CENTRE FOR PLANNING AND ECONOMIC RESEARCH

# No 125

## Is the Eurozone homogeneous and symmetric? An interest rate pass-through approach before and during the recent financial crisis

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July 2012

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CENTRE FOR PLANNING AND ECONOMIC RESEARCH

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# Είναι η Ευρωζώνη ομοιογενής και συμμετρική; Μια προσέγγιση μέσω των επιτοκίων πριν και κατά την διάρκεια της κρίσης.

**Γιάννης Παναγόπουλος και Αριστοτέλης Σπηλιώτης**

## ΠΕΡΙΛΗΨΗ

Το συγκεκριμένο άρθρο έχει ως σκοπό να διερευνήσει την ύπαρξη ομοιογένειας και συμμετρίας σε ότι αφορά την άσκηση νομισματικής πολιτικής μέσω των επιτοκίων χονδρικής (wolesale rates) στην ευρωζώνη. Η ύπαρξη των δυο προαναφερθέντων στοιχείων θεωρείται κρίσιμη από πλευράς Ευρωπαϊκής Κεντρικής (ΕΚΤ) στην προσπάθεια που κάνει να ακολουθήσει μια αποτελεσματική νομισματική και πιστωτική πολιτική στα 17 κράτη-μέλη. Συγκεκριμένα εξετάζεται ο τρόπος, το μέγεθος και η ταχύτητα μετάδοσης των μεταβολών των επιτοκίων χονδρικής (wolesale rates) προς τα επιτόκια λιανικής (retail rates) του τραπεζικού συστήματος της ευρωζώνης. Η ύπαρξη ομοιογένειας και συμμετρίας από την ΕΚΤ προς όλα τα κράτη-μέλη έχει σήμερα μια ιδιαίτερη βαρύτητα μιας και η ευρωζώνη δεν αντιμετωπίζει πια μόνο την χρηματοοικονομική κρίση που ξέσπασε τον Αυγουστο του 2007 αλλά και το δημοσιονομικό χρέος των χωρών της Ν.Α. Ευρώπης.

Με βάση τα οικονομετρικά αποτελέσματα, τα οποία παρήχθησαν με την χρήση της οικονομετρικής μεθόδου LSE-Hendry GETS αλλά και της περιγραφικής στατιστικής (Descriptive statistics) γίνεται εμφανές ότι:

Α) την περίοδο πριν την κρίση (2003-2007) παρουσιάζεται λιγότερη ομοιογένεια και περισσότερη συμμετρία, ενώ

Β) την περίοδο μετά το ξέσπασμα της κρίσης (2008-2010) παρουσιάζεται μεγαλύτερη ομοιογένεια και λιγότερη συμμετρία.

Τα προαναφερθέντα αποτελέσματα μας αφήνουν με ένα σαφή ανοικτό προβληματισμό ότι η ομογενοποίηση του τραπεζικού συστήματος της ευρωζώνης έχει ακόμα αρκετό δρόμο μέχρι να επιτευχθεί.

CONTENTS

ABSTRACT

This paper examines the existence of interest rate pass through (PT) Convergence (Homogeneity and Symmetry) in the Eurozone before and during the financial crisis. Our approach is based on the introduction of a new ratio, called the 'Speed Of Adjustment Elasticity Ratio' (SAER). This ratio examines the time needed for the increasing/ decreasing wholesale (money market) rate to complete its transmission to the retail rate in the loan and deposit markets of the twelve member states of the Eurozone. From the derived results, and especially those in the loan rates markets, this convergence is challenged.

**Keywords** *Interest rates pass-through · Eurozone's Convergence · Financial crisis*

**JEL Classification** *E52· E43*

## 1. Introduction

The interest rate pass-through process, from the wholesale to the retail rates, is one of the most crucial process initiated by every central bank (CB) for achieving its monetary policy goals. These goals are often related with price stability (e.g. applying an anti-inflationary policy) and with real economic activity (e.g. smoothing the business cycles). More specifically, CBs by affecting and steering the wholesale (money market) interest rates exert a strong influence on the retail bank interest rates. Consequently, regarding the price stability issue, a quick and full pass-through of wholesale interest rates to retail bank interest rates strengthens monetary policy transmission and thus may affect price stability (Bondt, 2005). For the real economic activity issue, any change in the CB policy rate is meant to be transmitted to retail interest rates, ultimately influencing consumer and business lending rates and therefore aggregate domestic demand and economic activity (Karagiannis, Panagopoulos and Vlamis, 2010; Wang and Lee, 2009). As a advocate to its significance as a channel, Angeloni, Mojon, Kashyap, and Terlizzese (2002) find that the interest rate channel is the most important for monetary policy transmission in the Euro area. However, the effectiveness of such monetary policy channel, through interest rates, is expected to be more difficult when we deal with the financial convergence of the Eurozone.

While the Maastricht criteria focused on nominal convergence of inflation rates, government deficits and debts, rather less attention has been given to the convergence of financial European integration. The recent financial crisis, however, has intensified the need for more efficient European monetary integration – taking into account that the retail (deposit and lending) banking markets are still the "least" integrated financial markets within the EU (e.g., Baele *et al*., 2004). It is well known, that before 1999, the national CBs in the EU were responsible for their own monetary policy. Therefore their effectiveness was based on their ability to comprehend how changes in the key interest rates (central and money market) are transmitted to bank interest rates in order to be able to estimate the effects of monetary policy decisions on commercial banks' behaviour. The shift from national CBs to the European Central Bank (ECB) since January 1999 may have affected the interest rate pass-through process and therefore the banks' behaviour, as Bagliano *et al.* (2000) have proven theoretically.

As it has already mentioned above, in the monetary policy literature, the adjustment of retail bank interest rates (deposit and lending rates) in response to changes in wholesale rates (central bank and interbank money market rates) is a cornerstone of the interest rate transmission mechanism. Such behaviour attracts special attention in the Eurozone as we are dealing with a single currency and a single ECB but with seventeen different financial systems (e.g. compared to the US). Therefore for achieving any monetary policy goal the ECB needs to secure that these banking systems converge across Euro area. In other words, the more homogenous the PT response of the Eurozone's retail banking system is the more effective the ECB policy rates will turn out to be for achieving any aggregate economic policy goal. Since the effectiveness of the ECB's monetary policy is related to the degree of convergence of the national financial systems, the question that arises next is whether the Eurozone financial system is homogeneous and symmetric.

Many authors (Sander and Kleimeier 2004, 2006; Vajanne 2007; Hofmann 2006, inter alia) have paid particular attention to testing the Eurozone's feasibility of convergence through the interest rate PT mechanism. Our study advances this line of research by: a) implementing a different disaggregated model; b) applying different descriptive statistics for tracing out convergence inside the Eurozone; and c) testing how the financial crisis has affected the issue of convergence.

Analytically, we employ a symmetric/asymmetric error correction (EC) approach to the interest rate PT relationship; the latter was initially presented by Bachmeier and Griffin (2003) and further developed by Rao and Rao (2008). Our approach is based on the LSE-Hendry GETS methodology. The main advantages of the model derive from the two different speeds of adjustments, related to the separate positive and negative change in the variables (wholesale and retail rates), as well as the long run and short run rigidities that can be simultaneously estimated. The structure of such a model allows us to move further in creating our own ratio, similar to that of Scholnick (1996). We call this 'new' ratio as 'Speed of Adjustment Elasticity Ratio' (SAER) and measures the time needed (e.g. weeks, months etc.) for an increasing/decreasing wholesale rate to complete its transmission to the retail rate. Algebraically, we derive this new ratio by dividing the estimated long run PT elasticities (rigidities) by the speed of adjustment coefficients.

However, since the main target of this paper is to measure convergence through the degree of symmetry and homogeneity in the Eurozone, we focus on the differences of PT transmissions of each member state relative to the Eurozone's transmission. As a result, interest is shown mainly in the 'deviations' that each country's SAER exhibits relative to the corresponding Eurozone SAER. Any significant deviation between the two ratios will be an indication of relative lack of convergence (the homogeneity aspect) between individual countries and the Eurozone. Moreover, any significant deviation between positive and negative PT SAER estimates could be used as a measure of the other aspect of convergence, i.e. asymmetry.

The structure of the paper is as follows: section 2 briefly discusses the literature on PT convergence; section 3 presents the data and the empirical strategy for testing homogeneity and symmetry in the Eurozone before and during the financial crisis while section 4 analyses the empirical results and section 5 concludes.

## 2. Review of the literature

Homogeneity exists when retail banking interest rates in different EU banking systems react similarly to changes in wholesale money market and/or CB interest rates. On the other hand, heterogeneity across banks' products in terms of PT "can be caused by cross-country differences in retail bank regulation and taxation, which may provide banks with different constraints and incentives when pricing their retail products" (see ECB, 2009 Monthly Bulletin). This issue within the current European Monetary Union (EMU) is well documented by various strands of research. Most Eurozone PT studies are based on a variant of the pioneering work by Cottarelli and Kourelis (1994). Important contributions include BIS (1994), Cottarelli *et al.* (1995), Borio and Fritz (1995), Mojon (2001), de Bondt *et al.* (2002), Sander and Kleimeier (2000, 2004), Toolsema *et al.* (2002), Heinemann and Schüler (2002, 2003), de Bondt (2005), and De Graeve *et al.* (2004). Typically, these studies find considerable differences in PT across the countries of the Eurozone. Moreover, they identify a substantial degree of short-run bank interest rate stickiness while there is very limited evidence for a full pass-through in the long run. Usually monetary transmission heterogeneities are mainly driven by financial structure

differences. In such cases, the PT convergence may be at the centre of monetary transmission convergence.

Symmetry, on the other hand, is related with the way positive and negative wholesale interest rates are transmitted in the retail rates. Any difference between the two transmission channels is considered as an asymmetric behaviour. Additionally, asymmetric adjustment of retail interest rates is also regularly documented. However, it has been argued that ‘‘differences in financial structure are the proximate cause for [these] national asymmetries in the monetary transmission mechanism’’ (Cecchetti, 1999). Finally, it is often argued that the single currency should act as a unifying force that has the potential to make the PT faster and at the same time more complete and homogeneous. However, as argued by Sander and Kleimeier (2004), legal and cultural differences may continue to preclude full convergence in the incumbent Eurozone.

Several different approaches have been used for testing EU financial integration. For instance, Baele *et al.* (2004) and Vajanne (2007) predominantly use the so-called beta- and sigma-convergence measures, while Sander and Kleimeier (2000), and Schüler and Heinemann (2002) investigate retail banking market integration using cointegration approach. In our study we will use the LSE-Hendry GETS methodology in retail markets (deposit and lending) of all the twelve member states and the Eurozone. Then, due to the GETS characteristics, we will create a ‘new’ ratio that will measures the time needed (e.g. weeks, months etc.) for an increasing/decreasing wholesale (e.g. MM) rate to complete the long run transmission to the retail rate for all cases examined. This ratio will be utilised, using some descriptive statistics, for testing the degree of convergence (homogeneity and symmetry) between the twelve member states and the Eurozone.

## 3. Data and empirical strategy

### *3.1. Data selection*

Monthly data (1/2003–1/2010) are retrieved from the *ECB Statistical Data Warehouse* database for all the twelve countries and the Eurozone[1]. This database contains a significant number of deposit and loan rates (more than 50 different rates). From this

[1] Although the time period is not extensively long, homogenous bank retail rates are available for almost all the countries of the Eurozone, from the ECB database, since 2003. Therefore only from that year onwards we can seek the existence of interest rate convergence in the Eurozone.

"store" we select a representative number for both retail rate markets. More specifically, for the deposit market the variables used are: the overnight rate for non-financial corporations (D1) and households (D2), the rate for non-financial corporations (D3) and households (D4) with maturity up to 1 year. For the loan market, the rate to non-financial corporations up to 1 year (L1), over 1 year to 5 years (L2), the rate for consumption (excluding revolving loans and overdrafts convenience and extended credit card debt) up to 1 year (L3), over 1 year to 5 years (L4), the rate for house purchase (mortgages) for over 5 years (L5), and the overdraft rate for non-financial corporations (L6) and for households (L7) are used. Regarding the wholesale (MM) rates we have tested four different variables: The EONIA and three different maturity Euribors (3-month, 6-month and 12-month). Following Bondt's (2005) methodology the appropriate wholesale rate for each retail rate in each country has been selected with correlation analysis.[2] Finally, it is worth mentioning that we split the examined time period into two sub-periods – the pre-financial crisis period (2003m1-2007m12) and the financial crisis period that could be distinct starting [3] from the beginning of the year 2008 and onwards (2008m1-2010m1).

*3.2. Modelling the interest rate PT process*

A variety of error correction models[4] have been used for modelling the interest rates PT interventional policy on behalf of the monetary authorities to the banking system. In the case of ECB, policy rates interventions have a significant and immediate effect on money market rates of different maturities. Changes in ECB policy rates in normal circumstances will result in more or less one-to-one spillover to unsecured short-term money market rates, such as the EONIA and, to a somewhat lesser extent, the different maturity Euribor (3-month, 6-month and 12-month) rates. Consequently, changes in the money market interest rates, in turn, are transmitted to the different retail bank interest

[2] The correlation analysis results are available upon request.
[3] Typically the crisis starts gripping the global financial markets during the last quarter of the year 2007. However, as marked out by the data, the crisis actually emerges at the beginning of the year 2008.
[4] Such models are: the ECM-GE (Engle and Granger, 1987), the Threshold Autoregressive model (Enders and Granger, 1998; Enders and Siklos, 2001) and the *disaggregated* GETS model (Bachmeier and Griffin, 2003; Rao and Singh, 2006; Rao and Rao, 2008).

rates (loan and deposits) of the twelve member-states, albeit to varying degrees. The following long term interest rates PT model (eq. 1) presents this transmission process:

$$IR_{r,c,t} = \gamma_0 + \sum_{j=1}^{n1} k_{r,c} * IR_{r,c,t-j} + \sum_{i=1}^{n2} \phi_{w,c} * IR_{w,t-i} + e_{r,c,t} \qquad (1)$$

where: $IR_{r,c,t}$ is the different retail (loan and deposit) rates $r$ of country $c$ of the Eurozone at time $t$, $\gamma_0$ is the constant mark up[5], $n1, n2$, indicate the optimal lag lengths, $k_{r,c}$ is the coefficient of the short run interest rate rigidity (elasticity) of the different retail rates $r$ interia of country $c$ of the Eurozone, $\phi_{w,c}$ is the long-run interest rate rigidity (elasticity) of the selected wholesale (money market) rate $w$ at country $c$ of the Eurozone, $IR_{w,t-i}$ is the selected wholesale (money market) rate (e.g. the overnight rate, the 3-month money market rates etc.) at time $t-i$, $e_{r,c,t}$ is the error term for each specific retail rate $r$ of country $c$ of the Eurozone at time $t$.

The aforementioned long term PT model can be transformed in the following simple dynamic error correction form:

$$\Delta IR_{r,c,t} = \gamma_0 + \sum_{j=1}^{n1} \rho_{r,c} * \Delta IR_{r,c,t-j} + \sum_{i=1}^{n2} \lambda_{w,c} * \Delta IR_{w,t-i} - \theta_{r,c} * e_{r,c,t-1} + u_{r,c,t} \qquad (2)$$

Where: $\Delta$ is the difference operator, $\rho_{r,c}$ is the short run interest rate rigidity (elasticity) of the different retail rates $r$ interia of country $c$ of the Eurozone, $\lambda_{w,c}$ is the short run interest rate rigidity (elasticity) of the selected wholesale (money market) rate $w$ at country $c$ of the Eurozone, $\theta_{r,c}$ is the speed of retail rate adjustment $r$ of country $c$ initiated from the wholesale rate ($w$) changes, $e_{r,c,t-1}$ represents the error correction term and $u_{r,c,t}$ is the error term for each specific retail rate $r$ of country $c$ of the Eurozone at time $t$.

[5] See Rousseas (1985).

In the simple ECM (eq. 2) the retail rates ($IR_{r,c,t}$) and the speed of adjustment coefficient ($\theta_{r,c}$) cannot be analysed separately when the wholesale rates ($IR_{w,t-i}$) are increasing or decreasing. A disaggregated VECM model tackles the above issue and the aforementioned eq. 2 can be represented in the following form:

$$\Delta IR_{r,c,t} = \gamma_o + \sum_{i=0}^{l1} \rho_{r,c}^{-} \Delta IR_{r,c,t-i}^{-} + \sum_{i=0}^{l2} \lambda_{w,c}^{-} \Delta IR_{w,t-i}^{-} + \theta_{r,c}^{-} e_{r,c,t-1} +$$

$$+ \sum_{i=0}^{l3} \lambda_{w,c}^{+} \Delta IR_{w,t-i}^{+} + \sum_{i=0}^{l4} \rho_{r,c}^{+} \Delta IR_{r,c,t-i}^{+} + \theta_{r,c}^{+} e_{r,c,t-1} + \gamma_1 T + \omega_{r,c,t} \quad (3)$$

Where: $l1$, $l2$, $l3$, $l4$ indicate the optimal lag lengths, $\rho_{r,c}^{-}$ and $\rho_{r,c}^{+}$, replacing aggregate $\rho_{w,c}$ of eq 2, represent the negative and positive rigidities (elasticities) of the short run different retail rates $r$ interia of country $c$ of the Eurozone, $\lambda_{w,c}^{-}$ and $\lambda_{w,c}^{+}$, replacing aggregate $\lambda_{w,c}$ of eq. 2, represent the negative and positive coefficients of the short run wholesale (money market) rate rigidities (elasticities) $w$ at country $c$ of the Eurozone, $\theta_{r,c}^{-}$ and $\theta_{r,c}^{+}$, replacing aggregate $\theta_{r,c}$ of eq. 2, are the speed of adjustment coefficients in the negative and positive case, $T$ is the time trend and $\omega_{r,c,t}$ is the error term for each specific retail rate $r$ of country $c$ of the Eurozone at time $t$.

As Rao and Rao (2005) point out, the (+)/(–) superscript on the coefficients indicates a positive/negative change in the variables included in the model. On the one hand, for any positive change ($\Delta IR_{w,t}>0$) in the independent variable, a corresponding response of all positive coefficients ($\beta_{w,c}^{+}, \theta_{c,t}^{+}$) is expected. On the other hand, the corresponding negative coefficients ($\beta_{w,c}^{-}, \theta_{c,t}^{-}$) will respond in any negative change of the dependent variable ($\Delta IR_{w,t}<0$). Moving a step forward, the disaggregated GETS model (eq. 3) could thus be presented in the following form:

$$\Delta IR_{r,c,t} = \gamma_o + \sum_{i=0}^{l1} \rho_{r,c}^{-} \Delta IR_{r,c,t-i}^{-} + \sum_{i=0}^{l2} \lambda_{w,c}^{-} \Delta IR_{w,t-i}^{-} + \theta_{r,c}^{-} (IR_{r,c,t} - \phi_{w,c} IR_{w,t})_{t-1} +$$

$$+\sum_{i=0}^{l3}\lambda_{w,c}^{+}\,\Delta IR_{w,t-i}^{+}\;+\sum_{i=0}^{l4}\rho_{r,c}^{+}\,\Delta IR_{r,c,t-i}^{+}+\theta_{r,c}^{+}\;(IR_{r,c,t}\text{ - }\phi_{w,c}\;IR_{w,t})_{t\text{-}1}\;+\gamma_1 T+\xi_{r,c,t} \qquad (4)$$

Where: $\xi_{r,c,t}$ is the error term for each specific retail rate $r$ of country $c$ of the Eurozone at time $t$.

The main advantages of the disaggregated GETS model include: i) its capability of estimating both negative and positive short-run elasticities (e.g. the $\beta_{w,c}^{-}$ *and* $\beta_{w,c}^{+}$ in eq. 4), ii) the direct and simultaneous estimation of the long-run ($\phi_{w,c}$ or alternatively $\gamma_0$ + $\phi_{w,c}$) and the short-run interest rate PT rigidities in the same model and iii) in contrast with the other error correction PT methodologies (see footnote 4) it does not pre-requires to test for unit root and co-inegrating vectors among variables (see Rao & Rao, 2008).

*3.3. The 'Speed Of Adjustment Elasticity Ratio' (SAER)*

First, using equation (4), which is estimated with Non-Linear Least Squares method (N.L.L.S), we extract the values of $\phi_{w,c}$, $\theta_{r,c}^{-}$ and $\theta_{r,c}^{+}$ coefficients in each country (for each different retail rate) as well as the corresponding weighted coefficients for the Eurozone. These estimates are needed in order to derive the appropriate 'Speed of Adjustment Elasticity Ratio' (SAER). SAER represents the time needed (e.g. weeks, months etc.) for a decreasing/increasing wholesale rate to complete its transmission to the retail rate. Algebraically, this ratio is derived by dividing the estimated long run PT elasticities (rigidities), $\phi_{w,c}$ ,by the speed of adjustment coefficients, $\theta_{r,c}^{+}$ and. $\theta_{r,c}^{-}$ .

$$\text{SAER}_{r,c}^{+}=\frac{\phi_{w,c}}{\theta_{r,c}^{+}} \qquad (5)$$

$$\text{SAER}_{r,c}^{-}=\frac{\phi_{w,c}}{\theta_{r,c}^{-}} \qquad (6)$$

The statistical estimates of $\phi_{w,c}$, $\theta_{r,c}^{-}$, $\theta_{r,c}^{+}$ coefficients and the SAER values are

analytically presented in Tables 1 to 5 in the Appendix.[6]

Next, we calculate the difference (deviation) of each country's (positive and negative) SAER value(s) from the corresponding (weighted) aggregate for the Eurozone i.e. the country's SAER value(s) minus the Eurozone's SAER (for all different retail rates). We derive the equivalent (two) arithmetic means ( $\mu^{+}_{IR_r}$ , $\mu^{-}_{IR_r}$ ) and the standard deviations ( $\sigma^{+}_{IR_r}$ , $\sigma^{-}_{IR_r}$ ) of the above mentioned differences. As was already mentioned, we apply this methodology for two time periods. The first period is before the emergence of the recent financial crisis (2003m1-2007m12) while the second could be defined as the financial crisis period with the 'starting point' of the first month of 2008 and onwards.

The existence of a close to zero arithmetic mean and a small and consistent standard deviation value of the above differentials (a country's SAER value minus the Eurozone's SAER) provides us with evidence about the degree of homogeneity within the Eurozone area. An indication of the existence of symmetry among the Eurozone countries, for all different interest rates examined, can be found from the comparison between the difference in the values of the arithmetic mean ( $\mu^{Diff}_{IR_r}$ ) and standard deviation ( $\sigma^{Diff}_{IR_r}$ ), respectively. Looking at the empirical results before and during the financial crisis, we re-examine the PT interest rate convergence (homogeneity and symmetry) issue as a structure stability problem.

## 4. Empirical Results

Following the above empirical strategy we could summarise the (numerical) results, shown in the Appendix, as follows (see Table 4):[7]

[6] Only the statistically significant coefficients are presented in the Appendix. Additionally, four optimal lag selection criteria were implemented for regressing equation (4): the modified Likelihood Ratio test statistic, the Final Prediction Error test, the Akaike, the Schwarz and the Hannan-Quinn information criteria. In most of the examined cases the aforementioned selection criteria do not all agree about the optimal lag length. In each case, the majority rule is applied as a sub-optimal solution.

[7] Belgium and Luxembourg produce no statistically significant results.

**Table 4:** The arithmetic means and the standard deviations of the differential SAERs[d]

| | **2003(1)-2007(12)** before the financial crisis | | | | | | **2008(1)-2010(1)** financial crisis period | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) $\mu^{+}_{IR_r}$ | (2) $\mu^{-}_{IR_r}$ | (1-2) $\mu^{Diff}_{IR_r}$ | (3) $\sigma^{+}_{IR_r}$ | (4) $\sigma^{-}_{IR_r}$ | (3-4) $\sigma^{Diff}_{IR_r}$ | (1) $\mu^{+}_{IR_r}$ | (2) $\mu^{-}_{IR_r}$ | (1-2) $\mu^{Diff}_{IR_r}$ | (3) $\sigma^{+}_{IR_r}$ | (4) $\sigma^{-}_{IR_r}$ | (3-4) $\sigma^{Diff}_{IR_r}$ |
| **Loan interest rates** | | | | | | | | | | | | |
| **L1** | 0.40$^{He}$ | 0.36$^{He}$ | 0.04$^{Sy}$ | 0.49$^{Ho}$ | 0.51$^{Ho}$ | -0.02$^{Sy}$ | -0.77$^{He}$ | -0.83$^{He}$ | 0.06$^{Sy}$ | 4.21$^{He}$ | 2.02$^{He}$ | 2.19$^{As}$ |
| **L2** | -1.66$^{He}$ | -1.95$^{He}$ | 0.28$^{As}$ | 2.76$^{He}$ | 3.16$^{He}$ | -0.39$^{As}$ | -0.27$^{Ho}$ | -1.36$^{He}$ | 1.1$^{As}$ | 0.18$^{Ho}$ | 3.47$^{He}$ | -3.3$^{As}$ |
| **L3** | -1.33$^{He}$ | -1.15$^{He}$ | -0.18$^{As}$ | 2.56$^{He}$ | 2.11$^{He}$ | 0.45$^{As}$ | -0.12$^{Ho}$ | -0.06$^{Ho}$ | -0.1$^{Sy}$ | 0.13$^{Ho}$ | 0.34$^{Ho}$ | -0.2$^{As}$ |
| **L4** | -0.64$^{He}$ | -0.6$^{He}$ | -0.04$^{Sy}$ | 0.61$^{Ho}$ | 0.58$^{Ho}$ | 0.04$^{Sy}$ | -0.46$^{He}$ | -0.5$^{He}$ | 0.04$^{Sy}$ | 0.31$^{Ho}$ | 0.67$^{He}$ | -0.4$^{As}$ |
| **L5** | -0.64$^{He}$ | -0.59$^{He}$ | -0.05$^{Sy}$ | 2.57$^{He}$ | 2.22$^{He}$ | 0.36$^{As}$ | -0.96$^{He}$ | -0.91$^{He}$ | 0.00$^{Sy}$ | 5.92$^{He}$ | 2.27$^{He}$ | 3.64$^{As}$ |
| **L6** | 0.16$^{Ho}$ | 0.19$^{Ho}$ | -0.03$^{Sy}$ | 0.98$^{Ho}$ | 0.94$^{Ho}$ | 0.04$^{Sy}$ | 0.27$^{Ho}$ | 0.33$^{Ho}$ | -0.1$^{Sy}$ | 0.13$^{Ho}$ | 0.38$^{Ho}$ | -0.3$^{As}$ |
| **L7** | -1.47$^{He}$ | -1.49$^{He}$ | 0.02$^{Sy}$ | 1.18$^{He}$ | 1.21$^{He}$ | -0.03$^{Sy}$ | 3.32$^{He}$ | 3.10$^{He}$ | 0.21$^{As}$ | 11.6$^{He}$ | 4.49$^{He}$ | 7.09$^{As}$ |
| **Total**[e] | -0.77$^{He}$ | -0.78$^{He}$ | 0.01$^{Sy}$ | 2.04$^{He}$ | 2.01$^{He}$ | 0.03$^{Sy}$ | 0.16$^{Ho}$ | -0.03$^{Ho}$ | 0.19$^{As}$ | 2.28$^{He}$ | 2.93$^{He}$ | -0.7$^{As}$ |
| **Deposit interest rates** | | | | | | | | | | | | |
| **D1** | 0.65$^{He}$ | -0.07$^{Ho}$ | 0.71$^{As}$ | 0.62$^{Ho}$ | 0.55$^{Ho}$ | 0.07$^{Sy}$ | -0.81$^{He}$ | -0.14$^{Ho}$ | -0.7$^{As}$ | 2.88$^{He}$ | 0.28$^{Ho}$ | 2.59$^{As}$ |
| **D2** | -0.29$^{Ho}$ | 0.03$^{Ho}$ | -0.32$^{As}$ | 0.67$^{Ho}$ | 0.91$^{Ho}$ | -0.24$^{As}$ | 0.63$^{He}$ | 0.76$^{He}$ | -0.1$^{Sy}$ | 0.01$^{Ho}$ | 0.26$^{Ho}$ | -0.2$^{As}$ |
| **D3** | 0.22$^{Ho}$ | NA | 0.21$^{As}$ | 0.67$^{Ho}$ | NA | 0.67$^{As}$ | 2.28$^{He}$ | -0.33$^{Ho}$ | 2.61$^{As}$ | 0.07$^{Ho}$ | 1.25$^{He}$ | -1.2$^{As}$ |
| **D4** | -0.72$^{He}$ | -0.96$^{He}$ | 0.24$^{As}$ | 1.89$^{He}$ | 0.76$^{Ho}$ | 1.14$^{As}$ | -1.31$^{He}$ | -0.13$^{Ho}$ | -1.2$^{As}$ | 2.62$^{He}$ | 0.36$^{Ho}$ | 2.26$^{As}$ |
| **Total**[e] | 0.00$^{H0}$ | -0.32$^{He}$ | 0.32$^{As}$ | 1.19$^{He}$ | 1.2$^{He}$ | -0.01$^{Sy}$ | 0.08$^{H0}$ | -0.04$^{Ho}$ | 0.12$^{Sy}$ | 1.88$^{He}$ | 0.84$^{Ho}$ | 1.04$^{As}$ |

Note: He (heterogeneity), Ho (Homogeneity), Sy (Symmetry) and As (Asymmetry). [d] All presented values are statistically significant at 5%. [e] The total arithmetic mean for all $SAER^{+}s$ and $SAER^{-}s$ for all countries and all banking products (retail interest rates) is derived as follows: $\mu_{total} = N_r * \mu^{(\pm)}_{IR_r}/N$. The total standard deviation $(\sigma_{total})$ is calculated as: $(\sigma_{total}) = \sqrt{\frac{\Sigma\left(N_i * \sigma^{\pm 2}_{IR_r}\right) + \Sigma\left(\mu^{\pm 2}_{IR_r} - \mu_{total}\right)^2 * N_i}{N}}$ where $N_i$ is the number of countries (subgroup) which their SAER values were found statistically significant in each banking product, $\mu^{\pm}_{IR_r}$ the (two) arithmetic means, $\sigma^{\pm}_{IR_r}$ the corresponding standard deviations and $N$ the summation of all $N_i$.

From the above results we observe that PT market transmission mechanisms in the Eurozone loan interest rate markets appear to behave mostly heterogeneously. The evidence (apart from the L6 case) clearly rejects the null hypothesis, i.e. the existence of close to zero arithmetic mean and small and consistent standard deviation values of the examined SAER differentials. In contrast, PT in the deposit markets appears more homogeneous.

On the contrary, the findings for the financial crisis time period seem to be more harmonized and inclined towards homogeneity. It looks as if in hard times, PT market transmission mechanisms become more unified and interrelated. As fear and uncertainty grow in the markets, the countries' retail interest rates tend to exhibit more 'uniform' reactions to money market changes and the central bank's policies, i.e. the arithmetical

means of the SAER differentials come closer to zero and the corresponding standard deviations become smaller[8]. This may be due to the fact that the systematic risk in the total market increases relatively faster than the individual country market risk. The common risk factor becomes the main driving force in the PT interest transmission process in the Euro monetary system.

As regards to the symmetry/asymmetry issue our findings look more uni-directionally signalled towards the null hypothesis, i.e. PT market transmission mechanisms are quite symmetric and less dependent on market timing. However, we should not overlook that the market's symmetric behaviour is loosened throughout the crisis period.

## 5. Conclusions

This paper examines the existence of interest rate PT convergence (homogeneity and symmetry) in the Eurozone before and during the financial crisis. A homogenous behaviour, on behalf of the retail interest rates of the Eurozone's different banking systems, is considered as crucial for the capability of the ECB policy rates to succeed some main aggregate economic targets (e.g. price stability and real economic growth in the Eurozone). Moreover, the convergence in the financial markets behaviour is more urgent today than a decade ago. This happens because the Eurozone's member states, after the eruption of the financial crisis in August 2007, face now the sovereign debt crisis of the south European economies and therefore a stable, homogenous and efficient monetary system and monetary transmission mechanism is almost a pre-condition for overcoming this new serious problem.

For testing the convergence we introduce a new ratio, called the 'Speed of Adjustment Elasticity Ratio' (SAER). This ratio indicates the time needed for the increasing/decreasing wholesale (money market) rate to complete its transmission to the increasing/decreasing retail rate in the loan and deposit markets of the twelve member states of the Eurozone. From the derived results, and especially those in the loan rates markets, the convergence is challenged. Before the onset of the financial crisis it is

[8] It is important to underline here that due to the limited amount of observations regarding to the examined financial crisis period (2008-2010), the derived empirical results may reveal econometric problems in the residuals (e.g. normality problems or autocorrelation) and therefore should be treated with caution.

challenged through the lack of homogeneity, while through the financial crisis the challenging factor becomes the lack of symmetry[9]. This type of information (in qualitative and quantitative terms) may be quite useful for regulatory authorities in their attempt to monitor and reinforce monetary policy effectiveness in the Eurozone area.

[9] On the issue of interest rate homogeneity in the Eurozone, in contrast to our results, the ECB (2009) claims that the cross country dispersion was not affected by the financial crisis that erupted in August 2007.

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## Appendix: Table 1: The long run PT rigidities (elasticities)

**Before the financial Crisis (2003(1)-2007(12))**

| $\phi_{w,c}$ | EU | DE | EU-DE | IE | EU-IE | GR | EU-GR | ES | EU-ES | FR | EU-FR | IT | EU-IT | NL | EU-NL | AT | EU-AT | PT | EU-PT | FT | EU-FT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Loan rates** | | | | | | | | | | | | | | | | | | | | | |
| **Lo1** | 0.83 | 0.81 | 0.02 | | | 0.69 | 0.14 | 1.03 | -0.20 | 0.56 | 0.27 | 0.78 | 0.05 | 0.74 | 0.09 | 0.93 | -0.10 | | | 0.90 | -0.07 |
| **Lo2** | 0.89 | 1.01 | -0.12 | 1.11 | -0.22 | 0.77 | 0.12 | 1.07 | -0.18 | 0.89 | 0.00 | 0.89 | 0.00 | 0.85 | 0.04 | 0.87 | 0.02 | 0.76 | 0.13 | 0.97 | -0.08 |
| **Lo3** | 0.67 | 0.56 | 0.11 | 1.16 | -0.49 | 0.81 | -0.14 | 0.99 | -0.32 | | | 0.32 | 0.35 | 0.96 | -0.29 | 0.86 | -0.19 | 0.59 | 0.08 | 1.49 | -0.82 |
| **Lo4** | 0.33 | 0.26 | 0.07 | | | 0.37 | -0.04 | 0.43 | -0.10 | 0.61 | -0.28 | 0.31 | 0.02 | | | 1.11 | -0.78 | 1.03 | -0.70 | 0.97 | -0.64 |
| **Lo5** | 0.55 | 0.29 | 0.26 | 1.00 | -0.45 | 0.43 | 0.12 | 1.07 | -0.52 | 0.23 | 0.32 | 0.88 | -0.33 | 0.36 | 0.19 | 0.80 | -0.25 | 0.85 | -0.30 | 0.99 | -0.44 |
| **Lo6** | 0.81 | 0.76 | 0.05 | 1.07 | -0.26 | 0.35 | 0.46 | 0.82 | -0.01 | 1.07 | -0.26 | 0.76 | 0.05 | | | 1.05 | -0.24 | 0.89 | -0.08 | 1.00 | -0.19 |
| **Lo7** | 0.55 | 0.66 | -0.11 | 0.02 | 0.53 | 0.90 | -0.35 | 0.88 | -0.33 | 0.59 | -0.04 | 0.35 | 0.20 | 0.68 | -0.13 | 0.91 | -0.36 | 0.78 | -0.23 | 1.20 | -0.65 |
| **Deposit rates** | | | | | | | | | | | | | | | | | | | | | |
| **de1** | 0.43 | 0.55 | -0.12 | | 0.43 | 0.17 | 0.26 | 0.41 | 0.02 | 0.08 | 0.35 | | | 0.54 | -0.11 | 0.57 | -0.14 | 0.3 | 0.13 | 0.58 | -0.15 |
| **de2** | 0.22 | | | | | | | 0.24 | -0.02 | | | | | 0.21 | 0.01 | 0.34 | -0.12 | 0.1 | 0.12 | 0.36 | -0.14 |
| **de3** | 0.95 | | | | | 1.09 | -0.14 | 0.92 | 0.03 | 0.91 | 0.04 | | | 0.94 | 0.01 | 0.97 | -0.02 | 0.99 | -0.04 | 1 | -0.05 |
| **de4** | 0.89 | | | | | | | 0.91 | -0.02 | 0.83 | 0.06 | | | 0.8 | 0.09 | 0.91 | -0.02 | 0.95 | -0.06 | 1.02 | -0.13 |

**Financial Crisis Period (2008(1)-2010(1))**

| $\phi_{w,c}$ | EU | DE | EU-DE | IE | EU-IE | GR | EU-GR | ES | EU-ES | FR | EU-FR | IT | EU-IT | NL | EU-NL | AT | EU-AT | PT | EU-PT | FT | EU-FT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Loan rates** | | | | | | | | | | | | | | | | | | | | | |
| **Lo1** | 0.77 | 0.62 | 0.15 | | | 0.74 | 0.03 | 0.74 | 0.03 | 0.58 | 0.19 | 0.81 | -0.04 | 0.74 | 0.03 | 0.81 | -0.04 | 1.01 | -0.24 | 0.99 | -0.22 |
| **Lo2** | 0.77 | 0.6 | 0.17 | 1 | -0.23 | 0.61 | 0.16 | 0.68 | 0.09 | 0.44 | 0.33 | 0.9 | -0.13 | 1.39 | -0.62 | 0.72 | 0.05 | 0.88 | -0.11 | 0.84 | -0.07 |
| **Lo3** | 0.24 | 0.04 | 0.2 | | | 0.31 | -0.07 | 0.46 | -0.22 | | | | | 0.26 | -0.02 | 0.6 | -0.36 | 0.84 | -0.6 | 1.28 | -1.04 |
| **Lo4** | 0.26 | 0.15 | 0.11 | | | 0.4 | -0.14 | 0.39 | -0.13 | 0.21 | 0.05 | 0.01 | 0.25 | | | 0.71 | -0.45 | 0.32 | -0.06 | 0.41 | -0.15 |
| **Lo5** | 0.44 | | | 0.6 | -0.16 | 0.46 | -0.02 | 0.95 | -0.51 | 0.09 | 0.35 | 0.62 | -0.18 | 0.17 | 0.27 | 1.25 | -0.81 | 1.17 | -0.73 | 0.92 | -0.48 |
| **Lo6** | 0.79 | 0.56 | 0.23 | 0.76 | 0.03 | 0.65 | 0.14 | 0.07 | 0.72 | 0.58 | 0.21 | 0.84 | -0.05 | | | 0.73 | 0.06 | 0.83 | -0.04 | 1.02 | -0.23 |
| **Lo7** | 1.23 | 0.56 | 0.67 | | | 0.63 | 0.6 | 0.42 | 0.81 | 1.52 | -0.29 | 0.7 | 0.53 | 0.75 | 0.48 | 1.51 | -0.28 | 0.5 | 0.73 | 1.28 | -0.05 |
| **Deposit rates** | | | | | | | | | | | | | | | | | | | | | |
| **de1** | 0.4 | 0.58 | -0.18 | | | 0.21 | 0.19 | 0.42 | -0.02 | | | | | 0.6 | -0.2 | 0.59 | -0.19 | 0.27 | 0.13 | 0.52 | -0.12 |
| **de2** | 0.2 | | | | | | | 0.09 | 0.11 | | | | | 0.08 | 0.12 | 0.39 | -0.19 | | | 0.28 | -0.08 |
| **de3** | 0.93 | | | | | 0.96 | -0.03 | | | 1.02 | -0.09 | | | 1.06 | -0.13 | 0.91 | 0.02 | 0.87 | 0.06 | | |
| **de4** | 0.79 | | | | | | | 0.7 | 0.09 | 0.83 | -0.04 | | | 0.78 | 0.01 | 1.05 | -0.26 | | | 1.05 | -0.26 |

## Appendix: Table 2: The speed of adjustment coefficients

**Before the financial Crisis (2003(1)-2007(12))**

| $\theta^{-}_{r,c}$ | EU | DE | EU-DE | IE | EU-IE | GR | EU-GR | ES | EU-ES | FR | EU-FR | IT | EU-IT | NL | EU-NL | AT | EU-AT | PT | EU-PT | FT | EU-FT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Loan rates** | | | | | | | | | | | | | | | | | | | | | |
| **Lo1** | 0.35 | 0.41 | -0.06 | | | 0.55 | -0.2 | 0.41 | -0.06 | 0.34 | 0.01 | 0.53 | -0.18 | 0.38 | -0.03 | 0.33 | 0.02 | | | 0.37 | -0.02 |
| **Lo2** | 0.41 | 0.21 | 0.2 | 0.56 | -0.15 | 0.34 | 0.07 | 0.11 | 0.3 | 0.35 | 0.06 | 0.69 | -0.28 | 0.08 | 0.33 | 0.29 | 0.12 | 0.34 | 0.07 | 0.36 | 0.05 |
| **Lo3** | 0.72 | 0.51 | 0.21 | 0.8 | -0.08 | 0.86 | -0.14 | 0.9 | -0.18 | | | 0.62 | 0.1 | 0.66 | 0.06 | 0.32 | 0.4 | 0.36 | 0.36 | 0.19 | 0.53 |
| **Lo4** | 0.48 | 0.37 | 0.11 | | | 0.75 | -0.27 | 0.48 | 0 | 0.39 | 0.09 | 0.37 | 0.11 | | | 0.56 | -0.08 | 0.53 | -0.05 | 0.52 | -0.04 |
| **Lo5** | 0.19 | 0.05 | 0.14 | 0.26 | -0.07 | 0.19 | 0 | 0.13 | 0.06 | 0.37 | -0.18 | 0.63 | -0.44 | 0.21 | -0.02 | 0.25 | -0.06 | 0.33 | -0.14 | 0.19 | 0 |
| **Lo6** | 0.34 | 0.25 | 0.09 | 0.75 | -0.41 | 0.21 | 0.13 | 1.14 | -0.8 | 0.4 | -0.06 | 0.56 | -0.22 | | | 0.27 | 0.07 | 0.42 | -0.08 | 0.35 | -0.01 |
| **Lo7** | 0.69 | 0.3 | 0.39 | | | 0.6 | 0.09 | 0.25 | 0.44 | 0.55 | 0.14 | 0.41 | 0.28 | 0.19 | 0.5 | 0.21 | 0.48 | 0.77 | -0.08 | 0.48 | 0.21 |
| **Deposit rates** | | | | | | | | | | | | | | | | | | | | | |
| **de1** | 0.5 | 0.23 | 0.27 | | | 0.46 | 0.04 | 0.31 | 0.19 | 0.91 | -0.41 | | | 0.41 | 0.09 | 0.35 | 0.15 | 0.93 | -0.43 | 0.4 | 0.1 |
| **de2** | 0.24 | | | | | | | 0.24 | 0 | 0.43 | -0.19 | | | | | 0.56 | -0.32 | 0.41 | -0.17 | 0.14 | 0.1 |
| **de3** | | | | | | | | | | | | | | | | | | | | | |
| **de4** | 1.02 | | | | | | | 0.59 | 0.43 | 0.62 | 0.4 | | | 0.57 | 0.45 | 0.84 | 0.18 | 0.29 | 0.73 | 0.43 | 0.59 |
| $\theta^{-}_{r,c}$ | **EU** | **DE** | **EU-DE** | **IE** | **EU-IE** | **GR** | **EU-GR** | **ES** | **EU-ES** | **FR** | **EU-FR** | **IT** | **EU-IT** | **NL** | **EU-NL** | **AT** | **EU-AT** | **PT** | **EU-PT** | **FT** | **EU-FT** |
| **Loan rates** | | | | | | | | | | | | | | | | | | | | | |
| **Lo1** | 0.35 | 0.41 | -0.06 | | 0.35 | 0.56 | -0.21 | 0.42 | -0.07 | 0.34 | 0.01 | 0.54 | -0.19 | 0.4 | -0.05 | 0.34 | 0.01 | | | 0.37 | -0.02 |
| **Lo2** | 0.4 | 0.21 | 0.19 | 0.56 | -0.16 | 0.34 | 0.06 | 0.11 | 0.29 | 0.36 | 0.04 | 0.68 | -0.28 | 0.1 | 0.3 | 0.3 | 0.1 | 0.34 | 0.06 | 0.36 | 0.04 |
| **Lo3** | 0.72 | 0.51 | 0.21 | 0.83 | -0.11 | 0.85 | -0.13 | 0.89 | -0.17 | | | 0.62 | 0.1 | 0.63 | 0.09 | 0.31 | 0.41 | 0.36 | 0.36 | 0.16 | 0.56 |
| **Lo4** | 0.49 | 0.37 | 0.12 | | | 0.77 | -0.28 | 0.45 | 0.04 | 0.4 | 0.09 | 0.38 | 0.11 | | | 0.5 | -0.01 | 0.55 | -0.06 | 0.5 | -0.01 |
| **Lo5** | 0.18 | 0.05 | 0.13 | 0.25 | -0.07 | 0.2 | -0.02 | 0.11 | 0.07 | 0.36 | -0.18 | 0.63 | -0.45 | 0.2 | -0.02 | 0.24 | -0.06 | 0.33 | -0.15 | 0.18 | 0 |
| **Lo6** | 0.34 | 0.25 | 0.09 | 0.74 | -0.4 | 0.22 | 0.12 | 1.21 | -0.87 | 0.35 | -0.01 | 0.57 | -0.23 | | | 0.27 | 0.07 | 0.41 | -0.07 | 0.36 | -0.02 |
| **Lo7** | 0.69 | 0.3 | 0.39 | | | 0.6 | 0.09 | 0.25 | 0.44 | 0.56 | 0.13 | 0.42 | 0.27 | 0.19 | 0.5 | 0.22 | 0.47 | 0.77 | -0.08 | 0.47 | 0.22 |
| **Deposit rates** | | | | | | | | | | | | | | | | | | | | | |
| **de1** | 0.27 | | | | | 0.54 | -0.27 | 0.28 | -0.01 | 0.78 | -0.51 | | | 0.45 | -0.18 | 0.34 | -0.07 | 0.94 | -0.67 | 0.38 | -0.11 |
| **de2** | 0.28 | | | | | | | 0.23 | 0.05 | 0.4 | -0.12 | | | 0.19 | 0.09 | 0.6 | -0.32 | 0.37 | -0.09 | 0.15 | 0.13 |
| **de3** | 0.54 | | | | | 0.57 | -0.03 | 0.31 | 0.23 | 0.74 | -0.2 | | | 0.59 | -0.05 | 0.92 | -0.38 | 1.23 | -0.69 | 0.82 | -0.28 |
| **de4** | 0.36 | | | | | | | 0.13 | 0.23 | 0.62 | -0.26 | | | 0.55 | -0.19 | 0.36 | 0 | 0.27 | 0.09 | 0.31 | 0.05 |

| Financial Crisis Period (2008(1)-2010(1)) | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\theta^{-}_{r,c}$ | EU | DE | EU-DE | IE | EU-IE | GR | EU-GR | ES | EU-ES | FR | EU-FR | IT | EU-IT | NL | EU-NL | AT | EU-AT | PT | EU-PT | FT | EU-FT |
| **Loan rates** | | | | | | | | | | | | | | | | | | | | | |
| **Lo1** | 0.98 | 1.2 | -0.22 | | | 0.37 | 0.61 | 0.6 | 0.38 | 1.15 | -0.17 | 0.94 | 0.04 | 1.23 | -0.25 | 1.33 | -0.35 | 0.14 | 0.84 | 0.94 | 0.04 |
| **Lo2** | 0.8 | 0.72 | 0.08 | 0.43 | 0.37 | 0.39 | 0.41 | 0.77 | 0.03 | 0.66 | 0.14 | 0.68 | 0.12 | 0.11 | 0.69 | 1.08 | -0.28 | 0.74 | 0.06 | 0.71 | 0.09 |
| **Lo3** | 0.69 | 1.05 | -0.36 | | | 1.15 | -0.46 | 1.64 | -0.95 | | | | | 1.26 | -0.57 | 0.97 | -0.28 | 0.79 | -0.1 | | |
| **Lo4** | 1.5 | 1.91 | -0.41 | | | 0.8 | 0.7 | 0.85 | 0.65 | 0.72 | 0.78 | 0.15 | 1.35 | | | 0.8 | 0.7 | 0.14 | 1.36 | 0.52 | 0.98 |
| **Lo5** | 0.3 | | | 1.06 | -0.76 | 0.2 | 0.1 | 0.13 | 0.17 | 0.67 | -0.37 | 0.46 | -0.16 | 0.17 | 0.13 | | | 0.25 | 0.05 | 0.54 | -0.24 |
| **Lo6** | 0.74 | 1.17 | -0.43 | 1.2 | -0.46 | 0.56 | 0.18 | 0.61 | 0.13 | 1.07 | -0.33 | 0.69 | 0.05 | | | 1.51 | -0.77 | 0.63 | 0.11 | 1.62 | -0.88 |
| **Lo7** | 0.18 | 0.26 | -0.08 | | | 0.38 | -0.2 | 0.88 | -0.7 | 0.15 | 0.03 | 0.67 | -0.49 | 0.46 | -0.28 | 0.11 | 0.07 | 0.49 | -0.31 | 0.76 | -0.58 |
| **Deposit rates** | | | | | | | | | | | | | | | | | | | | | |
| **de1** | 0.91 | 1.01 | | | | 2.08 | -1.17 | 1.04 | -0.13 | | | | | | | 0.88 | 0.03 | 0.37 | 0.54 | 0.51 | 0.4 |
| **de2** | 0.2 | | | | | | | 1.12 | -0.92 | | | | | 0.99 | -0.79 | 0.57 | -0.37 | | | 2.52 | -2.32 |
| **de3** | 0.8 | | | | | 0.96 | -0.16 | 0.22 | 0.58 | 2.06 | -1.26 | | | 1.45 | -0.65 | 0.71 | 0.09 | 2.18 | -1.38 | 0.43 | 0.37 |
| **de4** | 1.3 | | | | | | | 1.45 | -0.15 | 2.2 | -0.9 | | | 1.17 | 0.13 | 0.74 | 0.56 | | | 1.4 | -0.1 |
| $\theta^{+}_{r,c}$ | EU | DE | EU-DE | IE | EU-IE | GR | EU-GR | ES | EU-ES | FR | EU-FR | IT | EU-IT | NL | EU-NL | AT | EU-AT | PT | EU-PT | FT | EU-FT |
| **Loan rates** | | | | | | | | | | | | | | | | | | | | | |
| **Lo1** | 0.98 | 1.23 | -0.25 | | | 0.37 | 0.61 | 0.61 | 0.37 | 1.16 | -0.18 | 0.97 | 0.01 | 1.37 | -0.39 | 1.41 | -0.43 | 0.14 | 0.84 | 1.57 | -0.59 |
| **Lo2** | 0.88 | 0.76 | 0.12 | 0.48 | 0.4 | 0.38 | 0.5 | 0.77 | 0.11 | 0.64 | 0.24 | 0.8 | 0.08 | 1.01 | -0.13 | 1.1 | -0.22 | 0.77 | 0.11 | 0.78 | 0.1 |
| **Lo3** | 0.66 | 1 | -0.34 | | | 1.06 | -0.4 | 1.72 | -1.06 | | | | | 1.34 | -0.68 | 0.94 | -0.28 | 0.82 | -0.16 | 1.36 | -0.7 |
| **Lo4** | 1.52 | 1.89 | -0.37 | | | 0.8 | 0.72 | 0.86 | 0.66 | 0.73 | 0.79 | 0.15 | 1.37 | | | 0.74 | 0.78 | 0.17 | 1.35 | 0.51 | 1.01 |
| **Lo5** | 0.31 | | | 1.14 | -0.83 | 0.21 | 0.1 | 0.11 | 0.2 | 0.68 | -0.37 | 0.48 | -0.17 | 0.17 | 0.14 | 0.33 | -0.02 | 0.54 | -0.23 | 0.54 | -0.23 |
| **Lo6** | 0.8 | 1.17 | -0.37 | 1.23 | -0.43 | 0.59 | 0.21 | 0.57 | 0.23 | 1.04 | -0.24 | 0.73 | 0.07 | | | 1.48 | -0.68 | 0.64 | 0.16 | 1.61 | -0.81 |
| **Lo7** | 0.19 | 0.26 | -0.07 | | | 0.39 | -0.2 | 0.88 | -0.69 | 0.16 | 0.03 | 0.69 | -0.5 | 0.5 | -0.31 | 0.16 | 0.03 | 0.47 | -0.28 | 0.77 | -0.58 |
| **Deposit rates** | | | | | | | | | | | | | | | | | | | | | |
| **de1** | 1.14 | 0.11 | 1.03 | | 1.14 | 1.91 | -0.77 | 0.62 | 0.52 | | | | | 0.93 | 0.21 | 1.33 | -0.19 | 1.71 | -0.57 | 0.62 | 0.52 |
| **de2** | 0.26 | | | | | | | 1.03 | -0.77 | | | | | 1.05 | -0.79 | 1.31 | -1.05 | | | 2.87 | -2.61 |
| **de3** | 0.32 | | | | | 1.89 | -1.57 | | | 1.17 | -0.85 | | | 1.06 | -0.74 | 2.27 | -1.95 | 2.63 | -2.31 | | |
| **de4** | 1.18 | | | | | | | 1.46 | -0.28 | 2.07 | -0.89 | | | 0.19 | 0.99 | 0.28 | 0.9 | | | 0.92 | 0.26 |

## Appendix: Table 3: The Speed Of Adjustment Elasticity Ratio (SAER)

**Before the financial Crisis (2003(1)-2007(12))**

| $SAER^{-}_{r,c}$ | EU | DE | EU-DE | IE | EU-IE | GR | EU-GR | ES | EU-ES | FR | EU-FR | IT | EU-IT | NL | EU-NL | AT | EU-AT | PT | EU-PT | FT | EU-FT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Loan rates** | | | | | | | | | | | | | | | | | | | | | |
| **Lo1** | 2.371 | 1.98 | 0.3958 | | | 1.255 | 1.1169 | 2.512 | -0.141 | 1.65 | 0.724 | 1.472 | 0.9 | 1.95 | 0.424 | 2.82 | -0.4468 | | | 2.432 | -0.061 |
| **Lo2** | 2.171 | 4.81 | -2.639 | 1.982 | 0.189 | 2.265 | -0.094 | 9.727 | -7.557 | 2.54 | -0.372 | 1.29 | 0.881 | 10.6 | -8.45 | 3 | -0.8293 | 2.235 | -0.065 | 2.694 | -0.524 |
| **Lo3** | 0.931 | 1.1 | -0.167 | 1.45 | -0.52 | 0.942 | -0.011 | 1.1 | -0.169 | | | 0.516 | 0.414 | 1.45 | -0.52 | 2.69 | -1.7569 | 1.639 | -0.708 | 7.842 | -6.912 |
| **Lo4** | 0.688 | 0.7 | -0.015 | | | 0.493 | 0.1942 | 0.896 | -0.208 | 1.56 | -0.877 | 0.838 | -0.15 | | | 1.98 | -1.2946 | 1.943 | -1.256 | 1.865 | -1.178 |
| **Lo5** | 2.895 | 5.8 | -2.905 | 3.846 | -0.95 | 2.263 | 0.6316 | 8.231 | -5.336 | 0.62 | 2.273 | 1.397 | 1.498 | 1.71 | 1.18 | 3.2 | -0.3053 | 2.576 | 0.319 | 5.211 | -2.316 |
| **Lo6** | 2.382 | 3.04 | -0.658 | 1.427 | 0.956 | 1.667 | 0.7157 | 0.719 | 1.6631 | 2.68 | -0.293 | 1.357 | 1.025 | | | 3.89 | -1.5065 | 2.119 | 0.2633 | 2.857 | -0.475 |
| **Lo7** | 0.797 | 2.2 | -1.403 | | 0.797 | 1.5 | -0.703 | 3.52 | -2.723 | 1.07 | -0.276 | 0.854 | -0.06 | 3.58 | -2.78 | 4.33 | -3.5362 | 1.013 | -0.216 | 2.5 | -1.703 |
| **Deposit rates** | | | | | | | | | | | | | | | | | | | | | |
| **de1** | 0.86 | | 0.86 | | 0.86 | 0.37 | 0.4904 | 1.323 | -0.463 | 0.09 | 0.772 | | | 1.32 | -0.46 | 1.63 | -0.7686 | 0.323 | 0.5374 | 1.45 | -0.59 |
| **de2** | 0.917 | | 0.9167 | | 0.917 | | | 1 | -0.083 | | | | | | | 0.61 | 0.3095 | 0.244 | 0.6728 | 2.571 | -1.655 |
| **de3** | | | | | | | | | | | | | | | | | | | | | |
| **de4** | 0.873 | | 0.8725 | | 0.873 | | | 1.542 | -0.67 | 1.34 | -0.466 | | | 1.4 | -0.53 | 1.08 | -0.2108 | 3.276 | -2.403 | 2.372 | -1.5 |
| $SAER^{+}_{r,c}$ | EU | DE | EU-DE | IE | EU-IE | GR | EU-GR | ES | EU-ES | FR | EU-FR | IT | EU-IT | NL | EU-NL | AT | EU-AT | PT | EU-PT | FT | EU-FT |
| **Loan rates** | | | | | | | | | | | | | | | | | | | | | |
| **Lo1** | 2.371 | 1.976 | 0.396 | | | 1.23 | 1.139 | 2.45 | -0.08 | 1.65 | 0.724 | 1.444 | 0.927 | 1.85 | 0.521 | 2.74 | -0.36 | | | 2.432 | -0.06 |
| **Lo2** | 2.225 | 4.81 | -2.58 | 1.98 | 0.243 | 2.26 | -0.04 | 9.73 | -7.5 | 2.47 | -0.25 | 1.309 | 0.916 | 8.5 | -6.28 | 2.9 | -0.68 | 2.24 | -0.01 | 2.694 | -0.47 |
| **Lo3** | 0.931 | 1.098 | -0.17 | 1.4 | -0.47 | 0.95 | -0.02 | 1.11 | -0.18 | | | 0.516 | 0.414 | 1.524 | -0.59 | 2.77 | -1.84 | 1.64 | -0.71 | 9.313 | -8.38 |
| **Lo4** | 0.673 | 0.703 | -0.03 | | | 0.48 | 0.193 | 0.96 | -0.28 | 1.53 | -0.85 | 0.816 | -0.14 | | | 2.22 | -1.55 | 1.87 | -1.2 | 1.94 | -1.27 |
| **Lo5** | 3.056 | 5.8 | -2.74 | 4 | -0.94 | 2.15 | 0.906 | 9.73 | -6.67 | 0.64 | 2.417 | 1.397 | 1.659 | 1.8 | 1.256 | 3.33 | -0.28 | 2.58 | 0.48 | 5.5 | -2.44 |
| **Lo6** | 2.382 | 3.04 | -0.66 | 1.45 | 0.936 | 1.59 | 0.791 | 0.68 | 1.7 | 3.06 | -0.67 | 1.333 | 1.049 | | | 3.89 | -1.51 | 2.17 | 0.212 | 2.778 | -0.4 |
| **Lo7** | 0.797 | 2.2 | -1.4 | | | 1.5 | -0.7 | 3.52 | -2.72 | 1.05 | -0.26 | 0.833 | -0.04 | 3.579 | -2.78 | 4.14 | -3.34 | 1.01 | -0.22 | 2.553 | -1.76 |
| **Deposit rates** | | | | | | | | | | | | | | | | | | | | | |
| **de1** | 1.593 | | | | | 0.31 | 1.278 | 1.46 | 0.13 | 0.1 | 1.49 | | | 1.2 | 0.393 | 1.68 | -0.08 | 0.32 | 1.273 | 1.526 | 0.066 |
| **de2** | 0.786 | | | | | | | 1.04 | -0.26 | | | | | 1.105 | -0.32 | 0.57 | 0.219 | 0.27 | 0.515 | 2.4 | -1.61 |
| **de3** | 1.759 | | | | | 1.91 | -0.15 | 2.97 | -1.21 | 1.23 | 0.53 | | | 1.593 | 0.166 | 1.05 | 0.705 | 0.8 | 0.954 | 1.22 | 0.54 |
| **de4** | 2.472 | | | | | | | 7 | -4.53 | 1.34 | 1.134 | | | 1.455 | 1.018 | 2.53 | -0.06 | 3.52 | -1.05 | 3.29 | -0.82 |

| Financial Crisis Period (2008(1)-2010(1)) | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $SAER^{-}_{r,c}$ | EU | DE | EU-DE | IE | EU-IE | GR | EU-GR | ES | EU-ES | FR | EU-FR | IT | EU-IT | NL | EU-NL | AT | EU-AT | PT | EU-PT | FT | EU-FT |
| **Loan rates** | | | | | | | | | | | | | | | | | | | | | |
| **Lo1** | 0.786 | 0.5167 | 0.269 | | | 2 | -1.2143 | 1.233 | -0.448 | 0.504 | 0.2814 | 0.862 | -0.076 | 0.6016 | 0.184 | 0.609 | 0.1767 | 7.2143 | -6.429 | 1.053 | -0.267 |
| **Lo2** | 0.963 | 0.8333 | 0.1292 | 2.3256 | -1.363 | 1.564 | -0.6016 | 0.883 | 0.0794 | 0.667 | 0.2958 | 1.324 | -0.361 | 12.636 | -11.67 | 0.6667 | 0.2958 | 1.1892 | -0.227 | 1.183 | -0.221 |
| **Lo3** | 0.348 | 0.0381 | 0.3097 | | | 0.27 | 0.07826 | 0.28 | 0.0673 | | | | | 0.2063 | 0.141 | 0.6186 | -0.271 | 1.0633 | -0.715 | | |
| **Lo4** | 0.173 | 0.0785 | 0.0948 | | | 0.5 | -0.3267 | 0.459 | -0.285 | 0.292 | -0.118 | 0.067 | 0.1067 | | | 0.8875 | -0.714 | 2.2857 | -2.112 | 0.788 | -0.615 |
| **Lo5** | 1.467 | | | 0.566 | 0.9006 | 2.3 | -0.8333 | 7.308 | -5.841 | 0.134 | 1.3323 | 1.348 | 0.1188 | 1 | 0.467 | | | 4.68 | -3.213 | 1.704 | -0.237 |
| **Lo6** | 1.068 | 0.4786 | 0.5889 | 0.6333 | 0.4342 | 1.161 | -0.0931 | 0.115 | 0.9528 | 0.542 | 0.5255 | 1.217 | -0.15 | | | 0.4834 | 0.5841 | 1.3175 | -0.25 | 0.63 | 0.4379 |
| **Lo7** | 6.833 | 2.1538 | 4.6795 | | | 1.658 | 5.17544 | 0.477 | 6.3561 | 10.13 | -3.3 | 1.045 | 5.7886 | 1.6304 | 5.203 | 13.727 | -6.894 | 1.0204 | 5.8129 | 1.684 | 5.1491 |
| **Deposit rates** | | | | | | | | | | | | | | | | | | | | | |
| **de1** | 0.44 | 0.5743 | -0.135 | | | 0.101 | 0.3386 | 0.404 | 0.0357 | | | | | | | 0.6705 | -0.231 | 0.7297 | -0.29 | 1.02 | -0.58 |
| **de2** | 1 | | | | | | | 0.08 | 0.9196 | | | | | 0.0808 | 0.919 | 0.6842 | 0.3158 | | | 0.111 | 0.8889 |
| **de3** | 1.163 | | | | | 1 | 0.1625 | 4.136 | -2.974 | 0.495 | 0.6674 | | | 0.731 | 0.431 | 1.2817 | -0.119 | 0.3991 | 0.7634 | 2.395 | -1.233 |
| **de4** | 0.608 | | | | | | | 0.483 | 0.1249 | 0.377 | 0.2304 | | | 0.6667 | -0.059 | 1.4189 | -0.811 | | | 0.75 | -0.142 |
| $SAER^{+}_{r,c}$ | EU | DE | EU-DE | IE | EU-IE | GR | EU-GR | ES | EU-ES | FR | EU-FR | IT | EU-IT | NL | EU-NL | AT | EU-AT | PT | EU-PT | FT | EU-FT |
| **Loan rates** | | | | | | | | | | | | | | | | | | | | | |
| **Lo1** | 0.786 | 0.5041 | 0.2816 | | | 2 | -1.214 | 1.21 | -0.427 | 0.5 | 0.2857 | 0.835 | -0.049 | 0.54 | 0.246 | 0.574 | 0.211 | 7.214 | -6.43 | 0.631 | 0.155 |
| **Lo2** | 0.875 | 0.7895 | 0.0855 | 2.083 | -1.208 | 1.605 | -0.73 | 0.88 | -0.008 | 0.688 | 0.1875 | 1.125 | -0.25 | 1.376 | -0.5 | 0.655 | 0.22 | 1.143 | -0.27 | 1.077 | -0.2 |
| **Lo3** | 0.364 | 0.04 | 0.3236 | | | 0.292 | 0.0712 | 0.27 | 0.096 | | | | | 0.194 | 0.17 | 0.638 | -0.275 | 1.024 | -0.66 | 0.941 | -0.58 |
| **Lo4** | 0.171 | 0.0794 | 0.0917 | | | 0.5 | -0.329 | 0.45 | -0.282 | 0.288 | -0.117 | 0.067 | 0.104 | | | 0.959 | -0.788 | 1.882 | -1.71 | 0.804 | -0.63 |
| **Lo5** | 1.419 | | | 0.526 | 0.893 | 2.19 | -0.771 | 8.64 | -7.217 | 0.132 | 1.287 | 1.292 | 0.128 | 1 | 0.419 | 3.788 | -2.369 | 2.167 | -0.75 | 1.704 | -0.28 |
| **Lo6** | 0.988 | 0.4786 | 0.5089 | 0.618 | 0.3696 | 1.102 | -0.114 | 0.12 | 0.865 | 0.558 | 0.4298 | 1.151 | -0.163 | | | 0.493 | 0.494 | 1.297 | -0.31 | 0.634 | 0.354 |
| **Lo7** | 6.474 | 2.1538 | 4.3198 | | | 1.615 | 4.8583 | 0.48 | 5.996 | 9.5 | -3.026 | 1.014 | 5.459 | 1.5 | 4.974 | 9.438 | -2.964 | 1.064 | 5.41 | 1.662 | 4.811 |
| **Deposit rates** | | | | | | | | | | | | | | | | | | | | | |
| **de1** | 0.351 | 5.2727 | -4.922 | | | 0.11 | 0.2409 | 0.68 | -0.327 | | | | | 0.645 | -0.29 | 0.444 | -0.093 | 0.158 | 0.193 | 0.839 | -0.49 |
| **de2** | 0.769 | | | | | | | 0.09 | 0.682 | | | | | 0.076 | 0.693 | 0.298 | 0.472 | | | 0.098 | 0.672 |
| **de3** | 2.906 | | | | | 0.508 | 2.3983 | | | 0.872 | 2.0345 | | | 1 | 1.906 | 0.401 | 2.505 | 0.331 | 2.575 | | |
| **de4** | 0.669 | | | | | | | 0.48 | 0.19 | 0.401 | 0.2685 | | | 4.105 | -3.44 | 3.75 | -3.081 | | | 1.141 | -0.47 |