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

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Abstract

This paper investigates whether size and speed of the pass-through of market rates into short term business lending rates have increased in the wake of the introduction of the euro. Allowing for multiple unknown structural breaks we find two in four EMU countries, and in the UK as well, and a single one in five other countries. The pattern of dates fits national banking systems adjusting slowly to the new monetary regime and suggests caution in associating structural changes to the introduction of the euro. The estimated equilibrium pass-through in the last break-free period is on average more incomplete, hinting at a reduced effectiveness of the single monetary policy. This results runs against the economic intuition that a reduced volatility in money market rates is bound to mitigate uncertainty and to ease therefore the transfer of policy rate changes to retail rates; the run up to Basel 2 and a deterioration of competition in loan markets could be the motivations. Caution in extrapolating to more recent periods these findings is suggested by the differences between the unharmonized and the new harmonized retail rates.

JEL Classification: E43; E52; E58; F36

Keywords: Interest rates; Monetary policy; European Monetary Union (EMU); Cointegration analysis; Taylor principle

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1. Introduction*

The transmission of monetary policy hinges on how policy rate changes, via changes in market interest rates, are transferred to bank rates, that are likely to influence aggregate demand at least to some extent. An incomplete pass-through (PT) could actually violate 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) - and monetary policy would fail to be stabilizing. It is therefore interesting to investigate whether size and speed to equilibrium of PTs have *increased* in the wake of Stage Three of European Monetary Union (EMU), thus enhancing the effectiveness of the single monetary policy, and *converged*, thus making more uniform the transmission via the banking sector across countries.

The two key issues are the date of the structural break(s) in the PT relationship and the change in the parameters possibly associated with the new monetary regime. Angeloni and Ehrmann (2003) provide evidence that from January 1999 lending and deposit rate PTs became on average higher, though adjusting no faster, in four of the five largest EMU countries (the exception being Germany) and in the aggregate euro area. Doubts on the robustness of these findings are however cast by the tests on a common structural break across countries in coincidence with the introduction of the euro (de Bondt *et al* 2005) and by an alternative strategy of searching for a single unknown break date in each country (Toolsema *et al* 2002, Sander-Kleimeier 2004a,b). Moreover, there are no theoretical nor empirical grounds to assume a single break, because the innovations produced by the euro are the outcome of a *process*, announced well before its formal implementation and unlikely to follow the same path across countries (Di Lorenzo-Marotta 2006).

This paper follows and extends (Di Lorenzo-Marotta 2006), focusing on the determination of the short term business lending rate, the bank rate with the fastest and highest PTs, in nine founding EMU countries. A key feature of this study is the exploitation of the longest available data sample - up to September 2003 for some countries; in addition, to assess whether break-dates in PT relationship are likely to be associated to the euro, the empirical exercise includes a control non-EMU country like the UK. The robustness of the findings is checked investigating two issues. First, are the results on dating breaks robust to a refinement procedure, originally laid out for the case of multiple unknown breaks with stationary regressors in Bai (1997), when extended exploratively to the case of regressors integrated of order one, or I(1), as interest rates most often turn out to be?

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Second, does the expected competition enhancement of the single monetary policy influences short run PTs, when allowing for asymmetric responses to changes in market rates?

The paper contributes to the literature in many ways. Two structural breaks are indeed detected in four EMU countries, as well as in the United Kingdom, a single one in five and none in the case of one retail rate in Belgium; the date of the last break varies across countries, with a concentration around mid-1998/late 1999, up until early 2001. This pattern fits national banking systems adjusting slowly to a new monetary regime rather than anticipating it, contrary to the expectational rationale suggested in Sander-Kleimeier (2004a). Comparing the last two break-free periods, long run PTs stay constant (Ireland) or *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 only slightly more uniform. The results of the main exercise on break-dates survive the first robustness check; there is also evidence of an asymmetric impact PT only in two countries, hinting at a weak enhancement of competition in loan markets. Extending the implications of a reduced efficacy of monetary policy, because of lower PTs, beyond the sample period of the econometric exercise has to be resisted however: the new harmonized retail interest rate series, available as of January 2003, do show remarkable differences both in levels and dynamics with the unharmonized series used in this study and in related literature.

The paper is organized as follows. Section 2 surveys the literature and details the shared empirical framework; section 3 describes the data and provides an overview of lending spread patterns across countries; section 4 lays out the econometrics to search for multiple unknown break-dates in cointegrated relations and reports the results; section 5 discusses the findings; section 6 concludes.

2. Literature review

Empirical literature on retail rate PTs provides a wide range of results as to the date of a *single* structural break, possibly coincident with the start of Stage Three of EMU, as well as to the changes in long run PTs and the adjustment speed to them. Econometric specifications are based on a standard Klein-Monti model of a monopolistic bank, under the assumptions of risk neutrality, perfect information, no switching nor adjustment costs, no joint production of loans and deposits nor cross-subsidization between loans and deposits (Klein 1971, Monti 1972 and, for an extension to an oligopolistic setting, Freixas-Rochet 1997). The lending rate is determined as a mark-up over the marginal (opportunity) cost, proxied by a market rate, matching the maturity of loans. Assuming a linear approximation, the marginal cost coefficient can be interpreted as the long run PT, with a value close to one in the limiting case of a competitive loan market (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[1].

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) [2], 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.

The constant includes the credit risk premium; the presence of a linear trend in eq. (1) would be instead theoretically inconsistent (Hamilton 1994, 501). Short term dynamics parameters are obtained in the EG second step, according to the general-to-specific approach (Hendry 1995), dropping sequentially insignificant regressors from the unrestricted specification:

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

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), also known as loading factor and that should result statistically significant if cointegration holds; γ_0 represents the impact PT. Within this shared econometric framework the findings in the literature can be summarized as follows.

Angeloni and Ehrmann (2003) identify via rolling-window regressions January 1999 as a break-point and find that 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) in a set of lending and deposit rates. De Bondt (2005), on the contrary, having formally rejected with a Chow test the null of no break at January 1999, finds that long-run PTs for all euro area bank rates, except the mortgage one, are *lower* in the EMU period compared to the

[1] Weak exogeneity of market rates to the retail rates is explicitly or implicitly assumed in the literature.
[2] 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).

extended one (January 1996-June 2001). In particular, the estimates for the short term business lending rate shrink from 1.53 to 0.88.

Considering from now on this bank rate, because it turns out to have the highest PTs in most studies[3], cross-country and national studies disagree even more, owing to their choices on how to deal with EMU-related breaks[4] and how to choose the driving market rate(s) (Table 1).

Hofmann (2003), who *assumes* a unitary long run PT and as a driver the 3-months interbank rate, finds that the break in January 1999 is not statistically significant for Spain; in addition, the adjustment to equilibrium becomes faster after the introduction of euro, though remaining puzzlingly slow for Germany, and the sign of changes in impact PTs differs across countries.

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, up to end-2002. Their findings are that in the last period the bond yield becomes statistically insignificant, long run PTs *decrease* below one (except for the Netherlands), the sign of changes in impact PTs differs across countries. The estimates for Germany show always very large standard errors.

Sander and Kleimeier (2004a,b) endogenously search for a *single* break. They also adopt, as an alternative driver to a market rate matching the maturity of loaned funds, the overnight rate, taken as a proxy for the monetary policy rate, to capture also the PT from policy to market rates. The findings are rather heterogeneous across countries. Breaks as early as July 1994 and February 1995 using the overnight rate and as late as July and October 1999 using the other driver are detected for Italy and Portugal; 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 Spain (September/November 1996), France (June 1997) and Austria (August 1997) and as well as much later for Germany (July 2000/February 2001). Long run PTs show opposite patterns over time (on average, from 0.71 up to 0.87 with the overnight rate as a driver, from 0.91 down to 0.72 in the other case); impact PTs increase, if ever, slightly.

Di Lorenzo and Marotta (2006), allowing for more than a single unknown break, detect for Italy and Portugal a second break date, near to the start of Stage III of EMU and quite similar for either driving rates*,* as it should be expected given the very close correlation among overnight and

[3] A notable exception is Gropp et al (2007), with a an euro-wide PT over a semester of about 0.7 vs 0.9 for the long-term business lending rate, using quarterly series up to 2004 constructed by chain-linking the NRIR and the new MIR databases (see below par. 3.2).

[4] Earlier cross-country studies, with a reduced post-1999 sample, are Donnay-Degryse (2001) and Heinemann-Schüler (2003).

short-term interbank rates. In both countries, equilibrium PTs are lower in the latest post-break period.

Considering 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 faster 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 (2007) 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" additive binary dummy variable over the period 1995:03-1998:09.

[TABLE 1 APPROXIMATIVELY HERE]

3. Econometric framework and data

3.1 Econometrics

The assumption of a *single known* structural break in long run PTs in coincidence with the introduction of the euro is hardly motivated on economic grounds; a *single unknown* break, though a better starting point, is still an unduly restrictive assumption, because of the effects of forward looking actions on the one hand and of protracted adjustments on the other hand. The possibility of *multiple unknown* breaks is therefore the maintained hypothesis in this paper. The econometric literature does not provide however as yet a suitable framework for a search in the case of I(1) regressors, as interest rates almost invariably turn out to be (Perron 2006, 287).

To circumvent this obstacle, within the same reference setting adopted in the literature (Eqs. 1 and 2), this study follows and extends Di Lorenzo-Marotta (2006), that generalizes in turn the endogenous search for a single break of Toolsema *et al* (2002) and Sander-Kleimeier (2004a,b), to investigate whether long run PTs and the speed of adjustment towards equilibrium of short term business lending rates have changed across break-free periods.

The methodology adopted is the following.

First, having checked that both the retail and the driving market rates are I(1) over the full sample, a search for a single unknown break-date in the long run model (Eq. 1) is done using a 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)[5]. When the algorithm yields several local maxima, it is rerun, starting from the earliest break-point, to detect the successive one, and so on.

[5] 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.

Second, we check that in the last two break-free periods the *ecm* term, estimated in the first step of the EG procedure, is I(0), thus rejecting the null of no cointegration. This should help mitigate the problems of low power of tests for cointegration in the presence of breaks (Maddala-Kim 1998). 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. This study adopts therefore the dynamic OLS estimation method proposed by Stock and Watson (1993), that allows to make asymptotic inference about the first-step estimates of the *ecm* and is known also to have smaller biases in finite samples, thanks to the inclusion of leads and lags of first differenced regressors. In order to enhance comparison across countries, and owing to sample size constraints, up to 3 lags and leads are allowed. If cointegration holds, the EG second step for (Eq. 2) is implemented imposing the same short-run dynamics, with to 3 lags of first differenced regressors[6].

Third, when the null of no cointegration is rejected, a standard ARDL(3,3) is estimated and α and β are computed accordingly, obtaining their standard errors with the delta method.

3.2 Data

The national short term business lending rate are the series, coded "N4", selected by each of the nine EMU countries contributing to the unharmonized National Retail Interest Rates (NRIR) database at the European Central Bank (ECB)[7]. The series have several idiosyncratic features, witnessing the fragmentation of national retail banking markets, and are therefore hardly comparable across countries. Rates are computed as simple averages (Netherlands), sometimes excluding extremes (Austria, Germany, Portugal) or considering range of values for different types of loans (Ireland) or as weighted averages by stocks (for France, averages of three end of month rates)[8]; they refer to new businesses, except for Italy (outstanding stocks)[9]; borrowers include also non enterprises (Germany, Italy r_1); they are base rates, therefore excluding credit risk premia, in Netherlands and Belgium (r_2); they refer to loans explicitly secured (Germany, Ireland, Portugal) and of different maturities (from overdrafts for France and Ireland to 18 months for Italy); there are changes in January 1999 in the way the series are constructed (Netherlands, Portugal); for details

[6] k=1 when the estimation sample is quite short (two years). Estimates with a standard Engle-Granger two-step procedure and, as an alternative, with a non-linear least-squares one-step error correction specification, yielding very similar results, are available upon request.

[7] Two rates, coded as N4.1 and N4.2 (in this paper r_1 and r_2), for Belgium, Italy and Portugal.

[8] The monthly series for France looks like a quarterly one. Given the focus on the break dates search, this paper uses the original series to avoid the risk of altering its temporal pattern if interpolated, following Coffinet (2005) and contrary to de Bondt *et al.* (2005).

[9] 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).

see the NRIR methodology (ECB 2002). The retail rate series chosen for the UK, a control non-EMU country member of the European Union, is the unsecured personal loans rate (code N3.1), on the grounds that it is the closest substitute to the missing short term business lending rate in the NRIR database.

The sample starts, at the earliest, in January 1993[10] and the end is country-specific, from December 2002 up to September 2003[11].

The driving market rate, that should match the (short) maturity of the underlying credit aggregates for an appropriate pricing[12], is the national interbank rate most correlated (in first differences) with the retail rate, among the maturities of 1, 3, 6 or 12 months, following de Bondt (2002). The one month interbank rate turns out to be the most correlated with the retail rate, except for Belgium, where the 12- and 3-months interbank rates are selected with reference to the r_1 and r_2 rates respectively[13]. The choice of only an interbank rate as a driver is motivated by the findings on the similar dating of breaks when using as an alternative the overnight rate, if more than one break is allowed (Di Lorenzo-Marotta 2006).

A visual inspection of the lending spread (short term business rate net of the interbank rate) is useful to set the stage for the empirical investigation, against the backdrop of a dramatic fall of market rates since early 1995, in particular for Italy, Portugal and Spain, with a recovery 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 PT - and interbank rate changes should be uncorrelated if the adjustment to equilibrium is fast; they actually move instead quite differently through time and across countries. Leaving aside the Netherlands, whose base rate follows by definition the market rate, the spreads come close to the benchmark case in recent years only for France, Portugal and Spain, as it happens for the US by mid-1990s (Sellon 2002) and to some extent for the UK. The other EMU countries show instead upwards trending

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[10] 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). The initial year is 1995 for Austria and the UK, because of data availability.

[11] 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 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 and, for an explicit warning about any analysis based on chain-linking old and new statistics, Affinito-Farabullini 2006).

[12] 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. As a consequence, changes in PTs through time and/or across countries could be the result of a different mix of instruments/interest rate fixation characteristics.

[13] Results available upon request. For the selected interbank rates see Figure 1.

spreads, with end-sample levels even higher than at the beginning of the sample (e.g. Belgium r_2, Germany, Ireland).

Formally, the Kwiatkowski-Phillips-Schmidt-Shin (KPSS; 1992) (level) test statistics rejects always the null of stationarity for lending spreads at least at the 5% significance level (critical values, adjusted for sample size, from Sephton 1995) for the common period starting April 1995, except for Belgium r_1 and Italy r_1 and for Spain; the rejection rate is only slightly lower after January 1999 (Table 2).

This piece of evidence would then suggest for the euro area an a priori case against a complete PT during the entire sample and in the EMU period as well.

[FIGURES 1 AND 2 APPROXIMATIVELY HERE]

[TABLE 2 APPROXIMATIVELY HERE]

4 Results

4.1 Break dates

Augmented Dickey-Fuller (ADF) tests show that most retail and interbank 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. Breaks detected some months after the launch of the euro for Austria, Italy and for Germany (with the latest break in March 2001) hint at protracted adjustments of these banking systems to the new monetary environment. A note of caution in associating structural changes in PTs to the introduction of euro is suggested by the break dates - June 1997 and November 2001 - detected in the UK: only the former could be possibly motivated by the innovation of an independent Bank of England. Incidentally, this last result suggests that measuring long run PTs using individual UK bank data series over the period 1993-2004, as in Fuertes-Heffernan (2006), should consider testing for breaks.

Only five out of eighteen break dates for EMU countries are the same found when using an interbank rate as a driver in Sander-Kleimeier (2004a); Spain is the only case where a single break date is detected considerably later - June 1998 instead of November 1996. This finding, that casts doubts on the claim that the country would have moved very early anticipating the impact of the

[14] We checked that the dates are 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 - March 1997 - is 15 months earlier using the overnight rate instead of a 1-month interbank rate (results available upon request).

run-up to the EMU, can be explained by the choice in that study of the three months interbank rate, in contrast with the advocated criterion of the highest correlation with the retail rate[15].

[TABLE 3 APPROXIMATELY HERE]

4.2 Pass-through

The results of the econometric exercise are reported only for the last two break-free periods, owing to the focus on structural changes, possibly linked to the introduction of the euro (Table 4). Overall, most estimates are highly statistically significant and pass at least one of the cointegration tests[16] under the null of I(0) *ecm*: the first is the ADF statistic proposed by Phillips-Ouliaris (1990), the second is the τ_c statistic proposed by McKinnon (1996). Only for Germany, presumably owing to data problems, cointegration is always rejected and consequently an ARDL(3,3) specification is estimated.

The main findings on the key parameter of the PT relationship are as follows.

β shrinks everywhere in the last period, on average from 0.9 to 0.7, except for France, where it increases, and for Ireland, where it stays constant; correspondingly, the higher constant term signals an increase of the risk premium across periods; the cross-country range of β remains wide, going from 0.59-1.25 to 0.6-1.1, with a cluster in the last break-free period around 0.7 for most countries, Germany being an outlier (Table 5). The unitary value of equilibrium PT in the last period is outside the upper end of the 5% confidence interval everywhere, except for the base rate of the Netherlands.

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 offset by a faster adjustment to it. The averaged indicator $\beta\theta$ indeed increases (from 0.33 to 0.45). More precisely, taking into account the complete short dynamics estimates for Eq. 2, one percentage point change in the driving market rate translates on average, across the two break-free periods, into the same proportion within one and three months (49 and 75 basis points in the last but one period, 52 and 75 in the last one, respectively); the adjustment to equilibrium PT is on average complete within a quarter in the last period, whilst reaching about four fifths in the previous one.

[TABLES 4 AND 5 APPROXIMATIVELY HERE]

[15] 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).

[16] 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.

4.3. Robustness of the results

4.3.1 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 on the supF approach, assuming a maximum number of unknown breaks over the entire sample and intervals between dates sufficiently large to apply asymptotic theory (Bai-Perron 1998). In the first stage, as in this paper, the algorithm is rerun, starting from the earliest statistically significant break-point, to detect recursively the successive one. Let t_1, t_2 and t_3 be the break-dates found in the full sample $t_0 – T$. In order to get efficiency, the *refinement* implies further searching in the sub-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[17].

No formal theory is as yet available to extend Bai's procedure to the case of I(1) regressors, such as the interest rates in this paper. The exercise can be nevertheless justified interpreting it as an informal misspecification test on break detection. More precisely, it is surmised that unknown break dates are at most three in a sample starting on 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 creation 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 Stage Three of EMU, as national banking systems adjusted to it. The refinement procedure yields different results only for Italy (r_1), where a third break – February 1997 – is detected, and Germany, where the last break is anticipated to July 2000 (results available upon request). In the first case, the estimate of the long run PT for the last period but one remains however pretty the same (β = 1); the poor quality of the data could be the main cause in the second case. Overall, therefore, the findings of the main exercise on break-date detection are robust to a refinement-like procedure.

4.3.2 Asymmetric impact PT. A common finding in the PT literature is the asymmetric pattern of changes in bank rates when market rates rise or decline. A check on the symmetric specification for the short term dynamics in the main exercise (Eq. 2) is therefore implemented adding a regressor picking contemporaneous positive changes in the interbank rate (zero values otherwise). The expected sign of this slope-dummy regressor (γ^+) is negative if, owing to the competition in loan markets, banks are more reluctant to transfer increases in market rates than lowering them in the opposite case.

[17] 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 samples to refine first.

To save space, only the estimates when γ^+ is statistically significant at least at the 10% confidence level are reported (Table 6). The noteworthy finding is that the pattern of a positively signed γ^+ in the last but one break-free period for France and of a negatively one in the last period for the (base rate of the) Netherlands, respectively, hint at a quite limited enhancement of competition in loan markets in the euro area during the sample period.

5. Discussion

The bottom line of the econometric exercise is that in the decade the process of preparation and implementation of EMU took place banks' pricing policies on short term business lending rate in nine founding EMU countries underwent one or two structural changes. These changes, though resulting in a faster adjustment to equilibrium, did not produce the expected, owing to a more predictable ECB policy, larger long run PTs. The generalized, but for France and Ireland, reduction of β below one (the exception being the base rate in the Netherlands) hints at a reduced efficacy in the transmission of monetary impulses. These results help to put into perspective the heterogeneous findings of previous literature, based on shorter samples after the official start of Stage Three of EMU.

First, the introduction of the euro on January 1999 does not imply a coincident structural break in equilibrium PTs across countries, contrary to Angeloni-Ehrmann (2003). Allowing for more than one break, following Di Lorenzo-Marotta (2006), corroborates previous findings that a conventional Chow test does not rejects the null for at least for some countries (De Bondt et al 2005) and that the date is never selected when searching for a single unknown break (Sander-Kleimeier 2004a,b). This paper depicts rather a protracted adjustment of national banking systems to the new monetary regime, as break dates are detected in some countries even several quarters after the formal introduction of the euro, or at most few months before (Spain, Netherlands). An expectational rationale to account for structural breaks before the start of Stage III of EMU, once the process had become irreversible in late 1996/early 1997[18], proposed by Sander and Kleimeier (2004a), could fit only the French case (June 1997). The finding that break dates for slow-adjusting EMU countries are similar to the ones detected in the case of a non-EMU country like the UK suggests at any rate caution in associating structural changes in bank pricing policies (only) to the introduction of the euro.

[18] The early breaks in late 1994-early 1995 for Italy and Portugal were likely caused by the international financial turbulence at that time. 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.

Second, estimates before and after the last break run against the proposition, in Angeloni-Ehrmann (1993) and, when using the overnight rate as a driver, in Sander-Klemeier (2004a), that equilibrium PTs of short term business lending rates have increased and become closer to one in the period overlapping (at least partially) with the introduction of the euro. A reduced (on average) long run PT confirms instead, though with several revisions of break dates, results in Sander-Kleimeier (2004a,b), when using interbank rates as a driver, and de Bondt *et al* (2005). In addition, the estimated confidence intervals formally reject, except for the base rate in the Netherlands, the hypothesis of a unitary equilibrium PT, contrary to Hofmann (2003) and Gambacorta-Iannotti (2007).

Third, an incomplete PT is also in agreement with a panel study in a cointegrated framework, where the new harmonized bank rate series (MIR), from January 2003 to June 2004, are chain-linked backwards to January 1999, using the NRIR database. The estimated βs on short term business lending rate 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)[19].

What is the economics behind these results, over time and across countries? The different dating of breaks, established conditional on the quite heterogeneous definitions of retail interest rates collected in the NRIR database, hints at a persistent fragmentation of bank systems across countries a few years after the launch of euro (see also Trichet 2007). In principle, some factors would have suggested an opposite outcome: a reduced uncertainty in money markets owing to the single monetary policy; an enhanced competition in national banking markets, both from the supply side - increasing foreign penetration – and from the demand side – firms more able to go shopping for loans once removed the exchange rate risk. To a certain extent, the adjustment speed toward equilibrium has indeed become generally faster, with a slightly more uniform cross-country monetary transmission through banks. However, a candidate offsetting factor has likely been, 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 Basel 2 process towards the revision of capital requirements; in addition, competition in loan markets has not in fact improved significantly, perhaps owing to the consolidation of the banking industry mostly within national borders[20].

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

[19] 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.

[20] For instance, in 2002 the EU Commission convicted seven large Austrian banks for having arranged an interest rate cartel (Burgstaller 2003).

the increase in loan-loss provisions and the adoption of stricter lending criteria (ECB 2004). In the run up towards Basel 2 these developments could have led to higher risk premia embedded in the lending rates, as suggested by the generalized increase in αs (Table 4)[21]. In the case of Belgium, likely causes for the increase in the margins on most short-term loans since the end of 2000 are explicitly deemed to be the emergence of problem loans and the prospect of Basel 2 (Baugnet-Hradisky 2004). Additional evidence can be gathered considering the PT relationship, with estimated β close or equal to one, for the two base rates – hence, by definition, net of risk premia imposed on non-primary borrowers - collected in the NRIR database: no break is detected for Italy's r_2, the minimum rate for the 10 percent top-rated borrowers; for the Netherlands, the break date, very close to the launch of euro, is likely influenced by the change in computing the series on January 1999.

Domestic consolidation of the banking industry could have increased lenders' market power relative to SMEs. A piece of evidence is suggested in the Italian case by the pattern of βs for r_2 in comparison with r_1 - the lending rate to non-primary borrowers (Table 4; Figures 1 and 2). This result 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[22] could have instead produced the expected intertemporal smoothing for the broad-based lending rate (Berlin-Mester 1998). Evidence of a deterioration of competition in loan markets in the largest EMU countries (France, Germany, Italy, Spain) in the years 1998-2002 emerges also by recent work based on the Boone indicator estimated from a Bankscope database of banks' balance sheet data (van Leuvensteijn *et al* 2007); following the Panzar-Rosse approach, a structural break in H-statistic around 2001-2002, implying a decline in banking competition, is also detected for the same countries and for Austria as well in Bikker-Spierdijk (2008).

Panel studies exploiting the richness of microdata, along the lines of Gambacorta (2004), de Graeve *et al* (2004), Lago-Gonzalez and Salas-Fumás (2005), could help disentangling the different factors influencing PTs in aggregate retail interest rate series, provided they were integrated with a proper treatment of the multiple unknown structural breaks issue.

It is worth stressing that the main contributions of this paper to the literature on detecting possibly euro-related structural breaks and estimating the changes in bank rate PTs are conditional on the shared NRIR data base, discontinued in 2003. The harmonized rates most closely related to

[21] 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).

[22] 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).

the short business lending rate in the MIR database - lending to business with a floating rate and initial fixation up to one year, split for size (up to and over €1 million) - in the few overlapping months are indeed quite different not only in levels but also in dynamics (for a selected group of countries see Figure A2 in the Appendix). The likely modification of PT estimates when moving to the new database on the one hand does not warrant extrapolating the results for the last break-free period in this paper and on the other hand highlights the complex task of running monetary policy in the euro area, also because of the lack of reliable homogeneous statistical information over a long enough time span.

6. Conclusion

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

Instead of assuming a *single* break - either dated a priori January 1999 or endogenously detected - a search for *multiple unknown* breaks is implemented, allowing for expectational effects or adjustments after the inception of the new monetary regime. The data set includes the longest available national interest rate series for nine euro countries and for a control country like the UK, a non-EMU member of the European Union.

The empirical investigation yields a single break-date for Belgium (r_2), France, Ireland, Netherlands, Spain and none for Belgium (r_1); two are found for Austria, Germany, Italy (r_1), Portugal. A case for a structural break much before the inception of EMU, based on an expectational rationale advanced in previous literature, can be made only for France; further breaks are instead detected several quarters after January 1999 for Austria, Germany, Italy and Portugal, hinting at a protracted adjustment to the new monetary regime. The finding that break dates for slow-adjusting EMU countries are similar to the ones detected in the case of the UK suggests caution in associating structural changes in bank pricing policies only or mainly to the introduction of the euro.

A comparison of the pass-through 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. While the equilibrium rate pass-through shrinks, with the exception of France, well below the unitary value found for the Netherlands, the adjustment to equilibrium has become generally faster, being on average complete within a quarter in the last break-free period, whilst reaching about four fifths in the previous one. The transmission of monetary policy through banks has become slightly more uniform across countries, but still with sizable differences.

The overall 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 to ease therefore the transfer of policy rate changes to retail rates. These expected effects could have been offset by other contemporaneously developing processes in the sample period, such as the consolidation 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. Panel studies with microdata could help disentangling the effects of these different factors on lending rate pass-throughs, provided they include a proper treatment of multiple unknown structural breaks.

An incomplete equilibrium pass-through, even for the least sticky bank rate, violates the Taylor principle and combined with the persistence of cross-country heterogeneity raises doubts on the efficacy of an area-wide monetary policy. Caution in extrapolating to more recent periods these results is suggested however by the differences in levels and in dynamics between the short business lending rate series in the discontinued NRIR database, used in this paper and in related literature, and the most closely resembling harmonized rates in the new MIR database. The lack of homogeneous statistical information over a long enough time span adds a further dimension to the complex task of running monetary policy in the euro area.

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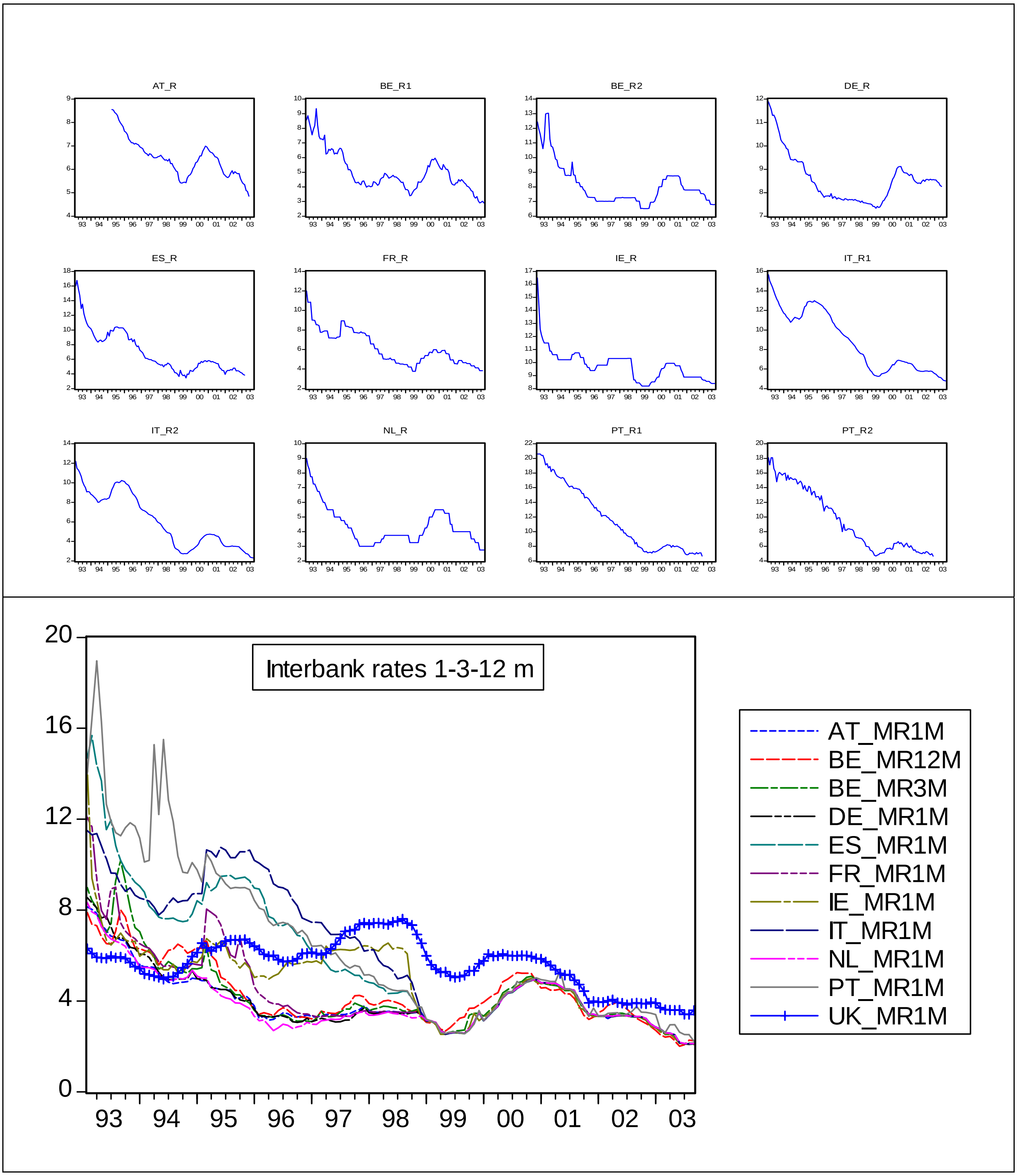
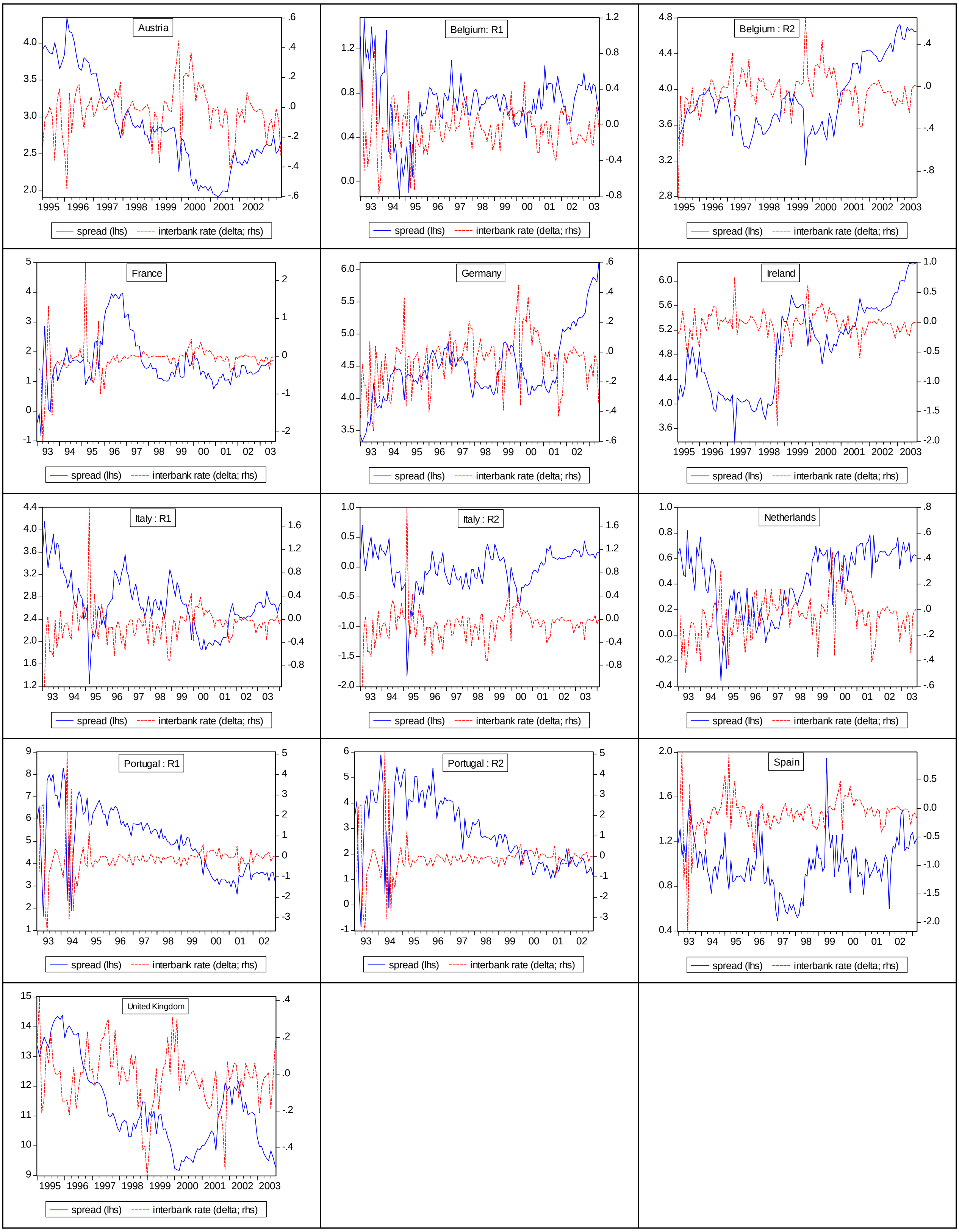
Figures and Tables

Figure 1 Short term business lending and interbank market rates (MR) in EMU countries and the UK



Source: ECB's NRIR database and National Central Banks' websites; unsecured personal loans rate for the UK. one-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.

Table 1 **Overview of interest rate pass-through estimates for short term business lending rates (NRIR database; adjustment speed and statistical significance levels where available)**

Study and estimation method	Market rate	Break date	Sample	Short run pass-through (γ_0)	Long run pass-through (β)	Adjustment speed (θ)
Austria						
Sander-Kleimeier (2004b) two-stages EG procedure	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 non-linear ECM	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						
Sander-Kleimeier (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* (Chow test *p*-value = 0.10)	94:04-02:12	0.75***/0.31***	0.59***/0.21*	-0.23
			99:01-02:12	0.96***/0.38***	0.81***/0.28**	-0.52**
Belgium : r_2						
Sander-Kleimeier (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 non-linear ECM	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***
Sander-Kleimeier (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	Sample	Short run pass-through (γ_0)	Long run pass-through (β)	Adjustment speed (θ)
Sander-Kleimeier (2004b)	Overnight	July 2000	93:01-00:07	0.16	0.81	
			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			
Sander-Kleimeier (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***
Sander-Kleimeier (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 non-linear ECM	Overnight	June 1999 (second 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 (second break)	95:04-99:05	0.21***	1.07***	-0.22***
			99:06-04:02	0.27***	0.75***	-0.46***
			Italy: r_2			
Sander-Kleimeier (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 (second break)	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			
Sander-Kleimeier (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			
Sander-Kleimeier (2004b)	Overnight	July 1994	93:01-94:07	-	0.26	
			94:08-02:10	0.22	1.52[a]	
	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) EG first-stage	Overnight	November 1999 (second break)	95:04-99:11	3.97	1.30	
			99:12-02:10	4.99	0.64	
	1 month interbank	October 1999 (second break)	95:04-99:10	4.17	1.24	
			99:11-02:10	4.87	0.66	
			Portugal:r_2			
Sander-Kleimeier (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) EG first-stage	Overnight	November 1999 (second break)	95:04-99:11	1.29	1.39	
			99:12-02:10	2.83	0.72	
	1 month interbank	November 1999 (second break)	95:04-99:11	1.31	1.36	
			99:12-02:10	2.57	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***
Sander-Kleimeier (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; Sander-Kleimeier (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]Long run computed 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[a]	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). [a]See Figure 1.

Table 3 Break dates for 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[a]	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]See Figure 1. [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.

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 (0.69)	0.40 (0.20)		0.12 (0.03)	ARDL (3,3) JB = 0.24, BG = 1.65
01:04-03:06	7.93 (0.20)	0.20 (0.05)		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 correlation of residuals up to the second order. [5]α and β computed out of the ARDL estimates; standard errors computed with delta method. Market rate: one-month interbank rate, except for Belgium (see Figure 1).

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

Percentage points and % of adjustment to equilibrium within 1, 3, 6 and 12 months (italics)

Country: last break date	**Pre-break**					**Post-break**				
	β±2SE	**1 mth**	**3 mths**	**6 mths**	**12 mths**	**β±2SE**	**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*
Germany: 2001:03	0-0.80	0.09 *22*	0.38 *94*	0.58 *145*	0.49 *122*	0.10-0.30	0.15 *77*	0.36 *180*	0.27 *134*	0.21 *104*
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 (excluding Germany)	**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 from Table 4 and short term dynamics, up to the third lag, estimates.

Table 6 Asymmetric short term business lending rate pass-through

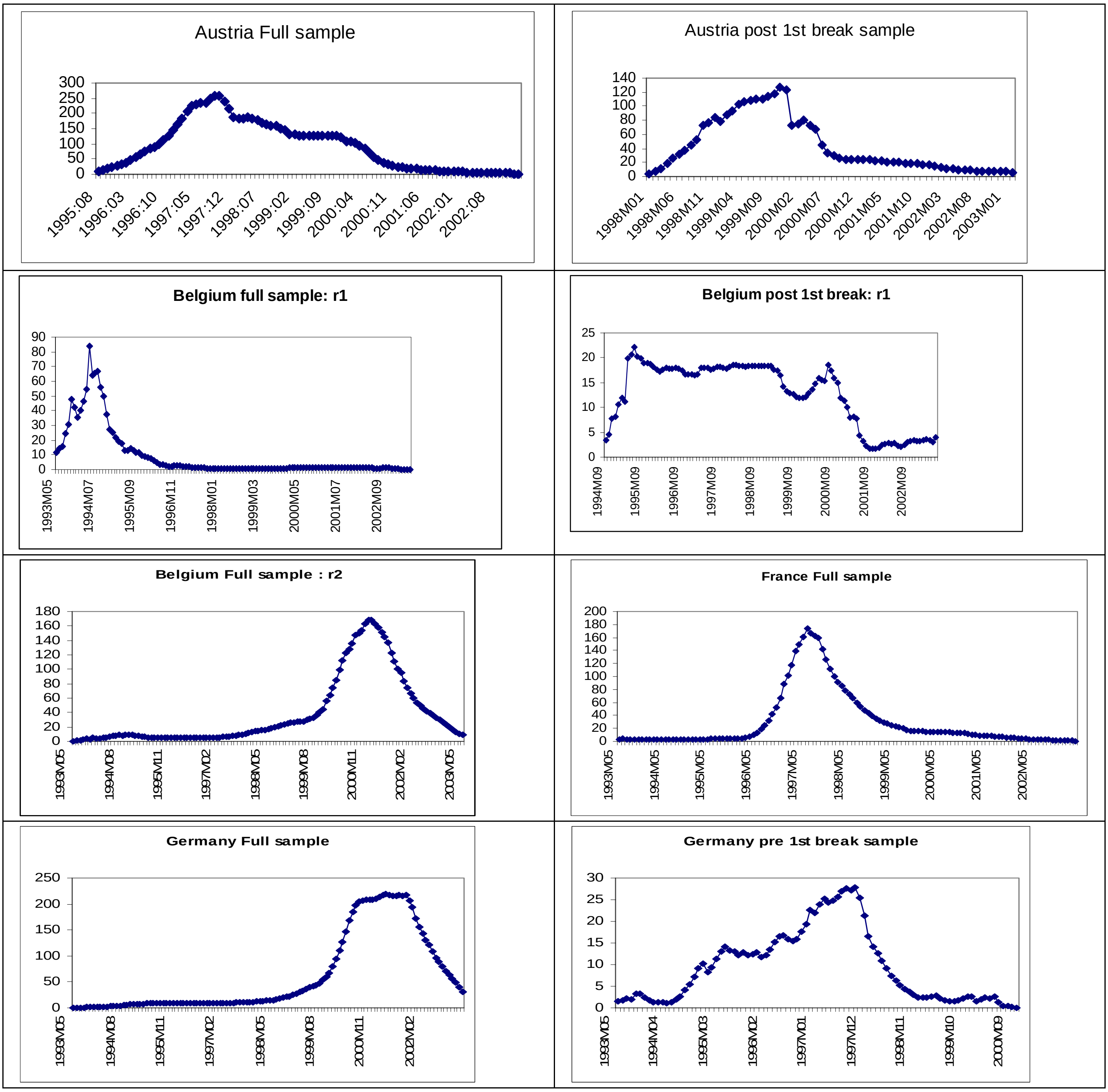
(Country/break-free periods with at least 10% statistically significant γ^+ estimates;
Dynamic OLS estimation procedure; heteroskedasticity consistent Newey-West tandard errors in brackets)

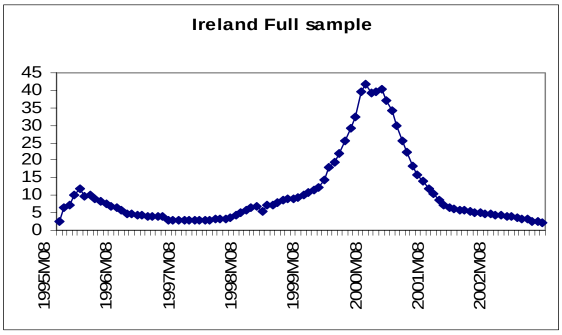
Country sample period	θ	γ	γ^{+a}	**Misspecification tests**
France 1993:01-1997:06	-0.33 (0.15)	0.05 (0.13)	0.40 (0.17)	JB = 5.68*, BG = 0.59
Netherlands 1998:10-2003:09	-0.99 (0.13)	1.04 (0.06)	-0.39 (0.10)	JB = 2.65, BG = 0.11

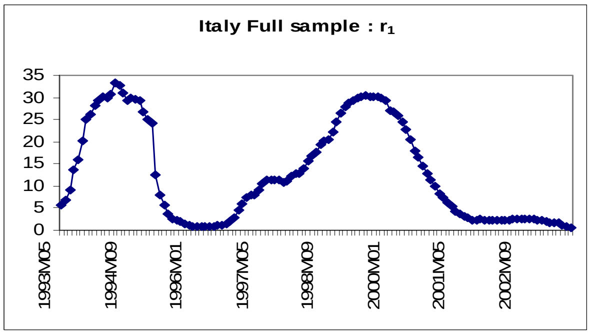
[a]The slope-dummy regressor includes interbank rate positive changes, zero values otherwise. Test statistics: see Table 4.

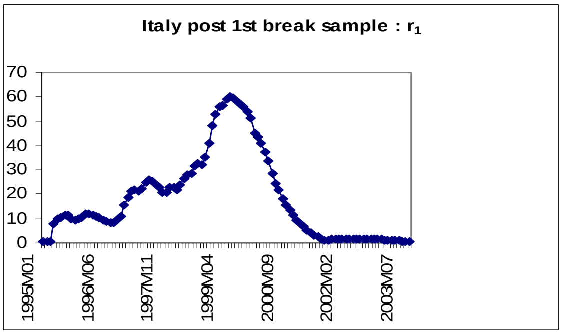
Appendix: Figure and Tables

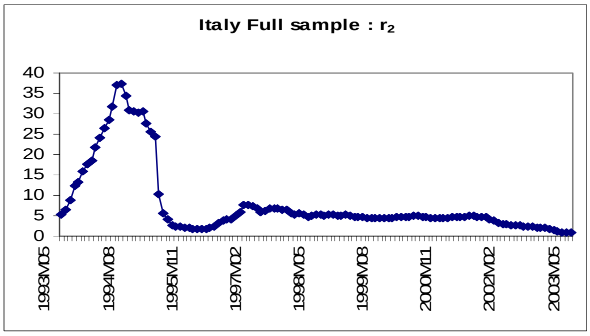
Figure A1 **SupF statistics[a]**

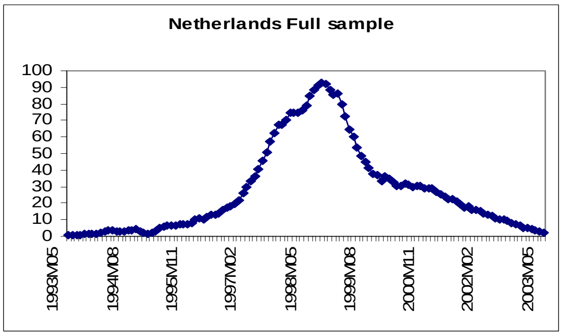


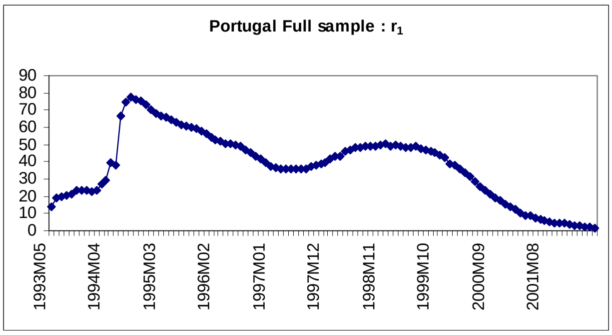

Ireland Full sample
45 40 35 30 25 20 15 10 5 0
1995M08 1996M08 1997M08 1998M08 1999M08 2000M08 2001M08 2002M08

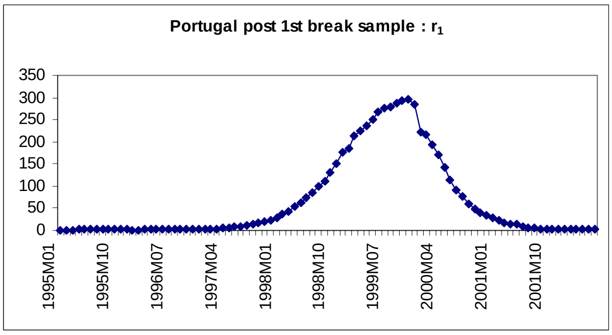

Italy Full sample : r₁
35 30 25 20 15 10 5 0
1993M05 1994M09 1996M01 1997M05 1998M09 2000M01 2001M05 2002M09

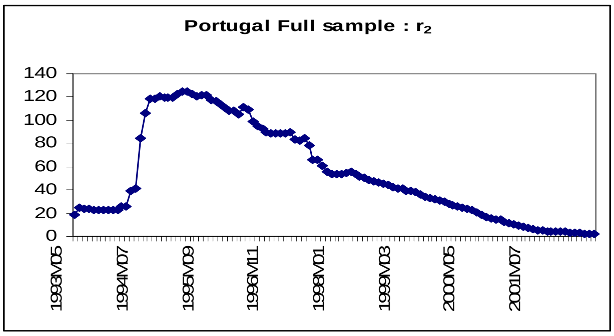

Italy post 1st break sample : r₁
70 60 50 40 30 20 10 0
1995M01 1996M06 1997M11 1999M04 2000M09 2002M02 2003M07

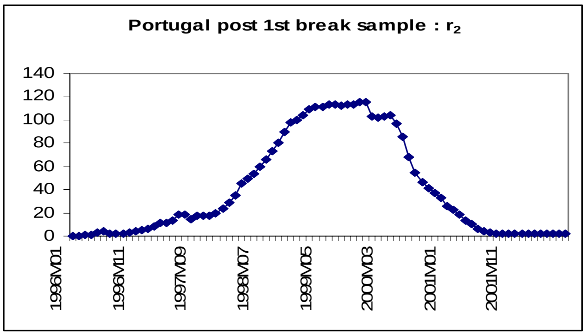

Italy Full sample : r₂
40 35 30 25 20 15 10 5 0
1993M05 1994M08 1995M11 1997M02 1998M05 1999M08 2000M11 2002M02 2003M05

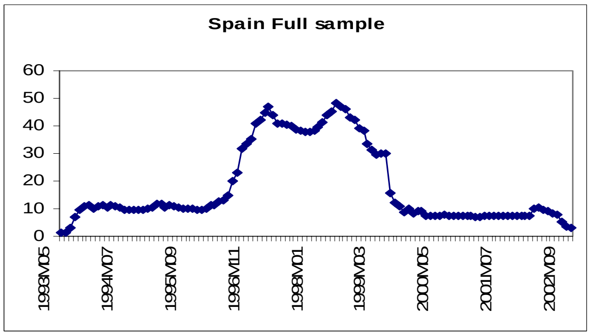

Netherlands Full sample
100 90 80 70 60 50 40 30 20 10 0
1993M05 1994M08 1995M11 1997M02 1998M05 1999M08 2000M11 2002M02 2003M05

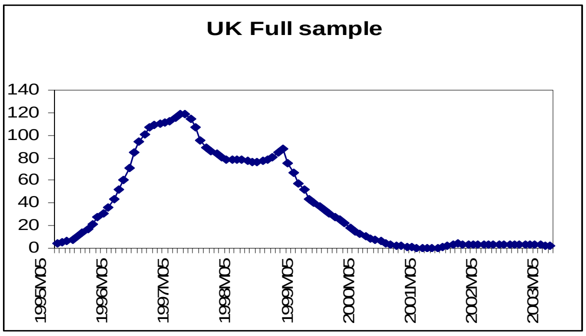

Portugal Full sample : r₁
90 80 70 60 50 40 30 20 10 0
1993M05 1994M04 1995M03 1996M02 1997M01 1997M12 1998M11 1999M10 2000M09 2001M08

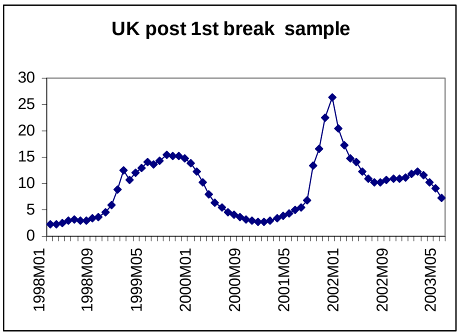

Portugal post 1st break sample : r₁
350 300 250 200 150 100 50 0
1995M01 1995M10 1996M07 1997M04 1998M01 1998M10 1999M07 2000M04 2001M01 2001M10


Portugal Full sample : r₂
140 120 100 80 60 40 20 0
1993M05 1994M07 1995M09 1996M11 1998M01 1999M03 2000M05 2001M07


Portugal post 1st break sample : r₂
140 120 100 80 60 40 20 0
1996M01 1996M11 1997M09 1998M07 1999M05 2000M03 2001M01 2001M11

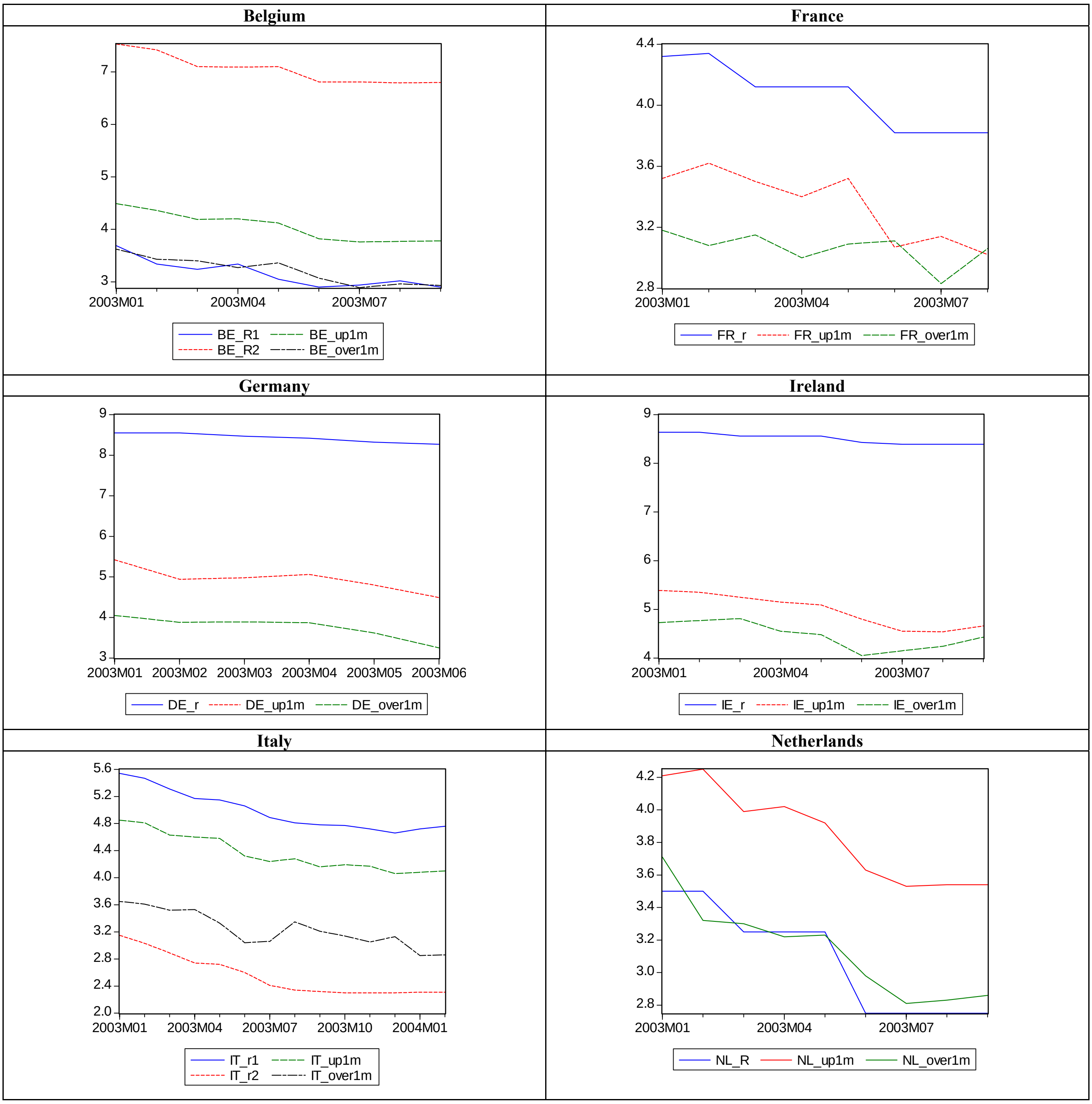

Spain Full sample
60 50 40 30 20 10 0
1993M05 1994M07 1995M09 1996M11 1998M01 1999M03 2000M05 2001M07 2002M09


UK Full sample
140
120
100
80
60
40
20
0
1995M05
1996M05
1997M05
1998M05
1999M05
2000M05
2001M05
2002M05
2003M05


UK post 1st break sample
30
25
20
15
10
5
0
1998M01
1998M09
1999M05
2000M01
2000M09
2001M05
2002M01
2002M09
2003M05

[a]See Table 3.

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



Source: ECB's NRIR and MIR (up to and over 1 million €) 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***
r_2	-2.20	-9.80***
3 months interbank	-2.16	-7.41***
12 months interbank	-2.41	-8.04***
	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[a]	-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. [b]Unsecured personal loans rate.