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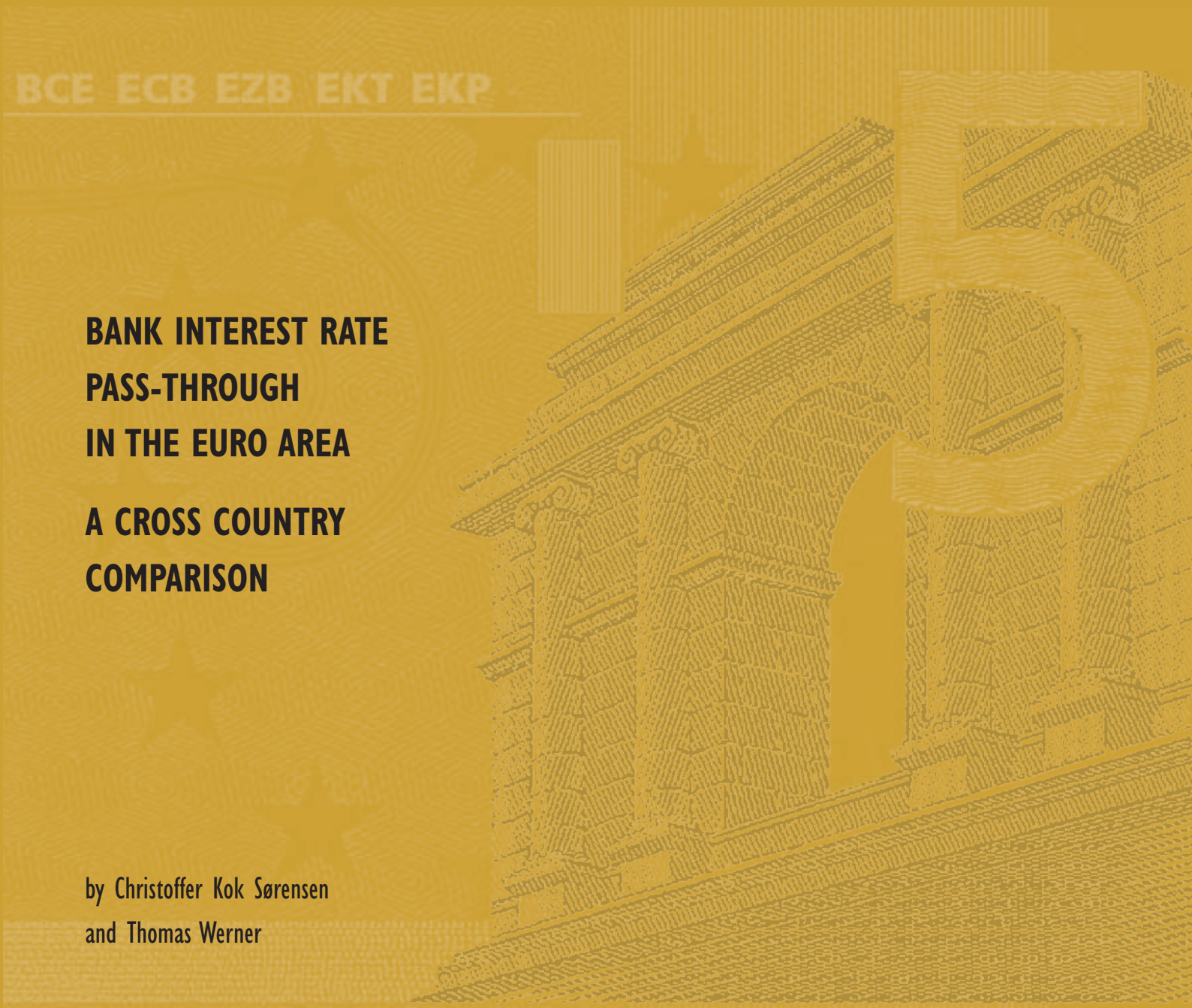

BANK INTEREST RATE PASS-THROUGH IN THE EURO AREA

A CROSS COUNTRY COMPARISON

by Christoffer Kok Sørensen
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In 2006 all ECB publications will feature a motif taken from the €5 banknote.

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CONTENTS

Abstract

The present paper investigates the pass-through between market interest rates and bank interest rates in the euro area. Compared to the large interest rate pass-through literature the paper mainly improves upon two points. First, a novel data set, partially based on new harmonised ECB bank interest rate statistics is used. Moreover, the market rates are selected in a way to match the maturities of bank and market rates using information provided by the new statistics. Secondly, new panel-econometric methods are applied to test for heterogeneity in the pass-through process. The paper shows a large heterogeneity in the pass-through of market rates to bank rates between euro area countries and finally possible explanations of the heterogeneity are discussed.

JEL classification: E43; G21

Keywords: Interest rate pass-through; euro area countries; panel cointegration

Non-technical summary

In this study, we examine the pass-through of market interest rates to various bank interest rates in a euro area cross-country perspective. Using a novel data set and some fairly new panel-econometric methods, we test for cross-country heterogeneity in the pass-through process.

Owing to the importance of banks in the euro area financial system and their role in the transmission of monetary policy, the bank interest rate pass-through is a key issue for central banks, such as the ECB. Partly as a result, there is a large literature on the topic which generally documents a sluggish and heterogeneous bank interest rate pass-through across bank products as well as across euro area countries. The present study contributes to the literature in basically two ways. First, in contrast to previous studies we use a harmonised (at least partially) data set, which in addition by commencing in January 1999 avoids the structural break imposed by the euro introduction. Moreover, the information contained in our data set allows us to select market interest rates corresponding to the various bank interest rates in a more precise way than other studies have been able to. Second, we apply recently developed dynamic panel-econometric tools to test the degree of cross-country heterogeneity in the euro area bank interest rate behaviour. As most of the previous studies on the topic, we make use of an error-correction framework in order to estimate the long-run relationship between bank interest rates and their corresponding market rates as well as the short-run adjustment to the long-run equilibrium. Our approach is new in this context in the sense that we estimate a panel error-correction model using dynamic seemingly unrelated regression (DSUR) methods, as proposed by Mark, Ogaki and Sul (2005), which allows us to take into account cross-section dependencies. One advantage with the DSUR method is the possibility to test for parameter homogeneity using a Wald type test. Hence, we are able to statistically test whether the pass-through process – in terms of both the long-run equilibrium relationship between market rates and bank interest rates and the speed of adjustment to this long-run equilibrium – differs across the euro area countries for various bank products.

We conduct our pass-through estimation for six types of retail bank products (i.e. mortgage loans; consumer loans; short-term and long-term loans to enterprises; current account deposits and time deposits) using a sample of monthly data covering the period January 1999-June 2004 for ten euro area countries.

In a well-integrated euro area banking sector, we should not expect to observe significant differences across countries in the way banks adjust their interest rates in reaction to changes in corresponding market rates. Our findings, however, suggest that there is a large degree of heterogeneity across the euro area countries with respect to both the long run equilibrium pass-through and the speed of adjustment to the long-run equilibrium. This may suggest some degree of fragmentation and lack of integration of the retail banking sector in the euro area. Our results likewise confirm the usual finding in the literature of a sluggish and sometimes incomplete adjustment of bank interest rates to changes in market rates. This does not, however, suggest that euro area banks are inefficient as the speed of adjustment coefficients are always statistically significant indicating that the adjustment process is working properly in all euro area countries. Bank interest rates thus react significantly to misalignments with market rates by adjusting towards their long-run equilibrium.

Looking at the product-specific results, we find that bank rates on corporate loans appear to adjust most efficiently, followed by the rates on mortgage loans and the rates on time deposits. The adjustment of rates on consumer loans and on current account deposits seems to work the least efficiently.

Finally, in an attempt to identify the underlying reasons behind the found heterogeneity in the retail bank interest rate pass-through we regress the speed of adjustment coefficients against a number of structural and cyclical variables. The different degree of competition in the banking sector of the euro area countries is the most robust and probably the most plausible factor that we identified. Nevertheless, due to data limitations our results on the potential determinants of the pass-through process are indicative only, and future research could extend the analysis of this issue.

1. Introduction

The pass-through of market interest rates to retail bank interest rates in the euro area is of special interest both from the perspective of banking theory and from a monetary policy point of view. It is therefore not surprising, that there is a huge literature on that topic. Most studies show that the interest rate pass-through is heterogeneous between the euro area countries and that there are structural breaks in the pass-through process occurring before the introduction of the euro in January 1999. Furthermore, there is some tentative evidence that the degree of adjustment and the speed of adjustment of interest rates are higher in the post-break period. This suggests an ongoing convergence towards an integrated and more homogeneous market, although considerable differences across the euro area countries still remain.

The present study contributes to the literature in several ways. First of all we focus on the period after the introduction of the euro to avoid mixing up the question of heterogeneity with the question of convergence to a common currency area. Related to this point is the construction of a novel data set. Interest rates used in most recent studies are not harmonised and some of the detected heterogeneity might be due to statistical problems. To soften this problem, we use fully harmonised data available since January 2003 and construct backward interest rate series back to January 1999. While the series thus constructed are not official Eurosystem time series (although being partially based on official statistics), the data set should be of a sufficient quality to conduct our econometric analysis. The information about the outstanding amounts of loans and deposits for different maturities allows us to take into account differences in the maturity structure between euro area countries. Using this information market rates with the same maturity structure as related bank rates can be constructed, avoiding the common "pre-test" problem arising from correlation-based interest rate selection. In addition, the present study contributes to the literature by using recent methods for non-stationary panel data. This allows testing for homogeneity of the pass-through process in a consistent econometric framework. In the literature, panel-data econometrics is used mostly for micro data, whereas macro data are usually analysed by standard time series econometrics.

The paper commences with a brief summary of the literature in Section 2 and a description of the data in Section 3. After an introduction to the econometric framework in Section 4, the empirical results for the interest rate pass-through are presented in Section 5. In Section 6 we relate the different speeds of pass-through to

cross-country indicators of the banking system, financial structures and the business cycle to explain the observed heterogeneity. Section 7 concludes.

2. Overview of the literature

In the past decade a number of studies examining the characteristics of the bank interest rate pass-through in the euro area countries has been conducted. With the advent of the Economic and Monetary Union (EMU) the number of papers looking at the pass-through of market rates to bank interest rates in a European context markedly increased. Particular attention has been placed on the extent to which national banking sectors under a common monetary policy regime react heterogeneously when setting bank interest rates, in which case the impact of the common monetary policy could be different across the euro area countries. In other words, most studies focused on the question whether there is a heterogeneous pass-through (both in terms of the degree and the speed of adjustment) to bank interest rates across the euro area countries, as well as across different interest rate categories.

The various studies differ widely in terms of scope and methods, as illustrated in Table 1. For example, some studies focus on aggregate interest rate series for individual countries (or the euro area as a whole) typically using single-equation error-correction models (ECM) to quantify the dynamics of the pass-through.[3] Other studies use micro bank data employing panel data techniques to examine the price setting behaviour of banks in individual euro area countries.[4] Previous studies also differ with respect to other dimensions, such as the time period covered, data sources and the selection of the exogenous market rate variable. As regards the latter, the majority of studies use a money market rate as exogenous variable against which to measure the pass-through to bank interest rates, although some more recent papers select a market rate of comparable maturity in order to better reflect the marginal cost-of-funds considerations inherent in banks' rate-setting behaviour.[5] The time period

[3] See Mojon (2000); Bredin, Fitzpatrick and O'Reilly (2001); Donnay and Degryse (2001); Heinemann and Schüler (2002); Toolsema, Sturm and de Haan (2002); de Bondt, Mojon and Valla (2002); Sander and Kleimeier (2002 and 2004a-b) for individual countries in the euro area; de Bondt (2002) for the euro area as a whole. See also Cottarelli and Kourelis (1994) and Borio and Fritz (1995) for an international comparison as well as Heffernan (1997) and Hofmann and Mizen (2004) for the UK and Berlin and Meister (1999) for the US.

[4] See e.g. Cottarelli, Ferri and Generale (1995) and Gambacorta (2004) for the case of Italy; Weth (2002) for Germany; and De Graeve, De Jonghe and Vennet (2004) for Belgium.

[5] In addition, the increasing competition between bank-based and market-based products may have induced banks to increasingly pay attention to market rates when setting bank interest rates.

covered in previous studies range from the late 1970s to 2002. The data on bank interest rates also differ considerably. Whereas most of the earlier studies relied on a highly diversified set of data (often the IMF's International Financial Statistics database), more recent studies have employed the national retail interest rate statistics collected by national central banks in the euro area.

Despite the diversity of approaches, the majority of the studies concludes that the degree and speed of pass-through differ considerable across countries as well as across banking products, especially in the short-run. The evidence of whether there is full pass-through in the long-run is more scattered and so far no clear consensus has emerged. However, at the same time, several studies document that differences in the pass-through have converged somewhat and hence that the adjustment process of bank interest rates to changes in market rates has become more homogeneous (and speedier) among the euro area countries.[6] Nevertheless, despite this relative convergence all studies conclude that substantial heterogeneity in the pass-through mechanism across countries and across bank products still remains. As regards the latter, most studies suggest that rates on loans to enterprises and rates on time deposits adjust relatively quickly, while rates on loans to households and rates on overnight and savings deposits are relatively stickier.[7] There seems to be a lesser degree of consensus as regards the explanatory factors behind the pass-through heterogeneity. Most studies relate it to structural differences in the financial systems, such as bank competition; rigidity and size of bank costs; banking system ownership; monetary polity regime; the extent of money market development; openness of the economy; the degree of development of the financial system (i.e. competition from direct finance) as well as the legal and regulatory system.[8]

Against this background, our study extends the existing literature with respect to several of the dimensions mentioned above. First of all, by contrast to all previous studies relying on aggregate bank interest rate data, we employ harmonised cross-

[6] See e.g. Mojon (2000); Toolsema, Sturm and de Haan (2002) and Sander and Kleimeier (2004a-b).
[7] See Mojon (2000); Bredin, Fitzpatrick and O'Reilly (2001); de Bondt (2002), De Graeve, De Jonghe and Vander Vennet (2004) and Sander and Kleimeier (2004a-b). The results of the studies are not uniform, which in part may be due to differences in the exogenous market rates.
[8] See Cottarelli and Kourelis (1994); Mojon (2000) and Sander and Kleimeier (2004a-b) on determinants of the pass-through. A related strand of literature concerns the determinants of bank margins: see e.g. Monti (1971); Klein (1971); Ho and Saunders (1981); Allen (1988); Angbazo (1997); Saunders and Schumacher (2000) and Maudos and de Guevera (2004).

country data that have recently started being collected by the ECB.[9] Second, in order to simultaneously take into account the cross-section and time series dimensions of the data we adopt a dynamic panel data econometric framework to assess the characteristics of bank interest rate pass-through across the euro area countries. To our knowledge, our study is the first within this strand of the literature, which applies dynamic panel data econometrics using harmonised, aggregate bank interest data.[10] Third, as also described in the next section, we apply the cost-of-funds approach[11] by selecting the exogenous market rate variables according to the maturity structure of the corresponding bank rates. While this approach may be criticised (see e.g. Sander and Kleimeier, 2004a-b), our data set provides the opportunity to select market rates with greater precision than in previous studies using this approach. Finally, as our focus is on the pass-through mechanism under the common monetary policy regime we cover only the EMU-period (January 1999-June 2004). Apart from being more up-to-date than all previous studies, we also more likely avoid any major structural breaks in the series reported in previous studies (banking sector deregulation, introduction of the euro, etc.).

[9] More detailed information on the data used in this study is provided in Section 3 and Appendix 2.
[10] In previous studies panel data approaches to the pass-through analysis have only been taken in studies using micro data.
[11] Which is based on the industrial organization theory of banking, see e.g. Freixas and Rochet (1997).

Table 1: Studies on interest rate pass-through

	Aggregation level			Selection of market rate		Data		Econometric approach		Time period	Extensions		
	Euro area level	Individual country level	Micro level	Money market rate as exogenous variable	Cost-of-funds approach	NRIR data	Other data	Single-equation ECM model	Panel data approach		Analysis of determinants of pass-through	Analysis of determinants of margins	Asymmetric/non-linear pass-through
Cottarelli and Kourelis (1994)		x		x			x	x		1980-1993	x		
Borio and Fritz (1995)		x		x			x	x		1984-1994	x		x
Cottarelli, Ferri and Generale (1995)			x (IT)	x			x		x	1987-1993	x		
Angeloni, Buttilgione, Ferri and Gaiotti (1995)			x				x						
Hefferman (1997)			x (UK)	x			x	x		1986-1993			
Berlin and Meister (1999)			x (US)				x		x	1977-1989	x		
Moazzami (1999)		x (US, CA)		x			x	x		1969-1995			
Mojon (2000)		x		x		x	x (IMF)	x		1979-1998	x		(x)
Bredin, Fitzpatrick and O'Reilly (2001)		x (IE)		x			x	x		1980-2001			
Donnay and Degryse (2001)	x			x		x		x (SVAR)		1980-2000			
Heinemann and Schüler (2002)		x			x	x		x		1995-1999			
de Bondt (2002)	x				x	x		x		1996-2001			
Toolsema, Sturm and de Haan (2002)		x		x		x	x (IMF: IT)	x (moving window)		1980-2000			
Sander and Kleimeier (2002)		x		x			x (IMF)	x		1985-1998			x
Weth (2002)			x (DE)		x	x (DE)			x	1993-2000	x		
Hofmann and Mizen (2004)		x (UK)		x			x	x		1985-2001			x
Gambacorta (2004)			x (IT)	x			x		x	1993-2001		x	
De Graeve, De Jonghe and Vennet (2004)			x (BE)		x		x		x	1993-2002	x		
Sander and Kleimeier (2004a)		x		x	x	x		x		1993-2002	x		x
Sander and Kleimeier (2004b)		x		x	x	x		x		1993-2002	x		x
de Bondt (2005)	x			x	x	x		x		1996-2001	x		
de Bondt, Mojon and Valla (2005)	x	x			x	x		x		1994-2002			x

3. Description of the data

Construction of bank interest rate series

The data on bank interest rates used in this study are based partly on non-harmonised monthly national retail interest rate statistics (for the period 1999-2002), which were collected by national central banks of the euro area and on harmonised, and more detailed, monthly MFI interest rate statistics (for the period 2003 onwards) collected by the Eurosystem of Central Banks (ESCB). Many previous studies on the bank interest rate pass-through for the euro area countries have, in lack of harmonised data, traditionally used the non-harmonised national retail interest rate statistics (NRIR, henceforth), which are based on already existing statistics within each country.[12] That is, the bank interest rate series within each instrument category are often based on different definitions and classifications depending on the country. Hence, within each interest rate category there might be considerable heterogeneity among the national interest rate series alone owing to the fact that the statistics are non-harmonised. This implies that the heterogeneity inherent in the data may bias the pass-through results in studies based entirely on the NRIR statistics in the sense that results of large heterogeneity across countries may to some extent be due to the use of country-specific statistics.[13]

This study attempts to circumvent this bias by making extensive use of the information contained in the new harmonised MFI interest rate statistics; i.e. not only for the data covering the period January 2003 to June 2004, but also in the construction of backward series covering the period January 1999 to December 2002. In fact, this is the first study (to our knowledge) on the bank interest rate pass-through that makes use of the new and harmonised MFI interest rate statistics (MIR, henceforth), which were introduced by the ECB in January 2003. It is important to note, however, that the time series used in this study are "constructed" and thus not (at least only partially) based on official Eurosystem statistics. It is our belief that the data series constructed for this study provide the best

[12] See e.g. Mojon (2000), Heinemann and Schüler (2002), de Bondt (2002, 2005), Toolsema et al. (2002), Sander and Kleimeier (2002, 2004a-b). Other studies use individual bank data to study the pass-through at a micro-level, see e.g. Cottarelli, Ferri and Generale (1995), Weth (2002), Gambacorta (2004) and De Graeve, De Jonghe and Vander Vennet (2004).

[13] The problem of bias may be less acute in studies using euro area aggregate series, such as de Bondt (2002), since some of the country effects may cancel each other out.

possible solution given the current data availability and are of a sufficiently good quality for the econometric analysis we have in mind.

Since the MIR statistics only extends back to January 2003, we have "chain-linked" these interest rate series with the series of the NRIR statistics. This inevitably causes a data break in the series, which may impact on the results. However, the linking of the MIR series with the NRIR series has been done in such a way that we obtain smoothed series and retain the dynamics of the original series.

In practical terms, the construction of the long-run interest rate series (covering the period January 1999-June 2004, i.e. 66 observations for each of the ten countries in the sample) has been carried out by aggregating the more detailed series of the MIR statistics to seven "synthetic" bank interest rate (BIR) categories, corresponding to the aggregation level of the NRIR statistics.[14] Hence, for each country we have constructed 4 series on lending rates (loans to household for consumption (N3); loans to households for house purchase (N2); short-term loans to non-financial corporations (N4) and long-term loans to non-financial corporations (N5)) and 3 series on deposit rates (current account deposits (N7); time deposits (N8) and savings deposits (N9)).[15] The weighting of the MIR interest rates used when aggregating to the "synthetic" bank interest rates on new business agreements is based on the volumes of outstanding amounts (and partly on volumes of new business) as reported in the MIR statistics. The weighting of the rates by outstanding amounts (instead of purely by new business volumes) is carried out to better reflect the historic maturity structure of the banks' loan and deposit portfolios when extending the series backward. In addition, new business volumes are often very volatile and sometimes affected by a few large transactions, whereas outstanding amounts are more stable over time and hence provide less volatile weights.[16] Following the construction of the

[14] Appendix 2 contains a more thorough description of the methods and assumptions used in the construction of the data.

[15] Some interest rate categories do not exist for various countries. In addition, rates for Greece and Luxembourg have not been included in the study. In the case of the latter because of lack of NRIR data and in the case of the former because Greek interest rates were still on a convergence path in the first half of the period of observation and consequently create too much noise in the regressions.

[16] The main problem using the outstanding amounts as weights on the new business rates is that the former are broken down by original maturity while the latter are broken down by period of fixation. Our weighting scheme assumes a one-to-one relationship between the original maturity (e.g. "over 1 year and up to five years") and period of fixation (e.g. "initial rate fixation over 1 year and up to five years"). This may generally be reasonable, but as we show below may provide biased results in cases where for example long-term loans are remunerated at floating rates.

compounded BIR rates for the period January 2003-July 2004, we link the "synthetic" rates to the NRIR rates using the difference between the original NRIR rates in January 2003 and the "synthetic" BIR rates in January 2003.[17] The difference is then added to the NRIR rates for all the months throughout the period January 1999-December 2002. While this method ensures that the dynamics of the NRIR series are retained, it implicitly assumes that the level difference between NRIR series and the "synthetic" BIR series is constant throughout the period. This may be a rather strong assumption, but as indicated by Charts A2.B in Appendix 3 in the period of overlapping observations (typically January 2003-September 2003) the dynamics of the NRIR and BIR series are broadly the same and the level differences seem relatively constant.

Selection of market rates

The analysis takes the "cost-of-funds" approach as a starting point.[18] That is, bank rates are assumed to be set according to their marginal costs, which are approximated by market rates comparable (in maturity) to the bank interest rate under consideration. The corresponding market rate is thus typically assumed to represent the opportunity cost (for lending rates) or the cost-of-funds (for deposit rates) against which the bank sets its interest rate, in terms of a mark-up to the market rate which compensates the bank for both the interest rate and credit risk.[19] Moreover, the selection of market rates of comparable maturity could also reflect the increasing degree of competition between traditional bank products (such as loans and deposits) and non-bank (capital market-based) products. That is, bank products may to an increasing extent be priced against market rates of comparable characteristics (e.g. maturity).

This mark-up could be expected to be set with respect to market rates with maturities matching those of the corresponding bank rates, as for example the granting of mortgage loans is often funded by issuing bonds of a comparable maturity, while short-term

[17] Most NRIR series end in September 2003. A few series end in December 2002, March 2003 and June 2003, respectively. As regards those series of which the last observation is December 2002, this observation has been used (instead of January 2003).

[18] See de Bondt (2002, 2005); De Graeve, De Jonghe and Vennet (2004) and Sander and Kleimeier (2004a-b).

[19] For the literature on the determinants of bank interest margins see also the model introduced by Ho and Saunders (1981) and its extensions: Allen (1988); Angbazo (1997); Saunders and Schumacher (2000) and Maudos and de Guevara (2004).

corporate loans typically are financed by issuing Certificates of Deposits. In previous studies, as Sander and Kleimeier (2004b) rightly note, it has been problematic to find proper matching maturities as the various bank interest rate categories (e.g. in the NRIR data) tended to cover several maturity bands. As an alternative, some studies have selected the market rates on the basis of their correlation with the bank interest rates.[20] This approach may, however, be criticised as it seems to "pre-judge" the results of the pass-through analysis in the sense that by a priori selecting those market rates most highly correlated with the corresponding bank interest rates (irrespective of the extent to which their maturities match) would be expected to imply the ex-ante fastest possible pass-through.

In our analysis, we attempt to correct for some of these problems.[21] First of all, using the information of the maturity/initial rate fixation structure contained in the MIR statistics allows us to select market rates of matching maturities with a much higher precision than in studies based solely on the NRIR statistics (that only include a few maturity breakdowns). Second, only within the various maturity bands do we conduct a correlation analysis to determine the most proper market rate of matching maturity for each country-specific bank interest rate. Third, using the maturity-based market rates according to the maturity structure, as reported in the national MIR statistics, we are able to take the characteristics of the national banking markets into account. That is, for each bank interest rate category in each country we calculate a market rate, which is based on a weighting scheme derived from the individual countries' maturity structure. Consequently, we derive aggregated "synthetic" market rates that have the same maturity structure as the bank interest rates and, as a result, we are able to disentangle the pass-through of marginal costs and term structure effects of the policy rates.[22]

[20] Most notably, de Bondt (2002, 2005).
[21] The construction of market rates is also more thoroughly described in Appendix 2.
[22] Ellingsen and Söderström (2001) provide evidence of the importance of the latter effect.

4. Econometric methodology

4.1 Panel unit root and cointegration tests

Unit root tests

Interest rates are potentially non-stationary. In our analysis of the propagation of market rates to bank interest rates, we have to take this into account. At least since Granger and Newbold (1974), it is well known that a regression analysis using non-stationary variables can easily end up with spurious results. The natural first step is therefore to investigate the unit root properties of the variables under investigation. Reasonable tests for unit roots, using panel data are relative new.[23] In this paper we apply two different types of tests based on two different null hypotheses. First, the Im, Pesaran and Shin (2003) test (IPS) is used, which is basically a panel version of the ADF test for unit root. It is based on the following regressions:

$$\Delta y_{it} = \alpha_i + \rho_i y_{i,t-1} + \sum_{j=1}^{p_j} \beta_{ij} \Delta y_{i,t-j} + \varepsilon_{it}, \quad i = 1,\cdots,N, t = 1,\cdots,T. \tag{1}$$

N is the number of sections (or individual countries) and T the number of time periods. The series under investigation is y_{it} and it must be observable for section *i* and each point in time t. The autoregressive parameter ρ_i is estimated for each section separately, which allows for a large degree of heterogeneity. The null hypothesis is $H_0 : \rho_i = 0$ for all i, against the alternative $H_A : \rho_i < 0$, for some sections. The test statistic of the IPS test is then constructed by cross-section averaging of the individual t-statistics for ρ_i. A rejection of the null indicates non-stationarity.

To complement the unit root analysis we add results based on Hadri's (2000) test. This test is basically a panel version of the KPSS test and it tests the null of stationarity. The underlying model of the Hadri test can be written as:

$$y_{it} = \alpha_i + \sum_{\tau=1}^{t} u_{i\tau} + \varepsilon_{it}, \quad i = 1,\cdots,N, t = 1,\cdots,T. \tag{2}$$

[23] For a survey see Banerjee (1999).

The time series y_{it} are decomposed in two components, a random walk component $\sum_{\tau=1}^{t} u_{i\tau}$ and a stationary component ε_{it}. The test statistic is based on the ratio $\frac{\sigma_u^2}{\sigma_\varepsilon^2}$ of the variances. The null hypothesis of this test assumes that this ratio is zero, which implies that there is no random walk component in the time series. Rejecting the null hypothesis of this test indicates a unit root behaviour of the variable under investigation. Both tests are asymptotically normal, which is fundamentally different from the time series case.

Cointegration tests

To test for cointegration we use a couple of tests developed by Pedroni (1999, 2004). Both these tests are residual-based test without pooling the slope coefficients of the cointegration regressions. This allows for different cointegrating vectors across the sections. In its most general form, the test uses the following regressions:

$$y_{it} = \alpha_i + \beta_{1,i} x_{1,it} + \cdots + \beta_{K,i} x_{K,it} + \varepsilon_{it}, \quad i = 1, \cdots, N, t = 1, \cdots, T. \tag{3}$$

The left hand side variables in equation 1 are related to the right hand side variables via the long-run coefficients $\beta_{k,i}$. These long-run coefficients can be different across the sections. In our case, the long-run pass-through coefficient (long-run multiplier) is allowed to be different between the euro area countries. The different types of Pedroni tests can be grouped into two sup-groups. First there are "panel" versions, which pool the residuals of the cointegration regression and second there are so called "group mean panel" versions which are based on averaging the corresponding time series unit root test statistics. For both groups of statistics the null hypothesis assumes a unit root in the residuals of the cointegration regression, which implies absence of cointegration. In the panel versions of the tests the alternative hypothesis assumes a root less than one but identical between the sections, whereas the group mean versions allow for different roots in different sections. Hence, the group mean versions allow for more heterogeneity. For both the panel version and the group mean panel version we use three different types of test statistics. A ADF type which is similar to the augmented Dickey Fuller statistic used in univariate unit-root tests, a nonparametric Phillips-Perron (PP) version, and a test version which is based directly on the autoregressive coefficient (ρ-test).

The results of standard panel unit root and cointegration tests, like the ones we discussed, should be interpreted with some caution. Implicitly all of the previously discussed tests are based on the assumption that there is no correlation and no cointegration between the sections. As shown by Banerjee et al. (2004) standard panel unit root and cointegration tests suffer from large size distortions if this assumption is violated. To solve this problem, a variety of new tests have been proposed recently but the research is still ongoing and is not very mature.[24]

Instead of using one of these very new tests, in this paper we assess the robustness of our results using a recently proposed approach to estimate the cointegration regression and the corresponding error-correction model, which takes possible cross-section correlations into account. This approach is summarised in the next section.[25]

4.2 Estimation of the ECM model by seemingly unrelated regression

If two variables y_t and x_t are cointegrated, it is very helpful to analyse the relationship between both variables using an error-correction framework. This allows disentangling the long-run co-movement of the variables and the short-run adjustment towards the equilibrium. In a two-step approach, first the following equations are estimated:

$$y_{it} = \alpha_i + \beta_i x_{it} + \varepsilon_{it}, \quad i = 1, \cdots, N, t = 1, \cdots, T, \tag{4}$$

This can be done in several ways, but the standard OLS estimation of the long-run multiplier (or cointegrating vector) β_i is problematic, because of the endogeneity bias. To solve this problem, Stock and Watson (1993) proposed a dynamic OLS (DOLS) method to estimate the β_i efficiently. This method is based on an extended cointegration regression adding leads and lags of first difference of the right-hand side variable to the regression equation. The idea behind the DOLS method was recently applied to the panel cointegration case by Mark, Ogaki and Sul (2005). With this method the cointegration parameters β_i are estimated using the following equations:

[24] For a first overview and assessment see Trabani (2004).

[25] The method we use is fully consistent with cross-sectional correlation but does not provide a test for cointegration. Nevertheless it allows to assess the significance of the adjustment coefficients in the error-correction model and therefore allows for an indirect test for cointegration.

$$y_{it} = \alpha_i + \beta_i x_{it} + \sum_{i=1}^{N} \sum_{s=-P}^{P} \delta_{i,s} \Delta x_{i,t-s} + u_{it}, \quad i = 1, \cdots, N, t = 1, \cdots, T. \tag{5}$$

In comparison to the single equation DOLS the leads and lags of the first differences of the right-hand side variables from all equations in the system are added. This allows capturing cross-section dependencies. The modified cointegration equations are then estimated jointly using the seemingly unrelated regression methods. Cross-section correlations between the residuals u_{it} are taken into account and the method is called dynamic seemingly unrelated regression (DSUR) approach. A very similar method was developed by Moon and Perron (2005). One important advantage of the DSUR method is the possibility to test for parameter homogeneity (the hypothesis that all β_i are the same) using a Wald type test.[26]

Given the long-run multipliers an error-correction model of the form:

$$\Delta y_{it} = \gamma_i + \theta_i (y_{it} - \beta_i x_{it}) + \sum_{i=0}^{p} \phi_{i,s} \Delta x_{i,t-s} + \sum_{i=1}^{q} \varphi_{i,s} \Delta y_{i,t-s} + \tilde{u}_{it}, \quad i = 1, \cdots, N, t = 1, \cdots, T, \tag{6}$$

can be estimated by OLS using SUR adjusted standard errors. This allows testing the adjustment parameters θ_i for homogeneity. A similar approach (called SURECM) was proposed by Thompson, Sul and Bohl (2002) and applied to cross-country modelling of the real exchange rate dynamics by Kim (2004).

4.3 Software implementation

Because the described methods are relatively new, they are not yet implemented in standard econometric packages. Therefore we had to rely on different types of software. The panel unit root tests are computed with EViews version 5. Pedroni's test on panel cointegration was computed using a RATS program written by Pedroni himself. It is available on the Estima web page (www.estima.com). To estimate the cointegrating vectors we used a Gauss package provided by Donggyu Sul[27] and the SURECM was estimated using the panel methods of EViews 5.

[26] A recent application of the DSUR method on testing for cross-country heterogeneity in exchange rate determination is provided by Rapach and Wohar (2004).
[27] The URL of his web page is: http://yoda.eco.auckland.ac.nz/~dsul013/home.htm.

5. Empirical evidence for pass-through

5.1 Unit root and cointegration

The results for the unit root tests are outlined in table A1 of Appendix 1. We test simultaneously for a unit root in the bank rates and the market rates for each loan/deposit category. For the Im, Pesaran and Shin test the null hypothesis of unit root can not be rejected for any of the variables. This is a first sign for non-stationarity of interest rates in the analysed period. [28] Additionally the null hypothesis of stationarity (Hadri test) can be clearly rejected for all series. It is therefore appropriate to model the interest rates using an error-correction framework, if there is a cointegration relationship between bank rates and market rates.

Table 2: Pedroni cointegration tests *(p-values in parentheses)*

	Panel			group mean panel		
	ρ-statistic	pp-statistic	adf-statistic	ρ-statistic	pp-statistic	adf-statistic
Mortgage loans	-4.22 (0.00)	-3.34 (0.00)	-2.70 (0.00)	-3.45 (0.00)	-3.38 (0.00)	-2.98 (0.00)
Consumers loans	-4.25 (0.00)	-3.53 (0.00)	-1.36 (0.09)	-3.98 (0.00)	-3.98 (0.00)	-2.04 (0.02)
Short term loans to enterprises	-6.53 (0.00)	-5.95 (0.00)	-0.5 (0.30)	-8.35 (0.00)	-7.42 (0.00)	-0.75 (0.22)
Long term loans to enterprises	-1.41 (0.08)	-1.19 (0.12)	-1.28 (0.10)	-0.87 (0.19)	-1.09 (0.14)	-2.17 (0.02)
Current account deposits	-2.47 (0.01)	-2.37 (0.01)	-1.77 (0.04)	-2.39 (0.01)	-2.65 (0.00)	-1.67 (0.05)
Time deposits	-2.63 (0.00)	-2.31 (0.01)	-1.28 (0.09)	-3.00 (0.00)	-2.88 (0.00)	-2.38 (0.01)
Saving deposits	-1.00 (0.15)	-0.87 (0.19)	0.57 (0.72)	-1.14 (0.13)	-1.02 (0.16)	0.80 (0.78)

Table 2 summarises the results for the panel cointegration tests. For bank interest rates on saving deposits the null hypothesis of no-cointegration cannot be rejected even at the 10% level. It seems to be the case that the adjustment of interest rates to saving deposits is so sluggish that even a long-run relationship can not be detected in our sample. This may well be due to the fact that in many countries the rates on savings deposits are subject to national regulations (for example, in the form of ceilings on rates, tax exemption rules, etc.) and hence are set independently of market conditions. For all other

categories, bank interest rates seem to be cointegrated with corresponding market rates, although with a less clear conclusion for interest rates on long-term loans to enterprises.

5.2 Long-run pass-through and speed of adjustments

The most important equation in our study of interest rate pass-through is the following one:

$$\Delta BR_{i,t} = \gamma_i + \theta_i (BR_{i,t-1} - \beta_i MR_{i,t-1}) + \phi_{i,0} \Delta MR_{i,t} + \phi_{i,1} \Delta MR_{i,t-1} + \varphi_{i,1} \Delta BR_{i,t-1} + \tilde{u}_{i,t} . \qquad (7)$$

In this equation the changes in bank interest rates (ΔBR_{it}) are explained by adjustments towards the long-run equilibrium between bank rates and market rates, measured by the speed of adjustment parameters θ_i, and by changes of past and current market rates. In addition changes of past bank rates are added to avoid misspecifications. Parameters for a higher lag length turned out to be insignificant. We estimate equation 7 using the two-step approach described in Section 4.2. First the long-run multipliers β_i are estimated by DSUR. A long-run multiplier of one implies a perfect (one-to-one) pass-through of market interest rates to bank interest rates in the long-run. A long-run multiplier less than one implies a limited pass-through even in the long-run, whereas a long-run multiplier larger than one implies a kind of over-shooting.[29]

The point estimates of the long-run multipliers are shown in tables A2 to A7 in Appendix 1. The DSUR method outlined in Section 4.2 is a panel method and allows testing for heterogeneity of the long-run multipliers across the countries. The Wald-test statistics for a test on equal long-run multipliers are also shown in tables A2 to A7. For all categories of loans and deposits the null hypothesis of equal long-run multipliers can be rejected. This is evidence of a large degree of heterogeneity in the long-run pass-through between the euro area countries.

Because the long-run multipliers are very different between the countries, it is sensible to estimate equation (7) using different point estimates of the long-run multipliers for each country instead of pooling the countries with respect to this parameter.

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[28] The Im, Pesaran and Shin test for the first difference of the interest rates strongly reject the null hypothesis of unit root, which implies that the interest rates we consider are appropriately modeled as I(1) variables.

[29] "Overshooting" may, for example, be due to credit risk factors reflecting the asymmetry of information between banks and their borrowers.

The next step is the estimation of the ECM model (equation 7) by SUR and to test for homogeneity of the speed of adjustment parameters θ_i, which can be done using standard Wald-tests. The speed of adjustment parameters and the Wald-test statistics are collected in tables A8 to A13 in Appendix 1. For all categories of loans and deposits the null hypothesis of an equal speed of adjustment can be rejected. Despite the heterogeneity of the speed of adjustment coefficients they are significant in almost all cases as indicated by the p-values shown in Tables A8 to A13. This proves that the adjustment process is working properly and provides an indirect argument for cointegration of market rates and bank rates.

In general, bank interest rates seem to adjust most quickly in Spain, with the exception of the interest rates for mortgage loans. The reason for the apparent slow adjustment of interest rates on mortgage loans in Spain, as well as in Ireland, Austria, Portugal and Finland is that the NRIR rates in these countries predominantly were floating rate loans. Therefore, as the speed of adjustment that we measure is related to a market rate corresponding to the "original" maturity structure of mortgage loans, we might underestimate the true speed of adjustment of mortgage rates in these countries.[30] For these reasons, as a consistency check we conducted our pass-through estimations for the mortgage loan segment using a data set where the synthetic market rates have been substituted by selected short-term money market rates for the above-mentioned countries to better reflect the price setting behaviour of banks in these countries. In addition, in the data set we adjust for the misalignment bias caused by the breakdown by "original maturity" of the amounts outstanding used as weights in our aggregation of rates.[31] The results of this consistency check were (as expected) a quicker pass-through in those countries for which an adjustment was made in respect of the reference market rate, but the main result of a heterogeneous pass-through of bank interest rates across countries

[30] The same may be the case for long-term loans to enterprises where the NRIR series for Belgium, Finland and Ireland are predominantly floating or short-term rate loans and hence the speed of adjustment estimates for these countries may be biased downwards. Similarly, the rates on time deposits in Spain and Italy may be biased downwards as the NRIR series are predominantly of a short-term nature, while the weights constructed are more long-term.

[31] That is, the misalignment occurs for example when relating new business rates with long-term initial rate fixation with rates on outstanding amounts with a long-term original maturity but denominated at floating rates. The adjustment is done by estimating a "residual maturity" breakdown, which better aligns the new business rates and the rates on outstanding amounts.

continues to hold (see Table A17 and A18 in Appendix 2). Unsurprisingly, the speed of adjustment estimates for Spain, Austria, Finland and Portugal increase somewhat (in particular, as the market rates used corresponds more closely with the floating rate nature of most mortgage loans in these countries), while by contrast they decrease somewhat for other countries (e.g. Germany and the Netherlands).

Overall it is difficult to see a clear structure when comparing the pass-through across countries. Countries with relatively low speeds of adjustments tend to have limited long-run pass-through as well, but otherwise there is no clear structure in the ranking of the adjustment speeds.

To get an impression of the degree of heterogeneity we have collected the minimum, maximum, spread, and standard deviation of the speed of adjustment coefficients for the different interest rate categories. For example, the lowest speed of adjustment coefficient for short-term loans to enterprises is -0.027. This means, that the disequilibrium between bank rates and market rates by 100 basis points induces a 2.7 basis point adjustment towards the equilibrium in the next period. A pretty small adjustment compared to the largest adjustment coefficient in this loan category, which is -0.925. In the respective country almost the entire disequilibrium (92.5 of 100 basis points) is reverted after one period. The heterogeneity is not as large for the other bank products as shown by the standard deviations in Table 3. The lowest degree of heterogeneity is observed for the mortgage loans. But this is the case due mainly to the fact that the adjustment speed is very low in all countries. The highest adjustment coefficient is -0.231 which implies that only 23% of dis-equilibrium is adjusted after one period in the country with the highest speed of adjustment.

Table 3: Heterogeneity in the speed of adjustment

Loan/deposit category	Minimum speed of adjustment	Maximum speed of adjustment	Spread (Min– max)	Standard deviation
Mortgage loans	-0.069	-0.231	0.162	0.055
Consumer loans	-0.058	-0.526	0.468	0.163
Short-term loans to enterprises	-0.027	-0.925	0.898	0.347
Long-term loans to enterprises	-0.103	-0.447	0.344	0.116
Current account deposits	-0.054	-0.320	0.266	0.137
Time deposits	-0.051	-0.396	0.345	0.114

Looking in more detail at the different bank products, we find that the weighted average speed of adjustment is highest for short-term loans to enterprises and lowest for current account deposits (see Table 4).[32]

Table 4: Average speed of adjustment by bank products (weighted averages)

Loan/deposit category	Average speed of adjustment	Average long-run pass-through	Relative adjustment
Mortgage loans	-0.161	1.166	-0.203
Consumer loans	-0.183	0.379	-0.123
Short-term loans to enterprises	-0.427	0.705	-0.350
Long-term loans to enterprises	-0.264	0.713	-0.260
Current account deposits	-0.091	0.145	-0.151
Time deposits	-0.257	0.842	-0.227

Table 4 also reports the average long-run pass-through across the various bank products. Interestingly, we find that there seems to be a positive relationship between the maturity and the completeness of the pass-through, as the long-run pass-through is most complete with respect to the rates on mortgage loans and long-term loans. This result is similar to the one found by De Graeve et al. (2004) for the Belgian case, but contrasts with most previous studies, which may be due to the use of a market rate of comparable maturity (rather than the policy rate – to which long-term rates are presumably less responsive than short-term rates) as the explanatory variable. The long-run pass-through is least complete with respect to the rates on current account deposits, which is also found in other studies.

However, when comparing the speed of adjustment across products and countries it is necessary to also consider the long-run equilibrium that the rates are adjusting to. That is, it makes a difference whether the bank rates adjust quickly to something less than the complete pass-through or more slowly to a complete level of pass-through. In terms of market efficiency it is not straightforward to judge whether one or the other scenario is preferable. In order to gauge the combined impact of the speed of adjustment and the

[32] As mentioned above, using the derived synthetic market rates for some products in some countries (mainly mortgage loans) we may underestimate the speed of adjustment. Running the regressions using specifically selected reference market rates for the relevant countries, we find that the weighted average adjustment speed of mortgage loans increases to 0.179 up from 0.161.

degree of long-run pass-through, we multiply the two coefficients to obtain a "relative adjustment" measure (Table 4; third column). Employing this measure, we find that bank rates on corporate loans appear to adjust most efficiently, followed by the rates on mortgage loans and the rates on time deposits. The adjustment of rates on consumer loans and on current account deposits seems to work the least efficiently.

Overall, these results are broadly in line with other studies that find a speedier adjustment of rates on corporate loans compared to rates on loans to households as well as a relatively sticky behaviour of deposit rates. These differences across product segments may partly be due to differences in the degree of competition and the characteristics of the bank clients. For example, large corporations might be less dependent on a stable bank relationship than small businesses and households and hence can easier "shop around" in the banking market. On the deposit side, the existence of switching costs may deter many depositors from shifting bank in and out of season. In the next section we try to link the differences in the speed of adjustment of bank rates to market rates to different financial indicators.

6. Potential explanations for the heterogeneity in the speed of adjustments

In this section we try to explain the ranking in the speeds of adjustment with different macroeconomic and financial indicators. The basic idea is that cyclical factors and specific characteristics of the financial structures may affect the costs for banks of keeping their loan and deposit rates out of equilibrium.[33] The set of indicators we collected contains general economic indicators like GDP growth as well as bank industry specific indicators like the Herfindahl index for competition in the banking sector.[34] To analyse the relationship between the different financial indicators and the speed of adjustments, we regressed the adjustment speed on the different financial indicators. Because we have only a small number of cross sections, which means only up to ten countries, we cannot explain the adjustment speeds simultaneously by all indicators. Instead the adjustment speeds are regressed separately against the different indicators. To

[33] See e.g. Cottarelli and Kourelis (1994); Cottarelli, Ferri and Generale (1995); Mojon (2000); Weth (2002) and Sander and Kleimeier (2004a-b).

[34] Table A16 in Appendix 1 gives a short description of the indicators.

assess the robustness of this regression we used a wild-bootstrap method for the computation of p-values in addition to standard p-values based on normal distribution.[35]

A priori it may be expected (see Table 5), according to the so-called "structure-conduct performance" hypothesis (as opposed to the "efficiency" hypothesis), that the degree of concentration (competition) and the market power of banks have a negative (positive) impact on the speed by which banks change their interest rates following a change in the market rates. Banks' loan pricing to some extent also reflects their assessment of the borrowers' credit risk. Under normal circumstances (i.e. in periods with no credit rationing) a bank holding a relatively large amount of credit risk would typically adjust its spread to the comparable market rate at a "normal" (and even relatively fast) speed. By contrast, in periods of credit rationing banks tend to restrict the supply of loans to riskier borrowers rather than adjusting their rates accordingly, thereby slowing down the speed of adjustment. At the same time, the level of credit risk may also be related to the degree of competition in the sense that banks in a more competitive environment would tend to lend to more risky borrowers in order to boost their market share. To the extent that this effect dominates the credit rationing effect, a relatively high level of credit risks would be related to a speedier pass-through. Yet another aspect is the fact that credit risk tends to show a pro-cyclical behaviour in the sense that the perceived credit risk of borrowers typically increases in economic downturns, and vice versa. As such, an inverse relationship between the comparable market rate (which typically decreases during economic downturns) and the amount of credit risk on loans held by the banks can be expected. However, the responses of bank interest rates to such a pro-cyclical correlation between market rates and credit risk would be expected to hinge on the presence of credit constraints and other factors (such as the degree of competition).

A large part of banks' business consists of granting loans at long-term and taking short-term deposits from the public. This maturity transformation entails a significant amount of interest rate risk, which banks often try to hedge away using various forms of financial instruments. Hence, the higher interest rate risk banks are exposed to, the more they need

[35] The bootstrap p-values are similar to the standard p-values and both are reported in the appendix (Table A14). In few cases the bootstrap results differ from the standard normal inference. If a coefficient is significant only for the bootstrap p-values it is marked by a (B) in the table. If a coefficient is only significant for the standard p-values and not for the bootstrapped p-values it is marked with a (nB).

to hedge and through their hedging activities the more sensitive they are to changes in market rates. This would tend to imply a speedier pass-through.[36] Alternatively, it may be argued that the interest rate risk is linked to the degree of capitalisation in the sense that the profit (and hence capital accumulation) of banks having a relatively large maturity mis-match is more sensitive to changes in market rates, which could induce them to adjust their interest rates more slowly in order to compensate for this potential loss.[37] Both banks' excess liquidity and excess capital may act as buffers against market fluctuations and would hence be expected to show a negative relation with the speed of adjustment. Moreover, it may be expected that a bank with a highly diversified portfolio of activities (i.e. banks that do not only rely on traditional banking activities such as granting loans and taking deposits, e.g. measured by the share of non-interest income) may be less sensitive to movements in market rates, which would imply a more sluggish pass-through. At the same time, it cannot be ruled out that in a highly competitive environment very diversified banks may be able to exploit this by offering more attractive rates to conquer market shares, implying a speedier pass-through. Furthermore, banks with a large and stable pool of deposit funding (e.g. measured by the share of deposits to total liabilities) would be expected to be less vulnerable to changes in market rates (as most of their funding is non-market based) thereby leading to a relatively slower speed of adjustment. Finally, cyclical factors which may serve as proxies of loan/deposit demand could on the one hand be expected to imply a more sluggish pass-through, as it may be easier for banks to retain rates at their current level without losing business. On the other hand, a high demand may be associated with a more dynamic market leading to more entries and higher competition, thereby speeding-up the speed of adjustment.

[36] As argued by Weth (2002) and De Graeve et al (2004).
[37] As argued by Gambacorta (2004).

Table 5: Overall impact on the speed of pass-through

	Expected	Estimated
Concentration	-	-
Market power (RoE)	-	-
Credit risk (provisions)	+/-	+
Interest rate risk (maturity mismatch)	+/-	-
Banks' excess liquidity	-	-
Diversification (non-interest income)	+/-	+
Banks' excess capital	-	-
Share of deposit funding	-	-
Loan demand (GDP growth, house prices)	+/-	+/-

The results are collected in Table 5 (and more detailed in Tables A14 and A15 Appendix 1). A "+" sign indicates a positive significant effect of an indicator on the speed of adjustment of the respective bank interest rate, whereas a "-" shows a negative significant effect. In most of the cases the indicators are not able to explain the adjustment speeds, but for some indicators and some interest rates a robust relationship can be detected. In most cases the explanatory power of the indicators is limited to only one category of loans and deposits with the exception of four indicators, which seem to explain the rankings of the speeds of adjustment for more than one category.[38]

Notably, the CR5 index and the Herfindahl index are significantly negative related to the adjustment speeds of interest rates for mortgage loans, long-term loans to enterprises, and time deposits. Because a lower value of these indices, ceteris paribus, implies higher competition, the negative relationship between the indices and the adjustment speed suggests a positive effect of competition on the pass-through process, i.e. higher competition forces banks to adjust their interest rates more quickly. This result is in line with the literature surveyed in Section 2. The CR5 index and the Herfindahl index are basically measures of the concentration of the banking sector, which according to the so-called "structure-conduct-performance" paradigm can be used as proxies for the market power of banks. Another strand of the literature, the so-called "efficient structure" paradigm, suggests that concentration indices may not be the best proxies for market

[38] In general, we should not expect that all the selected determinants are equally economically relevant across the bank product categories. For example, the annual growth rate of loans to households for house purchase and/or the consumer confidence indicator should be expected to have an impact on the pass-through of mortgage rates (and perhaps consumer credit rates).

power.[39] Instead, they develop indicators of competition, which are based on the industrial organisation theory of banking. One such indicator is the Lerner index, which measures the relative margin of banks (as the mark-up of prices over marginal costs).[40] A rough proxy of the Lerner index is the return on equity (RoE) and using this indicator we find that banks with higher market power (i.e. higher profitability) tend to adjust their interest rates more slowly, in line with the conclusions derived from the concentration index indicators, thereby lending further support to "structure-conduct-performance" hypothesis.[41]

Some cyclical factors, such as GDP growth, house price inflation and credit growth, tend to have a negative effect on the speed of adjustment. This seems to reflect that an increase in loan demand/supply of deposits allows banks to reduce the speed of interest rate adjustment (although the results are not unambiguous and thus may also partially support the "market entry" hypothesis). A higher share of non-interest income to total gross income seems to speed up banks' rate adjustment, which may reflect that banks which are relatively less dependent on interest-related income adjust interest rates more quickly to a change in the market rate, perhaps to capture market shares in a competitive environment. On the other hand, banks that have relatively large capital buffers (as measured by the ratio of "capital and reserves" to total liabilities), banks with excess liquidity and banks that are less dependent on marked-based funding (measured as the ratio of deposits from non-banks to total liabilities) tend to adjust their interest rates more slowly, as they are relatively less sensitive to changes in market rates. Furthermore, banks that are relatively exposed to interest rate risk tend to adjust their rates more slowly, thereby lending support to the "capital accumulation" effect. Finally, higher provisions on loans seem to imply a speedier pass-through. At first sight, this may seem puzzling as it can be argued that the costs of higher provisions could induce banks to adjust rates more sluggishly (especially in a situation of credit rationing). However, our data suggest that the ratio of provisions to gross income is highly negatively correlated with

[39] According to this hypothesis a higher concentration may be a result of more efficient banks taking over less efficient ones and through this process leading to a more concentrated, though not necessarily less competitive, banking sector.
[40] See e.g. de Guevara, Maudos and Perez (2005).
[41] The return on equity is only a rough proxy of banks' market power and, hence, due caution should be taken when interpreting the results.

concentration ratios. Hence, this might imply that banks in a more competitive environment on average take on more problematic loans (leading to higher provisions), which might explain the positive effect on the pass-through.[42]

7. Conclusion and outlook

The primary result of our study is the high degree of heterogeneity of the pass-through of market interest rates to bank interest rates in the euro area. Both the long-run multipliers and the speed of adjustment coefficients are different between the countries, which may suggest some degree of fragmentation and lack of integration of the retail banking sector in the euro area.[43] This does not imply that the European banking market is particularly inefficient. Quite the contrary is implied by cointegration of the bank interest rates and the corresponding market rates. Indeed, bank interest rates react significantly to misalignments with corresponding market rates and consequently adjust towards equilibrium for almost all interest rate categories and countries. Nevertheless, it is interesting to understand the reasons behind the persistence of heterogeneity, especially the differences in the speed of adjustment. The most robust and maybe most plausible factor we could identify is the different degree of competition in the banking sector of the euro area countries, while other plausible cyclical and structural determinants are less significant.

A natural next step would be to extend our analysis to a bank-level investigation of the interest rate pass-through in the euro area. This would improve the identification of potential explanatory factors of the observed heterogeneity. For example, the impact of competition could be measured in a more precise way than just using concentration indices and return on equity as proxies for competition. This task we have to postpone for future research. In addition, the database we have constructed would be well-suited to analyse the determinants of the bank interest margins as well as a closer examination of the process of financial integration.

[42] In addition, the positive relation between higher provision and the speed of adjustment may also partly suggest that significant credit constraints have overall not been present in the period under consideration.
[43] As also confirmed by other recent studies of the degree of financial integration in the European banking sector, see e.g. Cabral et al. (2002), Adam et al. (2002) and Baele et al. (2004).

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Appendix 1. Empirical results

Table A1: Panel unit root tests

	Im, Pesaran and Shin test		Hadri test	
	$Z_{t\ bar}$	p-value	Z_{τ}	p-value
Mortgage loans	0.55	0.71	9.55	0.00
Consumers loans	2.96	0.99	8.31	0.00
Short term loans to enterprises	1.56	0.94	7.54	0.00
Long term loans to enterprises	0.86	0.81	6.67	0.00
Current account deposits	1.09	0.86	5.11	0.00
Time deposits	2.59	0.99	8.88	0.00
Saving deposits	1.79	0.96	5.12	0.00

Table A2: DSUR for mortgage loans

Country	DSUR cointegration coefficient	95% Confidence interval	
		Lower bound	Upper bound
AT	0.698	0.416	0.981
BE	1.254	0.867	1.640
DE	1.422	1.341	1.504
ES	1.181	0.866	1.496
FI	1.160	0.907	1.413
FR	0.776	0.522	1.030
IE	0.770	0.288	1.253
IT	0.549	0.146	0.952
NL	1.326	1.237	1.414
PT	0.871	0.261	1.481
Homogeneity test			
Chi-Squared		p-value	
66.62		0.00	

Table A3: DSUR for consumer loans

Country	DSUR cointegration coefficient	95% Confidence interval	
AT	0.887	0.747	1.027
BE	0.420	0.229	0.611
DE	0.246	0.122	0.370
ES	0.761	0.618	0.903
FI	1.657	1.303	2.012
FR	0.648	0.530	0.765
PT	0.788	0.369	1.206
Homogeneity test			
Chi-Squared		p-value	
85.72		0.00	

Table A4: DSUR for short-term loans to enterprises

Country	DSUR cointegration coefficient	95% Confidence interval	
AT	0.755	0.633	0.877
BE	0.898	0.827	0.969
DE	0.408	0.279	0.537
ES	0.867	0.821	0.914
FR	0.789	0.736	0.842
IE	0.664	0.617	0.711
IT	0.694	0.666	0.722
NL	0.987	0.959	1.015
PT	0.932	0.845	1.019
Homogeneity test			
Chi-Squared		p-value	
289.47		0.00	

Table A5: DSUR for long-term loans to enterprises

Country	DSUR cointegration coefficient	95% Confidence interval	
BE	0.571	0.322	0.819
DE	0.957	0.849	1.064
ES	0.631	0.429	0.833
FI	0.335	-1.079	1.749
FR	0.867	0.634	1.101
IE	0.740	0.567	0.912
IT	0.790	0.678	0.902
Homogeneity test			
Chi-Squared		p-value	
36.80		0.00	

Table A6: DSUR for current account deposits

Country	DSUR cointegration coefficient	95% Confidence interval	
ES	0.349	0.291	0.407
FI	0.233	0.202	0.264
IT	0.436	0.412	0.460
Homogeneity test			
Chi-Squared		p-value	
205.172		0.00	

Table A7: DSUR for time deposits

Country	DSUR cointegration coefficient	95% Confidence interval	
AT	0.512	0.437	0.588
BE	0.926	0.884	0.967
DE	0.916	0.725	1.106
ES	0.917	0.826	1.007
FI	0.350	-0.044	0.744
FR	1.037	0.778	1.295
IT	0.722	0.613	0.831
NL	0.709	0.550	0.868
PT	0.477	0.407	0.546
Homogeneity test			
Chi-Squared		p-value	
319.925		0.00	

Table A8: ECM adjustment coefficient for mortgage loans

Country	adjustment coefficient	p-value
AT	-0.19217	0.0008
BE	-0.10349	0.0113
DE	-0.23072	0.0002
ES	-0.06927	0.0002
FI	-0.09777	0.0114
FR	-0.07620	0.0006
IE	-0.09711	0.0534
IT	-0.12944	0.0103
NL	-0.19023	0.0001
PT	-0.12393	0.0234
Homogeneity test		
Chi-Squared	p-value	
16.221	0.06	

Table A9: ECM adjustment coefficient for consumer loans

Country	adjustment coefficient	p-value
AT	-0.32986	0.0000
BE	-0.05788	0.1442
DE	-0.17974	0.0027
ES	-0.52609	0.0000
FI	-0.21095	0.0003
FR	-0.13281	0.0011
PT	-0.39689	0.0008
Homogeneity test		
Chi-Squared	p-value	
33.662	0.00	

Table A10: ECM adjustment coefficient for sort-term loans to enterprises

Country	adjustment coefficient	p-value
AT	-0.02711	0.6398
BE	-0.16555	0.1567
DE	-0.04659	0.0954
ES	-0.92511	0.0000
FR	-0.77998	0.0000
IE	-0.31543	0.0017
IT	-0.33011	0.0000
NL	-0.84933	0.0000
PT	-0.28686	0.0001
Homogeneity test		
Chi-Squared		p-value
86.98		0.00

Table A11: ECM adjustment coefficient for long-term loans to enterprises

Country	adjustment coefficient	p-value
BE	-0.1033	0.0366
DE	-0.44683	0.0000
ES	-0.29926	0.0000
FI	-0.15723	0.0374
FR	-0.17116	0.0002
IE	-0.18869	0.0000
IT	-0.27702	0.0000
Homogeneity test		
Chi-Squared		p-value
20.93		0.00

Table A12: ECM adjustment coefficient for current account deposits

Country	adjustment coefficient	p-value
ES	-0.05438	0.3325
FI	-0.24615	0.0010
IT	-0.3209	0.0004
Homogeneity test		
Chi-Squared		p-value
8.634		0.01

Table A13: ECM adjustment coefficient for time deposits

Country	adjustment coefficient	p-value
AT	-0.35459	0.0000
BE	-0.15272	0.1599
DE	-0.24633	0.0002
ES	-0.39599	0.0001
FI	-0.05155	0.1618
FR	-0.23295	0.0000
IT	-0.08674	0.1917
NL	-0.15359	0.0756
PT	-0.21287	0.0078
Homogeneity test		
Chi-Squared		p-value
24.322		0.00

Table A14: Regression coefficients and p-values for the impact of the indicators on the speed of adjustments

	Mortgage loans			Consumer loans			Short-term loans enterprises		
Ind.	beta	p-value	p-value (Boot)	beta	p-value	p-value (Boot)	beta	p-value	p-value (Boot)
1	-0.0130	0.05	0.02	0.0798	0.44	0.48	0.0171	0.72	0.75
2	-0.0050	0.12	0.00	0.0086	0.55	0.62	0.0441	0.03	0.05
3	-0.0002	0.87	0.91	-0.0034	0.24	0.15	0.0006	0.95	0.95
4	-0.0004	0.88	0.89	-0.0037	0.45	0.40	0.0176	0.06	0.04
5	0.0068	0.00	0.00	-0.0003	0.97	0.97	0.0108	0.56	0.50
6	0.0060	0.07	0.05	0.0134	0.18	0.14	-0.0367	0.16	0.16
7	-0.0031	0.09	0.07	0.0065	0.23	0.15	-0.0004	0.98	0.95
8	-0.0043	0.19	0.21	0.0096	0.48	0.58	0.0214	0.27	0.24
9	-0.0055	0.06	0.06	0.0270	0.03	0.00	0.0084	0.66	0.65
10	-0.0106	0.03	0.02	0.0139	0.31	0.26	0.0238	0.48	0.46
11	-0.0020	0.33	0.39	0.0102	0.10	0.10	0.0075	0.50	0.48
12	-0.0030	0.13	0.16	0.0176	0.02	0.04	0.0071	0.58	0.57
13	-2.2887	0.10	0.15	5.9251	0.11	0.14	10.4589	0.21	0.24
14	-0.3825	0.07	0.06	0.4577	0.59	0.59	0.2962	0.84	0.85
15	0.4097	0.18	0.26	-0.9051	0.27	0.38	-2.0188	0.23	0.21
16	-0.2004	0.41	0.38	-2.0402	0.00	0.00	-2.2648	0.14	0.10
17	-0.0512	0.01	0.02	-0.0962	0.25	0.20	0.0147	0.92	0.83
18	-0.2604	0.33	0.34	-0.7924	0.35	0.30	1.2726	0.58	0.61
19	-0.0008	0.36	0.37	-0.0019	0.52	0.54	0.0050	0.39	0.38
20	-0.0031	0.45	0.48	-0.0155	0.14	0.03	0.0087	0.74	0.72
	Long-term loans to enterprises			Time deposits					
Ind.	beta	p-value	p-value (Boot)	beta	p-value	p-value (Boot)			
1	-0.0169	0.35	0.34	0.0349	0.69	0.71			
2	-0.0072	0.54	0.58	0.0001	1.00	1.00			
3	-0.0053	0.20	0.19	-0.0024	0.41	0.44			
4	-0.0066	0.14	0.10	0.0020	0.53	0.55			
5	0.0093	0.23	0.25	0.0134	0.05	0.04			
6	0.0235	0.01	0.01	0.0149	0.01	0.01			
7	-0.0071	0.11	0.10	0.0002	0.98	0.96			
8	-0.0055	0.58	0.60	-0.0100	0.09	0.10			
9	-0.0031	0.73	0.77	-0.0007	0.93	0.93			
10	-0.0216	0.28	0.32	-0.0050	0.63	0.68			
11	0.0017	0.73	0.75	-0.0021	0.64	0.66			
12	-0.0005	0.93	0.94	0.0027	0.63	0.66			
13	-1.2374	0.78	0.82	0.2180	0.94	0.95			
14	-0.3965	0.45	0.46	0.0287	0.94	0.93			
15	0.4869	0.57	0.61	-0.4601	0.49	0.52			
16	-0.9720	0.10	0.12	0.1252	0.81	0.80			
17	-0.0917	0.10	0.08	-0.1500	0.01	0.01			
18	-1.0490	0.06	0.06	-0.8533	0.10	0.09			
19	-0.0039	0.03	0.02	-0.0020	0.22	0.24			
20	-0.0129	0.22	0.17	-0.0172	0.06	0.05			

Table A15: Impact on the speed of pass-through by product and indicator

Indicator	Mortgage loans	Consumer loans	Short-term loans to enterprises	Long-term loans to enterprises	Time deposits
GDP growth	-				
House prices	- (B)		(+)		
Consumer confidence indicator					
Non-interest income as % gross income			+		
Operating expenses as % gross income	(+)				(+)
Provisions on loans as % gross income	+			+	+
Profit after tax as % gross income	-				
Loans to households for consumer credit					-
Loans to households for house purchase	-	(+)			
Short-term loans to non-financial corporations	(-)				
Medium-term loans to non-financial corporations		(+)			
Long-term loans to non-financial corporations		(+)			
Capital & reserves/ Total liabilities	- (nB)				
Deposits/Total liabilities	-				
Debt securities issued/Total liabilities					
Banks' excess liquidity		-	- (B)		
Maturity transformation ratio	(-)			- (B)	-
Herfindahl index				-	-
CR5				-	
ROE		- (B)			-

Note. "(nB)" indicates that the determinant is only significant using the non-Bootstrap method, while "(B)" indicates that the determinant is only significant using the Bootstrap method. Signs in parentheses indicate that the determinant is only weakly (10% level) significant.

Table A16: Description of the indicators

No.	Indicator	Sources	Description
1	GDP growth	ECB	average 99-04; quarterly annual growth rates
2	House prices	ECB	average 99-04; quarterly annual growth rates
3	Consumer confidence indicator	ECB	average 99-04; quarterly data
4	Non-interest income as % gross income	OECD	average of 1999-2001
5	Operating expenses as % gross income	OECD	average of 1999-2001
6	Provisions on loans as % gross income	OECD	average of 1999-2001
7	Profit after tax as % gross income	OECD	average of 1999-2001
8	Loans to households for consumer credit	ECB	annual growth rate; average Jan 1999-Jun 2004
9	Loans to households for house purchase	ECB	annual growth rate; average Jan 1999-Jun 2004
10	Short-term loans to non-financial corporations	ECB	annual growth rate; average Jan 1999-Jun 2004
11	Medium-term loans to non-financial corporations	ECB	annual growth rate; average Jan 1999-Jun 2004
12	Long-term loans to non-financial corporations	ECB	annual growth rate; average Jan 1999-Jun 2004
13	Capital & reserves/ Total liabilities	ECB	annual data; average 1999-2003
14	Deposits/Total liabilities	ECB	annual data; average 1999-2003
15	Debt securities issued/Total liabilities	ECB	annual data; average 1999-2003
16	Banks' excess liquidity	ECB	cash and securities holdings to total assets; annual data; average 1999-2003
17	Maturity transformation ratio	ECB	LT assets/total assets vs. LT liabilities/total liabilities; annual data; average 1999- 2003
18	Herfindahl index	ECB	annual data; average 1999-2003
19	CR5	ECB	annual data; average 1999-2003
20	ROE (Return on equity)	OECD and Bloomberg	annual data; average 1999-2003

Appendix 2: Robustness of the main results

1. Testing for heterogeneity using the "correlation approach" to select market rates

In the main part of this paper (see section 3) we discussed in detail our approach to select or "construct" market interest rates comparable to the analysed bank interest rates. The most important point was the selection of market rates in accordance with the maturity of the bank rates. From a methodological point of view this is the "right way" to select market rates because pass-through should be defined as adjustment of bank interest rates to "comparable" market rates and not as adjustment to any market rate. The justification for this concept of pass-through comes from the potential pressure banks are exposed to due to outside competition. Firms, for example, could issue bonds instead of taking bank loans.

Nevertheless, it seems reasonable to ask whether the heterogeneity of pass-through we found is only due to the specific selection of market rates. To asses the robustness of our results, in this section we re-estimate the pass-through model for interest rates on mortgage loans using market rates selected according to specific information on the national mortgage markets.[44] Hence, for those countries where we have explicit information that the mortgage rates in the NRIR statistics were predominantly variable or short-term rates (i.e. Spain, Ireland, Austria and Portugal), we selected market rates of a short-term nature independent of the maturity structure of the bank rates. For the remaining countries, our standard approach is applied. In addition, the data set is adjusted for the bias caused by the use of original maturity volumes as weights when aggregating the MIR rates to the less-detailed breakdown of the NRIR rates. That is, in order to mitigate this bias we estimate the "residual maturity" of the amounts outstanding, which result in a better consistency between the period of rate fixation breakdown (in the new business volumes) and the maturity breakdown (in the amounts outstanding). [45]

The results for the long-run pass-through using the adjusted data set described above are shown in Table A17. The hypothesis of homogeneity of the long-run pass-through parameter between the countries can be rejected strongly. The chi-square test statistic is nearly twice as high as the corresponding statistic in Table A2. The heterogeneity of the long-run pass-through is therefore confirmed and seems to be even stronger compared to the construction of market rates along the methodology used in the main part of this paper. Table A18 shows the results for the speed of adjustment coefficients. Also in this case the hypothesis of homogeneity can be rejected. For some countries the speed of adjustment coefficient is larger using the correlation-based method to select market rates. For countries like Finland, Belgium, Austria, Portugal and

[44] The mortgage loan segment was chosen, since the selection method (according to comparable maturity) most likely provided the least accurate estimates, due to the presumably larger discrepancy between the share of variable rate loans and loans at long-term maturities.

[45] In practical terms this adjustment is carried out by assuming an average maturity of the "original maturity bands" and reallocating part of these to maturity bands of shorter maturity. For example, it is assumed that the average maturity of the maturity band "over one and up to five years" is 3 years (i.e. the middle of the band). Hence, 1/3 of the loans in this band is likely to mature within one year and accordingly is reallocated to the original maturity band "up to one year".

Spain this result was expected because the correlation approach selects short-term money market rates which are presumably closer linked with variable-rate mortgage loans (of longer-term maturity) in these countries due to legal regulations (as mentioned above). Nevertheless, from a methodological point of view the relation between bank rates and market rates with comparable maturity is of primary importance and if a bank rate is regulated the pass-through to the comparable market rate might therefore be slow. For some countries like the Netherlands and Germany the speed of adjustment estimates are even slower than before. This shows an important caveat of the correlation approach. High correlation implies not necessarily a long run equilibrium relation and a faster adjustment towards the equilibrium.

Summarising the results of this robustness exercise, it is fair to say that the main result of the paper, the heterogeneity of the bank interest rates across the euro area, seems to be pretty robust with respect to the selection of market rates.

Table A17: DSUR for mortgage loans (adjusted market rates)

Country	DSUR cointegration coefficient	95% Confidence interval	
		Lower bound	Upper bound
AT	0.688	0.520	0.856
BE	1.311	1.186	1.436
DE	1.202	1.137	1.268
ES	1.044	0.975	1.113
FI	1.083	1.014	1.152
FR	0.934	0.834	1.034
IE	0.919	0.738	1.100
IT	0.809	0.698	0.921
NL	1.134	1.021	1.246
PT	0.755	0.408	1.103
Homogeneity test			
Chi-Squared		p-value	
131.03		0.00	

Table A18: ECM adjustment coefficient for mortgage loans (adjusted market rates)

Country	adjustment coefficient	p-value
AT	-0.38480	0.0008
BE	-0.21954	0.0113
DE	-0.20127	0.0002
ES	-0.13994	0.0002
FI	-0.20056	0.0114
FR	-0.13324	0.0006
IE	-0.11121	0.0534
IT	-0.18507	0.0103
NL	-0.18005	0.0001
PT	-0.17051	0.0234
Homogeneity test		
Chi-Squared	p-value	
15.688	0.07	

2. Assessing heterogeneity using only harmonised MIR data

Another potential caveat of our analysis is the (partial) use of non-harmonised bank interest rates. The heterogeneity of the pass-through might be because the interest rate data are collected in a different way across the euro area countries. To assess whether the results are only due to the data we compute some pass-through regressions using only harmonised bank interest rates (MIR rates) which are available only since the beginning of 2003 (we use data up January 2005). Unfortunately the panel analysis we use in the main part of the paper is not applicable to such a short data set because the SUR method requires much more data points in time dimension than cross-section units. Nevertheless, to get a rough idea about the heterogeneity of the pass-through process we use a single equation approach instead of a panel-data method. But even with a single-equation approach the estimation of the long-run pass-through parameters is difficult given the small sample. To deal with the small sample bias we use the DOLS method developed by Stock and Watson (1993) which is known to feature better small-sample properties compared to standard OLS. Exemplary results for a selection of short-term rates are summarised in Table A19 and A20. The modelling of long-term interest rates turned out to be impossible because the long-run pass-through parameters are negative for some countries (possibly owing to high volatility in the underlying volumes of interest rates with long-term fixation). The following Table describes the bank interest rates we analyse:

Interest rates	Explanation	Corresponding market rate
MIR 2	MFI interest rate on deposits from households up to one year	Eonia
MIR 5	MFI interest rate on deposits from households redeemable at notice up to three month	EURIBOR (1 month)
MIR 15	MFI interest rate on loans to households for consumption with over five years initial fixation	7 year bond yield
MIR 16	MFI interest rate on loans to households for house purchase with a floating rate and initial fixation up to one year	EURIBOR (3 month)
MIR 24	MFI interest rate on loans up to €1 million to non-financial corporations with a floating rate and initial fixation up to one year	EURIBOR (3 month)
MIR 27	MFI interest rate on loans over €1 million to non-financial corporations with a floating rate and initial fixation up to one year	EURIBOR (3 month)

Because we can not formally test for homogeneity with such a small sample only an eye-ball assessment is possible. Nevertheless, both the long-run pass-through coefficients shown in Table A19 and the short-run coefficients shown in Table A20 seem to be different between the countries.

Given the small sample available a final assessment can only be preliminary, but it seems to be the case that at least part of the shown heterogeneity is not explainable by differences in the statistical collection of the data.

Table A19: Long-run path-through parameter for selected MIR rates (estimated with DOLS)

Country	MIR 2	MIR 5	MIR 15	MIR 16	MIR 24	MIR27
AT	0.641767	0.489545	0.082822	1.027285	1.007042	1.238532
BE	0.713869	0.747328	1.372187	0.230399	0.978923	0.975822
DE	0.655917	0.285948	0.262471	1.22602	1.194673	1.314184
ES	0.527636	0.108102	0.132072	0.99341	1.020036	0.771478
FI	0.678209	0.572502	0.57631	1.089767	0.783135	1.133156
FR	0.893239	0.909793	1.284003	1.267408	1.072675	0.474026
IE	0.754745	0.337638	1.119304	1.033884	1.282646	1.335543
IT	0.569575	0.330955	0.486511	0.97485	0.890536	1.010663
NL	0.681528	0.350038	0.503628	0.789736	0.859007	0.953898
PT	0.509328			0.747967	1.423546	1.016578

Table A20: ECM adjustment coefficient for selected MIR rates

Country	MIR 2	MIR 5	MIR 15	MIR 16	MIR 24	MIR27
AT	-0.7199	-1.16142	-0.5218	-0.56022	-0.24952	-0.64136
BE	-0.66998	-0.33587	-0.39043	-0.25198	-0.22271	-0.23363
DE	-0.81649	-0.85569	-0.6033	-0.44797	-0.75865	-0.94054
ES	-0.46874	-0.34804	-0.18603	-0.27367	-0.2285	-0.66916
FI	-0.61015	-0.72511	-1.06495	-0.34311	-0.44465	-1.03709
FR	-0.9468	-0.90932	-0.36777	-0.44035	-0.20046	-0.92152
IE	-0.71476	-1.40379	-0.83327	-0.36215	-0.54393	-1.33353
IT	-0.58622	-0.49364	-0.67533	-0.34057	-0.27649	-0.21392
NL	-1.00012	-0.36398	-1.17222	-0.14439	-0.25167	-0.46619
PT	-0.63853			-0.42159	-0.50875	-0.86221

Appendix 3. The construction of the backward national MIR data

The data on retail bank interest rates in the euro area countries for the period 1999-2004 are based on two different statistical sources: *i)* non-harmonised national retail interest rate statistics (NRIR) for the period January 1999 to September 2003 (some national series end earlier in 2003 than September 2003, though) and *ii)* harmonised national MFI interest rate statistics (MIR) for the period January 2003 to June 2004. It has therefore been necessary to link the two statistics into one series of the relevant interest rate categories, respectively, which is consistent throughout the period from January 1999 to June 2004. In addition, the examination of the pass-through of market rates to bank retail rates necessitates linking the MIR/NRIR rates with market rates of comparable maturity. The aggregation of national bank retail rates and market rates are described in turn below:

A) Bank retail rates

The NRIR statistics are more aggregated (i.e. less detailed in terms of breakdowns) than the MIR statistics. Hence, it has been necessary to aggregate the MIR series to a level corresponding to the NRIR series.[46] A number of issues are worth noting in this regard:

First, the MIR statistics contain complementary interest rate data on both outstanding amounts (OA) and new business (NB), whereas the NRIR predominantly features interest rate data on new business[47]. Hence, using the NB rates to link the two statistics seems to provide the better fit. Besides, the analysis of the pass-through of interest rates should preferably be based on NB rates as they reflect the rates on loans/deposits that have been granted/taken in the period under consideration – whereas OA rates also reflect rates on loans/deposits granted/taken in preceding,periods which are irrelevant for the pass-through period being analysed.

Second, as mentioned, the NB rate categories in the MIR statistics are much more detailed than in the NRIR statistics and therefore need to be aggregated to a level corresponding to the NRIR rates. The more detailed breakdown in the MIR statistics mainly relates to the maturity bands, whereas the broad product categories are mostly similar. For that reason, the aggregation is solved using the volumes within each maturity band as weights, as shown in Chart A below.

Third, when aggregating the MIR series to the level of breakdown of the NRIR series the weights could either be based on the volumes on new business (as reported in the MIR statistics) or on the volumes of outstanding amounts (as also reported in the MIR statistics). We have chosen to use the latter as weights when extending the MIR series backwards for the following reasons: First of all, the OA volumes to a larger extent reflect the historical maturity structure on bank loans and deposits and are therefore probably more representative for the maturity structure of the "old" NRIR-based rates than are the NB volumes, which only reflect the maturity structure at each specific data point. That is, the maturity structure of NB loans/deposits in January 2003[48] is most likely not representative of the average maturity structure of loans/deposits granted/taken over the period January 1999 to December 2002. Moreover, NB volumes tend to be more volatile than OA volumes over time, which provides another reason why the maturity structure of the OA volumes, in January 2003, is more likely to be representative of the average maturity structure of loans/deposits throughout the period January 1999-December 2002 than would be NB volumes. For example, the NB volumes in January 2003 could easily reflect an outlier with respect to the complete sample of the period January 1999-May 2004.

[46] In principle, it would have been possible to construct back data of the NRIR series with the level of detail corresponding to the MIR statistics, which, however, would require strong assumptions (due to lack of information) about the past maturity and product structure of the NRIR statistics.
[47] In the NRIR statistics, rates on NB represent between 70% and 100% across the various rate categories.
[48] The data point employed to link the MIR rates with the NRIR rates, see below.

Fourth, using the NB rates of the MIR statistics while aggregating by employing weights according to the OA volumes, it is furthermore necessary to link the breakdown of the NB rates (which are the more detailed) with the breakdown of the OA volumes. This has been done as illustrated in Chart B below:

In those cases where OA volumes have to be allocated to two or more NB categories[49], the average amount of NB volumes over the period January 2003-June 2004 have been used. This method takes account of the information contained in the NB statistics, while at the same time corrects for the volatile month-to-month behaviour of some NB categories.
The "synthetic" NB MIR volumes thus created are subsequently used as weights in the aggregation of NB MIR rates to the NRIR rates, which results in "synthetic" bank retail interest rates (BIR) for the period January 1999-June 2004.

B) Market rates

The subject of analysis is the pass-through of market interest rates to various bank retail interest rates. The selection of the exogenous market rate variable in the error-correction model is carried out in various ways in the literature. Indeed, some (most) studies simply select a short-term money market rate (to reflect the official central bank rate) and analyses the pass-through from changes in this rate to all bank interest rates, independent of their maturity. However, this approach does not take into account the cost-of-funds (in the case of loan rates) or opportunity cost (in the case of deposit rates) as it implicitly ignores both the "true" marginal costs of banks when setting their interest rates as well as term-structure effects of monetary policy rate changes.[50] Alternatively, some papers select the exogenous market rates on the basis of a mark-up model on the basis of the extent to which their maturity matches the maturity of the corresponding bank interest rate.[51] However, previous studies using the latter approach have been criticised for selecting the market rates of comparable maturity in a too arbitrary and imprecise manner. For example, Sander and Kleimeier (2004a-b) argue that the maturity breakdown of the NRIR data is too rough to be able to select the proper market rates and that selecting the market rates that display the highest correlation with the bank interest rates is too arbitrary.
While these points are certainly valid, a clear advantage of the MIR statistics is their much more detailed break downs by maturity (compared with the NRIR statistics). This allows selecting market rates of comparable maturity with a much greater precision than in previous studies. Hence, our approach has been to select market rates within the same maturity band as the corresponding bank interest rates. Within each maturity band, the market rate displaying the highest correlation with the corresponding bank interest rate has been selected. Chart C illustrates the links between the various MFI interest rates and market rates of comparable maturity.

In order to obtain a market rate corresponding to each instrument category or the "synthetic" BIR rates, the same method of aggregation as was used with respect to the bank retail rates has been used. That is, the weights derived in Chart B (based on OA volumes) are linked with market rates as reflected in Chart C

[49] E.g. OA loans to households for house purchase over 5 year has to be split between NB loans to households for house purchase "over 5 years and up to 10 years initial rate fixation" and "over 10 years initial rate fixation".
[50] See e.g. de Bondt (2002) and De Graeve, De Jonghe and Vander Vennet (2004).
[51] See de Bondt (2002); Weth (2002); de Bondt, Mojon and Valla (2002); De Graeve, De Jonghe and Vennet (2004) and Sander and Kleimeier (2004a-b).

resulting in compounded market rates of comparable maturity structure as the "synthetic" BIR rates shown in Chart A.

Compounded market rates are constructed for each country within each instrument category on the basis of euro area market rates and weighted by country-specific OA volumes to take into account the national characteristics of the bank loan and deposit portfolios (as described above).[52]

[52] Euro area market rates are used instead of national market rates as they reflect the bank financing conditions and the common monetary policy pertaining in the euro area as a whole…

Chart A. Linking the rates of the MIR and NRIR statistics

MIR statistics (new business)					NRIR statistics
		overnight			Current account deposits
Deposits	from households	with agreed maturity	up to 1 year maturity		Time deposits
			over 1 and up to 2 years maturity		
			over 2 years maturity		
		redeemable at notice	up to 3 months notice		
			over 3 months notice		Savings deposits
	from non-financial corporations	overnight			
		with agreed maturity	up to 1 year maturity		
			over 1 and up to 2 years maturity		
			over 2 years maturity		
Loans	to households	bank overdraft			Consumer loans to households
		for consumption	floating rate and up to 1 year initial rate fixation		
			over 1 and up to 5 years initial rate fixation		
			over 5 years initial rate fixation		
		for house purchases	floating rate and up to 1 year initial rate fixation		Mortgage loans to households
			over 1 and up to 5 years initial rate fixation		
			over 5 and up to 10 years initial rate fixation		
			over 10 years initial rate fixation		
		for other purposes	floating rate and up to 1 year initial rate fixation		
			over 1 and up to 5 years initial rate fixation		
			over 5 years initial rate fixation		
	to non-financial corporations	bank overdraft			ST loans to enterprises
		loans other than bank overdrafts up to an amount of EUR 1 million	floating rate and up to 1 year initial rate fixation		
			over 1 and up to 5 years initial rate fixation		
			over 5 years initial rate fixation		
		loans other than bank overdrafts over an amount of EUR 1 million	floating rate and up to 1 year initial rate fixation		LT loans to enterprises
			over 1 and up to 5 years initial rate fixation		
			over 5 years initial rate fixation		

Chart B. Linking the new business volumes with the outstanding amounts in the MIR statistics

MIR statistics (new business)					MIR statistics (outstanding amounts)		
		overnight*					
Deposits	from households	with agreed maturity	up to 1 year maturity				
			over 1 and up to 2 years maturity		up to 2 years	from households	with agreed maturity
			over 2 years maturity		over 2 years		
		redeemable at notice*	up to 3 months notice				
			over 3 months notice		up to 2 years	from non-financial c	with agreed maturity
	from non-financial corporations	overnight*			over 2 years		
		with agreed maturity	up to 1 year maturity				
			over 1 and up to 2 years maturity				
			over 2 years maturity				
Loans	to households	bank overdraft[4]					
		for consumption	floating rate and up to 1 year initial rate fixation				
			over 1 and up to 5 years initial rate fixation		up to 1 year	to households	for house purchases
			over 5 years initial rate fixation		over 1 and up to 5 years		
		for house purchases	floating rate and up to 1 year initial rate fixation		over 5 years		
			over 1 and up to 5 years initial rate fixation				
			over 5 and up to 10 years initial rate fixation		up to 1 year	to households	consumer credit
			over 10 years initial rate fixation		over 1 and up to 5 years		and
		for other purposes	floating rate and up to 1 year initial rate fixation		over 5 years		other loans
			over 1 and up to 5 years initial rate fixation				
			over 5 years initial rate fixation				
	to non-financial corporations	bank overdraft[4]					
		loans other than bank overdrafts up to an amount of EUR 1 million	floating rate and up to 1 year initial rate fixation				
			over 1 and up to 5 years initial rate fixation		up to 1 year	to non-financial corporations	
			over 5 years initial rate fixation		over 1 and up to 5 years		
		loans other than bank overdrafts over an amount of EUR 1 million	floating rate and up to 1 year initial rate fixation		over 5 years		
			over 1 and up to 5 years initial rate fixation				
			over 5 years initial rate fixation				

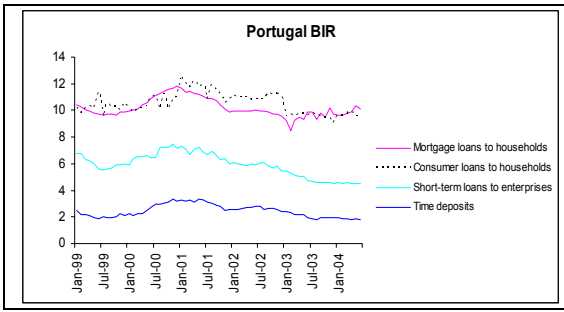
Note. Overnight deposits, deposits from households redeemable at notice and bank overdrafts are already based on outstanding amounts despite their classification as NB rates in the MIR statistics.

Chart C. Selected market rates

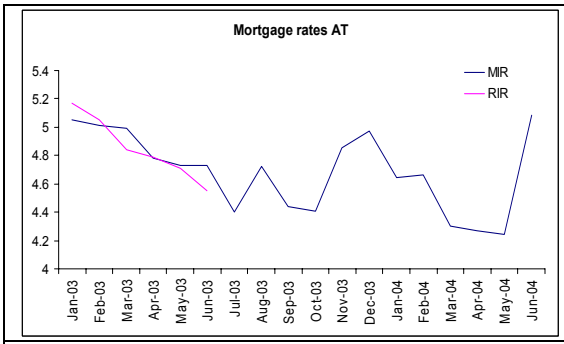
	Sector	Type of instrument	Original maturity / period of notice / initial rate fixation	Austria	Belgium	Germany	Spain	Finland	France	Ireland	Italy	Netherlands	Portugal
		overnight		EONIA	EONIA	EONIA	EONIA	EURIBOR.1M	EURIBOR.1Y	EONIA	EONIA	EURIBOR.3M	EURIBOR.3M
	to households	with agreed maturity	up to 1 year maturity	EONIA	EURIBOR.1M	EONIA	EURIBOR.1M	EURIBOR.1M	EURIBOR.1M	EURIBOR.1M	EONIA	EURIBOR.1M	EURIBOR.1M
			over 1 and up to 2 years maturity	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y		EURIBOR.1Y
			over 2 years maturity	Gov bond yield 2Y	Gov bond yield 10Y	Gov bond yield 2Y	Gov bond yield 10Y	Gov bond yield 2Y	Gov bond yield 2Y	Gov bond yield 5Y	Gov bond yield 10Y	Gov bond yield 2Y	Gov bond yield 2Y
Deposits in EUR		redeemable at notice	up to 3 months notice	EURIBOR.1M	EONIA	EURIBOR.1M	EONIA	EONIA	EONIA	EONIA	EONIA	EURIBOR.1M	
			over 3 months notice		EURIBOR.3M	EURIBOR.3M				EURIBOR.3M	EURIBOR.3M	EURIBOR.3M	
		overnight		EONIA	EONIA	EONIA	EONIA	EONIA	EONIA	EURIBOR.1M	EURIBOR.1M	EONIA	EURIBOR.1M
	to non-financial corporations	with agreed maturity	up to 1 year maturity	EURIBOR.1M	EONIA	EONIA	EURIBOR.1M	EONIA	EONIA	EURIBOR.1M	EONIA	EONIA	EURIBOR.1M
			over 1 and up to 2 years maturity	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y		EURIBOR.1Y
			over 2 years maturity	Gov bond yield 2Y	Gov bond yield 2Y	Gov bond yield 10Y	Gov bond yield 2Y	Gov bond yield 2Y	Gov bond yield 10Y	Gov bond yield 10Y	Gov bond yield 2Y	Gov bond yield 2Y	Gov bond yield 2Y
		Repos											
		bank overdraft		EONIA	EONIA	EONIA	EURIBOR.6M	EONIA	EONIA	Gov bond yield 10Y	EONIA	EURIBOR.1Y	EONIA
		for consumption	floating rate and up to 1 year initial rate fixation	EURIBOR.1M	EURIBOR.1Y	EONIA	EURIBOR.1Y	EURIBOR.1M	EURIBOR.1M	EONIA	EURIBOR.1Y	EONIA	EONIA
			over 1 and up to 5 years initial rate fixation	EURIBOR.1Y	Gov bond yield 2Y	EURIBOR.1Y	EURIBOR.1Y	Gov bond yield 2Y	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y	Gov bond yield 5Y	Gov bond yield 5Y
			over 5 years initial rate fixation	Gov bond yield 5Y	Gov bond yield 10Y	Gov bond yield 10Y	Gov bond yield 5Y		Gov bond yield 5Y	Gov bond yield 10Y	Gov bond yield 10Y	Gov bond yield 10Y	Gov bond yield 5Y
	to households	for house purchases	floating rate and up to 1 year initial rate fixation	EONIA	EURIBOR.1M	EONIA	EURIBOR.1M	EURIBOR.6M	EURIBOR.1M	EONIA	EURIBOR.1M	EURIBOR.1M	EURIBOR.1M
			over 1 and up to 5 years initial rate fixation	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y	Gov bond yield 5Y	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y	Gov bond yield 5Y
			over 5 and up to 10 years initial rate fixation	Gov bond yield 5Y	Gov bond yield 5Y	Gov bond yield 10Y	Gov bond yield 10Y	Gov bond yield 5Y	Gov bond yield 5Y	Gov bond yield 10Y	Gov bond yield 10Y	Gov bond yield 10Y	Gov bond yield 10Y
			over 10 years initial rate fixation	Gov bond yield 10Y	Gov bond yield 10Y	Gov bond yield 10Y	Gov bond yield 10Y	Gov bond yield 10Y	Gov bond yield 10Y	Gov bond yield 10Y	Gov bond yield 10Y	Gov bond yield 10Y	
Loans in EUR		for other purposes	floating rate and up to 1 year initial rate fixation	EURIBOR.1M	EURIBOR.6M	EURIBOR.1M	EURIBOR.1M	EURIBOR.1M	EURIBOR.1M	EURIBOR.1M	EURIBOR.1M	EURIBOR.1M	EONIA
			over 1 and up to 5 years initial rate fixation	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y
			over 5 years initial rate fixation	Gov bond yield 5Y	Gov bond yield 5Y	Gov bond yield 5Y	Gov bond yield 5Y	Gov bond yield 10Y	Gov bond yield 5Y	Gov bond yield 5Y	Gov bond yield 5Y	Gov bond yield 5Y	Gov bond yield 10Y
		bank overdraft		EURIBOR.1M	EONIA	EONIA	Gov bond yield 2Y	EONIA	EONIA	EONIA	EONIA	EONIA	EURIBOR.1M
		loans other than bank overdrafts up to an amount of EUR 1 million	floating rate and up to 1 year initial rate fixation	EONIA	EURIBOR.1M	EURIBOR.1M	EURIBOR.1M	EURIBOR.1M	EURIBOR.1M	EONIA	EURIBOR.1M	EURIBOR.1M	EURIBOR.1M
			over 1 and up to 5 years initial rate fixation	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y
			over 5 years initial rate fixation	Gov bond yield 5Y	Gov bond yield 5Y	Gov bond yield 10Y	Gov bond yield 5Y	Gov bond yield 5Y	Gov bond yield 5Y	Gov bond yield 5Y	Gov bond yield 5Y	Gov bond yield 10Y	Gov bond yield 5Y
	to non-financial corporations	loans other than bank overdrafts over an amount of EUR 1 million	floating rate and up to 1 year initial rate fixation	EONIA	EONIA	EURIBOR.1M	EURIBOR.1M	EONIA	EONIA	EONIA	EURIBOR.1M	EURIBOR.1M	EURIBOR.1M
			over 1 and up to 5 years initial rate fixation	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y	EURIBOR.1Y	Gov bond yield 2Y	Gov bond yield 2Y	Gov bond yield 5Y	EURIBOR.1Y	EURIBOR.1Y	
			over 5 years initial rate fixation	Gov bond yield 10Y	Gov bond yield 10Y	Gov bond yield 10Y	Gov bond yield 5Y	Gov bond yield 10Y	Gov bond yield 10Y	Gov bond yield 5Y	Gov bond yield 5Y	Gov bond yield 10Y	

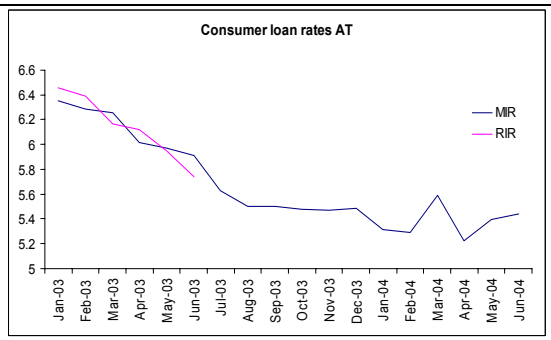
Descriptive charts

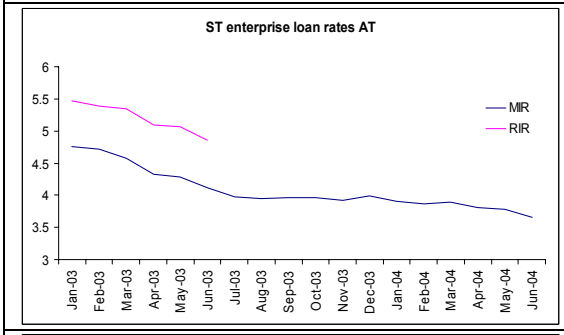
Charts A3.A on "synthetic" MIR rates, Jan. 1999 – June 2004

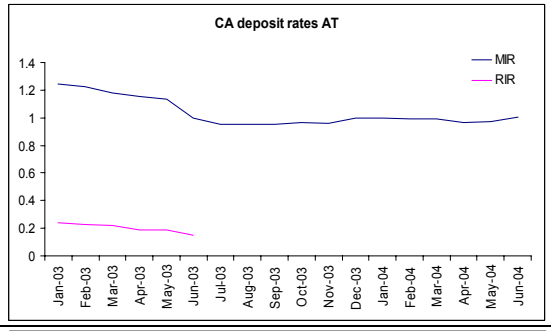


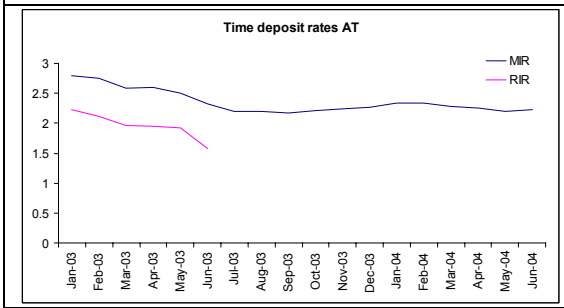
Charts A3.B comparing the "synthetic" MIR rates with NRIR rates, January 2003-June 2004

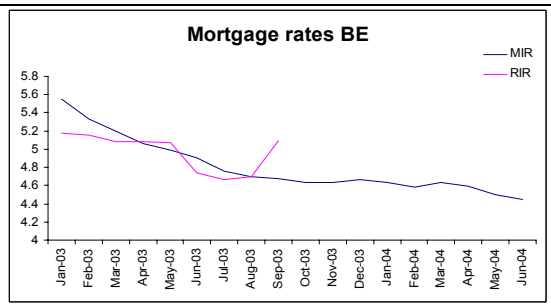


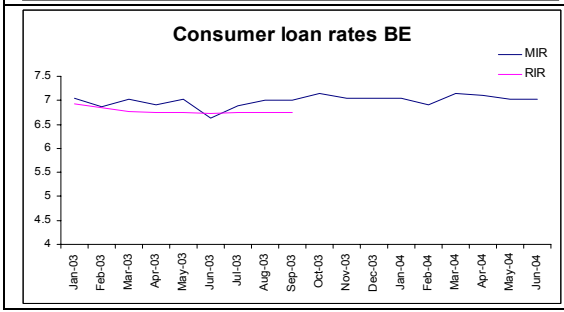


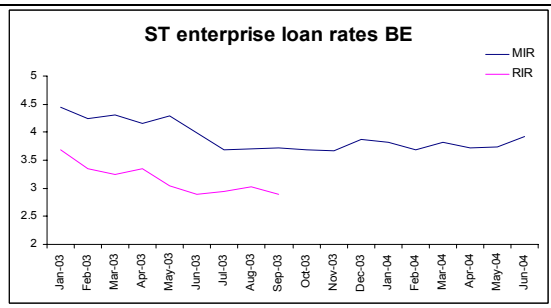


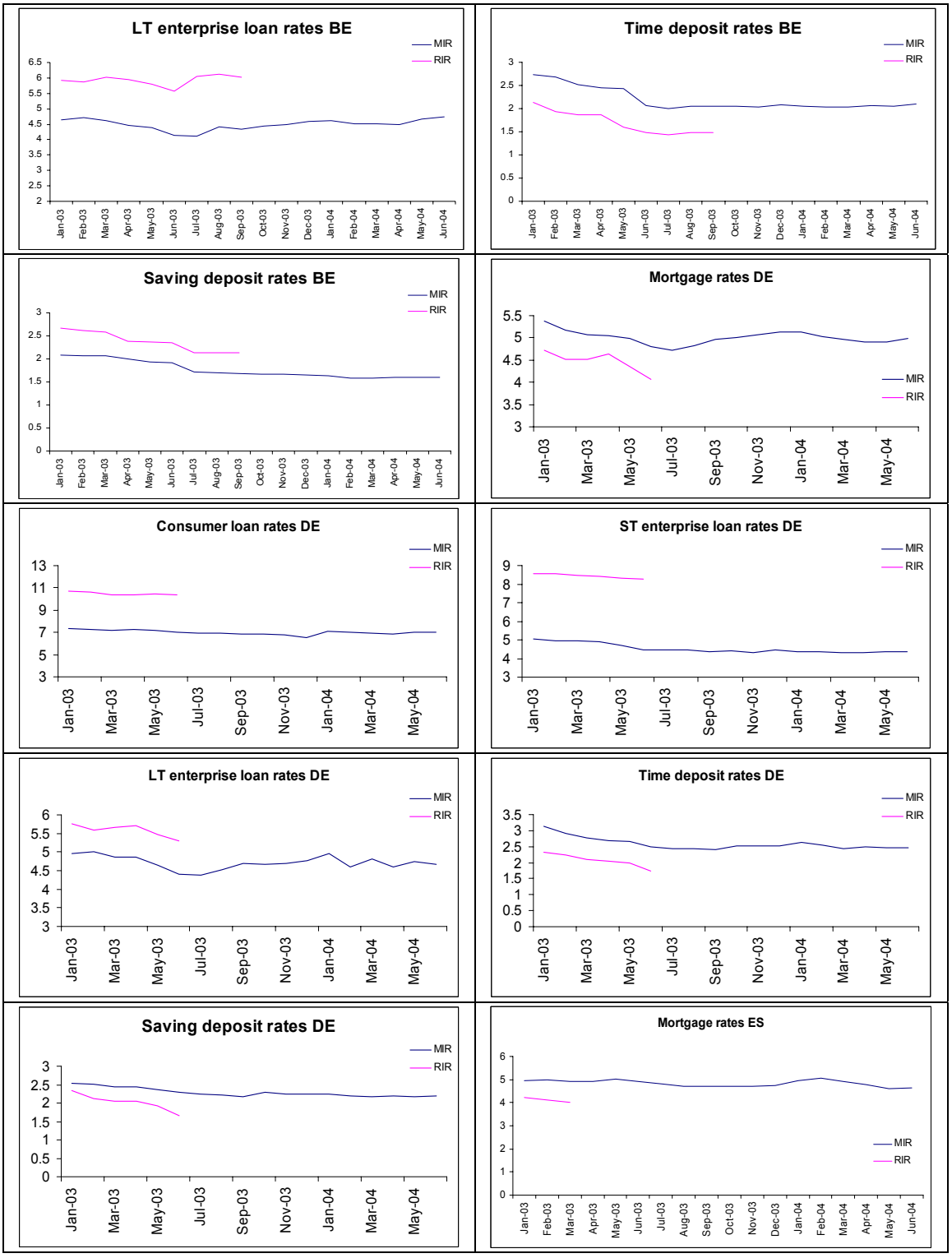








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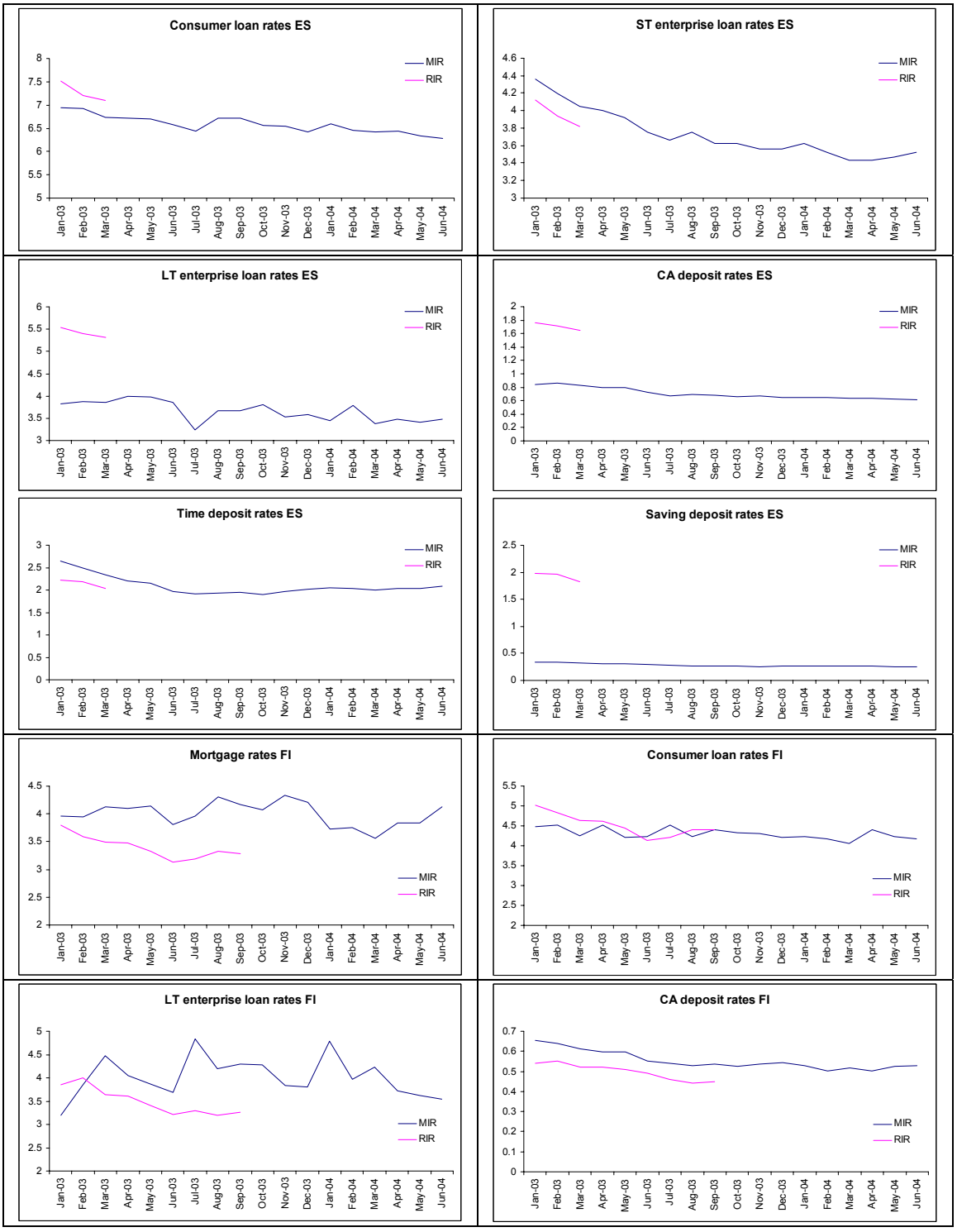
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Time deposit rates FI
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LT enterprise loan rates FR
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Saving deposit rates FR
Mortgage rates GR
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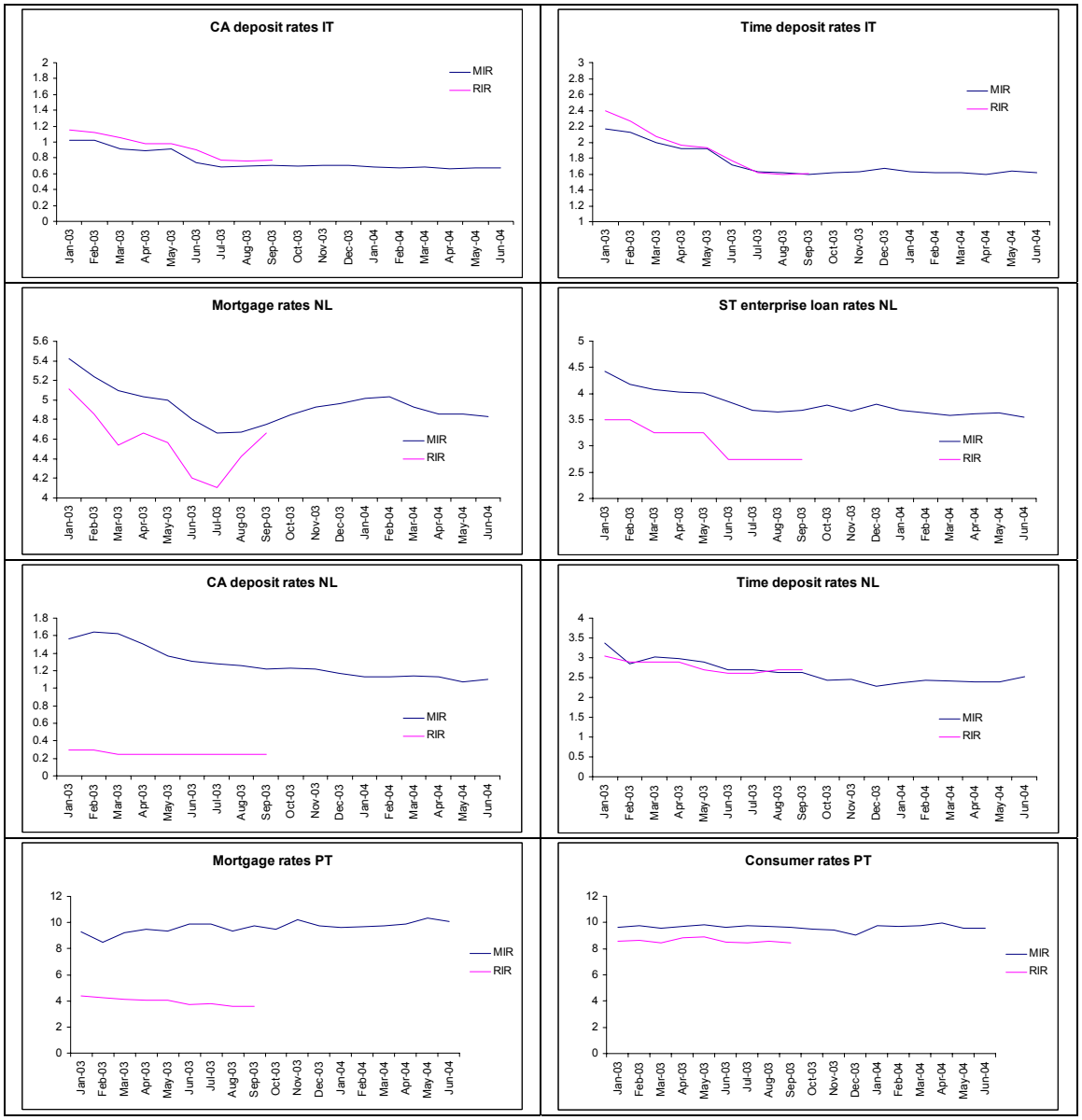
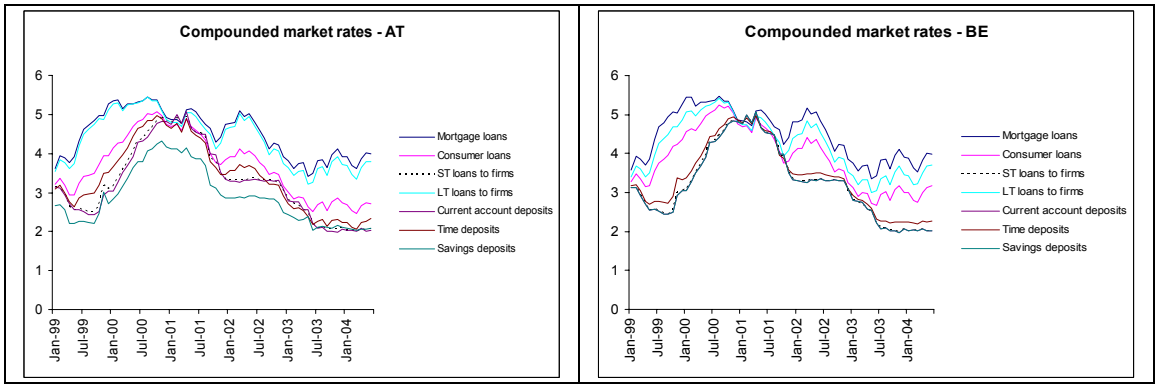
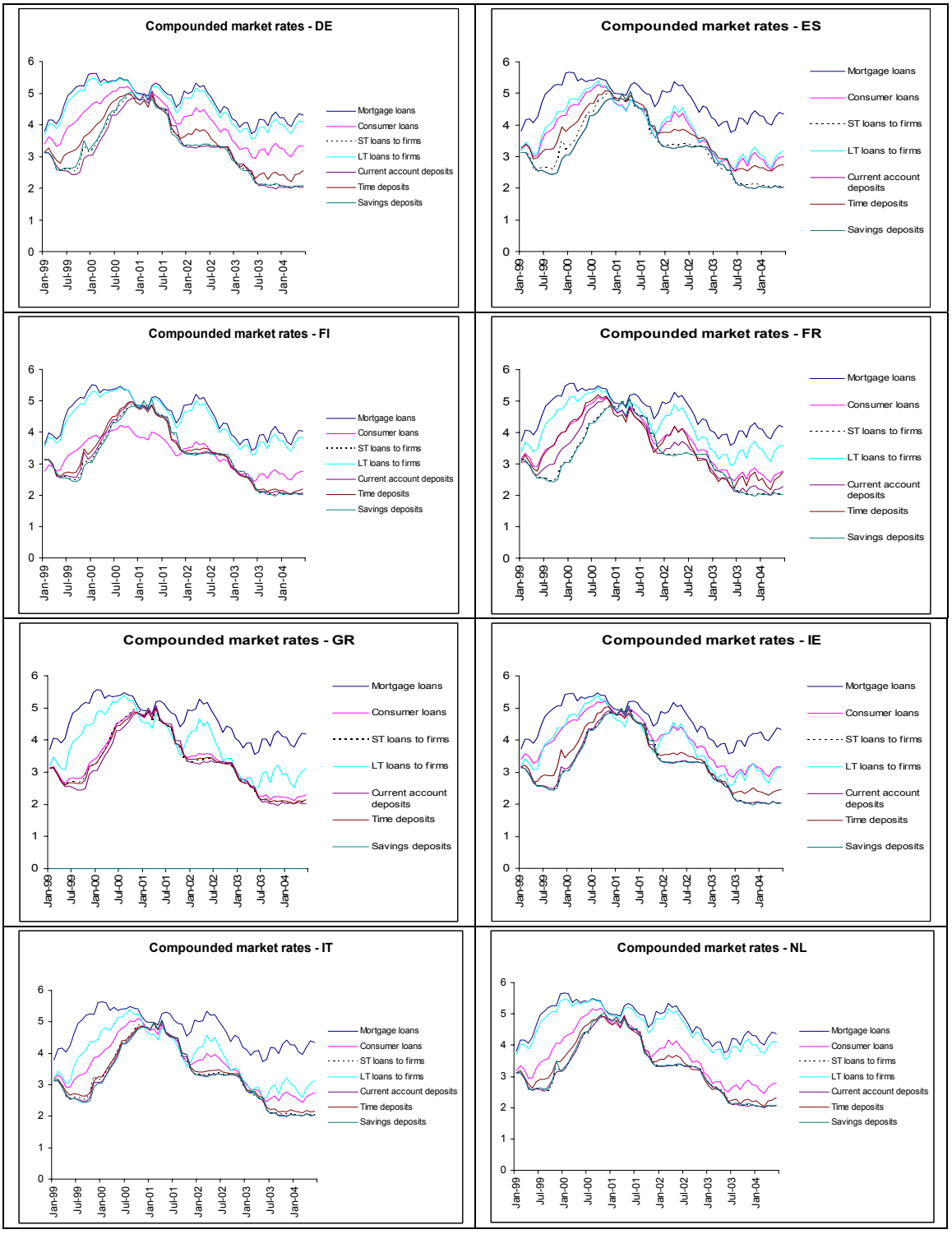
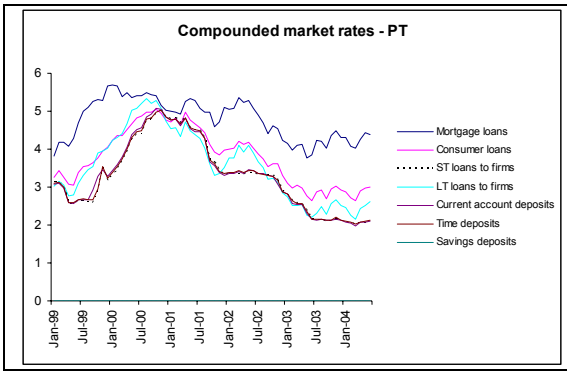


Charts A3.C Compounded national market rates, January 1999-June 2004




Compounded market rates - DE
Compounded market rates - ES
Compounded market rates - FI
Compounded market rates - FR
Compounded market rates - GR
Compounded market rates - IE
Compounded market rates - IT
Compounded market rates - NL
Mortgage loans
Consumer loans
ST loans to firms
LT loans to firms
Current account deposits
Time deposits
Savings deposits
0
1
2
3
4
5
6
Jan-99
Jul-99
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04


Compounded market rates - PT
6
5
4
3
2
1
0
Jan-99
Jul-99
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Mortgage loans
Consumer loans
ST loans to firms
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