Structural breaks in the interest rate pass-through and the euro

A cross-country study in the euro area and the UK

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this version: June 4th, 2007

Abstract

We search for breaks in the short term business lending rate pass-through in euro countries, possibly associated with the introduction of the euro. One break is detected in six national retail rates among EMU countries; two breaks are found in other six cases, and in the UK as well. The last break occurs much earlier for France while several quarters later for other countries, suggesting a loose link if ever with the event. Pass-throughs decrease (except for France), becoming even more incomplete (except for Netherlands); though the adjustment to equilibrium is faster, cross-country heterogeneity remains fairly large. With the new harmonized interest rates database, available since 2003, pass-throughs are much closer to one, especially for larger loans.

JEL Classification: E43; E52; E58; F36

Keywords: Interest rates; Monetary policy; European and Monetary Union (EMU); Cointegration analysis; Structural breaks

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Paper prepared for the 2007 annual European Financial Management Association Meeting, Vienna 27-30 June 2007.

1. Introduction[*]

The transmission of monetary policy hinges on how policy rate changes, via changes in market interest rates, affect bank rates, that are likely to influence aggregate demand at least to some extent. A monetary policy impulse, obeying the Taylor principle - that a central bank should raise its interest rate instrument more than one-to-one with increases in inflation (Woodford 2003, 91) - can however fail to be stabilizing if the pass-through (PT) to retail rates is incomplete even in the long run. Is this the case even after the introduction of the euro in a bank-based financial system such as the European Monetary Union (EMU)?

The issue has been investigated in the literature considering whether size and speed of PTs have *increased* in the wake of EMU, thus enhancing the effectiveness of the single monetary policy, and *converged*, thus making more uniform the transmission via the banking sector across countries. Angeloni and Ehrmann (2003) provide evidence that since January 1999 lending and deposit rate PTs became on average higher, though no faster, in the four largest countries (the exception being Germany) and in the euro area as a whole. Doubts on the robustness of their findings are however cast by the conflicting tests on a structural break in coincidence with the introduction of the euro (de Bondt *et al* 2005). In addition, criticism has been levelled at the assumption of January 1999 as a break date. An alternative empirical strategy has been searching for a single unknown break date and estimating PTs in the two periods (Toolsema *et al* 2002, Sander-Kleimeier 2004a, b).

The simple point raised in this paper is that there are however no theoretical nor empirical grounds to assume a single structural break. The historical innovation of the euro is in fact the outcome of a *process*, announced well before its formal implementation and unlikely to follow the same path across countries. If several break-dates were detected, we would be interested in *the* latest one when investigating the effects of EMU on the transmission of monetary impulses to bank rates, namely size and speed of PTs.

We explore the implications of this view focusing on short term business loans - the first link in the transmission mechanism through banks - because their PT turns out to be the largest one among the banking products in the literature that considers up to nine founding EMU countries. We include also a control non-EMU country like the UK, though with reference only to the issue of break detection, owing to the lack of a comparable business lending rate series. The robustness of the findings is checked investigating two themes. First, are the results on dating breaks robust to a refinement approach, originally laid out for the case of multiple unknown breaks with stationary

[*] I acknowledge financial support from MIUR. I thank participants at the XV International Tor Vergata Conference on "Money, Finance and Growth", University of Rome "Tor Vergata", held in December 2006, for useful comments and suggestions on a previous draft.

regressors in Bai (1997), when tentatively extended to the case of regressors integrated of order one, or I(1), as interest rates most often turn out to be? Second, are the long run PT estimates for the last break-free period confirmed when considering the new harmonized national retail interest rates series available since January 2003, after a period long enough for the national banking systems to have adjusted their pricing policies to the single money regime?

This paper makes several contributions to the literature. Considering nine EMU countries and their twelve interest rates, two breaks are detected in six cases, as well as in the UK; a single break is found in other six cases; the starting date of the latest break-free period varies across countries from mid-1995 to early 2001. Comparing the last two break-free periods in cointegrated relations, long-run PTs *decrease* (except for France) well below one (except for the Netherlands); the adjustment to equilibrium is generally *faster*; the monetary transmission across countries has become more uniform, though maintaining a significant heterogeneity. The results on break-date detection survive the first robustness check. Considering the new interest rate series, that start few months before the end of the ones examined in the main exercise, the estimated long run PTs, though in non cointegrated relations, are instead on average close to one in the case of floating rate loans over €l million and about 0.9 for smaller loans; in both cases, the range of estimates across EMU countries is as wide as thirty percentage points.

The paper is organized as follows. Section 2 surveys the background literature. Section 3 describes the main data set and provides an overview of lending spread patterns across countries. Section 4 lays out the empirical strategy to search for multiple unknown break-dates in cointegrated relations, while the empirical results are reported and discussed in Section 5. Section 6 summarizes and concludes.

2. Background literature

Recent literature on short term business lending rate PTs provides a wide range of results as to the date of a *single* structural break, possibly coincident with the start of EMU, as well as to the changes in long run PTs and the adjustment speed to them. Angeloni and Ehrmann (2003) argue that a single bank reserves market and the reduction in money market interest rates volatility, due to the ECB operating procedures, have already produced larger and faster bank rate PTs. First, they identify via rolling-window regressions January 1999 as a break-point. Second, they find that both impact and peak PTs for a set of lending and deposit rates have, on average, sizably increased in the period 1999-2002, compared to 1990-1998, in four of the largest EMU countries, Germany being the exception, and in the euro area as a whole. In particular, impact and peak PTs for short and long term business lending rates computed for the euro area show the largest increases (from 0.35 to

0.53, from 0.81 to 1.11, respectively)[1]. De Bondt (2005), on the contrary, finds that long-run PTs for all euro area bank rates, except the mortgage one, are *lower* in the EMU period - with a Chow test rejecting the null of no break at January 1999 - compared to the extended one (January 1996-June 2001). In particular, the estimated parameter for the short term business lending rate shrinks from 1.53 to 0.88.

Focusing on this bank rate, cross-country and national studies disagree even more, mostly because of the choice of the driving market rate and of how to deal with EMU-related breaks[2].

Hofmann (2003), who *assumes* a unitary long run PT and as a driver the 3-months interbank rate, finds that the break at January 1999 is not statistically significant for Spain and that while the adjustment to equilibrium becomes faster after the introduction of euro, though remaining puzzlingly slow for Germany, impact PTs increase in France and Italy and fall in Germany and Spain (Table 1).

De Bondt *et al* (2005) adopt as a driver a combination, with estimated weights, of the 3-months interbank rate and of the 10-years Government bond yield, under the assumption that the second one provides a signal on the persistence of changes of the policy rate. They also assume January 1999 as a break date and, even if a Chow test *does not* rejects the null for Italy and Portugal, they run estimates for all countries over an extended sample and over the EMU one. Their findings are that in the last period the long term market rate becomes statistically insignificant, long run PTs *decrease* well below one (except for the Netherlands), impact PTs rise in Austria, France, the Netherlands and Portugal and fall in Italy and Spain. The estimates for Germany are always poorly significant.

Sander and Kleimeier (2004a,b) endogenously search for a *single* break in PT equations with alternative driving market rates. They propose in fact a distinction between a “monetary policy approach” (*MPA*), with the overnight rate taken as a proxy for the monetary policy rate, and an industrial organization inspired “cost-of-funds approach” (*CoFA*), with a market rate to better proxy the marginal cost of loaned funds. The findings are rather heterogeneous across countries. Breaks as early as July 1994 and February 1995 under *MPA* and as late as July and October 1999 under *CoFA* are detected for Italy and Portugal[3]; dates differ by one year (August 1997 and 1998), depending on the driving rate, for the Netherlands. Under both approaches, break dates are located much before the introduction of the euro for France (June 1997), Austria (August 1997) and Spain

[1] No break was however detected in the equation for an index of lending rates in an euro area monthly monetary model (Bruggeman-Donnay 2003).
[2] We survey studies with up to 2002 data; earlier cross-country studies are Donnay-Degryse (2001) and Heinemann-Schüler (2003).
[3] Di Lorenzo and Marotta (2006) show that a second break date, much nearer to the start of EMU, can be found in the last period and is very similar under *MPA* and *CoFA,* as it should be expected given the very close correlation among overnight and interbank rates.

(September/November 1996) as well as much later for Germany (July 2000/February 2001). Long run PTs show opposite patterns over time (on average, from 0.91 to 0.72 under *CoFA*, from 0.71 to 0.87 under *MPA*); impact PTs increase if ever slightly.

In two national studies, under the assumption of January 1999 as a break-date, a slight *decrease* in the long run PT (well below a unitary value) but a quicker impact one are found for France (Coffinet 2005), while a reduction in both parameters occurs for Germany, though with a sample extending only to May 2001 (de Bondt 2005). Gambacorta and Iannotti (2005, Table 4) find for Italy a unitary long run PT but a rather low speed of adjustment (0.19), in an Asymmetric Vector Error Correction Model that includes in the long run PT relation a "convergence" dummy variable for the constant term over the period 1995:03-1998:09.

[TABLE 1 APPROXIMATIVELY HERE]

3. Data description

The short term business lending rate, as in the literature surveyed, is the series coded "N4" for each of the nine contributing countries to the unharmonized National Retail Interest Rates (NRIR) database at the European Central Bank (ECB)[4]. The sample starts, at the earliest, at January 1993[5] and ends, at most, at September 2003. The rate is computed as an average for new businesses, except for Italy (outstanding stocks with a maturity up to 18 months)[6]. For comparison with a non-EMU, but a member of the European Union, country we consider also the unsecured personal loans rate for the UK, on the grounds that it is the closest substitute to the short term business lending rate, missing in the NRIR base. The chosen driving market rate, that should match the (short) maturity of the underlying credit aggregates for an appropriate pricing[7], is the national interbank

[4] http://www.ecb.int/stats/money/interest/html/retail.en.html. The rates are two, coded as N4.1 and N4.2 (in this paper r_1 and r_2), for Belgium, Italy and Portugal. Though the most representative rates, being self-selected by each contributing country, the series show various data anomalies (Figure 1). In the case of Germany, the series fluctuates very little, possibly because, as explained in the Bundesbank web site, average rates are computed as unweighted arithmetic means from interest rates reported by banks, after eliminating those in the top 5% and the bottom 5% of the interest rate range. The monthly series for France looks almost a quarterly one. We prefer, given the focus on the break dates search, to stick to the original series, as also Coffinet (2005) does, instead of interpolating, as in de Bondt *et al.* (2005). Similar issues surface also in other countries (Belgium, Ireland).

[5] The choice of the starting year, 1993 in Sander-Kleimeier (2004a, b) or 1994 in de Bondt *et al* (2005), is meant to avoid the turbulence derived from the September 1992 crisis of the European Monetary System (EMS).

[6] This feature should not represent much of an inconsistency, because the correlation, both in levels and in first differences, with the average rate on overdrafts - not included in the NRIR database - is almost one (Di Lorenzo-Marotta 2006).

[7] If credit aggregates with longer maturity were considered, the (average) market interest rate relevant for their pricing would depend on the mix of fixed and floating rate instruments included, which could vary widely through time and across countries. As a consequence, the analysis could spot a change in the PT through time and/or across countries, when in fact there is nothing but a different mix of instruments with different interest rate fixation characteristics.

rate most correlated (in first differences) with the retail rate, among the maturities of 1, 3, 6 or 12 months, following de Bondt (2002)[8].

A visual inspection of the data is useful to set the stage for the empirical investigation. The lending spread (short term business rate net of the interbank rate) for the nine EMU countries and the UK yields several interesting features, against the backdrop of a dramatic fall of market rates since early 1995, in particular for Italy, Portugal and Spain, with an inversion in the first two years after the introduction of the euro and a subsequent - mid 2001 - further decline to low historical levels (Figures 1 and 2).

Lending spreads - approximately stationary in the benchmark case of a complete long run PT - and interbank rate changes should be uncorrelated if the adjustment to equilibrium is fast. The effective patterns for the two series are however quite varied through time and across countries. Only the spreads for France, the Netherlands, Portugal and Spain come close, in recent years, to the benchmark case, as it happens for the US by mid-1990s (Sellon 2002) and to some extent of the UK. The other EMU countries show instead upwards trending spreads, with end-sample levels sometimes higher than at the beginning (e.g. Belgium, Germany, Ireland).

A test of the null of stationarity for the lending spreads, using the Kwiatkowski-Phillips-Schmidt-Shin (KPSS; 1992) (level) statistic, adjusted for sample size (Sephton 1995), rejects always the null of stationarity of lending spreads at least at the 5% significance level for the common period starting April 1995, except for one of the two rates of Belgium and Italy and for Spain; the rejection rate is only slightly lower after January 1999 (Table 2).

The visual inspection of the data, corroborated by a formal test on stationarity, would then suggest for the euro area an a priori case against a complete long run PT during the entire sample and, perhaps more unexpectedly, even *against* a definite tendency towards it in the EMU period as well. This would be a rather puzzling result, if confirmed by the econometric investigation, because monetary policy has become more predictable and, as a consequence, the competition in banking markets has supposedly increased.

[FIGURES 1 AND 2 APPROXIMATIVELY HERE]
[TABLE 2 APPROXIMATIVELY HERE]

4. Econometrics

The assumption of a *single known* structural break in the interest rate long run PT in coincidence with the introduction of the euro is hardly motivated on economic grounds; a *single*

[8] Results available upon request. See for the chosen interbank rates Figure 1.

unknown break, though a better starting point, is still an unduly restrictive assumption, because forward looking behaviour on the one hand and protracted adjustments on the other hand in national banking systems cannot be ruled out. The maintained hypothesis in this paper is therefore of *multiple unknown* breaks. The econometric literature does not provide however as yet a suitable search procedure in the case of I(1) regressors, as interest rates almost invariably turn out to be (Perron 2006, 287).

To circumvent this obstacle and to provide answers to the key questions - do long run PTs and the speed of adjustment towards them have changed, and how much - we follow and extend Di Lorenzo and Marotta (2006), that generalize the approach of Toolsema *et al* (2002) and Sander-Kleimeier (2004b), and apply it to the longest available sample after the introduction of the euro for the short term business rates self-selected as the most representative by each EMU country.

The reference setting, as in the literature surveyed, is a standard Klein-Monti model of a monopolistic bank, with risk neutrality, perfect information, no switching or adjustment costs, no joint production of loans and deposits (Klein 1971, Monti 1972). The lending rate is determined as a mark-up over the marginal (opportunity) cost, proxyied by a market rate, matching the maturity of loans. Assuming a linear approximation, in a competitive market the marginal cost coefficient can be interpreted as the long run PT, with a complete transfer of changes of the driving market rate to the retail one (Lago-Gonzalez and Salas-Fumás 2005). For estimation purposes, whenever the null of cointegration is not rejected, the Autoregressive Distributed Lags (ARDL) specification in Cottarelli-Kourelis (1994) is reparametrized as an Error Correction Mechanism (ECM), following the Granger representation theorem for cointegrated variables[9].

Let an equilibrium, or cointegrated, relation between I(1) interest rates:

$$r_t = \alpha + \beta\, mr_t + \varepsilon_t \qquad \varepsilon_t \sim NID(0,\sigma_\varepsilon^2) \qquad (1)$$

with I(0) OLS residuals, *ecm*, at the first stage of the Engle-Granger (1987) two-step estimation procedure (EG)[10], where:

- *r* = lending rate;
- *mr* = driving market interest rate;
- *ecm* = stationary residual or deviation ("error" in the ECM acronym) of the lending rate from its long run equilibrium value.

Eq. (1) includes only a constant, that incorporates the lending risk premium; the presence of a linear trend would be theoretically inconsistent (Hamilton 1994, 501). Short term dynamics

[9] The weak exogeneity of market rates to the lending rate is explicitly or implicitly assumed in the literature, since bank rates are not expected to affect market rate developments.
[10] In a bivariate relation, with at most one cointegration relation, the EG procedure is preferable to the Johansen one, being more robust to misspecification and to reduced sample size (Maddala-Kim 1998).

parameters are obtained in the EG second step dropping sequentially insignificant regressors according to the general-to-specific approach (Hendry 1995):

$$\Delta r_t = \theta ecm_{t-1} + \sum_{i=0}^{k} \gamma_i \Delta mr_{t-i} + \sum_{j=1}^{k} \lambda_j \Delta r_{t-j} + u_t \qquad u_t \sim NID(0, \sigma_u^2) \tag{2}$$

where Δ is the first difference operator.

The key parameters are β (i.e. long run PT) and θ (i.e. the adjustment speed to β). The second parameter, also known as loading factor, should result statistically significant if cointegration holds. Within this framework the empirical investigation in this paper proceeds as follows.

First, having checked that both rates are I(1) over the full sample, we search for a single unknown break-date in the long run model (Eq. 1), adopting the supremum F (supF) testing procedure: the date is associated with the largest (and statistically significant) rolling Chow F-statistics computed under the null of a break occurring in each subsequent period through the mid-70% sample period (Andrews 1993)[11]. When the algorithm yields several local maxima, it is rerun, starting from the earliest break-point, to detect the successive one, and so on. We consider only an interbank driving rate, because of the Di Lorenzo-Marotta (2006) findings on the similar dating of breaks with an overnight rate as an alternative driver.

Second, we check that in the last two break-free periods the *ecm* term is I(0), thus rejecting the null of no cointegration. This should help mitigate the well known problems of low power of tests for cointegration in the presence of breaks (Maddala-Kim 1998). If cointegration holds, we proceed with the EG second step for (Eq. 2). A well known feature of the EG procedure is that, owing to the super-consistency of estimates for the cointegrated relation, the OLS *t*- and *F*-statistics cannot be interpreted in the standard way. To make asymptotic inference about the first-step estimates when estimating the *ecm* term we therefore adopt the dynamic OLS procedure proposed by Stock and Watson (1993), allowing for up to 3 leads and lags in first differenced regressors; the procedure is known also to have smaller biases in small samples. In order to enhance comparison across countries, and owing to sample size constraints, the same short-run dynamics is imposed, allowing for up to k=3[12]. When the null of no cointegration is rejected, we adopt a standard ARDL(3,3) and compute accordingly α and β.

[11] The asymptotic distribution is non-standard because, when the break-date is unknown, it is a nuisance parameter that appears only under the alternative hypothesis of structural break. For critical values see Table 3.

[12] k=1 when the estimation sample is quite short (two years).

5 Results

5.1 Break dates

To implement the proposed approach we have to choose first the driving market rate and test the order of integration of the regressors. The one month interbank rate turns out to be the most correlated (in first differences) with the bank rate; only for Belgium the chosen interbank rates are the 12- and 3-months for the retail rates r_1 and r_2, respectively[13]. Augmented Dickey-Fuller (ADF) tests show that most interest rates are I(1) over the full available samples (Table A1, in the Appendix).

A single break-date is detected for Belgium (r_2), France, Ireland, Italy (r_2), Netherlands, Spain; two are found for Austria, Belgium (r_1), Germany, Italy (r_1) and Portugal[14]; Table 3 and Figure A1 in the Appendix. These findings suggest first that, in contrast with the gist of Sander-Kleimeier (2004a), an expectational rationale for structural breaks in long run PTs before the start of EMU, once the process had become irreversible - say late 1996/first half 1997 - , could fit only the French experience. No such effects can be inferred for Portugal, being the breaks in late 1994-early 1995 likely caused by the international financial turbulence at that time[15]. Second, breaks detected some months after the launch of the euro for Austria, Italy and, even more, for Germany (with the latest break in March 2001), hint at protracted adjustments of these national banking industries. Third, a note of caution in associating PT structural changes to EMU is suggested by the break dates - June 1997 and November 2001 - detected in the UK: both of them could be motivated, as for an euro country, by a process of slow adjustment to a new monetary environment (e.g. Bank of England independence, Basel 2)

A case deserves a closer scrutiny. Spain is the only country where a single break date is detected considerably later with respect to Sander-Kleimeier (2004a) under *CoFA* (June 1998 instead of November 1996). This result, that casts doubts on the claim that the country would have experienced early the impact of the run-up to the EMU, can be explained by the choice of the three months interbank rate in that study, in contrast with the advocated criterion of the highest correlation with the retail rate[16].

[TABLE 3 APPROXIMATELY HERE]

[13] Results available upon request.

[14] We checked that the dates are indeed the same or differ at most up to four months, irrespective of the driving market rate, interbank or overnight. An exception is Spain, where the break date according to *MPA* - March 1997 - is 15 months earlier than under *CoFA* (results available upon request).

[15] The US$ depreciated by about 10% in the first quarter of 1995, causing tensions in the exchange rates within the EMS, with an official depreciation for the Portuguese and the Spanish currencies in early March; in addition, financial markets were hit by the Mexican debt crisis.

[16] The correlation coefficient for variables in levels is 0.99 for 1 month and 3 months interbank rates, but are 0.84 and 0.79, respectively, for the first-differences (Sander-Kleimeier 2004b, Table B1).

5.2 Pass-through

Owing to the focus on structural changes, possibly linked to the introduction of the euro, we report the results of the econometric exercise only for the last two break-free periods (Table 4). Overall, most estimates are highly statistically significant and pass at least one of the cointegration tests[17] for an ADF statistic under the null of I(1) *ecm*: the first is the one proposed by Phillips-Ouliaris (1990), the second is the τ_c statistic proposed by McKinnon(1996). Only for Germany, presumably owing to data problems (see fn. 4), cointegration is always rejected and consequently we estimate an ARDL(3,3) specification.

The main results on the key parameter are as follows.

β shrinks everywhere in the last period, even taking into account of confidence intervals, falling on average from 0.9 to 0.7, except for France; correspondingly, the constant term signals an increase of the risk premium across periods (Table 5). The unitary value in the last period is outside the upper end of the 5% confidence interval everywhere, except for the Netherlands. The cross-country range of values for β remains wide, going from 0.59-1.25 to 0.6-1.1, though with a cluster around 0.7 for most countries, with an outlier of 0.20 for Germany.

θ increases in most countries, except for Portugal (r_2) (on average, excluding Germany, from 0.34 to 0.57). It could be argued that, from a policy point of view, a reduced long run PT could be acceptable if the adjustment to it were faster. The averaged indicator $\beta\theta$ indeed increases (from 0.33 to 0.45). More precisely, taking into account also the short dynamics estimates for Eq. 2 (available on request), a one percentage point change in the driving market rate translates on average approximatively into the same proportion across periods within 1 and 3 months (49 and 75 basis points in the last but one period, 52 and 75 in the last one, respectively; Table 5); the adjustment to β is on average complete within a quarter in the last break-free period, whilst reaching about 4/5 in the previous one.

[TABLES 4 AND 5 APPROXIMATIVELY HERE]

5.3. Robustness

5.3.1 Refinement in the search for multiple breaks.

An efficient procedure to detect *multiple unknown* break dates in a linear model with stationary regressors proposed by Bai (1997) relies basically on the supF approach. In the first stage, as in this paper, when the algorithm yields several statistically significant local maxima, it is

[17] The exceptions are France and Portugal (r_2) in one period, but the loading factor θ is statistically significant at least at the 10% level.

rerun, starting from the earliest break-point, to detect the successive one, and so on. Let t_1, t_2 and t_3 be the break-dates found accordingly in the full sample $t_0 - T$. In order to get efficiency, the *refinement* implies further searching a break-date in the samples $t_0 - t_2$, $t_1 - t_3$ and $t_2 - T$. In this second stage the intermediate t_i could change and the search stops when the dates become stable[18]. The procedure assumes a maximum number of unknown breaks over the entire sample; the intervals between dates must also be sufficiently large in order to apply asymptotic theory (Bai-Perron 1998).

We surmise that break dates are at most three in a sample starting at January 1993. The first one could be motivated by the financial turbulence in the exchange rate markets in early 1995; the second one could be justified because of the expectations set into motion by the announced adoption of a single currency area, once the number of the founding countries was agreed (approximately late 1996 - first half of 1997); the third one could be located after the inception of EMU, as national banking systems adjusted to it. Replicating the refinement procedure yields differences with respect to previous findings only for Italy (r_1), where a third break date – February 1997 – is detected, and Germany, where the last break is anticipated to July 2000 (results available on request). In the first case, the estimate of the long run PT for the last period but one remains pretty the same ($\beta = 1$); in the second case, the poor quality of the data hinders an informed assessment. Our final evaluation is therefore that the main exercise findings on break detection are robust to a refinement-like procedure.

5.3.2 Long run pass-through with harmonized interest rates

As of January 2003 the ECB collects a new set of harmonized bank rates statistics (denoted with the MIR acronym), that relate to aggregates with common features across the EMU countries such as, for instance, the initial horizon of rate determination, an aspect that provides a synthetic representation of the contract maturity and of the rate fixation. Though bound to be the ideal data base for empirical analysis on PTs across countries, the as yet short sample hinders econometric exercises focused on long run parameters (see also Baele *et al*. 2004, Sørensen-Werner 2006, ECB 2006).

These warnings notwithstanding, we performed an econometric investigation with the longest available sample (2003:01-2007:03) for the two rates most closely related to the short business lending rate examined so far. The motivation is twofold. First, four years after the launch of the single currency national banking systems could have had enough time to adapt their pricing

[18] Implementing the procedure is a bit messy, because it is not obvious the sequence to refine further when an intermediate t_i changes. Suppose, refining over the interval $t_1 - t_3$, that an intermediate break point is found, different from t_2, implying a modification of the original $t_0 - t_2$ and $t_2 - T$ periods. It is up to the researcher to choose over which of the two sample refine first.

policy to the new monetary regime. Second, the availability of more refined interest rate series, in particular for lending to business with a well defined maturity (floating rate and initial fixation up to one year) and split for size (up to and over €1 million), should help better estimate the cross-country response to the same monetary impulse, proxied by a single interbank rate (Euribor).

Harmonized and unharmonized series in the few overlapping months are sizably different not only in levels but also in dynamics (for a selected group of countries see Figure A2 in the Appendix). Overall, the correlation of the unharmonized series is higher with the harmonized series for smaller loans.

Following the same procedure as before we run ADF tests for the order of integration (Table A2 in the Appendix): the 3-months Euribor rate was chosen as the driving market rate because, besides being I(1), it is almost always the mostly correlated (in first differences) with retail rates. A visual inspection of the lending spreads suggests that almost everywhere they are trending downwards over the period; a formal test confirms that the null of stationarity is rejected always, at least at the 5% confidence level, except for France and the Netherlands (larger loans); Figure 3 and Table 6).

Unsurprisingly, the null of cointegration is usually rejected; the exceptions are Ireland, Netherlands and Portugal, only for loans over €1 million (Table 7). In all other cases we estimate ARDL(3,3) specifications and compute accordingly long run parameters. The exercise suggests that β is on average 0.90 for smaller loans and 0.97 for larger ones; the range of values, 0.77-1.02 and 0.82-1.14, respectively, signals a sizable heterogeneity across the 9 EMU countries.

These results, hopefully because of better data, suggest that the expected effects of less incomplete PTs because of a more predictable monetary policy are eventually materializing, though national banking systems are still adjusting, as suggested by the prevalent no cointegration outcome.

[FIGURE 3 APPROXIMATIVELY HERE]

[TABLES 6 AND 7 APPROXIMATIVELY HERE]

5.4 Discussion

The bottom line of the empirical investigation is that all nine EMU countries underwent one or two structural changes in banks' pricing policies, at different dates, in the period, up to 2003, the process of preparation and implementation of EMU took place. These changes, though resulting in a faster adjustment to equilibrium, did not produce the expected, owing to a single monetary policy, larger long run PTs. Some candidate offsetting factors were, against the backdrop of a sluggish growth after the peak at mid-2000 in the EMU area and in some large countries in particular, the consolidation of the banking industry, mostly within national borders, and the Basel 2 process towards the revision of capital requirements[19].

The sluggish growth led to slower lending to the corporate sector. The negative effects on the financial position of firms produced a deterioration of the asset quality of banks, as witnessed by the increase in loan-loss provisions and the adoption of stricter lending criteria (ECB 2004). In the run up towards Basel 2 these developments are likely to have led to higher risk premia embedded in the lending rates, as suggested by the generalized increase in αs (Table 4)[20].

Domestic consolidation of the banking industry is likely to have increased lenders' market power relative to SMEs. A piece of evidence is suggested in the Italian case by the divergent pattern of βs for r_2 - the minimum rate for the 10 percent top-rated borrowers - in comparison with r_1 - the lending rate to non-primary borrowers (Table 4; Figures 1 and 2). This fact fits the working of a dual credit market. The best borrowers exploited their bargaining power, paying interest rates, close to money market ones; enhanced relationship lending with the bulk of customers[21] could have instead produced the expected intertemporal smoothing for the broad-based lending rate, r_1 (Berlin-Mester 1998).

The difficulties in disentangling the different factors on aggregate time series, as well as the detection of break-dates in the UK case, suggest caution in linking the structural changes in interest rate PTs to the inception, expected and effective, of EMU. Panel studies exploiting the richness of microdata could help, along the lines of Gambacorta (2004), de Graeve *et al* (2004), Lago-Gonzalez and Salas-Fumás (2005), provided they were integrated with a proper treatment of the multiple unknown structural breaks.

The results this paper offers on βs - a generalized significant reduction (except for France), well below one (except for the Netherlands) - that derive from endogenously dating breaks support the view of a dampening of the impulses of a single monetary policy in the long run via the short term business lending rate. These results run against the claims of Angeloni-Ehrmann (1993) and, under *MPA* though not under *CoFA*, of Sander-Klemeier (2004a, 474), while strengthening the scepticism of de Bondt *et al* (2005, 15), that long run PTs have come closer to being complete in the period overlapping (at least partially) with the introduction of the euro.

[19] Domestic market structure features can have further interacted. For instance, in 2002 the EU Commission convicted seven large Austrian banks for having arranged an interest rate cartel (Burgstaller 2003).
[20] The average lending margin for short and long term corporate lending increased, between May 98-May 99 and May 01-May 02, in four countries. Germany, in particular, had an increase of 36 basis points, and became the second most expensive lender after Ireland (Cabral *et al* 2002, Table 17).
[21] The developments for two indicators between June 1999 and September 2003, such as the number of multiple lending relationships, decreased by one sixth, and the share of the main bank's loans, increased by about seven percentage points, lend some support to this view (Di Lorenzo-Marotta 2006).

An incomplete PT is also in agreement with a panel study in a cointegrated framework, where the new harmonized bank rate series, from January 2003 to June 2004, are reconstructed backwards to January 1999, using the NRIR data set. The findings on short term business lending rate βs are very similar to those for the last break-free period (average of 0.82 vs 0.75 in this paper, leaving aside Germany), except for Portugal, that has a complete PT like the Netherlands; Sørensen-Werner (2006, Tables A4, A10)[22].

The main contributions of this paper to the literature on euro-related structural breaks are conditional on the NRIR data base available so far for the national aggregated retail interest rates and used in related studies. The explorative analysis with the harmonized interest rates MIR database helps putting in perspective this literature, as well as warning against drawing strong policy implications owing to the fragility of the statistical information. The results, over the period 2003-early 2007, hint that the puzzling result of a *reduced* long run PT, despite a more predictable monetary policy, could be to some extent heavily influenced by a quite different type of data. Even with the new database, lower βs for smaller loans compared to larger ones in most countries and higher risk premia embedded in the constant fit the intertemporal smoothing feature stressed in the literature on relationship banking with SMEs. The heterogeneity in PTs even in business lending across national banking systems, still adjusting their pricing policies to the single monetary regime, does underline the difficulties of running monetary policy in the euro area, also because of the lack of reliable homogeneous statistical base over a long enough time interval.

6. Conclusion

This paper makes several contributions to the empirical literature investigating structural break(s), possibly associated to the introduction of the euro, in the pass-though of monetary policy impulses, via changes in market rates, to bank interest-rates. The short term business lending rate is the natural choice to assess whether the monetary transmission has become more effective and uniform across countries, because in previous studies its pass-through is the largest and fastest among bank rates.

Instead of assuming a *single* break - either dated January 1999 or endogenously detected - we search for *multiple unknown* breaks, allowing for expectational effects or adjustments after the implementation of the new monetary regime. The data set includes the longest available national interest rate series after the introduction of the single currency - up to September 2003 - for nine

[22] The estimates for θ look however hardly plausible for Germany (-0.05), Austria (-0.03) and Belgium (-0.17). In addition, for the last two countries they are not statistically different from zero even at the 10% significance level, casting doubts on cointegration.

euro countries and for the UK, a non-euro member of the European Union, taken as a control country.

The empirical investigation detects among the EMU countries two structural breaks in half of the cases - Austria, Belgium (r_1), Germany, Italy (r_1), Portugal (r_1 and r_2) - and a single one in the other half - Belgium (r_2), France, Ireland, Italy (r_2), Netherlands, Spain. An argument for a break much before the inception of EMU, based on an expectational rationale once the process was perceived irreversible, can be made only for France; further breaks are instead detected several quarters after January 1999 for Austria, Germany, Italy and Portugal. The findings of two break dates also in the UK cast doubts on linking structural changes in banks' pricing policies to the introduction of the euro.

A comparison of the estimates for the last two break-free periods points to a dampening of the impulses of a single monetary policy via the short term business lending rate in the euro area. The long run interest rate pass-through shrinks, with the exception of France, well below the unitary value found for the Netherlands; the adjustment to equilibrium is instead generally faster, rising from 80% of the process to 100% within a quarter. An area-wide incomplete pass-through even for the least sticky bank rate and the persistence of a sizable cross-country heterogeneity make it tougher the job for the ECB.

This picture contrasts with the economic intuition that a reduced volatility in money market rates, owing to a single monetary policy, is bound to mitigate uncertainty and therefore to ease the transfer of monetary impulses to retail rates. These expected effects could have been offset by other contemporaneously developing processes in the period up to 2003, such as the consolidation and concentration of the banking industry, mostly within national borders, and the revision of Basel capital requirements, during a prolonged period of low output growth and of lenders' deteriorating creditworthiness in the euro area.

These contributions to the empirical literature on euro-related structural breaks could be partially modified by more recent, and qualitatively different, data. The expected effects of a more predictable monetary seem in fact eventually materializing to some extent with the new harmonized interest rate series in the period 2003-early 2007. Estimated long run pass-throughs are closer on average to one, at least for floating rate business loans over €1 million; cross-country heterogeneity remains however quite large. These results have to be however considered with caution, because of the discontinuity in interest rate series and of the evidence of national banking systems still adjusting their pricing policies to the single currency regime, as suggested by the downward trending lending spreads.

We see from here three promising research approaches. First, panel studies with microdata could help disentangling the effects of the different factors on lending rate pass-throughs - euro, banking consolidation, Basel 2 - , provided they include a proper treatment of multiple unknown structural breaks. Second, long interest series, appropriately linking NRIR and MIR databases, could help better detecting structural breaks and estimating pass-throughs. Another interesting issue for future research is to investigate the implications of an incomplete bank interest rate pass-through in the euro area on the use of standard Taylor rules in assessing the monetary policy of the ECB in comparison with the central banks of countries, like the US, where the transfer of policy rate changes to bank rates is complete, at least in the case of business lending.

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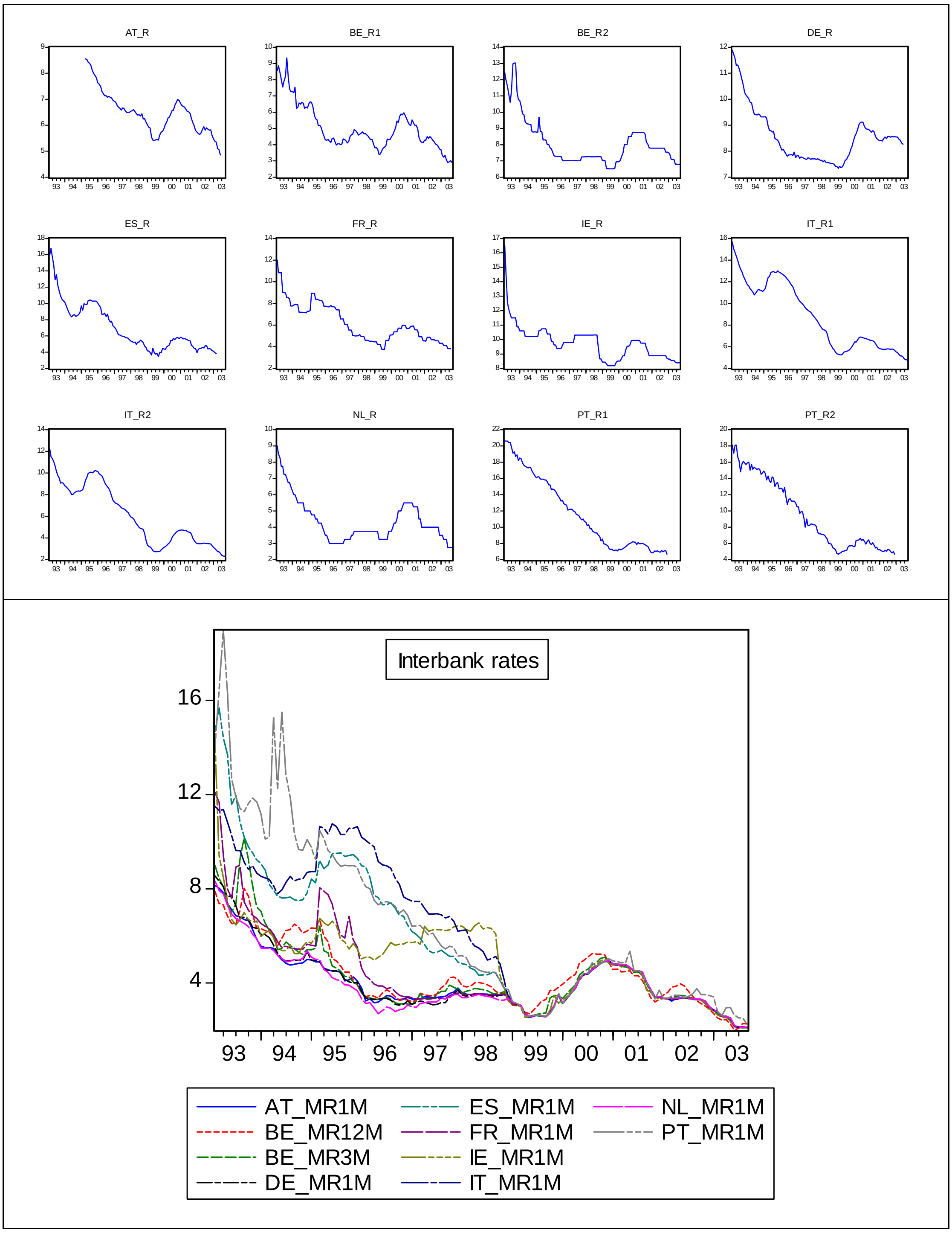
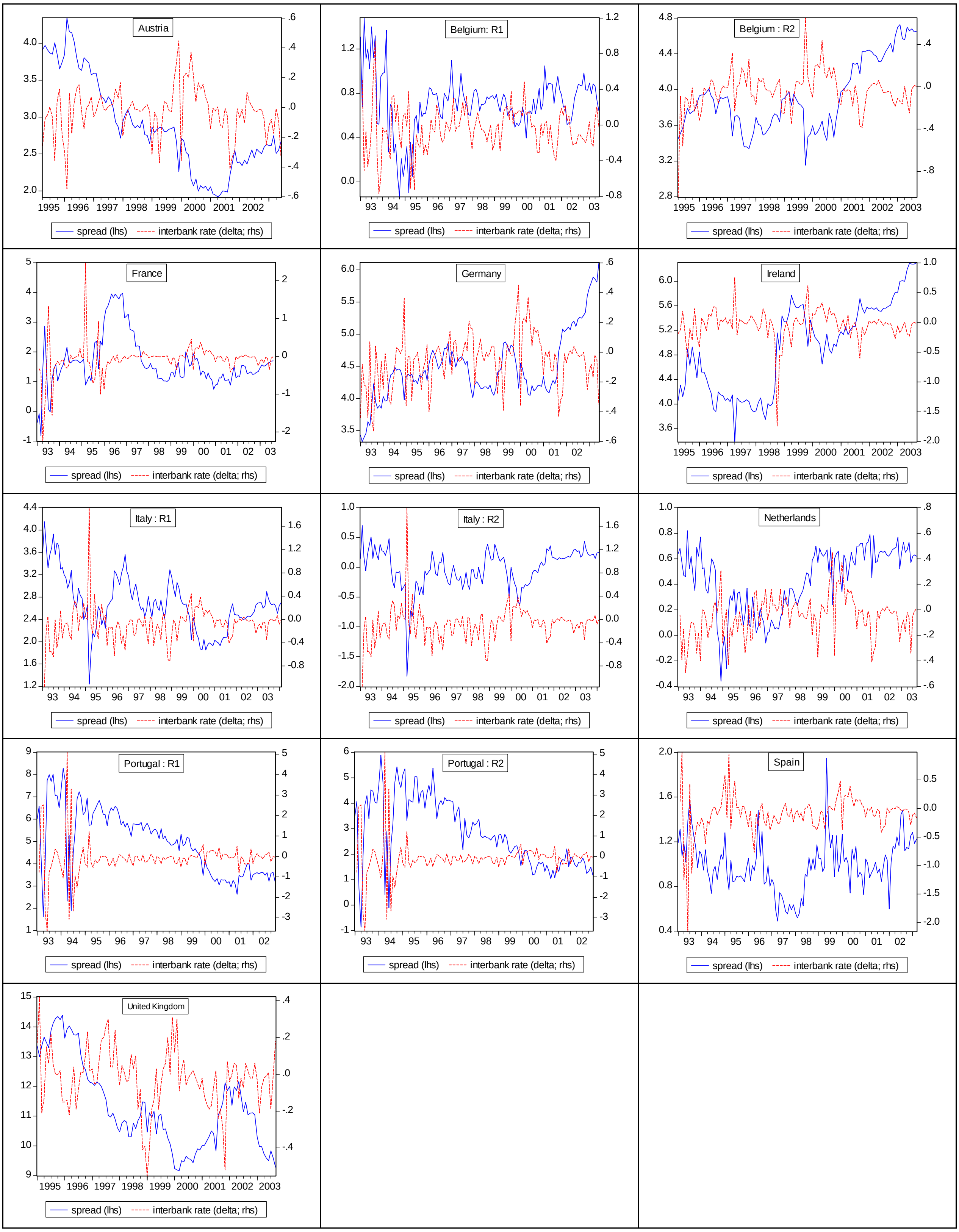
Figures and Tables

Figure 1 Short term business lending and interbank rates in EMU countries



Source: ECB's NRIR database and National Central Banks' websites. 1-month interbank rates, except for Belgium (12- and 3-months interbank rate for r_1 and r_2, respectively).

Figure 2 **Short term business lending spread and interbank rate changes**

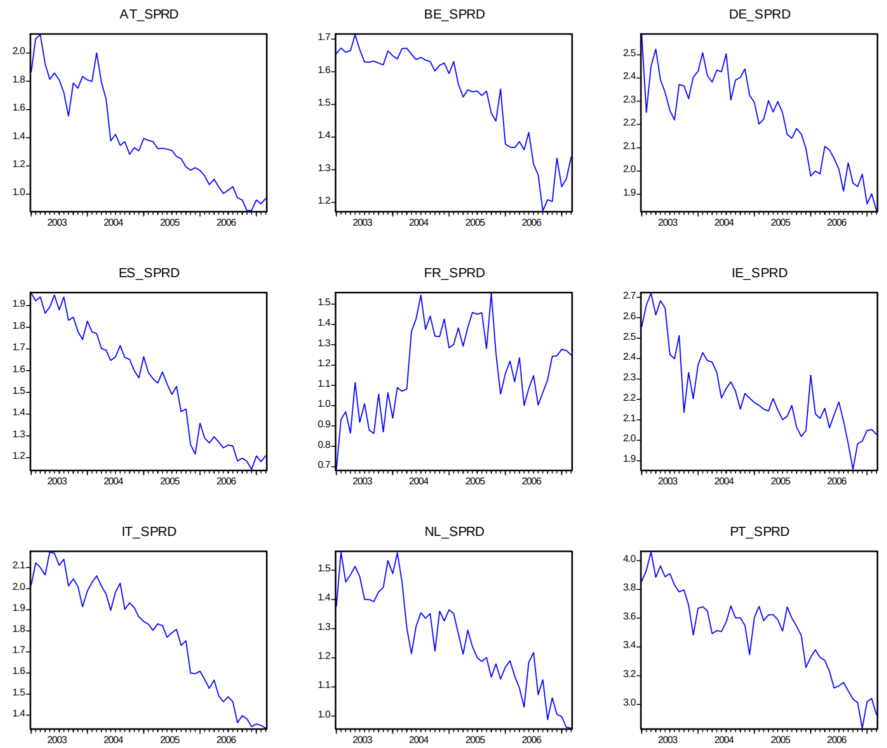


Source: see Figure 1. Unsecured personal loans rate for the UK

Figure 3 **Short term business lending spread**

MIR database; 2003:01-2007:03

Floating rate loans up to €1 million



Floating rate loans over €1 million

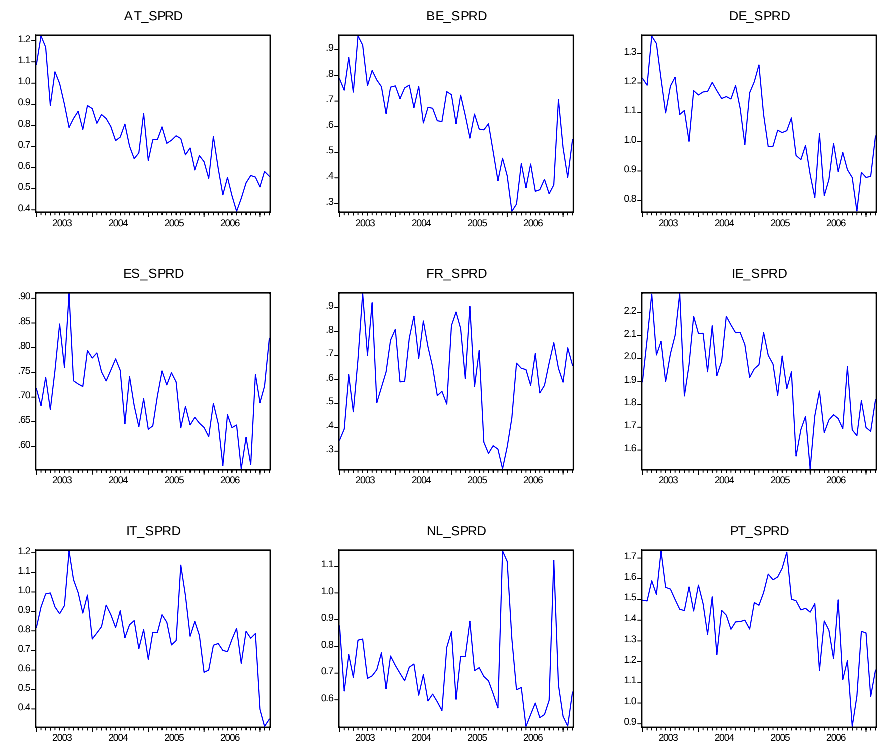


Table 1 Review of the literature on the pass-through to short term business lending rates

Study	Market rate	Break date	Sample	Short run pass-through (γ_0)	Long run pass-through (β)	Adjustment speed (θ)
Austria						
SK (2004b) EG procedure or, absent cointegration, ARDL estimation	Overnight	August 1997	95:04-97:08	0.03	1.02	
			97:09-02:10	0.24	0.52	
	Government 10 years bond		95:04-97:08	0.05	1.19	
			97:09-02:10	0.26	0.56	
de Bondt *et al*. (2005) one-step ECM estimation	3 months interbank / Government 10 years bond	January 1999, *a priori*	94:04-02:12	0.24***/-0.02	0.38***/0.65***	-0.12***
			99:01-02:12	0.38***/-0.01	0.62***	-0.37***
Belgium : r_1						
SK (2004b)	Overnight	April 1995	93:01-95:04	0.41	0.43	
			95:05-02:10	-0.01	0.80	
	6 months interbank	March 1995	93:01-95:03	0.20	0.44	
			95:04-02:10	0.39	0.84	
de Bondt *et al*. (2005)	3 months interbank / Government 10 years bond	January 1999, *a priori*	94:04-02:12	0.75***/0.31***	0.59***/0.21*	-0.23
		(Chow test *p*-value = 0.10)	99:01-02:12	0.96***/0.38***	0.81***/0.28**	-0.52**
Belgium : r_2						
SK (2004b)	Overnight	January 1994	93:01-95:04	n.a.	n.a.	
			95:05-02:10	0.27	0.84	
	3 months interbank	December 1993	93:01-93:12	n.a.	n.a.	
			94:01-02:10	0.29	0.85	
France						
Hofmann (2003); one step ECM estimation	3 months interbank	January 1999, *a priori*	95:01-02:11	-0.11	1 *a priori*	-0.11***
			99:01-02:11	0.62***		-0.42***
SK (2004b)	Overnight	June 1997	93:01-97:06	0.06	0.56	
			97:07-02:10	0.21	0.72	
	6 months interbank		93:01-97:06	0.27	0.54	
			97:07-02:10	0.32	0.77	
de Bondt *et al*. (2005)	3 months interbank / Government 10 years bond	January 1999, *a priori*	94:04-02:12	0.35 / -0.09	0.86 / 0.37*	-0.30***
			99:01-02:12	0.90 / -0.36	0.78***	-0.77
Coffinet (2005) one step ECM estimation	3 months interbank	January 1999, *a priori*	86:01-98:12	0.08	0.79***	-0.17
			99:01-03:09	0.48***	0.77***	-0.13
Germany						
Hofmann (2003)	3 months interbank	January 1999, *a priori*	95:01-02:11	0.28***	1 *a priori*	-0.06***
			99:01-02:11	0.23***		-0.08***

ctd.

Study	Market rate	Break date[a]	Sample	Short run pass-through (γ_0)	Long run pass-through (β)	Adjustment speed (θ)
SK (2004b)	Overnight	July 2000	93:01-00:07	0.16	081	
			00:08-02:10	0.30	0.44	
	1 month interbank	February 2001	93:01-01-02	0.23	0.78	
			01:03-02:10	0.26	0.25	
de Bondt *et al.* (2005)	3 months interbank / Government 10 years bond	January 1999, *a priori*	94:04-02:12	0.18***/ -0.02	0.36	-0.02
			99:01-02:12	0.08/0.01	- / 0.73	-0.02
de Bondt (2005)	1 month interbank	January 1999, *a priori*	96:01-01:05	0.12	1.05	-.13**
			99:01-01:05	0.02	0.89	-.23**
			Ireland			
SK (2004b)	Overnight	November 1995	93:01-95:11	0.40	0.65	
			95:12-02:10	0.26	0.53	
	3 months interbank	December 1993	93:01-93:12	n.a.	n.a.	
			94:01-02:10	0.43	0.57	
de Bondt *et al.* (2005)	3 months interbank / Government 10 years bond	January 1999, *a priori*	94:04-02:12	0.43***/-0.14**	0.55***	-0.09
			99:01-02:12	0.21**	0.87***	-0.19***
			Italy: r_1			
Hofmann (2003)	3 months interbank	January 1999, *a priori*	95:01-02:11	0.17***	1 *a priori*	-0.18***
			99:01-02:11	0.25***		-0.23***
SK (2004b)	Overnight	February 1995	93:01-95:02	0.31	1.09	
			97:03-02:10	0.16	0.96	
	1 month interbank	July 1999	93:01-99:07	0.27	1.02	
			99:08-02:10	0.31	0.68	
de Bondt *et al.* (2005)	3 months interbank / Government 10 years bond	NO (Chow test *p*-value = 0.20)	94:04-02:12	0.19***/-0.01	0.93*** / 0.12*	-0.15***
			99:01-02:12	0.16***/ -0.07	0.76*** / - 0.15***	-0.60***
Di Lorenzo-Marotta (2006) one step ECM estimation	Overnight	June 1999 (last break)	95:04-99:06	0.25***	1.03***	-0.11**
			99:07-04:02	0.30***	0.73***	-0.22***
	1 month interbank	May 1999 (last break)	95:04-99:05	0.21***	1.07***	-0.22***
			99:06-04:02	0.27***	0.75***	-0.46***
			Italy: r_2			
SK (2004b)	Overnight	February 1995	93:01-95:02	0.43	0.94	
			95:03-02:10	0.21	0.92	
	1 month interbank	June 1994	94:07-02:10	0.31	0.95	
Di Lorenzo-Marotta (2006)	Overnight	September 1997	95:04-97:09	0.31***	1.00***	-0.34***
			97:10-04:02	0.26***	0.81***	-0.24**
	1 month interbank	NO	95:04-04:02	0.29***	0.93***	-0.15***
			Netherlands			
SK (2004b)	Overnight	August 1997	93:01-97:08	0.44	1.08	
			97:09-02:10	0.40	0.99	
	1 month interbank	August 1998	93:01-98:08	0.19	1.06	
			98:09-02:10	1.01	1.00	
de Bondt *et al.* (2005)	3 months interbank / Government 10 years bond	January 1999, *a priori*	94:04-02:12	0.57***/-0.02	1.15***/-0.31***	-0.31***
			99:01-02:12	0.44***/-0.01	1.05***	-0.77***

ctd.

Study	Market rate	Break date	Sample	Short run pass-through (γ_0)	Long run pass-through (β)	Adjustment speed (θ)
			Portugal:r_1			
SK (2004b)	Overnight	July 1994	93:01-94:07	-	0.26	
			94:08-02:10	0.22	1.52[b]	
	1 month interbank	October 1999	94:10-99:10	0.25	1.24	
			99:11-02:10	0.23	0.65	
de Bondt *et al.* (2005)	3 months interbank / Government 10 years bond	NO (Chow test *p*-value = 0.57 at January 1999)	94:04-02:12	0.36***/-0.37***	1.24***	-0.25***
			99:01-02:12	0.64***/-0.28	0.93***	-0.27**
Di Lorenzo-Marotta (2006)	Overnight	November 1999	95:04-99:11		1.30	
			99:12-02:10		0.64	
	1 month interbank	October 1999	95:04-99:10		1.24	
			99:11-02:10		0.66	
			Portugal:r_2			
SK (2004b)	Overnight	February 1995	93:01-95:02	0.15	0.33	
			95:03-02:10	0.50	1.51	
	1 month interbank	November 1999	94:10-99:11	0.61	1.33	
			99:12-02:10	0.78	0.77	
Di Lorenzo-Marotta (2006)	Overnight	November 1999	95:04-99:11		1.39	
			99:12-02:10		0.72	
	1 month interbank	November 1999	95:04-99:11		1.36	
			99:12-02:10		0.78	
			Spain			
Hofmann (2003)	3 months interbank	NO (Chow test *p*-value = 0.19 at January 1999)	95:01-02:11	0.64***	1 *a priori*	-0.52***
			99:01-02:11	0.52***		-0.65***
SK (2004b)	Overnight	September 1996	93:01-96:09	0.24	0.85	
			96:10-02:10	0.39	0.78	
	3 months interbank	November 1996	93:01-96:11	0.64	0.97	
			96:12-02:10	0.64	0.79	
de Bondt *et al.* (2005)	3 months interbank / Government 10 years bond	January 1999, *a priori*	94:04-02:12	0.76***/0.03	0.96***	-0.41***
			99:01-02:12	0.58***/0.08	0.87***	-0.73***

Sources: Hofmann (2003), Table 1; SK (2004b), Tables B3-B4; de Bondt *et al*. (2005), Table 4; de Bondt (2005), Table A1; Coffinet (2005), Tableau A2 ; Di Lorenzo-Marotta (2006) Tables 3, 6. [a]Last of the two breaks detected in Di Lorenzo-Marotta (2006). [b]Long run coefficient in an ARDL specification. ***, **, *: statistically significant at the 1, 5 and 10 per cent level.

Table 2 KPSS stationarity tests for lending rate spreads
(short term business lending rate net of 1-month interbank rate)

Country	Extended sample	Test statistic	Post-EMU sample	Test statistic
Austria	1995:04-2003:06	2.07***	1999:01-2003:06	0.36
Belgium[a] r_1	1995:04-2003:09	0.24	1999:01-2003:09	0.35
Belgium[a] r_2	1995:04:2003:09	1.26***	1999:01:2003:09	1.26***
France	1995:04-2003:08	0.90***	1999:01-2003:08	0.21
Germany	1995:04-2003:06	0.92***	1999:01-2003:06	0.92***
Ireland	1995:04-2003:09	1.59***	1999:01-2003:09	0.85***
Italy r_1	1995:04-2003:09	0.42	1999:01-2003:09	0.37*
Italy r_2	1995:04-2003:09	0.92***	1999:01-2003:09	0.63**
Netherlands	1995:04-2003:09	1.75***	1999:01-2003:09	0.44*
Portugal r_1	1995:04-2002:12	2.25***	1999:01-2002:12	0.71**
Portugal r_2	1995:04-2002:12	2.23***	1999:01-2002:12	0.74**
Spain	1995:04-2003:03	0.66*	1999:01-2003:03	0.24
United Kingdom[b]	1995:04-2003:09	0.71*	1999:01-2003:09	0.15

Critical values, adjusted for sample size, for the null of level stationarity are drawn from Sephton (1995, Table 2). Significance levels at the 1% (***), 5% (**) and 10% (*). [a]12- and 3-months interbank rate for r_1 and r_2 for Belgium, respectively. [b]Unsecured personal loans rate for the UK.

Table 3 Break dates for short term business lending rates long run pass-throughs

Country	Full sample	1 month interbank rate[a]	
		Break date	supF[b]
Austria	1995.04-2003.06	*September 1997*	*256.54*
		November 1999	127.52
Belgium: r_1	1993.01-2003.09	April 1994	83.99
		June 1995	22.14
Belgium: r_2		January 2001	168.74
France	1993.01-2003.08	*June 1997*	*173.20*
Germany	1993.01-2003.06	October 1997	27.76
		March 2001	218.32
Ireland	1995.04-2003.09	July 2000	41.71
Italy: r_1	1993.01-2003.09	March 1995	24.06
		June 1999	*60.30*
Italy: r_2		August 1994	37.27
Netherlands	1993.01-2003.09	*September 1998*	*93.11*
Portugal: r_1	1993.01-2002.12	September 1994	77.49
		November 1999	*296.04*
Portugal: r_2		May 1995	124.89
		November 1999	115.67
Spain	1993.06-2003.03	June 1998	48.31
United Kingdom[c]	1995.01-2003.09	June 1997	118.89
		November 2001	26.32

In italics, break dates common with Sander-Kleimeier (2004a) for EMU countries. [a]12- and 3-months interbank rate for r_1 and r_2 for Belgium, respectively. [b]Critical asymptotic values of the supF with I(1) regressors are 16.2, 12.4 and 10.6, at the 1%, 5% and 10% significance levels, respectively (Hansen 1992, Table 1). See also Figure A1 in the Appendix. [c]Unsecured personal loans rate.

Table 4 **Short term business lending rate pass-throughs**

(Dynamic OLS estimation procedure; heteroskedasticity consistent Newey-West standard errors in brackets)

Sample Period	α	β	θ	γ_0	Cointegration and misspecification tests: ADF[1], τ_c[2], JB[3], BG[4]
			Austria		
97:10-99:11	2.56 (0.13)	1.09 (0.05)	-0.34 (0.16)	0.62 (0.17)	ADF = -2.97**; τ_c = -2.57 JB = 0.34; BG = 2.26
99:12-03:06	3.66 (0.04)	0.65 (0.01)	-0.51 (0.14)	0.45 (0.08)	ADF = -3.67***; τ_c = -2.56 JB = 0.38; BG = 0.20
			Belgium: r_1		
95:07-03:09	0.94 (0.09)	0.94 (0.03)	-0.52 (0.07)	0.96 (0.05)	ADF = -5.32***; τ_c = -4.59*** JB = 22.00***; BG = 1.11
			Belgium: r_2		
93:01-01:01	3.86 (0.07)	0.95 (0.01)	-0.33 (0.08)	0.82 (0.07)	ADF = -5.60***; τ_c = -3.34** JB = 20.95***; BG = 1.34
01:02-03:09	5.23 (0.07)	0.75 (0.02)	-0.61 (0.16)	0.63 (0.08)	ADF = -3.88***; τ_c = -3.34** JB = 0.76; BG = 0.17
			France		
93:01-97:06	5.28 (0.41)	0.43 (0.06)	-0.28 (0.13)	0.22 (0.16)	ADF = -2.17; τ_c = -2.61 JB =6.51**; BG = 0.36
97:07-03:08	2.22 (0.13)	0.76 (0.03)	-0.40 (0.10)	0.68 (0.12)	ADF = -4.65***; τ_c = -4.37*** JB = 32.85***; BG = 0.92
			Germany[5]		
97:11-01:03	6.40	0.40		0.12 (0.03)	ARDL (3,3) JB = 0.24, BG = 1.65
01:04-03:06	7.93	0.20		0.15 (0.03)	ARDL (3,3) JB = 0.94, BG = 0.87
			Ireland		
95:04-00:07	6.60 (0.09)	0.59 (0.02)	-0.24 (0.08)	0.24 (0.08)	ADF = -12.16***; τ_c = -2.50 JB = 7.23**; BG = 0.27
00:08-03:09	6.95 (0.13)	0.60 (0.03)	-0.29 (0.11)	0.44 (0.05)	ADF = -5.77***; τ_c = -2.64 JB = 5.08**; BG = 1.21
			Italy : r_1		
95:04-99:06	2.12 (0.21)	1.05 (0.02)	-0.19 (0.02)	0.21 (0.04)	ADF = -3.62***; τ_c = -2.48 JB = 0.23; BG = 1.18
99:07-03:09	3.38 (0.07)	0.71 (0.02)	-0.54 (0.06)	0.25 (0.04)	ADF =-2.69*; τ_c = -2.19 JB = 1.00; BG = 0.81
			Italy : r_2		
94:08-03:09	0.20 (0.05)	0.94 (0.01)	-0.14 (0.04)	0.24 (0.03)	ADF =-4.47***; τ_c = -3.98* JB =2.52;, BG = 1.35
			Netherlands		
93:01-98:09	-0.08 (0.11)	1.07 (0.03)	-0.26 (0.07)	0.46 (0.07)	ADF = -3.81***; τ_c = -3.20* JB = 7.65**; BG = 3.19**
98:10-03:09	0.58 (0.04)	1.01 (0.01)	-0.95 (0.13)	0.89 (0.09)	ADF = -6.99***; τ_c = -4.40*** JB = 8.23**, BG = 0.86
			Portugal : r_1		
94:10-99:11	3.75 (0.10)	1.25 (0.01)	-0.45 (0.05)	0.25 (0.06)	ADF = -5.64***; τ_c = -5.00*** JB = 4.84*; BG = 0.12
99:12-02:12	4.77 (0.23)	0.67 (0.05)	-0.47 (0.07)	-	ADF = -4.20**; τ_c = -3.26* JB = 11.43***; BG = 0.03
			Portugal : r_2		
95:06-99:11	1.07 (0.11)	1.36 (0.02)	-0.61 (0.09)	-	ADF = -2.76**; τ_c = -4.95*** JB =0.05; BG = 0.69
99:12-02:12	2.49 (0.18)	0.79 (0.04)	-0.40 (0.17)	0.48 (0.12)	ADF = -2.33; τ_c = -2.27 JB = 0.86, BG = 0.05
			Spain		
93:01-98:06	0.30 (0.10)	1.08 (0.01)	-0.61 (0.08)	1.07 (0.04)	ADF = -4.68***; τ_c = -3.38** JB =8.17**; BG = 0.36
98:07-03:03	1.73 (0.10)	0.82 (0.02)	-0.80 (0.07)	0.81 (0.09)	ADF = -6.78***; τ_c = -5.08*** JB = 7.53***, BG = 0.68

[1] Critical values under the null of I(1) EG first stage residuals for an ADF test statistic (Phillips-Ouliaris 1990, Table IIa, n=1). [2]Asymptotic critical values under the null of I(1) EG first stage residuals for a t-test statistic with constant and 1 lag (MacKinnon 1996). [3] Jarque-Bera test under the null of normality of residuals. [4] Breusch-Godfrey test under the null of no up to the second order correlation of residuals. [5]α and β computed out of the ARDL OLS estimates. Significance levels at the 1% (***), 5% (**) and 10% (*). Market rate: one-month interbank rate, except for Belgium (12 and 3 months interbank for r_1 and r_1, respectively).

Table 5 Pass-through of 1 percentage point change in the driving market rate

Absolute values (percentage points) and adjustment (%) to equilibrium within 1, 3, 6 and 12 months

Country: last break date	**Pre-break**					**Post-break**				
	β±2SE	**1 mth**	**3 mths**	**6 mths**	**12 mths**	**β**	**1 mth**	**3 mths**	**6 mths**	**12 mths**
Austria: 1999:11	0.99-1.19	0.62 *67*	0.89 *81*	1.03 *95*	1.09 *100*	0.63-0.67	0.45 *68*	0.72 *111*	0.82 *126*	0.59 *90*
Belgium r_2: 2001:01	0.93-0.97	0.82 *86*	0.96 *100*	0.97 *101*	0.95 *100*	0.71-0.79	0.63 *84*	0.73 *98*	0.75 *100*	0.75 *100*
France: 1997:06	0.31-0.55	0.22 *65*	0.33 *75*	0.40 *91*	0.43 *99*	0.70-0.82	0.68 *90*	1.05 *139*	0.81 *106*	0.77 *101*
Ireland : 2000:06	0.55-0.63	0.24 *39*	0.60 *97*	0.60 *97*	0.60 *97*	0.54-0.66	0.44 *73*	0.52 *87*	0.57 *95*	0.60 *100*
Italy r_1: 1999:06	1.01-1.09	0.21 *20*	0.62 *60*	0.89 *85*	1.00 *96*	0.67-0.75	0.25 *36*	0.61 *86*	0.70 *99*	0.71 *100*
Netherlands: 1998:09	1.01-1.13	0.46 *43*	0.85 *79*	1.07 *100*	1.07 *100*	0.99-1.03	0.89 *88*	0.91 *90*	1.04 *103*	1.05 *104*
Portugal r_1: 1999:11	1.23-1.27	0.25 *19*	0.79 *62*	1.21 *96*	1.27 *100*	0.57-0.77	- 0	0.67 *100*	0.72 *108*	0.68 *101*
Spain: 1998:06	1.06-1.10	1.07 *100*	0.93 *87*	1.06 *99*	1.06 *99*	0.78-0.86	0.81 *99*	0.82 *100*	0.84 *101*	0.83 *101*
Average	**0.76-0.99**	**0.49** ***55***	**0.75** ***80***	**0.90** ***96***	**0.93** ***99***	**0.70-0.79**	**0.52** ***67***	**0.75** ***101***	**0.78** ***105***	**0.75** ***100***

Source: own computation out of Table 4 and short term dynamics estimates.

Table 6 KPSS stationarity tests for MIR lending rate spreads

(interest rates on loans up to/over €1 million to non-financial corporations with a floating rate and initial fixation up to one year; 3 months Euribor as a market rate; 2003:01-2007:03)

Country	**Test statistic**	
	Up to €1m	**Over €1m**
Austria	0.91***	0.87***
Belgium	0.84***	0.81***
France	0.35*	0.15
Germany	0.87***	0.85***
Ireland	0.84***	0.77***
Italy	0.92***	0.80***
Netherlands	0.93***	0.13
Portugal	0.84***	0.48**
Spain	0.94***	0.54**

Critical values: see Table 1.

Table 7 Short term business lending rate pass-through of 3-months Euribor

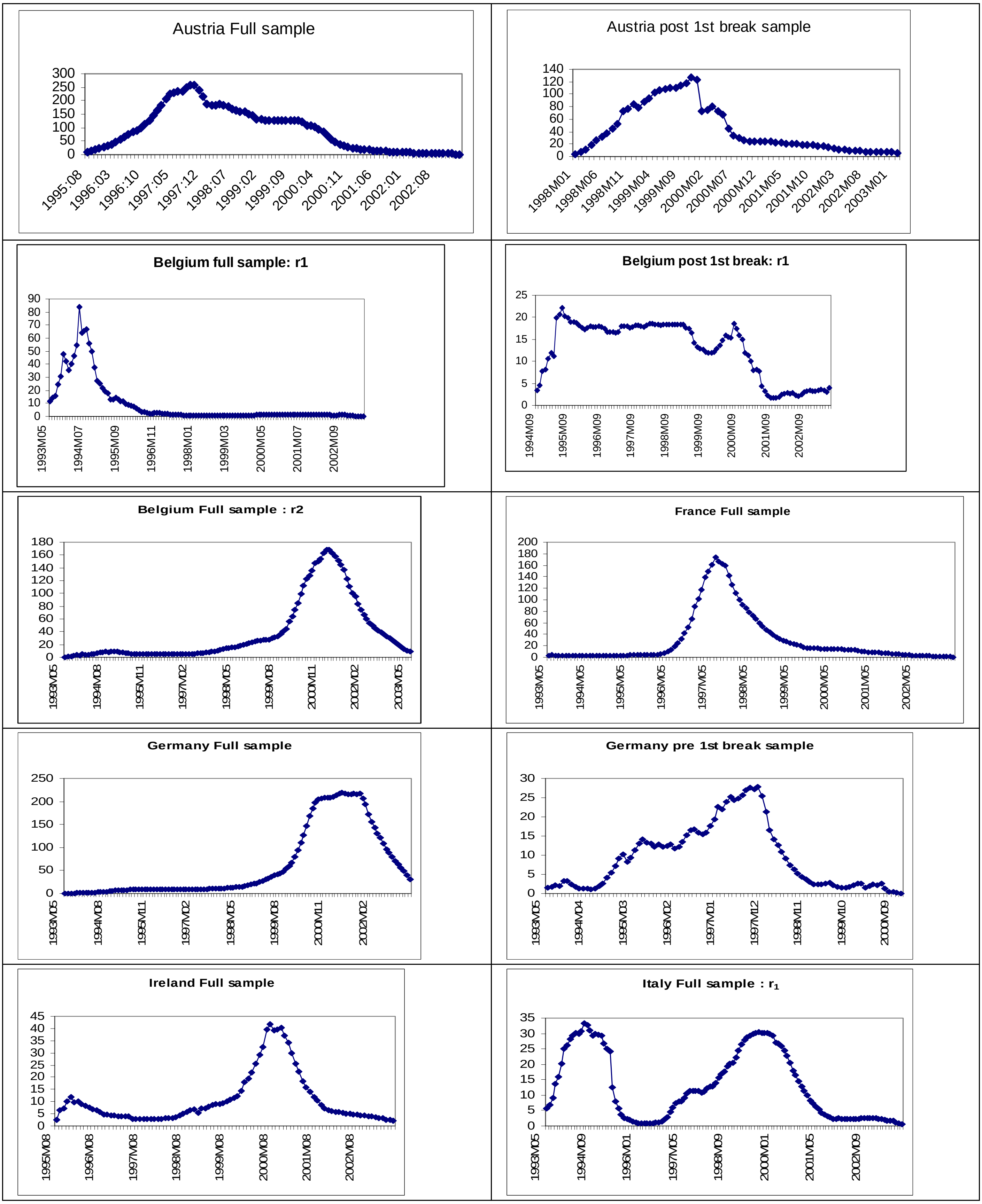
(MIR interest rates on loans up to/over €1 million to non-financial corporations with a floating rate and initial fixation up to one year; 3-months Euribor as a market rate; 2003:01-2007:03)

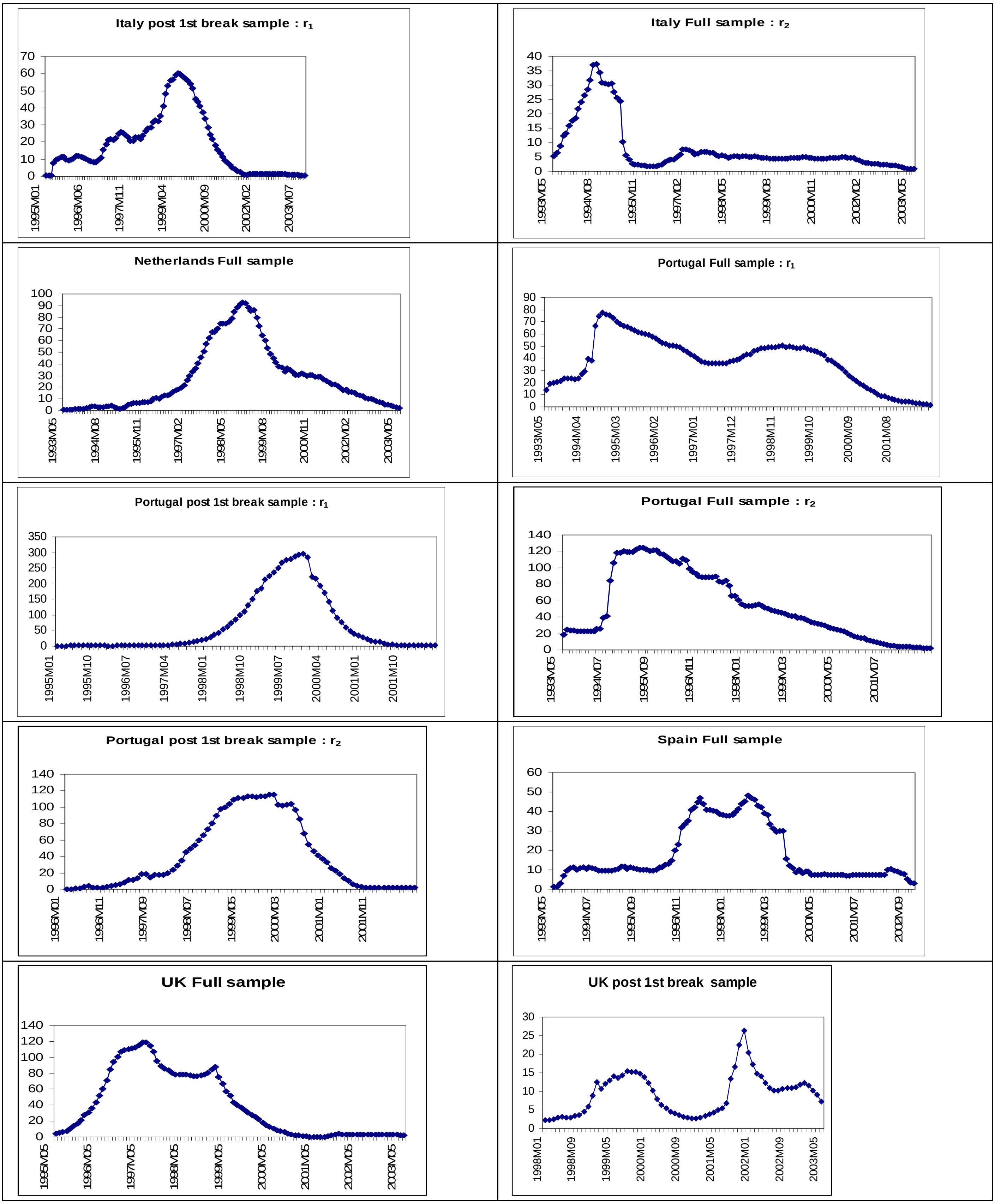
Country	Loans up to €1 million		Loans over €1 million			Cointegration and misspecification tests
	α	β	α	β	θ	
Austria	1.75	0.85	0.86	0.95		
Belgium	1.58	0.95	0.39	1.11		
France	1.45	0.92	0.39 (0.13)	1.14 (0.06)	-0.56 (0.13)	τ_c = -0.48** JB= 0.51, BG = 1.26
Germany	2.80	0.77	1.18	0.96		
Ireland	2.19	1.02	2.13	0.92		
Italy	1.94	0.93	1.18	0.84		
Netherlands	1.56	0.89	0.87 (0.06)	0.92 (0.03)	-0.67 (0.12)	τ_c = -0.72*** JB=41.57***, BG= 1.35
Portugal	4.07	0.78	1.85 (0.12)	0.82 (0.05)	-0.85 (0.14)	τ_c = -3.28* JB= 0.17, BG = 1.68
Spain	1.39	1.04	0.62	1.04		

For tests see Table 4. α and β computed out of the ARDL(3,3) estimates whenever cointegration rejected. Heteroskedasticity consistent Newey-West standard errors in brackets.

Appendix: Figure and Tables

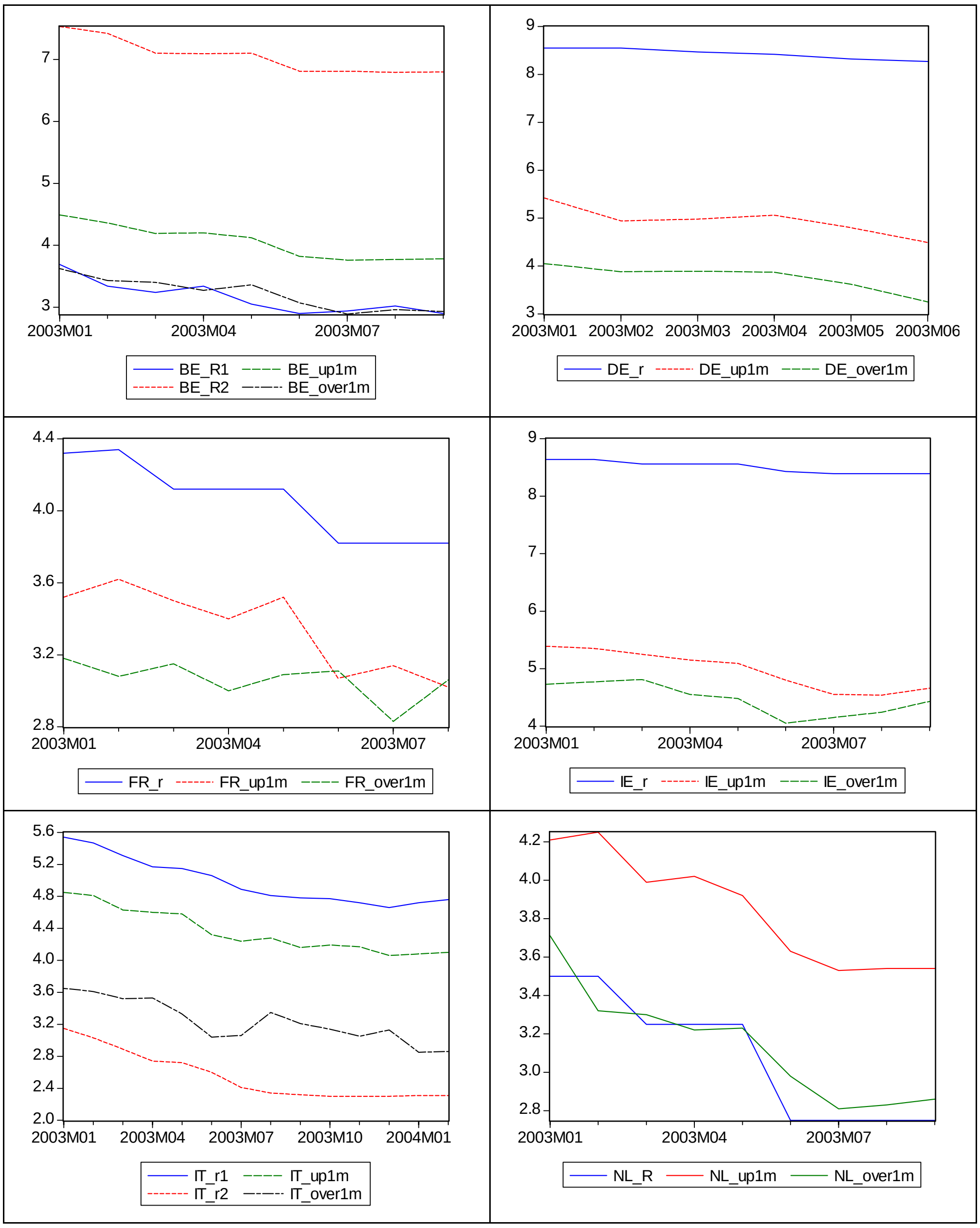
Figure A1 SupF statistics[a]




Italy post 1st break sample : r1
Italy Full sample : r2
Netherlands Full sample
Portugal Full sample : r1
Portugal post 1st break sample : r1
Portugal Full sample : r2
Portugal post 1st break sample : r2
Spain Full sample
UK Full sample
UK post 1st break sample

[a]See Table 3.

Figure A2 Harmonized and unharmonized short term business lending rates
(selected EMU countries)



Source: ECB's NRIR and MIR databases.

Table A1 **Unit root tests for short term business lending and interbank interest rates**

Interest rates	Augmented Dickey Fuller[a]	
	Level	First Difference
Austria 1995:04-2003:06		
r	-2.08	-6.17***
1 month interbank	-1.51	-6.65***
Belgium 1993:01-2003:09		
r_1	-3.45**	-9.39***
France 1993:01-2003:08		
r	-2.98**	-11.06***
1 month interbank	-4.51***	-8.55***
Germany 1993:01-2003:08		
r	-1.78	-8.95***
1 month interbank	-3.97***	-3.40***
Ireland 1995:04-2003:09		
r	-2.22	-9.86***
1 month interbank	-1.27	-8.16***
Italy 1993:01-2003:09		
r_1	-2.85*	-6.59***
r_2	-1.25	-4.35***
1 month interbank	-1.14	-9.03***
Netherlands 1993:01-2003:09		
r	-1.70	-7.94***
1 month interbank	-3.67***	-7.02***
Portugal 1993:01-2002:12		
r_1	-1.02	-8.21***
r_2	-2.08	-4.39***
1 month interbank	-1.95	-2.19**
Spain 1993:01-2003:03		
r	-3.05**	-8.39***
1 month interbank	-3.13**	-4.06***
United Kingdom 1995:01-2003:09		
r^b	-8.07***	-10.19***
1 month interbank	-1.33	-4.11***

[a]ADF tests with constant (level) and no constant (first difference); lags selected with the Schwartz Information Criterion. Significance levels at the 1% (***), 5% (**) and 10% (*). [b] Unsecured personal loans rate.

Table A2 **Unit root tests for short term business lending and interbank interest rates (2003:01-2007:03)**

Interest rates	Augmented Dickey Fuller[a]	
	Level	First Difference
Austria	-0.48 / 0.37	-2.56** / -1.80*
Belgium	1.59 / 0.95	-1.27 / -2.48**
France	1.96* / 0.43	-8.53*** / -8.25***
Germany	-0.40 / 1.23	-3.04*** / -2.27**
Ireland	0.26 / 0.74	-6.53*** / -8.63***
Italy	-1.05 / -0.42	-1.14 / -7.48***
Netherlands	0.72 / -0.20	-5.56*** / - 7.18***
Portugal	-0.75 / 0.67	-6.93*** / -9.69***
Spain	-0.29 / 2.50	-1.58 / -0.82
Euribor 1 month	2.24	-1.09
Euribor 3 months	0.84	-2.96***

[a]See Table A1.