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Diverse Degrees of Competition within the EMU and their Implications for Monetary Policy

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Abstract

Our paper calls attention to the heterogeneous levels of competition in EMU banking systems. We enhanced the ECB MFI interest rate statistics by calculating a lending rate average weighted by loan volumes for each EMU member country. Employing a modified Lerner Index, our unique data set enables us to calculate banks' price setting power in the national lending business alone, instead of measuring market power for banks' total business. For 12 countries, we ultimately show that market power in the exclusive segment of lending is greater than market power in total banking business. In an OLS regression model, we investigate to what extent loan rate variations can be explained by changing degrees of market power during the period 2003-2009. Significant cross-country differences can be observed. We find that changes in the national degree of competition considerably affect funding conditions in the individual countries and therefore hinder a homogeneous transmission of ECB monetary policy.

JEL classification: E43; E52; E58; L16

Keywords: banking competition; European Monetary Union; Lerner Index; monetary policy

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1 Introduction

The multitude of central bank interventions throughout the global financial crisis has made the evaluation of monetary policy actions both a popular and an essential field of study. When the European Central Bank (ECB) had been established in 1998, it more or less pragmatically decided to use short term interest rates as monetary targets and instruments. The interest rate on the main refinancing operations, which provide the bulk of liquidity to the banking system, was introduced as the key instrument. Adjustments of the refinancing rate are the central bank's essential tool to meet the (primary and ancillary) targets of monetary policy, i.e. to maintain stable inflation, to promote economic growth and to safeguard financial stability. In doing so, the ECB implicitly relies on an effective transmission of changes in the official rate to bank interest rates for loans as well as for deposits.

However, an effective transmission mechanism requires similar general conditions across the currency area. The European Monetary Union (EMU) is instead characterized by a large degree of heterogeneity. While regulatory standards have become increasingly harmonized in the respective banking systems, major differences in terms of market structures and banks' business models prevail. Moreover, diverse national inflation rates are a persistent feature of the currency union. The heterogeneous framework implies that ECB policy measures affect macroeconomic developments unequally across euro area countries. Even in case of identical macroeconomic constellations the conduct of monetary policy appears to be hampered by national banking system characteristics. First and foremost Cottarelli and Kourelis (1994) and Cecchetti (1999), currently Adams and Amel (2011), identified market concentration as a major source of interference with monetary policy transmission. Focussing on the funding conditions of enterprises, our paper shall analyse whether changes in national banking competition and dissimilar national inflation rates impede a homogeneous transmission of monetary policy actions in the EMU.

A meaningful analysis necessitates a precise definition and a correct measure of the influencing variables. With regard to the degree of competition in national banking systems, we entertain serious doubts about the eligibility of commonly used measurement approaches. Without consideration of differing business models and unequal banking market structures, previous contributions employed banks' total business to calculate market power, but often applied the subsequent interpretation to the funding conditions of corporations, which is rather reflected in the lending business of banks. Consequently, we regard this approach as imprecise and not beneficial for the analysis of monetary policy transmission. Hence, our

empirical analysis pursues two major goals. Firstly, we develop an adequate measure of competition in the specific lending business, which must be regarded as most crucial link to the real economy. Secondly, our paper displays the impact of changes in the national degree of competition on national loan rates and their interference with central bank actions.

Compared to the existing literature our paper offers five major improvements due to several specific characteristics in the chosen empirical setting:

(1) Our data set makes use of the ECB monetary financial institutions (MFI) interest rate statistics. Thus, we utilize completely harmonised retail interest rate series. This is a clear advantage compared to previous empirical studies which had to be based on national retail interest rate datasets not being harmonised pertaining to loan categories, maturities and fixed interest rate periods, and which often exhibited incomplete and unbalanced samples. Our analysis features no data break or biased results caused by dissimilarities of national definitions.

(2) Moreover, we enhanced the ECB MFI interest rate statistics by calculating an interest rate average weighted by loan volumes. To the best of our knowledge, this paper displays the first approach that tackled the laborious way through every national central bank statistic to calculate an accurate interest rate for total new business comparable across all member countries. By this, the explanatory power of conclusions regarding national lending business has risen significantly.

(3) Our empirical setting explicitly includes measures of competitiveness into the regression analysis. We employ a modification of the common Lerner Index on the banking industry and are able to generate results for specific segments of the lending business.

(4) The analysis comprises all founding member countries of the EMU and Greece. In doing so, we can detect cross-country differences whereas other studies estimated euro area wide parameters only.

(5) The deterministic approach applied in this paper directly focuses on the interdependency between central bank interest rate and bank lending rates. We avoid any proxies like money market or capital market rates, which fluctuate independently from the central bank rate due to exogenous shocks and banks' liquidity management.

Our paper is organized as follows. The next section gives a detailed overview of the existing literature on monetary policy transmission and illustrates the heterogeneous structures of European banking systems as an explanatory variable of the transmission

mechanism in the EMU. Section 3 addresses theoretical as well as empirical problems in defining appropriate measures of competition. Section 4 introduces the econometric methodology applied in our investigation. The paper closes with discussing the empirical results and drawing first conclusions from our findings.

2 Findings on monetary policy and banking market structures

The overall effect of monetary policy equals the sum of the effects conveyed in its transmission channels. Thus, the large literature on the monetary pass-through mechanism can be categorized according to the channel discussed and reflects the multidimensional character of the transmission analysis. Seminal contributions have been provided by Bernanke (1995), Mojon (2000) and Mishkin (2001). Regardless of which channel has been opted for scientific focus almost always is on the speed and the degree to which changes in monetary policy affect key macroeconomic variables. Pertaining to the European Currency Union empirical literature finds evidence for cross-country differences in how output and prices respond to ECB monetary policy actions, e.g. Mojon (ibid.), Peersman and Smets (2001), Angeloni and Ehrmann (2003) as well as De Bondt et al. (2005).

The reasons for the heterogeneity as displayed in academic contributions are manifold. With respect to retail bank interest rates a multitude of factors determines the level and changes of lending and deposit rates. ECB (2001) as well as De Bondt (2005) name the expected bank exposure to interest rate risk, credit and other risk premia, bank-customer relations and implicit level of asymmetric information as vital influencing variables on retail bank rates. Corvoisier and Gropp (2002) illustrate the price setting behaviour of banks and mention deposit holders' and borrowers' interest rate elasticity, regulatory costs, menu cost and marginal pricing costs in general. Furthermore, asymmetry in transmission may arise from differences in economic structures, as sensitivity to interest rate changes differs across sectors. Mojon (2000, 16ff.) points out that variations in the balance sheet structure of non-financial corporations or private households imply different wealth and income effects induced by changes in central bank interest rates. However, as already shown by Kashyap and Stein (1997) and Cecchetti (1999), a pronounced role in the transmission mechanism of monetary policy must be ascribed to financial market structures. The speed and the degree to which changes in policy-controlled interest rates are transferred to bank interest rates are considerably affected by both the structure as well as the competitive environment of the banking system. Schwarzbauer (2007) points out that even though the European interbank

money market experienced a strong push towards integration by the introduction of the common currency, differences in banking market structures continue to exist. This comprises both differences in the availability of primary capital market financing, as well as differences in the size, local presence, business objectives and degree of concentration of the country-specific banking systems.[1]

Table 1 illustrates the structural characteristics of euro area banking systems at year-end 2009 and the individual transformations over time starting in 2003. In terms of banks per 100,000 inhabitants the number of MFIs is spread very unevenly within the EMU. Next to Luxembourg, which is recognized as global financial centre, Austria and Finland are endowed with high numbers of banks per head. By contrast, the bank density in Greece and Spain corresponds to less than 10 % of the Finnish and Austrian figures respectively. Heterogeneity is reflected in the national branch density as well, with extreme values observed in Spain and the Netherlands. Not only the absolute number of banks, but also the concentration of major institutions within countries differs across EMU member states. The computation of the Herfindahl-Hirschman-Index as well as the Concentration Ratio of the largest 5 banks (by total assets) yields varied results. Both indicators imply major bank dominance in Belgium, Finland and the Netherlands, while the aggregate market share of large institutions is relatively low in Germany and Luxembourg. In respect of current levels of concentration Ireland and Italy range close to or below EMU average in 2009. However, during the whole period of investigation both countries experienced the strongest trend towards higher levels of concentration. In summary, the euro area financial system is characterized by heterogeneous national banking systems. The number of banks per head and the distribution of market shares within countries vary immensely. Eventually, the development over time does not suggest a reduction of diversity in the short and medium term.

"insert table 1 about here"

Not only is the conduct of monetary policy affected by the specific features of national banking markets, likewise the transmission of ECB actions differs among various loan segments. Diversity is reinforced by the peculiarities of the deposit-based lending business. Whereas the EMU market for deposits is regarded as highly contestable, the loan market is

[1] Reasons can be found in different historical paths as well as in legal, tax-related, regulatory and supervisory frameworks (cp. La Porta et al. (1997), Cecchetti (1999), Danthine et al. (1999), Amable (2003)). Moreover, retail customers favour banks close to their neighbourhood and (long-term) relationships. Reputation effects or brand names play a major role. As a result, retail loan markets tend to be local even within countries (cp. Gual (1999), Cabral et al. (2002, 35f. and 45f.)).

typically regionally bounded due to asymmetric information (Beck et al. 2004, Corvosier and Gropp 2009). Therefore, a harmonisation of the lending business in the euro area is improbable soon. Besides, De Bondt (2005) as well as ECB (2001) emphasize that rates on consumer loans respond much more sluggish than corporate loan rates and the pass-through for long-term lending rates tends to be less complete than for short-term ones. Thus, when evaluating the success of monetary policy, the need for differentiation between the particular segments of the lending business has become obvious. As a result of the disparate characteristics within EMU banking markets, European monetary policy faces a heterogeneous environment for the transmission via the banking system. Beyond doubt the structural framework of financial systems needs to be incorporated in the decision-making process.

As a meaningful consequence of diverse banking market structures and a major influence on the conduct of the lending business, the diverse degrees of competition among EMU banking systems are in a special focus of this paper. The degree of competition both within the banking market as well as from substitutive financial market products, i.e. the cross price elasticity of bank loan demand, impacts the magnitude and the speed banks adjust their lending rates to central bank rates. Ergo, the degree of competition is negatively correlated with the degree of bank rate sluggishness. Empirical literature confirms the argument of deeper and more complete financial markets boosting the speed of the interest rate pass-through (e.g. Payne and Waters 2008): A higher degree of competition within the banking sector and from alternative financial market products (i.e. a higher elasticity of demand for loans with respect to the retail bank interest rate) is combined with a faster and more complete pass-through. Moreover, a higher degree of competition reduces the asymmetries in the transmission process. Leuvensteijn et al. (2008) analyse the adjustment of retail bank interest rates to changes in (term-) corresponding market rates for 8 euro area countries for the period 1992 to 2004. They find that in a more competitive environment, first, bank loan rates respond quicker to changes in market rates, and second, the spread between loan and market rates is lower.

3 Measures of Competition in the Euro Area

In order to evaluate the intensity of competition within a banking system two methods come into consideration. Structural approaches regard the market structure as initial point and deduce information about the degree of competition thereafter. By contrast, non-structural

approaches investigate performance first to draw conclusions about the market power. Following the Structure-Conduct-Performance paradigm the Concentration Ratio and the Herfindahl-Hirschmann Index are the most prevalent structural methods. However, with respect to multi-product companies (such as banks) the definition of the relevant market, e.g. in terms of specific products and regions, must be considered virtually infeasible. On account of this, structural measures have become a controversial matter in recent literature on both theoretical and empirical grounds.[2] Avoiding these difficulties non-structural models address the characteristic behaviour of the market by analysing individual optimisation problems. A first example gives Iwata (1974). Based on oligopolistic markets he simultaneously estimates supply and demand functions to compare the actual price with the one in perfect competition. The resulting spread then indicates the individual's market power. While the concept is straightforward and simple, the practical implementation is not. The calculation of the market equilibrium requires detailed knowledge of both supply and demand side. Due to the data requirements the Iwata model is rarely utilised in empirical research.[3] A more common approach is presented by Panzar and Rosse (1987).[4] Their "*H*-statistic" is the sum of elasticities of a firm's total revenue with regard to its factor input prices and can be interpreted as an increasing function of elasticity of demand: A *H* value close to unity represents a market close to perfect competition. Akin to the Iwata model, there are a few drawbacks concerning data collection. Comprehensive company-related information is necessary, comprising all input goods and input prices. Another critical issue is the ordinal scale of *H*, which impedes the comparison of markets. Apart from that, the *H*-statistic only delivers mean values of the sample period and therefore hinders an evaluation between different points in time. The most recent proposal to measure the intensity of competition is offered by Boone (2004, 2008).[5] Accordingly, variations in marginal costs affect a company's market share given a constant degree of competition. Thus, lower marginal costs suggest higher productivity and therefore higher market share. The underlying theory is based on the Efficiency-Structure-Hypothesis of Demsetz (1973) and conflicts with the Relative-Market-Power paradigm (Shepard 1972) wherein high market shares can also be accompanied by above-average marginal costs.

[2] See Bikker and Haaf (2002) as well as Carbó et al. (2009) for a deeper insight into the discussion.
[3] Breshnahan (1982) alleviates this problem by employing aggregate data, computing results for "average" households and companies.
[4] Gischer and Stiele (2008) offer an implementation of the Panzar-Rosse approach to assess the competitive conditions in banking.
[5] Leuvensteijn et al. (2011) are the first to our knowledge who applied the general idea to the specific sector of banking.

After diligent consideration of the alternative concepts, we ultimately agreed on employing the well-established Lerner Index to quantify the degree of competition in the EMU banking systems. It is our perception that of all non-structural models the Lerner Index is suited best for the central questions of this article. First proposed by Lerner (1934) it determines the individual price setting power by the company's ability to raise prices above its marginal costs. Under standard assumptions, the first order condition of a profit maximising problem yields the following expression:

$$(1) \qquad LI_{t,k} = \frac{P_{t,k}(q_{t,k}) - MC_k(q_{t,k})}{P_{t,k}(q_{t,k})} = -\frac{1}{\varepsilon_{t,k}}.$$

Apparently, for time *t* and country *k* the Lerner Index of market power $LI_{t,k}$ is defined by the disparity between equilibrium output price $P_{t,k}$ and marginal cost MC_k as percentage of price. The quantity of goods sold is denoted by $q_{t,k}$, whereas $\varepsilon_{t,k}$ expresses the elasticity of demand.[6] The Lerner Index ranges between zero and one, whereby larger values indicate less competition and more market power. The higher the ability to charge prices above marginal costs and the more rigid demand reacts respectively, the higher will be $LI_{t,k}$. A market close to polypoly implies Index values close to zero. Hence, in equilibrium the Lerner Index equals the inverse of the elasticity of demand for output of the firm. It is important to note that the definition of a precise cut-off point to differentiate between high and low market power is infeasible. The Lerner Index is not a metric scale. Thus, interpretations can be drawn from relative differences only. As there is no linear relationship between price $P_{t,k}$ and $LI_{t,k}$, an increase of the Index from e.g. $LI_{t,k} = 0.3$ to $LI_{t,k} = 0.6$ does not signify a doubling of market power. A mathematical computation yields:

$$(2) \qquad \frac{dLI_{t,k}}{dP_{t,k}(q_{t,k})} = \frac{MC_{t,k}(q_{t,k})}{P_{t,k}(q_{t,k})^2} > 0,$$

$$\text{while } \frac{d^2 LI_{t,k}}{dP_{t,k}(q_{t,k})^2} = -2\frac{MC_{t,k}(q_{t,k})}{P_{t,k}(q_{t,k})^3} < 0.$$

[6] The model bears similarities to the one of Panzar and Rosse (1987). Given an isoelastic demand, it can be shown that there is a functional converse relationship between *H*-statistic and Lerner Index: $H = 1 - 1/LI$. See Shaffer (1983) for derivation.

There are a number of advantages that militate in favour of the Lerner approach. First, the $LI_{t,k}$ value can be easily calculated for companies, groups of companies as well as for the total market. Second, not only the absolute level of competition can be illustrated, but also developments over time. Third, the concept is regarded as exceptionally insusceptible against distortions from company- or country-specific influences (Carbó et al. 2009, p. 128). Beyond doubt the Lerner Index is well qualified for particular application in the segment of deposit-based lending business. A number of notable studies have already used the Lerner Index as indicator for the degree of market power in banking systems. Valuable works include first and foremost Shaffer (1983) with a demonstration for the Canadian banking sector as well as Angelini and Cetorelli (2003) with the Italian equivalent. A focus on the sample of EMU member countries is to be found in Maudos and Fernàndez de Guevara (2004, 2007), Carbó and Rodríguez (2007) and Carbó et al. (2009) and Weill (2011). Generally, the studies suggest a worsening of competitive conditions across the euro area during the period of the late 1990s and the beginning of the new century. Furthermore, all contributions identify noticeable and persistent disparities in the level of competition between various countries.

When computing Lerner Index values the market price is traditionally defined by the quotient of total revenues divided by total assets. Hence, both lending business and all other business were incorporated. Conclusions about segment-specific market power, for instance in the lending business alone, are not feasible with this common approach. In contrast to the investigations named above, we attach importance to a precise definition of the relevant market. The rich dataset collected from the ECB and the EMU national central banks enables us to solely analyse the effect of market power in the traditional lending business. Our calculation of the Lerner Index is based on the intermediation approach introduced by Sealey and Lindley (1977), i.e. loans are considered to be output, whereas deposits are the inputs necessary to generate that output. As a result, the output price shall be derived from an average national loan rate weighted by volumes and marginal costs shall be received from an average national deposit rate weighted by volumes.[7]

[7] All other costs, e.g. personnel and material costs, are supposed to be constant.

Equation (1) can thus be modified into:

$$(3) \qquad LI_{t,k} = \frac{\dfrac{\sum_{a=1}^{n} A_{t,k}^{a} \cdot i_{t,k}^{a}}{\sum_{a=1}^{n} A_{t,k}^{a}} - \dfrac{\sum_{p=1}^{m} P_{t,k}^{p} \cdot j_{t,k}^{p}}{\sum_{p=1}^{m} P_{t,k}^{p}}}{\dfrac{\sum_{a=1}^{n} A_{t,k}^{a} \cdot i_{t,k}^{a}}{\sum_{a=1}^{n} A_{t,k}^{a}}}$$

where $A_{t,k}^{a}$ stands for interest-bearing assets with $a = 1, \ldots, n$ specific loan categories, $P_{t,k}^{p}$ for interest-bearing liabilities with $p = 1, \ldots, m$ specific deposit categories and $i_{t,k}^{a}$ denotes the interest on debt at time t in country k. Similarly, $j_{t,k}^{p}$ symbolizes the interest on deposit transactions at time t in country k. Simplified, we make use of the following relation:

$$(4) \qquad LI_{t,k} = \frac{i_{t,k} - j_{t,k}}{i_{t,k}}$$

where $i_{t,k}$ defines the average commercial bank's loan rate weighted by volumes at time t in country k and $j_{t,k}$ its counterpart on the liabilities side.[8]

The application of our modified Lerner Index to the banking systems of the European Monetary Union yields both interesting and novel results. In the lending business of European banks systematic and significant level differences in price setting power become apparent. Table 2 displays the degree of competition in selected EMU member countries.

"insert table 2 about here"

On average, Austrian banks charged the lowest mark-ups and exhibited the highest degree of competition within the euro area, whereas Greek banks disclosed the most pronounced market power. Furthermore, the ability of banks to raise prices above marginal costs is large in Portugal, Italy and Spain. In comparison to the structural information on EMU banking systems as provided in table 1, interesting results come to light. Luxembourg and Austria are characterized by many banks per head, low concentration of major institutions and a low level of market power indeed, while the opposite is true for Portugal and Greece. However, the

[8] A technical derivation of the Lerner Index applied for the banking sector can be found in Koetter et al. (2008).

Netherlands and Germany show almost identical levels of competition although their structural data are highly different. Hence, the outcome demonstrates that structural features of banking systems cannot be utilized as faithful indicators to explain the inherent degree of competition in banks' lending business.

The analysis over time brings to light a noticeable trend between 2003 and 2008. The considerable initial spread of 47 percentage points between the maximum and the minimum Lerner Index value (or between Greece and Luxembourg, respectively) increased even further to 53 percentage points in 2008 (Greece and Austria). Our data reveal a rising divergence in the degree of competition of the various EMU member countries before the onset of the global financial crisis and underline the heterogeneity between banking systems in the euro area. Figure 1 illustrates the extent of market power in selected banking systems over time. Throughout the total period significant differences in levels can be observed among EMU member countries. Our results indicate persistently high values for Greece and Portugal, while Austria and Luxembourg are (predominantly) characterized by low degrees of market power in banks' lending business. Concerning the level of banking competition it is important to note that, for the period 2003-2009, a tendency of convergence cannot be detected within the euro area.

"insert figure 1 about here"

Apparently, in the years ex ante the financial crisis there seems to be a general trend towards lower levels of market power across countries. Only the French banking system shows a decrease in competition before 2008. Various policy measures, such as the Financial Services Action Plan introduced by the European Union, might supposedly have enhanced integration of financial markets and increased contestability of national banking systems. Moreover, risk premiums were declining before the global crisis lowering the spread between prices and marginal costs. However, the general trend is distorted in 2008 when a substantial rise in market power can be recognised in all countries but France. The global financial turmoil affected both lending rates and banks' marginal costs. On the one hand the alteration of the ECB tender procedure during the crisis extensively cheapened the refinancing costs of all member banks. On the other hand the need for depreciation forced banks to rapidly strengthen their revenue side and implicitly raised prices. Ultimately, in terms of degrees of competition remarkable differences within the EMU prevail.

In comparison with other current studies that employed the Lerner Index as a measure of banking competition within the EMU, e.g. Beck et al. (2011) and Weill (2011), our qualitative

results are confirmed. However, two quantitative differences shall be emphasized. Firstly, in our calculation the overall level of results is much higher across all countries suggesting that market power in the exclusive segment of lending is greater than market power in total banking business. Secondly, the spread between the maximum and the minimum Lerner Index value in the euro area is larger in our approach relative to the common measures introduced above. As a result, the heterogeneous effect of monetary policy actions on banks' lending business must be regarded even higher than previously assumed. Consequently, for the sake of an accurate measure of competition our methodology uncovers the need for a definition of the relevant business segment. The use of banks' data on total business must be regarded imprecise and not beneficial for the analysis of monetary policy transmission.

In conclusion, the diverse national degrees of competition among the euro area banking systems represent a potential source of interference with ECB actions. If monetary policy is to target the state of the real economy, the central bank authorities have to analyse the extent of competition in banks' lending business rather than market power in banks' overall activities. For this purpose, our novel measurement approach provides a well-qualified indicator for the degree of competition in banks' lending business with non-financial corporations.

4 Econometric Methodology

The aim of our model is to describe the respective effect of each influencing variable on the national loan rate in order to detect the diverse impacts of (changes in) monetary policy, inflation and the degree of competition in the banking system on that rate. Our goal runs contrary to the idea of common VAR models, which regard every variable as endogenously determined making it impossible to separately examine the exclusive effect of one variable. Therefore, a ceteris paribus assumption, which Sims (1980) intends to avoid when suggesting VAR analysis, is a key feature in our approach. We believe that central bank rates as well as short-term money market rates are not steered by loan rates and understand the transmission process as taking place in one direction only. Our assumption is in line with the findings of Cassola and Morana (2006, 24f.). In addition, we examine both expected and unexpected changes in the variables. Concerning the former, VAR analysis is not conducive to discovering repercussions on other variables. VAR models capture the feedback effects

allowing past and current values of the variables in the system.[9] As a consequence, only temporary shock-like changes in monetary policy are able to cause changes in other variables. Most monetary policy actions, however, represent a systematic response of the central bank to the state of the economy and do not come as surprises. As Gottschalk (2001) puts it correctly: "Most monetary policy actions are not monetary policy shocks". The same applies to changes in competition and inflation. Impulse response analysis does not account for that. Like a black box, VAR models tell little about the detailed mechanism inside. Due to these downsides and without the intention to contribute to the ongoing debate about the quality of VAR analysis, we reject the latter and choose a deterministic and well-understood approach. The setup of our model is based on a theoretical argumentation with a clear causality as follows:[10]

$$(5) \qquad i_{t,k} = \beta_0 + \beta_1 \cdot i_{t-1,k} + \beta_2 \cdot r_t + \beta_3 \cdot r_{t-1} + \beta_4 \cdot LI_{t,k} + \beta_5 \cdot \pi_{t-1,k} + u_t ,$$

where r_t defines the central bank's official interest rate at time *t*, i.e. the ECB's main refinancing rate. For each country *k* we incorporate the Lerner Index $LI_{t,k}$ as a proxy for the intensity of competition in an economy's banking industry. $\pi_{t-1,k}$ carries information about the national inflation lagged by one period, and u_t refers to an error variable with an expected value of zero and a constant variance.

To control for structural changes within the period under investigation, we additionally test our model (5) in first differences of the endogenous variables as well as of the exogenous variables:

$$(6) \qquad di_{t,k} = \beta_0 + \beta_1 \cdot di_{t-1,k} + \beta_2 \cdot dr_t + \beta_3 \cdot dr_{t-1} + \beta_4 \cdot dLI_{t,k} + \beta_5 \cdot d\pi_{t-1,k} + u_t ,$$

where *d* indicates absolute first differences of the variables examined. When investigating the pass-through of monetary policy actions to bank lending rates empirical literature often makes use of short-term interbank rates, such as the EONIA, as a proxy for the policy-determined interest rate. Instead, we directly utilize the central bank's official rate for two vital reasons. First, we place emphasis on the fact that the monetary transmission process is actually a two-stage one: (1) The central bank rate steers the short-term money market interest rates, which in turn (2) affect market rates with longer maturities and retail bank interest rates. The

[9] The respectable works of Stock and Watson (2001), Christiano et al. (1999), Cochrane (1998), Rudebusch (1998) and Sims (1998) give a comprehensive insight into the discussion.

[10] The closest models to ours are the deterministic approaches of Cottarelli and Kourelis (1994) and Toolsema et al. (2001) investigating interdependencies between central bank and loan rates.

distortions on interbank markets during the financial crisis of 2008/09 illustrated that a synchronous co-movement of official rate and money market rates cannot be taken for granted. Second, we regard the EONIA as inappropriate as the volatility of the short end of the yield curve is influenced by the liquidity management of banks. Due to high payment flows this is particularly obvious on the last day of the month or quarter and the last days of the maintenance period.[11] Neither are these volatilities related to monetary policy actions nor do they influence lending rates. Thus, these two downsides outweigh the convenience of daily fluctuations in short-term money market rates when applying OLS regression models.

Our study covers the period from January 2003 to December 2009 and 84 observations accordingly. The starting date enables us to make use of the harmonised ECB interest rate statistics, which were introduced at that time. Older data can only be constructed by employing non-harmonised national interest rate statistics based on different definitions and sub-categories for each instrument category. In order to avoid the large heterogeneity across countries inherent in the data and a possible bias in our results, we circumvent a data break by solely using the Eurosystem statistics. The analysis is conducted for all 11 founding member countries of the EMU and Greece, which joined the union in 2001.

The quality of our data set allows for a valuable contribution to the large literature on interest rate variations within the EMU. As the ECB publishes interest rates for various categories and maturities for every member country, but no corresponding national volumes, previous studies mainly focused on investigating specific credit categories and avoided statements on the total amount of credit. What has been largely missing so far is an analysis on a national loan rate that represents the whole spectrum of relevant credits. For identifying the effects of monetary policy, inflation and competition on the lending business, we regard an interest rate for new credit approvals alone as the relevant rate $i_{t,k}$. In contrast to the total amount of credits outstanding, the impact of changes in the influencing variables can be detected more clearly in conditions for new business. To compute the relevant loan rate $i_{t,k}$, we collected rates across the categories and maturities of the ECB harmonised cross-country data to weigh them by their volumes published by the respective national central bank. In doing so, we focused on loans other than revolving loans, overdrafts, convenience and extended credit card debt for non-financial corporations (annualized agreed rate). To the best of our knowledge, this paper displays the first approach that tackled the laborious way

[11] See Colarossi and Zaghini (2009, 155) as well as Bartolini and Prati (2006, 354f.) for empirical verification. Besides, during the period 01.01.2007-31.12.2009 correlating changes in the ECB main refinancing rate with changes in the daily EONIA rate yields a result of 0.38 suggesting that not even 50 % of the EONIA fluctuations could be explained by variations in the central bank rate during the financial crisis.

through every national central bank to calculate an accurate interest rate for total new business comparable across all member countries. By this, the explanatory power of conclusions regarding national lending business has risen significantly.

There are a least two vital reasons to concentrate on a loan rate instead of an interest rate for deposits when analysing the effects of monetary policy and the degree of competition in a banking system. Rarely does monetary policy actions target at conditions for deposits only. Besides, due to asymmetric information in the lending business the latter is usually less contestable than the deposit-taking business and therefore more susceptible to market power (see Beck et al. 2004). Consequently, structural changes in the banking industry will affect the loan rate of the banks concerned to a greater extent than their deposit rates.

The central bank's official interest rate r_t is obtained from the ECB's main refinancing operations (MRO). From June 2000 to September 2008 these were conducted as variable rate tenders. Then, the official rate was specified by the minimum interest rate at which counterparties may place their bids. Since October 2008 the MRO are carried out through a fixed-rate tender procedure, defining that fixed rate as the official rate r_t.[12] For each country inflation $\pi_{t,k}$ is taken from the annual percentage change of the harmonized indices of consumer prices (HICP). The Lerner Index $LI_{t,k}$ includes the loan rate $i_{t,k}$ as a surrogate for the sales price, whereas an appropriate deposit rate needs to be found as a proxy for marginal costs. As banks generally do not differentiate between deposits of households and corporations when refinancing its' issued credits, we use a weighted average of deposit rates paid on households' and corporate capital, comprising all categories and maturities of the ECB harmonised data set. We are convinced that this calculation of the Lerner Index is the most accurate approach given the current data availability.

The intuition that variations of the ECB's official rate and national inflation lead adjustments in the national loan rate shall be tested. A popular approach to evaluate causal relations between two time series is to examine if the prediction of one series could be improved by incorporating information of the other. More specifically, if the variance of the prediction error of loan rate $i_{t,k}$ at the present time is reduced by inclusion of past values from time series r_t and $\pi_{t,k}$, then the latter time series are said to have a causal influence on the loan rate respectively. If every influencing variable significantly contributes to forecasting

[12] The lag length was chosen in accordance with the minimum value of the Schwarz information criterion.

$i_{t,k}$, we speak of Granger causality in each case.[13] The positions of two time series can be reversed to assess the causal influence in the opposite direction. Both alternatives must be controlled. If the influencing variables are capable of Granger-causing the national loan rate with no equal effect vice versa, the setup of our OLS regression model seems well-grounded.

"insert table 3 about here"

The results reported in table 3 (predominantly) suggest causality in one direction: r_t and $\pi_{t,k}$ Granger cause loan rate $i_{t,k}$, at least in the temporal sense. Hence, the structure of our multivariate regression model follows a justified intuition.

Particular strands of the empirical literature entertain some doubt about the stationarity of interest rates, including Karfakis and Moschos (1990), Chong et al. (2006) and De Graeve et al. (2007). In this paper, we employ both the common Augmented Dickey-Fuller test (ADF) and the KPSS test proposed by Kwiatkowski et al. (1992). Results for the model (5) are reported in tables A1 and A2 of the appendix. The ADF clearly suggests stationary inflation rates in all member countries except Finland, Ireland and Portugal over the whole sample whereas it cannot deny non-stationarity for the national loan rate, the ECB official rate and the Lerner Index. One might argue that the failure to detect a stationary time series originates from the lack of power of the ADF test statistics. In this regard the KPSS test, in which the null hypothesis is stationarity, features apparent advantages. In fact, conducting the KPSS test yields interesting results. For the whole period and for every member country but Portugal the null of stationary loan rate $i_{t,k}$ cannot be rejected. Furthermore, the central bank's official rate r_t is proposed to be stationary as well. With the exception of a few smaller members of the EMU, the same conclusion holds for national inflation $\pi_{t,k}$ and Lerner Index $LI_{t,k}$. Thus, the KPSS test supports our notion that the time series applied here need not necessarily be non-stationary. However, neither on the basis of common stationarity tests nor in reference to the inconsistent literature can we draw a clear conclusion about the order of integration of our variables. Therefore, testing for cointegration is not an option, as the technique can only be applied to time series that are integrated of the same order. To mitigate this problem, we eventually prefer to work with a regression model in first differences.

[13] It is important to note that the concept used her is in the probabilistic and temporal sense, rather than the philosophical or structural sense.

Apart from that, we test for multi-collinearity among the explanatory variables. In model (5) a considerably high R-squared can be observed in almost every country. Computing the Variance Inflation Factor (VIF) for all of our regression coefficients in every sample country we obtain a value close to or above 10, which not only indicates collinearity among the exogenous variables, but (as well) demonstrates convincing arguments for conducting a model in first differences as shown in model (6).[14]

Testing model (6) for potential non-stationarity and multi-collinearity confirms our approach.[15] In the ADF test statistic the null hypothesis of non-stationary changes of the national loan rate dr_t can be rejected for all sample countries but Belgium, Luxemburg and Portugal. Applying the KPSS test, stationarity cannot be denied for (changes in) any national loan rate. Besides, both tests implicate stationary fluctuations in inflation rates $d\pi_{t,k}$ for all countries as well as stationary central bank rate adjustments dr_t. According to the ADF test results, changes in the national degree of competition $dLI_{t,k}$ can be regarded as stationary for all banking systems but the Dutch and Portuguese one. The KPSS test confirms that finding for all sample countries except Belgium and Luxemburg, and cannot reject stationarity for the Dutch and Portuguese market. Hence, both test statistics validate the assumption of stationary variables in model (6). Moreover, this approach will not give rise to multi-collinearity problems. Our calculations of the respective VIFs yield values well below 10.[16] It is therefore appropriate to model the influences on national loan rates in first differences of the explaining variables. Subsequent explanations will therefore refer to model (6) only.

5 Results

Our results underline the particular importance of banking competition in the lending business to variations of national loan rates. Implicitly, changes in the national degrees of banks' market power turn out to be a major source of interference with monetary policy actions. Table 4 subsumes the key results of our OLS regression model, which are determined by application of White's Test for Heteroskedasticity (White 1980). A potential misspecification of the model is tested by the Ramsey RESET and can be rejected for all countries but France and Finland.

[14] Owing to lack of space the multitude of VIFs is not reported in this paper but is available from the authors upon request.
[15] Results of the ADF and KPSS test statistics can be found in tables A3 and A4 of the appendix respectively.
[16] As for model (5), the multitude of VIFs of model (6) is not reported in this paper but is available from the authors upon request.

"insert table 4 about here"

At first, the general set-up of our model is confirmed by the respective test procedures. The coefficient of determination indicates that, on average, about 64 % of the variation in national lending rates can be explained by the exogenous variables. The F-statistic points out that the interdependencies illustrated in table 4 are not randomly generated.

As regards our chosen regressors, we find highly significant support for the hypotheses that both the current and lagged variation of the ECB official rate positively influence the commercial banks' adjustment of the loan rate. Across all EMU member countries the explanatory impact of both variables is significant at the 1 % level suggesting a fast pass-through of adjustments in the key interest rate. Likewise, we demonstrate that changes in the degree of banks' domestic market power substantially alter national lending rates. As a result, independently from ECB actions, banking market competition severely affects the funding conditions of domestic enterprises and thus potentially interferes with monetary policy intentions. By contrast, only in very few countries does the inflation rate difference have a significant effect on the market loan rate. This is explicitly true for Austria and Belgium. As should have been expected, in almost all countries the lagged first difference of the national lending rate shows no significant coefficient. Hence, we can clearly reject adaptive expectations in the majority of banking systems.

Our findings highlight the effectiveness of ECB monetary policy. Within two months, a high share of an initial change in the key interest rate is passed on to the national loan rates. Among the EMU member states, only France and Germany show rather moderate responses to monetary measures with cumulated coefficients of 0.619 and 0.708 respectively. However, although official rate alterations are almost fully transmitted in the short-term, our results give evidence that the ECB is not capable of perfectly steering lending rates in the EMU. Changes in banks' market power, due to mergers between institutions or modifications in competition policies, represent an additional major source of loan rate variations that cannot be controlled by central bank authorities. The impact of changes in the Lerner Index $dLI_{t,k}$ on the national loan rate is heterogeneous throughout the euro area. Analysing descriptive information from table 2 and estimations' results of table 4, there seems to be an interdependency between the level of market power and the impact changes in market power have on the respective lending rate. Relatively low coefficients can be found in countries which exhibit high degrees of competition, such as Austria and Luxembourg. On the contrary, adjustments in the Lerner Index strongly influence national loan rates in EMU members that show low levels of

competition (Greece, Italy). With reference to the lending business in euro area banking systems, we tentatively believe that the lower the level of competition is, the stronger a change in market power affects domestic funding rates.

In summary, independently from ECB measures the degree of competition in national banking systems significantly influences the loan rates in the EMU. Therefore, market power in the lending business must be regarded a vital source of interference with official monetary policy. The actual extent of interference appears to depend on the level of competition in domestic banking markets.

6 Conclusion

If monetary policy in the European Currency Union is to target lending rates in the individual member countries, which arguably represent the crucial link between monetary and real economy, policymakers need to incorporate a precise measure of banking competition in their analysis. In utilising a modified Lerner Index, we provide a qualified indicator to calculate the degree of market power in the domestic lending business to non-financial corporations. We ultimately show that independently from central bank actions national loan rates are affected by changes in the respective level of competition. Across countries, the impact of the competitive environment on lending rates greatly differs. As a consequence, the transmission of monetary policy within the euro area is hardly predictable in detail. A central bank that operates in a supposedly uniform currency area despite severe structural differences between the member states is almost inevitably bound to fail in reaching its targets.

We are thoroughly convinced that a conformation of European banking market structures and a convergence of the respective levels of competition will not arise in the foreseeable future. The financial crisis caused monetary financial institutions to rather reduce foreign business activities. As the ECB cannot overcome the heterogeneous conditions of its transmission mechanism, we believe that supplementary measures need to be implemented. Promising concepts would include (1) an intensified coordination of European economic policies within the Eurogroup as well as (2) the introduction of monetary policy instruments which can be scaled unequally in case of diverse national developments. Variable national minimum reserve requirements within the European Currency Union, set on a monthly basis, can be named as a favourable instrument.

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Appendix

Table A1. Augmented Dickey Fuller (ADF) Test Statistic

	AUT	BEL	FIN	FRA	GER	GRE	IRL	ITA	LUX	NED	POR	SPA
i_k	-1,7771	-1.8726	-1.1602	-1.5979	-1.7937	-1.9925	-1.2965	-1.1128	-2.0321	-2,1449	-2.0543	-1.6383
π_k	-3.9390***	-3.6922***	-1.6839	-5.3817***	-3.2414**	-5.5291***	-1.1728	-4.1496***	-4.7277***	-3.1686**	-1.2774	-4.3352***
r							-1.5773					
LI_k	-1.4931	-0.6533	-1.7799	-1.6576	-2.2618	-1.5338	-1.2491	-1.9254	0.4684	-1.7912	-1.3052	-1.8007

Notes: The null hypothesis tested is non-stationarity. Our computation is based on maximum lag length: 12, AIC criterion, with intercept.

*, ** and *** indicate a level of confidence at 90, 95 and 99 %, respectively.

Table A2. Kwiatkowski-Phillips-Schmidt-Shin (KPSS) Test Statistic

	AUT	BEL	FIN	FRA	GER	GRE	IRL	ITA	LUX	NED	POR	SPA
i_k	0.2314	0.2616	0.1929	0.3034	0.2477	0.3229	0.2308	0.2420	0.2274	0.2605	0.4244*	0.3174
π_k	0.1202	0.1062	0.6051**	0.2216	0.1683	0.2242	0.5273**	0.1933	0.2525	0.1634	0.5802**	0.3270
r							0.2280					
LI_k	0.7132**	0.2980	0.2550	0.3526*	0.0805	0.5700**	0.7712***	0.3181	0.2530	0.5310**	0.2496	0.2571

Notes: The null hypothesis tested is stationarity. All t-statistics are calculated based on the Newey-West heteroskedasticity-consistent standard errors.

*, ** and *** indicate a level of confidence at 90, 95 and 99 %, respectively.

Table A3. Augmented Dickey Fuller (ADF) Test Statistic

	AUT	BEL	FIN	FRA	GER	GRE	IRL	ITA	LUX	NED	POR	SPA
di_k	-3.7763***	-2.3247	-5.3752***	-3.3349**	-3.4512**	-4.5986***	-3.7697***	-5.3715***	-1.9192	-5.8651***	-2.3376	-3.6455***
$d\pi_k$	-4.6469***	-5.9955***	-4.0233***	-5.6387***	-3.4823**	-5.1646***	-3.5118**	-5.3897***	-4.9471***	-2.7980*	-4.4055***	-6.6420***
dr							-3.3635**					
dLI_k	-10.1867***	-3.6780***	-3.3924**	-3.8844***	-9.5830***	-3.0938**	-4.6333***	-6.6429***	3.7373***	-1.1509	-1.8164	-11.0609***

Notes: The null hypothesis tested is non-stationarity. Our computation is based on maximum lag length: 12, AIC criterion, with intercept.

*, ** and *** indicate a level of confidence at 90, 95 and 99 %, respectively.

Table A4. Kwiatkowski-Phillips-Schmidt-Shin (KPSS) Test Statistic

	AUT	BEL	FIN	FRA	GER	GRE	IRL	ITA	LUX	NED	POR	SPA
di_k	0.2041	0.2529	0.2298	0.2208	0.2259	0.1646	0.2687	0.2731	0.2854	0.1880	0.2485	0.2235
$d\pi_k$	0.0833	0.1213	0.1020	0.0729	0.1591	0.0494	0.2509	0.1933	0.0527	0.1029	0.0787	0.0747
dr							0.2328					
dLI_k	0.2718	0.3658*	0.2281	0.2343	0.1007	0.2382	0.1269	0.0703	0.3872*	0.1666	0.2641	0.1200

Notes: The null hypothesis tested is stationarity. All t-statistics are calculated based on the Newey-West heteroskedasticity-consistent standard errors.
*, ** and *** indicate a level of confidence at 90, 95 and 99 %, respectively.

Table 1. Structural characteristics of EMU banking systems

	bank density		branch density		HHI		CR_5	
	2009	2003-2009	2009	2003-2009	2009	2003-2009	2009	2003-2009
AUT	9.5	-6%	49.9	-8%	414	-26%	37%	-16%
BEL	1.0	-7%	40.1	-17%	1 622	-21%	77%	-8%
FIN	6.6	-1%	28.9	-4%	3 120	29%	83%	2%
FRA	1.1	-27%	59.8	43%	605	1%	47%	1%
GER	2.4	-12%	48.1	-17%	206	19%	25%	16%
GRE	0.6	9%	36.2	21%	1 184	5%	69%	3%
IRL	1.1	-45%	27.6	18%	881	76%	59%	32%
ITA	1.3	-5%	56.7	7%	353	47%	34%	24%
LUX	29.8	-22%	46.4	-23%	288	-9%	28%	-13%
NED	1.8	-40%	19.0	-21%	2 032	17%	85%	1%
POR	1.6	-19%	60.5	17%	1 150	10%	70%	12%
SPA	0.8	-8%	97.0	2%	507	0.2%	43%	0.5%
EMU-12	5.2	-15.9%	43.0	1.6%	1 077	13.5%	55.8%	5.0%

Notes: Bank density and branch density are calculated per 100 000 inhabitants.

Table 2. Lerner Index value characteristics

year	AUT	BEL	FIN	FRA	GER	GRE	IRL	ITA	LUX	NED	POR	SPA
2003	0.49	0.50	0.63	0.44	0.54	0.84	0.74	0.78	0.37	0.55	0.81	0.73
2004	0.45	0.53	0.62	0.46	0.54	0.86	0.75	0.79	0.38	0.59	0.81	0.73
2005	0.43	0.50	0.61	0.48	0.53	0.85	0.72	0.78	0.37	0.60	0.82	0.77
2006	0.33	0.45	0.57	0.57	0.57	0.83	0.67	0.77	0.31	0.59	0.78	0.79
2007	0.25	0.44	0.49	0.63	0.56	0.79	0.61	0.72	0.25	0.53	0.71	0.74
2008	0.22	0.47	0.45	0.62	0.53	0.75	0.56	0.69	0.24	0.49	0.69	0.69
2009	0.39	0.67	0.70	0.41	0.55	0.82	0.67	0.70	0.71	0.54	0.87	0.73
Ø	0.37	0.51	0.58	0.52	0.54	0.82	0.67	0.75	0.38	0.56	0.78	0.74

Notes: The sample includes 84 observations between the time period 2003M1 and 2009M12.

Table 3. Results Granger Causality Tests

	AUT	BEL	FIN	FRA	GER	GRE	IRL	ITA	LUX	NED	POR	SPA
π→i	3.09	1.84	2.14	1.49	2.70	3.55	1.47	3.12	1.23	4.18	1.88	2.38
	-0.01	-0.12	-0.07	-0.21	-0.03	-0.01	-0.21	-0.01	-0.30	0.00	-0.11	-0.05
π←i	1.83	0.95	1.02	0.05	0.70	0.35	1.46	0.20	0.68	2.19	2.80	1.00
	-0.12	-0.46	-0.42	-1.00	-0.63	-0.88	-0.21	-0.96	-0.64	-0.07	-0.02	-0.43
r→i	22.07	9.02	8.75	14.25	11.05	10.94	11.05	7.12	11.05	14.44	8.81	9.51
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
r←i	2.99	2.14	0.96	1.41	2.04	1.74	2.92	3.75	2.92	0.82	1.92	1.80
	-0.02	-0.07	-0.45	-0.23	-0.08	-0.14	-0.02	0.00	-0.02	-0.54	-0.10	-0.13

Notes: Bold values indicate statistical significance at the 5 % level. The lag length included is 5.

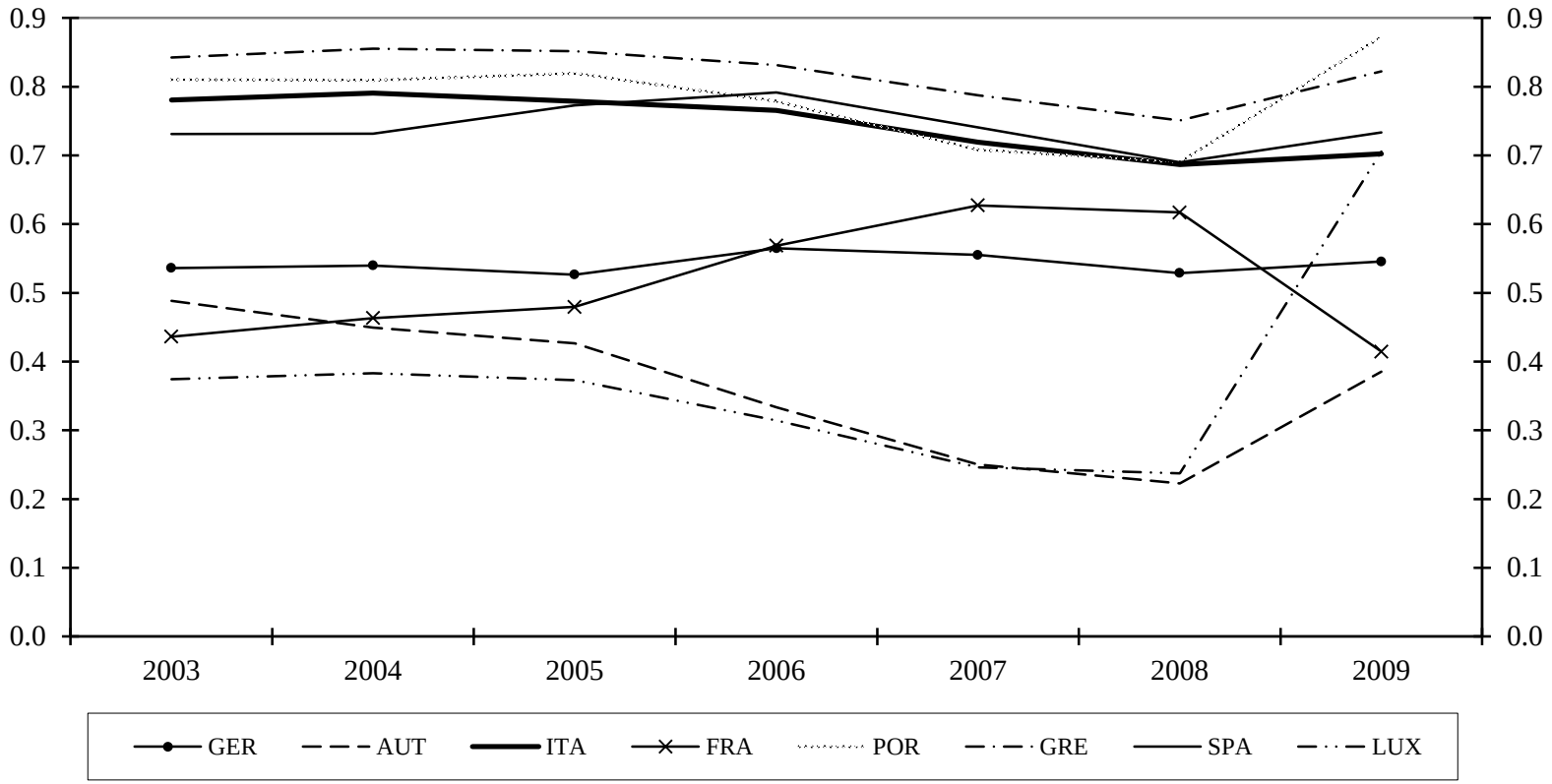
Table 4. Results OLS Regression in first differences

	AUT	BEL	FIN	FRA	GER	GRE	IRL	ITA	LUX	NED	POR	SPA
$di_{t-1,k}$	0.096	0.067	0.146	-0.013	0.059	-0.056	-0.169	0.189	-0.372	0.025	-0.227	-0.020
t-value	[1.11]	[0.83]	[1.40]	[-0.19]	[0.84]	[-0.52]	[-1.63]	[1.76]*	[-3.62]**	[0.27]	[-2.20]**	[-0.20]
dr_t	0.477	0.721	0.729	0.364	0.355	0.587	0.820	0.507	0.833	0.389	0.467	0.492
t-value	[4.96]***	[10.86]***	[7.89]***	[6.04]***	[5.72]***	[5.58]***	[8.20]***	[5.84]***	[7.27]***	[3.97]***	[3.13]***	[6.07]***
dr_{t-1}	0.519	0.441	0.516	0.255	0.353	0.447	0.538	0.401	0.535	0.589	0.486	0.460
t-value	[4.80]***	[5.14]***	[4.62]***	[3.30]***	[5.21]***	[3.85]***	[4.57]***	[3.81]***	[4.19]***	[5.47]***	[3.37]***	[4.46]***
$dLI_{t,k}$	2.074	4.783	4.301	4.338	6.127	8.703	5.531	6.008	1.218	3.910	3.020	1.813
t-value	[4.13]***	[7.94]***	[4.81]***	[9.49]***	[11.87]***	[4.38]***	[4.68]***	[3.84]***	[2.54]***	[5.95]***	[3.13]***	[2.34]***
$d\pi_{t-1,k}$	0.084	0.045	-0.018	-0.041	0.036	0.020	0.058	0.024	-0.027	-0.010	0.015	0.048
t-value	[1.91]*	[2.06]**	[-0.49]	[-1.39]	[1.37]	[0.43]	[1.36]	[0.45]	[-0.94]	[-0.18]	[0.28]	[1.37]
β_0	0.001	-0.008	-0.001	0.000	-0.008	0.005	0.007	-0.007	-0.009	-0.001	-0.002	0.005
t-value	[0.10]	[-0.76]	[-0.03]	[0.02]	[-0.85]	[0.33]	[0.47]	[-0.52]	[-0.54]	[-0.05]	[-0.08]	[0.41]
R-squared	0.651	0.796	0.672	0.803	0.822	0.536	0.651	0.611	0.541	0.623	0.351	0.672
Adj. R-squared	0.628	0.782	0.650	0.790	0.810	0.505	0.628	0.586	0.511	0.599	0.308	0.650
F-statistic	28.340	59.141	31.122	61.956	70.232	17.525	28.387	23.923	17.938	25.165	8.211	31.073
Durbin-Watson	2.325	2.072	1.973	2.233	2.101	2.082	2.127	2.155	2.369	2.412	2.133	2.144

Notes: The dependent variable is $di_{t,k.}$ The sample includes 84 observations between the time period 2003M1 and 2009M12.

*, ** and *** indicate a level of confidence at 90, 95 and 99 %, respectively.

Figure 1. Lerner Index for selected EMU member states



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