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90

Hannu Koskinen

Studies on Money and Labour Market Dynamics and Goods Market Imperfections

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‘He that loveth silver shall not be satisfied with silver;
nor he that loveth abundance with increase:
this is also vanity’
Eccl 5:10

ABSTRACT

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Finnish summary

The aim of this thesis is to analyse both empirically and theoretically the structures and functioning of the money, labour and goods markets, all of which have a crucial role in the conduct of monetary policy, in order to clarify the extent of their similarities or structural differences across some EU countries. The thesis consists of three empirical studies and one theoretical study: two of the empirical studies analyse the demand for money and one the effects of shocks on the labour market in the EU countries of interest. The theoretical study analyses the way different relative price changes affects the welfare of economic agents due to imperfect competition in goods market. In analysing the money markets the theoretical identification scheme relies on the Money-In-the-Utility function (MIUF) framework. Multivariate VAR procedures and cointegration are used to identify empirically the structural features and changes in each of the EU countries considered. In addition, special attention is paid to identifying smooth structural changes that could introduce nonlinearities into the cointegration relations of the country-specific variables. We verify the existence of parameter constancy in some problematic cases where the linearity conditions are violated (nonlinearity) by structural changes and the estimates of the parameters are otherwise associated with low precision. In the labour market analyses the theoretical scheme is the insider-outsider union bargaining framework, and the empirical identification of shocks relies on the identification restrictions proposed by Blanchard and Quah. In the goods market the theoretical analysis relies on the duality theorem for the theory of demand. This theorem is based on optimising behavior on the part of economic agents. The concept of duality offers a tractable way to evaluate the welfare gains or losses that an economic agent faces as a result of price changes. We find out that, even in an environment with aggregate price stability, imperfect competition in the goods market could lead to adverse welfare effects stemming from fluctuations in labour efforts. According to the empirical results, the structures and the dynamics of the markets studied, together with the implied preferences of agents, show notable differences.

Keywords: demand for money, goods and labour markets, cointegration, nonlinearities

Author's address

Hannu Koskinen
University of Jyväskylä
School of Business and Economics
P.O. Box 35
FIN-40014 University of Jyväskylä,
Finland

Supervisor

Kari Heimonen
University of Jyväskylä
School of Business and Economics
Jyväskylä, Finland

Reviewers

Jouko Vilmunen
Bank of Finland
Helsinki, Finland

Juuso Vataja
University of Vaasa
Vaasa, Finland

Opponent

Jouko Vilmunen
Bank of Finland
Helsinki, Finland

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This thesis springs from my desire to understand something more of the structures and functioning of a monetary union, comprising several different countries, and the problems involved in the implementation of its common monetary policy. At the beginning of this lengthy journey into the mysterious world of monetary integration in the EU, various possible ways to proceed and, naturally, many interesting questions presented themselves. Being faced with so many choices could be very confusing for a novice researcher. Therefore, I am deeply grateful for the many persons who made it possible for me to complete this process. First of all I would like to thank Professor Jaakko Pehkonen. Jaakko, who aroused my interest to empirics of economics, offered me the opportunity to start my research with a labour market study. He has also provided guidance and all the facilities needed throughout the entire research process. Professor Kari Heimonen patiently supervised my work on the monetary issues and raised many well founded questions concerning them and the way to proceed. To him I owe my warmest thanks.

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Jyväskylä, June 2010
Hannu Koskinen

CONTENTS

1 INTRODUCTION

1.1 Background and Motivation

Over the past two decades the structures of the European economies have undergone profound changes. These changes are mostly a consequence of two dominant parallel processes of development. These are the overall development of internalisation concerning the trade and production of goods and the process of integrating the European Union economies to form a monetary union with a single market. The underlying objective of integration has been to strengthen the economic performance and to improve the macroeconomic stability of the member countries. In seeking to achieve this goal, the structures and functioning of the money, labour and goods markets play a crucial role.

The economics of integration has given rise to several research projects focusing on monetary convergence, labour markets and inflation dynamics in Europe. These projects have resulted in numerous studies with, however, contradictory outcomes. Our interest in this study is on the structures and functioning of the money, labour and goods markets from the price stability point of view which, in turn, is crucial for macroeconomic stability. In this sense four different lines of research will be emphasized here. They are the demand for money, transmission of monetary policy, shocks to the labour markets and inflation differences across euro area economies. The relation of the above mentioned markets together with the objective of monetary policy is clarified in Figure 1 where the utility of economic agent is affected by real money balances (m/p), consumption of goods (C) and labour (N).

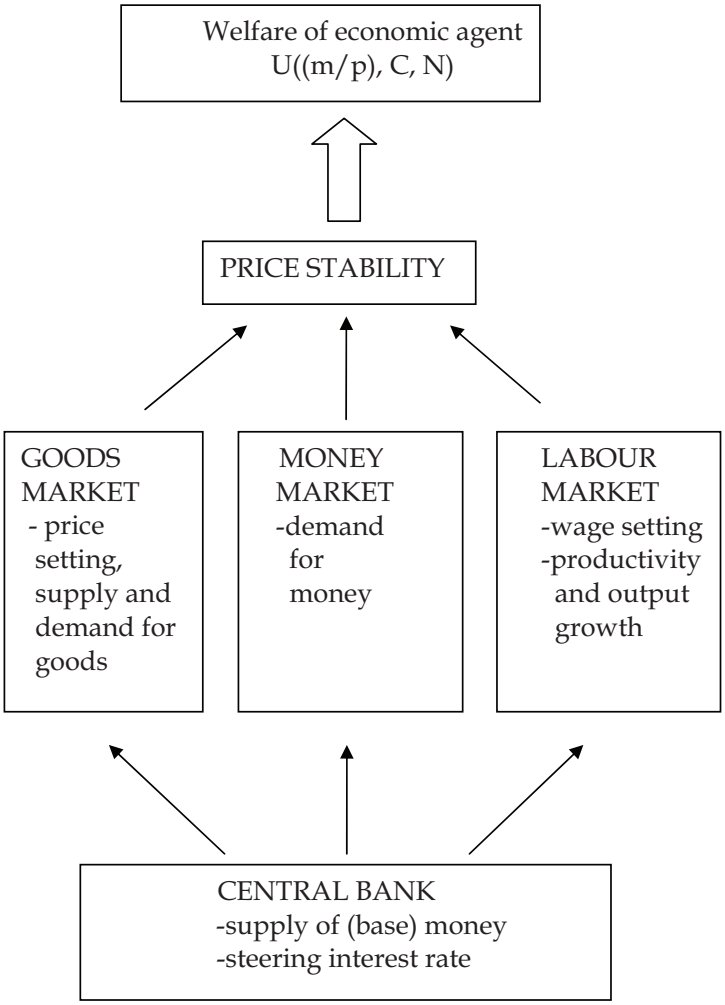

FIGURE 1 Economic environment for price stability and inflation dynamics

Concerning the demand for money in the euro area the study by Dedola, Gaiotti and Silipo (2001) reviews and analyses the question 'Do national differences matter?'. They conclude that national information is only of use in interpreting "special factors" and that there are no marked differences at the national level in the demand for money.

A valuable overview of the different problems arising after the setting up of the European Monetary Union (EMU) is provided in the April 1998 special issue of *Economic Policy*. In this issue a study by Dornbusch, Favero and Giavazzi (1998), is a good example of recent work on the topic of implementing the single European monetary policy. The transmission and effects of the common monetary policy in the euro area are analysed, followed by a discussion of the challenges facing the European Central Bank (ECB). Because the structures of

the different financial markets and wage-price processes are diverse, e.g. in terms of flexibility, the effects of these policies were not expected to spread uniformly. Voting on the ECB board and policy implementation would be a very new game in the early stages of union. Their conclusion was that national characteristics would have relevance from the point of view of the execution of the common monetary policy.

From the labour market point of view, a study by Balmaseda, Dolado and Lopez-Salido (2000) provides an interesting analysis of the effects of shocks to labour market-related variables in some OECD countries. They study the dynamic responses of real wages, real output and the unemployment rate to shocks interpreted as aggregate demand, productivity and labour supply disturbances. The shocks are identified by using a set of long-run restrictions to the system of equations forming the vector auto regression (VAR). These restrictions are placed along the lines developed by, among others, Blanchard and Quah (1989) and the theoretical scheme is the insider-outsider union bargaining framework. They find that the effects of similar shocks to these markets and real wage rigidities are different between the economies studied.

Two of the studies emphasized here analyse inflation differences across euro area economies. A study by Benigno and López-Salido (2002) presents supporting evidence of the existence of heterogeneity in inflation dynamics across euro area countries. Their study is based on theoretical approach of staggered nominal price setting allowing also for backward looking price setting (this implies inflation persistence and a hybrid form of Phillips curve). They focus on the different nature and degree of inflation persistence and they point out the existence of two different zones inside the euro area; one with significant forward looking component and another where inflation dynamics are mixed by forward and backward looking components. They exploit these results addressing some normative issues concerning optimal monetary policy rules; in cases where the backward looking components in inflation are important, monitoring the output gap can give the right information on the final goal, i.e. the price stability. Angeloni and Ehrmann (2004) in turn build a stylised 12-country general equilibrium model consisting of aggregate supply and demand equations. They use data over the period 1998-2003 for panel estimation and then use simulations to determine which factors have strongest effect on the size and the duration of the inflation differences. They find that high inflation persistence – even if equal across countries – is likely to generate more inflation divergence than other frequently mentioned factors like asymmetries in the transmission mechanism or demand or supply shocks.

These results imply some differences in the structures of the underlying markets. This, in turn, may account for the different outcomes of e.g. monetary policy shocks felt in these economies.

Despite the abundance of work already done in this area, there are number of issues that merit greater attention. Much of the earlier work on the money markets has concentrated on examining the functioning of the transmission mechanism and evaluating the efficiency of the intermediaries in financial mar-

kets. In other words, the focus has been on the transmission of monetary shocks within individual euro countries. Ehrmann (2000) is a good example of more recent work in this field. Much of the earlier work has also centred on linear relationships between variables. Certain extensions, such as nonlinearities due to structural changes, have had a minor role. In many cases these changes have been manifested as smooth transitions between different regimes rather than sudden breaks. This means that the structural relations existing between the variables can be abstruse to identify. The deregulation of the financial markets as well as the pressures arising from the demands of the single currency area could be seen as important institutional factors behind the potential changes in the economies in the countries under study. The convergence of the inflation rates of the euro countries also presents a potential opportunity for a more uniform restructuring of finance. European labour markets have also experienced changes which have influenced their equilibrium and process of adjustment; see e.g. Schettkat (2003) and references therein.

In spite of the integration that has occurred, it is most likely that during the early years of the EMU, and especially with its prospective enlargement, asymmetries will exist with respect to policy shocks; see De Grauwe (2000) and Driver and Wren-Lewis (1999). The observed inflation differentials are mainly explained by two sources in recent work on this issue; these differentials are due to inflation persistence or to Balassa-Samuelson[1] effect, which relates these differences to process of catching-up and different productivity growth in tradable and non-tradable sectors, see e.g. Reutter and Sinn (2000). Then the regional goods market imperfections have had minor role although variations in relative markups have been observed within a country, see Estrada and López-Salido (2002) and over time, see Bowdler and Jansen (2004). These variations affect marginal returns to factors in a way that is similar to productivity shocks; changes in relative prices across firms work like the level effects of productivity shocks, see Goodfriend and King (1997) p. 27.

This study pays attention to structural features and transmission processes that are characteristic of the euro area and are crucial for the objective of price stability. Transmission processes are changes that are caused by, for example, the convergence of institutions and alterations in preferences[2]. The background to this study is the convergence process that took place during the Exchange Rate Mechanism (ERM) period (1979-1998). This convergence is due to several institutional and legal arrangements in order to establish a common market area. The legal basis for the single monetary policy is the Treaty establishing the European Community together with the European Central Bank (ECB) and the European System of Central Banks (ESCB). Before responsibility for monetary policy was transferred to these authorities on the 1 January 1999 preparations to the establishment of the ESCB had taken place starting from 1.7.1990. The aim was to strengthen the cooperation and monetary policy coor-

1 See Balassa (1964) and Samuelson (1964).

2 As the structures in banking and financial infrastructure have converged (see p. 14), the preferences of economic agents may have altered as new products have been introduced.

dination of the various national central banks. From 1.1.1999 onward the conduct of the single monetary policy was centralised in one authority, the Governing Council of the ECB, and the aim of the institutional framework was to establish a central bank that would be independent of political influence. Thus there would be no role for the national strategies and procedures in the conduct of monetary policy. The influence of national central banks on e.g. agreements and contracts in the labour market policies was also keyed into the goals of the "Eurosystem". For example, exchange rate policy would have to focus on price stability instead of other objectives such as forcing a rise in foreign exports by devaluations of currency. In addition to this monetary policy framework, the Treaty stipulates that national economic policies (e.g. fiscal and structural) shall be regarded as a matter of common concern (convergence criteria for joining the monetary union and then the Stability and Growth Pact), despite being the responsibility of national governments. Moreover, the environment for economic activities in the euro area also changed in terms of moving towards a common (single) market and internalisation, bringing more competition to almost all sectors of the economy. The first stage of the realisation of economic and monetary union began in 1990 when in principle all restrictions on the movement of capital between member states were abolished. A response to changing market conditions is the trend towards consolidation in the financial sector. The consolidation process that took place in European banking industry was reflected in a marked decline in the number of financial institutions and credit institutions.

1.2 Monetary Policy

The primary objective for the monetary policy of the ESCB is to maintain price stability. The ECB's strategy to meet this objective consists of defining price stability and additional "pillars", such as a role for monetary phenomena and analyses of a wide range of other economic and financial indicators. These indicators are selected so as to provide a reliable framework for identifying threats to price stability. Analysis of these indicators is centred on e.g. models of the business cycle and on the effects of the interplay between supply and demand together with cost pressures on pricing behaviour in the goods, services and labour markets. For example, if wage increases are not justified by growth in productivity, this may lead to a self-sustaining spiral of higher costs, prices and wage demands. Of course, pricing decisions permitted by monopoly power will lead to higher prices and to maintain relative purchasing power shares of their earnings the labour unions will increase their wage demands if possible. Labour costs, having a significant impact on price formation, are an important determinant of production costs. The overall labour market conditions are of crucial importance in the monitoring of simultaneous developments and in assessing structural changes in the functioning of the euro area economy. Information from asset prices and financial yields is also utilised to reveal threats to price

stability via income and wealth effects, as wealthier share-owners will add to consumer demand and may fuel inflationary pressures. According to this strategy a change in the amount of money held by the public reveals information about future price movements and developments in the broader economy. Therefore a good understanding of those economic and institutional factors which may have an impact on the relationship between money, real activity, interest rates and prices is needed.

There are several channels through which monetary policy affects the economy. In this study we are interested in those related to the money, labour and product markets, as the interaction of these markets with each other and with monetary policy is linked to the institutional arrangements (and structural features) that prevail within these markets. For example, monetary shocks will have an effect on the cost of investments (and hence also on demand) through the money market. The central bank steering rate and inflation expectations determine the price of short-term (less than 12 months) financial claims. These expectations and changes in aggregate demand also affect wage and price-setting behaviour of economic agents. The total effect on the economy, however, depends on the response of the labour and product markets to these shocks as monetary shocks have impacts on investments and output, and these in turn will affect supply and demand in goods (product) and labour markets. An important factor in the labour market is the wage bargaining process, as productivity and wage development in the labour market, together with the interest rate, contribute to the determination of inflation / price level.

1.3 Theoretical and Methodological Approaches

The objective of this thesis is to conduct empirical and theoretical analysis of country-specific structural features in the money, labour and goods markets using uniform theoretical and methodological approaches. This allows us to compare the behaviour of the (representative) agents between the different national economies. This, in turn, has relevance for the implementation of monetary policy. Analysing the demand for money reveals important features about the transmission mechanism of monetary policy due to the relevance of monetary aggregates to the monetary policy implemented in the euro area, at least development of monetary aggregates provides information of future economic activity. Because of the (institutional) rearrangements and changes accompanying the transition to the euro area, the behavioural relations of economic agents may have changed. All these changes in turn will influence the transmission of economic shocks. It is assumed that the utilization of new innovations will bring increasing utility to agents and that this will cause changes in the existing relations between the macro variables. These changes, in turn, will be manifested in more or less smooth transitions from one regime to another. It is possible to model these changes /transmission processes by nonlinear methods; see

Ripatti and Saikkonen (2001). In the money market, for example, in Finland the traditional demand for money relation is augmented in this study with a smooth nonlinear trend in time. The significance of above mentioned changes and the remaining structural differences for the effectiveness of monetary policy is then re-evaluated.

In this thesis the micro foundation for analysing the demand for money is based on the utility that a representative agent faces by possessing money, i.e. the "money-in-the-utility function" (MIUF) framework by Sidrauski (1967). This approach characterizes and combines the different roles of money, e.g. the transactions and portfolio demands for money, and is attractive in empirical work due to its analytical straightforwardness. The optimising behaviour of economic agents in the MIUF framework is useful in gaining an understanding of the steady-state (welfare) implications of alternative rates of inflation and is therefore useful in studying the role of monetary policy. The steady-state parameters reflect the behaviour of representative agents, which allows us to compare the long run relations of the economies studied.

The theoretical analysis in the goods market is also based on optimising behaviour of economic agents. In order to evaluate the welfare effects of a disproportional price change between two sectors in an economy we utilise the duality theorem for the theory of demand as a micro foundation for our analysis. The utility function of representative agent consists of consumption and labour supply. By analysing price-setting behaviour of those agents we derive a general framework to study welfare effects of a relative price change originating from different price setting power of the existing sectors in the economy studied. The absence of money in our analysis of goods market results from the assumption that the utility function is separable. Then the welfare effects of price changes are driven by real marginal costs and, especially in our case, markups allowed by monopoly power in pricing. Hence the level of real activity affects these markups and marginal costs. To be precise, the quantity of money is not totally absent in our underlying model since the condition for real money balances must hold in equilibrium. Then the quantity of money is determined by the level of economic activity.

The behaviour of the labour market, in turn, is analysed after a shock. This reveals the dynamics of the underlying economy, which has important implications for economic policy. The theoretical framework for labour market analysis is the insider-outsider union bargaining framework which is considered to offer a relevant starting point for studying the labour markets in the OECD countries. As the results for labour markets studied suggest, there is a prominent role for wage stickiness. Then, in this economic environment, a straightforward way to integrate labour market into other economic activities of an economy is to consider a model based on optimizing behaviour of an agent in an environment with sticky prices and wages. These real / nominal rigidities have important implications for the inflation and output dynamics and then the real effects of monetary policy are non-trivial in the short-run; see e.g. Woodford (2003) and Walsh (2003) for theoretical scheme and empirical analysis. We consider here a

general equilibrium model in the spirit of ´New Open Economy Macroeconomics´ and incorporate labour supply as a part of a utility function of an economic agent. Then the economic agents maximise the expected present value of utility over consumption, real money balances and leisure (labour) according to

$$E_t \sum_{i=0}^{\infty} \beta^i [\tfrac{1}{1-\sigma} C_{t+i}^{1-\sigma} + \tfrac{\gamma}{1-b} (\frac{M_{t+i}}{P_{t+i}})^{1-b} - \chi \frac{N_{t+i}^{1+\eta}}{1+\eta}], \quad (1)$$

where C stands for consumption of composite good, (M/P) for real money balances and N for labour effort. Parameters σ, b and η are the respective elasticity of substitution parameters, β is the discount factor and γ and χ are the relative weights of the objectives.

In addition with insider-outsider union bargaining framework, we assume that wages are negotiated in an overlapping contract manner as wage stickiness implies, see Erceg, Henderson and Levin (2000). We utilise a Calvo (1983) style pricing specification for wages and assume that a randomly drawn fraction (1-v) of households optimally reset their wage each period, see Erceg et al. (2000) or Christiano, Eichenbaum and Evans (2005). As the Calvo specification implies, inflation depends on real marginal cost which, in turn, equals the gap between the real wage and the marginal product of labour (*mpl*). Thus the basic model for inflation adjustment yields

$$\pi_t = \beta E_t \pi_{t+1} + \kappa (w_t - mpl_t), \quad (2)$$

where w_t stands for the real wage. For derivation of this equation, see e.g. Walsh (2003). If wages are flexible, nominal wages adjust to ensure that the real wage equals the marginal rate of substitution between leisure and consumption (*mrs*) as in the labour supply equation

$$\frac{\chi N_t^{-\eta}}{C_t^{-\sigma}} = \frac{W_t}{P_t}. \quad (3)$$

With sticky wages, however, w_t and mrs_t can differ. If $w_t < mrs_t$, workers will want to raise their wage when opportunity to adjust arises. Then, as Erceg et al. show, the rate of nominal wage inflation is

$$\pi_t^w = \beta E_t \pi_{t+1}^w + \kappa^w (mrs_t - w_t), \quad (4)$$

where $\kappa^w = (\eta + \sigma) \frac{(1-v)(1-\beta v)}{v}$.

Then the real wage is

$$w_t = w_{t-1} + \pi_t^w - \pi_t. \quad (5)$$

These equations constitute the inflation adjustment block with wage and price rigidities. Which kind of rigidity accounts for the observed dynamics of inflation and output and what is the appropriate goal of monetary policy (to stabilize prices or wages) is then most likely an economy specific empirical question. The answer depends on the degree of rigidities in each market as Woodford (2003) shows. In this study the relative importance of wage rigidities to the inflation dynamics and hence to welfare remains still an open question and could be therefore subject to further study.

The empirical macroeconometrics used in this study is mostly based on the multivariate vector auto regression (VAR) approach. This enables us to treat the variables first as endogenous entities generated by stochastic time-dependent processes, and as such they are effectively described and investigated using probabilistic concepts. We are then able to reduce the general statistical model by imposing testable restrictions on the parameters. Next, on the basis of the VAR formulation every empirical statement can be checked for its consistency with all previous theoretical statements. The long time-dependence of the data generates nonstationarity (a unit root) of the series. This gives us the opportunity, by exploiting the cointegration property, to find out which other variable(s) have exhibited a similar stochastic trend. This is very useful for the empirical analysis of long- and medium-run macroeconomic behaviour.

1.4 Market Structures

The most important features of the national financial systems in the euro area during the ERM period are the following (from Ehrmann, Gambacorta, Martinez-Pages, Sevestre and Worms (2001), Ehrmann et al. afterwards). First, *corporate financing* is heavily dependent on bank loans, as market financing plays a minor role. Only the largest firms can issue debt securities, even in France where market financing is most developed in the euro area. Table 1 illustrates some of the variation that exists in these countries. The role of banks is dominant, although there are also some differences, as we shall note. A more salient feature is that *the maturity of loans* varies between countries. Italy is at one extreme where loans supplied by banks are typically short-term and with a variable interest rate. In Austria and the Netherlands, bank loans are long-term in maturity with a fixed rate. Shorter bank loans have to be renewed more frequently, a feature which could accelerate monetary transmission. Third, *the market concentration structure* varies across countries. Financial markets are less concentrated in Italy and Germany and more concentrated in Belgium, the Netherlands and Finland, as the Herfindahl index, which measures the degree of concentration, shows; see table 1. This could imply differences in response to a monetary shock as the liquidity and capitalisation of banks varies. On the other hand we have to recognize that these factors also diverge between the same-sized banks so that otherwise similar banks could response differently to mone-

tary policy shocks. Fourth, s*tate influence and ownership structures* contribute significantly to banks' loan supply. Government roles either as an owner or through public guarantees have been important in 1995 in most countries, e.g. Finland and Austria, but less so in others, like Spain, as we can see from Table 1. The role of governments in banking has declined in recent years.

TABLE 1 Some structural features of national financial markets during the ERM period

	Austria	Belgium	Finland	France	Germany	Italy	NLD	Spain
Importance of banks for corporate financing [1]	Very important	Important	Important	Important	Very important	Very important	Important	Very important
Fraction of short-term loans [2]	Average	Average	Low	Low	Low	High	Low	High
Fraction of loans at variable interest rates [3]	Low	High	High	Average	Low	High	Low	High
Market concentration [4]	Medium	High	High	Medium	Low	Low	High	Medium
State influence [5]	Strong	Medium	Strong	Medium	Strong	Strong	Weak	Weak

1 Source: Ehrmann et all, 2001. Countries rated "very important" comply with all of the following conditions: debt securities to GDP < 4%, debt securities to bank loans < 10%, stock market capitalisation to GDP < 60% and funds raised through issue of securities <50%. Countries that fail to comply with at least one of those conditions are rated "important".

2 "low": fraction of short term loans <20%; "high" > 35%.

3 low"; fraction of loans at variable interest rates < 40%; "high" > 50%.

4 "low"; Herfindahl index and the market share of five largest banks are in the range of 30 or below, "high" when the Herfindahl index stands at around 100 and the market share of the five largest banks does not give conflicting evidence. Market concentration is rated medium for intermediate cases.

5 Ranking according to the percentage of assets of top 10 banks owned or controlled by the government in 1995; "strong > 30%, "medium" between 10% and 30% and "weak" < 10%.

The structures of the financial and banking systems determine to some extent the response of the money market (and bank lending) to a monetary policy shock. The creation of the EMU and the EU's internal market programme together with technological progress and cross-border trade in financial services (see e.g. Koskenkylä, 2002) have contributed to the convergence of these structures. These, in turn, have impinged on the transmission of monetary policy. As there still are notable differences in these markets between the present (and especially between the accessing) monetary union countries, monetary transmission and hence responses to shocks can be expected to diverge as recent research has shown; see e.g. Dornbusch et al. (1998) and Ehrmann (2000) and references therein, and a study by Cecchetti (1999) concerning the effectiveness of the bank lending channel. Then, in these early years of the EMU, when the restructuring of financial markets and its institutions has been modest, asymmetric effects of the common monetary policy can be expected (for recent research

concerning asymmetric transmission and effects of shocks, see e.g. Clausen and Hayo (2002), De Grauwe (2000) and Driver and Wren-Lewis (1999)).

The functioning of the labour market is traditionally viewed according to its institutional arrangements. These arrangements are important factors in determining how well or badly monetary policy can achieve its primary objective. This particular objective in turn impinges on wider economic objectives such as economic growth and employment creation; for a discussion see Layard, Nickell and Jackman (1991)[3]. The interaction of the institutional arrangements of the labour market with shocks then becomes crucial. Changes in interest rates induced by monetary policy decisions affect the prices and yields of financial assets. These in turn influence on spending and saving behaviour and on the cost of inputs to production. Wage- and price-setting behaviour plays a significant role here. A study by Blanchard and Wolfers (2000) provides a good example of a basic model that can be used to analyse the issue. The state of studies in this field is reviewed by Nickell (2003). A general finding of these studies is that the impact of shocks together with national institutional arrangements makes a significant contribution to the development of price stability and unemployment, i.e. to the economic performance of a country. The institutions governing these markets will evolve over time, especially in Europe where central bank policies have drastically changed since the launching of the euro (in terms of the number of trade unions and institutions the central bank faces in bargaining).This in turn signals that a new environment will be created for the wage-price process, (with the primary objective of ensuring price stability) and improvement of employment in Europe.

The relatively poor economic performance of the euro area during the era of the exchange rate mechanism (ERM) has often been attributed to the institutional arrangements described above. In the economic sense these institutional arrangements limit the room for liberate decision-making in a perfect market. Because in the real world the perfect market model does not apply, various institutional arrangements have been introduced to correct the outcomes of imperfect markets. The interaction of these institutional features with shocks could be crucial in explaining the economic performance of a country. It also seems reasonable to focus on the reallocation of factors of production at all levels. This

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3 *The unemployment benefit system* potentially affects equilibrium unemployment through four channels; the level of benefits, the duration of these benefits, the coverage of the system and the strictness with which the benefits are granted. *Wage bargaining* appears to have a significant impact on wages and unemployment through several channels. Coordination of this bargaining, by which is meant the noting of wage determination implications for aggregate employment, varies between the euro countries. The centralisation aspect which, in turn, refers to the level at which bargaining takes place in the economy (plant, firm, industry or economy-wide) has important implications for price stability together with coordination. *Employment protection* laws are attempts to provide some security to workers in terms of job stability and are implemented via costs incurred by firms that lay off workers. The impact of *labour taxes* on employment remains unclear, although a large number of empirical investigations exist. It should be noted that taxation could influence the monetary circumstances and its evolution.

means that we should study the consequences of retaining, to a large extent, existing mass production technologies instead of seeking transformation into an innovation-based economy. Thus Europe has to a large extent remained competing with the newly industrialised countries.

By studying the ERM period in the empirical parts we focus on the economic conditions prevalent before the adoption of the single currency. This is of central importance to understanding the nature of a common single monetary policy area formed by individual states.

1.5 Outline of the Study and Main Results

The studies of this thesis analyse the structures and functioning of money, labour and goods markets from the conduct of monetary policy and the objective of price stability point of views. The central bank policy goal is the average price stability in the monetary union and it can only influence the price level of the euro area as a whole, thus ignoring differences across regions (see ECB 2004). In this sense we have considered and analysed here the cases where the structures of the small economy diverge from that of the average of the monetary union. If also the inflation processes diverge, then the possibilities of common monetary and fiscal policies are limited to correct those outcomes that are socially suboptimal. Inflation, in turn, has serious consequences for economic welfare; it causes inefficient production and consumption dispersion which reduces welfare, for theoretical grounds see e.g. Walsh (2003). In this situation the goal of attaining price stability can be problematic for a small country.

In the empirical part we have analysed the demand for money by combining the theoretical model with empirical econometric procedures allowing for nonlinearities in the behavioural parameters. We have been able to judge the effect of structural changes in the relations subsisting between the macro variables from the stability problem point of view. The results of the empirical study of labour market dynamics in Finland and Sweden suggest that wage stickiness and hysteresis is present in both countries during the time period studied. Hysteresis implies that the effects of shocks are persistent in the labour markets.

The theoretical study contributes to the economics due to some distinctive features. The model we construct assumes that the differences in the relative markups could be explained by weak substitutability between the existing sectors. Also the sectoral demand curves and price elasticity of demand differs. This causes sectoral price levels to diverge and allows greater pricing power for one of the sectors and permits it to rule price-setting in a distortionary manner. The welfare effects of price change are thus derived from the underlying preferences of economic agent. We notice that even in an environment of price stabil-

ity at an aggregate level there could be adverse welfare effects due to sectoral price diversification and imperfect competition between the sectors.

Chapter 2 models structural changes in money market relations. When monetary policy involves strategies that in any sense rely on monetary targeting, then a stable demand for money relation is crucial; see e.g. Lütkepohl and Wolters (2001). Using cointegration analysis in cases where these changes are not modelled is therefore problematic from the perspective of policy implementation. Changes in regimes and technology as well as some exogenous shocks are examples of changes that can alter the behaviour of economic agents gradually and hence the relations between variables. Gradual changes in the cointegration parameters bias the specification of the cointegration relations. In the study the multivariate cointegration technique coupled with a smooth nonlinear trend of time is applied to model the demand for money. The demand for broad money in Finland during the period 1980–1996 is analysed here. It turns out that, if the cointegrated VAR-model is extended with a nonlinear deterministic trend of time related to the intercept term, the missing cointegration relation between broad money and the scale variable is found and the cointegration space can be identified.

Chapter 3 focuses on the identification of cross-country differences in the structures of the money markets among some of the euro countries during the ERM-period. Whatever the sources of these differences are, they can be very important from the point of view of country-specific effects following common monetary (policy) shocks and, consequently, of understanding the potential differences across countries in the transmission mechanism of the common monetary policy. The approach taken in this study to identify the differences is based on the country-specific money market relations. The country-specific relations of the variables are analysed in a multivariate context using Johansen`s procedure. The structural equations and the dimension of the cointegration space are estimated. Special attention is paid to factors that can distort the normal I(1) SVAR analyses of the data, in particular, potential smooth structural changes that could introduce nonlinearities into the cointegration relations of the country-specific variables. A congruent model that fits most of the countries is specified. The results suggest that not only are there differences in the parameters of the country-specific money market relations, but the structural characteristics of these relations also display differences. Finally, our results indicate that we might pool the data only for a sub-sample of the countries, i.e., a set of five countries forms a homogeneous group whose parameters and structural features could be considered to be "close together".

Chapter 4 examines the dynamic effects of shocks to the labour markets of Finland and Sweden during 1980-2000. Although unemployment rates increased markedly during the 1980s in most OECD countries and particularly in Europe, the experience of Finland and Sweden in the early 1990s was unique in its severity. This study investigates empirically the processes of adjustment of the labour market by using a set of long-run identifying restrictions on a three-variable system, including output growth, real wage growth and un-

employment. The theoretical framework adopted in the study is the insider-outsider union bargaining framework which can be considered as a natural starting point for studying the functioning of labour markets in the OECD, as Balmaseda, Dolado and Lopez-Salido (2000) point out. This framework is used to identify and explain the independent structural shocks interpreted as disturbances in aggregate demand, productivity and labour supply that drive fluctuations in these variables; for the methodology used see Blanchard and Quah (1989). The results suggest that hysteresis is present in both countries, implying that the effects of shocks on the level of unemployment and real output are persistent. The results also suggest that the sources of variation and the magnitude of responses due to shocks differ between these countries. The response of real wages with respect to (positive) aggregate demand shock tends to be countercyclical in the short-run both in Finland and in Sweden. This allows a prominent role for wage stickiness. Then the nominal wages might be constant in the face of disturbances even when the effective cost of marginal hours of labour to firms changes and as such wages have influence to the inflation adjustment.

Chapter 5 models the welfare effect of a relative price change in a case, where a consumption bundle consists of two types of commodity groups manufactured in two respective sectors. The price elasticities between these two types of commodities differ and there is less substitutability between goods produced in different sectors than between different brands in a given sector. We assume imperfect competition in the two sectors. While the sectoral price levels differ, it is assumed that the aggregated price level remains constant. Although the aggregated price level remains constant, implementation of economic policies could be problematic after relative price changes of this kind between the sectors. This is because stabilization of an aggregate price index and stabilization of an aggregate output gap are no longer equivalent policies, as is implied by the "New Keynesian" Phillips curve. In order to evaluate the welfare effects of a disproportional price change, we utilize the duality theorem for the theory of demand. We record the welfare change after a price change by focusing on the uncompensated demand function for a good. We derive a difference equation to compare the utility levels related to this price change. It turns out that in an environment with imperfect competition these relative price changes have adverse welfare effects. In this model these adverse welfare effects are related to fluctuations in labour efforts without an appropriate increase in consumption possibilities. Moreover, it becomes clear, that the executed policy (keeping the aggregate price level constant) has a greater (negative) impact on the sector which, because it has greater price elasticity of demand puts less inflationary pressure on the economy and which, accordingly, has less pricing power and more internal competition.

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CHAPTER 2

MODELLING OF STRUCTURAL CHANGES IN DEMAND FOR MONEY COINTEGRATION RELATIONS*

Abstract
In this paper the multivariate cointegration technique coupled with a smooth nonlinear trend of time is applied to model the demand for money. Unmodelled gradual structural changes in the cointegration parameters affect the specification of the cointegration relations so that the number of cointegrating vectors found by linear methodology is smaller than suggested by the economic theory. Here the demand for broad money in Finland during 1980 – 1996 is analysed. It turns out, that if the cointegrated VAR model is extended with a suitable nonlinear deterministic trend of time related to the intercept term, then the missing cointegration relation between broad money and the scale variable is found and the cointegration space can then be identified.
(JEL: C32, C 51, E 41)

Keywords: gradual structural change, cointegration, nonlinear models

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1 Introduction

This study examines how the potential nonlinearity due to structural change in the demand for money relation could be modelled and then re-evaluates the stability problem from the monetary policy point of view. When monetary policy involves strategies that in any sense rely on monetary targeting, then a stable demand for money relation is crucial (Lütkepohl and Wolters, 1999). Changes in regimes and technology as well as some exogenous shocks are examples of the kinds of change that can alter the behaviour of economic agents gradually and thereby the parameters and relations between variables. Then the parameters of a linear model are not stable and the relations could not be correctly specified. However, it is possible to model such smooth structural changes by allowing for nonlinearities. Hence, even in the case of nonlinearities due to structural changes, we can find a stable cointegrating relation between the variables by using nonlinear modelling (see Ripatti and Saikkonen, 2001; Lin and Teräsvirta, 1994; and Lanne, 2002 and references therein), as an example in this paper will show.

Ripatti (1998) and Mannonen (2000), using Finnish data over the 80s and 90s, show that the parameters of interest for the demand for broad money are unstable. In particular, they did not find a stable relation for the scale variable and broad money. An explanation for this result could be the effect of institutional changes and business cycle fluctuations in the 1990s. These kinds of fluctuations and changes can cause nonlinearities in macro economic relations (see Potter, 1999 p. 516) and distort the identification of these relations. In order to evaluate the adequacy of these parameters we first have to model the existing nonlinearities, as unmodelled nonlinearity will distort the parameters.

Nonlinear modelling of economic time series has aroused growing interest amongst econometricians (see, for example, Potter 1999 for a review). The modelling of smooth transition regression has mainly concentrated on short-run dynamics when the long-run equilibrium has been assumed to be stable (Teräsvirta, 1994). To widen the perspective in the case of nonlinearities one should also consider cases where the long-run equilibrium alters in multivariable cointegrating relations.

This paper focuses on cointegration analysis in a case where gradual change in the parameters of interest could accompany gradual change in the behaviour of economic agents. Recently, nonlinearity has been introduced into cases of multivariate vector auto regressions (VAR) e.g. by Gennari (1998), Ripatti and Saikkonen (2001), Johansen, Mosconi and Nielsen (2000) and He, Teräsvirta and González (2002), who derived a parameter constancy test. Whereas Gennari estimated the nonlinear deterministic part in a single equation framework and then transferred it to multivariate VAR procedure of Johansen (1991), this paper proceeds along the lines of Ripatti and Saikkonen by estimating the nonlinear part in a multivariate setting. Ripatti and Saikkonen focused on a model with a gradually changing constant term in the cointegration space;

it is thus implicitly assumed that there are no (linear) trend components within the variables involved. Johansen et al. focused on structural breaks in the linear time trend in the cointegration space. This paper focuses on gradual and smooth change of intercept term (constant) with the nonlinear component in the cointegration space, but no constant or linear time trends constrained to it (for the motivation to this see e.g. Ripatti and Saikkonen 2001).

The theory for estimation and statistical inference for the models considered in this paper are those developed by Teräsvirta (1994) to univariate stationary models and subsequently extended by Saikkonen (2001, a, b) to multivariate cases where stationarity conditions are violated in the long-run.

The approach taken in this paper is to form an economic theory-based assumption about the number of the relations between the variables forming the VAR. The demand for money is then derived from the money-in-the-utility-function approach; this is done in section 2. The description of the theoretical statistical model for structural changes is done in section 3. In section 4 the Finnish monthly data for broad money demand is analysed by linear methods. An empirical application for the estimation of nonlinearities is performed in section 5. Finally, section 6 concludes. It examines the results from the statistical and economic theory point of view. Some suggestions for future research are also made.

2 Money Demand

In this paper we incorporate money balances into the representative agent utility function. This money-in-the-utility-function (MIUF) model was originally developed by Sidrauski (1967), who employed a neoclassical growth framework to the study of monetary phenomena. In this context the analysis of monetary issues relevant to monetary policy implementation is straightforward. The parameterisation of the utility function in this paper is the one originally developed by Ripatti (1998). The advantage of this approach is that it gives the number and contents of theoretical relations.

A general form of the representative household's utility function, when money is introduced into it, consists of flow of services yielded by money and consumption in real terms. The utility function is assumed to be increasing in both arguments, strictly concave and continuously differentiable. In the case of rational economic agents, the flow of services yielded by money consists only of real money balances M/P, where M is the nominal amount of money and P is price level.

The household maximises the discounted sum of the expected utility from consumption and from money under the budget constraints specified later:

$$E_0 \sum_{t=0}^{\infty} \delta^t (u(C_t) + \xi_t v(M_t / P_t)), \qquad (1)$$

where δ^t is the discount factor, ξ_t is a stochastic weight on the real money balances in the utility function and C_t is the real value of consumption.

In this study we will focus on the long-run (preference) parameters and their constancy. This refers to a situation of equilibrium in the money market. Therefore we do not include the adjustment costs, which drive the dynamics of the system, in the equations. The steady state solution alone implies that money is neutral. But the dynamics continue to exist even if we do not model them here, and thus the real nature of money deviates from the neutrality assumption.

The household allocates its real income, y, and other earnings among consumption goods (C_t), bonds (B_t) and real money balances, M_t/ P_t, which pay a gross return of P_t/ P_{t+1}. A bond is here a commonly available asset (a financial market instrument), which pays a gross real return $1+ r_t$ (from time t to time t+1) and (nominal) gross return $I_t \equiv 1 + i_t$. Money also yields a nominal return (own yield of money) of $O_t \equiv 1+o_t$ for some definitions of it. The budget constraint that the household faces is

$$C_t+B_t+Mt/P_t < y + (O_{t-1}M_{t-1})/P_t+(1+r_{t-1})B_{t-1}. \qquad (2)$$

The first order conditions of the household's optimisation problem (2.1) subject to (2.2) can be written as

$$\frac{\xi_t v'(M_t / P_t))}{u'(C_t)} = 1 - \frac{O_t}{I_t} \qquad (3)$$

After parameterisation of the utility (to constant relative risk aversion form) function the stationary equilibrium looks as follows;

$$1 - \frac{O_t}{I_t} = \xi C^{\rho} (\frac{M}{P})^{-\omega}. \qquad (4)$$

In the steady-state, the stochastic processes should have finite variance, which is not the case if any of the variables in the model are integrated of order d, I(d), and d is a positive integer. However, it is possible that a linear combination of these I(d) variables is stationary, i.e., they are cointegrated. In the (log of) stationary equilibrium the adjustment costs are zero and M_t = M, C_t = C, I_t = I etc., It is assumed that the linearized version of the steady-state solution of the model should represent the stationary linear combination of the variables and we obtain the following log-linear equation for the level variables:

$$(m - p - \frac{\rho}{\omega} c) + (i - o) = (m_t - p_t - \frac{\rho}{\omega} c_t) - (i_t - o_t) + (1 - O/I)(\zeta_t - \zeta) \qquad (5)$$

where the last term (1-*O/I*)(ζ_t - ζ), is the deviation of the log-linearized velocity process from its steady-state value and lower cases denote the log-transformation of the variable, log $\xi = \zeta$, *o* and *i* are the own yield of money and return on the nominal bond in fractions. Moreover, ρ and ω are risk aversion parameters; ρ for consumption and ω for money.

In order for the equation (5) to have a stationary right-hand side, the levels of the variables on the same side, z_t = [m_t, p_t, c_t, i_t o_t]´, should be cointegrated. This particular parameterisation (2.5) suggests two cointegration vectors. The first is the net opportunity cost of money, i_t - o_t, and the second is the `adjusted´ velocity, m_t- p_t- $c_t\rho\omega^{-1}$. Interest rates are nominal, and so according to the Fisher parity, short-term interest rate depends on expected inflation. The expectations hypothesis of the term structure of interest rates predicts that the long-term interest rate is the average of the expected short-term interest rate for the entire time to maturity. Hence inflation is included in these nominal rates of interest. The Fisher parity and the expectations hypothesis of the term structure of interest rates are in many cases rejected where an empirical study relies on linear modelling of time series. If we notice the potential nonlinearities and asymmetric behaviour of the time series, then it becomes less easy to reject these hypothesis (for a discussion and examples, see e.g. Enders and Granger (1998)).

Other parameterisations with different numbers of cointegration vectors are also possible. When there are five integrated variables, in case of order one, the maximum number of cointegrating vectors will be four. Thus what is needed in any case, is to test for cointegration rank, after which one can apply the restrictions implied by the theoretical model to identify the cointegration vectors (in the case of single cointegration vector we can combine the terms of the two levels on the right-hand side of (5)). It can then be assumed that the variables in z_t are cointegrated and that β represents the cointegration vectors. Then we have

$$\beta` = \begin{bmatrix} 0 & 0 & 0 & 1 & -1 \\ -1 & 1 & \rho/\omega & 0 & 0 \end{bmatrix} \quad \text{and} \quad z`_t = [m_t \;\; p_t \;\; c_t \;\; i_t \;\; o_t\,] \; .$$

The price homogeneity restriction imposed to the long-run relations hereafter, as in the case of earlier studies (e.g. Ripatti 1994, 1998), could not have been rejected for Finland for the period under analysis and we use the same data set as Ripatti (1998). It is important to note that shorter periods could reveal deviations from that restriction. Moreover as the Fisher parity implies, we can not include inflation twice in the relations as it is already included in the nominal rates of interest.

3 Statistical Model

3.1 Linear Model

An n-dimensional time series generated by a VAR process of order k, which has an observable outcome y_t, $t = 1,\ldots, T$, can be written as

$$\Delta y_t = d_t + \Gamma_1 \Delta y_{t-1} + \ldots + \Gamma_{k-1} \Delta y_{t-k+1} + \Pi y_{t-1} + \varepsilon_t, \qquad (6).$$

where Δ is a difference operator, Π and Γ are $(n \times n)$ matrices of unknown parameters and d_t is a deterministic $(n \times 1)$ vector of level parameters. Furthermore, the initial values $y_{-k+1},\ldots, y_0$ are observable and $\boldsymbol{\varepsilon_t} \sim$ NID(0, $\boldsymbol{\Omega}$) with $\boldsymbol{\Omega}$ positive definite. It is also assumed that the matrix Π is of reduced rank r $(0 < r < n)$ so that we can write

$$\Pi = \alpha\beta',$$

where α and β are $n \times r$ matrices of full column rank. We also assume that the parameters of the model satisfy the conditions of Johansen´s (1995, p. 49) version of Granger's representation theorem because we are interested in time series cointegrated of order (1, 1). So, with a suitable specification of initial values, both Δy_t and $\beta' y_t$ are stationary around deterministic trends (see Johansen, 1995 p. 49). Thus we can conclude that the ML estimator of the space spanned by β and the rest of the parameter estimators can be found by Johansen`s algorithm (1991).

3.2 Nonlinear Model

In its deterministic sequence d_t the standard model described above may contain an intercept term, several dummies and possibly a linear time trend. The standard model may fail if the mean of the error correction term $\beta' y_t$ changes in a nonlinear fashion. As a consequence the stationarity conditions are violated and the parameters of the model are not properly estimated. In this study the nonlinear deterministic trend of time is absorbed into the cointegrating relations but, however, the intercept term cannot be restricted into the cointegration space here. Then the sequence $\boldsymbol{d_t}$ is of the form

$$\boldsymbol{d_t} = \chi_t - \alpha g_t(\mu) \qquad (7)$$

where χ_t is a $n \times 1$ column vector of those deterministic components that are not included in the cointegrating relations and $g_t(\mu)$ is a generally nonlinear deterministic function of time with parameter vector $\boldsymbol{\mu}$. Thus we can proceed as Ripatti and Saikkonen (2001) and rewrite the equation (6) as

$$\Delta y_t = \chi_t + a(\beta` y_{t-1} - g_t(\mu)) + \Gamma_1 \Delta y_{t-1} + \ldots + \Gamma_{k-1} \Delta y_{t-k+1} + \varepsilon_t. \qquad (8)$$

From Granger's representation theorem we can thus conclude that yt has Wold moving average representation.

A convenient way to specify the nonlinear sequence gt(μ) is to assume that it depends on t/T such that gt(t/T; μ) takes values between 0 and 1. The function gt(; μ) may be specified as

$$g_t(t/T;\mu) = [1 + exp\{-\gamma(t/T - \tau)\}]^{-1}\delta \qquad (9)$$

or

$$g_t(t/T;\mu) = [1 - exp\{-\gamma(t/T - \tau)^2\}]\delta \qquad (10a)$$

or

$$g_t(t/T;\mu) = exp\{-\gamma(t/T - \tau)^2\}\delta \ , \qquad (10b)$$

where μ =[δ`, γ, τ]` with δ unknown n×1 parameter vector while γ and τ are scalar parameters with τ and γ >0 . These functions model a smooth or continuous structural change in the coefficients of a dynamic regression model (see Teräsvirta, 1998, for a review). In (9) the smooth change is modeled by a logistic function and the idea is to add a new level to the equilibrium described by β´yt. In (10a) and (10b) the density function of the normal distribution is utilised and the change about parameter τ, which determines the average location of the change, is symmetric. Parameter γ is a slope parameter which indicates how rapid the change is. The smaller the value of γ, the longer it takes for the term to reach its new level. If in (9) the value of γ is `large`, we are close to the case of a sudden structural break i.e. step dummy (for details see, for example, Ripatti and Saikkonen, 2001). Finally, there can be more than a single smooth transition in the term to which the transition applies.

The parameters of the nonlinear model in (8) can be estimated by ML, see Saikkonen (2001 a,b). Conventional dummy variables may also be included. The most important cases to be excluded are structural breaks with unknown break dates (conventional regime switching models) or dummy variables with jump dates which depend on unknown parameters. This maximisation problem is naturally nonlinear. Saikkonen (2001a) shows that, under suitable regularity conditions, the ML estimators are consistent and standard inference can be applied except for the linearity hypothesis because of an identification problem of the slope parameter, see Lin and Teräsvirta (1994).

4 Empirical Study

4.1 Data and History

The data are from the Bank of Finland and Statistics Finland databases and consist of seasonally unadjusted monthly data on harmonised broad money (M3H) defined on February 2002, a monthly volume indicator (a combined index of various indicators such as industrial production, retail sales, consumption of electricity, etc.) for real gross domestic product (GDP) as a scale variable (a proxy for consumption), the consumer price index (1990 = 100), the three-month money market interest rate as an opportunity cost for money and the own yield on money from the years 1980 – 1996. Graphs of the variables and specific definitions are shown in Figure 1.

During the time period considered in this study the financial institutions in Finland changed significantly; see e.g. Vihriälä (1990) and Koskenkylä (ed.) (2003). In the 1980s deregulation of the financial market took place in Finland as in other OECD countries; deposit and loan rates were liberalised, credit rationing was abolished, money markets were created and capital movements were deregulated. As a result of cross-border trade in financial services (tighter competition), technological advancement and banking crisis of the early 1990s the Finnish banking sector changed substantially. Recession of the early 1990s and some severe crisis in the development of international economy resulted to floating of Finnish markka in 1992. Then the Finnish markka devaluated substantially. In 1996 Finland joined to the Exchange Rate Mechanism (ERM) system and the course of Finnish markka was fixed against the other euro currencies. These changes could be seen as reasons for economic agents to alter their behaviour in a nonlinear manner (in some cases also in advance when the agents know the forthcoming mandatory change).

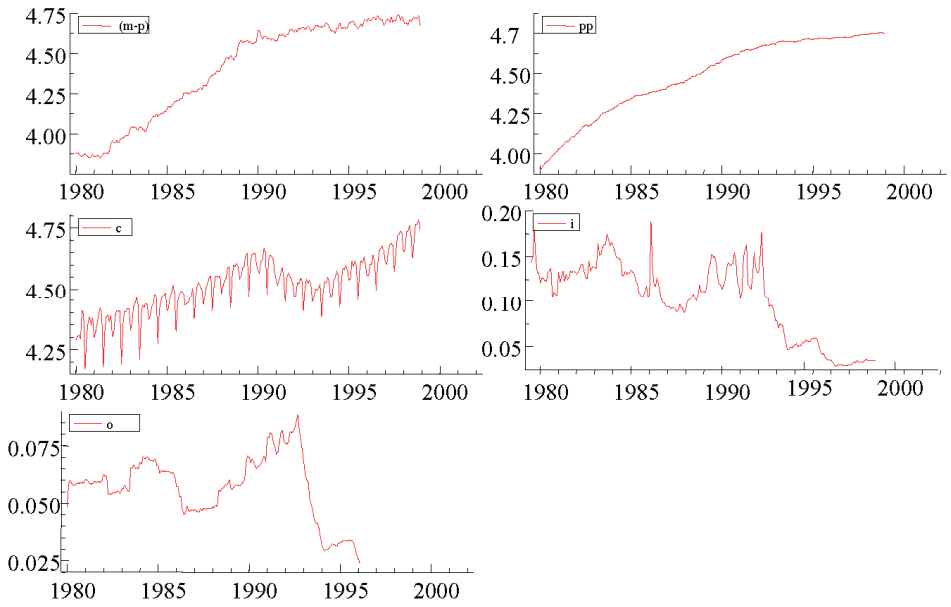

FIGURE 1 Variables graphs: *(m-p)* is the log index of harmonised real money balances (1990 = 100, mm-pp), *pp* the consumer price index (1990 = 100), *c* the log index of monthly volume indicator for real gross domestic production (1990 = 100) as a proxy for consumption, *i* the 3-month money market rate and *o* the own yield of broad money after taxes.

4.2 Linear Model for Finnish Money Demand

Before we consider including any nonlinear component in the cointegrating relations, we proceed as Ripatti (1998) and form a linear empirical model from the equilibrium relations between the variables. These parameters then reflect the parameters of the utility function (Ripatti 1998, p. 88).

First we form an unrestricted VAR for real money, real GDP, the short term interest rate and the own yield of money included in the system. Lag length k = 4 produced the best results to eliminate the autocorrelation of the residuals, but the normality conditions were violated due to excess curtosis. Centred seasonal dummies were included in the model because of the strong seasonal pattern of the scale variable (GDP). Those dummies do not affect to the asymptotic distributions of the test statistics of the model. We added a dummy to the cointegration space to capture the possible effects of the financial liberalisation of the year 1987 for period 4 onward (D87:4) to interest rate relation (for the motivation for this, see Ripatti and Saikkonen, 2001; there was a deregulation of issuing certificates of deposits in 1987). Therefore the critical values of the trace test for the cointegration rank r reported in Table 1 are calculated with Disco program by Nielsen (1997).

TABLE 1 Trace test of cointegration rank (Johansen & Nielsen 1993)

H_0	λ_{trace}	95%	97.5%
r = 0	66.31	51.25	54.36
r ≤ 1	33.51	32.67	35.11
r ≤ 2	14.19	17.94	20.30
r ≤ 3	3.50	5.96	7.20

The trace test suggests one cointegrating vector in the parameter space instead of the two expected according to the theory. The results are parallel to those of Ripatti (1998) for broad money, as in the main the same data was used (the only exception is for broad money, the definition of which was renewed). One reason for this could be that some of the parameters are integrated of order two, I(2). Another reason may be the presence of nonlinearity. As the stationarity conditions could be violated by this I(2):ness, we have to test it. The test is carried out according to the two-step procedure proposed by Johansen (1995). In this case the possible I(2):ness is clearly rejected by the test (results available upon request).

We then restricted the relations according to the theory presented in section 2. In the restricted relations the parameters of the semi elasticity of the own yield of money, scale elasticity and step dummy 87:4 were estimated freely. The results are presented in Table 2.

TABLE 2 Restricted cointegration relations

real broad money	real gdp	short term interest rate	own yield of money	D87:4
1	-3.3387 (0.33757)	0	0	0
0	0	1	-1.819 (0.12397)	0.023835 (0.0035035)

The restrictions can not be rejected (the p-value equals 0.11). The potential presence of nonlinearity could affect the rank as the discussion in Ripatti and Saikkonen (1998) shows. The recursive estimates of the parameters and stability test (not shown here, test results available upon request) are unstable.

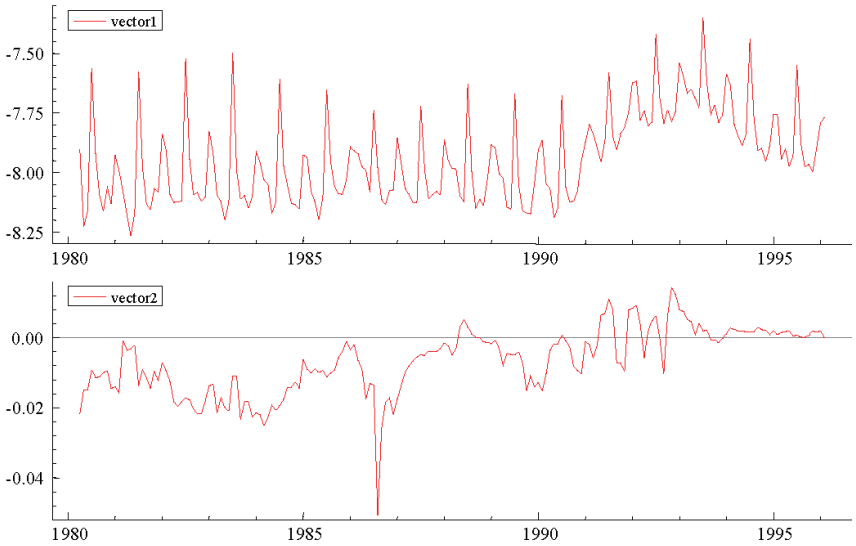

FIGURE 2 Restricted cointegration relations

Figure 2 shows the cointegration relations restricted according to the theory derived in section 2. The first vector that is not stationary in any sense (possibly due to the recession on account of the timing of the nonstationarity) is between money aggregate M3H and the scale variable (GDP as a proxy for consumption); these variables are in logarithmic form. The second vector is between interest rates which, instead are not in logarithmic form. Because of very strong seasonal pattern the seasonality could be seen from the figures although seasonal dummies are included.

An explanation for the fact, that we did not find the expected cointegration with the scale variable and aggregate money, lie in the fluctuations of the business cycle during the 1990s. Fluctuations of this kind could induce nonlinearities into the macro economic relations (see Potter, 1999 p. 516). These unmodelled changes could possibly be fixed by nonlinear modelling. As discussed earlier, the nonstationarity in the present case could potentially be modelled by a smooth deterministic function of time that describes the gradual change in the preferences of economic agents.

5 Nonlinear Model for Finnish Money Demand

We continued modelling the demand for money in Finland by adding a nonlinear part into the cointegration space to model the change in the intercept term (but, of course, the change could happen in any of the parameters). This enables us to judge whether the nonlinear extension gives a model with better stability properties.

We continue with the model that was estimated by linear methods in previous section and is derived and constrained according to the theory outlined in section 2. As in the linear case, we added a step dummy, d87: 4, to approximate a change in the intercept term in the interest rate relation. Ripatti and Saikkonen (2001) modeled the same change with a gradually changing smooth deterministic trend of time that is additive to the intercept term. As we want to limit the number of transition variables to be estimated we do not include a separate deterministic trend to this interest rate relation. From the graphs of the restricted cointegration relation shown in Figure 2 we can get an idea of the possible timing and shape of the gradual change. To select the best-fitting model we try different specifications of the shape of underlying nonlinearity (functions 9 – 10b), and in each case test the restrictions on the cointegration space implied by the theory. The highest p-value is for a model that is specified as function 10b, in which case the transmission has been a symmetrical 'bell shape' change (see the transition function in Figure 3). The timing of the nonlinear trend is found in its natural place in the deepest years of the recession of 1990s.

FIGURE 3 The estimated nonlinear deterministic time trend.

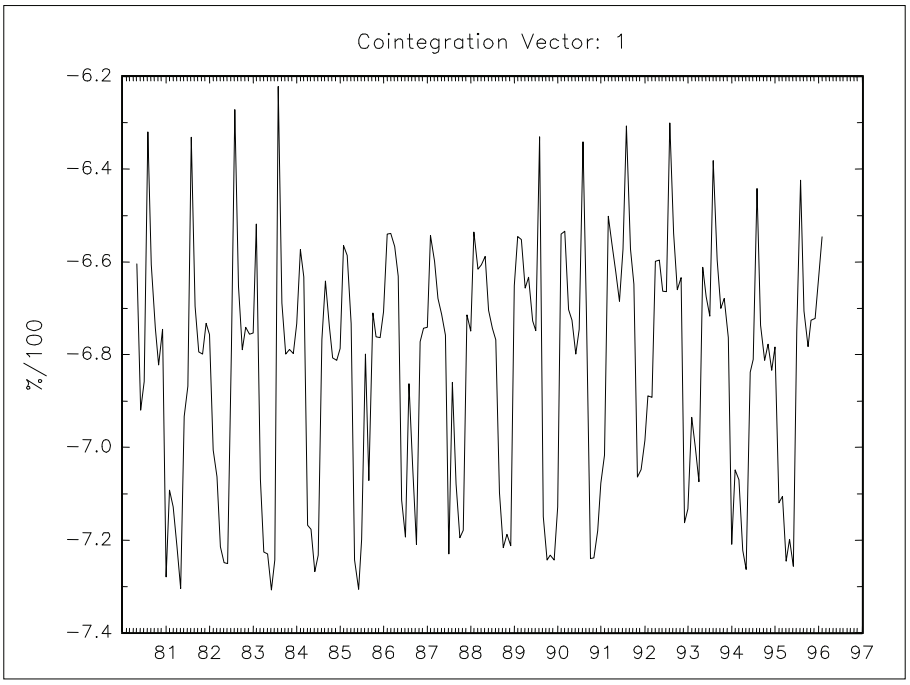

FIGURE 4 Cointegration relation with estimated nonlinear time trend.

The preferred restricted model is

$$\Delta \boldsymbol{y}_t = \boldsymbol{\chi} - \boldsymbol{a}\{\boldsymbol{y}_{1,t-1} - \boldsymbol{A}\, \boldsymbol{y}_{2,t-1} - \boldsymbol{d} - \boldsymbol{\varphi} f(\boldsymbol{\gamma}((t/T) - \tau))\} - \boldsymbol{\Gamma}\boldsymbol{q}_t + \boldsymbol{\varepsilon}_t , \qquad (11)$$

where $\boldsymbol{\chi}$ is a 4×1 parameter vector of the intercept terms, $\boldsymbol{y}_t=[y_{1,t}' , y_{2,t}']'$ with $\boldsymbol{y}_{1,t}= [(m_t - p_t)\ i_t]'$ and $\boldsymbol{y}_{2,t}=[c_t\ o_t\ ]'$, where $(m_t - p_t)$ is the logarithmic index of the real money balances, i_t is the nominal 3-month interest rate, c_t is a logarithmic index of the scale variable (GDP volume indicator, 1990=100) as a proxy for consumption and o_t is the nominal own yield of money. Moreover, $\boldsymbol{A}$ is a 2×2 matrix and $\boldsymbol{\varphi}$ is a 2×1 vector of parameters and $f(\gamma((t/T) - \tau) = exp\{\gamma((t/T)-\tau)^2\}$. It is then assumed that the form of nonlinearity is the same in each cointegrating relation. The step dummy d87:4 is included in the 2×1 vector $\boldsymbol{d}$.

Visual inspection of Figure 4 indicates, that the cointegrating vector between the money aggregate and the scale variable is stationary. Thus there is evidence in favour of a cointegration relation if the changes in behaviour of economic agents occur in the nonlinear fashion given by model (11) form.

The ML estimates of the long-run parameters of the model are as follows (standard errors of the level parameters are given in parenthesis);

$$\Delta\begin{bmatrix}(m-p)\\ c\\ i\\ o\end{bmatrix}_t = \begin{bmatrix}-0.6776 & -0.1647\\ -0.0097 & 0.0769\\ 0.2153 & -0.0512\\ -0.2709 & -0.0133\end{bmatrix}\left\{\begin{bmatrix}(m-p)\\ i\end{bmatrix}_{t-1} - \begin{bmatrix}2.4796 & 0\\ (0.0983) & \\ 0 & 1.7679\\ & (0.576)\end{bmatrix}\begin{bmatrix}c\\ o\end{bmatrix}_{t-1} - d - \begin{bmatrix}0.3399\\ (0.0318)\\ 0\end{bmatrix}\exp[-55(\frac{t}{T}-0.8604)^2]\right\}$$

$$+ \chi + \Gamma q_t + \varepsilon_t$$

The estimates for the scale elasticity and semielasticity of the own-yield of money are quite reasonable in the model that contains the nonlinear time trend. Nonetheless the magnitude of these parameters is greater than expected. A theoretically and empirically congruent explanation could, however, be found: the contents of the components belonging to the money aggregate M3H were formed at the beginning of the period under study and no such components existed before the deregulation of the money market. Moreover, as Fase and Winder (1999) show, the strong increase in broad money (in Europe) should be attributed to portfolio investment considerations rather than to an expansionary monetary policy. The same market formation is naturally also behind the semi elasticity parameter of the own-yield of money.

The nonlinear deterministic trend of time is restricted to appear only in the relation between money and its scale variable, because in the other relation for the interest rates it is rejected by the LR-test at the 5% significance level, and only distorts the relation in an unstationary direction. All the parameters have been estimated as conditional on the location and slope parameters of the transition process (τ- and γ-parameters which are found after several iterations of estimation conditional on the other parameters).

6 Conclusions

The purpose of this paper is to examine how the potential nonlinearity due to structural change in the demand for money relation could be modelled and then re-evaluate the stability problem from the monetary policy point of view. The proposed approach is demanding because of the statistical problems related to the ML estimation of the parameters in the case of a nonlinear time trend. The results show that a stable demand for money relation can be found by utilizing nonlinear methods. It is the level of money holdings with respect to the scale variable which appears to have been affected by the recession because nonlinearity seems to be related to the intercept term. By taking into account the

potential nonlinearities we can thus receive a reasonable solution from the stability point of view. But from the stand point of monetary policy some considerations remain. First, where do these nonlinearities due to structural changes come from? Then, what effect do these changes have on the attainment of the objectives of a given monetary policy?

It could be that the preferences of economic agents have changed during period under study or that the policy regime has changed thereby inducing changes in the behaviour of agents (Lucas, 1976) or that the technologies have changed. It is reasonable to assume that the recession would have affected the level of financial assets held by agents but not their preferences because the smooth transition is related to the intercept term. Hence the demand for money is not unstable if we allow for nonlinearities in the model. If instability is the only reason for rejecting money growth as an intermediate target for monetary policy implementation, then it has to be re-evaluated. In the linear world we thus can draw the wrong conclusions and inferences. Evaluating the second question is more problematic. Recent research has shown that the connections between the monetary transmission mechanism and the objectives of monetary policy depend to a large extent on the structure of the economy (Juselius, 1999 in Lütkepohl & Wolters ed)). Therefore we have to take into account the sources of nominal rigidities (Walsh, 2002) and the framework (monetary – or inflation targeting or a mixture of both) under which monetary policy is executed. Before we can make any conclusions about the usefulness of money growth as an intermediate target in monetary policy implementation, we have to step away from a linear world. This calls for a proper theoretical framework within which to analyse these monetary issues.

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CHAPTER 3

STRUCTURAL DIFFERENCES IN DEMAND FOR MONEY OF SOME EURO COUNTRIES*

Abstract
This paper focuses on the identification of cross country differences in the structures of the money markets among some of the euro countries during the ERM period. Whatever the sources of these differences are, they can be very important from the point of view of country-specific effects of common monetary (policy) shocks and, consequently, of understanding the potential differences across countries in the transmission mechanism of common monetary policy in the euro area. The approach taken in this paper to identify the differences is based on the country- specific demand for money relations. The country-specific relations of the variables are analysed in a multivariate context using Johansen`s procedure. Here the structural equations and the cointegration space are identified. We specify a congruent model that fits most of the countries. The results suggest that not only are there differences in the parameters of the country-specific money demand functions, but the structural characteristics of the money demand relations also display differences. Finally, from the monetary policy point of view, our results indicate that only a subsample of the countries forms a uniform group where the parameters and the structures of demand for money are of the same kind. (JEL: C32, E 41, E 52)

Keywords: demand for money, structures of the money markets, cross country differences

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1 Introduction

This study analyses the structural differences in the money markets of several euro countries, namely Austria, Belgium, Finland, France, Germany, Italy, The Netherlands and Spain, during 1983-1998 in the Exchange Rate Mechanism period (ERM-period). The money market plays a crucial role in the operating procedures of central bank. Since 1.1.1999, the countries participating in the European Monetary Union (EMU) have formed a single monetary policy regime. The conduct of this policy is centralised under one authority, the Governing Council of the European Central Bank (ECB Council). The national central banks have each their own governor in this council and hence they have influence on the unified policy-making process. The national economic information and -structure may contribute to the decision making, see e.g. De Grauwe (2000) and to the effects of monetary policy, see e.g. Juselius (1999), Dedola, Gaiotti and Silipo (2001), Golinelli and Pastorello (2002) and Ehrmann (2000). Hence it is of crucial importance to detect the extent to which the economic structures of these participating countries bear similarities. Although the institutional change has been huge, its influence on economic behaviour and structures need not have been as drastic, see e.g. Clausen and Hayo (2006) and Mihov (2001). Earlier studies imply that asymmetries in the effects of monetary policy could exist owing to different economic structures; for a discussion see e.g. Angeloni, Kashyap and Mojon (eds), (2003).

Structural differences in the markets involved, and hence asymmetries in transmission processes, will disappear over a relatively short period if their main source has been institutional such as through the different operating procedures of central banks. We can, however, distinguish at least three reasons related to the structures of these markets for conducting empirical research on asymmetries. Despite the integration process that has taken place, asymmetric transmission due to structural differences exist in the circumstances outlined below.

First, the evolution of the national money market as a part of wider financial markets has diverged. Those markets are affected by economic conditions which, in turn, are affected by the divergent production structures of the member countries. Also the countries could be affected by shocks that generate diverse responses. Second, there will be new member countries in the future. In those countries the financial markets have evolved differently from those in recent member countries, see e.g. Clausen and Hayo (2006) and Golinelli and Rovelli (2001). Third, as long as there are differences in taxation between the member countries, the allocation of capital will diverge, leading to differences in the production structure and demand for money as well.

These structural differences, in turn, impinge on the channels through which monetary policy is transmitted and probably also show up in differential effects of the common monetary policy, see Ciccarelli and Rebucci (2006).

Empirical research that concerns the implementation of monetary policy and its effects in the EMU has been widely carried out and studies focusing on

different aspects of asymmetries are numerous. Because of its breadth only the main aspects of this research are briefly surveyed in the following section. Despite all this intensive research, a comprehensive study of the structural differences in the demand for money related to the functioning of the national money markets of the economies in EMU is useful. This is because earlier studies have not considered national characteristics of the demand for money as closely as they deserve. This is one of the contributions of this paper. Another important feature of this paper is that it considers the importance of the structural differences to the transmission of shocks. As noted by e.g. Golinelli and Pastorello (2002), euro area-wide money demand equations that are based on aggregated data seem to perform well, but are obvious to hide the national characteristics. In other words, an average money demand equation for the euro area could be significantly different from those of individual countries. For this reason we specify the equations at national level by starting from a similar structure and then identify the structural characteristics that potentially generate differences. We then compare these characteristics to see if a potential subgroup exists which forms a uniform group in terms of parameters magnitude.

The scheme for identifying the differences in the countries' money markets relies on the interaction of variables that have relevance for the demand for money. As far as structural differences are concerned, this paper focuses on long-run money demand relations and, in particular, on potential heterogeneity of the money market structures and parameters, reflecting, among other things, preferences of economic agents. Methodologically this paper is closely akin to the multivariate VAR scheme (Vector Auto Regression) employed by Juselius (1999) in her study comparing the monetary transmission mechanism and changes in it in three EU countries (Germany, Denmark and Italy). The country-specific structural equations reflecting the behaviour (preferences) of economic agents and institutional features are derived after several restrictions and tests and hence the country specific cointegration space is identified. Due to fact that the data is seasonally adjusted and converted into one currency, the euro, we do not study the potential nonlinearities. This is because it is not known what may happen to nonlinearities of a (currency) series when it is converted and moreover filtered by applying some seasonal adjustment procedure.

The rest of this chapter is structured as follows. Section 2 surveys the existing studies on asymmetries (concentrating on transmission and shocks) from the monetary policy point of view. The main points of the history during the ERM-period together with the data are surveyed in section 3. Section 4 in turn deals with considerations of monetary policy design as well as requirements for empirical studies based on pre-EMU data to provide valuable information on monetary transmission after the formation of the EMU. The theoretical model to derive the demand for money and related money market relations is also considered here. The empirical single country models are analysed in section 5 with special attention to structural changes and breaks in the long-run demand for money relations. Finally section 6 concludes the study.

2 Review of Approaches Regarding Structural Differences

In this section the main approaches of the empirical and of the theoretical research concerning asymmetries faced by the monetary authority are reviewed. First of all, we distinguish two kinds of asymmetries by their nature (origin): shocks and transmission. The case of asymmetric shocks is the traditional situation in the theoretical Optimum Currency Area literature that dates back to Mundell (1961): a group of economies (identical in transmission structure) forming a monetary union face a shock that is not common to all. Asymmetry in transmission in turn means that economies face a common shock but the different economic structures of these economies generate diverse responses to these shocks. This latter case is the main focus of this paper.

2.1 Some Theoretical Aspects

A study by Driver and Wren-Lewis (1999) examines the costs imposed by asymmetric shocks under the EMU in a simple two-country New Keynesian framework. As these costs depend on the interaction of real and nominal inertia within economies the study considers how two countries might respond to such a shock in a rational expectations model combining nominal inertia in price setting with real wage rigidity. Their model could also be extended to asymmetric structures and across several countries.

De Grauwe (2000), in turn, examines the problems of common monetary policy execution in a two-country model assuming that the inflation dynamics of these two countries is generated by a forward-looking Phillips curve. In De Grauwe's study both the shocks and transmission process differ between countries. As a natural finding the paper shows that as the degree of asymmetries increases, the effectiveness of the stabilisation of output and unemployment is reduced because of asymmetry in the transmission of the procedures for stabilisation. In this respect an interesting aspect would be, if national central banks continue to exert influence (for reasons of national interest) on the policy-making process of the European System of Central Banks, ESCB, as they are assumed to act without (strong) national interest.

A third related study (and approach) is that of Walsh (2002). The study is an examination of the lessons that recent academic research offers, mainly in relation to the choice of monetary policy framework. Walsh considers different aspects of economic structures that contribute to monetary policy design. The choice of monetary policy framework is classified into targeting the money supply or inflation, depending on the focus of the policy (goals or intermediate targeting procedures). One of the several findings is that both of the operating procedures can ensure that a policy is implemented in a transparent and credible manner that anchors private sector expectations about future inflation. It is then that the connections between the monetary transmission mechanism and the monetary policy objectives account for the success of the policy imple-

mented, this is also pointed out by Svensson (2003b). These different operating procedures to some extent also seem to explain the findings of the present study.

2.2 Some Empirical Considerations

Empirical work on asymmetries in the macroeconomic effects of monetary policy in the euro area is mainly based on VAR models and impulse response analyses[4]. The number of euro countries covered, the theoretical considerations and hence variables included, and identification scheme, however, differ between studies. Nevertheless, the main finding of all these studies is that differences in the transmission process exist, see e.g. Ciccareli and Rebucci (2006), Ehrmann (2000) for a review, Marques-Ibanez (2009) for the role of banks in the transmission mechanism and Beyer and Juselius (2010) for methodological issues concerning aggregation of the areawide data on monetary policy transmission analysis.

Another strand of studies examines the effects of monetary policy by relying on simulations from macroeconomic models, either country-specific or multi-country. These studies use the main transmission channels, namely the exchange rate, substitution-effect-in-consumption, cost-of-capital, cash flow / income and wealth channels in their analyses as well as, in some cases, country-specific channels. For a review of these studies, see for example Els, Locarno, Morgan and Villetelle (2003).

A third approach relies on structural or semi-structural modelling; see e.g. Clausen and Hayo (2006). This approach utilises a system of equations but, unlike normal VAR models, it does not treat all variables as endogenous. It does not include all the variables in all equations and does not impose the same lag length for each variable. This approach, then, ought to avoid some statistical problems evident in more structural approaches, while being reasonably accurate reflection of the data generating process.

A fourth approach examines the heterogeneity of countries or the behaviour of intra-country economic agents utilising panel data methods. Examples of the first are the studies by Golinelli and Pastorello (2002), and Dedola, Gaiotti and Silipo (2001). These studies focus on the poolability (aggregating) of national money demand data, differences in the elasticity parameters of national models and the heterogeneity of adjustment (short-run) parameters in an areawide relationship. Utilising panel data methods to examine intra-country transmission channels and the heterogeneity of agents see e.g. Topi and Vilmunen (2003) for Finland, and Loupias, Savignac and Sevestre (2003) for France.

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[4] From the present perspective these studies mostly neglect other extensions of integration than I(1) analyses. Therefore, although with this procedure it is possible to detect to some extent the characteristics of the process that has generated the data, we may obtain distorted and imprecise estimates of underlying parameters.

3 History and Data

This study mainly covers the years 1983-1998 from the ERM-period. The exact period of investigation for each country depends on the availability of the data and date of membership of the European Monetary System, EMS. This period represents the most homogeneous years from the monetary regime point of view, in spite of some country- specific reforms, realignments and deregulation of the financial markets that took place. As the purpose of this paper is to examine money market structures and cross-country differences in them, while avoiding the risk of parameters instability, the time period has been chosen to include only one monetary policy regime in each country. Two of the countries, namely Finland and Spain (from 1995 onward) were inflation targeters during this period while the others were monetary targeters. Whether these different operating procedures resulted in different outcomes from the money market point of view will be discussed in the empirical part.

TABLE 1 Countries' membership in the ERM and period of study

country	ERM membership	the estimation sample
Austria	9.1.1995 – 31.12.1998	1988:3 – 1998:4
Belgium	13.3.1979 – 31.12.1998	1983:1 – 1998:4
Finland[5]	14.10.1996 – 31.12.1998	1983:1 – 1997:4
France	13.3.1979 – 31.12.1998	1983:1 – 1998:1
Germany	13.3.1979 – 31.12.1998	1983:1 – 1998:4
Italy	13.3.1979 – 17.9.1992 and 25.11.1996 – 31.12.1998	1983:1 – 1998:1
Netherlands	13.3.1979 – 31.12.1998	1983:1 – 1998:4
Spain	19.6.1989 – 31.12.1998	1983:1 – 1997:3

As the table 1 show, the sample periods are slightly different for some of the eight countries depending on availability of the data and the creation of the money market in the country in question.

Differences in the financial structures of these countries could reveal another plausible reason for the existence of differences in money market-related relations. A general feature of most European countries is that corporate sector finance relies to a large extent on bank loans. Although this is the case in the countries under study, some notable country level differences exist, as confirmed by the work of Ehrmann, Gambacorta, Martinez-Pages, Sevestre and Worms (2001). This in turn implies the existence of gaps in response to monetary policy due to differences in the structure of the banking system in the euro area.

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5 By a unilateral decision Finland was linked to the ecu (European currency unit) for a short period during 1991-1992.

The data are from OECD`s database Main Economic Indicators and consists of seasonally adjusted quarterly data on broad money M3, gross domestic product (GDP) as a proxy for consumption, the 3-month money market interest rate, long-term (5-7 year) bond rate and the consumer price index, CPI (1995 = 100). The seasonal variation is filtered (by X-11 Arima) and a flexible exchange rate is utilised in relation to the basket currency, the ecu (European currency unit), during the period under study. As the focus is here on the long run relations, we do not study the short-run adjustment processes (or exact nature of nonlinearities) in the relations.

4 Implementation of Monetary Policy and Demand for Money

We have to consider, do analyses of monetary aggregate behaviour in the pre-EMU period give any valuable information for the analysis of monetary policy implementation in the EMU where the regime is a common monetary policy area. Some studies, (e.g. Ehrman, 2000 and Mojon & Peersman, 2001) that compare monetary policy transmission and effects across the same period and countries as here, do not include money in their model. The motivation for this has mainly been that the exchange rate goal has been dominant in these countries. Monetary aggregates have then had a secondary role in the countries' policy strategies. It is also noted, that interest rates in other ERM countries have adjusted to the German rate (see e.g. Ehrmann, 2000). However because in decision making (monetary targeting) by the ECB monetary analysis has a prominent role (at least money serves as an indicator variable) and the convergence of the structures of the economies within the sample countries is most likely a gradual one, we have good reasons to analyse the structures of money markets and behaviour of monetary aggregates, see e.g. Clausen and Hayo (2006) and Gerlach and Svensson (2003), with historical data and money still have an important role for implementation of monetary policy, see Schabert and Stoltenberg (2005) and Nelson (2003). This study, then, will reveal how much the countries studied bear similarities in terms of structures of the demand for money relations before launching of euro.

A simple (but controversial, see Svensson 2003 a) example illustrating the transmission mechanism following a monetary expansion goes as follows:

$$\begin{array}{ccccccccc} & (+) & & (-) & (-) & & (+) & & (+) \\ (m - m^*) & \rightarrow & R_S & \rightarrow & R_l & \rightarrow & (y - y^*) & \rightarrow & \Delta p \end{array},$$

where m stands for money, R_S for short-term and R_l for long-term interest rates, y for consumption and Δp for inflation. An asterisk over a variable stands for a steady-state value determined later. When the economy experiences excess liquidity $(m - m^*) > 0$ it causes interest rates to fall and hence consumption / investments to rise.

If the Central Bank raises interest rates it will cause a reverse mechanism to take place.

4.1 Money Demand

A general form of the money demand function is

$$M/P = f(Y, R_s, R_b), \tag{1}$$

where Y is a scale variable (real production, consumption), R_s is the own rate of return on money (usually 0) and R_b is the opportunity cost of holding money. In log linear terms, with the scale variable (production / consumption) in real terms and using semi-elasticity for the interest rates, (1) can be written as

$$m_t - p_t - (\beta_0 + \beta_1 y_t + \beta_2 R_{st} + \beta_3 R_{bt}) = \mu_t, \tag{2}$$

where μ_t is a stochastic error term and t is an index for period. Such a relationship can be derived, for example, from the (intratemporal) marginal rate of substitution between real balances and consumption in an intertemporal optimisation problem of a representative agent with preferences represented by a money-in-the-utility-function model. This allows us to compare the preferences of agents across different economies as the parameters of the utility function are reflected in the coefficients of the long-run money demand function. The money-in-the-utility-function (MIUF) model was originally developed by Sidrauski (1967), who employed a neoclassical growth framework to the study of monetary phenomena. In this context the analysis of monetary issues relevant to monetary policy implementation is analytically interesting.

In what follows we shall work with a specific, easily log-linearizable form of the utility function the parameterisation of which was developed by Ripatti (1998) in his money demand analysis. Naturally, other forms and parameterisations are possible; see e.g. Stracca (2001). More specifically, given separable consumption and real money balances per period utility function with isoelastic functional forms, the marginal rate of substitution between consumption and real money balances implies[6]

$$1 - \frac{R_{st}}{R_{bt}} = \xi_t C_t^{\rho} \left(\frac{M_t}{P_t} \right)^{\omega},$$

where ξ_t is the stochastic weight on the real money balances in the utility function, ρ and ω are risk aversion parameters, ρ for consumption and ω for money. Log linearising and denoting log levels by lower case letters we have (with the steady state value equal to one)

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[6] For a more detailed analysis, see Koskinen (2004).

$$\frac{1}{\omega}\left(1-\frac{R_s}{R_b}\right)v_t=\left(1-\frac{R_s}{R_b}\right)\left(m_t-p_t-\frac{\rho}{\omega}c_t\right)+\frac{R_s}{R_b}\frac{1}{\omega}\left(r_{bt}-r_{st}\right). \qquad (3)$$

In order for the r.h.s. to be stationary, given that the log levels of the individual variables are generated by unit root processes, they must be cointegrated. Different parameterisations give rise to different cointegration relations, but we are particularly interested in two specific parameterisations and, hence two sets of cointegrating vectors. First of all, the particular parameterisations above suggest two cointegrating vectors: net interest rate opportunity cost, r_{bt} - r_{st}, and the `adjusted´ velocity, m_t- p_t- $c_t\rho\omega^{-1}$. These should be stationary so that the corresponding vectors would form the two rows of the matrix

$$\beta_1`=\begin{bmatrix}1 & -1 & -\frac{\rho}{\omega} & 0 & 0\\ 0 & 0 & 0 & 1 & -1\end{bmatrix}.$$

On the other hand a slight reparameterisation of the r.h.s. of (3) gives rise to the following cointegration vector:

$$\beta_2'=\begin{bmatrix}1 & -1 & -\frac{\rho}{\omega} & \frac{1-\kappa}{\kappa\omega} & -\frac{1-\kappa}{\kappa\omega}\end{bmatrix},$$

where $\kappa=1-\frac{R_s}{R_b}$. Our maintained hypothesis, then, is that the vector

$$x`_t=[m_t \quad p_t \quad c_t \quad r_{bt} \quad r_{st}]$$

is cointegrated. The rank of the cointegration space is either two or one, with the corresponding cointegration relations given, respectively, by $\beta_1' x_t$ or by $\beta_2' x_t$. In the former case the cointegration space is generated by the two column vectors of the β_1 matrix, say $\beta_1.1$ and $\beta_1.2$, so that all the other stationary linear combinations among the components of the x_t vector, including $\beta_2' x_t$, can be generated by $\beta_1.1$ and $\beta_1.2$, e.g. $\beta_2' x_t$ = $(\beta_1.2$ + $\frac{1-\kappa}{\omega\kappa}\beta_1.2)'x_t$, ie. β_2' = [1 $\frac{1-\kappa}{\omega\kappa}$] β_1' = $\boldsymbol{H}\,\beta_1'$.

4.2 Statistical Model

An n-dimensional vector of time series processes generated by a VAR process of order k, which has observable outcome y_t, t = 1,…, T, can be written in the difference form

$$\Delta y_t=d_t+\Gamma_1\Delta y_{t-1}+\ldots+\Gamma_{k-1}\Delta y_{t-k+1}+\Pi y_{t-1}+\varepsilon_t, \qquad (4)$$

where Δ is a difference operator, $\boldsymbol{\Pi}$ and $\boldsymbol{\Gamma}$ are ($n\times n$) matrices of unknown parameters and d_t is ($n\times 1$) vector of deterministic level variables. Furthermore, the initial values $y_{-k+1},\ldots, y_0$ are observable and $\boldsymbol{\varepsilon_t}$ ~ NID(0, $\boldsymbol{\Omega}$) with $\boldsymbol{\Omega}$ positive

definite. This last assumption is made to facilitate the discussion of likelihood-based methods and could be relaxed if necessary. If it turns out, that the matrix $\mathbf{\Pi}$ is of reduced rank r ($0 < r < n$), so that we can write

$$\mathbf{\Pi} = \alpha\beta',$$

where α and β are $n \times r$ matrices of full column rank, we can conclude that there is cointegration among the variables. We also assume that the parameters of the model satisfy the conditions of Johansen´s (1995, p. 49) version of Granger's representation theorem because we are interested in time series cointegrated of order (1, 1). Thus we can conclude that the ML estimator of the space spanned by β and the rest of the parameter estimators can be found by Johansen`s algorithm (1991). So, with a suitable specification of initial values, both Δy_t and $\beta' y_t$ are stationary around deterministic trends (see Johansen, 1995 p. 49).

5 Empirical Single Country Studies

To study the individual countries´ characteristics in money markets we start with a data vector which is similar for all eight countries, i. e.

$$x'_t = [(m - p),\ y, R_s, R_b,]_t ,$$

where $(m - p)$ is the log of seasonally adjusted real broad money M3, p is log of Consumer Price Index CPI, y is the log of seasonally adjusted real GDP as a proxy for consumption[7], as we use semi-elasticity of interest rates, R_s is short-term (3 month) money market interest rate and R_b is the yield on long-term bonds. Because the own rate of return of money was not available for most of the countries, it is not included in the relations. Omission of the own yield could cause the parameter estimates of the interest rates to be of unexpected sign in relation to money.

The steady-state level parameters β' are estimated by Johansen´s (1991) procedure using PcGive 10 (Doornik, Hendry, 2001) software. The cointegrated VAR in (4) was chosen as the baseline model. Lag length k = 2 was chosen according to the information criteria (Akaike and Schwarz) and to eliminate the autocorrelation for residuals.

In order to identify the cointegration space and the structural relations we continue as follows:

First the data vector is analysed by the trace test to detect the rank; see table 2 and appendix 3. The eigenvalues of the companion matrix of $\mathbf{\Pi}$ are then estimated to augment the trace test and to investigate if some root is on the unit circle. This companion matrix has $n \times k$ roots and counting the number of those near the unit circle and subtracting these from the number of endogenous va-

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7 Unlike for GDP uniformly determined time series for consumption were not available for most of the countries.

riables, we get the number of cointegrating relations, r. Third we test for I(2):ness by the two-step procedure proposed by Johansen in 1995. Then the likelihood ratio test is used to test for the validity of the cointegration restrictions implied by the MIUF model presented earlier. Weak exogeneity of regressors is tested for a chosen rank to support the interpretation of the equation as a contingent model of the demand for money. If the procedure described above does not give stable and plausible cointegration relations, potential nonlinearities could be present; these can be detected and modelled e.g. with the procedure described in chapter 2 of this thesis. These nonlinearities are probably due to structural changes that have happened, altering the parameter values in the cointegration relations in ways that adversely affect the inference on the rank of the cointegration space.

TABLE 2 Results for the rank

variables	Austria	Belgium	Finland	France	Germany	Italy
$(m-p)$, y, R_s,R_b	r = 1	r = 2	r = 1	r = 1	r = 2	r = 2

variables	NLD	Spain
$(m-p)$, y, R_s,R_b	r = 2	r = 1

In Table 2, r indicates the number of cointegrating relations (rank). Here the information from the trace tests (Johansen and Nielsen 1993) and companion matrix are utilised to detect the rank[8]. Several step dummies were included as deterministic terms in cointegration spaces, and therefore the critical values of the trace tests are calculated with the Disco program by Johansen and Nielsen (1993). Intercept and trend terms are not restricted to the cointegration space.

By performing a formal test for I(2):ness (Johansen 1995), we are able to determine the existence of an I(2) component(s) in the system of variables. The p-values of the hypothesis for a given rank and existence of an I(2) component in the LM relation in Austria and Spain[9] are [0.12] for Austria and [0.07] for Spain. However, given the borderline p-values and short time span of the time series, we can conclude in favour of rejecting the hypothesis of I(2) components. In addition, as the short time series (their level) could be governed by local smooth trends, we also check whether there is smoothness caused by a linear deterministic trend; see table 3.

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8 The results for Austria and Finland get support from the companion matrix, results for the trace tests are shown in appendix 3.

9 This is relevant, if domestic inflation is an I(1) variable; see, e.g. Kongsted (2003) and references therein.

TABLE 3 LR-test for exclusion of a trend, p-values for the rejection of the restriction are in parenthesis.

Country	Exclusion of trend from Md relation
Austria	[0.30]
Belgium	[0.45]
Finland	[0.51]
France	[0.00]
Germany	[0.19]
Italy	[0.03]
NLD	[0.01]
Spain	[0.06]

Table 3 shows the results for exclusion of a trend (which is not considered to be in the cointegration space) as the short time series could be governed by local (smooth) trends. In case of Austria, Belgium, Finland, Germany and Spain we can exclude the trend from the money demand relation.

We then proceed to identify the normalised cointegration vector β', where the vector consists of real money, the scale variable, the short-term money market rate and the yield on long-term bonds. To achieve stability of parameters and cointegrating relations we should also consider here the inclusion of step dummies in the cointegration space. This is related to the structural changes that have happened during the time period studied and which could be connected e.g. to the deregulation process of the markets and institutional changes. As economic agents have learned to utilise the available money market instruments, their preferences have altered, and now these are seen as transitions from one level to another.

After estimating the normalised cointegration vector β' (in cases r = 1 we reparameterise the r.h.s. of (3) as $\beta 2'$) we test the restrictions suggested in section 4.1.

In the case of β_1' the restriction matrix is of the form $\begin{bmatrix} 1 & * & 0 & 0 \\ 0 & 0 & 1 & * \end{bmatrix}$,

where we utilise the real money balances (m-p) and the asterisks (*) stands for freely estimated parameters. We are not able to reject the restriction $\beta 1'$ in Belgium and Germany at conventional significance levels, as the p-values are, for these countries respectively, [0.10] and [0.50]. We continue the testing procedure of H $\beta 1'$. In case of Italy and Netherlands we can detect two vectors by adding another of the interest rates to the velocity relation; the p-values (of remaining restrictions) are [0.19] and [0.21] for the two countries respectively.

TABLE 4 Normalised β' vectors, standard deviations in parenthesis[10].

country	$(m\text{-}p)$	y	R_s	R_b
Austria	1	-0.79 (0.03)	0.61 (0.16)	-0.50 (0.30)
Belgium	1	-1.47 (0.06)	0	0
	0	0	1	-1.52 (0.16)
Finland	1	-2.30 (0.44)	3.88	-18.50
France	1	-1.57 (0.16)	-1.78 (0.53)	0
Germany	1	-1.20 (0.04)	0	0
	0	0	1	-1
Italy	1	-2.98 (0.31)	-12.2	0
	0	0	1	-1
Netherlands	1	-1.65 (0.07)	0	-0.508 (0.49)
	0	0	1	-2.38 (0.45)
Spain	1	-1.41 (0.08)	1.97 (0.38)	-1.83 (0.59)

The stability of the parameters and relations is achieved by adding several step dummies to the cointegration space; see appendix 1. This is due to structural changes that have happened in the money markets under scrutiny. These changes, which have altered the preferences of the agents, are now seen as sudden transitions from one level to another, although they are more likely to resemble smooth ones whith a nonlinear nature. Multivariate diagnostic tests show no disturbing heteroscedasticity (test results in appendixes). In the case of Italy and Germany the LR-test supports restricting the relation between interest rates to one-to-one. In the case of Finland and Italy we have fixed the coefficient

10 The standard deviations are not reported in cases where the parameters are fixed in order to identify the normalized cointegration vectors.

of the interest rate(s) to estimate the scale elasticity, otherwise these coefficients are of irrational size.

After determining the cointegration vectors existing in the cointegration space, we test which of the variables are weakly exogenous for it; e.g., in the demand for money relation, agents decide their money holdings (endogenous variable) once they know the current state of these (exogenous) variables. The remaining (endogenous) variables adjust to the disequilibrium caused by exogenous shocks to the system. This test is conducted by means of the likelihood ratio (LR) and, since it depends on the choice of rank, the system as a whole should be considered when interpreting the results. This means that we should also study the driving factors of the other relations in the system to give an explanation, e.g. for the monetary policy execution. In order to test for weak exogeneity of a variable for money, we set the feedback of this variable to zero (restricting the parameter in the loading matrix α to zero) in the equation where money holdings are considered to be endogenous. In this way the p-value of the test is related to acceptance of the given restrictions shown in the table below.

TABLE 5 Test for weak exogeneity of a variable w.r.t. the CI-relation

variable	Austria	Belgium	Finland	France	Germany	Italy
y	no	yes	no	yes	no	yes
R_s	yes	yes	yes	yes	no	yes
R_b	yes	yes	yes	------	yes	no
p-value	[0.07]	[0.09]	[0.40]	[0.09]	[0.61]	[0.52]

variable	NLD	Spain
y	yes	yes
R_s	yes	no
R_b	yes	yes
p-value	[0.15]	[0.65]

As table 5 shows, a conventional demand for money relation, where both interest rates and real consumption are weakly exogenous when money is considered to be endogenous, can be found for Belgium and the Netherlands. Cases where real consumption is exogenous could be considered as implying that monetary policy has no long-run effects on real consumption if money is serving as a medium through which that policy operates (this is naturally the case when monetary policy is considered to have long-run effects only on price level). According to this table, this seems not to be the case in Austria, Finland and Germany. In Italy also the long-term interest rates (together with money holdings) seem to adjust to the disequilibrium caused by exogenous shocks. In Austria, Finland and Spain the results concerning long-term bond rates and their impact on money holdings are interesting: as long-term bonds are found to be

weakly exogenous and have a positive effect on money holdings, they seem to govern the wealth effect for money demand (for a more detailed analysis see e.g. De Santis, Favero and Roffa (2008) and Stern and Stern (2008). If this holds, then the expected equity returns could have a positive impact on the demand for money in the long run.

Next, in order to select the countries which form a uniform and homogeneous group we have to look at the stability and magnitude of the parameters. This uniform structure allows us to possibly pool the data and thereby investigate the properties of the demand for money in the area of these eight countries as a whole.

The stability of the parameters, which reveals the potential structural changes, is investigated by recursive estimation of the cointegration space parameters (Hansen – Johansen, 1993). It is not reasonable to include Finland, Italy and Spain in this uniform and homogenous group because of parameter instability (caused by structural breaks). This is possibly due to the reasons already mentioned, such as institutional change and changes in the preferences of agents. In Finland we found one cointegration relation for real money balances, the scale variable and interest rates. When the demand for broad money in Finland during 1980-1996 is analysed using the nonlinear procedure described in chapter 2 (Koskinen 2004), it turns out that the two cointegration relations suggested by the theory could be found.

The magnitudes of the scale parameters, in turn, are significantly greater in Finland and Italy, as can be seen from table 6.

TABLE 6 Scale elasticity and 95% confidence intervals

country	scale elasticity	95% confidence intervals
Austria	0.79	± 0.01
Belgium	1.47	± 0.01
Finland	2.30	± 0.11
France	1.57	± 0.04
Germany	1.20	± 0.01
Italy	2.98	± 0.08
Netherlands	1.65	± 0.02
Spain	1.41	± 0.02

It has been quite a common practice to aggregate all the data on individual countries (see e.g. Coenen and Vega, 2001) and investigate the properties of this area-wide data. These studies have shown for example that the demand for money has been stable during the ERM period and that the data has properties, such as stability, which allows forecasts to be made. But taken as a whole this kind of procedure will mean that all the country-specific features are lost, as, e.g. Golinelli and Rovelli (2001) have shown. When the estimation period is extended to cover the period from 2001 onwards, these models also suffer from parameter instability. If the vector of variables explaining the demand for

money is augmented with variables capturing the wealth effect, these models will perform well again, as shown, among others, by Beyer (2009) and De Santis et al.

In sum these results show that the money market structure differs across euro-area countries. This occurs in terms of the number of linear relations between variables, the specifics of the estimated system´s adjustment dynamics as well as the implied magnitude of the economies´ preference parameters. These facts are described by the estimated long-run parameters as well as the structure of the cointegration space.

In order to answer the questions about the operating procedures of central banks and the financial structures of these countries we have to remember that the goal of most of these central banks during the period under study was exchange rate stability. This does not vitiate the importance of analysing the money markets during this period for future prospects, as argued earlier. As Walsh (2000) noted, the financial sector and its institutional structure usually determines the operating procedures of central bank, and as these evolve it makes a contribution to the execution of monetary policy.

6 Conclusions

In this paper, using multivariate methods, we studied structural differences in the money markets of some euro countries during the ERM period. This methodology revealed the different nature of the money markets in the countries under scrutiny. The focus was on the country-specific structural characteristics of the cointegration relations between real money balances, real income and interest rates. These structural features should be of interest at the national level of economic policy decision making and execution as they contribute to the asymmetry of the transmission and effects of a common monetary policy. Hence using a targeting rule, for example interest rate operating procedures, for monetary policy execution is not always a simple task, as Svensson (2003 a, b) and Walsh (2002) point out.

A general finding is that a stable linear demand for money relation in the period and countries studied could be specified only for a subset of countries (the 'core' euro countries), namely Austria, Belgium, France, Germany and the Netherlands. A finding related to that on the structural characteristics of the money market relations in the countries studied is that with the linear method utilised here the number of relations between the variables in the ERM period varies and, moreover, parameters are unstable in some cases. This is probably due to different policy implementation and timing in the deregulation of these markets in individual countries as the wealth effect also arises as governing the demand for money. Consequently, as economic agents have gradually learned to utilise the available money market instruments, these relations could display a nonlinear nature. This feature is revealed by adding of several step dummies

to the cointegration relations in order to achieve stability of parameters. Although at this point these dummies are now seen as sudden transitions from one level to another, they are more likely to resemble smooth transitions. Finally, the structural characteristics differ in the nature of the adjusting variables for money holdings.

Parameter heterogeneity with respect to magnitude in turn relates to the different preferences of agents between economies. It is, however, most likely that such heterogeneity will disappear as the integration process continues under the common monetary policy, and market structures and procedures converge.

All these findings are in line with earlier as well as other recent studies concerning the demand for money in the euro area and monetary policy transmission in it; see e.g. Ciccarelli and Rebucci (2006). The main contribution of the present study is that although related studies exist, this is a comprehensive one which examines existing differences before the launch of the euro[11]. Here all the relevant money market information is collected together and the perspective is extended to structures behind the asymmetric transmission of monetary policy in the euro area.

11 Recent research concerning the period since the introduction of the euro have found that while differences concerning structures and monetary policy transmission continue to exist, the EMU has removed the source of idiosyncratic monetary shocks and in consequence the relative variability in performance has narrowed; see Amisano, Giammarioli and Stracca (2009).

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APPENDIX 1

Country	Dummies were included to have a value 1 (zero otherwise) as follows
Austria	1996:2 – 1998:4 in the cointegration space
Belgium	1987:1–1998:4 all in the velocity for money equation in the cointegration space 1991:4 – 1992:1 1993:4 – 1994:2
Finland	1986:3, 4 1987:4 – 1998:4 all in the cointegration space
France	1990:3 – 1993:2 in the cointegration space
Germany	1988:2 – 1989:4 1990:1 - 1992:4 in all the equations in the cointegration space 1992:2, 3
Italy	1989:4 – 1990:4 1991:1 - 1992:4 in all the equations in the cointegration space
NLD	1983:1 – 1986:1 in all the equations in the cointegration space 1985:2 – 1989:1 in the interest rate equation in the cointegration space 1992:1 – 1993:4 in all the equations in the cointegration space 1996:1 – 1998:4 in all the equations in the cointegation space
Spain	1985:2 – 1989:4 in the cointegration space

APPENDIX 2

Single equation tests for residuals

TEST FOR NORMALITY

variable/ country	Austria $\chi^2(2)$	Belgium $\chi^2(2)$	Finland $\chi^2(2)$	France $\chi^2(2)$	Germany $\chi^2(2)$	Italy $\chi^2(2)$	NLD $\chi^2(2)$	Spain $\chi^2(2)$
(m-p)	0.689	0.282	3.404	0.748	**23.052**	0.999	2.964	0.167
y	2.893	0.462	**6.852**	1.694	0.040	0.250	**14.158**	5.839
R_s	4.991	0.294	5.703	**19.297**	6.806	7.250	3.472	**15.494**
R_b	0.009	5.557	**19.029**	1.642	1.011	**19.652**	0.557	0.178

H_0: Normality of residuals

TEST FOR HETEROSCEDASTICITY

test	Austria F(17,7)	Belgium F(19,25)	Finland F(17,23)	France F(17,26)	Germany F(19,25)	I t a l y F(18,24)
(m-p)	0.326	1.125	0.628	0.669	1.291	1.459
y	0.258	0.608	0.525	0.640	0.976	0.339
R_s	0.161	0.427	0.699	1.835	2.288	0.712
R_b	0.247	0.701	1.232	0.682	1.154	0.476

test	N L D F(20,23)	S p a i n F(17,24)
(m-p)	0.526	0.554
y	0.580	0.821
R_s	0.488	0.896
R_b	0.776	0.654

H_0: No disturbing heteroskedasticity

TEST FOR ERROR AUTOCORRELATION from lags 1 to 2

	Austria F(2, 47)	Belgium F(2,47)	Finland F(2, 44)	France F(2, 45)	Germany F(2, 47)	Italy F(2, 45)
(m-p)	0.518	**4.989**	1.626	**7.856**	0.243	0.692
y	0.736	1.038	2.294	0.313	0.586	1.303
R_s	0.159	1.570	0.678	2.350	**11.796**	0.297
R_b	0.662	0.596	2.785	0.766	2.228	0.303

	NLD F(4, 79)	Spain F(2, 44)
(m-p)	0.348	0.541
y	0.909	0.804
R_s	1.311	1.469
R_b	1.218	0.082

H_0: No error autocorrelation
Bold values indicate rejection of the hypotheses at 95% significance level.

APPENDIX 3
Cointegration trace tests, Johansen (1991) and Johansen & Nielsen (1993).

Austria

H_0	statistic	90%	95%
r = 0	51.968	51.321	55.070
r ≤ 1	26.884	34.598	37.294
r ≤ 2	8.634	20.552	22.935

Belgium

H_0	statistic	90%	95%
r = 0	89.966	53.749	57.094
r ≤ 1	48.452	36.045	39.032
r ≤ 2	22.525	21.423	23.953

Finland

H_0	statistic	90%	95%
r = 0	51.69	53.560	57.044
r ≤ 1	27.16	35.981	38.900
r ≤ 2	12.62	21.230	23.644

France

H_0	statistic	90%	95%
r = 0	67.585	45.618	49.082
r ≤ 1	29.140	28.870	31.715
r ≤ 2	10.176	15.380	17.417

Germany

H_0	statistic	90%	95%
r = 0	73.444	53.749	57.094
r ≤ 1	33.981	36.045	39.032
r ≤ 2	14.711	21.423	23.953

Italy

H_0	statistic	90%	95%
r = 0	84.844	45.618	49.082
r ≤ 1	41.420	28.870	31.715
r ≤ 2	13.079	15.380	17.417

NLD

H_0	statistic	90%	95%
r = 0	80.871	53.749	57.094
r ≤ 1	37.944	36.045	39.032
r ≤ 2	15.207	21.423	23.953

Spain

H_0	statistic	90%	95%
r = 0	55.160	53.402	56.891
r ≤ 1	26.944	35.900	38.852
r ≤ 2	9.114	21.242	23.633

CHAPTER 4

THE DYNAMIC EFFECTS OF SHOCKS TO THE LABOUR MARKETS IN FINLAND AND SWEDEN*

Abstract
This study analyses the dynamic effects of shocks to the labour markets of Finland and Sweden during 1980- 2000. The process of adjustment of the labour market is analysed by using a set of long-run identifying restrictions by Blanchard and Quah (1989) on a three-variable system including output growth, real wage growth and unemployment. Three independent structural shocks interpreted as aggregate demand, productivity and labour supply disturbances drive fluctuations in these variables. A common feature in both countries seems to be the full persistence of shocks during the time period under study. The sources of variation and the magnitude of responses due to shocks differ between these countries. In general the responses can be explained by sticky wage theories and hence the labour market dynamics have important implications for monetary policy implementation. (JEL: C 32, E 24, J 29)

Keywords: labour market shocks, Structural Vector Autoregression, insider-outsider union bargaining

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1 Introduction

The issue of how labour markets adjust to shocks has attracted attention for decades. In most OECD countries, particularly in Western Europe and the US, labour markets have come under intensive study (Blanchard and Wolfers (2000)). Recently, the creation of the European Monetary Union has also stimulated interest in understanding the sources and processes of adjustment to shocks of labour markets, see e.g. Adnett (1996) as they potentially affect the price stability which is the primary goal of many of the central banks in western countries.

Although unemployment rates have increased markedly since the 1970s in most OECD countries and particularly in Europe, the experience of Finland and Sweden in the early 1990s is in a sense incomparable with any other. Within three years (1991 – 1993) the Finnish unemployment rate rose approximately from 3 to 20 per cent of the labour force. That same development took place in Sweden although not to quite the same level as in Finland.

This paper investigates empirically the processes of adjustment of the labour market in Finland and in Sweden. To shed some light on this issue, it is crucial to understand both why unemployment has remained at a high level in Finland and how economic policy can be utilised to push unemployment down. The theoretical framework adopted in this study is the insider-outsider union bargaining framework. It is used to identify and explain the shocks that drive fluctuations in the three-variable system. The obtained results are parallel to those implied by sticky wage theories and as such labour market dynamics have implications for inflation dynamics which in turn is a subject of monetary policy implementation.

No similar exercises have been done in Finland with the methodology used in this paper, namely Structural Vector Autoregression (SVAR). However, some related labour market studies exist. Rasi and Viikari (1998) present statistical estimates on the Non Accelerating Inflation Rate of Unemployment (NAIRU) and potential output in Finland. They find out that NAIRU and potential output variate in the long run less than the actual unemployment rate and output. Blanchard and Wolfers (2000), using panel data, examine interactions between shocks and institutions for 20 OECD countries. They find out, that these interactions are crucial for the performance of the labour markets.

The rest of the paper is structured as follows. Section 1.2 present a simplified model of the labour market, designed to help in interpreting the nature of structural shocks driving economic fluctuations. Section 2 describes the implementation of the SVAR methodology. Section 3 describes the data and presents the results in terms of impulse-response functions and forecast error variance decompositions. Then, some concluding remarks are drawn in section 4.

1.2 Theoretical and Methodological Considerations

The research method applied in this study is the so-called Structural Vector Autoregression approach (SVAR) developed by Blanchard and Quah (1989), among others. We make use of a set of long-run restrictions in a VAR in order to interpret reduced form innovations as structural shocks stemming from different sources. These shocks rise out from the variables which can be seen as driving the fluctuations in these markets. In this manner it is possible to study the consequences of a particular shock on the variables forming the VAR. Blanchard and Quah (1989) analysed the dynamic correlations of real output growth and the unemployment rate in the US. They identify the effects of aggregate demand and supply shocks by making use of neutrality restriction where demand shocks do not affect the level of output in the long-run. Several studies have extended the analysis by enlarging the size of the VAR including, for example, real wage growth; see e.g. Balmaseda, Dolado and Lopez-Salido (2000), Balmaseda et. al. afterwards, and Dolado and Jimeno (1997).

The real output, real wages and the unemployment rate are considered to be here the key labour markets variables which joint dynamic behaviour is explained by three structural shocks labelled aggregate demand, productivity and labour supply shocks respectively. These shocks are traditionally seen as the most contributing factors in explaining the variety of labour market outcomes observed across OECD economies during the post-war period. Hence we analyse their importance to labour market fluctuations in Finland and Sweden, highlighting in particular both their shared as well as different effects on their respective labour markets.

The approach taken in this study follows that of Balmaseda et. al. (2000). They analyse several OECD countries for 1950-1996, including Sweden but not Finland. The model is a stylised generalized macroeconomic model. It is assumed that wages are set in an insider-outsider bargaining framework a` la Blanchard and Summers (1986). This appears to be a natural starting point for studying the functioning of labour markets in the OECD. This modelling strategy does not assume stationarity of unemployment and actually allows for full hysteresis, i.e., a unit root in unemployment. This feature is likely to characterise the high persistence of unemployment in some European countries.

The theoretical scheme of identification of the insider-outsider model is often related to the Real Business Cycle theory (RBC). The identification of aggregate demand shocks is convenient for analysing another relevant issue in the behaviour of labour market, namely the cyclical pattern of real wages. In the RBC context the usual approach to measuring cyclical behaviour is to regress the growth of real wages on some proxy for business-cycle fluctuations, such as real output growth. The problem with this approach is that demand and supply shocks are expected to lead to opposite movements in the real wage. It should be noted that this SVAR approach is not limited to RBC and can be used in a wider sense in macroeconomic analysis. It is possible to evaluate another relevant issue, namely wage rigidity by analysing the response of real wages to a demand

shock and then proceed to evaluate whether sticky wage theories provide a better description of real wage behaviour.

Testing for a unit root in the insider-outsider model is closely related to the persistence of unemployment. The tendency of an unemployment rate to remain on a higher level after being hit by a shock is called hysteresis. If an unemployment rate has a unit root then all the shocks are fully persistent. The starting point of this analysis is to test the unit root hypothesis by two different methods, an augmented Dickey-Fuller type test (Φ_1–test) and Johansen cointegration procedure. Other extensions are also considered, namely asymmetries and nonlinearities which could bias the unit root tests toward acceptance; see e.g. Skalin and Teräsvirta (1999).

An important notification concerning the time period (1980-2000) and labour market under study is the use of endo-/exogenousious variables and dummy variables. The econometric approach applied here treats all variables as endogenous. This is parallel to the probability approach of Haavelmo (1943). As far as institutions during this time period are concerned, we can observe that it is possible to proceed without taking account of any significant institutional changes within the period, and thus there is no need to posit exogenous dummy variables which in turn would affect the dynamics of the model. A general notion is that the wage setting behaviour in these countries has been highly corporatist. If these exceptional years of the early 1990s, which are dominant in both countries, are handled as outliers with exogenous dummy variables, then neutralising them implies that they only affect the level of the processes and leave the dynamics intact; for further discussion, see Skalin and Teräsvirta (1999).

2 A Stylised Model to Interpret Shocks

The key variables in this study are real wages, real output and the unemployment rate. As already mentioned, it is possible that the unemployment rate has a unit root. This, in turn, implies full persistence of shocks. One of the attractions of this approach is that it is able to explain the differences in unemployment in the Nordic countries. Despite their relatively generous benefits, high firing and hiring costs and rigid relative wages, these countries managed to maintain high employment rates until hit by a large macroeconomic shock in the early 1990s. Since then these countries have experienced similar problems of persistence of unemployment to those in the rest of Western Europe; see Adnett (1996).

2.1 The Hysteresis Framework

A macroeconomic model, the framework of which is set out in Blanchard and Summers (1986) and Blanchard and Quah (1989), is utilised here to interpret labour market shocks. It has been followed by several authors, for example Balma-

seda et al. (2000), and Dolado and Jimeno (1997). Following Balmaseda et al. (2000)[12], the model consists of five equations as follows:

$$y = \varnothing(d-p) + a\theta \quad (1)$$

$$y = n + \theta \quad (2)$$

$$p = w - \theta \quad (3)$$

$$l = \alpha(w-p) - bu + \tau \quad (4)$$

$$w = arg\{n^e = \lambda l_{-1} + (1-\lambda)n_{-1}\}, \quad (5)$$

where y, p, n, w, $(d-p)$, l, denote the logs of real output, price level, employment, nominal wages, real aggregate demand and labour force, n^e in turn, is the expected value of (log) employment, u denote the unemployment rate, and τ is a labour-supply shift factor. This shift factor is governed by variations in the labour market participation rate. θ and d, in turn, represent shift factors in productivity and nominal expenditure (affected by economic policies).

Because coefficients a>0 and ∅>0, aggregate demand in equation (1) is allowed to be affected through investment or consumption decisions. In the aggregate production of goods we assume constant returns to scale (CRS) technology in the long run, as denoted by equation (2). The price-setting rule is a function of nominal wages and productivity, as described by equation (3). Equation (4), in turn, relates real wages $(w-p)$ and the unemployment rate (u) to form a labour-supply function, where b is a coefficient for the rate of participation of the unemployed (related to this, see e.g. Blanchard (1991) for theoretical arguments on how the outsider mechanism can lead to additional persistence and thus to a smaller disciplinary effect of unemployment on wages). As an insider-outsider framework offers a suitable microfoundation to characterize the behavior of the European labour markets (see Balmaseda, Dolado and Lopez-Salido (2000)), the wage setting behaviour in equation (5) follows that framework. Then the targeted nominal wages are chosen one period in advance and are set so as to equate expected employment to a weighted average of lagged labour supply and employment. When 0<λ<1, partial-hysteresis take place, and when λ= 0, full-hysteresis.

The exogenous shift factors are governed by stochastic processes, and hence d, θ and τ evolve simply as random walks. In a more general setting the vector of exogenous shift factors could be I(1) processes, and hence

$$\Delta d = e_d \quad (6)$$

$$\Delta\theta = e_s \quad (7)$$

12 Similar models are presented by Blanchard and Quah (1989) and Gamber and Joutz (1993).

$$\Delta\tau = e_l \quad (8)$$

where *e*:s are uncorrelated i.i.d. aggregate demand, productivity and labour-supply shocks which govern the evolution of d,θ and τ. Solving equations (1)–(8) for real wages, real output and unemployment as in Gamber and Joutz (1993) and Balmaseda et al. (2000) yields

$$\Delta(w-p) = e_s \quad (9)$$

$$(1-\rho L)\Delta y = \varnothing\Delta e_d + [\varnothing + a - (1+c)(1-\rho)]\Delta e_s - (1-\rho)\Delta e_l + (1+\alpha)(1-\rho)e_s + (1-\rho)e_l \,, (10)$$

$$(1-\rho L)u = (1+b)^{-1}[(1 + \alpha - \phi - a)e_s - \phi e_d + e_l], \quad (11)$$

where L is the lag operator, $\Delta \equiv 1-L$ and $\rho=(1+b)^{-1}(1+b-\lambda)$. The persistence of unemployment is an increasing function of both b and the influence of lagged employment on wage determination (λ) in a partial-hysteresis framework. Whereas real wages and output will remain I(1) processes in partial- and full-hysteresis frameworks, unemployment is an I(1) variable in full-hysteresis case only and then, for finite b, ρ=1 is equivalent to λ=0. The long-run identifying restrictions embedded in eqs. (9)-(11) are more obvious when we write the matrix of long-run multipliers of the system in the following form:

(12)

$$\begin{pmatrix} \Delta(w-p) \\ \Delta y \\ u \end{pmatrix} = \begin{pmatrix} C_{11}(1) & 0 & 0 \\ C_{21}(1) & C_{22}(1) & 0 \\ C_{31}(1) & C_{32}(1) & C_{33}(1) \end{pmatrix} \begin{pmatrix} e_s \\ e_l \\ e_d \end{pmatrix}$$

where C11(1)=1, C21(1)=(1+α), C22(1)=1, C31(1)=D^{-1}(1+α-∅-a), C32(1)= D^{-1} and C33(1)=-∅D^{-1} with D=(1+b)(1-ρ).

By making use of neutrality restrictions in equation (12) demand shocks do not affect the levels of real output or real wages in the long-run. These restrictions are in line with the natural rate hypothesis, i.e., that u is an I(0) process. The CRS assumption in the production function implies that in the long-run real wages are driven by productivity shocks only, which in turn, through real wages, affects labour-supply shocks.

Allowing for full-hysteresis implies that the wage setting equation (5) becomes w = arg(n^e = n_{-1}). This yields a different form for the long-run matrix of the multipliers, where unemployment has to be differenced once and aggregate demand and labour-supply shocks change their ordering, i.e.,

(12`)

$$\begin{pmatrix} \Delta(w-p) \\ \Delta y \\ \Delta u \end{pmatrix} = \begin{pmatrix} C_{11}(1) & 0 & 0 \\ C_{21}(1) & C_{22}(1) & 0 \\ C_{31}(1) & C_{32}(1) & C_{33}(1) \end{pmatrix} \begin{pmatrix} e_s \\ e_d \\ e_l \end{pmatrix}$$

where now C11(1) = 1, C21(1) = ∅ + a, C22(1) = ∅, C31(1) = D^{-1}(1+α -∅ - a), C32(1) = -D^{-1}∅ and C33(1) = D^{-1}, with D = (1+b).

This full-hysteresis framework, where λ=0, yields an identification scheme with the unemployment rate being an I(1) process. Then, under full-hysteresis, labour supply shocks have no long-run effect on output but aggregate demand shocks could have. Next, in order to identify the different shocks and interpret them, the stochastic properties of the unemployment rate will be crucial in choosing the appropriate identification scheme.

2.2 Identification of the Structural Shocks from the Data

The three shocks defined above could be identified from the data by utilising the Structural Vector Autoregression methodology. Now X_t is a 3-dimension vector of a time series of variables including ($\Delta(w-p)_t$, Δy_t, u_t) in the partial-hysteresis case or ($\Delta(w-p)_t$, Δy_t, Δu_t) in the full-hysteresis one. The VAR(k) model for this time series is

$$A(L)X_t = \mu_t + \eta_t \,, \tag{13}$$

where A(L) is a k-th order matrix of lag polynomials in the lag operator L, μ_t is a vector of deterministic terms and η_t is a vector of zero-mean i.i.d innovations with covariance matrix Σ. As we assume stationarity of the data vector and A(0) = I, it has a Wold moving-average representation given by

$$X_t = D(L)\eta_t \,, \tag{14}$$

where D(L) = $A(L)^{-1}$ and D0 = I (the deterministic terms have been omitted for simplicity). Expressing the innovations as linear combinations of the shocks, η = Se_t, where S is a (3 x 1) mapping matrix. Since the innovations are from different sources, we can assume that the e_t`s are uncorrelated i.i.d shocks with unit variances. Then we obtain the following structural moving-average representation:

$$X_t = C(L)\varepsilon_t \,, \tag{15}$$

where C(L) = D(L)S, Co= S. As the orthonormality of et already imposes six restrictions stemming from the different elements of the covariance matrix Σ, we need three restrictions more to identify the nine elements in S. These restrictions can be obtained from the structure of S in expression (12) as we have used a neutrality restriction where the long-run impacts of some shocks on some of the variables vanish. In this theoretical model we have assumed that the matrix of long-run multipliers C(1) is lower triangular. S can then be obtained as

$$S = D(1)^{-1}C`, \tag{16}$$

where C` is the unique Cholesky factor of the matrix D(1)ΣD(1)´ which can be estimated from the VAR in (13).

3 Data and Results

The data are from the OECD`s data base Main Economic Indicators and consist of seasonally adjusted quarterly data on real gross domestic product (GDP), real labour costs (RW) and the national definition of the unemployment rate (UER) from the years 1980 - 2000. Graphs of the variables are shown in Appendices 1a and 1b.

The economic decline in the early 1990s in both countries is clearly visible. Although the fall in GDP and in employment was not so deep in Sweden than in Finland, both countries suffered from similar problems. The reasons behind the recession were in part the same but the structure of foreign trade, such as the great importance of the former Soviet Union for Finland for example, and also the relative weigh of public and private sectors was different. During the time period considered the labour market institutions in the two countries remained mostly the same, although there were reforms e.g. in the wage bargaining structure in Sweden; see Vartiainen (1997). The structural frameworks of these institutions were nearly the same in these countries. Also globalisation, as international co-operation had become more important in every economic area, was strong during the period. This may have induced some structural changes in the behavioural relations of the variables under scrutiny in this study. These changes could be due to e.g. growing international competition in the industrial production as the factors of production have faced remarkable reallocation and financial deregulation. Nominal wages tended to increase but real wages declined in both countries during the worst years of the recession. This could be considered as a sign of a partial consensus came into being among employees, employers and labour unions about wage determination and employment.

3.1 Unit Root Tests on Unemployment

In order to see which specification scheme is more appropriate, we tested whether unemployment is an I(0) or I(1) variable[13]. Here we used the Φ1-test as well as a multivariate framework using Johansen`s (1995) cointegration approach which, due to the incorporation of covariates, will add more power to unit root testing.

TABLE 1 Φ_1-tests for unemployment rate

Country	Statistic	lags	1%value	2.5%value	5%value	10%value
Finland	2.26	3	6.70	5.57	4.71	3.86
Sweden	1.26	3	6.70	5.57	4.71	3.86

Note: the hypothesis is accepted when the calculated value < tabulated value. H0 is a joint hypothesis of a unit root and the intercepts value of zero. Critical values are tabulated by Dickey-Fuller (1981) table 4.

Table 1 reports the results of the Φ1-tests for unemployment rate. According to these tests the level of unemployment is an I(1) variable in both of the countries.

To reach a firm conclusion whether unemployment is an I(0) or I(1) variable, we model a VAR in levels, including ((w-p), y, u) together with unrestricted linear trend and intercept. If the cointegration space is generated by one variable and we reject r = 0 for r = 1, stationarity can exist where some of these variables are I(0) originally. If we know that (w-p) and (y-p) are I(1) processes, this will mean that unemployment is I(0). This will be in agreement with the partial-hysteresis specification of the VAR.

TABLE 2 Johansen`s cointegration trace test for Finland

H_0	Statistic	50%	80%	90%	95%	97.5%	99%
r = 0	45.18	29.53	35.56	39.06	42.44	45.42	48.45
r ≤ 1	14.73	15.59	20.19	22.76	25.32	27.75	30.45
r ≤ 2	4.95	5.55	8.65	10.49	12.25	14.21	16.26

TABLE 3 Johansen`s cointegration trace test for Sweden

H_0	Statistic	50%	80%	90%	95%	97.5%	99%
r = 0	25.38	29.53	35.56	39.06	42.44	45.42	48.45
r ≤ 1	7.50	15.59	20.19	22.76	25.32	27.75	30.45
r ≤ 2	2.71	5.55	8.65	10.49	12.25	14.21	16.26

[13] Here we present the results only for unemployment because real wages and real GDP are clearly I(1) variables, test results available upon request.

Tables 2 and 3 report the results of Johansen's trace test for the countries under study, and we see that in the case of Finland r = 1 could be the right choice (at 5% significance level). For Sweden the corresponding implication is that r =0. To further analyse the variable(s) forming the vector and identify it in the case of Finland, certain linear restrictions on the parameters of the I(0) vector process are needed. We perform a Likelihood Ratio-test (LR-test) for every possible variable combination (z) of cointegration space $\beta' = ((w\text{-}p), y, u)$ that could form stationarity.

TABLE 4 LR-test for restricted variable combinations, p-values for the restriction are in parenthesis.

(z)	$\chi^2(2)$	p-value
(1, 0, 0)	25,568	(0,00)
(0, 1, 0)	42,670	(0,00)
(0, 0, 1)	13,444	(0,00)
(1, θ, 0)	17,113	(0,00)

where θ is a freely estimated parameter. These LR-tests clearly reject stationarity, as the p-values for these restrictions are practically zero. To avoid any ambiguity concerning the specification scheme, the parameter stability test is carried out. The stability test of cointegration rank (reported in Appendices 2a and 2b) shows that structural changes in both countries occurred during the period in question. This could be evidence of (a misspecified model or) nonlinearity, which would bias the test results. Here the testing procedure follows that of Hansen-Johansen (1993), and the results for the so called R- and Z-models are presented for both Finland and Sweden. In the Z-model all the parameters are estimated recursively. In the case of Sweden the results contradict those of the R-model, which does not estimate the short run parameters recursively, but considers them fixed.

Further evidence of the full dynamic effects of shocks to unemployment in both countries can be obtained from the impulse response functions and their behaviour. In both countries these impulse responses behave like unemployment being an I(1) process. In any case one has to be cautious when interpreting the results because of the strong possibility of a moving equilibrium (i.e. in the case of unemployment its equilibrium rate may vary over time) or nonlinearities in general. Skalin and Teräsvirta (1999) tested the existence of nonlinearities in unemployment data in univariate setting for several OECD countries for a period similar to that in this study. They rejected the linearity hypothesis against the nonlinearities in case of Finland and Sweden, and hence it is not tested here. But as a result of smooth structural change, these nonlinearities could be taken as characterising the same reality as the unit root but from a different perspective (for a discussion, see Skalin and Teräsvirta (1999) or Gustavsson and Österholm (2006)). They then indicate that while shocks to the system are rather persistent, the other implications, including policy ones, might be quite different.

3.2 Impulse-response Functions

Figures 1 and 2 show the structural impulse response functions for the three variables in the system and their responses to productivity, aggregate demand and labour supply shocks, respectively. When interpreting the results the stochastic properties of the unemployment rate, i.e. whether it is an I(1) or I(0) variable, will be crucial in choosing the appropriate identification scheme. As mentioned here the I(1) process was chosen and the the data vector is of form $(\Delta(w\text{-}p)_t, \Delta y_t, \Delta u_t)$. The wage setting equation implies that the best forecast for expected value for employment is the employment rate of previous periods. This means that during the time period under scrutiny the shocks in question seem to have permanent effect on the unemployment rate.

In the impulse response figures the solid lines depict point estimates of the response of the variable to a one-unit standard deviation shock. **Real wages** response is expected with respect to a positive *productivity shock*. The magnitude of the response differs slightly between the countries: in Finland real wages have a stronger tendency to rise than in Sweden. In the short run the response of real wages to *labour supply shocks* differs between Finland and Sweden, which is probably due to differences in economic, and particularly in labour market policy in the 1990`s; see Vartiainen (1997) for a discussion. This is also the case with the short run responses of real output to labour supply shocks, as they are of different signs. For example, in Sweden the attempt to reduce or diminish the wage gap between different sectors of the economy, groups of employees and occupations has led to difficulties in finding highly educated professionals. One obvious difference is the size of the public sector, which is much larger in Sweden both in terms of contribution to GDP and as an employer.

To a productivity shock **To an aggregate demand shock** **To a labour supply shock**

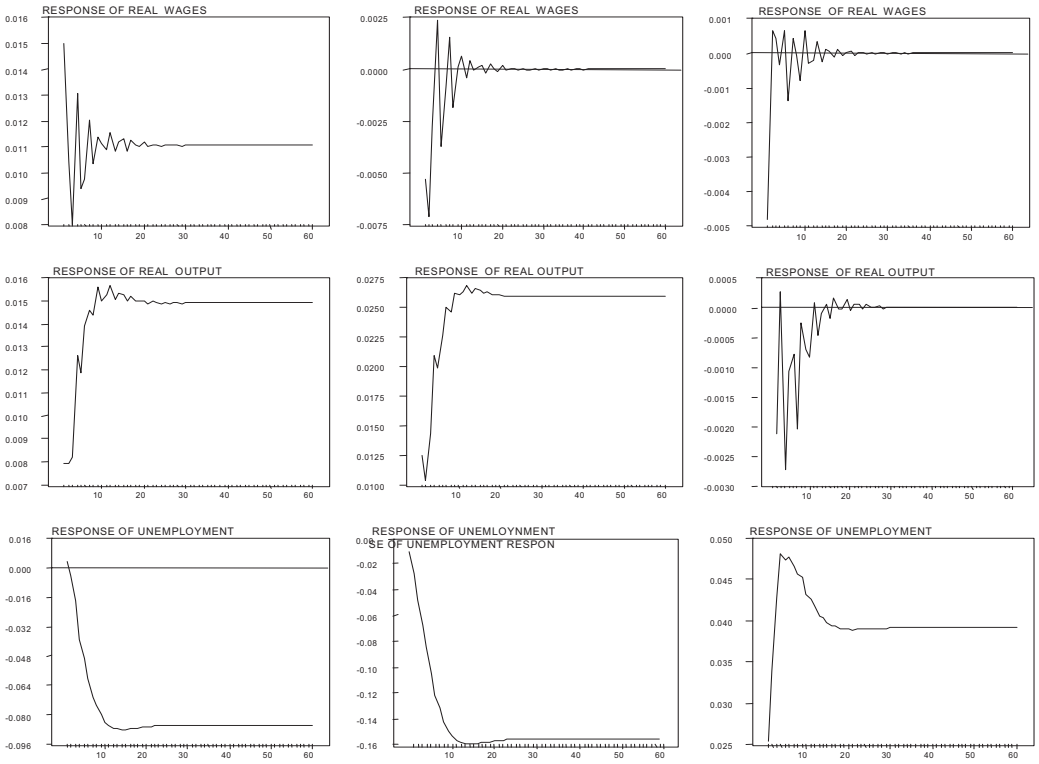

FIGURE 1 Structural impulse response functions for Finland

To a productivity shock **To an aggregate demand shock** **To a labour supply shock**

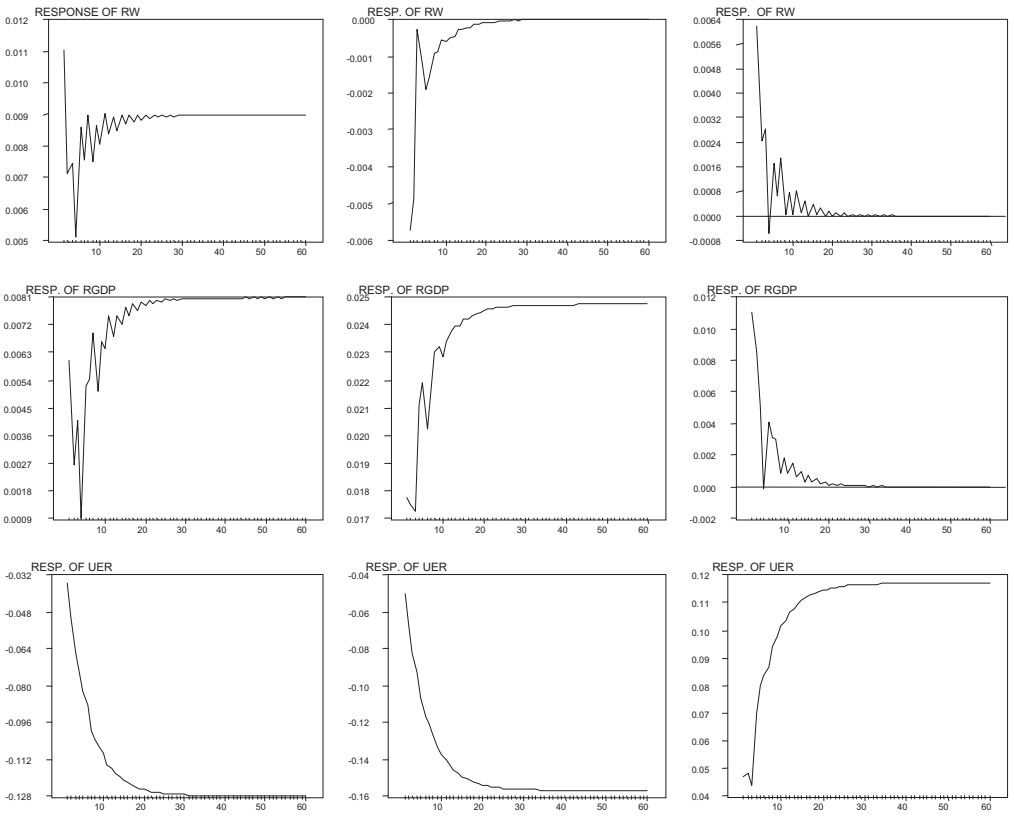

FIGURE 2 Structural impulse response functions for Sweden

The short run responses of real wages to *aggregate demand shocks* can be explained by sticky wage theories. In the long run aggregate demand shocks do not have permanent effects on real wages. The response of real wages with respect to (positive) aggregate demand shock tends to be counter cyclical in the short-run both in Finland and in Sweden. This allows a prominent role for wage stickiness. Then the nominal wages might be constant in the face of disturbances even when the effective cost of marginal hours of labour to firms changes and as such wages have influence on the inflation adjustment. Inflation, in turn, has serious consequences for economic welfare; it causes inefficient production and consumption dispersion which reduces welfare (for theoretical grounds see e.g. Walsh (2003)). In addition to insider-outsider union bargaining framework, we can thus assume that wages are negotiated in an overlapping contract manner as wage stickiness implies, see Erceg, Henderson and Levin (2000).

With respect to the responses of **real output** to the different shocks we observe that in the long-run it tends to react positively to a productivity and ag-

gregate demand shock whereas labour supply shocks have no permanent effects. The magnitude of the response with respect to a positive productivity shock differs between the countries: in Finland it is two times larger than in Sweden. The reactions to aggregate demand and labour supply shocks, instead, are similar in the long-run in both countries.

The short-run responses due to labour supply shocks are of different magnitude. A constant-returns-to- scale technology holds in both countries as the response of real output reacts positively to all shocks.

The most interesting results are those related to the response of **unemployment** to different kinds of shocks. Within the partial hysteresis framework not any of these shocks have permanent effect on the level of unemployment whereas under full hysteresis they all have permanent effect on the level of unemployment. From the figures we see that full hysteresis is also the case in countries studied here. In both Finland and Sweden productivity and aggregate demand shocks have the effect of reducing unemployment but the magnitude of this effect is twice as large in Sweden owing to productivity shocks. The explanation for the permanent effect of productivity shocks on unemployment has to be related to the exceptional years of the early 1990`s and to the lengh of the time period under study. As productivity has a positive effect on real wages, which in turn is reflected in increased aggregate demand and hence in real output, it tends to lower unemployment when it is not at its equilibrium rate. In other words productivity seems to be related to the response of real output to aggregate demand shocks in the full hysteresis framework where consumer consumption increases as a result of an increase in real wages. The short- and long-run response of unemployment to a labour supply shock is also different in magnitude between Finland and Sweden. This can also be explained, as earlier, by reference to the different kinds of economic policy persuaded in the two countries.

The role played by each shock in explaining the variability of each variable in the system is depicted in the forecast-error variance decomposition function (FEVD) figures for each variable at various horizons up to 15 years. This long-run 15-year contribution can be seen as asymptotic to the variance of the forecast errors in the VAR.

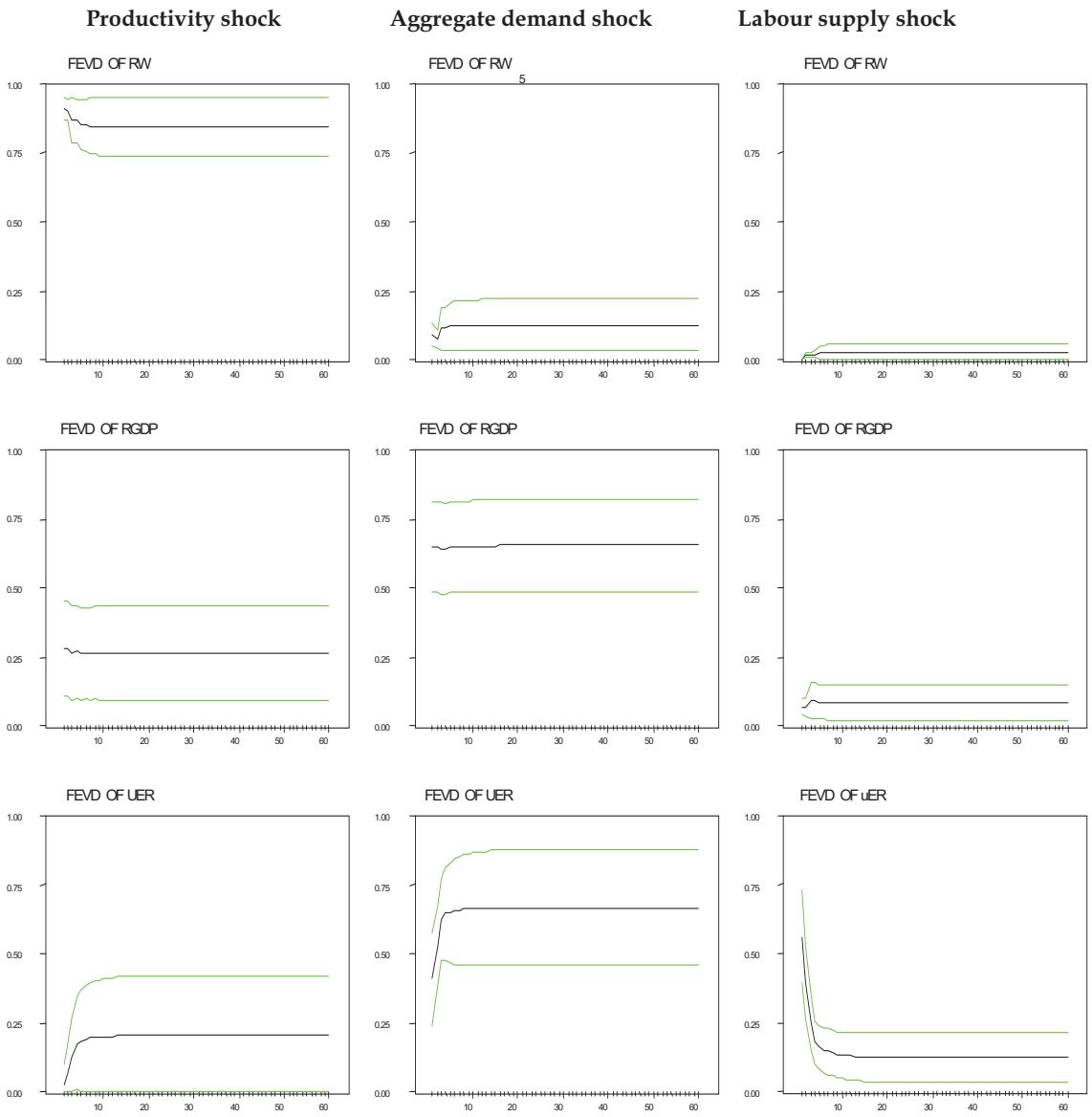

FIGURE 3 Forecast error variance decomposition (FEVD) functions for Finland

Productivity shock **Aggregate demand shock** **Labour supply shock**

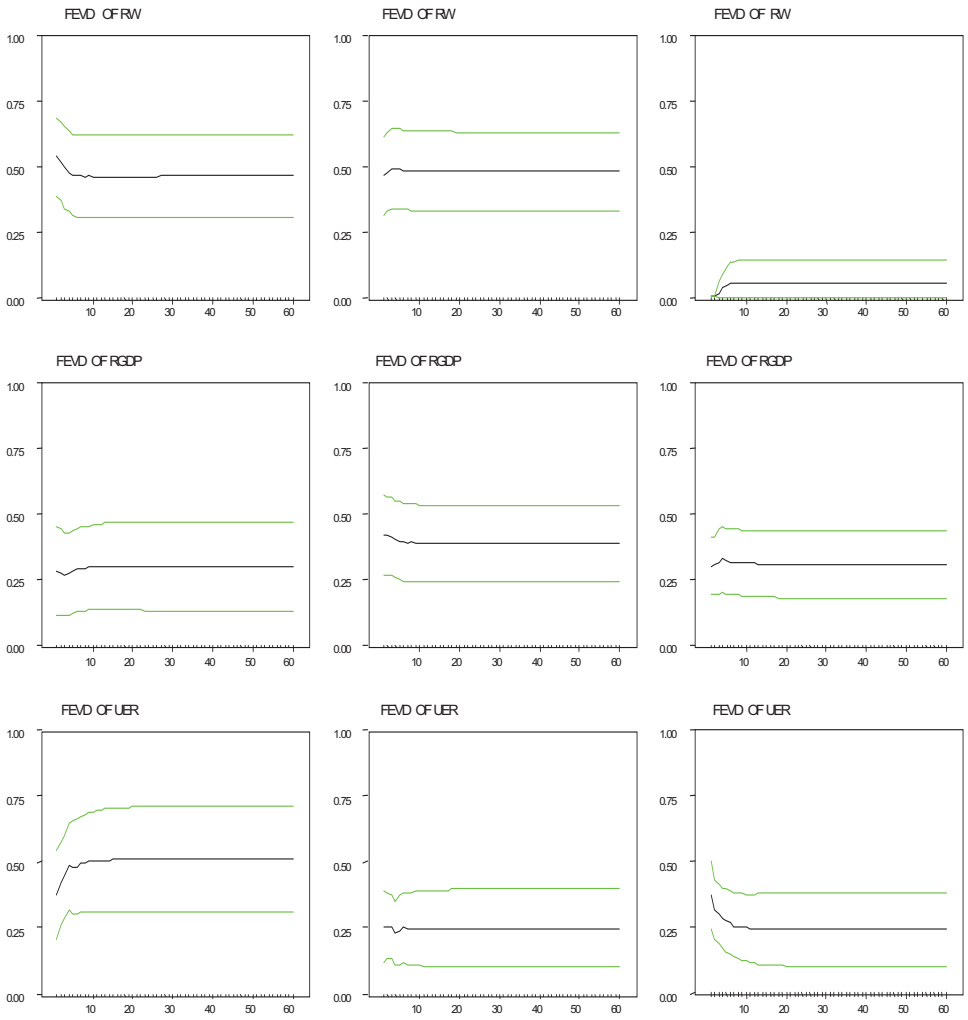

FIGURE 4 FEVD functions for Sweden

In the first row in each figure the variability of **real wages** shows marked differences between the two countries. In Finland productivity shocks account for over 80% of the variance of real wages in the long run and in Sweden both *productivity* and aggregate demand shocks have almost the same importance. Labour supply shock seems to have no importance in either country.

In Finland aggregate demand shocks have the greatest effect on **real output** in the long run. In Sweden both productivity and aggregate demand

shocks have important effects on real output. Labour supply shock, however, did not account very much of variance for the real output in either country.

In Finland aggregate demand shocks have the greatest effect on fluctuations in the **unemployment rate,** whereas in Sweden, where both aggregate demand and labour supply shocks have importance, productivity shocks account for most of the variation in the unemployment rate. In Finland labour supply shocks do not account very much for fluctuations in unemployment in the long run.

The share of the variation of a variable between the different shocks stabilises quite fast, in most cases after 5 periods in both countries. This can be seen quite well, for example in the fluctuation in unemployment in Finland, where labour supply shocks account for over 50% of this variance in the short run, but less after 5 to 6 periods.

The present results concerning unit roots and hysteresis differ from those reported by Balmaseda et al. for most OECD countries including Sweden. This is perhaps due to timing and length of the period under study. In this study the period, characterised by structural breaks (economic decline together with combination of policy decicisions such as exceptionally handled financial deregulation), dominates. In general the responses can be explained by sticky wage theories, as implied by Balmaseda et al. (2000) for other OECD countries except the US. The present results concerning variance decompositions clearly indicates the importance of the demand driven economic policies followed in the two countries studied. This is evident in the FEVD figures for real output variance in the long run, as it is dominated by the demand shocks in both countries. These results contradict those of Balmaseda et al. (2000) but can be explained by governments` attempts to beat the recession.

4 Concluding Remarks

The purpose of this study was to analyse the dynamic effects of shocks on the labour market in Finland and Sweden during the years 1980-2000 and then consider their consequences for inflation adjustment process. The results suggest that hysteresis is present in both countries, thereby implying that the effects of shocks on the level of unemployment are permanent. Moreover the response of real output is different in the long-run with respect to that under partial hysteresis, as here aggregate demand shocks have permanent effects on real output.

The impulse responses were of the expected sign within the full hysteresis framework. The shape and sign of the responses of real wages and real output to labour supply shocks differed in the short run between Finland and Sweden. This is probably due to the different economic policies practised in Finland and Sweden in the 1990`s. In the long-run the magnitudes of the responses of real output and unemployment to productivity shocks are different. The responses are parallel to those implied by sticky wage theories. The theoretical considera-

tions based on wage and price stickiness revealed that the real wage rigidities have potential influence to inflation process. Their relative importance in the countries under study was not, however, empirically tested and therefore gives us a potential subject for further study.

The forecast-error variance decomposition pictures show that the sources of variation also differ between the two countries. The main sources are productivity and aggregate demand shocks, which have different weights in Finland and Sweden. Labour supply shocks seem to have a modest influence in both countries.

The timing and length of the period under analysis produced different results compared to these of Balmaseda et al. (2000), where the structural breaks in the early 1990s and the evolution of the variables was not considered, for example, from the nonlinear point of view. This structural VAR analysis is based on the interpretations of those instantaneous linkages between the endogenous variables that are left uninterpreted in the usual VAR representation. In conclusion, the dynamic effects of disturbances analysed here, seem to be quite plausible.

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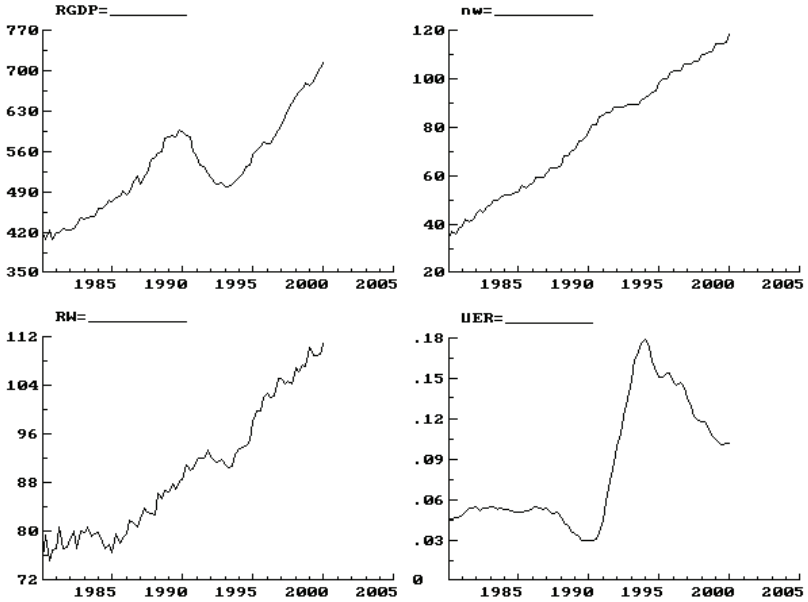
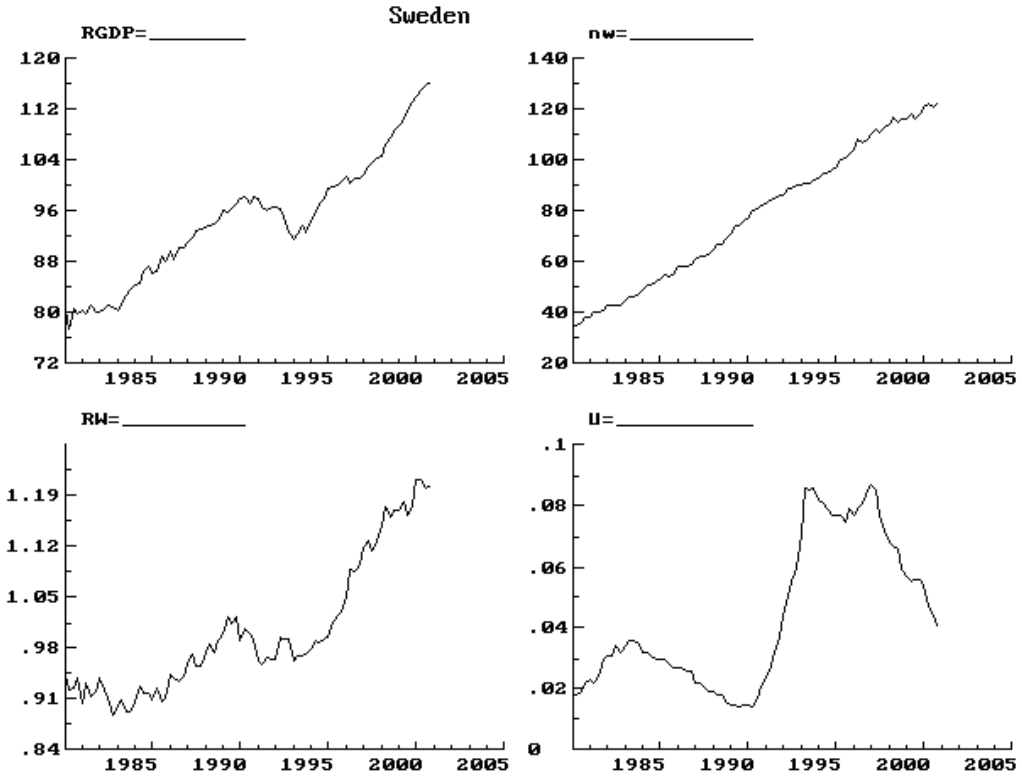
APPENDIX 1
Time series of the analysed variables

1a) Finland

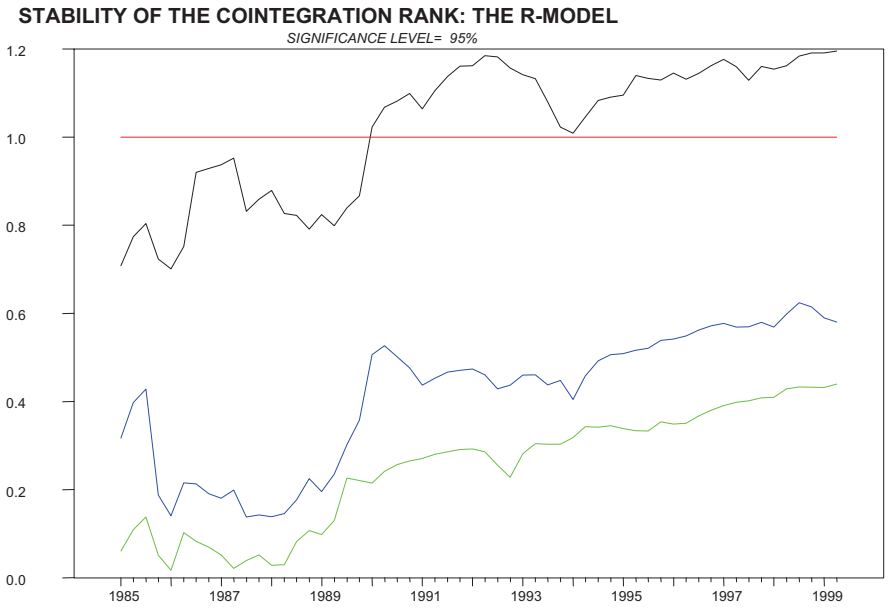


RGDP= real gross domestic product
RW= index for real wages,
nw stands for nominal wages
UER= u = unemployment rate

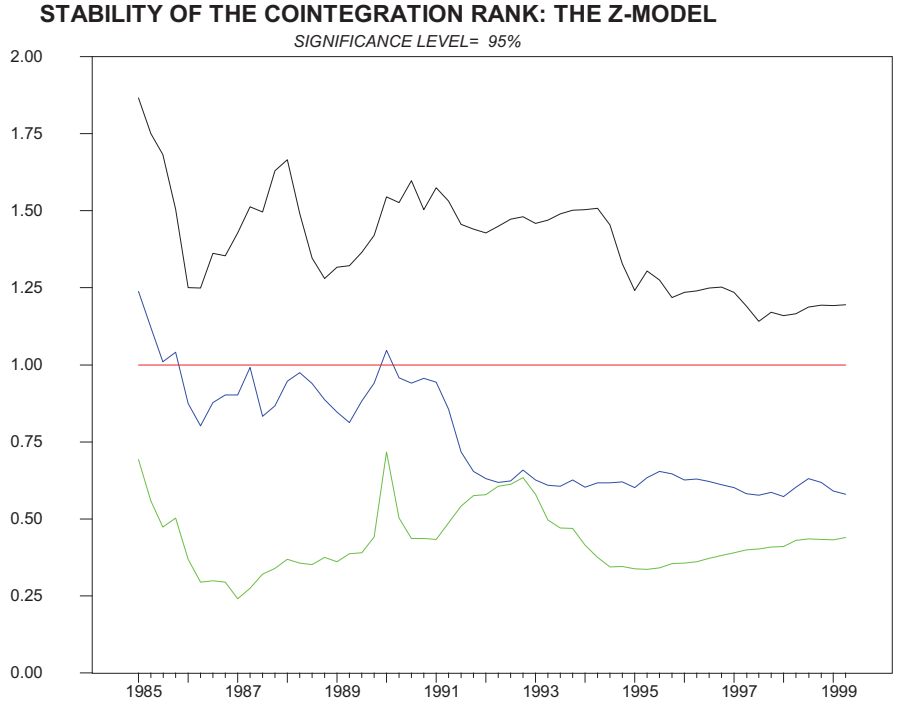
1b) Sweden


Sweden
RGDP=
120
112
104
96
88
80
72
1985
1990
1995
2000
2005
nw=
140
120
100
80
60
40
20
RW=
1.19
1.12
1.05
.98
.91
.84
U=
.1
.08
.06
.04
.02
0

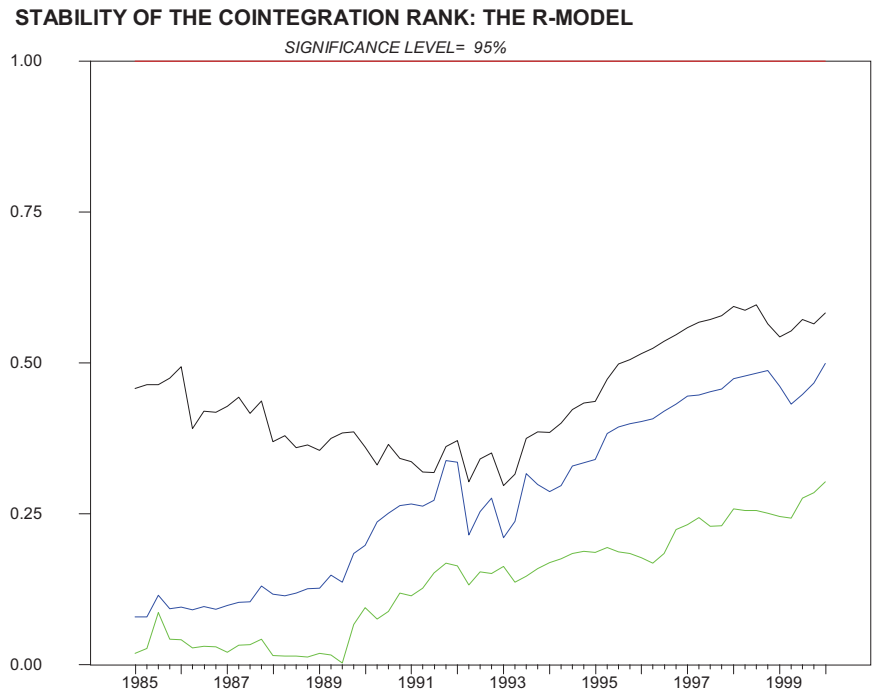
2a) Stability test for cointegration rank; Finland

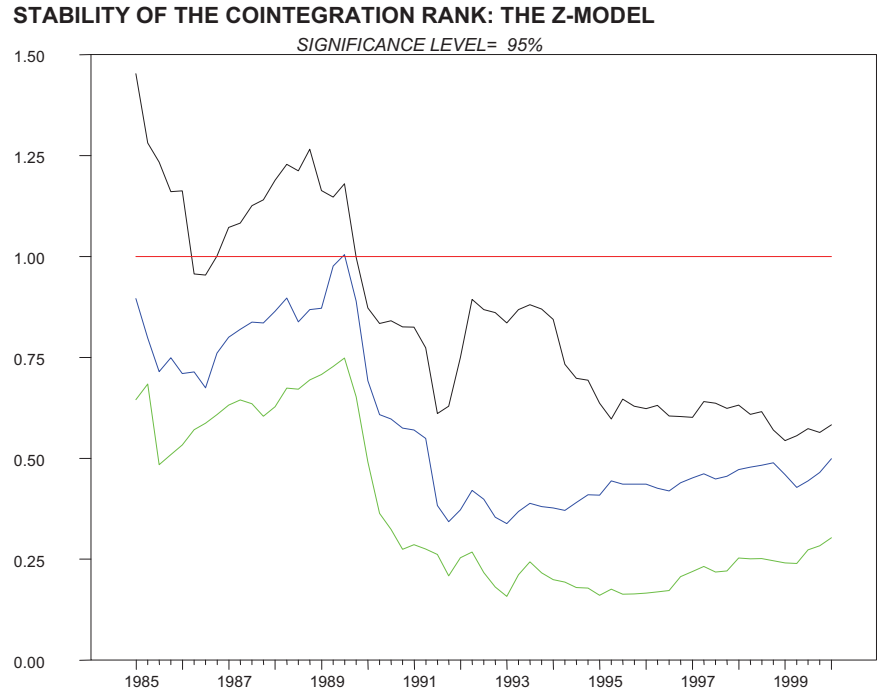


A value larger than one means that the hypothesis is rejected, the uppermost line represents the test for the hypothesis r = 0, which, in this case is rejected after 1989. The second upper line represents the test for 1 ≥ r, and so on.



2b) Stability test for cointegration rank; Sweden





CHAPTER 5

EVALUATING WELFARE EFFECTS OF CHANGES IN SECTORAL PRICES UNDER THE POLICY OF A CONSTANT AGGREGATE PRICE LEVEL*

Abstract
This study proposes that relative changes in sectoral prices between two groups of commodities produced in two different sectors can have welfare implications even though the aggregate price level remains constant. We assume imperfect competition in the two sectors and that the price elasticities between the two types of commodities differ. As a consequence relative price changes could have adverse welfare effects despite price stability at the aggregate level. We construct a simple model to evaluate these welfare effects and present conditions under which these effects are negative. It turns out that the adverse welfare effects stem from fluctuations in labour efforts. Through an empirical example we seek to provide evidence to back our main assumption that (own) price elasticities differ across different categories of goods. This is done for seven consumption categories using Finnish consumption data over the 1975-2008 period. It is found that the price elasticities differ in a manner that could give rise to welfare effects from sectoral price changes of the kind suggested in this paper. (JEL: D 43, D 60, E 31)

Keywords: imperfect competition, welfare effects of price changes

* I would like to thank Jouko Vilmunen, Kari Heimonen, Jaakko Pehkonen and Antti Penttinen for many valuable comments.

1 Introduction

It is often argued that price stability minimizes the welfare cost of inflation. The standard arguments on the cost of inflation are those presented by Friedman (1969). He relates the cost of inflation to inefficiency in the money holdings of an economic agent[14]. Friedman (1969) suggests that a zero nominal rate of interest is optimal and eliminates this inefficiency in money holdings in an environment with flexible prices and perfect competition. This, in turn, implies that the optimal level of inflation could even be negative (deflation) at a rate equal to the real rate of interest.

Other studies have related the cost of inflation to price dispersion. In an environment with price rigidities and monopolistic competition fluctuation in prices may have welfare implications since only some firms will be able to change prices as a result of staggered price setting[15]. For example, if the price level rises, consumption will rise for the goods whose relative price has fallen and fall for those goods whose relative price has risen. This causes welfare-reducing consumption dispersion. Khan, King and Wolman (2000) analysed both these kinds of distortions and concluded that optimal inflation is closer to zero than suggested by the Friedman (1969) rule. Woodford (2003) presents a detailed analysis also for the consequences of sectoral asymmetries. These asymmetries are due to difference in the sectoral Calvo (1983) pricing parameters, i.e. prices are not equally sticky for different types of goods, which causes the sectoral inflation dynamics to diverge.

These approaches, however, are limited as they neglect the possible distortions caused by sectoral differences in firms' pricing power. Such sectoral differences in pricing power may generate relative price changes. These changes in the relative prices of commodity groups, which may show up in the aggregate price level, could generate adverse welfare effects in an economy. If firms face different elasticity of demand for their products, the macroeconomic implications of relative price changes may be difficult to evaluate. The reason is that although the policy maker could hold the aggregate price level constant, households will change their labour supply and relative demand for different goods[16]. This leads also to reallocation in the production of goods as well as of labour input between sectors. In other words, the purpose of this study is to point out that from the policy maker point of view the presence of such asymmetries is problematic. This is because stabilization of an aggregate price index and stabilization of an aggregate output gap are not equivalent policies as is implied by the "New Keynesian" Phillips curve, see e.g. Woodford (2003).

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14 In this case real money balances are treated as a consumption good and inflation as a tax on real balances, for a partial equilibrium approach see Bailey (1956) and Friedman (1969).

15 For alternative models of staggered price adjustment see, for example, Calvo (1983) or Taylor (1979).

16 This kind of substitution effect could lead to a substantial bias in the Consumer Price Index; see e.g. Aizcorbe and Jackman (1993) and Moulton (1996).

This study examines the welfare implications of relative price changes in a static two-sector model. The economic environment is characterised by imperfect competition in both sectors. The preferences of economic agents imply less than perfect substitutability between the goods produced in the different sectors. Hence, firms in the two sectors face different price elasticities of demand for their products. More specifically, firms in one of the sectors have higher pricing power than firms in the other sector. Our results can be summarized as follows. Flexibility of the relative prices at the sectoral level is needed to sustain price stability at the aggregate level. That is, if the central bank neutralizes a shock that puts pressure on the aggregate price level to change, the relative price between sectors has to adjust appropriately for the central bank to succeed in its attempts to stabilize the aggregate price level. This implies a reallocation of production and consumption across the two sectors and, hence, changes in consumer welfare. The reasons for the changes in the sectoral price levels are outside the aim of this study but any shock that threatens price stability will do. Several empirical studies have shown that imperfect competition is an important source for sectoral relative price changes in an economy. Moreover, in a dynamic context these sectoral asymmetries lead to dual inflation; for examples, see e.g. Arratibel, Rodriguez-Palenzuela and Thimann (2002), Estrada and López-Salido (2002) and ECB (2003) for a more general discussion.

This study measures the welfare effects of a relative sectoral price change and presents the conditions under which these effects are negative. It is found that, as the proportion of imperfect competition increases, the potential adverse welfare effects are related to fluctuations in labour input without corresponding change (increase) in consumption possibilities of the goods.

2 A Model for the Analysis of Welfare Effects After a Relative Sectoral Price Change

The market is characterised by two groups of goods, goods H (high pricing power in sector H) and goods L (low pricing power in sector L) and imperfect competition between these groups. The demand curves between the groups differ and they have modest substitutability. A typical household in this economy is a producer of one of the two types of goods and a representative consumer of all the goods produced. Since the types are imperfect substitutes for each other, some of the producers have monopoly power in pricing as the price elasticities of these two goods differ. The producers with a more price inelastic demand for their products thus have more pricing power.

The preferences of a typical producer-consumer are given by

$$U(C,N) = C + \gamma \log(1-N), \tag{1}$$

where C stands for composite consumption good and N for labour effort (input). Parameter γ is the welfare weight on leisure.

2.1 Consumption Allocation

The composite consumption good consists of two groups of goods, H and L, and the aggregate economy is defined by constant elasticity of substitution (CES) aggregator as follows:

$$C = \left[n^{\frac{1}{\zeta}} C_H^{\frac{\zeta-1}{\zeta}} + (1-n)^{\frac{1}{\zeta}} C_L^{\frac{\zeta-1}{\zeta}} \right]^{\frac{\zeta}{\zeta-1}}, \qquad (2)$$

where the elasticity of substitution ζ between sector H and L goods is $\zeta \neq 1$, and n determines the weight of the sector H in the consumption bundle. For $\zeta=1$, (2) reduces to log-aggregator.

It is more difficult to substitute goods C_H, produced in the higher pricing power-owning sector H, with goods from the other sector L. The different respective elasticities of substitution (price elasticities of demand) imply accordingly that if the price of C_H rises by 1 unit demand for it will fall substantially less from its initial value than would be the case with C_L if the price of the latter is raised by the same relative amount. That is, as the price of goods C_H rises, total spending on C_H will be cut only modestly or will rise so that the relative share spent on C_H will remain at nearly the same level or will rise. Thus the demand for C_H is inelastic. As a result of the (monetary) policies executed, the producers in sector L will have to lower their prices. This is due to the high substitutability of products C_L; hence in order to sell more units, prices have to fall (see Table 1). Table 1 presents the response of total expenditure on a good with respect to different price elasticities.

TABLE 1 Price elasticity, $e_{Q,P}$ and total expenditure

	Total expenditure PQ	
demand	price increase	price decrease
Elastic, $e_{Q,P}<-1$	falls	rises
Unit elastic $e_{Q,P}=-1$	no change	no change
Inelastic $e_{Q,P}>-1$	rises	falls

The sub aggregator for the sectoral (j = H, L) composite consumption good is assumed to be in Dixit-Stiglitz form and is defined as

$$C_H = \left[n^{\frac{-1}{\theta_H}} \int_0^n c_h(k)^{\frac{\theta_H-1}{\theta_H}} dk \right]^{\frac{\theta_H}{\theta_H-1}} \text{ for sector H,}$$

$$\text{and } C_L = \left[(1-n)^{\frac{-1}{\theta_L}} \int_n^1 c_l(k)^{\frac{\theta_L - 1}{\theta_L}} dk \right]^{\frac{\theta_L}{\theta_L - 1}} \text{ for L.} \quad (3)$$

We assume that the elasticity of substitution between the individual goods $c_j(k)$ produced within a sector j is $\theta_j>1$, and that θ_j differs between sectors H and L (j:s) and moreover $|\zeta| < |\theta_j|$ because the products of the firms within a sector are more substitutable with each other than those across sectors. Goods $c_h(k)$, $k \in [0, n]$ are produced by sector H and $c_l(k)$, $k \in (n, 1]$ by sector L. Accordingly, these goods enter into agents' preferences, i.e., they share a preference value which could be measured and weighted by their relative pricing content (the market power of a household in pricing).

When faced with the problem of minimizing the cost of buying a basket of C_H, for example, the household's decision problem is to minimize expenditure

$$\min_{c_{h(k)}} \int_0^n p_h(k) c_h(k) dk$$

subject to maximizing utility of consuming

$$\left[n^{\frac{-1}{\theta_j}} \int_0^n c_h(k)^{\frac{\theta_h - 1}{\theta_h}} dk \right]^{\frac{\theta_h}{\theta_h - 1}} \geq C_H, \quad (4)$$

where $p_h(k)$ is the price of good k ($k=0,\ldots,n$) and θ_h is the elasticity of substitution between goods produced in sector H. Letting ψ denote the Lagrangian multiplier on the constraint, the first order condition for good k is

$$p_h(k) - \psi \left[n^{\frac{-1}{\theta_h}} \int_0^n c_h(k)^{\frac{\theta_h - 1}{\theta_h}} dk \right]^{\frac{1}{\theta_h - 1}} c_h^{\frac{-1}{\theta_h}} = 0.$$

We now rearrange $c_h(k) = (p_h(k) / \psi)^{-\theta_h} C_H$ (this is the demand for different brands within a sector). From the definition of the composite level of sectoral consumption (3) this implies

$$C_H = \left[n^{\frac{-1}{\theta_h}} \int_0^n \left[\left(\frac{p_{ht}(k)}{\psi_t} \right)^{-\theta_h} C_H \right]^{\frac{\theta_h - 1}{\theta_h}} dk \right]^{\frac{\theta_h}{\theta_h - 1}} = \left(\frac{1}{\psi} \right)^{-\theta_h} \left[n^{\frac{-1}{\theta_h}} \int_0^n p_h(k)^{1-\theta_h} dk \right]^{\frac{\theta_h}{\theta_h - 1}} C_H.$$

Solving for ψ,

$$\psi = \left[n^{-1} \int_0^n p_h(k)^{1-\theta_h} dk \right]^{\frac{1}{1-\theta_h}} \equiv P_H. \quad (5)$$

Now P_H is the sectoral price index for sector H and represents the minimum expenditure required to purchase one unit of the corresponding basket. Similarly for sector L we obtain the sectoral price index P_L.

The demand for good $c_j(k)$, which the producers face (as an constraint), is then

$$c_j(k) = \left[\frac{p_j(k)}{P_j}\right]^{-\theta_j} C_j. \tag{6}$$

As the products of firms within a sector are more substitutable with each other than those across sectors, all firms aim to set the same price at the time of price change within that sector. This will minimize the potential loss of market share due to price dispersion; for further argumentation on this see Bhaskar (2002)[17]. Then, assuming that in equilibrium all the producers belonging to the same sector choose the same price at the same moment, the demand for an individual product $c_j(k)$ will be that of the whole sector C_j. Thus

$$c_j(k) = C_j, \text{ as the ratio } \left[\frac{p_j(k)}{P_j}\right] \text{ is one.}$$

The consumers then optimize total consumption *C*, which was given by eq. (2),

$$C = \left[n^{\frac{1}{\zeta}} C_H^{\frac{\zeta-1}{\zeta}} + (1-n)^{\frac{1}{\zeta}} C_L^{\frac{\zeta-1}{\zeta}} \right]^{\frac{\zeta}{\zeta-1}},$$

subject to the budget constraint

$$P_H C_H + P_L C_L = WN = PC \equiv Y, \tag{7}$$

where *W* stands for the nominal wage, *P* for the consumption-based aggregate price index for the whole economy and *Y* for nominal income. By substituting eq.(2) into the budget constraint (7) we derive the sectoral market demand functions from the first order conditions for C_j , j=H, L as follows; the Lagrangian for the first order conditions

$$n^{\frac{1}{\zeta}} C_H^{-\frac{1}{\zeta}} - \lambda P_H = (1-n)^{\frac{1}{\zeta}} C_L^{-\frac{1}{\zeta}} - \lambda P_L \quad \Leftrightarrow$$

$$\left(\frac{C_H}{C_L}\right)^{-\frac{1}{\zeta}} = \left(\frac{1-n}{n}\right)^{\frac{1}{\zeta}} \left(\frac{P_H}{P_L}\right) \tag{8}$$

17 This approach can also yield staggered price setting behaviour in a dynamic context; see e.g. Bhaskar (2002).

or

$$C_L = \left(\frac{1-n}{n}\right)\left(\frac{P_H}{P_L}\right)^{\zeta} C_H. \tag{9}$$

From the budget constraint

$$P_H C_H + P_L\left(\frac{1-n}{n}\right)\left(\frac{P_H}{P_L}\right)^{\zeta} C_H = Y \Leftrightarrow$$
$$\left[nP_H^{1-\zeta} + (1-n)P_L^{1-\zeta}\right]nP_H^{\zeta} C_H = Y \Leftrightarrow$$
$$P^{1-\zeta} nP_H^{\zeta} C_H = Y.$$

The sectoral market demand functions in equilibrium are then

$$C_H = n\left(\frac{P_H}{P}\right)^{-\zeta}\left(\frac{Y}{P}\right) = n\left(\frac{P_H}{P}\right)^{-\zeta} C\,. \tag{10}$$

Also

$$C_L = (1-n)\left(\frac{P_L}{P}\right)^{-\zeta}\left(\frac{Y}{P}\right) = (1-n)\left(\frac{P_L}{P}\right)^{-\zeta} C. \tag{11}$$

2.2 Production of the Goods

Producers maximise profits subject to three constraints. First, production is solely a function of labour input N_j :

$$c_j\,(k) = N_j\,(k). \tag{12}$$

This implies, that the capital is assumed to be fixed and, moreover, could be producer (firm) specific, which, in turn in dynamic context have important implication for the inflation dynamics. The second constraint producers' face is the demand (substitutability) of their products. The third constraint is the price setting behaviour described above.

We then consider the producer's cost-minimisation problem, This involves minimizing $W N_j\,(k)$, where W is nominal wage, subject to producing $c_j\,(k) = N_j\,(k)$. This problem can be written, in real terms, as

$$\min_N \left(\frac{W}{P_j}\right) N_j(k) + \varphi_j(c_j(k) - N_j(k)),$$

where φ_j is equal to the firm's real marginal cost. The first order condition implies that the real marginal cost is $\varphi_j = W / P_j$. From the preferences of a household (eq. (1)) we can derive the first order condition for the optimal labour supply as $W/P = \gamma / (1-N)$, which, in turn, can be written as

$$N = 1 - \gamma\left(\frac{P}{W}\right) = 1 - \frac{\gamma}{w}, \tag{13}$$

where w denotes the aggregate or consumption based real wage W/P. The form of the household's utility function implies, then, that labour supply N is independent of consumption C, so that there is no wealth effect in household's labour supply. Hence the labour market effects are solely due to demand of the labour, which depends on (the change of) the real wage.

2.3 Welfare Effects

We now proceed to derive a direct (money metric) measure for the welfare effects of the differences in monopoly power implied by the differential price elasticities of demand. Under the same period, prices are set[18] in sector H and L so that the aggregate price level remains constant i.e. $dP = 0$. We assume that the substitution possibilities are more limited in sector H than those in sector L.

Given the sectoral market demand functions (10) and (11) we can rewrite aggregate consumption as

$$C = C[C_H(P_H, P_L, Y, P), C_L(P_H, P_L, Y, P)]. \tag{14}$$

Since the combination of changes in the prices P_H and P_L that keep the aggregate price level constant is given by $dP = 0 = P_{P_H} dP_H + P_{P_L} dP_L$, we obtain the trade-off $\left(\frac{\partial P_L}{\partial P_H}\right)|_{dP=0} = -\frac{P_{P_H}}{P_{P_L}}$. Consequently, under the assumption of a constant price level, e.g. central bank keeps the price level constant, we can compute the marginal effect of a change in the price of the low elasticity sector, P_H, on aggregate consumption as

$$\frac{dC}{dP_H} = \frac{\partial C}{\partial P_H} + \frac{\partial C}{\partial P_L}\frac{\partial P_L}{\partial P_H}$$

18 The underlying reasoning for price changes is not the subject of this study as it has no implications for the outcomes obtained.

$$= \left[\frac{\partial C}{\partial C_H} \left(\frac{\partial C_H}{\partial P_H} + \underbrace{\frac{\partial C_H}{\partial P_L}}_{=0} \frac{\partial P_L}{\partial P_H} \right) + \frac{\partial C}{\partial C_L} \left(\underbrace{\frac{\partial C_L}{\partial P_H}}_{=0} + \frac{\partial C_L}{\partial P_L} \frac{\partial P_L}{\partial P_H} \right) \right], \tag{15}$$

since $\frac{\partial C_H}{\partial P_L} = 0 = \frac{\partial C_L}{\partial P_H}$ under the assumption of the Dixit-Stiglitz consumption aggregator and price level targeting by the central bank. Dixit-Stiglitz aggregator implies that

$$\frac{\partial C}{\partial C_H} = n^{\frac{1}{\zeta}} \left(\frac{C}{C_H} \right)^{\frac{1}{\zeta}} \text{ and}$$

$$\frac{\partial C}{\partial C_L} = (1-n)^{\frac{1}{\zeta}} \left(\frac{C}{C_L} \right)^{\frac{1}{\zeta}}.$$

The price dual to the Dixit-Stiglitz consumption aggregator implies, in turn

$$P_{P_H} = \frac{\partial P}{\partial P_H} = n \left(\frac{P}{P_H} \right)^{\zeta} \text{ and}$$

$$P_{P_L} = \frac{\partial P}{\partial P_L} = (1-n) \left(\frac{P}{P_L} \right)^{\zeta} \Rightarrow \frac{\partial P_L}{\partial P_H} = \frac{n}{1-n} \left(\frac{P_L}{P_H} \right)^{\zeta}.$$

Demands consistent with Dixit-Stiglitz aggregator

$$C_H = n \left(\frac{P_H}{P} \right)^{-\zeta} C$$

$$C_L = (1-n) \left(\frac{P_L}{P} \right)^{-\zeta} C,$$

so

$$\frac{\partial C_H}{\partial P_H} = -\zeta \frac{C_H}{P_H}$$

$$\frac{\partial C_L}{\partial P_L} = -\zeta \frac{C_L}{P_L}$$

since the aggregate price is constant. Consequently

$$\frac{\partial C}{\partial P_H} = \left[-n^{\frac{1}{\zeta}} \zeta \left(\frac{C}{C_H} \right)^{\frac{1}{\zeta}} \left(\frac{C_H}{P_H} \right) - (1-n)^{\frac{1}{\zeta}} \zeta \left(\frac{C}{C_L} \right)^{\frac{1}{\zeta}} \left(\frac{C_L}{P_L} \right) \left(-\frac{n}{1-n} \right) \left(\frac{P_L}{P_H} \right)^{\zeta} \right]$$

$$
\begin{aligned}
&= -\zeta C^{\frac{1-\zeta}{\zeta}} P_H^{-1} \left[n^{\frac{1}{\zeta}} C_H^{\frac{\zeta-1}{\zeta}} - (1-n)^{\frac{1}{\zeta}} C_L^{\frac{\zeta-1}{\zeta}} \left(\frac{n}{1-n} \right) \left(\frac{P_H}{P_L} \right)^{1-\zeta} \right] \\
&= -\frac{\zeta}{P_H} + \frac{\zeta}{P_H} \left(\frac{C_L}{C} \right)^{\frac{\zeta-1}{\zeta}} (1-n)^{\frac{1-\zeta}{\zeta}} \left(\frac{P}{P_L} \right)^{1-\zeta} \\
&= -\frac{\zeta}{P_H} \left[1 - \left(\frac{C_L}{C} \right)^{\frac{\zeta-1}{\zeta}} (1-n)^{\frac{1-\zeta}{\zeta}} \left(\frac{P}{P_L} \right)^{1-\zeta} \right] \\
&= -\frac{\zeta}{P_H} \left[1 - \left(\frac{(1-n)\left(\frac{P_L}{P} \right)^{-\zeta} C}{C} \right)^{\frac{\zeta-1}{\zeta}} (1-n)^{\frac{1-\zeta}{\zeta}} \left(\frac{P}{P_L} \right)^{1-\zeta} \right] \\
&= 0
\end{aligned}
\tag{16}
$$

This result states that by stabilizing the aggregate price level the central bank can neutralize the aggregate consumption effects of changes in sectoral prices. Also, aggregate welfare effects from changing sectoral prices under this policy can only arise if aggregate labour supply (employment) is affected.

Accordingly, the level of utility in terms of aggregate consumption remains the same. Only the relative shares of goods for consumption alter. Although the utility of aggregate consumption remains unaltered as a result of changes in relative prices, this change in the relative shares consumed could have an impact on how labour inputs change between the two sectors. This raises the interesting question of whether any changes would occur in the relative share of income between the sectors.

Equilibrium in the labour market presumes that the labour supply (eq.(13)) equals aggregate labour demand as

$$
\begin{aligned}
&N = 1 - \frac{\gamma}{w}, \text{ aggregate labour supply} \\
&N_H + N_L = \left[n \left(\frac{P_H}{P} \right)^{-\zeta} + (1-n) \left(\frac{P_L}{P} \right)^{-\zeta} \right] C, \text{ aggregate labour demand} \\
&\Rightarrow w = \frac{\gamma}{1 - \left[n \left(\frac{P_H}{P} \right)^{-\zeta} + (1-n) \left(\frac{P_L}{P} \right)^{-\zeta} \right] C},
\end{aligned}
$$

where w is the real wage. When P_H rises, the wages will adjust according to

$$\frac{\partial w}{\partial P_H} = \left(\frac{1}{1-\left(n\left(\frac{P_H}{P}\right)^{-\zeta} + (1-n)\left(\frac{P_L}{P}\right)^{-\zeta}\right)C}\right)^2 \gamma\left(-\zeta n\left(\frac{P_H}{P}\right)^{-\zeta}\frac{1}{P_H} - \zeta(1-n)\left(\frac{P_L}{P}\right)^{-\zeta}\frac{1}{P_L}\frac{\partial P_L}{\partial P_H}\right)$$

$$= -\gamma\zeta n\left(\frac{1}{1-\left(n\left(\frac{P_H}{P}\right)^{-\zeta} + (1-n)\left(\frac{P_L}{P}\right)^{-\zeta}\right)C}\right)^2\left(\left(\frac{P_H}{P}\right)^{-\zeta}\frac{1}{P_H} - \left(\frac{P_H}{P}\right)^{-\zeta}\frac{1}{P_L}\right)$$

$$= \gamma\zeta n\left(\frac{P_H}{P}\right)^{-\zeta}\left(\frac{1}{1-\left(n\left(\frac{P_H}{P}\right)^{-\zeta} + (1-n)\left(\frac{P_L}{P}\right)^{-\zeta}\right)C}\right)^2\left(\frac{1}{P_L} - \frac{1}{P_H}\right)$$

$$= \frac{\gamma\zeta n}{P_L}\left(\frac{P_H}{P}\right)^{-\zeta}\left(\frac{1}{1-\left(n\left(\frac{P_H}{P}\right)^{-\zeta} + (1-n)\left(\frac{P_L}{P}\right)^{-\zeta}\right)C}\right)^2\left(1 - \frac{P_L}{P_H}\right). \tag{17}$$

If PH > PL, this equality will be positive (and the second derivative will be negative when $\zeta > 0$). Hence the real wage, which is the same for both sectors, tends to rise (when the price in sector H, sector with less competition, rises but that in sector L falls as the aggregated price level remains unaltered[19]). Then there will be only a relatively minor reduction in the demand for sector H products, whereas the demand for sector L products will grow relatively more. As the utility of a representative agent (household) from consumption remains unaltered but the labour demand (and effort) grows and leisure declines as the sectoral prices change, we can conclude that

$$\frac{\partial U}{\partial P_H} < 0, \text{ if } P_H > P_L. \tag{18}$$

When the budget constraint in eq. (7) holds, the sectoral change in consumption and production will now be dependent on three parameters of preference. First θ_j:s and ζ:s will determine how strong the sectoral difference in pricing power is, and these parameters will also govern the magnitude of the sectoral redistribution of the production of goods. Moreover, γ will determine the welfare weight (the real value) of leisure. As a result of this relative price change the allocation of consumption and labour across the two sectors will change.

The full employment requirement implies that nominal wages are flexible. If the real wage is less than the relative share of leisure vs. the relative share of labour, producers will want to raise their nominal wage when the opportunity arises.

Greater pricing power in one of the two sectors will cause sectoral price levels to diverge. These kinds of effects do not occur in competitive markets,

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19 In that situation the *H* sector will face relatively lower real marginal cost (as a consequence of higher prices) but this cost for sector L will be higher. It also should be noted that since there is less competition in sector H it is reasonable to assume that the price level in that sector is higher, i.e. the condition $P_H > P_L$ is likely to be satisfied.

which points to the role of market openness and competition in the determination of inflation and welfare.

3 An Empirical Example with Finnish Consumption Data

We then proceed by empirically estimating the price elasticity of demand for seven different categories (two main categories and one main sub category with four different sub categories) of consumption commodities. This is done in order to evaluate the potential differences in the pricing of different commodities, and so implying the possible existence of imperfect competition in an economy. As explained in previous paragraphs, if the price elasticities for these commodities differ, this suggests that the producers (firms) can set a relatively bigger markup for commodities with less price-elastic demand. The differences between these elasticities are then also assumed to reflect the possible welfare distortions (effects) due to monopolistic pricing behaviour. This means that the resulting price changes could have the adverse welfare effects described above.

3.1. Data and Empirical Methodology

The empirical estimation of (long-run) elasticity parameters[20] for the different commodity categories (groups as proxies for sectors) is done using Finnish consumption data over the period 1975-2008. The data are drawn from the Statistics Finland data base on consumption and we utilise the concept of expenditures on consumption. This refers to the expenditures of a certain sector on the consumption commodities of interest but ignores who really consumes them. The data consist of seasonally adjusted quarterly data on expenditures on real consumption (C), which has two main categories: private consumption (Cpr) and public (government) consumption (Cg). In this study private consumption, in turn, has one main sub category, i.e the household's aggregate consumption (Ch). The households' aggregate consumption is then further divided into four sub categories; households' consumption of nondurables (Chnd), households' consumption of semi durables (Chm), households' consumption of durables (Chd) and households' consumption of services (Chs). The appropriate price indexes are calculated from the nominal and real consumption data. More information about the consumption data utilised can be found in Statistics Finland's web pages[21].

The theoretical scheme and the economic environment for the demand analysis relies on the theoretical model derived in chapter 2 of this study. Utilising a stochastic, discrete time logarithmic formulation of the Dixit-Stiglitz con-

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20 For a detailed analysis and the distinction between short- and long-run price elasticities and their practical consequences see e.g. Fibich, Gavious and Lowengart (2005).

21 http://www.stat.fi/meta/kas/index.html

sistent demand framework, the demand model to be estimated for each of the producer in a consumption category takes the following form:

$$c_{it} = n_i + \theta_i (p_{it} - p_{jt}) + c_t + \varepsilon_t + other\ controls, \tag{19a}$$

where c_{it} is the tth observation of the consumption of a good in the consumption category i (i = *Cpr*, *Ch*, *Chnd*, *Chm*, *Chd*, *Chs*, *Cg*), n_i is the weight of the category (an intercept term) in the consumption bundle, p_{it} is the appropriate price index for a consumption category, p_{jt} is the consumption-based aggregate price index for the (next) superior consumption category j ($j \neq i$, j= *C, Cpr, Ch , Cg*), c_t is total (real) consumption, ε_t is a stochastic error term and θ_i is the elasticity parameter of interest to be estimated. It defines the category i- (sector) specific long-run price elasticity of demand with respect to aggregate consumption. The term *other controls* refers to the price indexes of the upper (superior) consumption categories; e.g. households' aggregate demand is (when based on theory on section 2)

$$c_i = \left[\frac{p_i}{P_j}\right]^{-\theta_j} \left[\frac{P_j}{P}\right]^{\zeta} C,$$

where notation i refers to households' aggregate and j to superior categories. The logarithmic demand model to be estimated is then

$$c_{it} = n_{it} + \theta_i (p_{it} - p_{jt}) + \zeta (p_{jt} - p) + c_t + \varepsilon_t, \tag{19b}$$

where p is the consumption-based aggregate price index.

The elasticity parameters are then estimated by Instrumental Variable (IV) methodology in order to avoid biased inference related to the problem of endogeneity. This (endogeneity) problem may arise because the error term (disturbance) could be correlated with some of the causal variable; in this case the disturbance is probably correlated with the price term(s). We use constant, lagged consumption (lag 2), gross domestic product or other price indexes as instruments. The instruments are selected through a testing procedure; see e.g. Stock, Wright and Yogo (2002) for a survey of methods for evaluating (weak) instruments.

3.2. The Results

Table 2 provides estimation results for the above demand model (eq. (19 a)).

TABLE 2 The estimated price elasticities of the demand parameters for the selected consumption categories.

consumption category	price elasticity of demand (standard deviations in parenthesis)
private consumption	-0.773 (0.101)
households' aggregate consumption	-0.692 (0.027)
households' consumption of nondurables	-0.46 (0.44) ~0 statistically
households' consumption of semi durables	-1.233 (0.332)
households' consumption of durables	-1.235 (0.219)
households' consumption of services	0.56 (0.71) ~0 statistically
public consumption	-0.349 (0.110)

Table 2 indeed suggests differences in the price elasticities of these commodities, although the relatively large standard errors of the parameter estimates could make it difficult to establish the statistical significance of these differences. However, the commodity categories could be divided into two groups: private and households' aggregate consumption demand together with public consumption and households' consumption of nondurables and services has price inelastic demand whereas households' consumption of semi durables and durables seems to be price elastic. That public consumption seems to have price inelastic demand could be explained by the fact that public consumption is governed by laws and regulations. Although we are not interested in the elasticity parameters as such, the main point here is the differences between the parameters. The long-run price elasticity of the demand parameters suggests that the parameters of interest diverge in a way that could produce different pricing power for producers in different sectors and thus the welfare effects suggested in this study. This could happen even in the environment of price stability at the aggregate level.

4 Conclusions

This study examined the welfare effects of a change in relative prices of a consumption bundle in a two-sector one-period model under a policy of a constant aggregate price level. Substitutability between the goods produced in the two sectors is weak. Price inelastic demand in one sector implies monopoly power

in product pricing in that sector, while the other faces a very price elastic demand for its products. Hence the sectoral markups and marginal cost diverge. In such an imperfect competitive environment a change in relative prices could have adverse welfare effects. These adverse welfare effects stem from fluctuations in labour effort and demand. In a dynamic context the sectoral inflation dynamics will diverge.

The extent of the substitutability between the two groups of goods will guide how consumption is shared between them as result of a change in prices. Naturally this assumes that all the prices in a given sector change simultaneously. As a result of a change in relative prices the amounts of goods produced between the sectors will change. Households will not remain on the same utility level in terms of leisure (labour input) as labour demand rises although the utility of consumption remains unaltered. The share of relative sectoral production (and income) remains constant (if the price level is fixed) and labour input will adjust according the demand (and supply) for labour (or the MRS between consumption and leisure) with a given sectoral demand for production.

The novel feature of this study is that it also considers sectoral differences in price-setting power. This allows for the possibility of evaluating the cost (welfare effects) of price changes in a multi-sector framework. Previous studies on the welfare effects of price-setting behaviour have considered a homogeneous one-sector environment in terms of demand elasticity, although imperfect, monopolistic competition has been included. In this study a heterogeneous two-sector model with imperfect competition between the existing sectors was derived. This enables an analysis of the welfare effects of change in relative prices between commodity groups. This kind of policy ($dP = 0$) has a greater (negative) impact on the sector which puts less inflationary pressure on the economy with greater price elasticity of demand and which, accordingly, has lower pricing power and faces more competition within and between the sectors.

In an empirical example we estimated the price elasticity of demand parameters for seven consumption categories using Finnish consumption data over the period 1975-2008. We found, that the elasticities differed in a manner that could give rise to differences in pricing power for some of the producers.

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SUMMARY IN FINNISH (YHTEENVETO)

Tutkimuksia raha- ja työmarkkinadynamiikasta ja hyödykemarkkinoiden epätäydellisyyksistä

Tämä väitöskirja tarkastelee joidenkin EU-maiden raha-, työ- ja hyödykemarkkinoiden rakenteita ja toimintaa sekä empiirisesti, että teoreettisilla analyysivälineillä hintavakauteen tähtäävän rahapolitiikan näkökulmasta. Kansalliset erot näiden markkinoiden rakenteissa voivat komplisoida yhteisen rahapolitiikan toteuttamista ja tutkimuksen painopisteeksi voidaan katsoa erityisesti rahataloudellinen integraatio, koska tietämys kyseisten markkinoiden toiminnasta ja yhteneväisyyksistä on tärkeää yhteisen rahapolitiikan suunnittelun ja toteutuksen kannalta. Väitöskirja koostuu johdanto-osuudesta ja neljästä itsenäisestä tutkimuksesta joista kolme on empiirisesti ja yksi teoreettisesti painottunut.

Rahamarkkina-analyysin teoreettisena identifiointiperustana käytetään raha hyötyfunktiossa (money-in -the-utility-function, MIUF) tarkastelukehikkoa josta johdetaan empiirisesti ifentifioitavat rahamarkkina-relaatiot monimuuttujaisella vektoriautoregressiivisellä proseduurilla yhteisintegroituvuutta hyödyntäen. Erityistä huomiota rahamarkkinatutkimuksissa kohdennetaan pehmeiden rakenteellisten muutosten identifiointiin ja parametrien stabiiliuteen. Nämä pehmeät muutokset voivat aiheuttaa maakohtaisten yhteisintegroituvuusrelaatioiden parametreissa epälineaarisia muutoksia, jotka vaikeuttavat relaatioiden tunnistamista lineaarisilla menetelmillä niissä tällöin ilmenevän parametrien epästabiiliuden ja -tarkkuuden vuoksi. Työmarkkina-analyysissä teoreettisena perustana käytetään työmarkkinoiden sisä- ja ulkopiiriläiset tarkastelukehikkoa (insider-outsider union bargaining framework). Tähän kehikkoon perustuen työmarkkinashokkien empiirinen vaikuttavuustarkastelu toteutetaan käyttäen Blanchard-Quah identifiointi rajoitteita rakenteellisessa vektoriautoregressiivisessä (Structural Vector Autoregressive) mallissa. Hyödykemarkkinoiden toiminnan tarkastelussa lähdetään liikkeelle talouden toimijoiden hyvinvoinnin optimoivasta käyttäytymisestä kuluttajan hyötyfunktion koostuessa kulutuksesta ja vapaa-ajasta, jolloin duaaliteorian mukaisesti kustannukset minimoimalla pyritään hyödyn maksimoimiseen. Tällöin tämä hintaduaalisuus tarjoaa käyttökelpoisen tavan tarkastella taloudentoimijoiden hintamuutoksista johtuvia hyvinvoinnin muutoksia.

Ensimmäinen empiirinen tutkimus luvussa 2 mallintaa rahamarkkinarelaatioiden rakenteellisia muutoksia monimuuttujaisella yhteisintegroituvuusmenetelmällä jota täydennetään epälineaarisella aikatrendillä. Tavoitteena on saavuttaa parametrien stabiilisuus rahan kysyntärelaatiossa tapauksessa, jossa muutokset talouden toimijoiden preferensseissä, esimerkiksi talouden regiimimuutosten tai teknologiamuutosten seurauksena, aiheuttavat em. rakenteellisia muutoksia kyseisissä relaatioissa. Yhteisintegroituvuusanalyysin käyttö tällaisissa tapauksissa, mikäli näitä muutoksia ei mallinneta,

on problemaattista talouspoliittisen päätöksenteon näkökulmasta. Tutkimuksessa analysoidaan Suomen laajan raha-aggregaatin M3 kysyntää vuosien 1980-1996 välisenä aikana. Osoittautuu, että mikäli yhteisintegroitunutta VAR-mallia laajennetaan epälineaarisella vakiotermiin liittyvällä deterministisellä aikatrendillä, puuttuva yhteisintegroituvuusrelaatio raha-aggregaatin ja skaalamuuttujan väliltä löydetään ja yhteisintegroituvuus-avaruus voidaan identifioida.

Toinen empiirinen tutkimus kolmannessa luvussa tarkastelee rahan kysyntää kahdeksassa EU:n rahaliiton maassa erm-ajanjaksolla vuosina 1983-1998. Tutkimus keskittyy kansallisiin eroihin rahan kysynnän rakenteessa tarkoituksena näin arvioida eroja monetaaristen shokkien vaikutuksissa ja siten myös ymmärtää rahapolitiikan välittymisen eroja. Nämä erot identifioidaan maaspesifeistä rahan kysyntärelaatioista hyödyntäen edellisessäkin kappaleessa käytettyjä proseduureja. Tutkimuksessa voidaan määritellä kysynnän rakenne ja parametrien taso, joka soveltuu keskeisille euro-alueen maille, mutta havaitaan samalla, ettei kaikkien tutkimuksen euromaiden rahamarkkina-relaatioiden rakenne ole samanlainen kuin tämän ydinryhmän.

Kolmas empiirinen tutkimus väitöskirjan neljännessä luvussa analysoi aggregaatti kysyntä-, tuottavuus- ja työntarjontashokkien dynaamisia vaikutuksia Suomen ja Ruotsin työmarkkinoihin vuosina 1980-2000. Molempien maiden yhtenevänä piirteenä voidaan pitää kyseisellä ajanjaksolla ilmenevää ns. hysteresis-ilmiötä, jolloin kyseessä olevilla shokeilla on pysyväisluonteisia vaikutuksia tarkasteltaviin muuttujiin. Yleisesti ottaen, vaikkakin vasteissa ilmenee maakohtaisia eroja, muuttujien vasteet shokkeihin voidaan selittää palkkajäykkyysteorioilla ja näin ollen työmarkkinadynamiikalla on merkittäviä rahapolitiikan toteuttamiseen vaikuttavia seuraamuksia.

Väitöskirjan neljäs itsenäinen tutkimus tarkastelee ensin teoreettisella tasolla suhteellisten sektorikohtaisten hintamuutosten hyvinvointivaikutuksia tapauksessa, jossa aggregaattihintataso pidetään vakioisena rahapolitiikan keinoin. Taustalla on olettamus epätäydellisestä kilpailusta sektorien välillä, ja että sektorikohtaiset hintajoustot eroavat. Tällöin suhteellisilla hintamuutoksilla voi olla hyvinvointivaikutuksia vaikka kokonaishintataso pysyisi stabiilina. Tutkimuksessa johdetaan kuluttajien preferensseihin perustuen yksinkertainen malli näiden vaikutusten arvioimiseksi. Osoittautuu, että negatiiviset hyvinvointivaikutukset liittyvät vaihteluihin työpanosten suhteellisessa tarjonnassa sektorien välillä. Tutkimuksen empiirisessä osassa analysoidaan, saako olettamuksemme hintajoustojen erilaisuudesta eri hyödykeryhmien (sektorien) välillä tukea Suomen hinta-aineistosta ajanjaksolla 1975 - 2008. Havaitaan, että hyödykeryhmien hintajoustot eroavat tavalla, joka saattaa aiheuttaa tutkimuksen teoreettisessa tarkastelussa esitettyjä hyvinvointi-vaikutuksia suhteellisten sektoreittaisten hintamuutosten tapahtuessa.

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