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Financial Structure and its Impact on the Convergence of Interest Rate Pass-through in Europe: A Time-varying Interest Rate Pass-through Model

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Founded in 1963 by two prominent Austrians living in exile – the sociologist Paul F. Lazarsfeld and the economist Oskar Morgenstern – with the financial support from the Ford Foundation, the Austrian Federal Ministry of Education and the City of Vienna, the Institute for Advanced Studies (IHS) is the first institution for postgraduate education and research in economics and the social sciences in Austria. The **Economics Series** presents research done at the Department of Economics and Finance and aims to share "work in progress" in a timely way before formal publication. As usual, authors bear full responsibility for the content of their contributions.

Das Institut für Höhere Studien (IHS) wurde im Jahr 1963 von zwei prominenten Exilösterreichern – dem Soziologen Paul F. Lazarsfeld und dem Ökonomen Oskar Morgenstern – mit Hilfe der Ford-Stiftung, des Österreichischen Bundesministeriums für Unterricht und der Stadt Wien gegründet und ist somit die erste nachuniversitäre Lehr- und Forschungsstätte für die Sozial- und Wirtschafts-wissenschaften in Österreich. Die **Reihe Ökonomie** bietet Einblick in die Forschungsarbeit der Abteilung für Ökonomie und Finanzwirtschaft und verfolgt das Ziel, abteilungsinterne Diskussionsbeiträge einer breiteren fachinternen Öffentlichkeit zugänglich zu machen. Die inhaltliche Verantwortung für die veröffentlichten Beiträge liegt bei den Autoren und Autorinnen.

Abstract

So far studies concerned with the interest pass-through of monetary policy have not taken into account one central issue that arose in Europe in the late 1990s: the importance of financial structure for the convergence of monetary transmission. This study addresses this shortcoming. We estimate a time varying interest pass-through allowing us to test for the importance of financial structure and its impact on the convergence of the effects of monetary policy. We find convergence in banks' reaction to money market movements, which is additionally reduced in groups of countries with similar financial structure. Furthermore, there is a significant impact of financial structure on the extent of transmission of monetary policy impulses within the same month. Thus, differences in financial structure between countries must not be ignored when considering convergence of monetary transmission in Europe.

Keywords

Convergence, interest rate pass-through, EMU, financial structure, money and bank interest rates, transmission mechanism

JEL Classification

E43, G21, E52

Comments
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Contents

Introduction

During the 1990s efforts to foster integration of the European market were intensified which led to an increase in the degree of integration. The single most outstanding event in the decade was the introduction of the common currency. This had - amongst other reforms - a strong impact on financial markets. Out of financial markets the money markets experienced the main push toward one single integrated market. Arbitrage opportunities were essentially reduced by the introduction of one currency managed by a single monetary authority through a single interest rate as well as a single Euro-area wide payment system. Another indication for the increased integration is the stark increase in intra-EMU cross-border interbank lending over the 1990s till now. (Hartmann, Maddaloni & Manganelli 2003)

The integration of capital markets is not so pronounced, but there is evidence that capital market movements have synchronized over the last decade. (see Fratzscher 2001) The lesser degree of integration in capital markets points at factors which cannot simply be eliminated by the removal of cross-border transaction risk, stemming from exchange rates and divergent interest rates.

Therefore differences in financial structure were preserved in the course of European financial integration. As a result, intermediaries, which are of considerable importance within the financial structure of economies, play different roles, which is reinforced by the fact that only few cross-country mergers were observed in the EMU area until 2002.(see Schmidt 2001) The concentration on bank lending as well as the lack to draw resources from capital markets directly might also be rooted in the origin of the legal system in the country under consideration, as was put forward by a number of authors such as La Porta, Lopez-de Silanes, Shleifer & Vishny (1997), La Porta, Lopez-de Silanes, Shleifer & Vishny (1998) and Cechetti (1999). Summing up, financial structure will have a considerable impact on the operation and effects of the European central bank and is likely to lead to asymmetries in the European monetary transmission. (Mojon 2000)

As Amable (2003) demonstrates, even though there was some considerable transformation of financial structures within the last twenty years, most notably in France (compare also Hackethal, Schmidt & Tyrell 2002) due to privatisation of the banking sector and capital market reforms, through privatisation of parts of the economy other than banking and pension reforms, financial structures are far from being uniform. This assigns different importance to intermediaries such as banks throughout Europe. Banks will, depending on the environment they operate in, reinforce or stand against actions of the central bank. In bank-based financial systems, they will stand by their related customers and provide resources even in a time of monetary tightness. Ehrmann, Gam-

bacorta, Sevestre & Worms (2003) stress the importance of banking networks, such as loan cooperatives and savings banks in some EMU economies like France, Germany, Austria and Finland. The question that therefore arises is whether differences in financial structure in Europe facilitate the operation of monetary policy of the European Central Bank or not as financial structure seems to determine the nature of monetary transmission mechanism through interest rate setting behaviour.

Cottarelli & Kourelis (1994) were the first to estimate the degree and speed of pass-through of interest rates trying to link the effects of monetary policy in various countries on banks and explaining it by financial structure variables. They show that there is significant influence of financial structure on the monetary transmission mechanism which differs between various countries. There are three other studies that seem to be of importance for the topic above. Mojon (2000) estimates the interest pass-through by a vector error correction model (VECM) for a rather large variety of different interest rates for some economies of the Euro area for various subsamples up until 1998. Therefore it is not possible to draw any conclusions about the effects of the introduction of the common currency. de Bondt (2005) also estimates interest pass-through VECMs for the Euro area as a whole between 1996 and 2001. Again, as for Mojon this specification does not allow to test for convergence issues as a VECM implies that there is no adjustment to a new equilibrium but to the old. This is unlikely to occur when a new policy regime like a common currency is introduced. With respect to convergence Haan, Sturm & Toolsema (2001) provide interesting insights. In contrast to de Bondt (2005) they estimate interest channels for a small set of individual member states of the European union. They secondly let the pass-through parameters in contrast to VECMs vary over time to tackle the question whether differences in interest pass-through across countries vanish over time due to the introduction of the Euro. They find however little evidence of convergence, but this may be due to the relatively short span of the Euro in operation. This paper tries to redo on the one hand the analysis of Haan et al., as we have a longer period of the Euro in operation. On the other hand it goes beyond their analysis in terms of countries covered and the convergence analysis undertaken combined with financial structure considerations. Thirdly it investigates the role of financial structure as an explanation for the differences in the immediate interest pass-through in the European economies under consideration.

To test for the influence of the financial structure the following hypotheses will be evaluated:

Hypothesis 1 *There is convergence in the transmission mechanism within the EMU member states.*

Hypothesis 2 *There is faster convergence between countries with similar financial*

structures than between economies with different financial structures.

Hypothesis 3 *Due to the rigidity of financial structures there will not be any significant speeding up of convergence in the European monetary transmission mechanism due to the introduction of the Euro.*

These three hypotheses lie at the heart of this paper. The first tests whether there is convergence at all. Given that there is convergence hypothesis 2 states that one should see a faster pace of convergence between countries with similar financial structures which was not considered in Haan et al. (2001). The third hypothesis then aims to disentangle exchange rate risk and the financial structure effect. So if all three hypotheses cannot be rejected we have established that it is the financial structure that is important for the degree of asymmetry.

The remainder of the paper is organized as follows. Section 1 estimates and discusses the main characteristics of the underlying econometric model. The second part (1.2) will present the main results of the first step of the analysis. Section two presents the three ways convergence and financial structure are linked in the paper, Sigma convergence, cluster methods and panel regression analysis.

1 The Effects of Monetary Policy

1.1 The model

In this section we estimate the pass-through of monetary policy impulses through the banking system of most old-EU economies. Even though this was done to some extent by Mojon (2000) the specification differs in this study as we take into account the dynamics of monetary integration. In contrast to Mojon (2000) the rolling regression technique is used to assess the time variation in the estimators. Furthermore we do not estimate cointegrating relationships between bank and policy interest rates as it is not clear whether there exists such a stable relationship or whether it has changed due to the introduction of the Euro. In this case we would estimate something that does not exist, a stable long run relationship between bank lending and money market rates. The data coverage is the third distinguishing feature of this analysis. Last but not least, due to data availability, only a general bank lending rate instead of more precise bank interest rates was used. As a baseline, the model used is due to Cottarelli & Kourelis (1994), which also forms the basis of Mojon's (2000) model.

Cottarelli & Kourelis (1994) model assumes that financial intermediaries such as banks are not neutral conveyors of monetary policy impulses. This is motivated by the observation that bank rates are relatively inelastic with respect to shifts in the demand

for loans as well as deposits and that bank rates change less in magnitude than do money market rates.

As a first step, an equation that links bank lending rates to money market and discount rates is considered[1]:

$$\begin{aligned}\Delta i_{j,t} = \quad & \alpha_{j,1} + \alpha_{j,2}\Delta i_{j,t-1} + \beta_{j,0}\Delta d_{j,t} + \ldots + \beta_{j,k}\Delta d_{j,t-k} + \\ & \gamma_{j,0}\Delta m_{j,t} + \ldots + \gamma_{j,n}\Delta m_{j,t-n} + u_{j,t}, \end{aligned} \tag{1}$$

where $\Delta i_{j,t}$, $\Delta m_{j,t}$ and $\Delta d_{j,t}$ represent changes of the *lending* rate, *money market* rate and the *discount* rate at t for country j, where $j = 1, \ldots J$. The values of β and γ will vary over the countries in the sample, therefore there will be a different degree of stickiness in the interest rates in every country. From the βs or γs, various sets of multipliers are derived, which will be in general nonlinear functions of the two parameter sets, and are given by

$$h_{m,0} = \gamma_{j,0}, \tag{2a}$$

$$h_{d,0} = \beta_{j,0}. \tag{2b}$$

$$h_{m,t+p} = \alpha_{j,2}^{p}\gamma_{j,0} + \ldots + \alpha_{j,2}\gamma_{j,p-1} + \gamma_{j,p} = \sum_{i=0}^{p} \alpha_{j,2}^{p-i}\gamma_{j,i}, \tag{3a}$$

$$h_{d,t+p} = \alpha_{j,2}^{p}\beta j, 0 + \ldots + \alpha_{j,2}\beta_{j,p-1} + \beta_{j,p} = \sum_{i=0}^{p} \alpha_{j,2}^{p-i}\beta_{j,i}. \tag{3b}$$

In the discussion we shall however mainly focus on the money market multiplier, taking into account the direct effect of monetary policy in some countries.

1.2 Results

Before showing the multipliers implied by the estimated country models, a few words about the model selection methodology. The country models are based on Cottarelli and Kourelis, and the optimal lag length was chosen by minimizing the AIC criterion. As during the 1980s monetary policy did not solely rely on discount rate manipulation,

[1] This equation corresponds to Cottarelli & Kourelis's (1994) model 2. Model 1 is in levels for the lending rates and money market rates, whereas the discount rate is in differences. The reason for that is that they want to control for policy changes which are signals to the market. Model 2 was chosen because nearly all interest rates of the countries investigated here are not stationary in levels, so that a model in first differences is more appropriate.

but also on other means such as credit control, the model selection was also undertaken between estimating a pure bank lending lending rate and money market rate model as well as a model that additionally included the discount rate of the central bank in the respective country. There is evidence in nearly every country, as figure 5 points out, that excluding the discount rate for the whole sample leads to a misspecification of the interest pass-through models as there is additional information in the discount rate, that is not captured by variation in the money market rates only.

For the assessment of the impact of European monetary policy discount rates of central banks exert a statistically positive influence on bank lending behavior. Not taking this into account leads to misspecified models for these countries.

Figure 5 in the appendix plots the difference of absolute values between the absolute value of the AIC of the money market rate only model and the absolute value of the AIC of the model also including the discount rates over time. If the difference is positive, then we would select the money market rate only model, if negative we would do the opposite. In case of Belgium, Ireland, Italy and the Netherlands it can be seen that the inclusion of the discount rate makes the mixed specification better over time, whereas in France and Finland the difference is stable at slightly below zero. For the case of Austria and the UK the money market rate only specification is preferable. Nevertheless in order to ensure comparability with the other models the discount rate was included. For Finland the money market only model was chosen, as there is not that a big difference between both specification on the one hand and because the discount rate series for Finland only just begins in 1987, which considerably restricts the number of estimation subperiods. The exact specifications which were chosen are shown in appendix B.

The money market multipliers

Figure 1 shows some important results. Only the impact multipliers are shown , but figures (6) and (7) in the appendix will show some of the patterns at the beginning and at the end of the sample period. As these figures show, the model mainly characterizes the first four periods following a money market rate shock. For the fifth and sixth we find hardly any significant movement. This is in line with the analysis of Cottarelli & Kourelis, as they have firstly set up a model which analyzes the short run effects only, which secondly produces significant multipliers up to the third lead. This can be also justified on the basis of economic theory as in the long(er) run other factors such as the demand for loans are important determinants for bank lending rates.

The impact multipliers for market oriented economies like the Netherlands or the UK are stronger than for typical bank-based economies such as Germany. Also, as Hackethal et al. (2002) and Amable (2003) explain, France is moving toward the group of market-oriented economies due to structural reforms in the mid-1980s. This development becomes dominant at the end of the time span. Thus, the French banks' response

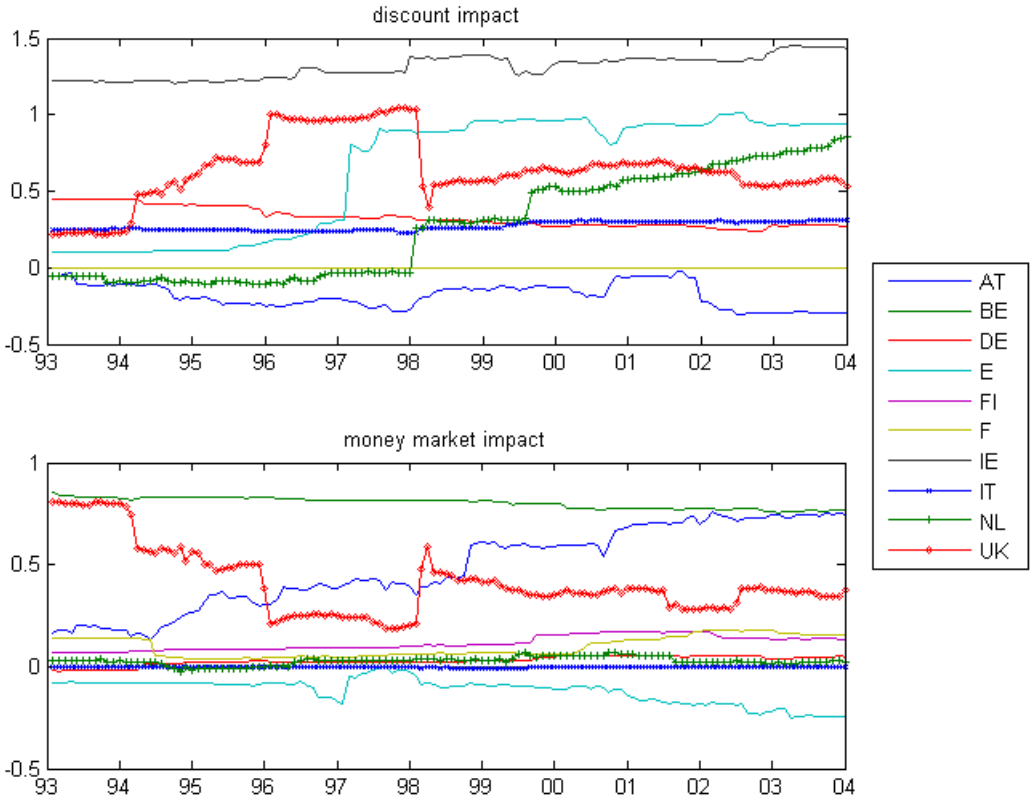

Figure 1: Impact Multipliers

to money market movements is stronger in latter regressions than in previous.

Belgium and Austria deserve special attention. According to Amable (2003) Belgium displays the second lowest intermediation ratio of all EMU countries with a declining tendency. As a consequence it is not surprising that money market impulses are transmitted quite strongly. On the other hand Austria remains puzzling. As Amable shows Austria has by far the persistently highest degree of intermediation, which could explain the outstandingly high transmission after three months. But what remains puzzling is the high degree of transmission at impact.

2 Impact of Financial Structure

To link the multipliers to financial structure variables, Cottarelli & Kourelis (1994) suggest that they depend on the structural features of the financial structure of the economy:

$$h_{j,l} = Z_j \eta_l + \upsilon_{j,l} \ , \tag{4}$$

where Z_j is a n-element vector describing the financial structure of the economy j and $\upsilon_{j,l}$ are errors that are not correlated between the countries. Taking together all countries the multiplier system can be re-written in the following matrix form:

$$h_0 = Z\eta_0 + \upsilon_0 \ , \tag{5}$$

where Z is a $J \times K$ matrix and $l = 0$, so that h_0 is the impact multiplier. In a similar manner medium and long term multipliers can be formulated,

$$h_l = Z\eta_l + \upsilon_l. \tag{6}$$

These equations enable us to study the effects of financial structure on the effects of monetary policy in the various countries. While section 2 will deal with the multipliers and look at the development of these over time, section 3 will discuss the direct effect of financial structure on the transmission of monetary impulses.

The empirical model combined with the rolling regression technique allows to track changes in the relationships we are interested in. There are various ways to characterize financial structures of economies: We consider two concepts, the first being the *legal family concept* due to La Porta et al. (1997) and for the second we follow the grouping by Amable (2003).

The idea behind the concept first introduced by La Porta et al. (1997) is that the legal origin of the countries' law code matters for the role capital markets play within the economy, as they differ with respect to shareholder and investor protection. They globally find four main families:

1. common law (English)
2. civil law
   (a) French
   (b) Scandinavian
   (c) German

Civil law countries do give fewer rights to parties in capital markets, but the rights are strongest enforced in German and Scandinavian countries.

By principal component and cluster analysis Amable (2003) pins down four groups which are similar to the legal family grouping, but not entirely the same. He finds a factor that explains 45 percent of the total variation, and which is defined by negative and positive components:

1. **negative:** stock market cap. to GDP, ownership of large listed companies, percentage of share held by institutional investors, M&A activity, accounting standards, importance of venture capital

2. **positive:** ownership concentration, scope of public ownership % the public sector, control of large firms by families, share of bonds in institutional investors' portfolios

From this first step he performs a cluster analysis and finds four groups,

1. high level of protection, high importance of stock markets and institutional investors, low public ownership
   USA, Canada, UK, Switzerland, Australia and Japan

2. larger than average control of firms by financial institutions
   France, Norway and Sweden

3. low importance of family control
   Ireland, Denmark, Finland and Austria

4. ownership concentration, lack of coherence to international accounting standards, low M&A activity, low development of capital markets
   Germany, Spain, Italy Portugal and Greece

These two groupings will be taken as proposed by theory in the first two sections of the section. To gain more robust evidence the following three ways are undertaken to assess potential changes, Sigma convergence, cluster analysis and panel regression analysis.

2.1 Sigma-Convergence

2.1.1 Concept

The concept of σ-convergence originally stems from the growth literature. It states that there is convergence (in growth) between a group of economies if the variation (in growth rates) within the group declines over time. This is of course a more general idea that is also applicable to other notions of convergence as well.

More explicitly, we are interested in the development of some kind of dispersion measure such as the standard deviation,

$$\sigma_K = \sqrt{\sum_{j=1}^{K}(m_j - \overline{m}_K)^2} \ , \tag{7a}$$

where K is a group of k countries and m is the respective multiplier.

As however different different groups have different means this might bias the results and thus lead to the wrong conclusions. To take into account the different means we will alternatively consider the coefficient of variation, which is defined as

$$cv_K = \frac{\sqrt{\sum_{j=1}^{K}(m_j - \overline{m}_K)^2}}{\overline{m}_K}. \tag{7b}$$

For this purpose the appropriate groups have to be defined. These groups should be found by using an appropriate measure for the financial structure.

2.1.2 Results

Figures 2, 3 and 4 not only give the grouping effect according to financial structure, but let us also assess possible convergence patterns across countries, over time and over the periods following a shock in the money market as well as discount rates.

Overall effects

Figure 2 displays convergence patterns distinguishing between money and discount rates. We find that there is a clear trend towards a more uniform reaction of banks after one to three months. This pattern clearly emerges in the late 1980s/ early 1990s, as the mass of observations are in the subsamples at the beginning. However for the discount rate multipliers there is a clear trend toward diversity over the 1990s and the beginning of the new century. From the discussion about measuring monetary policy and the relative importance of money market and discount rates we have to give more weight to the money market rate, especially as the discount rate multiplier is not included in a third of the economies involved. Summing up we cannot reject hypothesis one, even though there seems to be a contrary development for the impact multiplier and the reaction four to six months after the interest rate movement.

It should be noted at this stage that the convergence measures for figures 2, 3 and 4 differ in the sense that figure 2 uses the ordinary standard deviation measure, whereas the latter figures show coefficients of variation for obvious reasons.

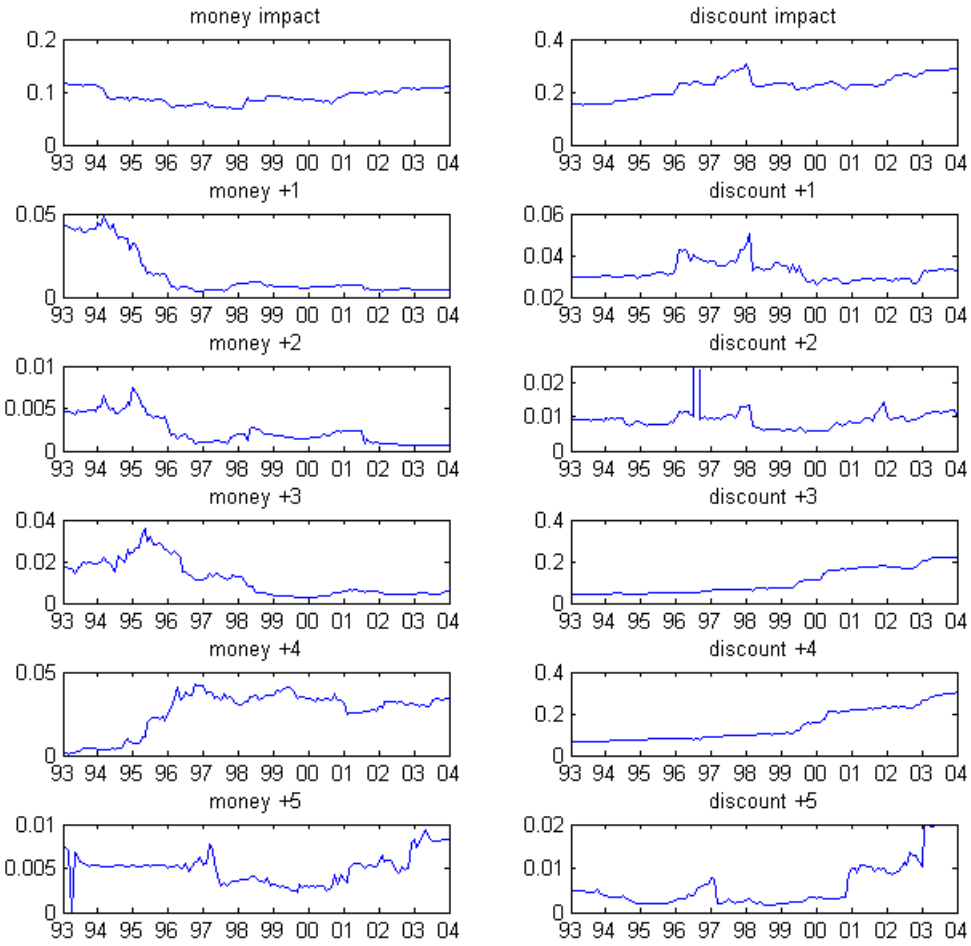

Figure 2: Variance of Multipliers

Legal Family

Looking at the money market first, grouping according relative to legal families does have an important influence on the variation of bank behavior in the first three and the fifth months after the movement in the money market and only these are shown. The remainig months are not shown for presentational clearness. As to the impact multiplier a significant impact cannot be found, as the French legal families response as well as the German families response is being more and more divergent. In case of the French family this seems to have to do with the money-market effect in Belgium, which is by far larger than in all the other economies within this group. For the German legal family this divergence seems to be driven by the Austrian development.

There is convergence in monetary transmission in Europe in the 1990s. This convergence can be observed in the first three month following a money market rate movement.

Financial Structure

Looking at financial structure from a less historical perspective and for the other strategy that uses the *Amable-factors* a problematic feature is that we have to drop the Netherlands and can only look at group three and four because we only have the UK of his group one and for group two we only have France. Therefore it does not make sense to look at deviation measures for the first two groups.

For the money market (figure 4) grouping makes sense for five out of six cases (5th month after the change in the money market rate). Similar to the legal family distinction a significant grouping effect for the impact and the first three months after the change in the money market rate is obtained. This seems to be robust across the two grouping procedures.

Given convergence in Europe following a money market movement in the first three months, the dispersion between countries with similar financial structure is further reduced. There is a significant impact of financial structure on the convergence of the European monetary transmission.

The conclusion is that there is a clear pattern of convergence in the money market in the first three months following an interest rate movement. This is is even reinforced when we look at the grouping motivated by financial structure. Not only do we find convergence in these months, but furthermore the variation in countries with similar financial structure is also lower in these economies. This might be interpreted as an indication that financial structure influences the convergence of the monetary transmission mechanism.

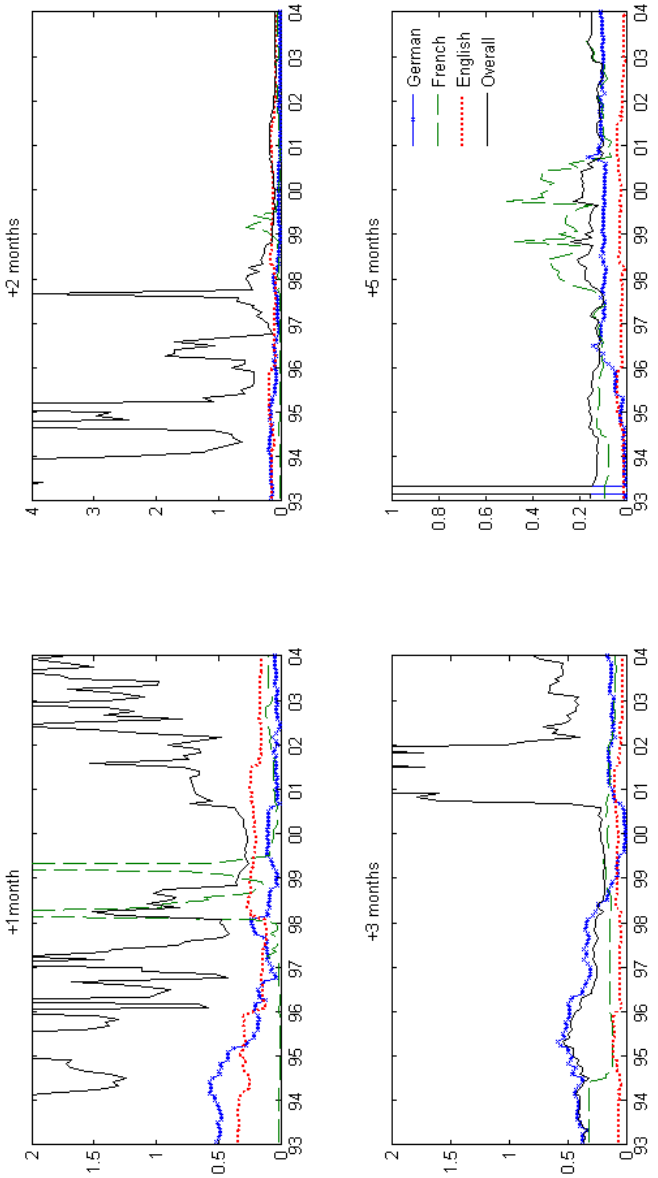

Figure 3: Variation due to legal family

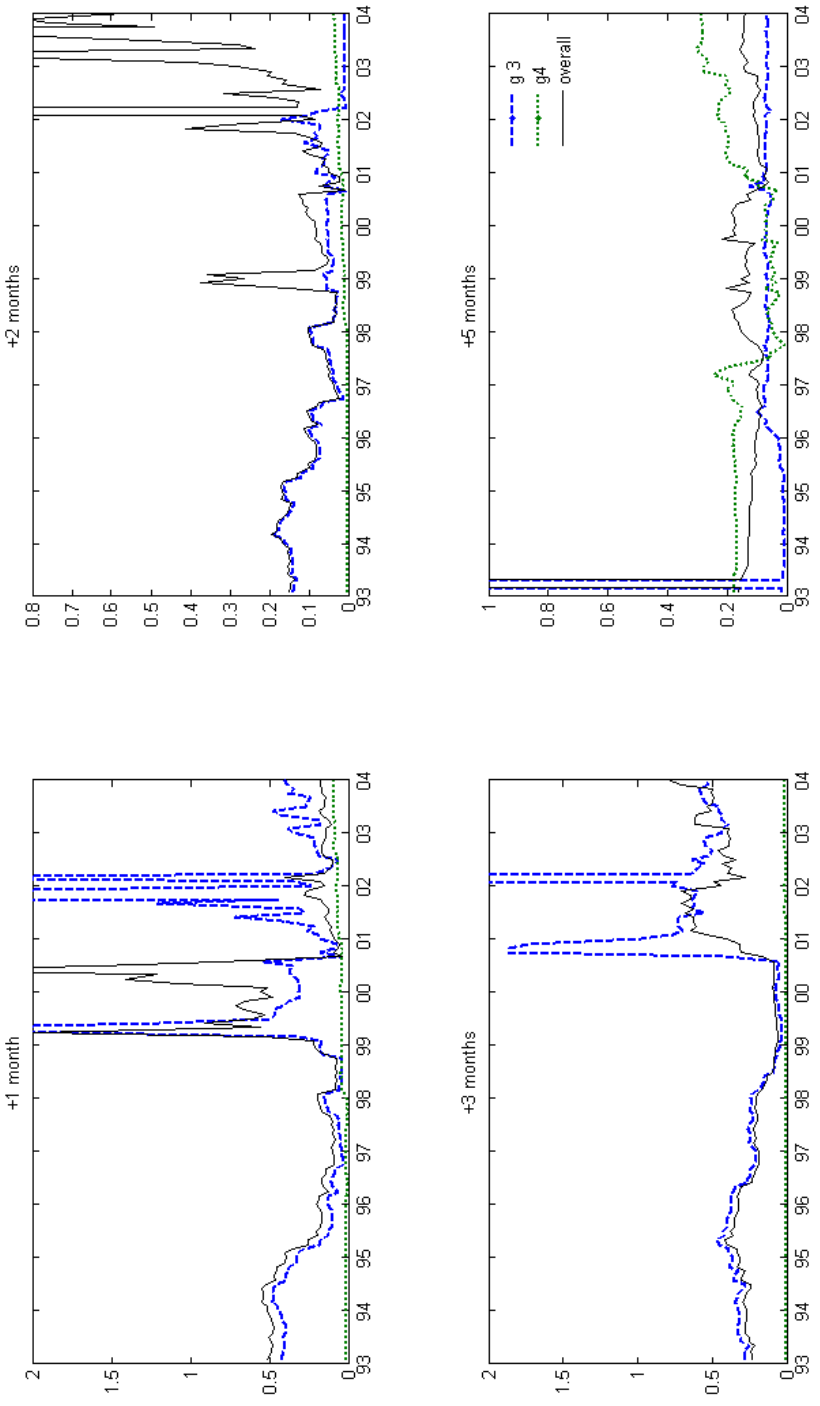

Figure 4: Variation due to financial structure

2.2 Cluster Analysis

2.2.1 Concept

The cluster approach[2] turns the problem of σ-convergence upside down as from only observing the estimated multipliers groups will be formed. It is interesting whether the groups that are formed on the basis of some measure that will later correspond to the groups that financial structure would predict.

For our purposes we define for each sample period $n = 1, \ldots, N$ and country $j = 1, \ldots, J$ a point

$$s_{n,j} = (h_{j,m,0}, h_{j,d,0}, \ldots, h_{j,m,p}, h_{j,d,p}) \ , \tag{8}$$

where p are again periods ahead, h are the multipliers and m and d refer to the money market and discount rates respectively.

Starting with $s_{n,j}$ groups on the basis of minimizing the distance between the country points, groups with similar characteristics will be formed. The classical concept of distance between points is *Euclidian distance*, which is defined as follows. Take any two points $s_i = (x_1, x_2, \ldots, x_p)$ and $s_j = (y_1, y_2, \ldots, y_p)$, the Euclidian distance is defined by

$$d_{i,j} = [(x_1 - y_1)^2 + \ldots + (x_p - y_p)^2]^{1/2}.$$

In general there are two ways to do cluster analysis, **hierarchical** and **non - hierarchical** clustering. Within the first class it can be distinguished between *agglomerative* and *divisive* methods. In case of the agglomerative method J clusters are the staring points, so each country forms a cluster. The two closest clusters are successively combined until only one cluster, which consists of the whole group, remains. Divisive methods start from the biggest available group and step down until there are exactly J groups. A popular way to find the closest cluster to a given cluster is the centroid technique. For the agglomerative cluster method each cluster consists of only one point. The centroid is the point the coordinates of which are just the mean of all coordinates of the points in the respective cluster. So at the start each point is the centroid of its own cluster. Then the two points the centroids of which are closest are grouped into one cluster. Afterwords the minimal distance between the centroids of all clusters is searched and the two clusters with the minimal distance are formed and so on until one single cluster is left.

A popular **non-hierarchical** clustering technique is *k-means clustering*. For this method the points are grouped into K clusters by some method. The centroids of these clusters are calculated. Then the distance between every point in the set and the

[2]The discussion of cluster analysis follows closely Afifi, Clark & May (2004), chapter 16

centroid of each cluster is calculated. If it is closest to its own centroid the point is kept within the group. If not it is assigned to the centroid of the group the centroid of which it is closest. This is repeated until no point is re-assigned.

2.2.2 Results

In the following subsection another way of detecting convergence is presented. Given the sets of multipliers for the economies, can groups be identified and if yes, do these correspond closely to the ones, the grouping of which is motivated by theory, i.e. *legal family* or *financial structure* groups?

For this purpose we first consider partitional clustering and look at the four group stage given in tables 1 and 2.

Table 1: Partitional Cluster Analysis: **both multipliers**

	group			
	1	2	3	4
1994	ie	at	de,e,f,fi,it,nl	uk, be
1995	ie	at, f, fi, nl	de,e,it	uk,be
1996	ie	at, be	de,e,f,fi,it,nl	uk
1997	ie	at, be, f, fi, nl	de,e,it	uk
1998	ie	at, be	de,e,it,uk	nl,f,fi
1999	ie, e, uk	at, be	de,f,fi,it,nl	it
2000	be	at	de,e,f,fi,ie,nl,uk	it
2001	ie	at, be	de,e,f,fi,nl,uk	it
2002	ie	at, be	de,f,fi	e,it,nl,uk
2003	ie	at	de,e,f,fi,it,nl,uk	be
2004	ie	at, be, f, fi	de,nl,uk	e,it
grouping	ie	at, be	de,e,f,fi,nl,it	uk

Looking at the overall effect a clear separation of the Common Law system from the Civil Law system can be observed, as both, Ireland and the UK are clearly separated over the individual years as well as on average. The difference between German and French law system seems to be less pronounced in comparison, as France and Germany as well as Belgium and Austria are often grouped into the same category. It is interesting that in every year, France and Finland seem to be closest, as they are always in the same group.

Taking the other proposed proxy for financial structure proposed by Amable, there seems to be a clear contradiction to Amable's (2003) results, as France (an Amable group 2 country) an Germany (an Amable group 4 country) are grouped almost always in the same group in this analysis. What is in line with Amable (2003) is the grouping of Italy, Germany and Spain in the overall consideration.

Table 2: Partitional Cluster Analysis: **money market multipliers**

	group			
	1	2	3	4
1994	at	de,e,ie,it	f,fi,nl	be,uk
1995	at	de,f,fi,ie,it,nl	e	be,uk
1996	at	de,f,fi	e,ie,it,nl	be,uk
1997	at,be	de,f,fi,ie,it,nl	e	uk
1998	at,be	de,f,fi,ie,it,nl	e	uk
1999	at	de,f,fi,ie,it,nl,uk	e	be
2000	at,be	de,f,fi,ie,it,nl	e	uk
2001	at,be,uk	de,f,ie,it,nl	e	fi
2002	at	de,e,ie,it,nl	be	uk,f,fi
2003	at	de,f,fi,ie,it,nl	e	uk,be
2004	at,be	de,ie,it,nl	f,fi	uk
grouping	at	de,f,fi,ie,it,nl	e	uk

Additional to that a hierarchial cluster method was undertaken, which is summarized in table 3. Dissimilarity between the economies increased in the late 1990s, but decreased after 2000, which is compatible with the results obtained from the section on sigma convergence. Another similarity can be seen in table 1 that Ireland and the UK occupy a special position, and most European economies are grouped into one group, which appears to be growing over time.

Table 3: Hierarchial Cluster Method

	minimal distance*	group			
	for 4 clusters	1	2	3	4
1995	0.92	at, f, fi, nl	de, e, it	ie	be, uk
1997	1.02	at, be	de, e, f, fi, it, nl	ie	uk
2000	1.03	at, be	de, f, fi, it, nl, uk	e	ie
2003	0.68	at, be	de, f, fi, it, nl, uk	e	ie

*Euclidian distance metric

Observing the pattern of monetary transmission mechanism we cannot identify groups according to their financial structure.

Considering the subset of money market multipliers the UK still differs from the rest of Europe, but also Austria is separated. This latter observation can potentially be attributed to the strong and dominant impact effect of the Austrian money market on bank-credit interest rates. Another difference to table 1 is that Spain is nearly always singled out. Again the difference between French and German legal families does not seem to be too strong as in the overall case. As Amable (2003) is concerned the money

market multiplier that groups 3 and 4 (with the notable exceptions of Austria and Spain) seem to have merged. So judging from cluster analysis we cannot fully identify groups due to financial structure from only looking at the response of banks in the respective economies.

2.3 Panel Regression Analysis

2.3.1 Concept

Another way to assess the impact of financial structure on monetary transmission is to estimate it directly by a panel regression. Within this framework proxies for the financial structure can be directly tested for their influence on monetary transmission, in this case on the multipliers of the money market as well as the discount rate multipliers. By a panel regression the (set of) economy(ies) we are interested in can be accounted for more directly.

More formally we have the following system:

$$h_{0,(j,t)} = Z_{jt}\eta + u_{j,t} \ , \tag{9a}$$

$$u_{j,t} = \mu_j + \nu_{jt} \ , \tag{9b}$$

where $j = 1, \ldots, J$, $t = 1, \ldots, T$, Z_{jt} is a vector of financial structure variables, μ_j measures the individual effect in country j and $\nu_{jt} \sim N(0, 1)$ is a disturbance term.

The parameter vector η accounts for the influence of financial structure on the transmission of monetary policy impulses. We first require all the parameters to differ significantly from zero. As we also take into account time we will incorporate the Euro effects and this will have of course influence the estimation of the parameters.

If we were to account for changes over time, we could slightly change the specification of equation (9b) to

$$u_{j,t} = \mu_j + \lambda_t + \nu_{jt} \ , \tag{9c}$$

where λ_t measures the time-specific effects. The model comprised of equations (9a) and (9c) is typically referred to as a two-way panel.

The following structural variables will be used:

1. *Volatility of of the money market*
   residuals from an ARMA(p,q) fitted to the money market rate

2. *Capital market deepness*
   ratio of domestic market capitalization to GDP

3. *Degree of intermediation*

   (a) bank deposits to GDP and

   (b) bank credits to GDP (both overall and non-financial corporations)

To account for other influences also inflation is included in the panel regression estimates.

From the previous discussion the following expectations can be made about the influence of financial structure variables.

In an economy where financial structure matters all variables have a significant influence on the multipliers. In countries with a higher degree of intermediation volatility and capital market deepness exerts a lesser whereas the degree of financial intermediation exerts a higher influence on the multipliers. In bank based or relationship based economy the latter effect is expected to dominate the other two and thus a negative individual effect (μ_j), which is reversed for the market based or (arm's length) economies.

2.3.2 Results

Of the countries investigated previously we unfortunately had to drop UK and Ireland as for the UK there are not bank deposit series in the IFS database and for Ireland the market capitalization is only published from 1994 onwards. Whether to include Ireland or not is debatable, even if the data were observable, as it is expected that the inclusion of this economy would have adverse effects on the results due its fast growth during the 1990s. As table 11 in the appendix shows there is no significant difference between the one- and the two way models, whereas the poolability tests indicate that estimating a pooled regression is worse than estimating a panel regression model. In order to achieve parsimony the one-way fixed effects model was chosen. Given that there are only 8 countries in the sample a fixed effects model is clearly the better choice over a random effects model. Five specifications were estimated.

In table 4 the variables market capitalisation(mc), bank deposits to GDP (bd) and the yieldspread (ys) influence the impact money market multiplier significantly. Starting with the maximum specification as discussed above we consecutively dropped all insignificant variables until all variables were significant. This was done in a way to avoid a decrease in the adjusted R-squared. If such a decrease occured we would have left the otherwise insignificant variable in the regression. The variable bd shows a positive influence on the multiplier as expected. As the influence of banks channeling funds from households to firms increases so does the rigidity of banks with respect to money market movements. The negative coefficient of mc is not easily interpretable. It could probably be explained by the fact that if banks dominate the stock market, the higher

Table 4: Panel Regression Results

	(1)	(2)	(3)	(4)	(5)
market cap.	.0005	-.0016	-.0018	-.0020	-.0019
	(.0009)	(.0005)	(.0006)	(.0006)	(.0006)
bank dep./GDP	-2.1510	2.7579	2.6056	2.5071	2.5713
	(.5286)	(.5588)	(.5907)	(.5828)	(.5842)
yieldspread	.0115	.0202	.0165	.0154	.0194
	(.0181)	(.0058)	(.0074)	(.0067)	(.0076)
AT	-	.1980	.1896	.2004	.2333
		(.054)	(.0547)	(.0533)	(.0660)
BE*	-	.2735	.2981	.3112	.2959
		(.0354)	(.0466)	(.0442)	(.0461)
DE*	-	-.5639	-.5429	-.5319	-.5455
		(.039)	(.0469)	(.0449)	(.0464)
E*	-	-.7372	-.7116	-.6972	-.7118
		(.0443)	(.0545)	(.0524)	(.0539)
F*	-	-.5711	-.5483	-.5322	-.5395
		(.0561)	(.0629)	(.0622)	(.0624)
FI*	-	-.5314	-.4924	-.4702	-.4921
		(.0460)	(.0666)	(.0630)	(.0658)
IT*	-	-1.0127	-.9708	-.9462	-.9685
		(.1129)	(.1243)	(.1216)	(.1229)
NL*	-	-.5653	-.5226	-.4972	-.5191
		(.0430)	(.0679)	(.0645)	(.0671)
t	-	-	.0043	-	-.0145
			(.0053)		(.0128)
t^2	-	-	-	.0006	.0017
				(.0004)	(.0011)
Obs.	80	80	80	80	80
Adj. R-squ.	0.1525	0.9498	0.9496	0.9505	0.9507
F-Stat.	5.74	150.55	136.25	138.99	128.06

Standard Errors in parentheses.

* relative to Austria

their influence in capital markets the lower the power of the market to compete with the banks. This crucial implication depends on the assumption that banks are dominant players in capital markets. The yield spread is the third source of influence, and it has a positive effect. Considering a positive spread, when the margin between long and short term interest rates widens, it becomes more attractive for banks to adjust their portfolio. This is due to the fact that every adjustment is costly and therefore only adjustment is undertaken if the gains from rebalancing the portfolio exceed the corresponding costs. This occurs more often the bigger the spread in yields.

Financial structure significantly influences the extent of monetary transmission, because financial structure factors exert a significant impact on the magnitude of transmission of interest movements by European banks.

Furthermore all country dummies are significant. Belgium, which displays the lowest intermediation ratio, has also a bigger multiplier than Austria. Netherlands and France which usually display low degrees of intermediation have however a smaller intercept term than Austria. This could be attributed to the fact that French and Dutch banks are more international, which dampens the propensity of banks to react to money market movements.

We consecutively eliminated insignificant explanatory variables, still the signs were preserved and the variables mc, bd and ys stayed significant.

From specifications (3) - (5) there is no significant and common influence of the trend, neither linear nor quadratic on the impact multiplier. Also the sign of the coefficients remain unchanged. As however only 10 time points could be used this should be treated with caution. After the inclusion of various forms of trends the influence of the proxies for financial structures are reduced whereas the influence of country specifics are more pronounced, which could be interpreted as an indication for a change. The adjusted R-squared indicates that model (5) is preferred to model (3), indicating a negative non-linear trend for $h_{0,m}$.

Conclusions

This paper has several objectives. First it tries to investigate how to best assess the impact of monetary policy on bank behavior. The result is that for the structure of the chosen model it is best for most European countries to include the discount rate next to the money market rate, because this exerts statistical influence on bank behavior. Secondly we find that not accounting for the change in European monetary transmission over the last decade and only estimating a cointegration relationship misses the essential development in European monetary policy: the convergence of the nature of monetary transmission. This study argues that bank behavior after a money market

rate movement has in fact synchronized over the 1990s, not at impact but at the three months following the movement. This is even more emphasized when countries with similar financial structure are grouped accordingly. Starting with the nature of bank response and trying to form groups accordingly, these do not resemble groups with similar financial structure however. Last but not least we established that there is a significant impact of financial structure, because factors such as the ratio of bank deposits to GDP or market capitalization to GDP as well as the term structure have a statistically significant impact. So all in all we do not find a falsification of the three hypotheses proposed.

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A Data Description

Table 5: Data Description

Type	Label	Source	Range	category
Austria				
Base Rate	d_{AT}	OENB	1M1980:9M2004	key rate
3-month interbank rate	m_{AT}	WIFO	1M1980:12M1998	market rate
new emmissions rate	l_{AT}	WIFO	1M1980:12M2004	lending rate
industrial production	ip_{AT}	IFS	1M1980:12M2004	output
CPI	cpi_{AT}	IFS	1M1980:12M2004	Inflation
Belgium				
discount rate	d_{BE}	IFS	1M1980:12M1998	key rate
t-bill rate	m_{BE}	IFS	1M1980:12M1998	market rate
lending rate (corporations)	l_{BE}	IFS	4M1985:9M2004	lending rate
industrial production	ip_{BE}	IFS	1M1980:12M2004	output
CPI	cpi_{BE}	IFS	1M1980:12M2004	Inflation
Germany				
discount rate	d_{DE}	BuBa	4M1980:12M1998	key rate
3-m money market rate	m_{DE}	BuBa	1M1980:12M1998	market rate
lending rate (corporations)	l_{DE}	IFS	1M1980:6M2003	lending rate
industrial production	ip_{DE}	IFS	1M1980:08M2004	output
CPI	cpi_{DE}	IFS	1M1980:09M2004	Inflation
Finland				
HELIBOR	d_{FI}	BoFi	4M1980:12M1998	key rate
3-m money market rate	m_{FI}	BoFi	12M1986:12M1998	market rate
lending rate (corporations)	l_{FI}	IFS	1M1980:6M2003	lending rate
industrial production	ip_{FI}	IFS	1M1980:08M2004	output
CPI	cpi_{FI}	IFS	1M1980:09M2004	Inflation
France				
discount rate	d_{FR}	BDF	4M1984:12M1998	key rate
to be continued ...				

Table 5: Data Description

Type	Label	Source	Range	category
3-month interbank rate	m_{FR}	BDF	12M1986:12M1998	market rate
daily money market rate	$m1_{FR}$	BDF	1M1980:12M1998	market rate
lending rate (corporations)	l_{FR}	IFS	1M1980:9M2004	lending rate
industrial production	ip_{FR}	IFS	1M1980:08M2004	output
CPI	cpi_{FR}	IFS	1M1980:09M2004	Inflation
Ireland				
short term credit facility	d_{IE}	BoIre	1M1980:12M1998	key rate
3-m money market rate	m_{IE}	BoIre	1M1980:12M1998	market rate
lending rate (corporations)	l_{IE}	IFS	1M1980:9M2004	lending rate
industrial production	ip_{IE}	IFS	1M1980:08M2004	output
CPI	cpi_{IE}	IFS	1M1980:09M2004	Inflation
Italy				
discount rate	d_{IT}	BI	1M1980:12M1998	key rate
3-m money market rate	m_{IT}	BI	1M1980:12M1998	market rate
lending rate (corporations)	l_{IT}	IFS	8M1983:2M2004	lending rate
industrial production	ip_{IT}	IFS	1M1980:08M2004	output
CPI	cpi_{IT}	IFS	1M1980:09M2004	Inflation
Netherlands				
Call money market rate	d_{NL}	DNB	1M1980:12M1998	key rate
Aibor 3m	m_{NL}	DNB	1M1980:12M1996	market rate
lending rate (corporations)	l_{NL}	DNB	1M1980:10M2002	lending rate
industrial production	ip_{NL}	IFS	1M1980:08M2004	output
CPI	cpi_{NL}	IFS	1M1980:09M2004	Inflation
Spain				
refinancing marginal rate	d_E	BEsp.	1M1980:9M2004	key rate
off. interbank reference rate	di_E	BEsp.	1M1980:9M2004	key rate
3 month interbanking rate	m_E	BEsp.	1M1980::9M2004	market rate
Lending rate (corporations)	l_E	IFS	1M1980:9M2004	lending rate

to be continued ...

Table 5: Data Description

Type	Label	Source	Range	category
UK				
Monthly average of El. bills	d_{UK}	BoE	1M1980:10M2004	key rate
discount rate, 3 month				
t-bill rate	m_{UK}	IFS	1M1980:9M2004	market rate
lending rate	l_{UK}		1M2004:8M2004	lending rate
industrial production	ip_{UK}	IFS	1M1980:08M2004	output
CPI	cpi_{UK}	IFS	1M1980:09M2004	Inflation
EMU Data				
main refinancing, fixed rate	d_{EMU}	ECB	1M1999:6M2000	key rate
main refinancing, min. rate	d_{EMU}	ECB	6M2000:1M2005	key rate
EURIBOR, 3m	m_{EMU}	BuBa	1M1999:1M2005	market rate
fixed conversion rates	-	ECB	-	-

Table 6: Panel Regression Data

Variable	Range	Frequency	Source
market cap. to GDP	1988:2003	y	World Dev. Indicators
bank deposits	1980:2003	y	IFS database
Bank credits	1980:2003	y	IFS database
private sector bank credits	1980:2003	y	IFS database
GDP	1980:2003	y	IFS database
gvt. bond yield	1M1980:12M2003	m	Datastream

B Regression Specifications

Austria

$$\begin{aligned}\Delta l_{at,t} = \quad & \alpha_0 + \alpha_1 \Delta l_{at,t-1} + \beta_0 \Delta d_{at,t} + \gamma_0 \Delta m_{at,t} + \gamma_1 \Delta d_{at,t-1} + \\ & \gamma_2 \Delta m_{at,t-2} + \gamma_3 \Delta m_{at,t-3} + \epsilon_t \end{aligned} \tag{10}$$

Belgium

$$\begin{aligned}\Delta l_{be,t} = \quad & \alpha_0 + \alpha_1 \Delta l_{be,t-1} + \gamma_0 \Delta m_{be,t} + \gamma_1 \Delta d_{be,t-1} + \gamma_2 \Delta m_{be,t-2} + \\ & \gamma_5 \Delta m_{be,t-5} + \gamma_7 \Delta m_{be,t-7} + \gamma_8 \Delta m_{be,t-8} + \epsilon_t \end{aligned} \tag{11}$$

Germany

$$\begin{aligned}\Delta l_{de,t} = \quad & \alpha_0 + \beta_0 \Delta d_{de,t} + \beta_2 \Delta d_{de,t-2} + \beta_3 \Delta d_{de,t-3} + \beta_4 \Delta d_{de,t-4} + \\ & \beta_5 \Delta d_{de,t-5} + \gamma_0 \Delta m_{de,t} + \epsilon_t \end{aligned} \tag{12}$$

Spain

$$\begin{aligned}\Delta l_{e,t} = \quad & \alpha_0 + \alpha_1 \Delta l_{e,t-1} + \beta_0 \Delta d_{e,t} + \beta_1 \Delta d_{e,t-1} + \beta_3 \Delta d_{e,t-3} + \\ & \beta_4 \Delta d_{e,t-4} + \beta_5 \Delta d_{e,t-5} + \beta_7 \Delta d_{e,t-7} + \gamma_0 \Delta m_{e,t} + \gamma_4 \Delta m_{e,t-4} + \\ & \gamma_5 \Delta m_{e,t-5} + \gamma_6 \Delta m_{e,t-6} + \gamma_1 0 \Delta m_{e,t-10} + \gamma_1 1 \Delta m_{e,t-11} + \epsilon_t \end{aligned} \tag{13}$$

Finland

$$\Delta l_{fi,t} = \quad \alpha_0 + \alpha_1 \Delta l_{fi,t-1} + \textstyle\sum_{i=0}^{5} \gamma_i \Delta m_{fi,t-i} + \epsilon_t \tag{14}$$

France

$$\Delta l_{f,t} = \quad \alpha_0 + \alpha_1 \Delta l_{f,t-1} + \textstyle\sum_{i=0}^{14} \gamma_i \Delta m_{f,t-i} + \epsilon_t \tag{15}$$

Ireland

$$\begin{aligned}\Delta l_{ie,t} = \quad & \alpha_0 + \alpha_1 \Delta l_{ie,t-1} + \beta_0 \Delta d_{ie,t-0} + \beta_1 \Delta d_{ie,t-1} + \beta_3 \Delta d_{ie,t-3} + \\ & \beta_4 \Delta d_{ie,t-4} + \epsilon_t \end{aligned} \tag{16}$$

Italy

$$\Delta l_{it,t} = \alpha_0 + \alpha_1 \Delta l_{it,t-1} + \sum_{i=0}^{2} \beta_i \Delta d_{it,t-i} + \gamma_0 \Delta m_{it,0} \epsilon_t \tag{17}$$

The Netherlands

$$\Delta l_{nl,t} = \alpha_0 + \alpha_1 \Delta l_{nl,t-1} + \sum_{i=0}^{6} \beta_i \Delta d_{nl,t-i} + \gamma_0 \Delta m_{nl,0} \epsilon_t \tag{18}$$

United Kingdom

$$\begin{aligned} \Delta l_{uk,t} = \alpha_0 + \alpha_1 \Delta l_{uk,t-1} + \beta_1 \Delta d_{uk,t-1} + \beta_2 \Delta d_{uk,t-2} + \beta_6 \Delta d_{uk,t-6} + \\ \beta_1 0 \Delta d_{uk,t-10} + + \gamma_0 \Delta m_{uk,t} + \epsilon_t \end{aligned} \tag{19}$$

C Regression and Test Statistics

C.1 Multiplier Models - Regression Statistics

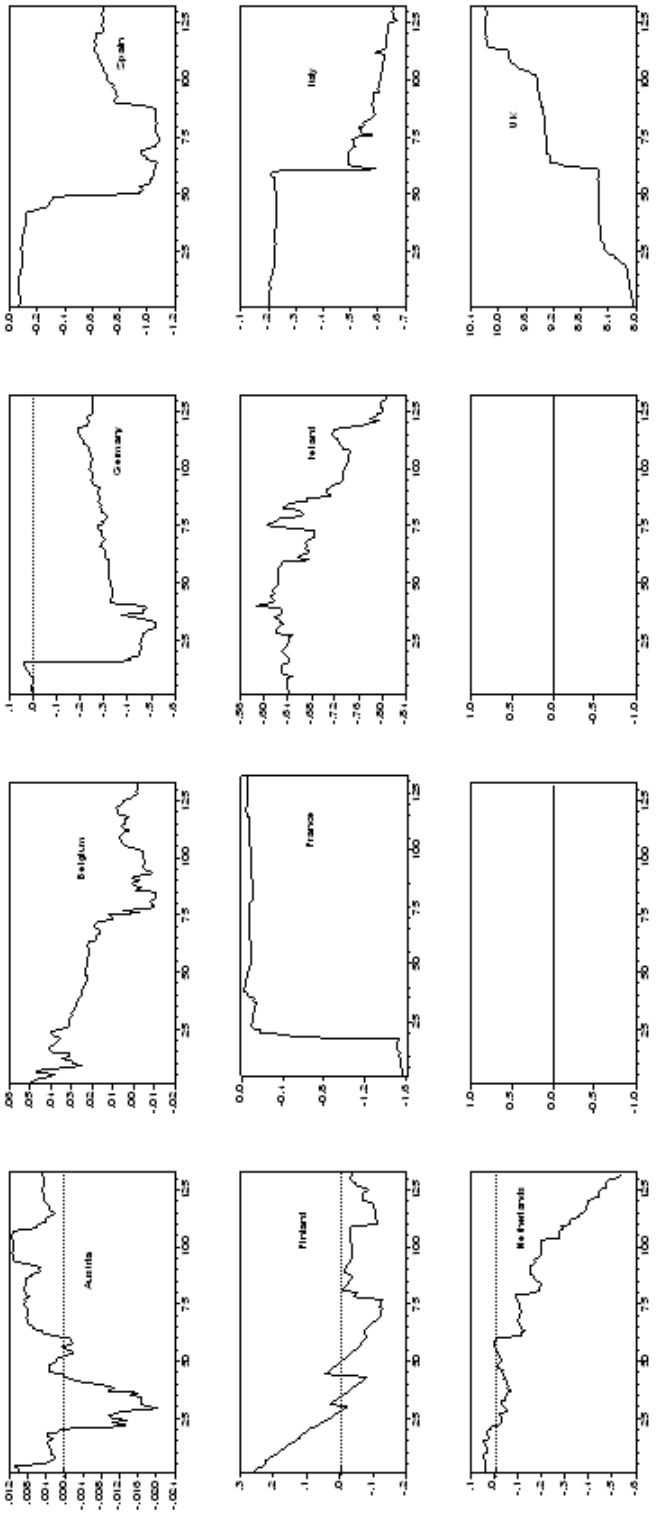

Figure 5: Modelselection by AIC

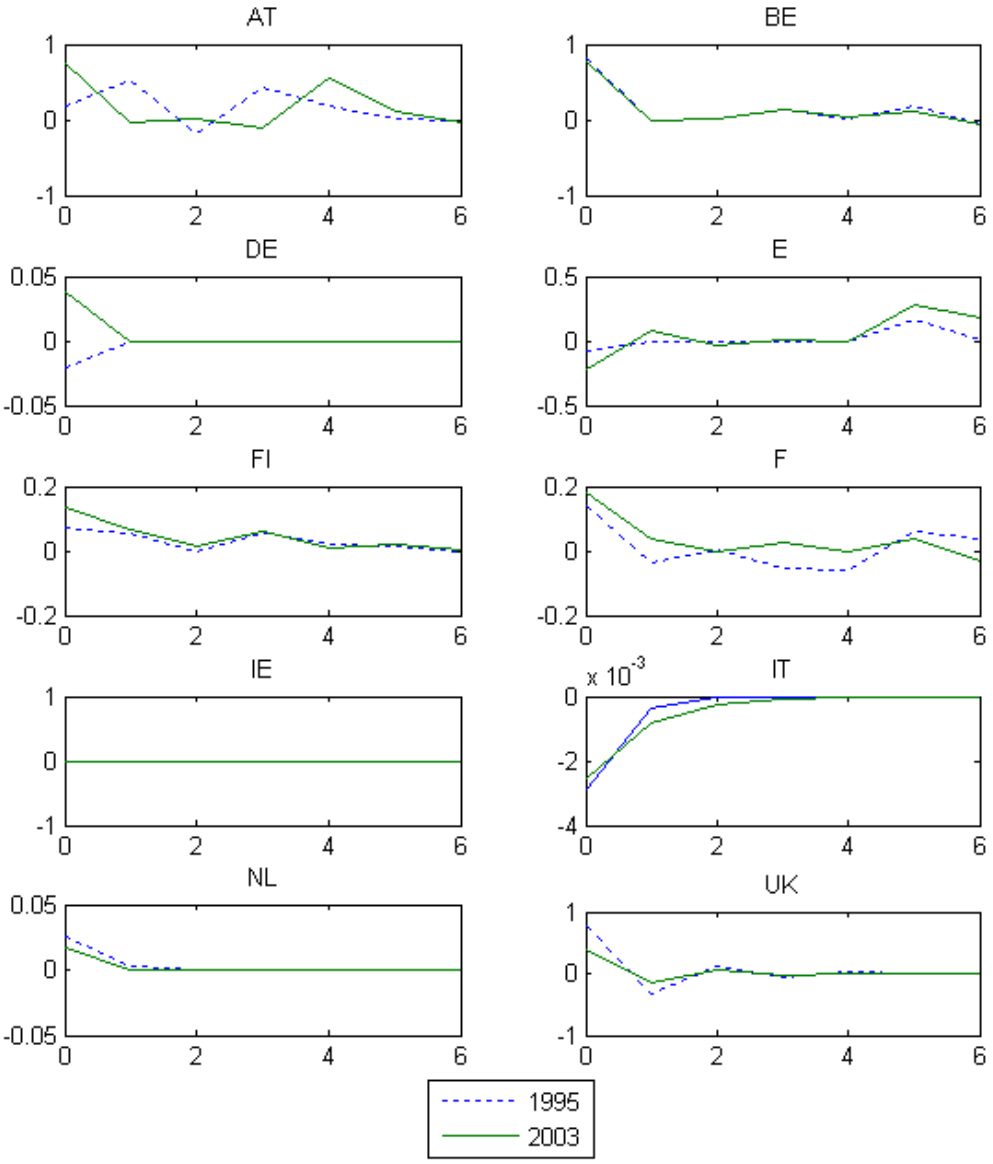

Figure 6: Multipliers (money market rate)

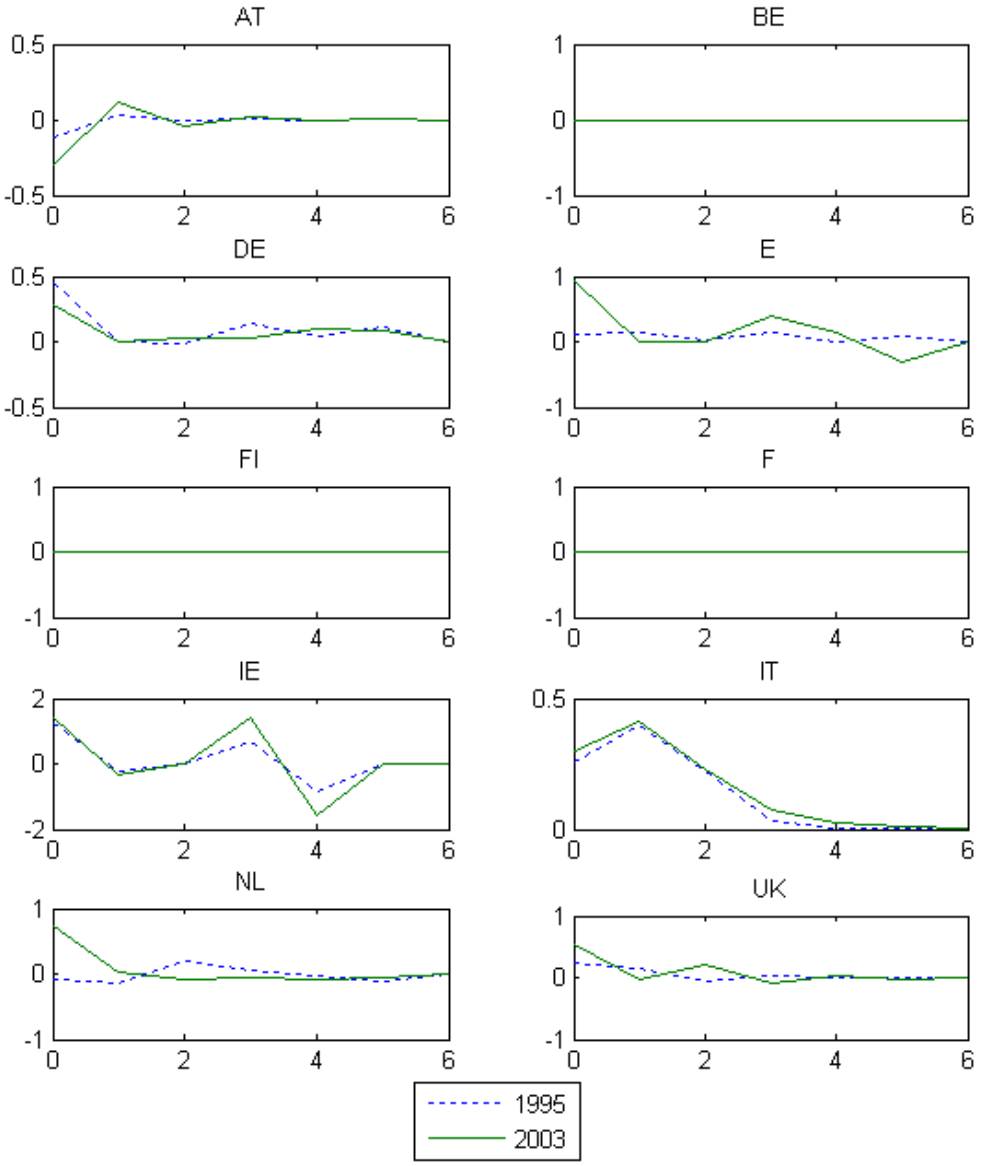

Figure 7: Multipliers (discount rate)

C.2 Residual Tests

As table indicates 7 we have serial correlation in Germany, France, Finland and Italy indicating changes in the nature of the estimated relationship as when estimating the rolling regressions this autocorrelation disappears.

The regression residuals from France, Finland and Italy display heteroskedasticity. Thus, the rolling regressions are estimated as before, but the standard errors are calculated correcting for heteroskedasticity, which is due to White (1980) and computes the variance - covariance matrix the following way:

$$\widehat{\Sigma} = \frac{T}{T-k}(X'X)^{-1}\left(\sum_{t=1}^{T} u_t^2 x_t x_t'\right)(X'X)^{-1}$$

where u_t are the OLS residuals, T is the sample size and X is a $T \times k$ matrix of regressors.

Table 7: Breusch-Godfrey Serial Correlation LM Test

Austria			
F-statistic	16.87907	Probability	0
Obs*R-squared	44.52453	Probability	0
Belgium			
F-statistic	3.675106	Probability	0.000498
Obs*R-squared	28.22671	Probability	0.000433
Germany			
F-statistic	1.557115	Probability	0.160072
Obs*R-squared	9.57447	Probability	0.143754
Spain			
F-statistic	1.742387	Probability	0.059768
Obs*R-squared	22.61518	Probability	0.031176
France			
F-statistic	0.806678	Probability	0.44755
Obs*R-squared	1.642769	Probability	0.439822

to be continued ...

Table 7: Breusch-Godfrey Serial Correlation LM Test

Finland			
F-statistic	0.334148	Probability	0.937485
Obs*R-squared	2.549151	Probability	0.923351
Ireland			
F-statistic	12.27252	Probability	0
Obs*R-squared	43.55738	Probability	0
Italy			
F-statistic	1.292046	Probability	0.276636
Obs*R-squared	2.642507	Probability	0.266801
The Netherlands			
F-statistic	2.74554	Probability	0.01316
Obs*R-squared	16.4464	Probability	0.011548
UK			
F-statistic	3.416235	Probability	0.000116
Obs*R-squared	39.19506	Probability	0.000098

Table 8: White Heteroscedasticity Test

Austria			
F-statistic	1.773358	Probability	0.05221
Obs*R-squared	20.7012	Probability	0.054931
Belgium			
F-statistic	3.584163	Probability	0.000001
Obs*R-squared	63.22639	Probability	0.000007

to be continued ...

Table 8: White Heteroscedasticity Test

Germany			
F-statistic	3.171316	Probability	0.000025
Obs*R-squared	50.14	Probability	0.000072
Spain			
F-statistic	7.652177	Probability	0
Obs*R-squared	171.0423	Probability	0
France			
F-statistic	0.296645	Probability	0.938119
Obs*R-squared	1.818618	Probability	0.935602
Finland			
F-statistic	1.361072	Probability	0.14832
Obs*R-squared	26.35834	Probability	0.1543
Ireland			
F-statistic	65.63948	Probability	0
Obs*R-squared	224.3686	Probability	0
Italy			
F-statistic	0.15187	Probability	0.998807
Obs*R-squared	1.579833	Probability	0.998664
The Netherlands			
F-statistic	10.1433	Probability	0
Obs*R-squared	116.7338	Probability	0
UK			
F-statistic	10.1882	Probability	0
Obs*R-squared	155.1124	Probability	0

Table 9: Normality Tests

Austria		Ireland	
Jarque-Bera	381.33	Jarque-Bera	15941
probability	0	probability	0
Belgium		Italy	
Jarque-Bera	50.06	Jarque-Bera	90437
probability	0	probability	0
Germany		The Netherlands	
Jarque-Bera	6629.62	Jarque-Bera	726.51
probability	0	probability	0
Finland		Spain	
Jarque-Bera	5538.70	Jarque-Bera	1649
probability	0	probability	0
France		UK	
Jarque-Bera	390.81	Jarque-Bera	2538.9
probability	0	probability	0

C.3 Panel Regression Tests

Table 10: Variable description

Variable	Description	Calculation
MC	Market capitalization as a share of GDP	obt. from the DB (7 yr. ma*)
bd	Bank deposits to GDP	obt. from the DB (7 yr. ma*)
bpuc	public bank loans to GDP (total loans - private loans)	obt. from the DB (7 yr. ma*)
bpc	Bank credits to GDP (excl. public loans)	obt. from the DB (7 yr. ma*)
inf	last year's Inflation (1994, ..., 2003)	
ys	Spread between government bonds and 3-month mmrates	return (gvt. bonds) - mmrate
vola	Volatility of the money market	s.e. of fitted ARMA processes from the mmr (2yr. ma*)

* ma = moving average

Table 11: Poolability Tests

	pooled	one-way	two-way
rss	2.2054	0.29442	0.22998
df	7	64	55

	Fstat.	Fcrit	dffcrit
ols vs 1w	59.3431735	2.15	(n-1,nt-n-k)
ols vs 2w	67.48916055	2.18	(n-1,nt-n-t-k+1)
1w vs 2w	0.240795395	1.54	(nt-n-k,nt-n-t-k+1)

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