic, nor what is aimed at in the construction of an adjustment model.

The adjustment model can be derived by defining the adjustment costs to consist of two types of costs: first, there is the "out-of-equilibrium" cost and, secondly, there is the cost related to the changes in the stocks of the assets, which are both taken to be convex functions in A_t (for more on this type of a treatment and derivation see Feige (1967), Hunt and Upcher (1979)).[9] One important point to be noted in these derivations is that they are static and portfolio adjustment is considered to be a decision concerning only one period.

Portfolio adjustment models of the Brainard-Tobin type have typically been the starting point in construction of empirical flow-of-funds models. The most advanced model in this category is the "optimal marginal adjustment" model developed by Friedman (1977), and further developed by Friedman and Roley (1979), (1980b) and by Roley (1980). Friedman and Roley (1980b) state that a portfolio adjustment model should allow for the following four requirements:

a) effects of differential transactions costs between the investor's allocation of a new investable financial flow and the corresponding reallocation of existing asset holdings,
b) dependence of the allocation of new investable financial flows on desired equilibrium asset holdings,
c) effects of new investable financial flows on the reallocation of existing asset holdings, and
d) asymmetric effects from positive and negative new investable financial flows.

The original adjustment model of Brainard and Tobin satisfies only the first of these, i.e. property a). Friedman and Roley state that a model which satisfies properties a)-c) but not d) is the following marginal adjustment model[10)]

$$(23) \qquad \Delta A_{it} = \sum_{k=1}^{n} \theta_{ik}(\alpha_{kt}W_{t-1} - A_{k,\,t-1}) + \alpha_{it}(\Delta W_t)\,, \; i = 1, \ldots\ldots, n\,.$$

Here the first term represents reallocation of the initial wealth (W_{t-1}) to correspond to the optimal allocation of this wealth at the end of period t. The second term represents the allocation of the increase in wealth, e.g. saving in the case of households. An important feature of this model is that saving is allocated according to the optimals shares α_{it} derived above in (3) and (4). The stock adjustment coefficients satisfy the constraints $\sum_{i=1}^{n}\theta_{ik} = \theta$ for all k=1,...,n, where θ can be arbitrary. This can be easily checked to be sufficient to satisfy the budget constraint $\sum_{1} A_{it} = W_t$. [11)] Roley (see e.g. Roley (1980)) has further enlarged the model in (23) and distinguished between the allocation of positive and negative flows. Roley has also made a distinction between the effects of various sources of funds in a banking sector model because of the differences in their variability. In their original model Brainard and Tobin (1968) made a distinction between saving and capital gains as components of the increase in wealth. We consider this problem more closely on pages 93-94 below.

The above marginal adjustment model can be conceived to be a combined solution to two allocation problems, the first being the optimal reallocation of the existing stock of wealth, and the second being a non-constrained allocation of saving. It is, however, true that the model is not derived from a model of optimal adjustment behaviour.[12)]

It is to be noted that the matrix of adjustment coefficients θ_{ik} is not in general symmetric, as Hunt and Upcher (1979) have shown. They also show that a portfolio adjustment model is always stable when it is derived from the cost of adjustment framework presented more thoroughly below, and that the characteristic roots of the difference equation system should be real and lie between zero and unity. Thus a flow-of-funds model does not exhibit oscillations in the portfolio adjustment but may show turning points (e.g. overshooting) in the adjustment process.

The above model (23) is broadly the starting point also in our empirical flow-of-funds models. Another feature in our model is that we, like Roley, consider the various flow items in the budget as separate variables, potentially with different coefficients. These solutions are discussed more closely in connection with each individual flow-of-funds model.

The standard adjustment model is derived via minimization with respect to actual holdings A of the following quadratic function

$$(24) C = (A - A^*)'C_1(A - A^*) + (A-A_{-1})'C_2(A-A_{-1}) \text{ subject to } i'A = W ,$$

where A^* is the solution to the optimization problem (1), C_1 is the matrix of the out-of-equilibrium costs and C_2 represents the adjustment costs. An intuitively clear-cut way is to define the out-of-equilibrium costs in terms of the objective function F(A) = EU(W) of the static allocation problem above (1) and accordingly set $(C_1)_{ij} = -\partial^2F(A^*) / \partial A_i \partial A_j$ which is a symmetric matrix. Not even in this case can we derive an adjustment model where the coefficient matrix for the interest rate vector r^e and also the coefficient matrix related to the lagged stocks A_{-1} would be symmetric. In the model of the London Business School (see Keating (1984)) it is assumed that the covariance matrix of the asset returns is diagonal, as is the matrix of the adjustment costs. With the matrix C_1 defined as just suggested the asset flows are symmetric with respect to the interest rates and the adjustment matrix is diagonal. In general, the solution to the minimization problem (24) is not symmetric, as was mentioned already above.

Let us next consider the derivation of the adjustment model from another point of view. Above we have defined adjustment costs in period t to be

$$(25) \qquad C_t(A_t, A_{t-1}, A_t^*) ,$$

where C is a convex function. One essential feature in the models above is that the problem of adjustment is formulated to consist of only one decision making process, even though in fact we should consider adjustment over time. Because of the adjustment costs, also expected changes in the factors determining the future desired stocks influence the current decision. Instead of (25) we should minimize

$$(26) \qquad C = \sum_{t=1}^{T} R^{-t} C_t (A_t, A_{t-1}, A_t^*)$$

with respect to $A_1, A_2, \ldots, A_T$. Here R is the interest factor, R = 1+r. This optimization gives as necessary conditions for an optimum

$$(27) \qquad \frac{\partial C_t}{\partial A_t} + R^{-1} \frac{\partial C_{t+1}}{\partial A_t} = 0 .$$

The standard framework presented above neglects the second term in (27). The optimality condition (27) includes A_{t+1} and A_{t+1}^* in addition to the normal A_t and A_{t-1}. Kennan (1979) showed in the case of a partial adjustment model, and Neusser (1985) in the case of a general portfolio allocation model, that the solution to (27) is in fact similar to that of the static adjustment framework discussed above, with the exception that the desired stock A_t^* must now be replaced by a weighted average (with geometrically declining weights) of the current and future desired stocks. We consider this enlarged framework further in connection with the estimation of the flow-of-funds model in section 5.5.

Usually, in connection with the portfolio adjustment no attention is given to the units of account and capital gains. Let us finally in this section consider this important problem.

The agent holds in period t a certain physical quantity $\tilde{x}_{it}$ of each asset, such as the physical housing stock or the number of bonds. In the case of deposits this is simply their nominal value. The real market value of this stock valued at current market prices is $x_{it} = (q_{it}/P_t)\,\tilde{x}_{it}$, where q_{it} is the market price of a unit of asset i and P_t is a general price index. It is to these real market values of wealth that the desired portfolio allocations refer to.[13] In planning the new investment in a certain asset to be carried out during period t, the agent first evaluates the existing stock of the asset concerned at the new prices in order to be able to find out the need for a new investment flow to fill the gap between desired and existing real wealth in the asset concerned. The general multi-asset portfolio adjustment model is then a linear combination of these discrepancies between desired and actual holdings.

We have as an identity,

$$(28) \qquad x_{it} = x_{i,\,t-1}(1 + (\Delta q/q)_{it} - (\Delta P/P)_t - d_i) + (q_i/P)_t \Delta\tilde{x}_{it} \;.$$

Here $(\Delta q/q)_{it}$ is capital gains on asset i in period t, $(\Delta P/P)_t$ is the rate of inflation in period t and d_i is the rate of depreciation of asset i. Now we can see that the above idea behind specification of the desired and actual holdings and the need to adjust the holdings leads to the specification of the adjustment equations in a flow-of-funds model in terms of real investment flows. This is so because the difference between the left hand side of (28), taken as a desired entity, and the first term on the right hand side of (28) is just the discrepancy on which investment decisions are based. This idea also means that the lagged asset stocks with respect to which the gradual adjustment takes place should be valued at the (real market) prices prevailing in period t rather than in the previous period.

5.4 Separation and integration of financial and real expenditure decisions

So far we have considered the change in wealth or in investable portfolio ΔW_t to be exogenous in the portfolio decision. This is a standard view in portfolio analysis and also in many empirical financial market models (see e.g. Backus et al. (1980) and Green (1984a)). In some sectors, e.g. the banks, the investable flow is typically determined by the behaviour of another sector. But in the case of households the flow depends on the consumption decisions of the sector itself. In the case of firms we have to consider whether investment and decisions concerning financing of investments are integrated with or separable from each other.

There is, however, a theoretical justification for the separation of the saving-consumption decision and the portfolio allocation decision. The solution to an optimal lifetime consumption-portfolio allocation problem, under the assumption of constant relative risk aversion and no risk related to inflation or relative prices of consumption in different periods, is such that it produces this sort of separation. The optimal consumption and the optimal allocation of wealth in a safe and a risky asset do not in any way depend on each other, consumption being a function of total wealth and the portfolio allocation depending on the parameters of the problem, like the interest rate, as Samuelson (1969) has shown.[14)]

Purvis (1978) has argued that this separation result is not valid if there are adjustment costs with respect to changing the level of asset holdings. The existence of adjustment costs means that we cannot consider separately the portfolio allocation problem but "rather a longer-run problem of determining an optimal path for each asset and for the level of consumption" (Purvis (1978, p. 403)). In this case a rational household would decide between consumption C_t and asset demands A_{it} on the basis of the full list of inherited stocks of assets, not just on the basis of total wealth and income Y_t, and long-run asset considerations.

Let us first specify a consumption function of the following type

$$(29) \qquad C_t = \alpha_{0t} Y_t + \sum_{k=1}^{n} \beta_{0k} A_{k,\, t-1}{}'$$

where Y_t is income. By defining $\Delta W_t = Y_t - C_t$ we can transform the flow-of-funds model presented in (23) above into the following form:

$$(30) \qquad \begin{aligned} \Delta A_{it} &= \alpha_i' y_t + \sum_{k=1}^{n} \beta_{ik} A_{k,\, t-1},\ i = 1,\dots,n \text{ and} \\ C_t &= \alpha_0 Y_t + \sum_{k=1}^{n} \beta_{0k} A_{k,\, t-1}, \end{aligned}$$

with the constraints

$$(31) \qquad \alpha_0 + \sum_{i=1}^{n} \alpha_i' = 1\,,\ \beta_{0k} + \sum_{i=1}^{n} \beta_{ik} = 0\,,\ k = 1,\dots,n\,.$$

We should remember that the coefficients α_i and α_{ik} in general include, in addition to the constant terms and pure adjustment coefficients θ_{ik}, also terms related to the desired allocation of wealth, i.e. the interest rates. The model presented in (30) is the prototype of an integrated model where both real expenditures and portfolio allocations are considered to be determined simultaneously.

The separable model is a special case of this model because then only the total wealth has any influence on consumption. In an empirical application Backus and Purvis (1980) have constructed an integrated flow-of-funds model for the household sector in the USA and strongly conclude in favour of the integrated model. The same conclusion is also reached by Poloz (1986) in his model for the portfolio behaviour of the Canadian household sector. This is also one starting point in our household sector submodel to be presented in chapter 7.

The issue of integration vs. separation of real expenditure and portfolio allocation decisions in flow-of-funds models has been mostly discussed in the context of consumption and saving decisions of the households (see Owen (1986a), chapter 3 for a discussion on the various possibilities to construct an integrated flow-of-funds model). It seems that this problem has not been tackled previously in connection with financial models of firm behaviour based on the flow-of-funds approach, so let us suggest here how the issue of integration-separation could be studied in this case. Broadly speaking, under separation real investment decisions do not react to the source of the funds available to their financing needs.[15)]

Let us denote by K^* the desired stock of real capital and r_K the yield on it. Let L_i, $i = 1,...,n$ be the n sources of funds available to finance the real capital stock. Let us further assume that based on the preferences of the management of the firm we can derive analogously as in section 5.1 above the optimal liability portfolio shares α_i summing to unity. The desired stocks of liabilities L_i^* are

$$(32) \qquad L_i^* = \alpha_i K^* .$$

The optimal capital stock is specified by the function

$$(33) \qquad K^* = f(r_K - r^*) , f' > 0 .$$

Here r^* represents the financing costs at the optimum,

$$(34) \qquad r^* = \sum_{i=1}^{n} \alpha_i r_i ,$$

where r_i is the cost per unit of liability i.[16)]

Now a flow-of-funds model describing simultaneously the real investment and financial behaviour can be defined to be separable if the decision making of the firms is recursive in the manner presented in (32)-(34) and the real investment flow does not react differently to various imbalances in the individual liability items but reacts only to the gap between total liabilities (= capital stock) and the desired value of them. Imbalances in the various liability items are adjusted solely within the liability items and do not have spillover effects on the real investment process. So we can specify the following flow-of-funds model under separation with the adding-up constraints,

$$\Delta K = \quad f(K^* - K_{-1})$$

$$(35) \quad -\Delta L_1 = -\alpha_1 f(K^* - K_{-1}) + \beta_{11}(L_1^* - L_{1,-1}) + ... + \beta_{1n}(L_n^* - L_{n,-1})$$

$$\vdots$$

$$-\Delta L_1 = \alpha_n f(K^* - K_{-1}) + \beta_{n1}(L_1^* - L_{1,-1}) + ... + \beta_{nn}(L_n^* - L_{n,-1})$$

$$\text{Sum:} 0 = 0 \qquad + 0 \qquad + ... + 0$$

5.5 Estimation of the flow-of-funds model

5.5.1 Estimation of the standard model

An essential feature of the flow-of-funds model is that, in its most general form, it is a very little constrained hypothesis with a very large number of free parameters to be determined by the data. Accordingly, this has caused problems in many empirical flow-of-funds models. At least some of the interest rates, which should all appear in each equation, are usually quite strongly correlated with each other, as are often also the lagged stocks of assets. In a flow-of-funds model in the initial estimations typically at most half of the coefficients are significant and of the right sign (see Backus et al. (1980), Backus and Purvis (1980) and Green (1984a)). As a remedy to this situation, a Bayesian estimation method based on the use of a priori information with respect to coefficients is suggested instead of the fully free OLS estimation. Even so, it seems to be difficult to get satisfactory results. A Bayesian estimation method was initially suggested for the flow-of-funds model by Smith and Brainard (1976), who concluded that in an out-of-sample prediction test this kind of estimation method outperforms the conventional estimation.[17)]

In the following our starting point has differed from that in the above flow-of-funds estimations because we have had at our disposal, and been able to construct, only annual flow-of-funds data starting from the year 1960.[18)] Further, in Finland we only have annual national accounts with sectoral income and expenditure data (quarterly data exists for expenditure and production items). So we have started with preliminary complete flow-of-funds estimations and carried out some testing of the basic ideas concerning this kind of a model, e.g. the integration vs. separation issue, nature of the adjustment process, and homogeneity with respect to nominal interest rates and inflation, as well as some of the interesting parameters raised above in chapters 2 and 3.

After this we have proceeded to achieve a more parsimonious model with more degrees of freedom by successively eliminating variables with coefficients which are not significant and are implausible in sign as to the short-run impact effects. The outcome of this procedure is perhaps not a "unique" estimation result, but it should be satisfactory in the important sense that the individual coefficients are meaningful and usually also statistically significant.[19),20)] Then the model should not include coefficients which could be a cause of non-sensible results later on in the model solutions. It should be remembered that the Bayesian estimates are also subject to the critique of subjectivity, as the differences in opinion between Duesenberry (1980) and Backus et al. (1980) concerning the prior distributions show.

Because of the adding-up constraints, the residuals across the equations sum to zero and the covariance matrix of the errors is nonsingular. Therefore, one equation should be deleted from the estimation and its coefficients solved from the estimated coefficients of the rest of the equations and the adding-up constraints. It can be shown that we can delete any equation without altering the outcome. In a complete flow-of-funds model with every rate of return variable and every lagged asset stock as explanatory variables in every equation, it is a well-known fact that OLS applied to each equation separately is an optimal method of estimation. These estimates also automatically fulfil the adding-up constraints (see e.g. Alho (1972) for more on this). As the covariance matrix of the residual vector (across the equations) is singular, this calls for using the technique of seemingly unrelated regression estimation (SURE) of Zellner (1962) as in general the errors are correlated with each other.

In a more general framework we also want to constrain the coefficient matrix with additional linear constraints, e.g. we can omit some explanatory variables from an equation, as we have done in our model. The estimation of this kind of a system has been discussed, for example, by Theil (1971), Alho (1972), and Anderson and Blundell (1982). First, one equation is deleted from the system. From the adding-up constraints we transform the rest of the linear constraints to include only the coefficients of the remaining equations. The remaining equations are estimated by SURE or equivalently by the generalized least squares (GLS) method applied to the system of equations. In this way the correlation between the residuals in the various equations is utilized in order to increase the efficiency of the estimation (see e.g. Theil (1971) for more details on this). After this we solve the estimates and the standard errors of the coefficient estimates of the omitted equation.[21)]

Another method to estimate a flow-of-funds model is to further constrain it by symmetry restrictions discussed above in sections 5.1 and 5.3. Constraints of this type have been incorporated in the flow-of-funds models of the London Business School (see Keating (1984) and the discussion on this by Courakis (1988)) and also in the FREIA model of the Dutch Central Planning Bureau (see Okker et al. (1983)). This sort of symmetry is not a feature of the Brainard-Tobin model nor has it been incorporated into the flow-of-funds models for the US constructed in this spirit.[22)]

In the estimation of the flow-of-funds model the simultaneous equation bias has naturally also received attention. This problem arises from, for instance, the interest rates which are explanatory variables in the asset demand equations, and which are then determined by the market clearing conditions between the demand and supply equations of the assets. So, the interest rates are endogenous variables in the full model, and this calls for a consistent estimation method, usually the instrumental variables method. We can note that this problem does not appear to be so prominent in the case of our model because the role of this kind of flex-price asset markets has been fairly limited in the Finnish conditions, where rigidity of the interest rates has been a dominant feature in the financial markets.

5.5.2 Treatment of expectations in a flow-of-funds model

There is a place for uncertainties and surprises of many kinds in a flow-of-funds model, like in all econometric models. It suffices to mention expectations and surprises related to income (sources of funds), whether a change in income is at the same time a change in permanent income or is an unexpected windfall or loss, whether credit rationing is considered to be permanent or temporary, and what is the relationship of the current yield on assets to the long-term yields. In our model the two latter problems are the most relevant. We think that credit rationing is only temporary for individual economic agents and can be eliminated through increased accumulation of their own funds, i.e. saving. For the sector as a whole in a certain period a rationed volume of credits is, however, a binding constraint. On the other hand, we have so limited a number of degrees of freedom available that extensive experimentation with respect to various expectations and surprises outlined above cannot be carried out.

Above we briefly presented the dynamic partial adjustment model considered in the context of rational expectations by Kennan (1979) and

Neusser (1985). We should now discuss somewhat more thoroughly the role of expectations in a flow-of-funds model. In addition to the dynamic model with expectations on the future values of the desired stocks mentioned above, expectations also play a role in the static adjustment model. At the moment of portfolio allocation the rates of returns on at least some assets are uncertain and the allocation decisions must be based on expected rates of returns. Because assets are typically of longer maturity than the decision period, the rate of return on an asset is generally

$$(36) \qquad r_t = \frac{b_t + (q^e_{t+1} - q_t)}{q_t} ,$$

where b_t is the coupon of the asset and q_t the market price of the asset. Also with fixed price assets (e.g. bank deposits and loans) we can think of uncertainty related to possible changes in the rate during the unit period, whereas in (36) uncertainty is considered to be related only to the future market price of the asset.

We can specify various hypotheses on the formation of expectations on the future market prices of the assets. Friedman and Roley (1979) considered this explicitly in building bond demand equations for the various categories of institutional investors in the USA. They studied unitary expectations (i.e. the capital gains component is expected to be zero, which is the efficient market case), rational expectations and adaptive expectations. Their conclusion was that adaptive expectations gave the best overall results in terms of model fit. An interesting finding in their model is that, in contrast with the model fit, the fit for the actual rates of return is, of course, much better by rational expectations than by the other two hypotheses of expectations formation.

The hypothesis of rational expectations is used extensively in the flow-of-funds submodel of the London Business School (see Keating (1984)). The model is not a dynamic adjustment model discussed by Kennan (1979) (see section 5.3. above), but instead a standard flow-of-funds model including rational expectations for the rate of return variables (36).

Let us now discuss the dynamic adjustment model presented above. As mentioned in section 5.3 Kennan (1979) showed that this sort of dynamic adjustment model gives an outcome that is similar to that of its static counterpart in the case of a partial adjustment model, with the exception that now the desired stocks refer to a weighted average of all future desired stocks, in our case i.a. to an average of future rates of returns.[23)] In an efficient market context Mishkin (1980) has argued that all future values of q_t, or equivalently the long-term interest rates, should follow a random walk and would therefore be optimally forecast to be equal to the present price. However, Begg (1984) has shown that this result is in general incorrect, because it is based on a relationship between the short rates and the long-term rate, where the coupon payments are assumed to be invested at the average long rate rather than at the short-term rate, as should be. In some important special cases the result is valid, e.g. when there is a zero-coupon asset or when the short-term rate of interest is expected to be a constant.

It would be convenient if we could rely on the above result by Mishkin, because in the model we could replace future values of the desired stocks by current interest rates. The model would then in fact be a static one. In a direct estimation of the partial adjustment model we would then circumvent one critique presented by Kennan (1979) against the model where in one estimation both the adjustment process and the determination of the desired stocks are estimated at the same time, namely, that we cannot identify the adjustment lag and the forecasting rule from each other. Only the total lag between the variable determining the optimal stock and the decision variable can be identified in this sort of an estimation.

Our treatment of expectations is fairly crude in what follows. We use current period values of interest rates quite extensively. In the case of constant short-term interest rates there should be no anticipated changes in the prices of long-term bonds. This should quite closely resemble the Finnish case where the nominal interest rates have been very rigid. The uncertainty attached to the financial portfolio decisions typically arises to a much higher degree from the uncertainty connected with the inflationary expectations. [24] We have used various types of inflationary expectations to be discussed in more detail later on in subsequent chapters. Sometimes we have simply used the current period inflation. Because our unit period of observation, a year, is fairly long in the context of financial decision making, this specification resembles a sort of "perfect foresight" assumption in the model.

5.5.3 Identifying the credit rationing effects in a flow-of-funds model

Above we have discussed the specification and estimation of a "standard" flow-of-funds model. In this section we briefly discuss how the credit rationing effects should be taken into account in this kind of a model. Ito (1980) has shown in the context of consumer behaviour applying a Cobb-Douglas utility function that rationing in some markets produces effective demand functions where the notional demand functions are corrected by additive spillover terms of the discrepancy between the desired quantity for the rationed good and the rationed amount of it. A direct application of this idea to our case gives the following system,

$$(37) \qquad \Delta x_i = \Delta x_i^d + h_i(\Delta L - \Delta L^d), \; 0 \leq h_i \leq 1, \; i = 1,\dots,n,$$

where Δx_i^d and ΔL^d are desired notional flow demands for asset i and loans, x_i is the effective, i.e. credit constrained, demand for asset i, with ΔL being the actual flow of borrowing. Real spending is simply specified to be the nth asset category.[25)] Let us further specify that the desired asset demands are of the following type:

$$(38) \qquad \Delta x_i^d = \alpha_i Y + \beta_i Z + \varepsilon_i \;,$$

where Y is disposable income and Z is the column vector of other explanatory variables, i.e. rates of return and lagged stocks, α_i and β_i (row vector) the respective parameters, and ε_i is the residual term. Now we can derive the desired loan demand from the budget constraint,

$$(39) \qquad -\Delta L^d = Y - \sum_{i=1}^{n} \Delta x_i^d = (1 - i'\alpha)Y - i'\beta Z - i'\varepsilon \;,$$

where α is the column vector of the α_i's, i is a nx1 unit vector, β is a matrix with the β'_is as rows and ε is the column vector of the n residuals ε_i. If we denote by ε_L the residual of the loan demand equation (39), we have $\sum_{i=1}^{n} \varepsilon_i + \varepsilon_L = 0$, because of the budget constraint. We now substitute the loan demand equation into the system (37) and (38) and get

$$(40) \qquad \Delta x_i = (\alpha_i + h_i(1 - i'\alpha))Y + (\beta_i - h_i i'\beta)Z + h_i(\Delta L) + (\varepsilon_i + h_i \varepsilon_L) \;, \quad i=1,\dots,n.$$

It is important to notice the structure of the coefficients in (40) because they have an essential influence on the interpretation of the parameters in the empirical models (see chapters 7 and 8 below).

In the system (40) we have as an identity that the spillover effects of credit rationing sum to unity

(41) $$\sum_{i=1}^{n} h_i = 1 \ ,$$

and the residuals sum to zero, so the equations are linearly dependent and we have to estimate them in the manner explained above. First n-1 of them are estimated as a system and then the last equation is solved on the basis of the estimated equations and the budget constraint.

Let the estimated system be the following in a vectoral form

(42) $\Delta x = aY + BZ + \bar{h}\Delta L$, with the adding-up properties

$$i'a = 1, i'B = 0, i'\bar{h} = 1 \ ,$$

where $x = (x_1,...,x_n)'$ and other notations conform to this.

On the basis of (40) and (42) we can write the following equation system

(43) $$(I - \bar{h}i')(\alpha \ \beta) = (a - \bar{h} \ B) \ .$$

The matrix $I - \bar{h}i'$ is singular and therefore we cannot in general solve the notional demand functions on the basis of a rationed system. But we can proceed some steps in this direction. If $h_i = 0$, i.e. if credit rationing does not have a spillover effect on asset i, we can from (40) infer that in this case a_i and B_i of (42) are estimates of the notional demand parameters α_i and β_i, as is natural. So this kind of an equation can be properly estimated from data covering a period of credit rationing, which is quite a clear result.

For the remaining k functions Δx_i in (42) with $h_i > 0$, we can solve k-1 of them if we fix the coefficients of the kth equation α_k and β_k. In principle, we can use this kind of information in combining data from rationed and non-rationed periods. In effect (43) produces a set of linear restrictions binding estimation of the k-1 equations in the non-rationed period.

There may still be an interesting possibility to make inferences concerning the non-rationed system. As we are going to discuss later on, the solution of the bank loan market may in fact be a combination of demand and supply factors, if there is short-run accommodation of loan demand by the banks to some extent. We have then

(44) $$\Delta L = h_L \Delta L^d + (1 - h_L)\Delta L^s \ , 0 \leq h_L \leq 1 \ ,$$

with ΔL^s being the flow of notional supply of credit by the banks. Even though in general the parameters appearing in this equation cannot all be identified, we could, if $h_L \neq 0$, infer for example that the variable z_j does not appear in the L^d function. In the above formulation this would imply that $(i'\beta)_j = 0$ and so on the basis of (43) $(B)_j$ is an estimate of the notional $(\beta)_j$, where the parentheses are used to indicate the column vector of a matrix. The estimated coefficients for this variable z_j apply as such also in the non-rationed period (see (40) above to confirm this). In general we are using (40) combined with (39) in the empirical interpretation of the parameter estimates in the subsequent chapters.

Notes

1) For a general presentation of a flow-of-funds model built in the Brainard-Tobin and the "Yale-school" tradition, see also Owen (1986a).
2) Newbery and Stiglitz (1981) present a general discussion of the properties of the asset demand functions in the case of constant absolute and relative risk aversion and quadratic utility functions which all produce linear asset demand functions.
3) This is a result of the fact that B_t is a positive semidefinite matrix. For a proof, see e.g. Hunt and Upcher (1979).
4) Another important case where B and a are nonconstant is that over time the properties related to the risks (i.e. the matrix S in (3)) of the various assets change, as Tobin (1982) has argued.
5) This assumption means that we have constant absolute risk-aversion. The behaviour of a financial firm under uncertainty is quite often described in this framework. For example, Parkin (1970), Melton and Roley (1981) and Green (1984b) used this assumption.
6) In this case we also have for the residuals $i_1'U_1 = 0$ and now it suffices to assume only that S_{33} is diagonal in order to reach the result presented in (19).
7) It should be pointed out that the assumption $Z_1'i_1 = 0$ only affects the interest rate setting r_1, and not at all the choice of assets A_2.
8) This can be seen from note 11 on the next page. The wealth constraint implies that the adjustment coefficients in this case are all unity. If consumption is included in the model, in the partial adjustment specification all lagged stocks should be included in the consumption equation; see chapter 7.

9) Hunt and Upcher also mention some of the earlier, more restricted derivations of the portfolio adjustment model through cost minimization.

10) It is, however, difficult to see how the model (23) would strictly allow for the property c) because it consists of two additive parts describing separately the stock and flow aspects of desired allocation.

11) A standard flow-of-funds portfolio model is of the form

$$(*)\ \Delta A_{it} = \sum_k \theta_{ik}\ (A^*_{kt} - A_{k,t-1}) \text{ with the property } \sum_i \theta_{ik} = 1\ .$$

See Smith (1975) for a discussion on the confusions arising in the explicit treatment of the implicit budget constraint (i.e. increase in wealth) included in (*). For more on this see also Owen (1986a).

12) A derivation of this kind would obviously lead to an integration of the stock and flow allocation components to each other. See also Stenius (1986), section 1.2 for a discussion of adjustment of asset holdings.

13) For a general description of the desired asset demands and adjustment, see Tobin (1982) and Tobin (1980), pp. 87-88.

14) Merton (1969) independently proved this same result in a continuous time framework while Samuelson used a discrete time formulation. Merton, however, used the assumption of joint normality of asset returns which Samuelson did not. See the general discussion concerning separability in consumption decisions by Deaton and Muellbauer (1980), chapter 5.

15) See Koskenkylä (1985), chapter 4 for a discussion on the interrelationship between investment and financing decisions.

16) If we have a more complex situation where e.g. the costs of borrowing depend on the borrowed amount, we should use a framework of the kind presented in section 5.2.

17) Duesenberry (1980, p. 319) quite convincingly presents the argument in favour of this kind of estimation when commenting on the large flow-of-funds model for the US by Backus et al. (1980): "... Finally, the estimation procedure will contain an important Bayesian element. A Bayesian approach is necessary in this model because of the very large number of parameters that have to be estimated for each equation. In fact, I have long believed that a Bayesian approach should be used in time series equations with even a moderate number of parameters. There is so little information in the relatively short time series available, so many common cyclical and trend elements, so much serial correlation in error terms, and so much correlation in errors across equations that we simply cannot expect to get very accurate estimates for structural parameters from the available data. I believe that this application of a Bayesian approach will prove to be one of the most valuable features of this project."

18) Our data ends in the year 1982, which may be considered to be an end point of the regulated financial markets and effective administrative controls in the financial markets.

19) We should be careful in this respect because the coefficients of the various rate of return variables are linear combinations of the adjustment coefficients θ_{ik} and the long-run coefficients included in the terms α_k (see (23) above). Normally we have the case $\theta_{ii} > 0$ and $\theta_{ik} < 0$, $i \neq k$, because if there is a positive discrepancy between the desired and actual holdings of asset i, there is such a shift in the portfolio that holdings of other assets are reduced and that of asset i is increased. If the assets are gross substitutes for each other in the long run, we can infer that the short-run coefficient of the rate of return variable i in the ith equation should be positive, but the coefficients of other rates are unclear. However, the adding-up constraints indicate that they are normally negative. We should also remember that in (23) the various interest rates have an effect through the allocation of the increase ΔW in the budget, too.

20) Of course, it should be remarked that the significance of the estimates is not so high in reality, because the estimates are to some extent influenced by data mining; see Lovell (1983).

21) We have used in the estimations the QTSP program installed in the computer of the University of Helsinki. The program reaches a solution iterating the covariance matrix of the residuals across the equations and allows for linear constraints within and across the equations. It also computes values and standard errors of linear combinations of parameters of the equations, which allows estimation of the residual equation simultaneously.

22) It is possible to include in the model restriction that the long-run asset demands solved from the model are symmetric with respect to the interest rates; see on this Friedman (1983). He, however, concluded that these restrictions had to be clearly rejected for the US data.

23) A model for the input choice of a firm with rational expectations has been derived and estimated by Pindyck and Rotemberg (1983).

24) Valkonen (1990) presents an analysis of inflation uncertainty on portfolio decision making.

25) The term $(\Delta L - \Delta L^d)$ has been denoted by -z in chapters 2 and 3 above. In this rationed framework the loan "equation" is simply $\Delta L = \Delta L^d - z$, which is the mirror image of the n rationed demand functions in the goods and financial markets as the sum of the spillover terms h_i in (37) is unity.

6 Structure of the empirical analysis

As mentioned in the beginning of the previous chapter, our aim is not to build a complete macroeconomic model, the interrelationships of the real side and the financial side being described in an integrated fashion in the spirit of the flow-of-funds approach. Our aim is to describe and analyze the transmission mechanism from the financial markets to the real side along these lines, but closing the model with a full balance of resources and expenditure as well as describing the inflationary process would lead to such a large task that it lies outside the boundaries of the present study.

In particular, we are interested in describing to which extent the effects of credit rationing are reflected in the real expenditures and to which degree its effects are absorbed within the financial markets. Our discussion in chapter 2 raised this as an interesting point and a determinant of the typology of the transmission mechanism of monetary policies. This point can best be analyzed within integrated flow-of-funds models. The degree to which the demand for deposits depends on the tightness in the bank loan markets is one important factor in this respect, as is also the reaction of the foreign capital flows with respect to the situation in the domestic financial markets. The ambiguous results in the theoretical model of chapter 3 were to some extent a result of the dependence of the demand for deposits on the real disposable income and real wealth items and on the way in which bank lending is affected by these factors. These are interesting empirical items to be analyzed in the following.

Each financial model based on the flow-of-funds approach first specifies

- the sectors to be analyzed in the model
- the markets, i.e. the disaggregation of the goods and financial markets
- the ways in which the markets clear.

The sectors in a complete model of the economy could be: households, firms, banks, government, central bank, other financial institutions and the rest of the world, i.e. the foreign sector. In a behavioural sense the most important sectors in the model are the first three mentioned, for which we are going to build sectoral flow-of-funds models in the next three chapters of this study.

We have already in chapter 2 to some extent defined the structure of markets with which we are dealing in this study. The demand for cash balances is omitted in the empirical model because of its relatively minor role in a macroeconomic context. The equity of firms is also omitted because of the fairly small proportion of share issues in the financing of the investments of the firm sector. Instead of this as markets with flex-rate assets we have in the model the market for the existing stock of housing capital and also the market for government bonds. Private bonds and shares do not have a market of their own in the model.[1)] Foreign capital flows are aggregated here into a single liability and no distinction is made between capital flows in the convertible and tied currencies.

A common problem in flow-of-funds accounting is that there is a residual item between the real side, i.e. the national accounts data and the financial statistics concerning changes in assets and liabilities. This is due both to errors and omissions and differences in definitions between the two statistics. We have to cope with this problem in some way. Our procedure in this study is the standard one (see e.g. Backus and Purvis (1980)), according to which the residual item for each sector is treated as one source of funds and is combined with the disposable income of households and firms.

Of the financial markets, the most important are the markets for bank loans and deposits, the market for central bank debt of the banks, and the market for foreign debt to which the firms, banks and government have access. The market for loans is taken to be sectorally divided between the households and the firms, and we take as a starting point in the empirical model that there has not been an efficient secondary market in the economy where the private sector could have adjusted the imbalances between its borrowing requirements and the actual supply of credit arising in the primary market, the bank loan market.

An essential element in the model is the determination of the quantities in the rationed markets. A common solution is made for the market for bank deposits, where the banks are taken to be rationed at the prevailing deposit rate of interest, the volume of deposits being determined by the public. The most difficult problem is the treatment of the bank loan markets and the potential rationing there. This problem can be divided into three parts: how is the current period market solution determined, how are the short-run spillover effects from rationing to other markets described, and how does the economy adjust to the disequilibrium in this market in a longer run? The second one of these was already discussed in section 5.5.3.

If we take the loan interest rate as fixed, as we can well do in the Finnish conditions in the period of administrative interest controls, we may first think about the possibility that the banks meet all the demand for credit by their clients. This would not be a true case of credit rationing in spite of the fixed loan interest rate. This assumption is made in the short run in the flow-of-funds model for the US by Backus et al. (1980). Another assumption is that there is rationing of customers in these markets because, as in Finland, the central bank has fixed the average loan rate of the banks at a low level in relation to funding costs. In a time series context we can combine these two views and adopt a "disequilibrium" approach (see in a theoretical context e.g. Muellbauer and Portes (1978) and in an empirical context Sneessens (1983)). This approach was adopted in the quarterly model (BOF3) of the Bank of Finland (see Tarkka (1983) for more on this).

Another way to combine these two views is to take the markets to be heterogeneous where some clients are rationed and some are not. Casual empirical evidence suggests that this would most resemble the case in the real world, and it is also the broad view assumed in this study. The risk related to the loans extended by the banks to the firms is reduced and the expected return rises when there is a positive shift in the marginal productivity curve for investment, and therefore the parameters of the revenue function from loans also change. We have as an outcome the fact that the market is heterogeneous with the simultaneous influence of demand and supply in the market solution. This is discussed in more detail in chapter 9.

We are therefore more willing to describe the bank loan market in Finland as a non-homogeneous market with credit rationing of varying degrees, depending, i.a., on the monetary policy measures of the Bank of Finland. In our sectoral model we assume that credit rationing was (virtually) binding with respect to the whole household sector, whereas the firm sector is more heterogeneous with some firms being virtually non-rationed and some being even quite strictly rationed.

The estimation of a model with homogeneous markets in disequilibrium may be based on available extra information concerning the periods when the market has been supply and when demand determined. This sort of estimation has been carried out in the London Business School flow-of-funds model (see Keating (1984)). It is, however, quite difficult to operate with this kind of a model later on in forecasting and simulations because in fact the change in "regime" is an endogenous factor. This has been allowed for in the BOF3 model where the bank loan market has been estimated so that the estimation decides which periods are supply and which demand determined. Our reluctance towards the disequilibrium approach is partly due to the analytical reasons mentioned above. And last but not least, we must mention the small number of observations at our disposal in the estimation of the model which has often limited even our possibilities to carry out standard flow-of-funds estimations, a problem mentioned in the previous chapter.[2)]

The way in which the spillover effects from rationing can be described was discussed in section 5.5.3. The main channels of adjustment to credit rationing in the Finnish conditions have been through adjusting real expenditure, through raising foreign finance by the firms to the extent allowed by the exchange regulation, and to some extent through running down liquid balances, e.g. bank deposits. The last element in the treatment of rationed markets mentioned above is the adjustment towards equilibrium in a longer run. The assumption of initially demand determined loans and gradual adjustment through the interest rate towards equilibrium is made in the flow-of-funds model for the US by Backus et al. (1980). In our case we need not consider this channel because there has not been adjustment through the interest rates in the bank loan markets as a consequence of the administrative interest rates. We have assumed that there has been a permanent excess demand for credit of a varying magnitude. Below we have also briefly contrasted this hypothesis with that of permanently demand-determined loans in describing the firm sector behaviour.

Notes

1) The shares and bonds issued by the firms in the portfolios of the banks are included in the loans of the banks to the firms.
2) See Aurikko (1986) for an empirical model with two markets, the goods and loan markets, potentially in disequilibrium.

7 The flow-of-funds model for the household sector

The aim of this chapter is to present the model for the expenditure and financial portfolio decisions of the household sector. The chapter first presents the empirical specification of the household sector model, then some tests concerning the structure of the model, and then a final estimation result of it.

Koskela and Virén (1984a) have briefly presented the works dealing with the life-cycle theory of consumer behaviour under capital market imperfections. In their paper they showed that a fall in the future credit limit and a rise in the probability for facing the binding credit constraint in the future tends to increase current saving for precautionary reasons. Pissarides (1978) analyzed the role of liquidity in a model where there are transaction costs in the asset market. He concluded that current income and consumption should be more highly correlated than what is suggested by the permanent-income and life-cycle theories of consumer behaviour and that an unexpected decrease in current income leads to a decrease in current consumption, even if known to be truly transitory, provided that the individual is not able to finance the whole of the decrease from liquid assets. Another contribution in this field is Koskela and Virén (1985a), who analyzed the consumption function in the case of labour supply rationing and borrowing constraints (see on this also King (1985)).

For us it is interesting to study how much of the effects of credit rationing are absorbed within the financial markets and how much of them are reflected as spillover effects on the goods market. Normally, the private sector is willing to substitute its deposit holdings for bank loans which are in a short supply, but intertemporal considerations may, however, violate this conclusion. The access to credit is secured if the household accumulates enough deposits at banks. So the tighter this link is, the more likely it is that deposits are increased rather than reduced when there is a shortage of borrowed funds and so a tightening of credit rationing would be primarily reflected in real expenditures.

Montiel (1986) has built a dynamic optimizing model of household behaviour under credit rationing where the funds of a household are used for consumption, investments in real capital and holdings of cash balances. The results of the analysis depend on whether the constant marginal rate of time preference is higher or lower than the loan rate of interest. In order to have a credit constraint binding throughout we should assume that the rate of interest is lower than the time preference, because otherwise the consumer reaches through capital accumulation the notional equilibrium where the rate of interest, the marginal productivity of capital and the marginal utility of holding money coincide. Credit rationing is introduced as a simple fixed exogenous amount of credit to which the consumer has access all the time. Montiel proves that in his model an easing of credit rationing has the short-run effect that consumption and the demands for money and capital are raised as a result of an increase in the supply of credit. This is the most general distribution of spillover effects of credit rationing, which we have also allowed for in the previous chapters. Montiel also demonstrates that in the long run the level of consumption falls. This is a result of a reduction in the disposable income as the interest payments to the banks rise. Holdings of money and capital will be drawn down over time because the higher levels of consumption are associated with dissaving in the form of negative investment and dishoarding. The long-run desired stock of capital will not be affected by a change in the supply of credit, and the long-run desired stock of money will fall as transactions needs decrease together with consumption.[1)] In the following we are dealing with the short-run effects of credit rationing and assume that the household sector, taken as a whole, each year faces a binding credit constraint.

7.1 Specification of the household sector flow-of-funds model

We have already in chapter 5 discussed the many problems related to the specification and estimation of a flow-of-funds model and they need not be repeated here. Our aim is to construct a model covering both the real expenditures and the financial portfolio allocations of the household sector.[2)]

As endogenous variables in this submodel we have the following items as real uses of funds:

c_{nd} = non-durable consumption expenditures

c_d = durable consumption expenditures

i_h = housing investment

Δdep = change in the stock of time deposits at banks

Δb_g = change in the stock of government bonds.

As explained in previous chapters, we do not explicitly specify the (firm) equity market in the model, but instead of it we consider a probably much more important flex-price asset market in the Finnish conditions, namely the market for housing capital. The main reason for the omission of the private bond and equity market in the household sector model is the "underdeveloped" nature of the Finnish financial market system where the banking sector has had a central role in financial intermediation, and loans have been the dominating form of finance for the firms. The share market has so far been quite tiny, although recently it has become more important. The government has until recently virtually "monopolized" the bond market for its own financing needs. Therefore, we feel entitled to omit these markets from the model (see, however, their treatment in the models for firms and banks).

The secondary market for claims on real capital is potentially of much more importance in the case of the housing stock, the share of which in the wealth of the households considered in our model being on the order of 60 per cent (see figure 7.3). The housing capital is valued in the figure at the prices of the secondary market. This is done with full awareness of the large risks and difficulties attached to the empirical measurement of these prices.[3)]

The real sources of finance of the households are the following:

y = disposable income of households

ΔL_{hb} = flow of bank lending to households

ΔL_{hg} = flow of government lending to households.

The flow budget constraint for period t is now the following

(1) $$c_{nd} + c_d + i_h + \Delta dep + \Delta b_g = y + \Delta L_{hb} + \Delta L_{hg} \; .$$

All the variables are measured as real flows in period t. In the following figures 7.1-4 the sources and uses of funds of the household sector[4] as well as the corresponding stocks and the yields on these assets are presented.[5]

The starting point in our household sector model is - as was stated above in section 5.3 - a transformed version of the optimal marginal adjustment model of Friedman and Roley, discussed above. The model is as follows for the desired entities x_{it}^* in period t:

(2) $$x_{it}^* = W_t\alpha_{it} \, , \; i = 1,\ldots,n \text{ and in vector notation}$$
$$x_t^* = W_t(a+Br_t),$$

where W_t represents resources (= inherited wealth W_{t-1}^p and current income y_t) and α_{it} the desired shares, $x_n = c_{nd}$ (nondurable consumption), a is a column vector with elements summing to unity and B a matrix with columns summing to zero and r_t the vector of interest rates.

For real flows Δx_{it}, with the exception of borrowing from banks, we have the adjustment model (see section 5.5.3)

(3) $$\Delta x_{it} = \theta_i'(\alpha_t W_{t-1}^p - x_{t-1}) + \alpha_{it}y_t + h_i(\Delta L_t - \Delta L_t^d) \, , \; \theta_i' = (\theta_{i1},\ldots, \theta_{in}) \, ,$$

where ΔL_t is the flow of lending to households. As was stated above in section 5.3, the lagged stocks x_{t-1} refer to real stocks at the end of the last period valued at prices of the current period. In addition to current income y_t and inherited wealth W_{t-1}^p we should also allow for the discounted expected future wage income, denoted by WI_t , to have an effect on the allocations.

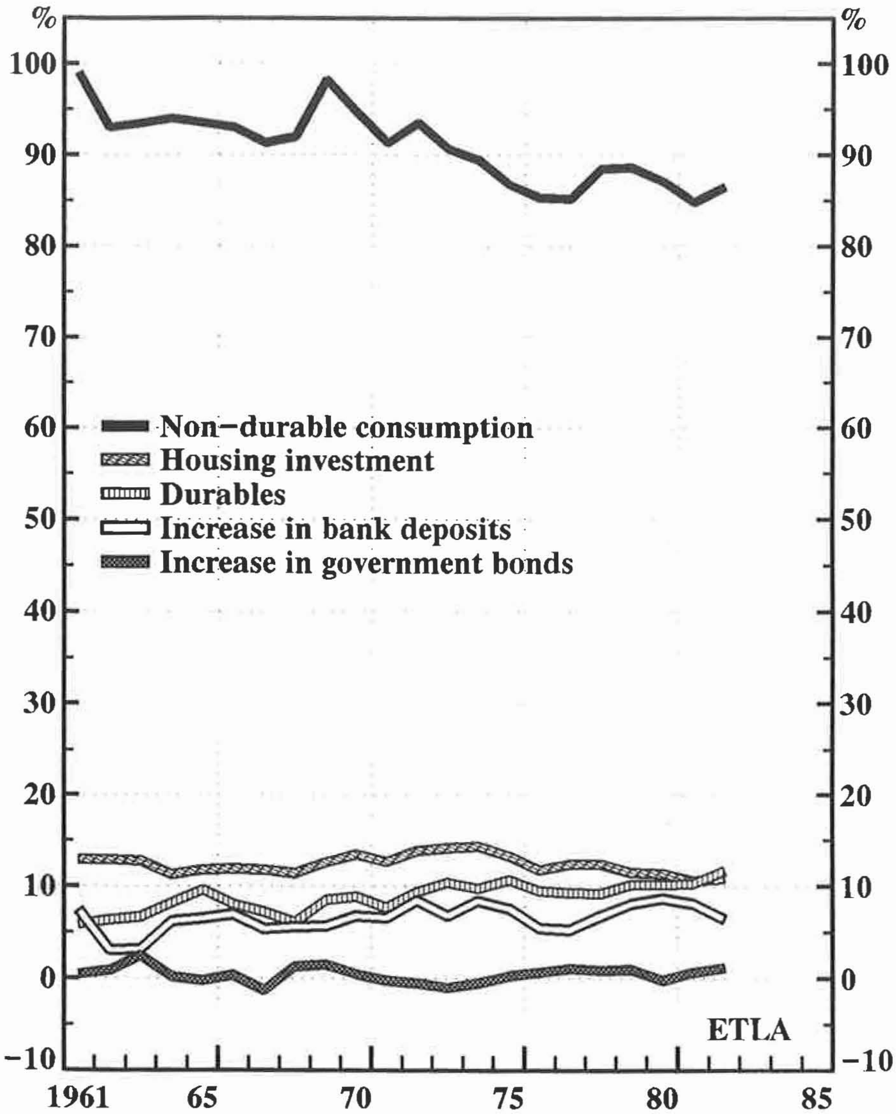


Figure 7.1 Uses of finance of the household sector in Finland, real flows as a per cent of real disposable income in previous year

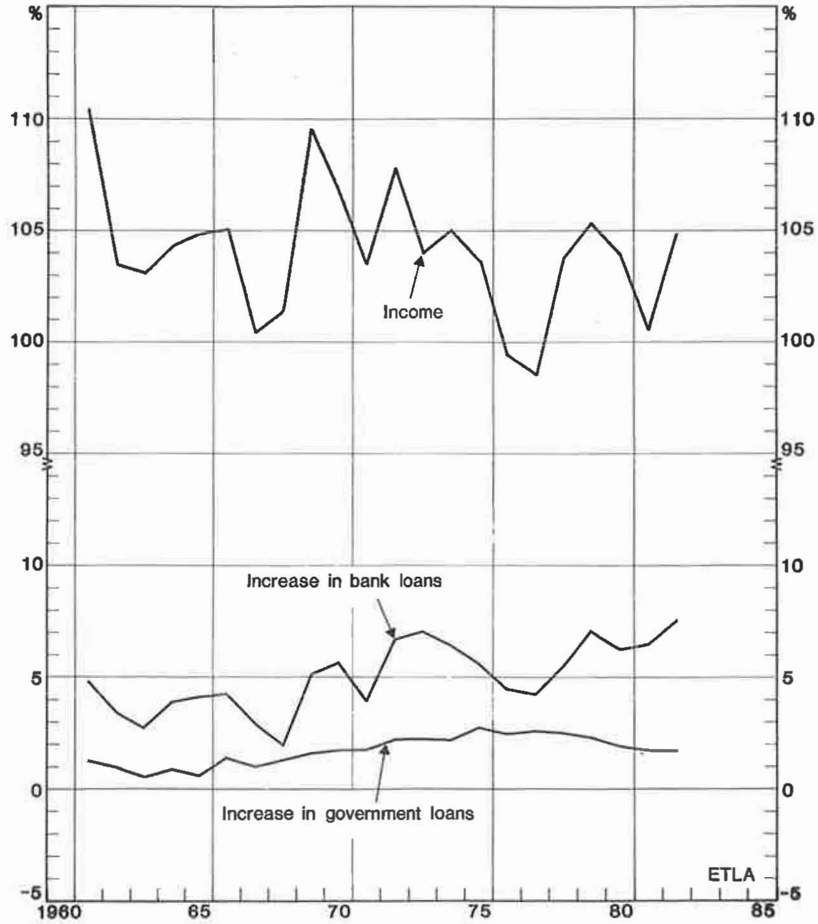


Figure 7.2 Sources of finance of the household sector in Finland, real flows as a per cent of real disposable income in previous year

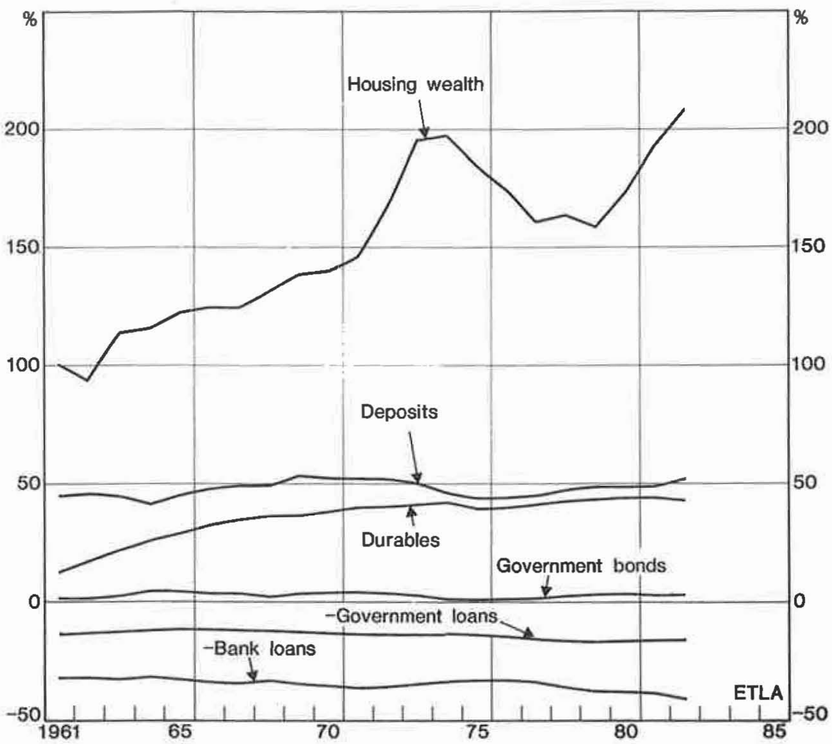


Figure 7.3 Assets and liabilities of the household sector in Finland, as a per cent of disposable income

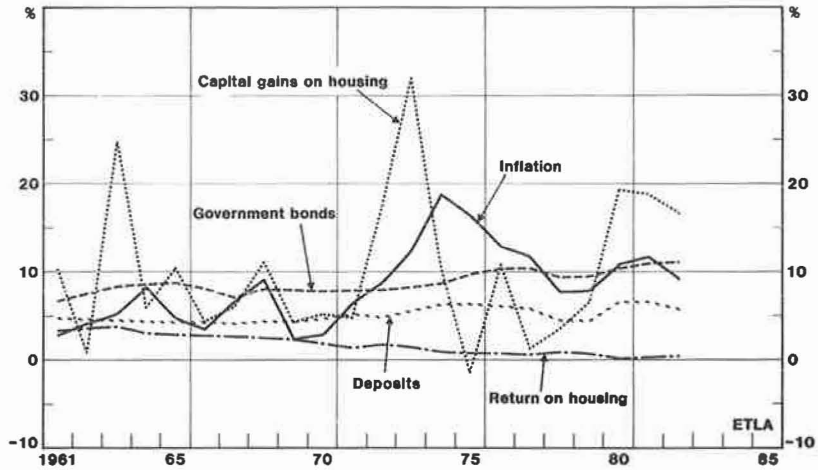


Figure 7.4 The nominal rates of return on the assets of the household sector in Finland

Both sides of (3) are next divided by the lagged income y_{t-1}, and by combining similar terms we get

$$(4) \qquad \frac{\Delta x_{it}}{y_{t-1}} = c_i \frac{WI_t}{y_{t-1}} + \sum_{j=1}^{n-1} (\theta'_i \alpha_t - \theta_{ij}) \frac{x_{j,t-1}}{y_{t-1}}$$

$$- \theta_{in} \frac{c_{nd,\,t-1}}{y_{t-1}} + \alpha_{it} \frac{y_t}{y_{t-1}} + h_i \frac{\Delta L_t - \Delta L_t^d}{y_{t-1}}.$$

As is the usual case in flow-of-funds models, also this model has a large number of free parameters to be determined by the data (for more on this point see the discussion in section 5.4). It is necessary to constrain the model in (4) in some way. One possibility to cope with this is to assume that irrespective of the multiplicative terms where the interest rate variables included in α_{jt} are multiplied by the lagged wealth and by the income variable, the coefficients of the rate of return variables are roughly constant. Doing this and substituting in (4) the equation for $-\Delta L^d$ gives us the following "final" form of the model

$$(5) \qquad \frac{\Delta x_{it}}{y_{t-1}} = (c_i + h_i c_L)\frac{WI_t}{y_{t-1}} + \sum_{j=1}^{n-1} (d_i - h_i\theta_{Lj} - \theta_{ij}) \frac{x_{j,\,t-1}}{y_{t-1}}$$

$$- (\theta_{in} + h_i\theta_{Ln}) \frac{c_{nd,\,t-1}}{y_{t-1}} + (a_i + h_i a_L) \frac{y_t}{y_{t-1}} + \sum_{j=1}^{n-1} \beta_{ij} r_j + h_i \frac{\Delta L_t}{y_{t-1}} \ ,$$

where the β_{ij}' s are now taken to be constant parameters of the model.[6)] Note that in (5) the speeds of the adjustment coefficients are transformed by terms depending on credit rationing. As the adjustment terms θ_{Lj} are normally negative in the equation for $-(\Delta L^d)$, the speeds of own adjustment are lowered in (4) from their "notional" values. The constants d_i serve as a scale variable, because their sum over the equations is $\overline{\theta}$, the same as that of $h_i\theta_{Lj} + \theta_{ij}$ (see section 5.3).

In the following we have quite simply assumed that the ratio of the expected future wage income to current income is roughly a constant and therefore no attempt is made to identify this factor in the model. Our observation period consists of two subperiods with somewhat different financial regimes. Up to the year 1968 index-tied financial instruments such as index deposits and government bonds were issued side by side with the non-indexed instruments, but in the latter part of the period, which ends in the year 1982, it was forbidden to issue them. Our attitude toward this division of the observation period has been fairly crude in the sense that we have taken the non-indexed and indexed deposits, and the non-indexed and indexed government bonds to be perfect substitutes for each other so that in the case of bonds we have simply taken the yield on non-indexed bonds to be the relevant interest rate for them. In the case of bank deposits we have calculated their average yield by dividing the interest revenues of the households by the corresponding stock of deposits at the end of the previous year.

7.2 Testing some hypotheses related to the structure of the household sector flow-of-funds model

There are several important questions related to the household sector flow-of-funds model raised by the considerations presented above which can only be tried to be settled in an empirical analysis. These can be divided into two categories. The first of these concern issues raised in chapter 5, e.g. whether the (non-durable) consumption and the allocation of the saving flow are integrated with or separable from each other, and the nature of the adjustment process, whether it can be described in terms of partial adjustment, where each asset reacts only to disequilibrium in the asset concerned, or whether the general disequilibrium model of Brainard and Tobin is more appropriate. The second category of interesting hypotheses is linked to the nature of the transmission mechanism of monetary policy and the spillover effects of credit rationing.

Let us start with the former set of hypotheses. If the consumption-saving and the portfolio allocation decisions were separable from each other, consumption would only react to the discrepancy between the desired and actual wealth, and we could aggregate all the wealth items into a single net worth variable in the non-durable consumption equation.

This is usually examined in several phases so that first it is tested whether the various financial assets and liabilities can be aggregated into total financial assets and total liabilities, then whether they can be aggregated into a net financial wealth variable, and finally whether they can be aggregated with the real wealth variables into a single net worth variable (see Backus and Purvis (1980), Poloz (1986) and Owen (1986b)). The conclusion which all these studies share is that asset composition is important with respect to the real expenditure decisions: the empirical evidence favours the integration hypothesis. Real expenditures react in different ways to disequilibrium in different assets, and so they are decided in a decision making process covering simultaneously both the real expenditures and the financial portfolio allocations.

If separability prevails, this has other implications, too. The asset yields on real assets should not have any effect on the inner distribution of the financial portfolio; they will influence only the total volume. And analogously, disequilibrium in a real asset holding should not have different effects on various financial portfolio allocations.

Let us now specify the following hypotheses concerning integration vs. separation:

H_1: Financial assets can be aggregated into total financial assets and accordingly the financial liabilities can be aggregated into total financial debt.

H_2: Financial assets and liabilities can be aggregated into a single net financial wealth variable.

H_3: The real stocks of wealth and the net financial wealth can be aggregated into a single net worth variable.

As can be seen, these hypotheses are nested within each other. They can be tested in each equation separately by an F test. The wealth items in our model are the following:

real wealth:	stock of durables
	stock of housing wealth
financial assets:	stock of bank deposits
	stock of government bonds
financial liabilities:	stock of bank loans
	stock of government loans

In addition to this, we also included the lagged non-durable consumption in the equations to imply the possible non-instant adjustment of consumption expenditures. Because we have at our disposal only annual observations for the period 1961-1982, we have in this connection combined the five different yield variables (the nominal interest rates on deposits and bonds, the after-tax rate of return on the housing stock excluding capital gains, the capital gains on housing and the inflation rate) into their two principal components.[7] The results of these tests, which are based on separate OLS estimations for the various items, are presented in table 7.1.

According to these results we can conclude that, with the exception of durable consumption, the asset composition effects would not be very prominent in the Finnish data, in contrast to the results obtained in other countries

Table 7.1
Testing the integration vs. separation hypothesis, values of the F test

	Equation		
Hypothesis	Non-Durable consumption	Durable Consumption	Housing Investment
H_1: financial assets and liabilities $F_{2,11}(.05)=3.98$	1.36	8.23	1.82
H_2: net financial wealth $F_{3,11}(0.5)=3.59$	1.08	5.63	2.11
H_3: net worth $F_{5,11}(.05)=3.09$	1.84	3.41	2.02

such as the US, UK and Canada (see Backus and Purvis (1980), Poloz (1986) and Owen (1986b)). The separability hypothesis is not rejected with respect to the nondurable consumption, which is in contrast with the a priori conception that in a country with less developed financial markets consumption and asset portfolio decisions would be intertwined with each other.

Upon closer examination, however, we find that the consumption equation, when various wealth items are aggregated into a single net worth variable, gives a meaningless negative coefficient for this variable. The residuals of this equation are also strongly positively correlated in this case. So, the evidence in this wider sense does not favour the separability hypothesis. From table 7.1 we find that with respect to durable consumption, the separability hypothesis is clearly rejected. This is due to the strong presence of the lagged stock of bonds in this equation.

The second hypothesis related to the flow-of-funds model concerns the basic nature of the flow-of-funds model specified in the spirit of Brainard and Tobin as a multivariate adjustment mechanism so that several (or indeed all) interest rates and lagged stocks affect the allocation of each asset. The alternative hypothesis is the partial adjustment hypothesis. Usually in the literature also this hypothesis is tested on an equation-by-equation basis. It is, however, to be noted that a consistent specification of the partial adjustment hypothesis, where in each asset equation only its own interest rate and its own lagged stock appear as explanatory variables, implies that all these variables have to be included in the nondurable consumption equation, because the sum of their coefficients across all the equations in the system has to be zero. We

Table 7.2
Testing the multiple versus partial adjustment hypothesis

Equation	Residual sum of squares	
	Multiple adjustment	Partial adjustment
Nondurable comsumption	7.52	8.23
Durable consumption	7.65	12.79
Housing investment	5.04	6.86
Deposits	15.14	20.81
Bonds	8.23	18.22
The whole model: log of likelihood function	-53.14	-71.67
AIC	156.28	189.34
SBIC	183.56	214.43

have carried out the test so that we compared the partial adjustment hypothesis to our final model (presented in table 7.5). The small number of observations was the reason for performing the "test" in this way.

The increase in the residual sum of squares in all equations in table 7.2, except the housing and nondurables equations, is very high indeed. These hypotheses are not fully nested within each other, and therefore we have used the model selection criteria which clearly favour the general adjustment hypothesis (there are two parameters more in our general adjustment model than in the partial adjustment model).

There are still other hypotheses which probably have not been examined before in the context of a flow-of-funds model. These are related to how the asset demands depend on inflation, e.g., whether the asset demand equations are homogeneous with respect to the nominal interest rates and the (expected) inflation rate so that the asset demands could be specified in terms of real rates of return. We consider testing of these hypotheses at the end of the next section.

7.3 An estimation result of the flow-of-funds model for the households

Above we mentioned that partly due to the small number of observations we have proceeded to build a parsimonious flow-of-funds model for the households by successively eliminating variables with insignificant coefficients and with coefficient estimates which are implausible in sign.[8] In the preliminary estimations related to table 7.1 we treated the sources of funds as one entity. It is anyway quite clear that we should separate the income flow from the credit flow in order to be able to identify the h_i terms of credit rationing specified in section 5.5.3. In table 7.5 the influence of the income flow is, as expected, heavily concentrated on the nondurable consumption with a coefficient of approximately one half. The government lending is clearly concentrated on the housing investment equation, which is also an expected effect because this lending is tightly linked with actual building of new housing. In the model estimations government lending has a slight spillover effect on durables, which is on the order of 10 per cent, but which is also quite insignificant. So we decided to concentrate its effects solely on housing investment (with a coefficient of unity).

The bank lending flow is, as was discussed above in chapter 2, an important element, because it is the main variable indicating which items have been influenced by credit rationing. In the preliminary model estimations it seemed to have an effect on durables, housing and deposit holdings, but not on nondurable consumption and bonds. This we then tested after having reached a fairly parsimonious set of explanatory variables in the model (see table 7.3). The empirical evidence clearly indicates that bonds are not affected by credit rationing. There is a small and statistically insignificant effect on non-durable consumption on the order of 10 per cent. Because of the very small value of the likelihood ratio test statistic in table 7.3, we decided to remove this effect from the model.

The evidence also to some extent favours the idea that credit rationing has an effect on holdings of deposits, which was raised in chapter 2 as an important element in the transmission of monetary policy.

With respect to the rate of return variables it is clear that we have to delete quite many of them in order to reach a sensible structure. The rate of return on the housing stock is a combination of two variables: the physical return on the housing stock, net of tax, and the capital gains.[9)]

These two components had widely diverging coefficients from each other in the preliminary estimations so that the coefficient of the capital gains component is only a small fraction of the yield component. This may perhaps be explained so that capital gains on the housing stock arise to a large extent unexpectedly, and so do not influence much the current period portfolio allocations and the expenditure decisions. On the other hand, they may also be considered to be transitory and perhaps do not therefore give rise to corrective measures on the part of the wealth-owners. Hence, it is natural that the reactions to capital gains are fairly small in the short run in comparison to changes in taxation and interest rates, which may to a higher degree be foreseen earlier and considered to be more permanent.[10)]

The rate of return on the housing stock got positive coefficients in the nondurable and durable consumption equations. Therefore, we constrained it to be an explanatory variable only in the housing and deposit equations.

Table 7.3

Testing of the hypotheses related to the effects of credit rationing

	The bank credit flow has		
Statistic	effects on all items	effects on durables, housing and deposits	effects only on durables and housing
log of likelihood function	-46.670	-46.765	-50.314
LR-test statistic	.	0.19	7.288
critical value of	.	$\chi^2_{.05}(2)=5.99$	$\chi^2_{.05}(3)=7.815$

Of the other rates, it is interesting that the bond rate seems to work in a meaningful way as a short-run impact effect in the equations for the nondurable consumption and in the housing investment equation. In the durables equation there is no financial asset interest rate. Because of the multiple adjustment mechanism, however, also these rates have an influence on future levels of the durables. The deposit and bond rates have fairly high coefficients in both the deposit and the bond equations, indicating a high degree of substitutability between these two assets.

With respect to the inflation rate there are also some interesting hypotheses which have not been tested previously. It is a usual practice to specify demand for money and other financial asset equations so that they only depend on nominal interest rates, while the real expenditure equations depend on the real interest rates. One possible way to combine these views in a consistent manner in a flow-of-funds model is to specify the financial asset equations so that the inner allocation of the financial portfolio does not depend on the inflation rate but depends only on the nominal rates, while the total financial portfolio depends on inflation. In a model estimation this would mean constraining the inflation rate to have the same (negative) coefficients in the deposit and bond equations. This case is represented by the second column in table 7.4.

The usual way to specify that the financial asset, e.g. deposit and bond, demand equations are not to be at all dependent (third column in table 7.4) on the inflation rate is inconsistent with the hypothesis that the real expenditure decisions only depend (negatively) on the real interest rates. In this

Table 7.4
Testing hypotheses related to the effects of the inflation rate in the model

	Hypothesis			
Statistic	Inflation rate non-constrained	Inflation rate neutral with respect to financial portfolio allocation	Inflation rate does not affect at all financial portfolio allocation	Equations are homogeneous of degree zero in nominal interest rates and inflation
log of likelihood function	-52.09	-52.79	-52.85	-61.78
LR statistic	.	1.40	1.51	19.39
Critical value of χ^2	.	$\chi^2_{.05}(1)=3.84$	$\chi^2_{.05}(2)=5.99$	$\chi^2_{.05}(4)=9.49$

specification the inflation rate would not appear in the financial equations at all and would have positive coefficients in the real expenditure equations, which is not consistent with the zero sum property of the coefficients across all the equa tions in the model. The evidence in our estimations (see table 7.5), however, indicates that the nondurable consumption depends negatively on the inflation rate while the durables and the housing investment depend positively on inflation. This dependence of consumption on inflation which is also encountered in other studies,[11)] can perhaps best be explained by the fact that durables and housing are an inflation hedge.[12)]

The results of the tests related to the treatment of the inflation variable in table 7.4 favour the inclusion of it only in the three expenditure equations. The evidence also rejects quite clearly the homogeneity property, i.e. that it would be the real interest rates which would determine the household behaviour throughout.

The "final" model for the households is to be seen in table 7.5. Here the speed of adjustment of the nondurable consumption is very rapid, which is also an intuitively clear result. The empirical evidence in all the estimations of the model gives quite a strong indication that there is a somewhat peculiar cross-adjustment effect from non-durables to durables. Namely, a positive gap between the desired and lagged non-durable consumption gives rise to an increase in the demand for durables, which is on the order of one half of the gap. Furthermore, it is somewhat surprising that the estimations showed that this gap would be financed by decreasing bond holdings rather than deposits, the latter being probably a more natural means of finance. Constraining the model so that the financing effect comes from the deposits instead of bonds was statistically rejected.

The coefficient of the lagged durable stock in the durables equation was insignificant. In interpretating this coefficient it must be remembered that it also includes as a positive component the depreciation investment in durables, which is on the order of 20 per cent per annum. This must be deducted from the estimated coefficient in order to get a proper estimate of the speed of the durables' own adjustment.

In addition to this, we must also take into account the effect of credit rationing mentioned above in section 7.2 on the speed of the adjustment. A rise in the stock of durables causes a reduction in the discrepancy between the desired and actual stock of durables which causes a fall in the demand for credit. This causes an increase in the expenditures in durables. A consequence is that the estimated coefficient is in absolute value smaller than the "true" notional speed of the adjustment.

The lagged stock of housing wealth also has quite small coefficients. The same reasoning as in the case of durables also applies here. The notional speed-of-adjustment coefficient is certainly much higher than the estimated one. In the final model presented in table 7.5 the housing investment equation does not include the lagged stock of housing wealth because its coefficient was usually quite insignificant. The housing stock variable has a wealth-type effect on the nondurable consumption, which is then financed by running down bank deposits.

The speed of the deposits' own adjustment is implausibly small, but it may also be influenced by the above-mentioned credit rationing effect. It may also be that in the credit rationing context it is more difficult to adjust the deposit holdings to their desired value than in the case of perfect capital markets. The speed of adjustment of deposits was somewhat higher, around 0.3 in the model where the dependent variable was the change in the real asset stock instead of the real flow as in table 7.5. Inclusion of the lagged deposit stock in the nondurables equation was statistically rejected. The speed of adjustment of bonds is very rapid, which can be explained by the fact that the bond-holders have perhaps been more interest sensitive than the deposit-holders. There are also quite marked cross-adjustment effects between these two assets.

Our treatment of inflationary expectations has been crude in the above reported estimations. As a proxy for inflationary expectations we also used the model solutions of the annual econometric model of ETLA (see Pylkkänen-Kinnunen (1981) and Lassila (1985)). We also included the unexpected inflation rate in the model. The estimation showed that the reactions are very similar with respect to expected and unexpected inflation.[13)] The deposit equation was a deviation from this general pattern, but the coefficients of the two inflationary expectations variables were insignificant in this equation.

It is also interesting to analyze the effects of expected vs. unexpected income flow. Similarly, as in the case of inflationary expectations, we constructed from the annual model solutions for disposable income of the households according to the econometric model of ETLA a variable which we call expected income flow. We also included in the model the corresponding unexpected income flow. Again, the results showed quite similar reactions with respect to the two sources of finance. Therefore, we have preserved in table 7.5 the simpler hypothesis with these two components of sources of funds as aggregated into only one variable.

Table 7.5
The final flow-of-funds model for the household sector [14)]

Equation	Constant	$\frac{y}{y_{-1}}$	$\frac{\Delta L_{hb}}{y_{-1}}$	$\frac{\Delta L_{hg}}{y_{-1}}$	i_{hous}	i_{dep}	i_{bond}	p	$(\frac{c_{nd}}{y})_{-1}$	$(\frac{k_h}{y})_{-1}$	$(\frac{dep}{y})_{-1}$	$(\frac{b_g}{y})_{-1}$	$(\frac{L_{hb}}{y})_{-1}$	demog	R^2	D-W
nondurables	19.368	0.554					-0.450	-0.223	0.202	0.016			-0.145		0.977	1.952
c_{nd}/y_{-1} (1)	(9.376)	(.065)					(.160)	(.045)	(.103)	(.008)			(.075)			
durables	37.196	0.162	0.396					0.112	-0.559			0.316		-0.175	0.863	1.449
c_{dur}/y_{-1} (2)	(6.887)	(.085)	(.098)					(.032)	(.150)			(.115)		(.120)		
housing	4.166	0.051	0.264	1.000	0.756		-0.478	0.110						0.175	0.781	2.187
i_h/y_{-1} (3)	(5.955)	(.046)	(.089)	(.000)	(.187)		(.151)	(.031)						(.120)		
deposits	-11.877	0.157	0.339		-0.756	1.182	-0.587			-0.016	-0.090	0.394	0.145		0.682	1.667
$\Delta dep/y_{-1}$(4)	(10.336)	(.075)	(.152)		(.187)	(.160)	(.260)			(.008)	(.030)	(.096)	(.075)			
gov. bonds	-48.853	0.076				-1.182	1.515		0.357		0.090	-0.710			0.490	1.423
$\Delta b_g/y_{-1}$ (5)	(8.241)	(.067)				(.160)	(.146)		(.112)		(.030)	(.112)				
sum	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	log L = -53.142

Appendix. Construction of the variables

The household sector covers here both the households and the non-profit institutions (including the housing companies) in the national accounts. The variables used in the estimations are the following. All volumes in the model for households, as well as in those for firms and banks are calculated at constant 1975 prices. Similarly, the price indices have 1975 as their base year.

c_{nd}	volume of nondurable consumption[15)]
c_{dur}	volume of durable consumption
i_h	volume of housing investment
Δdep	real flow of deposits of the households, i.e. the nominal change in the stock of deposits of the households (see below) deflated by the price index of the private consumption expenditures
Δb_g	real flow of government bonds of the households, i.e. the nominal change in the stock of government bonds (see below) deflated by the price index of the private consumption expenditures
$k_{dur,-1}$	lagged volume of the stock of durables. The data for the years 1960-1980 is from Luukkainen (1983). The years 1981-1982 have been estimated on the basis of the depreciation coefficient in the earlier period and the flow of consumer durable expenditures in the national accounts.
$k_{h,-1}$	real market value of the housing stock at the end of the previous year measured in prices of the current year. The secondary market prices which refer to housing prices in the Helsinki area have been normed by the prices of housing investment in such a way that this price ratio was on average unity in the period 1960-82.
dep_{-1}	stock of time deposits of the households at banks at the end of the previous year deflated by consumer prices of the current year. The stock of deposits of the households is estimated as total time deposits at banks less the time deposits of the local government and the insurance companies at banks (source financial market statistics).[16)]
$b_{g,-1}$	stock of government bonds at the end of the previous year deflated by consumer prices of the current year. The stock of government bonds held by the households is estimated by the series "government bonds held by the private sector" excluding those held by the financial institutions in the financial market statistics.
$L_{hb,-1}$	stock of bank loans of the household sector at the end of the previous year deflated by prices of the current year. The data on

the stock of household sector bank loans has been provided by the Bank of Finland.

y — real disposable income of the household sector (including also the statistical discrepancy between the sources and uses of funds). (y_{-1}= real disposable income, net in the previous year).

ΔL_{hb} — real flow of bank lending to households, i.e. nominal change of the corresponding stock deflated by consumer prices

ΔL_{gh} — real flow of government lending to households, nominal change of the corresponding stock deflated by consumer prices (source Valkonen (1986))

p — rate of inflation measured by consumer prices, i.e. annual rate of change of the implicit deflator of private consumption

i_{hous} — after-tax rate of return on housing capital. It is defined as follows: $i_{hous} = (1 - \theta)\,\dfrac{\pi_h - i_L L_{-1}}{(q_k K_h)_{-1}}$, where

θ = weighted average of marginal tax rates in personal taxation, estimated by Christian Edgren at ETLA

π_h = capital income, gross, in the sector ownership of dwellings in the national accounts

i_L = average bank loan rate of interest

L = total loans of the households from the banks and the government

q_k = nominal secondary market price of a unit of housing capital in the Helsinki area

K_h = stock of the housing capital at constant 1975 prices

i_{dep} — interest rate on bank deposits measured as a ratio of the interest income on bank deposits of the households according to national accounts to the stock of bank deposits of households at the end of the previous year

i_{bond} — interest rate on new issues of government bonds, yearly average (source interest rate statistics)

demog — demographic variable, the share of the 25-29 year olds in the total population (source population statistics)

Notes

1) See also Rantala (1986) chapter 4 for an intertemporal analysis of household behaviour under imperfections in capital and rental markets.
2) Luukkainen (1983) has also constructed a flow-of-funds model of the integrated type for the household sector in Finland. Her models differs from ours i.a. in its different disaggregation of the financial assets, more aggregate treatment of various sources of funds and different valuation of the housing stock.
   Barr and Cuthbertson (1989a,b) have presented a two-stage specification of the portfolio allocation model where in the first stage the long-run properties, specified as an AIDS demand model, are studied with the aid the cointegration technique and in the second stage the short-run dynamics are examined using the error correction technique.
3) The housing stock is valued at secondary market prices by assuming that the q ratio between market prices and prices of housing investment was on average unity in the period 1960-82.
4) The household sector consists of the "pure" households and the non-profit institutions including also the housing sector.
5) The construction of the variables in the model are explained in detail on pages 129-130.
6) In (5) we have the following adding-up constraints:
   $\sum_i(c_i + h_i c_L) = 0$, $\sum_i(d_i - h_i\theta_{Lj} - \theta_{ij}) = 0$, $\sum_i(\theta_{in} + h_i\theta_{Ln}) = 0$,

   $\sum_i(a_i + h_i a_L) = 1$, $\sum_i \beta_{ij} = 0$, and $\sum_i h_i = 1$.

   Normally we also have $\beta_{ii} > 0$ (see note 19 on p. 106).
7) The rate of return on durables is taken to be a constant plus the inflation rate.
8) In the estimation the bond equation is the residual one.
9) See the appendix to this chapter for the construction of the variables used in the model.
10) As a simple forecasting rule for the capital gains component we built a model where the capital gains are related to the inflation rate and the capital gains in the previous period. We constrained the model to give the long-run relationship that the real capital gains on the housing stock have been on average 1.5 percentage points per annum. This kind of a model would suggest a very rapid adjustment of the capital gains expectations with respect to changes in the inflation rate and the lagged capital gains term was insignificant. So, we decided to replace the expected capital gains on housing simply by the inflation rate in the estimations. It should

be added that, as a result of the way in which the housing stock variable is constructed, the real capital gains on housing are present in the equations for nondurable consumption and deposits in table 7.5.

11) See Holtham and Kato (1986) and Koskela and Virén (1984b).

12) See the discussion on the effects of anticipated and nonanticipated inflation by Koskela and Virén (1985b).

13) This was also roughly the case in the consumption study of Koskela and Virén (1985b).

14) Estimation covers the period 1962-82. All variables, except the constant, are multiplied by one hundred. For a detailed description of the construction of the variables, see the appendix to this chapter. In each cell the upper figure is the coefficient estimate and the lower the estimate of the stantard error of the coefficient estimate.
The covariance matrix of untransformed residuals is:

	1	2	3	4
1	0.342	-0.177	-0.113	-0.122
2		0.348	0.035	0.025
3			0.229	-0.274
4				0.688

15) If otherwise not indicated, the data source in all the empirical models in chapters 7, 8, and 9 is the annual national accounts for the years 1960-82 compiled by the Central Statistical Office of Finland.

16) The term financial market statistics refers to the annual statistics on sectoral sources and uses of funds including also data for corresponding stock variables compiled up to the year 1969 by the Bank of Finland and thereafter the Central Statistical Office of Finland.

8 The flow-of-funds model for the firm sector

8.1 The availability of finance and the investment process

The key role of the firm sector is to produce the bulk of the nation's output. Therefore, the most important of the firms' decisions are those related to production and use of productive inputs. For us from the point of view of building a flow-of-funds model where both real and financial portfolio decisions are considered, the most essential issue is the relationship between the investment decisions and the financial decisions of the firm.

The firm faces the problems of how much of the profits to distribute as dividends and how much to put into investments which generate future dividends, and how to finance the capital stock, whether by issuing new shares or by raising loan capital. The famous Modigliani-Miller theorem (1958) says in its basic form that the market value of the firm, the objective of the firm's decision making in the neoclassical analysis, is independent of its capital structure. As a consequence, financial decisions are irrelevant as to the market value of the firm, and therefore also irrelevant with respect to investment decisions. This result is valid only in a specific model, and introduction of factors such as taxation and risk of bankruptcy in general means that there is a relationship between the financial structure and the market value of the firm.

There is in general an optimal level of debt-equity ratio which minimizes the cost of finance for the firm (for more on this see e.g. Ylä-Liedenpohja (1986)).

Another aspect concerning the influence of financial factors on the investment decision is the role of the financial flow variables in the investment equation. Since the rise of the Jorgensonian neoclassical investment function into a dominating position in the investment theory in the 1960's, the "naive" liquidity or profit theories of investment behaviour came under attack and were also tested to be empirically worse than the dominating model.[1)] The critique pointed out that financing of investments is just the mirror image of the investment process and that profits are highly positively correlated with output and the rate of capacity utilization, see e.g. Feldstein and Flemming (1971) on this.

It is, however, possible to integrate the role of past profits in the neoclassical model of the firm as a cost of funds factor, as Nickell (1978, p. 179) shows.[2)] Profits may also have an important role as an expectation variable. If past profits were the best predictor of future levels of profit, they would be the major or even only determinant of business investment.[3)]

In the neoclassical framework of the firm an important aspect in the relationship between past profits and the firm's investment is the fact that this is typically considered to be of a short-run nature. This status of profits in the neoclassical analysis of the investment behaviour is due to the fact that, in the long run, competition between various investment opportunities eliminates all differences in the rates of return and there are no pure profits in any investment object. So, it would be quite meaningless to operate independently with such a concept as the long-run profitability in a neoclassical framework.[4)] On the other hand, in the Keynesian growth literature the investment function is based on the notion of income distribution, so that undistributed profits, as well as distributed profits, are key factors in explaining the volume of investment in the economy.[5)]

Let us next turn to discuss the role of loan finance, the other component of finance of the firm. In the standard framework, the firm is supposed to be able to raise finance in loan markets which can be described to be of the well-functioning type. In practice there may be many features which violate this assumption such as various kinds of rigidities and rationing of credit in the financial markets.

One important consequence of this is the fact that there are often constraints concerning the amount of external finance a firm can raise in one period for its investment projects.[6)] And secondly, the equity market in many countries is of a limited importance, and there is so little equity finance available that the bulk of the firm's own funds are usually made up of the cumulated retained earnings. This causes the fact that there are no great possibilities to perform portfolio type changes in the capital structure of the firm between equity and debt capital; equity virtually rises pari passu with profits.[7)]

In dynamic neoclassical models of the firm, however, the optimal capital accumulation path and the optimal financial structure are both solved in the optimization. This can be divided into two parts. First, in a static optimization problem a capital structure of the firm is found out which minimizes the capital costs of the firm.[8)] If there are high adjustment costs related to the capital structure just because of the small possibilities to achieve any major portfolio adjustments through the equity market, we have the situation discussed in Steigum (1983) where in this first phase of the problem we in fact find out the optimal volume of the capital stock as a function of the equity capital, i.e. cumulated retained earnings. In the second phase a dynamic subproblem is solved where the entrepreneur maximizes the flow of dividends over time. This produces the outcome that optimal investment behaviour can in general be described by a relationship presenting the idea of a flexible accelerator model of investment.

In a credit rationing context we may also find that the firm cannot instantaneously adjust its debt to the desired level. We can find such an effect that the lenders supply loans in a positive relationship with the customers' own funds (for more on this see Jaffee and Modigliani (1969), Smith (1972), Arzac et al. (1981) and Alho (1984b)).

Let us illustrate the investment process with the following simple diagram. The retained earnings function of the firm in the case of no dividends is the following:

(1) $$dE = Pf(K) - iL - u(Pf(K) - iL - \beta\alpha K),$$

where dE is retained earnings, i.e. increase in equity E, f(K) is the production function, P the price of output, i the rate of interest, L the stock of debt, u the income tax rate in firm taxation, β the rate of depreciation in the firm taxation, and α the ratio of the capital stock used as a basis for depreciation allowances in taxation to the physical capital stock (usually clearly less than one, perhaps in the Finnish conditions α is on the order of one fourth or one third, (see Alho (1980b), p. 79). Assuming the production function exhibits decreasing marginal products and that there is simply a fixed relationship between the debts and the capital stock of the firm, we can draw the curve for the retained earnings dE as a function of the capital input K by summing the respective parts of the retained earnings included in (1) (see the figure 8.1).

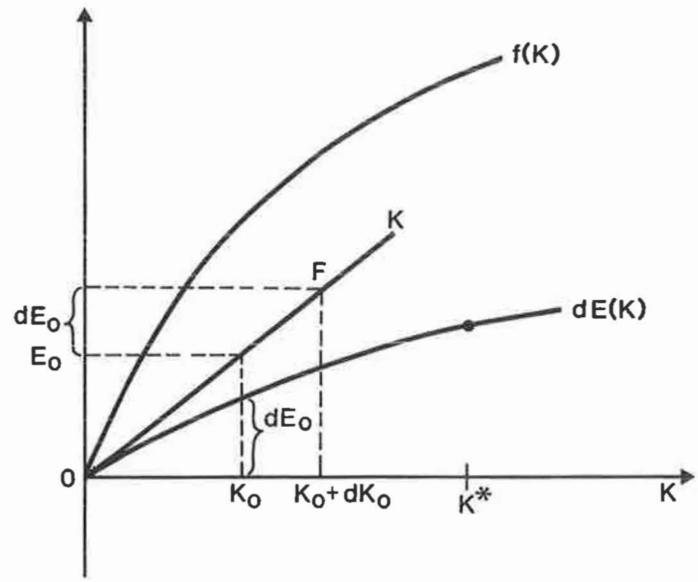


Figure 8.1 A diagrammatic presentation of the investment process

Starting from an initial position K_0 and E_0, where E_0 is marked on the vertical axis, we can first find out the retained earnings related to the capital stock K_0, which we then add to the firm's own initial funds E_0 to get their new level $E_0 + dE_0$. These then "entitle" the firm to get total finance of the amount $K_0 + dK_0$ according to the availability of funds line marked OFK. In making the investment decision on the basis of the profit function dE(K) the firm also has to take care that the new investment is profitable enough compared to the risk-free interest rate i. So the slope of the dE(K) curve has to be steeper than i in order for the capital accumulation process to continue. The firm aims to reach a point denoted by K^* where this equilibrium condition is reached, and K^* is then the optimal capital stock.

This desired capital stock does not depend on profits (with a fixed i) but the speed of adjustment towards it depends on the flow of internal and external funds in the case of a credit rationed firm.[9)] There are situations where only the tightness of credit and the profitability of the firm determine the actual volume of investment. On the other hand, we may find situations where the firm is not credit constrained because of slack capacity. This can be seen as follows. We add to the production function a shift parameter γ representing conditions in the output market, $f = \gamma\bar{f}(K)$. A lowering of γ, i.e. slack capacity, may cause such a big downward shift in the production function f and also in the profit function dE(K) that there is less desire to invest than there are available funds.

8.2 Specification of the flow-of-funds model for the firms

The model of the firm sector operates with the following balance sheet.

assets:	K	stock of fixed capital
	K_{inv}	" inventories
	$DDep$	" demand deposits at banks
liabilities:	E	" equity
	L_{bf}	" bank loans
	L_{for}	" foreign net debt
	L_{odom}	" other domestic debts
	Res_f	" residual item, net

Equity accumulates on its own because we disregard here decisions concerning the volume of dividend payments and firm equity issues. We examine below in section 8.3 more closely the role of the bank credit flow in the model as a demand or supply determined variable. Primarily it is supply determined in the following estimations. Other domestic debts are an exogenous variable, as is also the residual item.

So we are initially left with making a decision between fixed capital, holding goods in inventories, holding domestic bank deposits and acquiring foreign assets, or in our notation, reducing foreign net liabilities. For these items we build a flow-of-funds model taking the other items in the balance sheet as predetermined. Let us denote by π (profits) the sum of these real flow items Δx_i (x_1 is fixed capital) under consideration except for the flow of bank lending ΔL. We specify for the real flows a relationship of the following kind (see section 5.3):

$$(2) \qquad \frac{\Delta x_i}{K_{-1}} = \sum_{j=1}^{n} \theta_{ij} \frac{(x_j^* - x_{j,-1})}{K_{-1}} + \alpha_i \frac{\pi}{K_{-1}} + h_i \frac{\Delta L - \Delta L^d}{K_{-1}}$$

$$= (\theta_{i1} + h_i\theta_{L1})(K^* - K_{-1})/K_{-1} + \sum_{j>1} (\theta_{ij} + h_i\theta_{Lj}) \alpha_j -$$

$$\sum_{j>1} (\theta_{ij} + h_i\theta_{Lj}) \frac{x_{j,-1}}{K_{-1}} + \alpha_i \frac{\pi}{K_{-1}} + h_i \frac{\Delta L}{K_{-1}} ,$$

where $\alpha_i = x_i^*/K_{-1}$, $i = 1,...,n$ are the desired allocations taken to be homogeneous with respect to capital stock and linear functions of the rate of return and user cost variables. The desired relative increase $(K^* - K_{-1})/K_{-1}$ in fixed capital has been first approximated by the logarithmic change $\log(K^*/K_{-1})$. As we assume the firms to typically operate under a demand constraint in the goods market, the desired capital stock is specified as $K^* = AQ_e(P/c)^\sigma$, where Q_e is the expected output, c is the user cost of fixed capital and P the price of output, A is a constant and σ the elasticity of substitution between capital and labour (for details on this see Feldstein and Flemming (1971)).

In the following we have set the price of output to be the unit labour cost w added to a constant mark up and written the expected output as the lagged output multiplied by one plus the expected rate of growth g_e of output. So we have

(3) $$\frac{K^* - K_1}{K_{-1}} \sim A' + \log(Q/K)_{-1} + g_e - \sigma\log(c/w) .$$

In the following we have not made system-wide experiments with the g_e variable but have simply taken it to be a constant on average.[10)] We have also had to simplify the multiplicative terms $\alpha_i\pi$ in (2) when formulating the empirical model in a similar way as in the case of the household sector model. We have also combined the flow of other domestic credits than bank credits with the gross profit flow of the firms.

In figures 8.2 and 8.3 we present the uses and sources of funds considered as either endogenous or exogenous in the firm sector model. Figure 8.2 presents the uses of funds, of which fixed investment is naturally the most dominating one. We have estimated equations only for investments of the narrow firm sector excluding the investments by the financial institutions which, however, according to the figure would not change the model much. On the other hand, during the years of the early 1980's the leasing investments, which are in fact investments made by the firms but which in the national accounts are included in the financial institutions' investments, increased quite rapidly. This somewhat changes the overall development.

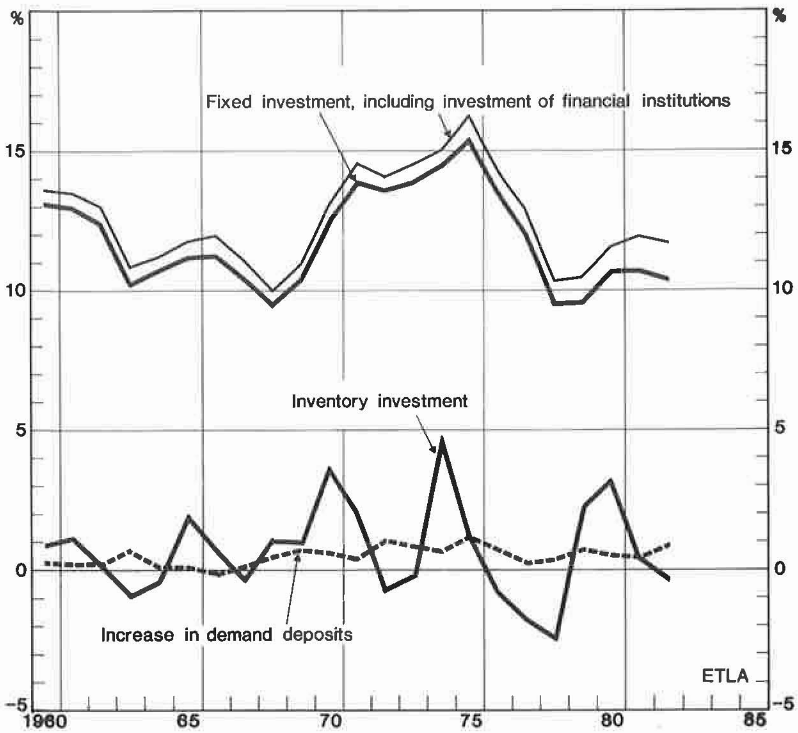


Figure 8.2 The uses of funds of the firm sector in Finland, as a per cent of GDP

The inventory investments have fluctuated very much depending on the cyclical situation. The increase in domestic bank deposits (demand deposits) has been quite a smooth variable in this comparison.

Of the sources of funds in figure 8.3 gross income (net profit + depreciation allowances according to national accounts) is the dominating one. We can see a sharp decrease in the profits of the firms in the mid-1970's and a rapid upturn thereafter as a consequence of devaluations and economic policy measures in those years. Foreign borrowing has also been an important source of finance especially in the mid-1970's, when there was a very big discrepancy between domestic investment and saving, i.e. a big current account deficit. The increase in bank loans[11)] has also been quite fluctuating and diminished to a lower level in the late 1970's, as was also the case with the foreign borrowing.

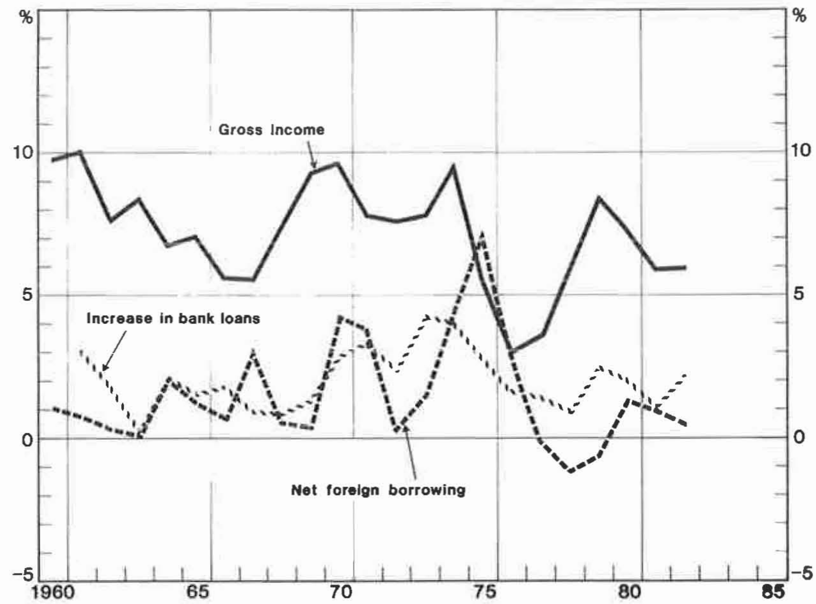


Figure 8.3 The sources of funds of the firm sector in Finland, as a per cent of GDP

In figure 8.4 the corresponding stocks are presented as a per cent of GDP. The fixed capital stock increased quite rapidly in the first half of the 1970's but has thereafter shown a decreasing relative trend as a consequence of diminished investment activity. The inventory capital has, on the other hand, been falling as a per cent of GDP. Demand deposits are quite a small item in this comparison. Net foreign debt of the firm sector was at a very low level in the early 1960's but rose rapidly to 20 per cent of GDP in the mid-1970's. Thereafter foreign indebtedness diminished reflecting the improved balance between domestic saving and investment. On the contrary, the bank loans to firms have been quite steadily at the level of almost 20 per cent of GDP all through the period. Other domestic debts have grown quite rapidly. This is to a large degree due to the increase in lending by the insurance companies, which is a result of the rapid growth in the pension funds, the working pension system in Finland being taken care of by the private pension institutions.

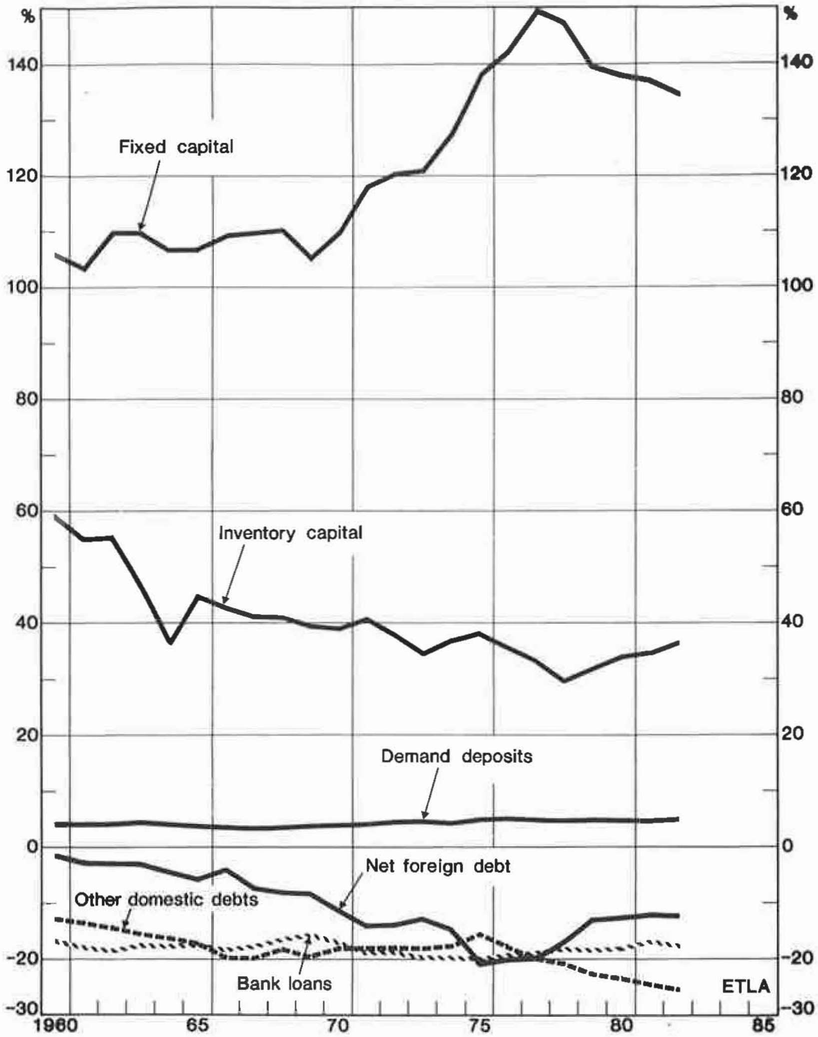


Figure 8.4 The stocks of assets and liabilities of the firm sector in Finland, as a per cent of GDP

Before proceeding to the empirical estimation of the flow-of-funds model for the firm sector we should pay attention to the treatment of the various interest rates and user cost of capital variables in the model. Of these the most problematic is how to measure the cost of fixed capital services.

In the appendix to this chapter we have presented in more detail the construction of the user cost variable for fixed capital. We should also construct such a variable for inventory capital where various tax rules, especially the inventory deduction system, could be taken into account. Here we have used the user cost of inventory capital constructed by Hernesniemi (1989). In a partial model of optimal firm behaviour consisting only of inventory investment he has studied the property of optimal inventory policy under the constraint that dividends cannot exceed the profit shown in company taxation and has derived the inventory cost variable in this framework. His result is that under certain conditions the firms may even operate in a no-taxation situation where the cost of inventory capital is represented just by the interest rate.

We now have the following list of cost of capital or real rate of return variables.

Fixed capital:	$uc_K = q(i + d - \dot{p}_e)\, f(B, u, H, i)$, where q is the price of a unit of fixed capital, i represents a weighted average of the domestic interest rate i_L and the foreign rate ($i_{for} + E\dot{e}$,$E\dot{e}$ is the expected rate of devaluation of the home currency), d is the rate of depreciation of fixed capital and $\dot{p}_e$ is the expected rate of inflation. The function f represents the influence of the various factors of company taxation on the user cost (see the appendix to this chapter.)
Inventory capital:	$uc_{II} = g(\bar{i}, u) - \dot{p}_e$, where the function g represents the effect of interest rates $\bar{i}$ and taxation u on the user cost of inventory capital (see Hernesniemi (1989)).
Foreign debt:	$r_{for} = i_{for} + E\dot{e} - \dot{p}_e$
Domestic debt:	$r_L = i_L - \dot{p}_e$
Demand deposits:	$r_{DD} = -\dot{p}_e$

The cost of the fixed capital variable in the model is in proportion to labour costs (including indirect labour costs) and is transformed into a logarithmic form as was explained above (see the appendix to this chapter). In a flow-of-funds model all the user cost and interest rate variables should be included in each equation of the model. As can be seen from the above list, there is much redundancy in the user cost variables, so that we are not able to estimate them separately. In the empirical estimations of the model we have combined them into three parts, where one is the ratio of investment goods prices and labour costs and the f(B,u,H,i) component having equal coefficients, and the second consists of the domestic interest rate, foreign interest rate adjusted by the devaluation expectations and the expected inflation rate, and the third component is the inventory cost variable less the expected rate of inflation.

8.3 Estimation of the flow-of-funds model for the firms

The demand deposit equation is the residual in the estimations. The effect of the flow of bank lending on the allocation is in some sense quite special and needs a careful interpretation. Namely, according to the estimations, which can be seen from table 8.1, the bank lending flow has an effect of roughly its own size on both the fixed and inventory investment, and at the same time it has the effect that foreign borrowing is increased to finance this almost doubling in expenditures. So, by looking at the flow terms we cannot find the expected offset phenomenon between the domestic and foreign sources of finance.

The offset phenomenon can be seen in the coefficients of the interest rate variables. We could also find in the preliminary estimations a cross effect from the stock of domestic bank loans to foreign borrowing. This coefficient was not, however, significant, and therefore we deleted it. Also in some estimations the effect of the domestic loan rate was quite dominant in the equations for foreign borrowing, but this could only be discerned when we also included this variable in the model in the investment equations.[12)]

In table 8.2 we have constrained the model so that the coefficients of the gross profits and the flow of bank lending are constrained to be equal in all equations. As can be seen, the result is now more sensible and shows a slight, even though quite insignificant, offset between the domestic and foreign sources of finance. It should be noted that as a result of this constraint the fit of the equations for fixed investment and foreign borrowing becomes much weaker than in the equations in table 8.1.

Another factor which deserves a comment is the coefficient of the domestic interest rate in the preliminary estimations of the investment equations. In both the fixed and inventory investment equations the domestic interest rate gets a significant positive coefficient. The explanation for this could be the credit rationing effect, because as explained above in section 5.5.3, the coefficient of the interest rate is a sum of its direct (notional) impact effect on investment which is negative, plus the credit rationing coefficient,

Table 8.1

An estimation result of the firm sector flow-of-funds model[13)]

Equation	Constant	Gross profit π/K_{-1}	Bank lending flow $\Delta L_{fb}/K_{-1}$	Capacity utilization $\log(Q/K)_{-1}$	Cost of fixed capital $\log(q/W)_{-1}$ $+\log f(BuHi)_{-1}$	Foreign interest rate i_{for}	Inflation rate py_{-1}	Inventory capital $(K_{inv}/K)_{-1}$	Foreign net debt $(L_{for}/K)_{-1}$	Demand deposits $(DDep/K)_{-1}$	R^2, DW
Fixed investment I/K_{-1} **(1)**	13.667 (1.090)	0.077 (.065)	0.847 (.112)	0.217 (.029)	-0.011 (.006)	-0.120 (.035)	0.122 (.020)				0.960, 1.719
Inventory investment I_{inv}/K_{-1} **(2)**	018.375 (5.290)	0.542 (.128)	0.701 (.218)	0.166 (.069)		-0.174 (.113)		-0.447 (.096)	-0.388 (.089)		0.771, 1.556
-Foreign net borrowing $-\Delta L_{for}/K_{-1}$ **(3)**	-33.854 (5.433)	0.290 (.145)	-0.548 (.268)	-0.426 (.076)	0.011 (.006)	0.295 (.123)	-0.122 (.020)	0.447 (.095)	0.293 (.085)	0.419 (.218)	0.759, 1.324
Increase in demand deposits $\Delta DDep/K_{-1}$ **(4)**	1.812 (1.406)	0.091 (.057)		0.043 (.022)					0.094 (.032)	-0.419 (.218)	0.371, 1.800

which is here almost unity, times the impact effect of the loan rate of interest in the notional demand for the bank loans equation, which is negative. In the case of gross substitutability between assets, this last mentioned coefficient is, in absolute terms, greater than the impact effect in the investment equation. A consequence of this is the fact that the total coefficient of the domestic interest rate may well be positive in the investment equations. On the other hand, the magnitude of the coefficients of the domestic loan rate, which is more than a half, raises doubts about its inclusion in the investment equations on this ground.

A similar line of reasoning explains why the lagged stock of bank loans gets a positive coefficient in the fixed investment equation. The positive value of the coefficient of the lagged stock of debt implies that an increase in bank loans leads to a reduction in the excess demand in the bank loan market and thereby has an expansive effect on investment. However, if we omit the bank loan rate from the investment equations, the lagged stock of bank loans also becomes quite insignificant in the model. Therefore we have also deleted it from the equations for fixed investment and inventory investment in the models presented in tables 8.1 and 8.2.

The foreign interest rate gets coefficients which in the various equations are of the expected sign and which are also quite significant. In fact, as was discussed above, we should in combination with the foreign interest rate consider the expectations regarding devaluation of the markka. We tested the influence of the actual devaluations, but could find only very modest effects from this variable. We took this as evidence of fairly constant devaluation expectations which in the case of long-term foreign borrowing may well be the case affecting the behaviour of firms. So, we decided to omit this variable from the model. Construction of a more sophisticated variable describing devaluation expectations would be an alternative to this solution.

The inflation rate consistently got a negative coefficient in the inventory equation and a positive coefficient in the equation for demand deposits. Therefore, we decided to omit it from these equations.

The effect of the user cost of fixed capital variable is lagged by one year and is present as expected in the equation for the fixed investment. A natural equation in which this variable should be included is foreign borrowing, but we could not find this effect in the data. In the models in table 1 and 2 we have, however, imposed this effect. The user cost for inventories variable was not a significant variable and therefore we have not included it in the reported models.

With respect to the stock adjustment coefficients, we can find a clear cut cross adjustment pattern between the inventories and foreign loans. The coefficient of the bank loans in the demand deposit equation was negative. It

Table 8.2

Constrained estimation result of the firm sector flow-of-funds model[14)]

Equation	Constant	Gross profit π/K_{-1} + Bank lending flow $\Delta L_{fb}/K_{-1}$	Capacity utilization $\log(Q/K)_{-1}$	Cost of fixed capital $\log(q/W)_{-1}$ $+\log f(BuHi)_{-1}$	Foreign interest rate i_{for}	Inflation rate py_{-1}	Inventory capital $(K_{inv}/K)_{-1}$	Foreign net debt $(L_{for}/K)_{-1}$	Demand deposits $(DDep/K)_{-1}$	R^2, DW
Fixed investment I/K_{-1} **(1)**	15.462 (1.674)	0.264 (.085)	0.299 (.042)	-0.031 (.009)	-0.096 (.057)	0.113 (.031)				0.906, 2.113
Inventory investment I_{inv}/K_{-1} **(2)**	16.932 (4.907)	0.458 (.112)	0.170 (.059)		-0.137 (.111)		-0.414 (.090)	-0.338 (.086)		0.771, 1.627
-Foreign net borrowing $-\Delta L_{for}/K_{-1}$ **(3)**	-34.535 (5.339)	0.101 (.152)	-0.502 (.078)	0.031 (.009)	0.233 (.133)	-0.113 (.031)	0.414 (.090)	0.270 (.081)	0.547 (.214)	0.627, 1.576
Increase in demand deposits $\Delta DDep/K_{-1}$ **(4)**	2.142 (1.359)	0.087 (.048)	0.033 (.024)					0.068 (.034)	-0.547 (.214)	0.413, 1.773
Sum	0	1	0	0	0	0	0	0	0	logL = -45.249

tells us that if there is a positive gap between the desired and existing stock of bank loans, more demand deposits would be held, which is a feature that could fit the behaviour of the households under credit rationing conditions, but not the behaviour of the firms so well. We decided therefore to omit this variable from the whole model. The demand deposits work as expected in the equation for foreign lending and in its own equation showing quite a rapid adjustment towards the desired stock of bank deposits. The speed of adjustment with respect to discrepancy between the desired and actual capital stock is described by the coefficients of the capacity utilization variable. This was explained above in connection with expression (3). The results show that there is a complementary relationship between fixed and working capital and that their increase is financed by foreign borrowing.[15)]

In the models in tables 8.1 and 8.2 the effect of the gross profit of the firms (including also the increase in net domestic debts other than the bank loans) is clearly concentrated on the inventory investment. In table 8.1 gross profit is also a substitute for foreign borrowing. Profits also have a slight effect on the holding of demand deposits, but this estimate is not very significant.

As can be seen in table 8.1, the estimation result is not satisfactory with respect to the quite strong positive autocorrelation of the residuals. We tried to correct this by specifying the residuals to be a first order autoregressive process but this did not give a meaningful result and in two equations the autoregressive coefficient proved to be even negative.[16)]

In the above analysis of the firms we have so far not paid attention to the probable simultaneity between the desired investment activity of the firms and the bank lending. We can on several grounds argue that bank lending reacts positively to loan demand (see our discussion on this in section 9.3 below). We also studied this empirically in the the banking sector model and came to the conclusion that the bank loans to firms have been influenced by the demand for credit factors. We examined this problem here in the context of the firm sector flow-of-funds model by specifying three alternative flow-of-funds models. The first was the above model combined with a loan supply equation for the bank loans of the firm sector.

The second was a model with demand determined loans where we have added to the above model a fifth equation in which the demand for bank loans is specified in a way similar to the other equations in the model, and removed the loan supply flow as an explanatory variable. As the third model we had a model where the bank loan equation is a mixed one, a combination of both demand and supply factors. The results showed that the pure demand model explains the data quite poorly. The supply determined loans model works much better, but on the other hand, worse than the mixed model.

The above results suggested that there are no significant cross-adjustment terms in the equation for fixed investment, which would suggest a separation of this equation from the rest of the model.[17)] In the equations for inventory investment and foreign borrowing we could observe strong mutual cross adjustment.

Appendix. Construction of the variables

All volumes are measured at constant prices of the year 1975. This is also the base year of the various price indices.

I	= volume of firms' fixed investment, the value of fixed investment by firms deflated by the price index of the private non-residential fixed investment
K	= volume of firms' fixed capital stock, constructed from the data on the capital stock by branches published by The Central Statistical Office and using in some branches investment data to separate the stock of capital belonging to the firm sector
Q	= volume of GDP
py	= rate of inflation measured by the implicit price index of GDP
q	= implicit price index of firms' fixed investment (see the construction of the variable I)
w	= index of total labour costs in manufacturing = wage rate + indirect labour cost per unit of working hour
$f(BuHi)$	= the component of the cost of fixed capital per unit of capital of the firms representing the effect of company taxation on the user cost (see below)
ΔL_{fb}	= change in the loans (including promissory notes, shares and bonds issued by the firms and purchased by the banks) granted by the banks to the firm sector (including credits granted to non-bank financial institutions), deflated as the variable I above
π	= gross profit (= net profit + depreciation according to national accounts) of the firm-sector, deflated in the same way as the variable I. In the estimations this variable also includes the flow of other domestic credits granted by the non-bank financial institutions (including Bank of Finland) to the firms.
I_{inv}	= volume of firms' inventory investment, value of inventory investment by firms deflated by the implicit price index of change in inventories in the whole economy
K_{inv}	= real stock of inventories. The stock for the year 1980 has been estimated at ETLA as inventories for manufacture and com-

merce. The stock figures for other years have been chained by the real flow of inventory investment by the firms.

ΔL_{for} = net foreign borrowing of the firms and financial institutions other than the banks, deflated in the same way as the variable I, source financial market statistics and balance of payments statistics

$L_{for,-1}$ = real value of the stock of net foreign debt of the firms and financial institutions other than the banks at the end of the previous year, evaluated at the prices of the current period, source the same as in the case of the previous variable

$DDep_{-1}$ = real value of the stock of demand deposits at the domestic banks at the end of the previous year, evaluated at the prices of the current year, deflated in the same manner as the variable I (source bank statistics)

i_L = bank loan rate of interest, annual average (source interest rate statistics)

i_{for} = a weighted average of four main foreign short-term interest rates (USD, GDP, DEM, CHF) according to the weights of these currencies in the currency index of Bank of Finland in the year 1980 (source Bank of Finland).

The user cost of fixed capital variable is constructed in the following manner: Let us use the following notation

MP_0 = marginal productivity of capital at the moment of installment, i.e. in period 0. This is the required before tax rate of return on new investment

P_0 = price of output in period 0

d = rate of depreciation of fixed capital

i = nominal rate of interest, expected rate is set equal to actual with static expectations

$\dot{p}_e$ = expected rate of inflation

u = tax rate in the income taxation of firms

q_0 = price of unit of capital in period 0

B = present value of future depreciation allowances in company taxation per unit of capital

$\mathcal{L}$ = present value of future interest payments per unit of capital

u_K = tax rate in company taxation in the local government taxation

Y_{k-v} = excess of taxable income of the firms in local taxation to that in state taxation per unit of capital

v = wealth tax rate of companies

H = present value of wealth taxes per unit of capital

Using these symbols we can determine the marginal capital cost per unit of new capital equipment from the break-even condition

$$MP(1-u)\sum_{t=0}^{\infty} P_0\,(1+\dot{p}_e)^t(1-d)^t(1+i)^{-t} + uq_0B + uq_0\tilde{L}$$

$$- u_K q_0 Y_{k-v}\sum_{t=0}^{\infty}(1+\dot{p}_e)^t(1-d)^t(1+i)^{-t} - vq_0H \geq q_0\,.$$

The first term on the left hand side is the present value of the net after-tax income from a unit's investment, the second is the tax gain from depreciation allowances, the third the tax gain from the deductibility of the interest expenses, the fourth is the extra tax burden in the local taxation (its present value) and the last is the term representing the effect of the wealth taxation of companies in force up to the year 1967 (temporarily also in 1976). All nominal entities are here expected to rise together with inflation, but the nominal rate of interest is taken to be fixed because of the small changes in the nominal rate of interest and large variations in the real interest rate in Finland.

Next we utilize the close approximation

$$(4)\qquad \sum_{t=0}^{\infty}(1+\dot{p}_e)^t\,(1-d)^t(1+i)^{-t} \sim (i+d-\dot{p}_e)^{-1}\,,$$

and transform the cost of capital c as

$$(5)\qquad c = P_0MP_0 = q_0(i+d-\dot{p}_e)(1-u(B+\tilde{L})+vH)(1-u)^{-1}$$

$$+ u_K q_0 Y_{k-v}(1-u)^{-1}\,.$$

We have first calculated B and H over manufacture and other firms, buildings and machines respectively, and then aggregated them for the whole firm sector.[18)]

In figure 8.5 we present some of the components of our cost of capital variable. In the estimations we have transformed the cost of capital P_0MP_0 into a logarithmic form,

(6) $$\log c = \log P_0 MP_0 \sim \log q_0 + \log(i - \dot{p}_e + d) + \log f(B,u,H,i) + u_K Y_{k-v}(1-u)^{-1} f(B,u,H,i)^{-1}(i - \dot{p}_e + d)^{-1} \sim \log q_0 + \log d + \frac{1}{d}(i - \dot{p}_e) + \log f(B,u,H,i) + A$$

where $f(B,u,H,i)$ is the component $(1 - u(B + \bar{L}) + vH)(1 - u)^{-1}$ and A is the last term in the first approximation in (6). In the empirical construction of this variable we have not taken into account variations in the A term but have simply taken it to be a constant, and considered only the three first terms in (6) (see Alho (1981) for more details on the construction of this cost of capital variable).

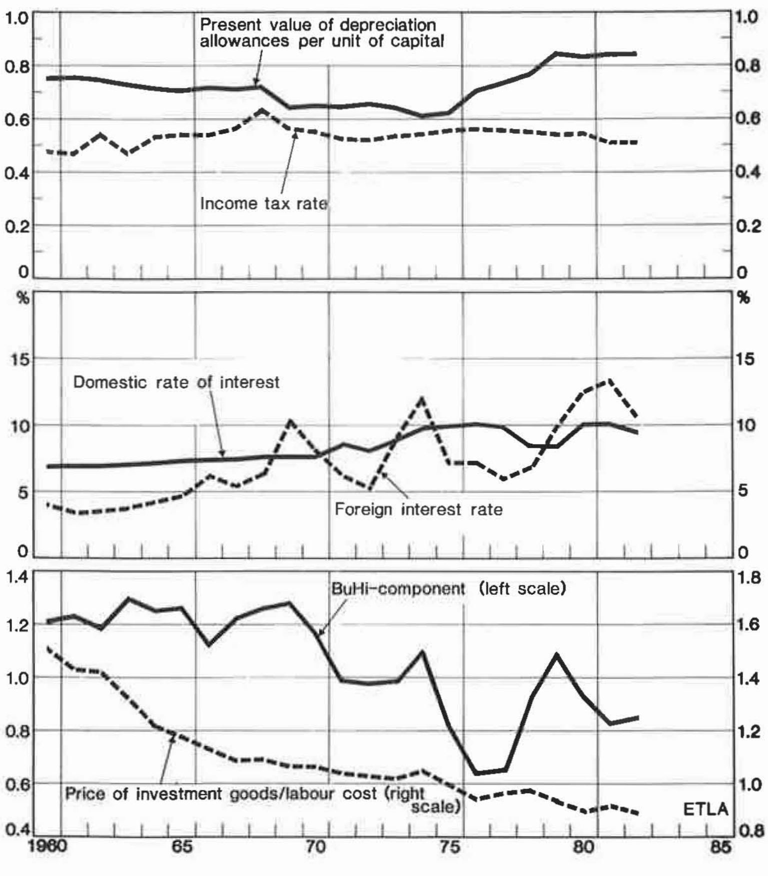


Figure 8.5 Components of the variable for the user cost of fixed capital

Notes

1) See Jorgenson and Siebert (1968) and Jorgenson (1971). See also Clark (1979) for a comparison of the performance of the various investment equations in the mid-1970's recession.
2) "So we can conclude that high past profits, by increasing the funds available to the firms will have a tendency to lower the combined firm and owner level of debt and, since the debt must be procured from individuals who are more averse to risks of the firm than the owners, such a reduction will lower the effective cost of capital schedule and raise the optimal level of investment".
3) Nickell (1978, p. 183) states on this point: "The other, perhaps more forceful, argument is that a higher profit earned by the firm may actually influence prospects in the direction of optimism, thereby lowering the effective cost of capital. This could well be an extremely important effect and may possibly be the dominant reason why current profitability would influence the firms' investment plans".
4) Costrell (1983) presents a full equilibrium analysis on the relations between profits and investment where the competitive financial markets eliminate pure rents as a difference between profits and the rate of interest and thus disputes results of the partial analysis of Malinvaud (1982) where the interest rate is kept fixed.
5) See e.g. Eltis (1973) for a survey of this.
6) Schworm (1980) presents an analysis of optimal investment behaviour when the firm is under the financial constraint of not being able to raise new loans. This has the effect that the capital stock is never greater than the unconstrained capital stock and the shadow rental of capital services is never less than the unconstrained value. Koskenkylä (1985) presents an in-depth analysis concerning the effects of various kinds of imperfections, whether these are in the output market or in the financial market and may be of different kinds. The general outcome of his analysis is that these imperfections may influence investment behaviour both in the short and in the long run.
7) In Finland the investments of the firm sector have been on the average some 10 per cent of GDP and the issues of new shares, including also those of the banks, at the Helsinki Stock Exhange were in the 1970's at most on the order of half a per cent of GDP and retained gross profits have been on the order of 6 per cent of GDP.
8) See Steigum (1983) and our short elaboration on this point in section 5.4.
9) But if, as stated above, the cost of capital also depends on the flow of profits or on the stock of the firm's own funds, we have a more general

case where the profitability of the firm has an effect on both the equilibrium capital stock and the speed of adjustment towards it (see Koskenkylä (1985)).

10) Partial estimations of the use of funds equations revealed some influence of the lagged growth rate of output, but this was not a significant variable.

11) Bank loans cover here all lending (in the form of promissory notes, bonds and shares) by the banks to firms (including lending to financial institutions) in domestic currency. The loans denominated in foreign currency in the balance sheets of the banks are included in foreign borrowing of the firms; see on this section 9.1.

12) The offsetting capital flow can be also seen if we kept the domestic activity unchanged by adding the consequent residual terms to the equations for fixed and inventory investment and foreign borrowing.

13) The profit variable also includes the flow of other domestic credits than bank credits to the firms and the firm sector residual item. Estimation covers the period 1962-82. All variables, except the constant, are multiplied by one hundred. For a detailed description of the construction of the variables, see the appendix to this chapter. In each cell the upper figure is the coefficient estimate and the lower in parenthesis is the estimate of the stantard error of the coefficient estimate. The covariance matrix of untransformed residuals is:

	1	2	3
1	0.150	0.101	-0.200
2		0.496	-0.483
3			0.646

14) The profit variable also includes the flow of other domestic credits than bank credits to the firms and the firm sector residual item. The covariance matrix of untransformed residuals is:

	1	2	3
1	0.347	0.139	-0.472
2		0.490	-0.523
3			0.997

15) Kostiainen (1981) has constructed a flow-of-funds model in the Brainard-Tobin spirit for the manufacturing firms in Finland. His model differs from ours in many respects, first of all in its different definition of the sector concerned, as we are building a model for the whole firm sector. There are also differences in the classification of the assets and liabilites, as he used balance sheet data, and, for example, therefore aggregated

domestic and foreign debts, which we have treated as separate items. Kostiainen also considered debts as one item of uses of funds. Trade credit was also one item in the stocks of financial assets and liabilities, which we have not considered here. His results were to some extent different from ours in that he concluded that the cost and availability of credit have not had a short-run effect on investment in fixed capital, its effect being felt on the investment in the working capital and on financial assets. Our results showed an effect of availability of finance on both types of real investment, i.e. fixed capital and inventories. Kostiainen's results also showed a somewhat more rapid speed of own adjustment in the items of the balance sheet of manufacture, even though the adjustment coefficients were not in general significant in his model.

16) It should be noted that the autocorrelation is quite sensitive even for small changes in the model. If we include the user cost of fixed capital in the inventory equation where it is an insignificant variable, and the model is otherwise identical with that in table 8.1, the values of the Durbin-Watson statistic all lie between 1.5 and 2.

17) Partial testing of the separability of the fixed investment equation reveals that the lagged stock of the foreign debts is a significant variable in this equation but its coefficient is strongly positive, so we will not include it in this equation.

18) The term $\mathcal{L}$ representing the deductability of interest expenses has been estimated so that first the share of borrowing in financing of new investment has been estimated on the basis of national accounts as one minus the ratio of gross profits to gross investment. This has been multiplied by the current average lending rate of banks and transformed into a present value of the future interest expenses by assuming that loans are roughly amortized in six years.

9 The flow-of-funds model for the banking sector

9.1 The basic framework

The aim of this chapter is to present the structure of the submodel for the banking sector and its estimation. We have already above in section 5.2 discussed the behaviour of a financial firm in the mean-variance framework and noted that this analysis produces fairly complicated results. So we have decided to discuss here the behaviour of the banks, especially their loan supply behaviour, in a simpler framework assuming perfect certainty. The starting point of the model is the following balance sheet of the banks,

(1) $L_h + L_f = D + CB + NFD + O$,

where L_h = loans to households

L_f = loans to firms

D = deposits

CB = central bank debt of the banks

NFD = net foreign debt of the banks

O = other liabilities, net.

The loans to the firm sector consist of loans denominated in domestic currency L_f^{dom} and loans denominated in foreign currency L_f^{for} , whereas all the loans to households are denominated in the domestic currency.

The net foreign debt of the banks consists of two components: the foreign debts raised to finance the loans supplied to firms denominated in the foreign currency[1)] L_f^{for} and the net forward position of foreign exchange of the banks FP which has to be covered by an equivalent amount of foreign borrowing in order that the banks have (in practical terms) a closed currency position with respect to the Finnish markka, which is required by the exchange regulation of the central bank. Thus we can write

(2) $$NFD = L_f^{for} + FP .$$

It is important for the analysis of the banks' behaviour to form an idea concerning the functioning of the foreign versus domestic sources of finance and their substitutability. This is also very important with respect to the effectiveness of the monetary policy measures by the Bank of Finland. As an extreme case of optimal bank behaviour under certainty, if the banks have at their disposal a foreign credit channel with an infinitely elastic supply of finance at a fixed foreign rate of interest, then all measures by the central bank to influence the domestic supply of credit would be futile because they would in these conditions be completely neutralized by foreign capital flows.

In the Finnish conditions the banks and the firms have had to use the foreign credit channel together in a way and are here constrained by the exchange regulation. In general, the acquisition of foreign liabilities and assets required in our estimation period in the case of long-term capital direct permission from the Bank of Finland and in the case of short- term capital obeyance of the control schemes set by the central bank for the banks. These generally require a commercial background for the foreign capital transactions. Anyway, experience shows that foreign borrowing has been a channel extensively used by the firms in periods of large deficits in the current account, which has also been approved by the monetary authorities, as otherwise the foreign reserves of the central bank would have been depleted.

From (1) and (2) we see that the part of the foreign finance directly affecting the domestic liquidity of the banks is the net forward position of the banks. The bulk of the banks' net foreign debt is just a means to finance loans denominated in foreign currency to the firms. These we have included in chapter 8 in the total foreign borrowing of the firms and treated them in the model for the firm sector.

The net forward position of the banks is primarily a reflection of the net sales of foreign currencies in the forward market by the firms to the banks. The forward position of the banks is also influenced by the interventions of the Bank of Finland in these markets and the sales and purchases of foreign currency in the forward markets between domestic and foreign banks. In chapter 4 we already specified that the rates in the forward markets are perfectly linked through arbitrage to the market for central bank finance of the banks or to the domestic short-term rates in general.

Because the foreign currency position of the banks vis-à-vis the Finnish markka has to be closed, the banks cannot on their own substitute foreign debt for central bank debt. The elasticity of this channel depends on the behaviour of the firms with respect to the interest differential between domestic and foreign sources of finance and the availability of domestic credit.

The conclusion from these considerations is that the foreign items in net terms are not the same kind of decision parameter of the banks as are decisions concerning changes in their loan supply and liquidity position, which in the Finnish financial markets essentially meant borrowing from the central bank. We consider the determination of the net foreign debt of the banks to be analogous to that of the deposits of the public.

Let us next turn to the revenues of the banks. A key point in our model is the division of the banks' clients into firms and households. Basically the loans to both these sectors are quite identical because of the regulation of the average lending rate of the banks. The two sectors are, however, in other respects quite different from each other. The households are net lenders to the banks, the funds of the banks being basically made up by the deposits of the households. The firms are, on the other hand, net debtors of the banks, and make up relatively little of total deposits. But on the other hand, the firms extensively use other services of the banks, i.a. bank guarantees on their loans, foreign transactions and current account credits, the overdraft facilities of which generate revenues for the banks.

In a credit rationing system the customer relations between a bank and its potential borrowers are more pronounced than in a more competitive system. Borrowing facilities are an important aspect in the selection of a bank and in a possible change of a bank. New clients are attracted by promising better access to credit. We assume that loans to households give rise to other revenues and to (extra) future deposits according to the function $H = H(L_h)$, which is concave and non-decreasing. These deposits are then supposed to be invested in the best possible way to yield at the margin the rate of return i_m, which is also the internal rate of interest of the bank. So, the present value of the other revenues related to the loans extended to the households can be simply represented by the function $H(L_h)$. The other revenues, described above, earned from the loans to the firms are correspondingly described by a concave non-decreasing function $R(L_f^{dom})$.

9.2 Properties of the loan supply behaviour of a bank

As above in chapters 2 and 3, the cost of the central bank debt is supposed to be represented (each year) by a convex function i_{cb} which determines the marginal interest rate i_m on the central bank debt CB of the banks to be (approximately) linear in the following way:

(3) $$i'_{cb} = i_m = h_0 + h_1 CB, \; i_{cb}'' = h_1 \geq 0 \text{, } h_0 \text{ and } h_1 \text{ are constants .}^{2)}$$

The forward discount (f) for the Finnish markka is determined by the covered interest rate parity

(4) $$f = i_d - i_{for} \text{,}$$

where i_{for} is the foreign and i_d the relevant domestic interest rate. We further suppose that $i_d = i_m$, i.e. that arbitrage drives the banks to quote the forward contracts on the basis of the marginal cost on their central bank debt.

We are now ready to present the profit function of the representative bank,

(5) $$\pi = i_L(L_h + L_f^{dom}) + R(L_f^{dom}) + H(L_h) - i_D D^h - i_{cb}(CB) - i_m MF - i_m FP.$$

Here the loans to households and to firms are taken to have the same average lending rate i_L . In (5) D^h is deposits supplied by the households, the deposits D^f of the firms having a zero interest rate and therefore not present in (5). The last term on the right hand side of (5) represents the costs associated with the forward contracts, which consist of the foreign interest rate i_{for} on the covering debts and the forward discount of the markka, which by assumption (4) is $i_m - i_{for}$. By approximating i_{cb} in (5) linearly around the point FP=0 we can derive an expression for the profit function where all the foreign items are missing. In the same way we can handle the (possible) domestic short-term funds, held by the non-banks at banks, denoted by MF (which are included in the term O in (1)), the interest rate on which is through arbitrage taken here to be equal with the marginal interest rate on the central bank debt.[3)] Now we can write

$$(6)\ \pi = i_L(L_h + L_f^{dom}) + R(L_f^{dom}) + H(L_h) - i_D D^h - i_{cb}(L_h + L_f^{dom} - D - O).$$

Here D represents total deposits at banks, $D = D^h + D^f$. An important feature is the assumption of the dependence of bank deposits on bank lending. As above in chapters 2 and 3, we assume that both the derivatives $D^h_{L_h}$ and $(D^f)_{L_f^{dom}}$ are positive and less than unity for the representative bank.

By taking the derivative of (6) with respect to L_h and L_f^{dom}, we get the first order conditions for the optimal loan supply behaviour of a bank

$$(7)\qquad \frac{\partial \pi}{\partial L_h} = i_L + H'(L_h) - i_D D^h_{L_h} - i_m(1 - D^h_{L_h}) = 0\,.$$

$$(8)\qquad \frac{\partial \pi}{\partial L_f^{dom}} = i_L + R'(L_f^{dom}) - i_m(1 - D^f_{L_f^{dom}}) = 0\,.$$

We next want to make a comparative statics analysis with the aid of this simple model for the optimal behaviour of a bank. The determinant d of the system (7) and (8) is

$$(9)\qquad d = H''R'' - H''h_1(1 - D_{L_f})^2 - R''h_1(1 - D_{L_h})^2 > 0\ ,$$

where we have somewhat abreviated the symbols for dependence of deposits on loans. Let us consider the effects of changes in the loan and deposit rates and in the marginal interest rate schedule on the central bank debt of the banks, as well as a change in the volume of deposits. The results are summarized in the following table.

There are some uncertain effects in table 9.1. These depend on the fact that the dependence of deposits on loan supply may differ between the households and the firms. We may find grounds for thinking that this coefficient is higher for the households than for the firms. One reason for this is the foreign leakage, which is clearly higher for the firms.[4)]

In this case an increase in the loan rate would certainly increase the loan supply to households but could, if the penalty interest rate slope parameter h_1 is high enough, even lower the loan supply to the firms. However, the total loans to households and firms unambiguously increase as a result of an increase in the loan rate. If h_1 is zero, i.e. if we have the prototype of the call money market system in the market for the central bank finance of the banks, differences in the two sectors with respect to the deposit multipliers have no effect on the division of the loan supply to the two client sectors. An increase in the deposit rate causes a reduction in the loan supply to both sectors. The loans to firms, however, remain unchanged if the parámeter $h_1 = 0$.

The effects of an increase in the marginal interest rate schedule on the central bank debt, i.e. an upward shift in the parameter h_0, unambiguously reduces the loan supply to both sectors. Furthermore, the higher the penalty coefficient h_1, the smaller this effect is (on the condition that D_{L_h} or $D_{L_f}$are positive.)

There are, however, some special cases when the central bank policy has no effect on the bank lending behaviour. If D_{L_h} were unity, the supply of loans to the households would not change as a consequence of a change in h_0. This is also intuitively clear because in this case the bank(s) need not run up their debt with the central bank as a result of an increased supply of loans

Table 9.1

Effects of changes in the exogenous parameters on the loan supply of the banks. In columns (1), (2) and (3) the volume of deposits is a fixed quantity.

Effect of a change in: / On	(1) i_L $h_1=0$	(1) i_L $h_1>0$	(2) i_D $h_1=0$	(2) i_D $h_1>0$	(3) i_m (h_0) $h_1=0$	(3) i_m (h_0) $h_1>0$	(1)+(2)+(3)	D [d)] $h_1=0$	D [d)] $h_1>0$
L_h	+	?, + [a)]	-	-	-	-	?, 0 [c)]	0	+
L_f	+	? [b)]	0	-	-	-	?, 0 [c)]	0	+
$L_h + L_f$	+	+	-	-	-	-	?, 0 [c)]	0	+

The "?" shows an uncertain reaction, and followed by a sign the likely reaction.

a) The sign is positive if $D_{L_h} > D_{L_f}$.

b) The sign is positive if $D_{L_h} < D_{L_f}$.

c) The sum is exactly zero if $D_{L_f} = 0$.

d) $dL_i/dD = -h_1 dL_i/dh_0$.

to the households (see our discussion on this in section 2.3). Also if R″ is zero the same result is achieved. This condition implies that there are constant returns in raising other revenues attached to the loans extended to the firms.[5)] In this case all the firm loans are identical in their profitability for the bank. As a consequence of a rise in the marginal rate on the central bank debt, the bank has to cut the firm loans because its loans to households are better loans at the margin (because in the optimum they are equally profitable at the margin and $H'' < 0$) from the bank's point of view. The same applies, mutatis mutandis, to the supply of loans to the firms.

We also have in table 9.1 the result that the sum of the effects of the three interest rates is roughly zero on the loan supply to each sector, and is exactly zero if $D_{L_f} = 0$. The intuitive reason behind this is that an increase in all the mentioned rates does not change the profit of the bank and does not therefore have an effect on the loan supply behaviour of a bank.

An important feature of the above results is that the impact effects depend on the properties of the supply curve of the central bank debt to the banks. The slope parameter h_1 of the penalty interest scheme, which is crucial here, has changed a lot during the years (see figure 9.2). This is one empirical factor which we have not, however, been able to take fully into account in the following. So the estimates of the coefficients of the interest rate variables have to be interpreted as some sort of historical averages prevailing in the estimation period.

We have so far adopted profit maximization as the goal of the representative bank. In concentrated banking markets a measure frequently used in assessing the success of the various banking groups is the change in their market shares, usually calculated in terms of deposits.

A formulation which combines the two views concerning the short-run decision making process of a bank is the specification of an objective function of the type

(10) $\quad U = U(\pi, L),\ U_1, U_2 > 0.$

In (10) the second argument refers to the market share goal. We come to the normal profit hypothesis if U_1/U_2 goes to zero and in this case we have as the goal of the bank

(10)' $\quad L = \max,\ \text{subject to } \pi \geq \pi_0\ (\leq \pi_{max})$.

The views concerning the proper objective of a bank have an influence on some of the properties of the banking sector model. In particular, this is

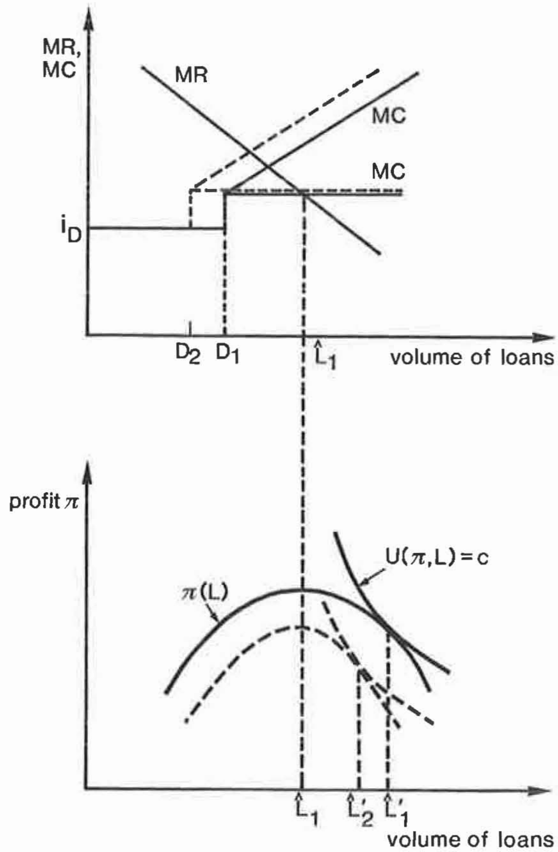


Figure 9.1 The dependence of the loan supply of the banks on the changes in the volume of deposits

important with respect to the dependence of the credit supply on changes in deposits, which are also shown in table 9.1. We illustrate this with the above diagram, where for simplicity the private sector is treated as a single unit. In the upper part of the diagram there are the downward sloping marginal revenue curve MR for loans and the either rising or horizontal marginal cost curve MC for central bank debt. The marginal cost curve is rising in the case where the market for central bank finance is organized according to the quota system (when each bank has its own quota for its central bank debt) with rising penalty interest rate schedules for use of central bank debt in excess of the

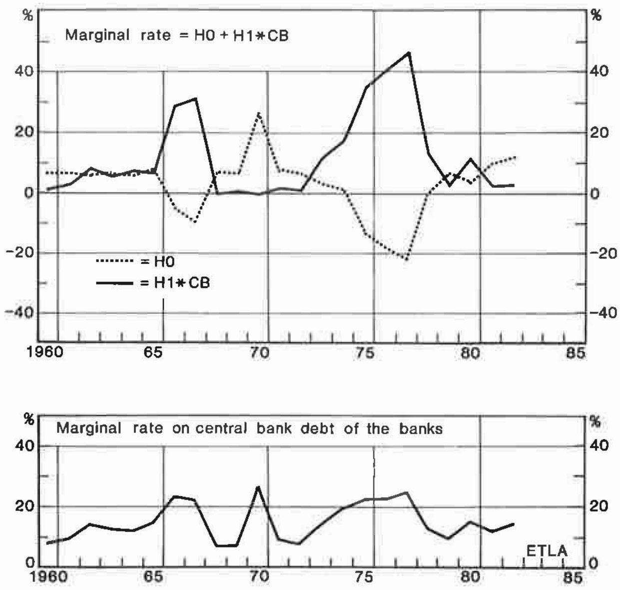


Figure 9.2 Decomposition of the marginal rate on the central bank debt of the banks

quota ($h_1 > 0$) or the central bank obeys such a policy rule which produces this case, and it is horizontal if the interest rate on central bank debt is constant, i.e. if we have a pure call money market system in the market for central bank debt of the banks ($h_1 = 0$). In the lower part of the diagram we have described the profit of the bank as a function of loans and the determination of the optimal credit supply in the two cases of either profit maximization or the two-goal objective function (10).

Let us now consider the dependence of the loan supply on a change in deposits. In the case of a horizontal marginal cost curve and profit maximization, a reduction in deposits from D_1toD_2 (shown by the dotted lines in the diagram) does not at all affect the optimal loan supply. In all the other three possible cases a reduction in deposits causes a shift in the profit function either straight down or downward to the left and so causes a reduction also in the optimal loan supply of a bank. (We have not reproduced in the lower part of the diagram the case of a rising marginal cost curve).

9.3 Specification of the banking sector flow-of-funds model

In figure 9.3 we see the actual allocation of bank credits to households and firms. One quite striking feature here is the lack of a negative correlation between the flow of credits to these two sectors. The other feature is the divergency in the two curves in the late 1970's and the marked decrease in the flow of bank credits to the firm sector. In the late 1970's there was a clear deceleration in the investment rate of the firms while their profitability was roughly restored to the average level of the high investment activity period of the 1960's and the early 1970's (see figures 8.2 and 8.3). It would be quite meaningless to argue that these changes in the investment trends would have been primarily caused by some change in bank loan supply policy, because we cannot find any drastic changes in its determinants.

The monetary policy of the Bank of Finland was indeed very strict in the years 1975-77 but eased rapidly afterwards (see figure 9.2). So, we should analyze more closely the relationship between loan demand and loan supply at least in the case of the firm sector and the apparent positive reaction of loan supply to loan demand and its microeconomic rationale.

We can think about several factors contributing to this phenomenon. The credit markets are not made by anonymous buyers and sellers but by

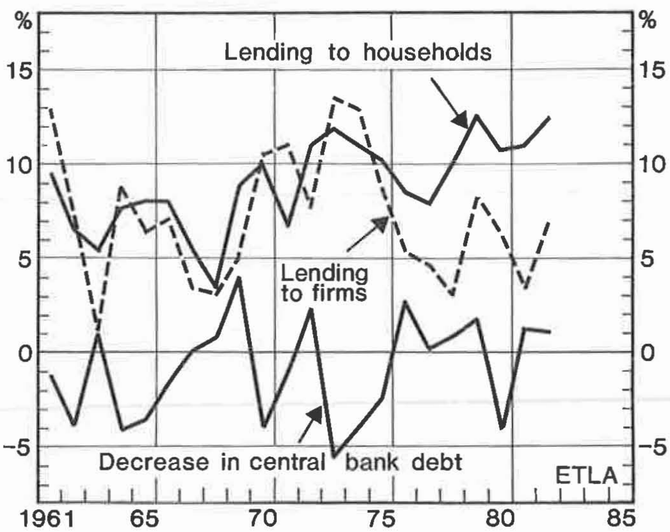


Figure 9.3 Increase in bank loans to households and firms and decrease in central bank debt, real flows as a percentage of the volume of time deposits at the end of the previous year

banks and the customers of the banks who are permanent users of the services of the banking industry. The banks do not extend loans only to finance various projects but finance customers on a permanent basis. Thus, if there are no reactions by a bank with respect to changes in loan demand, a loss of permanent clients would be an obvious result of this.

A change in the demand for loans can be traced from a shift in the marginal productivity curve for physical capital. A positive shift should reduce the risk related to the loans extended by the bank. In section 5.2 we analyzed the decision making of a bank under uncertainty. It is quite an easy task to demonstrate that an increase in the profitability of a firm or a project should both increase the expected return on the projects the bank is financing and lower the variance of the rate of return.[6)] According to our analysis in section 5.2. these changes should increase the loan supply of a bank. A similar kind of reasoning is used by Blinder (1987) in his specification that the loan supply depends positively on the loan demand. Thus, the loan supply should also change as a result of changes in the determinants of loan demand. These remarks should lead us to think that the loan supply of the banks to the firms would have increased, rather than decreased, in the late 1970's.

To explain the actual developments we must take into account that the loan supply meets potential credit demand constraints before it becomes the market solution. The lower the investment activity, the more likely it is that the loan supply meets the effective demand constraint, which was evidently the case at the end of the 1970's. We consider this issue empirically in the next section.

The empirical model considers three endogenous variables: the allocation of deposits and other bank funds to facilitate increases in the loans denominated in domestic currency to firms (ΔL_{fb}), increase in loans to households (ΔL_{hb}) and reductions in the central bank debt of the banks ($-\Delta CB$) . The funds consist of ordinary deposits (D), demand deposits (DDep) and other liabilities, net (O). All three endogenous variables are constructed from the respective stocks as first differences, which are then deflated into real flows, and divided by the lagged stock of the volume of ordinary deposits (and multiplied by one hundred to represent a percentage). The specification of the flow-of-funds model for the banks is similar to the portfolio adjustment model presented in section 5.3. The desired asset stocks are taken to be homogeneous with respect to the stock of ordinary deposits. So, we have as explanatory variables the various interest rates, the adjustment terms where the lagged stocks of the assets are also divided by the lagged stock of ordinary deposits and the flow of sources of funds transformed in the same way.[7)]

9.4 Estimation of the flow-of-funds model for the banking sector

The equation for the decrease in the central bank debt was the residual in the estimations. The coefficient of the contemporaneous marginal interest rate variable of the central bank debt of the banks consistently got slightly positive values, which is partly due to the strong simultaneity between the current period lending, the central bank debt of the banks and the marginal interest rate on it. It is also due to the fact that changes in the penalty interest rate schedules have been very sudden and at least to some degree unexpected and the banks have obviously had only a few possibilities to make rapid changes in their loan supply behaviour and lending commitments. We tried to remove the problems raised by the simultaneity by adding to the model the identity explaining the determination of the marginal interest rate on the central bank debt of the banks in the way presented in figure 2, and by estimating then the model by the full information maximum likelihood method. There was not, however, any great change in the coefficient of the contemporaneous marginal rate of central bank debt.

So we decided to include solely the lagged value of the central bank rate in the model. Nevertheless, we did not find that the central bank policy had an effect on the loans to the firms. One explanation for this may be the fact that the loans to the firms are here a combination of two types of loans: the ordinary loans which have been extended under the average interest rate control of the central bank and loans in the form of bonds and equity which have not been under this kind of control. So if these two types of loans are sufficiently close substitutes for each other, we cannot presume to be able to discern the effect of central bank policy on their total volume. Another explanation is the fact referred to above that if there have been constant returns in raising new household deposits by increasing the loan supply to them, then the whole burden of the changes in central bank policy is born by the lending to the households.

An estimation result of the banking sector flow-of-funds model is presented in table 9.2 on page 168. With respect to the cross-adjustment coefficients, we were not able to reach a clear-cut pattern which would show that the loans to firms and to households are substitutes for each other from the banks' point of view and that central bank finance is a complement for them. We could, on the other hand, find a cross-adjustment effect from the loans to the firms in the equation for the loans to the households indicating that if the banks desire to extend more loans to the firms, they will slightly curb loans extended to the households.

Furthermore, we could find a complementary effect between the loans to the households and the firms in the equation for the firm sector loans, but we were not able to include this in the estimation of the model as a system because there was not a proper counter effect for this in the equation for the household sector loans. We also could find clear evidence of the effect that central bank debt is a complement for the loans extended to the firms and households. We also examined statistically, whether we can constrain the speed of adjustment in the central bank debt equation to be unity, which would imply instantaneous adjustment with respect to imbalances between optimal and actual central bank debt. The conclusion given by the data is positive, so we can include this constraint in the model.

In the model presented in table 9.2 we have the effects of the loan and deposit rates as expected, and their coefficients are to some extent significant in the equation for the loans to the households, but hardly significant in the equation for the loans to the firms. We have imposed on the model presented in table 9.2 the constraint discussed above that the sum of the coefficients of the loan, deposit and central bank rate is zero if $D_{L_f} = 0$. The value of the likelihood ratio test for these constraints is 4.5, which is statistically significant at the 10 per cent level of confidence but not at the 5 per cent level.

We examined the effect of the demand for credit variables in the model and variables describing the financial position of the private sector, which was introduced in the previous section as one explanation for the determination of bank lending. In preliminary estimations we could not find much effect from these variables in the loans to the households and therefore concentrated solely on examining them in the equation for the loans to the firms, where we could find that they then had a strong effect. We see that in the model in table 9.2 the added variables, i.e. the rate of capacity utilization, the lagged stock of foreign loans, the foreign interest rate and the gross profit flow of the firms, are quite significant. We could not, however, find any effect of the lagged stock of the loans of the firms.

In the theoretical model in chapters 2, 3 and 4 an important element was the behaviour of the public with respect to the demand for deposits and the dependence of bank behaviour on them, which had many effects on the properties of the model through the markets for bank loans and central bank debt of the banks. In the estimation result in table 9.2 we can find that the loan supply of banks clearly depends on the flow of sources of funds to them, which should be the normal case in a period with rising marginal cost curves for central bank finance, as was shown above. According to table 9.2 also the demand for central bank debt depends on the flow of deposits to the banks, although the effect is weaker.[8)]

Table 9.2
Estimation of the flow-of-funds model for the banks[9)]

Equation	Constant	Sources of funds $\Delta SO/D_{-1}$	Loan rate i_L	Deposit rate i_{dep}	Marg. rate on cb debt $(i_m)_{-1}$	Loans to firms $(L_{fb}/D)_{-1}$	Central bank debt $(CB/D)_{-1}$	Profit of firms π/K_{-1}	Capacity utilization $\log(Q/K)_{-1}$	Foreign debt of firms $(L_{for}/K)_{-1}$	Foreign interest rate i_{for}	R^2, D-W
Loans to households $\Delta L_{hb}/D_{-1}$ **(1)**	-17.267 (3.086)	0.404 (.053)	2.890 (.733)	-2.835 (0.731)	-0.055 (.022)	0.284 (.050)	-0.625 (.148)					0.865 1.947
Loans to firms $\Delta L_{fb}/D_{-1}$ **(2)**	5.804 (6.555)	0.379 (.035)	2.428 (2.092)	-2.428 (2.092)			-0.375 (.148)	-0.298 (.261)	0.492 (.094)	0.432 (.192)	0.183 (.122)	0.755 1.615
Central bank debt $-\Delta CB/D_{-1}$ **(3)**	11.464 (1.478)	0.216 (.071)	-5.318 (1.981)	5.263 (1.977)	0.055 (.022)	-0.284 (.050)	1.000 (.000)	0.298 (.261)	-0.492 (.094)	-0.432 (.192)	-0.183 (.122)	0.511, 1.881
Sum	0	1	0	0	0	0	0	0	0	0	0	logL = -62.957

Appendix. Construction of the variables

The base year of all the price indices and volume variables is the year 1975.

L_{hb} stock of loans granted by the banks to the households (see the appendix to chapter 7). When transformed into a real flow ΔL_{hb}, its difference is deflated by the prices of private consumption.

L_{fb} stock of loans granted by the banks to the firms, including also shares and bonds issued by the firms owned by the banks denominated in domestic currency (see the appendix to chapter 8). When transformed into a real flow ΔL_{fb} its difference is deflated by the price index of GDP.

CB annual average of central bank debt of the banks (source: Saarinen (1986)). When transformed into a real flow, its difference is deflated by the price index of GDP.

D_{-1} volume of stock of ordinary deposits at banks at the end of the previous year (source bank statistics). When transformed into a volume series, the nominal stock has been deflated by the implicit price index of the private consumption expenditure.

i_m marginal interest rate on central bank debt of the banks, annual average, constructed by approximating linearly for each year the marginal cost curve of central bank debt using information on the various supply curves of central bank debt given by Saarinen (1986), and the actual volume of central bank debt (see figure 9.2 on page 163)

i_L average lending rate of the banks, annual average of quarterly values (source interest rate statistics)

i_{dep} average deposit rate on bank deposits of the households (see the appendix to chapter 7)

i_{for} annual average of 3-month eurodollar rate (source: International Financial Statistics)

ΔSO real flow of sources of funds of the banks, change in deposits and other liabilities, net, of the banks (including the residual item), i.e. this variable is equal to the sum of the three asset flows ($\Delta L_{hb} + \Delta L_{fb} - \Delta CB$) to be explained in the model

Other variables are defined in the same manner as in the appendix to chapter 8.

Notes

1) To be precise instead of foreign currency loans we should consider loans less deposits in foreign currency at the banks. This does not in any way influence the following argument.
2) The variety of the terms on central bank debt of the banks is presented in detail by Saarinen (1986), on which we have based our estimates of the annual parameters of the linear cost function. See figure 9.2.
3) Empirical evidence in the early 1980's does not support this hypothesis, but in the middle of the 1980's this does not seem to be too far from the truth (for a more thorough analysis of this see Alho et al. (1985), chapter 5).
4) Another reason is that, on average, firms held much lower deposit balances than the households.
5) In this case we must have $H'' < 0$ and $h_1 > 0$ in order to get a finite solution of the model for bank lending behaviour.
6) In terms of the analysis carried out in section 5.2, these changes are reflected as an increase in the expected rate $\bar{r}_2$, because the probability of bankruptcy of a firm the bank is financing is lowered. The same factor normally also causes a reduction in the variance of the return on a loan.
7) The multiplicative terms $\alpha_i(\Delta W)$ are also here simplified in the same manner as in connection with the firm sector model.
8) The above considerations in sections 9.1 and 9.2 suggest that the forward position of the banks is a perfect substitute for their central bank debt. Thus, we should in fact separate this item from the other sources of funds and concentrate its effect completely on the equation for central bank debt. The reason why we have not done this is that the forward position of the banks was very small before the early 1980's and started to grow only afterwards (see Suvanto (1983)).
9) The estimation is based on annual observations for the period 1961-82. For construction of variables, see the appendix to this chapter. All variables, except the constant are multiplied by one hundred before estimation. In each cell the upper figure is the coefficient estimate and the lower in parenthesis is the estimate of the standard error of the estimate. Covariance matrix of untransformed residuals:

	1	2
1	0.782	-0.767
2		2.514

10 Conclusions

In this study we have covered a wide range of research topics related to the conduct of monetary policies and analysis of financial markets. We have both theoretically and empirically analyzed the basis of macro economic policies and the transmission mechanism of monetary policies in a framework based on portfolio theory, on a general equilibrium approach in describing the interrelationships between the various markets and on the general disequilibrium adjustment scheme, originating in the classic "Pitfalls" paper by Tobin and Brainard. We have both discussed the operation of the financial markets, the general method to be applied in their analysis and applied it to the empirical description of financial markets in Finland. In all these respects we hope to have been able to add some new results and interpretations to the existing stock of knowledge.

In chapter 2 we presented a basic macroeconomic analysis of an economy with inside money and a rudimentary short-term money market, the behaviour of the banks playing a dominant role in the short-run equilibrium in this kind of an economy. We were also able to discuss both the case of effective interest controls and a freely floating loan rate of interest in the bank loan markets. This analysis produced for us what we can call a typology of the short-run macroeconomic equilibrium. Another novelty was the introduction of a flex-rate asset market, which makes the analysis richer but which may also cause ambiguities with respect to the effect of macroeconomic policies.

In chapter 3 we first analyzed a set of policy measures in the case of fixed prices. We compared different means of financing public expenditure and presented conditions under which public spending financed by securities is completely crowded out and measures by the central bank are fully neutralized.

In chapter 3 we further extended the model to cover the case of an endogenous price level and inflationary expectations. At the same time we introduced a careful specification of budget constraints of the sectors and a wide range of exogenous shocks and policy measures, the effects of which we analyzed with the aid of our model. In this connection we used the technique of partitioned matrices in order to be able to reduce the dimension of the system. In some cases we were able to detect a clear pattern of impact effects but in others we were not. There remain uncertainties, in particular with respect to the reactions of the interest rates, as a result of a consistent tracking of the financial flows in the economy. This emphazizes the fact that it is essential to describe in a detailed enough manner the relationships between the real and financial side of the economy. We could apply the model also to the present case where there has been a shift to competitive and deregulated financial markets with free interest rate formation. The qualitative properties of the model should remain unchanged irrespective of this structural change in the financial markets.

As an extension of the model we further imposed open interest parity and derived the devaluation expectations with the aid of it. In these somewhat richer surroundings, where we reduced the size of the model, we encountered the possibility of a perverse effect of domestic monetary policies, as a tightening in policies is going to be offset through a rise in the inflationary expectations as expectations of a future devaluation of the domestic currency are thereby raised.

In chapter 5 we turned to the second part of the study where our aim was to analyze empirically the financial behaviour of the private sector in Finland. We built a flow-of-funds model based on a consistent specification of the equality between sources and uses of funds and on portfolio theory in explaining the determination of the desired portfolio allocations, as well as on the idea of the general disequilibrium adjustment model in explaining the actual allocations during the unit period. Chapter 5 was devoted to a general presentation concerning the specification and estimation of a flow-of-funds model. In this context we were able to derive an extended model for portfolio decision-making in a general framework of imperfections in the financial markets. We also devoted a section in this chapter to the estimation problems encountered in a flow-of-funds model. In particular, we were interested in estimation of the spillover effects of the disequilibrium in the bank loan market on real expenditures and on other financial markets.

Chapter 7 was devoted to the empirical analysis of the household sector behaviour. Our preliminary testing produced some interesting results with respect to the structure of the household real expenditure and portfolio allocations. We reached a mixed conclusion about whether non-durable consumption expenditures are integrated with portfolio allocations, although the conventional test pointed towards separation of the two decisions. The general disequilibrium adjustment mechanism was also found to be clearly more adequate than the partial adjustment one. Furthermore, we also found clear evidence that the government bond market has not been affected by credit constraints and that there has been a close relationship between the deposit and bond markets. As deposits react to a change in the bond rate, we may also infer that bond financed government expenditure has been expansive (see condition (11) on page 47). The bond rate was found to play an important role as an alternative cost variable in the equations for the real expenditures. In general, the spillover effects of credit rationing were found to be reflected in both the financial and the goods market in the model for the households.

In chapter 8 we built a flow-of-funds model for the firm sector. The empirical results gave some support for the hypothesis that the investment in real capital and other uses of finance can be separated from each other. The domestic interest rate did not work in a meaningful way in the model and only has an effect through the tax deductability of interest costs, which is a component of the user cost for fixed capital variable. The foreign rate has a significant effect on the allocations. The profits of the firms have a markedly stronger effect on inventory investment than on fixed investment. There was a clearcut pattern of cross adjustment between the investment in inventories and foreign borrowing, and between the demand deposits and foreign borrowing.

Chapter 9, the last of the empirical part of the analysis was devoted to studying how the banks' funds are allocated between the loans to households and to firms and used to reduce their debt to the central bank. In this connection we also encountered problems in reaching a meaningful estimation result. In the flow-of-funds model of the households our problem was the slow adjustment in some respects and in the case of the firms it was the effects of the flow variables that were problematic. Here in the model for the banks it was the interest rates which caused a great deal of trouble in reaching a meaningful estimation result for the sector. We reached the conclusion that the demand for central bank debt has depended on the deposit flow to the banks and that the loan supply behaviour of the banks has depended on it, too.

The adjustment of the bank's actual central bank debt towards the desired value was found to be very rapid.

As an empirical framework, the flow-of-funds approach is a general and flexible hypothesis allowing for identification of the effects of the various rate of return variables, for the gradual adjustment of the portfolio towards the desired one because of the adjustment costs, and for the spillover effects of various flow items in the budget. The empirical success of the flow-of-funds models has been mixed. The main reason for this has been that the hypothesis has so few constraints that it usually produces a large number of insignificant coefficients or coefficients of implausible sign. Also here in our models we encountered this phenomenon, and we tried to reduce it by discarding variables producing these awkward results. Especially in the model for the households we had to delete a great number of explanatory variables.

In the study we paid a considerable amount of attention to the effects of credit rationing on the behaviour of the households and the firms. We outlined not only theoretically but also empirically a few steps which can be used in future efforts to combine data and information regarding the behaviour of households, firms and banks during the period of interest controls and rationing prevailing in Finland until the yearly 1980's with data covering the more recent period of gradual suspension of these controls and the rise of market-oriented financial markets.

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