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Zacharias Bragoudakis
Alexandros Tsioutsios

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BANK OF GREECE
Economic Analysis and Research Department – Special Studies Division
21, E. Venizelos Avenue
GR-102 50 Athens
Tel: +30210-320 3610
Fax: +30210-320 2432

www.bankofgreece.gr

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BANK CONCENTRATION AND ASYMMETRIC INTEREST RATE SPREADS PASS THROUGH: EVIDENCE FROM SELECTED EURO AREA COUNTRIES

Bragoudakis Zacharias
Bank of Greece, Economic Analysis and Research Department

Tsioutsios Alexandros
Department of Economics & UoA Center for Financial Studies, School of Economics and Political Sciences, National and Kapodistrian University of Athens.

ABSTRACT

The reaction of bank retail interest rates and deposit rates to shifts in interbank rates is influenced by the structural characteristics of the financial and banking system, as well as by the degree of competition within the banking sector. A recursive momentum threshold autoregressive asymmetric error correction model (Recursive MTAR-AECM) with non-linear adjustment is used to explore the existence of asymmetries in the adjustment of lending-deposits spreads to deviations in interbank rates for a group of selected euro countries. The findings provide evidence in favor of asymmetric adjustment in interest rate spreads and the asymmetric adjustment associated with the market power of banking sector concentration explanation of interest rate rigidity.

Keywords: Asymmetric adjustment, Banking concentration, Interest rates rigidity of spreads, Recursive MTAR-AECM.

JEL: C20, C22, E43

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Correspondence:
Zacharias Bragoudakis
Economic Analysis and Research Department
Bank of Greece
El.Venizelos 21, 10250 Athens, Greece
Tel.: +30-2103203605
email: zbragoudakis@bankofgreece.gr

1.Introduction

The concept of asymmetric interest rate asymmetric adjustment (interest rate pass-through hypothesis) and its implications for monetary policy transmission has been a subject of extensive research. The reaction of bank retail interest rates to shifts in interbank or wholesale market rates is influenced by the structural characteristics of the financial system and the degree of competition within the banking sector. Cross-country differences in financial architecture can lead to heterogeneity in the pass-through mechanism from money market rates to retail lending and deposit rates. This topic has garnered considerable attention in academic literature due to its implications for the transmission channels of monetary policy. Notably, the persistence of interest rate stickiness in bank pricing behavior has been analysed within an oligopolistic framework, see for example Hannan and Berger (1991)[1] and Neumark and Sharpe (1992).

When banking markets are more concentrated, business loan rates take longer to follow policy moves, margins stay wider for longer, and the lending channel weakens for firms, while household rates barely react to concentration. This aligns closely with the existing literature, as empirical findings have consistently linked market power to wider margins and slower pass-through rates.

The aim of this paper is to analyze the asymmetric interest rate pass-through hypothesis and examine the effect of banking sector concentration on asymmetric price adjustments in interest rate spreads. The interest rate spread is defined as the difference between lending rates (the rates charged by banks on loans to private sector customers) and deposit interest rates (the rates paid by commercial or similar banks on demand, time, or savings deposits).

The literature on interest rates pass through and asymmetric adjustments is abundant, however, this paper contributes to the literature in two ways: Firstly, we employ a recursive threshold autoregressive asymmetric error correction model for

[1] Hannan and Berger (1991) have pointed out that the exercise of market power to the own advantage of firms may trigger reactions on the part of customers which may manifest itself in a substitution of deposits with other forms of saving. By analogy, it may lead to a switching from bank lending into alternative types of financing. Under this ¨customer reaction¨ explanation, which is beneficial to customers deposit rates will be characterized by a relative downward rigidity and lending rates by a relative upward rigidity. Therefore, it can be argued that in a competitive environment it can be to the advantage of banks to adjust interest rates asymmetrically in favor of their customers.

selected euro area countries to investigate the evaluation of asymmetries in interest spreads pass-through dynamically. The recursive threshold autoregressive asymmetric error correction model is a more advanced econometric technique than other models used in the literature and allows for a time-varying perspective. Secondly, we use the estimated recursive parameters of the model to test the impact of banking sector concentration, for the selected euro area countries, on the interest spreads rigidity.

Donatos, Moschos, & Bragoudakis (2003) analysed the asymmetries of bank deposit and lending rates in response to changes in interbank interest rates in several OECD countries using an ECM model. The results indicate significant asymmetries in rate adjustments in countries such as Canada, France, the UK and the US, while no significant asymmetries were observed in Germany, Greece, Portugal and Spain. Also, Lazaris et al., (2021) used an autoregressive distributed lag (ADL) model to measure interest rate pass-through, that is, how quickly and to what extent banks adjust customer deposit and loan rates in response to movements in money market rates. Their findings show that long-term pass-through is very strong for term deposits. In contrast, open deposit products exhibit much weaker sensitivity.

Scholnich (1999) found little evidence of significant asymmetries in interest rate adjustments across various financial products and markets in Canada and the United States. Specifically, asymmetric interest rate pass through has been found for US, UK and Australia. This was found through a nonlinear ARDL, which also revealed that the asymmetric behavior was present even after financial crisis only for Australia (Apergis and Cooray,2015). A further look into Australia revealed that Australian bank interest rates responded differently to rising and falling interest rates. (Lim,2001) The authors used Markov switching vector autoregressive model which indicated that in the short run, banks were quicker to adjust their loan and deposit rates in response to decreases in the bank-bill rate than to increases. However, this asymmetry was not observed in the long run, suggesting that short-term factors might influence banks' rate-setting behavior. De Bondt (2005) also found that the pass-through of official interest rates to market rates was complete for short-term money market rates but not for long term. The authors utilizing VECM found a differential influence of monetary policy across different financial instruments. Similarly, Roelands (2012) found that there are asymmetries in interest rates pass through, which could be attributed in regulatory factors such as capital and liquidity requirements. Nguyen & Islam (2010) found that

banks adjusted their lending rates more quickly when the spread between lending and deposit rates was widening. Focusing on Thai banking sector the authors implemented a threshold autoregressive and momentum threshold autoregressive model. The findings support the consumer reaction hypothesis. Policy implications indicate the need for regulatory measures to prevent potential exploitative behaviors in interest rate adjustments. Tai, Sek, & Har (2012) also explored the lending rates, in Asia. The estimations through SUR equations showed slow transmission from the money market rate to deposing and lending rates. Later on, Liu (2019) found that the pass-through from money market rates to lending rates in China are partial using a cointegration analysis. Khan, Khan and Saleem (2023) studied developing Asian economies using panel ARDL and pooled mean group estimation. The study showed an inverse relationship between monetary policy (measured by broad money supply) and bank lending rates, suggesting that increases in money supply lowered loan costs. In Nambia in contrast to the finding of Tai, Sek, & Har (2012) and Liu (2019), Sheefeni (2013) found that there is no long run relationship between deposit and lending rates, indicating a limited effectiveness of traditional interest rate policies in the Namibian context. Kenya also exhibits challenges in monetary policy effectiveness. Nyangu, Waweru, & Marwa (2023) empirical findings from VECM present symmetric and/or asymmetric adjustment speed across different deposit rate categories. Whereas Polo (2021) revealed imperfect pass-through to deposit rates is a significant source of amplification of monetary policy shocks.

The Euro area has been widely studied, leading to significant findings (Aristei and Gallo (2014), Karagiannis, Panagopoulos, and Vlamis (2010), and Égert, Crespo-Cuaresma, and Reininger (2007), which indicate mixed results). Rocha (2023) pointed out that pass-through of policy rates to retail bank rates was not uniform across different sectors and types of loans. The analysis, focusing on Portuguese banking and based on VECM, revealed that some sectors experienced more complete pass-through than others. Although, in Czech Republic Gregor & Melecky (2018) found significant and complete pass through for SME lending rates, but unreliable consumer lending rates. Implementing a cointegration approach the authors point out the need for targeted monetary policy tailored differently for each sector. Similarly, Havranek, Irsova, & Lesanovska (2016) Marotta (2009) focused solely on post-euro introduction in Euro Area, indicating a limited effectiveness of the single monetary policy in influencing

retail rates, based on the incomplete equilibrium pass through that was found. The methodology of choice was structural breaks. Similar findings are presented by Micallef, Rapa & Gauci (2016) for Malta. The authors implemented disaggregated estimated and found incomplete pass-through even in the long run. A broad approach was brought by Cheikh, Zaied, & Ameur (2023) investigating the impact of geopolitical risk on exchange rate pass-through (ERPT) into domestic prices. The study utilized a dynamic panel threshold regression model which revealed significant regime dependence of exchange rate passthrough (ERPT) to geopolitical factors, especially in developed economies.

Crisis periods have variously impacted the pass-through relationships. Austria experienced a temporary change in the pass-through relationship, with lending rates increasing less than expected based on historical patterns (Jobst & Kwapil, 2008). Greece on the other hand experience an increase in Greek deposit (Papadamou & Markopoulos, 2018). The authors implemented a Markov-Switch Vector autoregression model, showing that this increase was prevalent after interbank rate shocks during high volatility periods. Chionis &Leon (2006) also focused on Greece using a bivariate cointegration and error correction. The findings show a significant structural break in interest rate transmission post-2001. The assessment led to a more responsive banking sector to the policy rate, indicating a closer alignment with the European Central Bank's policies.

Negative Interest Rate Policies (NIRP) and their impact on the banking sector has been a focal point in recent economic research, with studies by Boungou & Mawusi (2023), De Groot & Haas (2023), Molyneux, Reghezza, Thornton, & Xie (2020), and Demiralp, Eisenschmidt, & Vlassopoulos (2021) offering critical insights. Boungou & Mawusi (2023) examine how NIRP influences bank lending margins, uncovering that negative rates lead to a contraction in margins, particularly impacting smaller and less capitalized banks. This finding is pivotal in understanding NIRP's varied effects across different banking institutions. Meanwhile, De Groot & Haas (2023) shift the focus to the signaling channel of negative interest rates, arguing that NIRP can signal future lower deposit rates. Their research suggests that this signaling aspect is more influential than the banks' interest margin channel, adding a layer of complexity to NIRP's effectiveness. In a broader context, Molyneux, Reghezza, Thornton, & Xie (2020) analyze NIRP's impact on bank lending across OECD countries, revealing that bank

lending tends to weaken in NIRP-adopter countries. This effect is more pronounced in smaller banks and those reliant on retail deposit funding, highlighting the policy's differential impacts. Conversely, Demiralp, Eisenschmidt, & Vlassopoulos (2021) present a somewhat different picture, indicating that NIRP can be expansionary within the euro area, promoting higher risk-taking among banks.

The contribution of our paper is based on the novel integration of a recursive threshold autoregressive asymmetric error correction model to dynamically analyse the evolution of asymmetric pass-through in lending-deposits spreads to changes in interbank rates and its correlation with banking concentration. Unlike the prevailing literature, which largely focuses on static analyses or specific episodic events using traditional econometric models like ARDL, VECM, and Markov switching, our approach allows for a more nuanced understanding of how these asymmetries evolve over time and under varying market structures. It is worth noticing that we also provide a disaggregated perspective showing the differences in interest rate spreads between households and corporations.

Specifically, our work adds a critical dimension by examining how the degree of banking concentration is related to the rigidity of interest rate spreads. This exploration is significant as it addresses an underexplored area in the asymmetry of interest rate pass-through by linking it directly to changes in the banking market structure. By examining a dynamic evolution of asymmetric pass-through, we provide insights into whether the relation of banking concentration to interest rate spread adjustments is persistent, intensifies, or diminishes over time. Our findings provide evidence highlighting a significant asymmetric effect for corporate spreads (Beyer et al. 2024, Corvoisier and Gropp 2002, Saunders and Schumacher 2000).

Furthermore, our research enhances the understanding of monetary policy transmission across different banking environments and periods, offering valuable implications for policymakers concerning the effectiveness of interest rate policies in diverse banking contexts. This approach not only contributes to academic discourse but also provides practical insights for regulatory strategies aimed at optimizing monetary policy impact.

Stronger competition tightens retail pricing and boosts credit supply, especially when banks cannot lean as hard on deposit franchises to delay pass-through (Liebersohn

2024, Brugués and De Simone 2024, Beyer et al. 2024, Byrne 2024). Policy recommendations are simple, in particular, tighten merger control and monitor concentration locally, lower entry barriers for cross-border and digital banks, and give customers real switching power through account portability, standard APIs[2], and one-click refinancing tools and open-banking rails (Colangelo 2025).

Thus, our paper enriches the existing body of literature by providing a dynamic perspective on the relationship between banking market concentration and interest rate pass-through. The rest of the paper is structured as follows. Section 2 describes the econometric methodology. Section 3 analyzes the data. Section 4 provides empirical results, and Section 5 concludes.

2. Methodology

This paper employs an advanced econometric framework to investigate the existence and dynamics of asymmetric adjustment in lending-deposit spreads to changes in interbank rates. Our approach builds upon the traditional Error Correction Model (ECM) of Engle and Granger (1987), which determines the long-run equilibrium relationships between economic variables while modeling short-run deviations.

Initially, we examine whether a long-run equilibrium exists between the interbank rates and the lending-deposit spreads, through the following cointegration relationship:

$$Spread_t = \delta_0 + \delta_1 InterbankRate_t + u_t \quad (1)$$

where $Spread_t$ is the spread between the loan and deposit rates, $InterbankRate_t$ is the 3-month interbank rate, δ_0 captures fixed costs, δ_1 measures the long-run pass-through, and u_t denotes deviations from the equilibrium.

If both series are found to be integrated into order one, I (1), the existence of a long-run equilibrium relationship is tested by assessing the stationarity of the residuals of equation 1 using Dickey-Fuller type procedures. The ECM is defined as

$$\Delta Spread_t = \sum_{i=1}^{k_1} \alpha_i \Delta Spread_{t-i} + \sum_{i=0}^{k_2} \beta_j \Delta InterbankRate_{t-j} + \gamma\, \hat{u}_t^{-1} + \varepsilon_t \quad (2)$$

[2] APIs are technology-driven protocols that allow computer systems or data sources to interact with other software, enabling applications to share data and functionality (see Colangelo 2025).

where $\gamma < 0$ indicates convergence toward the long-run equilibrium.

The baseline Error Correction Model (ECM), in its original symmetric form as presented in Equation 2, is based on the following assumptions: (a) The residuals have a zero mean., (b) Deviations of the residuals from their mean revert to the mean symmetrically, that is, at the same speed., (c) The dependent variable responds symmetrically to any deviation from equilibrium. This implies that the speed at which the dependent variable adjusts back to equilibrium is identical, regardless of whether the residuals are negative (below the mean) or positive (above the mean).

Nevertheless, the AECM (Asymmetric Error Correction Model) has been shown to be statistically invalid in cases where asymmetric adjustment is detected. Balke and Fomby (1997), as well as Enders and Granger (1998), indicate that if the residuals' adjustment toward their mean is not symmetric, relying on a symmetric model could lead to misleading results.

The Asymmetric ECM model (AECM) divides errors into positive $u_{t-1}{}^{+}$ and negative $u_{t-1}{}^{-}$ deviations of r_t from equilibrium.

$$\Delta Spread_t = \sum_{i=1}^{k_1} \alpha_i \Delta Spread_{t-i} + \sum_{i=0}^{k_2} \beta_j \Delta InterbankRate_{t-j} + \xi_1 u_{t-1}^{+} + \xi_2 u_{t-1}^{-} + \varepsilon_t \quad (3)$$

where:

$$u_{t-1}^{+} = 1 \ if \ \hat{u}_{t-1} > 0$$
$$u_{t-1}^{-} = 0 \ if \ \hat{u}_{t-1} < 0$$

with $\xi_1, \xi_2 < 0$ represent adjustment speeds for positive and negative deviations, respectively.

Equation (3) assumes that the adjustment speed is ξ_1 for positive deviations and ξ_2 for negative ones. The first indication of asymmetric adjustment comes up when the estimated values are not equal. The AECM specification allows for a statistical test for the symmetric hypothesis (that the coefficients are equal) H_0: $\xi_1 = \xi_2$.

We employ the Recursive MTAR-AECM to address this issue, accounting for potential asymmetries in the momentum (first differences) of the deviations from the long-run

equilibrium. The crucial point in the TAR/MTAR methodology is to identify the threshold value $\hat{\tau}$ for which the asymmetric adjustment is statistically significant. Enders and Siklos (2001) propose the "Chan's approach" (1993) for detecting $\hat{\tau}$ among all residual values resulting from the cointegration relationship. According to this method, a search procedure over all possible values of the attractor to minimize the sum of squared residuals providing a consistent estimator of the threshold. The MTAR-AECM can be written as follows:

$$\Delta Spread_t = \sum_{i=1}^{k_1} \alpha_i \Delta Spread_{t-i} + \sum_{i=0}^{k_2} \beta_j \Delta InterbankRate_{t-j} + \xi_1 u_{t-1}^{+} + \xi_2 u_{t-1}^{-} + \varepsilon_t (4)$$

where:

$$u_{t-1}^{+} = 1 \ if \ \Delta\hat{u}_{t-1} > \hat{\tau}$$
$$u_{t-1}^{-} = 0 \ if \ \Delta\hat{u}_{t-1} < \hat{\tau}$$

In this paper we depart from the above traditional asymmetric techniques. We contribute to the literature and introduce a more robust model using a recursive estimator to capture dynamic behavior of adjustment speeds. The proposed model that we use is the recursive momentum threshold autoregressive asymmetric error correction model (Recursive MTAR-AECM) which extends the traditional model by allowing for time-varying parameters.

More specifically we estimate the model (4) for all the samples and then we define a constant period and create a loop with step h=12 aim to determine the up and down speed of adjustment for each year. The model (4) is estimated repeatedly over different sample periods, providing insights into the dynamic behavior of adjustment speeds and other parameters over time.

For each time t, the following model is estimated:

$$\Delta Spread_t = \delta_0^{(t)} + \sum_{i=1}^{k_1} a_i^{(t)} \Delta Spread_{t-i} + \sum_{i=0}^{k_2} \beta_j^{(t)} \Delta InterbankRate_{t-j} + \xi_1^{(t)} u_{t-1}^{+} + \xi_2^{(t)} u_{t-1}^{-} + \varepsilon_t \quad (5)$$

Where: $\delta_0^{(t)}, \alpha_i^{(t)}, \beta_j^{(t)}, \xi_1^{(t)}, \xi_2^{(t)}$, are the time-dependent with

$$u_{t-1}^{+} = 1 \ if \ \Delta\hat{u}_{t-1} > \hat{\tau}^{(t)}$$
$$u_{t-1}^{-} = 0 \ if \ \Delta\hat{u}_{t-1} < \hat{\tau}^{(t)}$$

This approach allows for dynamic modeling where we can observe how the adjustment speeds change over time, providing insights into the temporal behavior of the underlying economic relationships.

3. Data and preliminary analysis

In this section, we analyse the data from our study. We use monthly data from January 2003 to December 2021 for Greece, France, Portugal, Spain, Germany, and Ireland. Greece, France, Portugal, Spain, Germany and Ireland have unique economic characteristics and experiences over the study period (2003-2021). This selection allows for a comprehensive analysis of interest rate behavior. Greece, Portugal, Ireland and Spain were particularly affected by the euro area debt crisis, providing insights into interest rate dynamics during periods of significant economic stress. Germany is the largest and most stable eurozone economy, so is a good benchmark for interest rate behavior in stable economic conditions. France is a bit of an intermediate case, combining stability and vulnerability. These countries together provide a balanced perspective on how economic volatility and structural factors affect interest rates.

Table 1 presents the description and the source of selected variables.

Table 1: Description of Variables

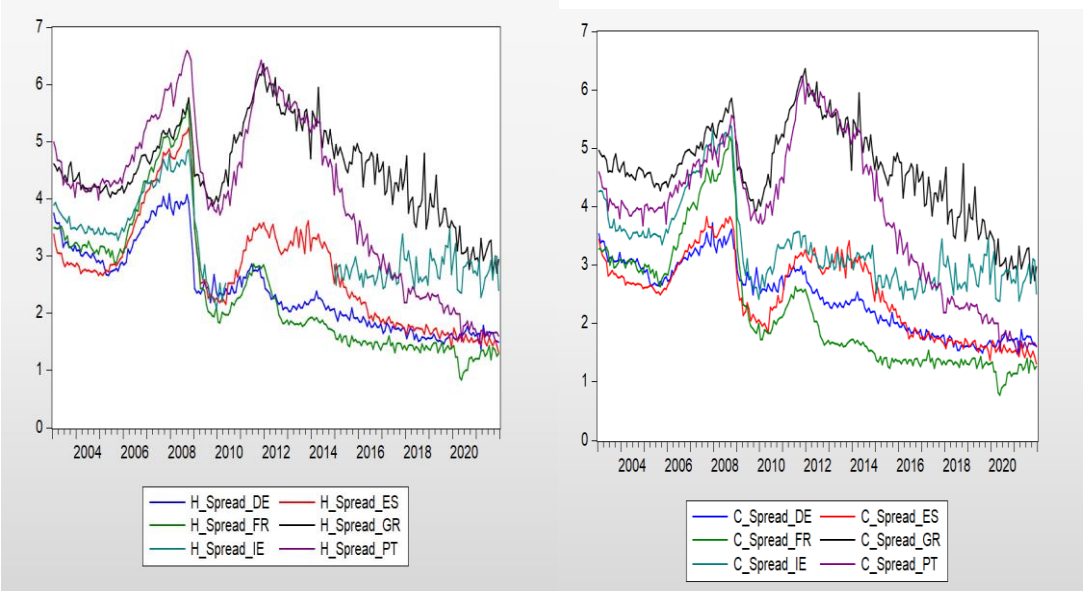
VARIABLE	EXPLANATION	SOURCE	LINK
INTERBANK 3M	The Interbank3M represents the 3-month short-term interbank rate.	Banco de España	Link
H_SPREAD	This variable is calculated as the difference between the cost of borrowing for new short-term loans and the interest rate on overnight deposits from households.	ECB	Link
C_SPREAD	This variable is calculated as the difference between the cost of borrowing for new short-term loans and the interest rate on overnight deposits from corporations.	ECB	Link
CONCENTRATION	The assets of the three largest commercial banks as a share of total commercial banking assets.	Global Financial Development	Link

Figure 1 illustrates the evolution of the cost of borrowing-deposit spreads for households and corporations across several European countries from 2003 to 2021, highlighting key financial trends. During the European sovereign debt crisis (2008-2012), spreads in Greece, Portugal, and Ireland surged significantly, reflecting

heightened financial risks, while Germany maintained consistently lower spreads, serving as a benchmark for stability. Post-2014, most countries saw stabilization, though Greece's spreads remained elevated, indicating ongoing financial distress. Corporate spreads appear more volatile than household spreads, suggesting differences in credit risk assessment. The observed trends align with the interest rate pass-through phenomenon, where spreads fluctuate based on financial conditions, economic shocks, and monetary policy measures, underscoring the persistent fragmentation within the euro area's banking sector.

Figure 1: The evolution of spreads for households and corporations

a) Households b) Corporations



Source: Banco de España, ECB and Global Financial Development and authors calculation (See Table 1)

Table 2 presents the descriptive statistics for spreads, capturing the divergence between borrowing costs and reference rates across households, corporations, and the interbank market in the euro area. Panel A, which focuses on household spreads, highlights notable cross-country differences. Germany (H_Spread_DE) has the lowest average spread (2.419), indicating relatively stable financial conditions and a well-functioning credit market. In contrast, Greece (H_Spread_GR) and Portugal (H_Spread_PT) exhibit significantly higher spreads (4.528 and 4.082, respectively), suggesting persistent financial fragmentation and higher risk premiums in these economies. Spain (H_Spread_ES) and France (H_Spread_FR) have moderately lower

spreads (2.752 and 2.415), while Ireland (H_Spread_IE) sits in between with an average spread of 3.210, reflecting a gradual normalization post-crisis.

Panel B examines corporate spreads, which follow a similar trend but with some key distinctions. Germany (C_Spread_DE) again records the lowest spread (2.448), reinforcing its position as a benchmark for financial stability. Greece (C_Spread_GR) and Portugal (C_Spread_PT) continue to show the highest spreads (4.606 and 3.884, respectively), indicating that corporate borrowers in these economies face significantly higher financing costs relative to benchmark rates. A notable observation is that corporate spreads tend to be lower than household spreads in most countries, suggesting more favorable borrowing conditions for firms, likely due to collateralization and risk-adjusted pricing in business lending.

Panel C presents the interbank market spread (Interbank3M), which exhibits a mean of 1.094, with substantial fluctuations ranging from -0.582 to 5.113. The higher volatility of interbank spreads compared to household and corporate spreads highlights the sensitivity of interbank lending conditions to macroeconomic shocks and monetary policy shifts.

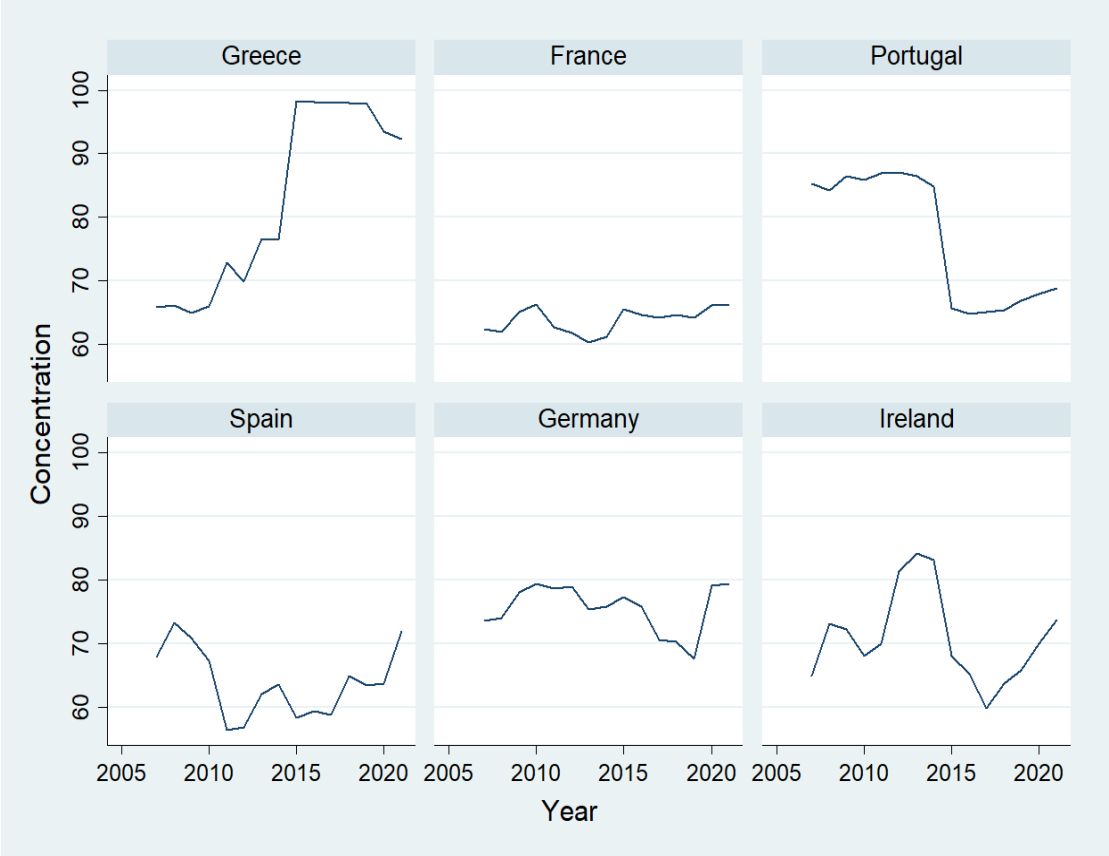
Table 2: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Panel A:Households					
H Spread DE	228	2.419	0.736	1.370	4.090
H Spread ES	228	2.752	0.947	1.320	5.250
H Spread FR	228	2.415	1.169	0.830	5.650
H Spread GR	228	4.528	0.795	2.680	6.360
H Spread IE	174	3.210	0.689	2.100	4.860
H Spread PT	228	4.082	1.419	1.480	6.590
Panel B:Corporations					
C Spread DE	228	2.448	0.605	1.480	3.720
C Spread ES	228	2.487	0.685	1.310	3.830
C Spread FR	228	2.234	1.068	0.770	5.190
C Spread GR	228	4.606	0.813	2.700	6.360
C Spread IE	228	3.315	0.711	2.380	5.400
C Spread PT	228	3.884	1.264	1.480	6.220
Panel C: Interbank Rate					
Interbank3M	228	1.094	1.587	-0.582	5.113

Source: Banco de España, ECB and Global Financial Development and authors calculation (See Table 1)

Figure 2 illustrates the market concentration in the banking sector for Greece, France, Portugal, Spain, Germany, and Ireland from 2007 to 2021. Greece shows a significant increase in concentration starting around 2010, peaking near 100% around 2015, followed by a slight decrease, indicating substantial consolidation likely due to the financial crisis. Portugal also exhibits high concentration initially, followed by a notable drop around 2015, and then stabilizing. France and Germany display relatively stable concentration levels with minor fluctuations, suggesting a stable competitive environment. Spain and Ireland show more variability; Spain has a dip around 2011 followed by a gradual increase, while Ireland experiences peaks and troughs, indicating periodic changes in market structure. Overall, Greece and Portugal exhibit the most dramatic changes in concentration, while France and Germany maintain stability.

Figure 2: Bank market concentration per country



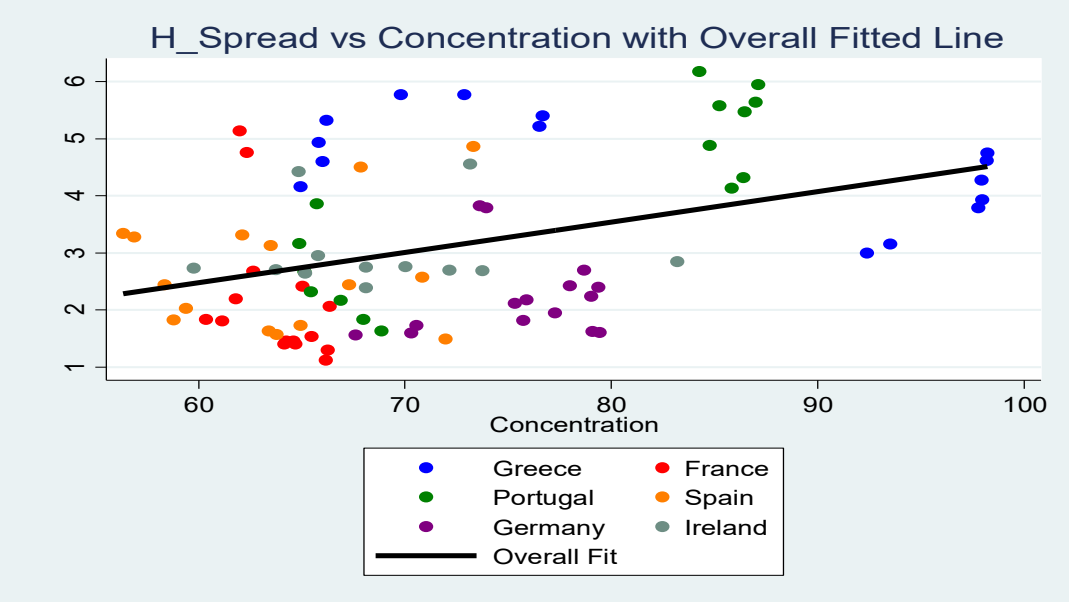
Source: Data from database: Global Financial Development and authors calculation (See Table 1)

After the brief presentation of data, Figure 3 shows a positive relationship between spread and concentration, as the overall fitted line indicates. Data points are

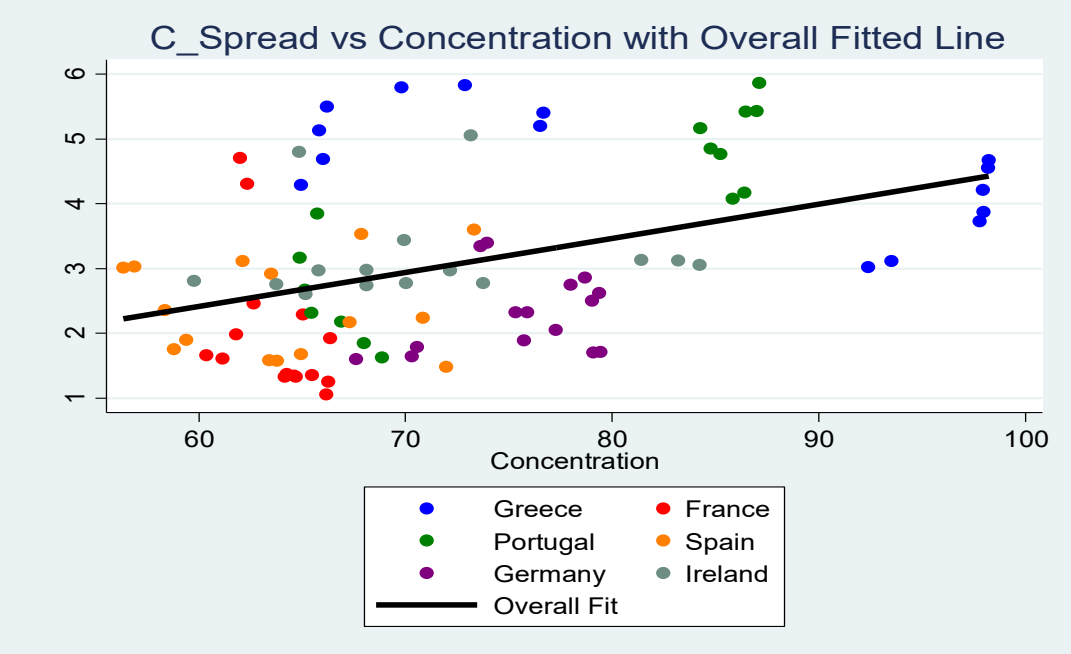
grouped by country (Greece, France, Portugal, Spain, Germany and Ireland), each represented by a different color. While the overall trend shows higher concentration levels are generally associated with higher spreads, there is considerable variability within each country. Greece and Portugal have a wider range of concentration and spread, while France is more clustered at lower levels.

Figure 3: Scatter plot of Interest rate spread and concentration

a) Households



b) Corporations



Source: Banco de España, ECB and Global Financial Development and authors calculation (See Table 1)

4.Empirical results

In this section we address the main research questions empirically. Firstly, we provide the recursive equilibrium parameters for the countries, and secondly, we employ an OLS regression to study the effect of concentration on asymmetric effects, following Bedrossian, & Moschos, (1988).

4.1 Asymmetries

The first research hypothesis is to investigate asymmetries on interests' rate markets[3]. Table 3 presents the descriptive statistics of dynamic error correction parameters. The coefficients $\xi_1 \; and \; \xi_2$ determine the asymmetric adjustment speed. In the case of Germany, the speed of adjustment for households ranges from 9.9% to 9.9%, with symmetric corrections. This means that if the spread is 10% above its long-run equilibrium, 9.9% of the deviation will be eliminated in the subsequent period, and if it is 10% below equilibrium, the adjustment will also be 9.9%. For corporations, the speed of adjustment ranges from 9.1% to 14%, with positive changes being larger in absolute value than the negative ones. This suggests that when the spread is above equilibrium, 14% of the deviation is corrected, while 9.1% is eliminated when below equilibrium. Corporations adjust more rapidly when the spread is above equilibrium, while households exhibit a perfectly symmetric response.

In the case of Spain, the speed of adjustment for households ranges from 8.1% to 2.8%, with negative changes being larger than positive ones. This means that if the spread is 10% above its long-run equilibrium, only 2.8% of the deviation will be eliminated in the next period, while if it is 10% below equilibrium, 8.1% will be corrected. For corporations, the adjustment ranges from 10.2% to 8.8%, showing a more

[3] First, we apply unit root tests and find that all variables are I (1). Then we apply the bivariate cointegration test for all periods. The next step is the recursive estimator to investigate the dynamics of the asymmetries. We set an initial estimation with 60 observations and then we employ the recursive estimation with 12 steps to determine the annual parameters of error correction model

balanced correction pattern. If the spread is 10% above equilibrium, 8.8% of the deviation will be eliminated, whereas if it is 10% below equilibrium, 10.2% will be corrected. Corporations exhibit a more symmetrical adjustment, while household spreads take longer to adjust when above equilibrium.

In the case of France, the speed of adjustment for households ranges from 27.8% to 53.8%, with positive corrections being much larger than negative ones. If the spread is 10% above equilibrium, 53.8% of the deviation will be eliminated, while 27.8% will be corrected when below equilibrium. For corporations, the adjustment ranges from 37.8% to 50.1%, showing similar dynamics but with a more balanced pattern. If the spread is 10% above equilibrium, 50.1% of the deviation will be eliminated, while if it is 10% below equilibrium, 37.8% will be corrected. France exhibits strong positive corrections for both sectors, with corporations showing a more proportional adjustment than households.

In the case of Greece, the speed of adjustment for households ranges from 4.7% to 19.6%, with positive corrections being significantly larger. If the spread is 10% above equilibrium, 19.6% of the deviation will be eliminated, while if it is 10% below equilibrium, only 4.7% will be corrected. For corporations, the adjustment ranges from 15.5% to 0.5%, showing an opposite pattern, where negative corrections dominate. If the spread is 10% above equilibrium, only 0.5% of the deviation will be eliminated, whereas if it is 10% below equilibrium, 15.5% will be corrected. This indicates that corporate spreads in Greece are more resistant to positive adjustments, while household spreads return to equilibrium more quickly when above their long-run level.

In the case of Ireland, data is unavailable for households, making corporate adjustments the primary focus. The speed of adjustment for corporations ranges from 28.8% to 30%, with positive changes being slightly larger than negative ones. This means that if the spread is 10% above equilibrium, 30% of the deviation will be corrected, while if it is 10% below equilibrium, 28.8% of the difference will be eliminated. Ireland demonstrates one of the most balanced correction patterns, where the adjustment speed is nearly identical in both directions.

In the case of Portugal, the speed of adjustment for households ranges from 12% to 4.4%, with negative corrections being much larger than positive ones. If the spread is 10% above equilibrium, only 4.4% of the deviation will be eliminated, whereas if it

is 10% below equilibrium, 12% will be corrected. For corporations, the adjustment ranges from 22% to 12.1%, with negative corrections dominating. If the spread is 10% above equilibrium, 12.1% of the deviation will be corrected, while if it is 10% below equilibrium, 22% will be eliminated. Corporations in Portugal adjust much more aggressively when the spread is below equilibrium, while households follow a similar but less pronounced pattern.

Table 3: Recursive Asymmetric Adjustments (2007-2021)

COUNTRY	VARIABLE	OBS	MEAN
	PANEL A: HOUSEHOLDS		
DEU	ξ_2	15	-0,099
DEU	ξ_1	15	-0,099
ESP	ξ_2	15	-0,081
ESP	ξ_1	15	-0,028
FRA	ξ_2	15	-0,278
FRA	ξ_1	15	-0,538
GRC	ξ_2	15	-0,047
GRC	ξ_1	15	-0,196
IRL	ξ_2	0	-
IRL	ξ_1	0	-
PRT	ξ_2	15	-0,120
PRT	ξ_1	15	-0,044
	PANEL B: CORPORATIONS		
DEU	ξ_2	15	-0,091
DEU	ξ_1	15	-0,140
ESP	ξ_2	15	-0,102
ESP	ξ_1	15	-0,088
FRA	ξ_2	15	-0,378
FRA	ξ_1	15	-0,501
GRC	ξ_2	15	-0,155
GRC	ξ_1	15	-0,005
IRL	ξ_2	15	-0,288
IRL	ξ_1	15	-0,300
PRT	ξ_2	15	-0,220
PRT	ξ_1	15	-0,121

Notes: The table describes the descriptive statistics of the recursive estimators for the cointegration parameters below and above the long-run equilibrium for the period 2007-2021 using annual data. The calculation is based on monthly data from January 2003 to December 2021, but we use a constant window and then estimate the parameters with step (h=12) to investigate the annual coefficient for long-run adjustments. Ireland has missing values for households and for this reason we do not run the model for reasons of data availability.

Table 4 shows the average periods (in months) of convergence to the long-run equilibrium. We can observe that for household spreads the convergence provides a

symmetric adjustment for Germany and a faster adjustment above the equilibrium for France, and for Greece, Spain and Portugal we observe a weaker adjustment above the equilibrium than below it. For corporate spreads we observe a faster adjustment above equilibrium and for all other cases a weaker adjustment above equilibrium. These results suggest that countries with higher concentration need more time to converge above equilibrium (higher portfolio margins for banks) than below.

Table 4: Periods to convergence to long run Equilibrium

Country	Group	Periods to convergence (Above Equilibrium)	Periods to convergence (Below Equilibrium)
DEU	Households	10.1	10.1
ESP	Households	35.7	12.3
FRA	Households	1.86	3.60
GRC	Households	5.10	21.3
IRL	Households	—	—
PRT	Households	22.7	8.33
DEU	Corporations	7.14	11.0
ESP	Corporations	11.4	9.80
FRA	Corporations	2.00	2.65
GRC	Corporations	200.0*	6.45
IRL	Corporations	3.33	3.47
PRT	Corporations	8.26	4.55

Notes: For Greece, the values tend to infinity because the error correction terms are close to zero. When the error-correction coefficient (ξ) approaches zero, the implied adjustment speed becomes extremely slow. Because the mean lag is calculated as $1/(|\xi|)$, very small values of ξ generate disproportionately large mean-lag estimates, sometimes approaching infinity. This does not indicate an actual infinite adjustment period, but rather reflects that the system exhibits almost no short-run correction back to equilibrium. In such cases, the convergence measure becomes highly sensitive to small estimation errors, and the resulting large values should be interpreted with caution.

4.2 Market structure and rigidity

The second research hypothesis is based on how market concentration relates to the asymmetric pass-through of interest rates. To address this research question, the negative and positive error correction terms are employed to investigate whether there is asymmetric adjustment. Bedrossian and Moschos (1988) examined how market structure, particularly industrial concentration, impacts how quickly prices adjust in response to changes in costs. The study posits that two main effects— the "leadership effect" and the "industry profitability effect" operate in opposing directions to influence

this speed of price adjustment. The leadership effect suggests that in concentrated markets, dominant firms can influence pricing dynamics significantly, often leading to quicker adjustments as these firms tend to behave as price leaders. In contrast, the industry profitability effect implies that higher profit margins within an industry might slow down the speed of price adjustment, as firms are less pressured to rapidly adjust prices in response to cost changes due to their comfortable profit cushions. The interplay of these effects, along with the length of the production period, determines whether the relationship between concentration and price adjustment speed is positive or negative. In the recent literature, Agiomirgianakis et al. (2024) show that the oligopolistic structure of the Greek banking sector allows banks to maintain unusually high interest margins due to limited competitive pressure. Similar conclusions are drawn by Bertsatos (2023), who also highlights the impact of weak competition on banking sector.

Tables 5a and 5b explore the relation between concentration and speed of adjustment. The regression results examine whether concentration is associated with the speed of adjustment in spreads toward long-run equilibrium. While we cannot claim causality, for households, concentration does not seem to significantly influence either positive or negative adjustments, as indicated by the insignificant coefficients in both models. This suggests that changes in market concentration are not materially related to how quickly household spreads revert to equilibrium after deviations. In contrast, for corporations, higher concentration has a significant negative association with the positive speed of adjustment, meaning that when spreads increase, adjustment back to equilibrium may be slower in more concentrated markets.

However, concentration is not significantly associated with the negative speed of adjustment, indicating no clear relation when spreads decline. These findings highlight the asymmetric association of concentration, with corporate spreads being more sensitive to market structure, particularly in periods of positive deviations from equilibrium.

Table 5a: Regression Analysis for Households

VARIABLES	Model_1 ξ_1	Model_2 ξ_2
log Concentrationn	0.34378	-0.06376
	(0.38020)	(0.25995)
Constant	-1.64981	0.14753
	(1.62445)	(1.11064)
Observations	75	75
R^2	0.05185	0.00294
Number of Countries	5	5

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The results validate the research question, as under equilibrium, a positive and statistically significant association with contraction is observed. Consequently, larger concentration allows for more rapid changes, although the effect on the positive term is not statistically significant. This may allow the banks to maintain higher levels of loan-deposit spread.[4]

Table 5b: Regression Analysis for Corporations

VARIABLES	Model_1 ξ_1	Model_2 ξ_2
Log Concentration	-0.39637*	-0.10057
	(0.18759)	(0.40466)
Constant	1.49996	0.22374
	(0.80099)	(1.72786)
Observations	90	90
R^2	0.04490	0.00297
Number of Countries	6	6

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5. Conclusions

The aim of the paper is to investigate the interest rates pass through for selected countries from the eurozone and to identify the effect of market concentration of the

[4] For robustness, we also employ a cross-sectional dependence–robust covariance matrix to account for potential heterogeneity. Under this specification, the coefficient for households in the positive adjustment equation is statistically significant, whereas for corporations the coefficient becomes statistically insignificant (see Appendix A).

bank sector on these asymmetries. This paper investigates the relationship between bank concentration and asymmetric interest rate pass-through in selected euro area countries, employing the Recursive MTAR-AECM. The findings provide evidence of asymmetric adjustments in spreads, revealing that banking market structure plays a crucial role in determining the speed at which spreads revert to their long-run equilibrium.

The empirical analysis shows that household spreads exhibit no significant relationship between concentration and the speed of adjustment, indicating that banking sector concentration is not materially related to how quickly household spreads return to equilibrium after deviations. This suggests that household lending and deposit markets may be less sensitive to structural changes in the banking sector, possibly due to regulatory constraints or consumer protection mechanisms that limit pricing flexibility.

Conversely, for corporate spreads, the results highlight a significant asymmetric relation. Higher concentration in the banking sector is associated with a slower positive adjustment in spreads, implying that when corporate spreads widen, banks in concentrated markets take longer to correct deviations. This finding suggests that market power may enable banks to sustain wider spreads for longer periods, potentially reducing the efficiency of interest rate transmission. However, no significant effect is observed for negative adjustments, indicating that when spreads decrease, banks do not appear to systematically alter their adjustment behavior based on market structure.

The study contributes to the broader literature on interest rate pass-through by introducing a recursive framework to assess asymmetries in spread adjustments. The results highlight that banking concentration affects spread dynamics differently across borrower segments, with stronger implications for corporate lending markets. However, a limitation of this study is that, due to data availability, we could not apply alternative estimation methods, and future research could extend the analysis by incorporating additional proxies for market structure. Future research could explore the interaction of banking concentration with other structural factors, such as financial stability, risk perception, and macroeconomic uncertainty, to further refine our understanding of interest rate rigidity and pass-through efficiency in the euro area.

From a monetary policy perspective, these findings underscore the importance of market structure in influencing the effectiveness of policy transmission. In more concentrated banking markets, the slower correction of upward deviations in corporate spreads may weaken the intended effects of interest rate policies, leading to prolonged distortions in credit conditions. Our findings provide evidence highlighting a significant asymmetric effect for corporate spreads and are in line with related research works (see Beyer et al. 2024, Corvoisier and Gropp 2002, Saunders and Schumacher 2000).

This reinforces the need for regulatory measures aimed at promoting competition and improving the responsiveness of lending markets, particularly for businesses. Recent evidence supports our policy recommendations that stronger competition tightens retail pricing and boosts credit supply, especially when banks cannot lean as hard on deposit franchises to delay pass-through (Liebersohn 2024, Brugués and De Simone 2024, Beyer et al. 2024, Byrne 2024). Hence, the policy recommendations are simple and clear, making rivalry work where transmission matters most, the corporate segment. In particular, tighten merger control and monitor concentration locally, lower entry barriers for cross-border and digital banks, and give customers real switching power through account portability, standard APIs, and one-click refinancing tools and open-banking rails (Colangelo 2025).

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Appendix A: Comparative analysis using robust and DK standard errors

Households

	(1)	(2)	(3)	(4)
	Model_1	Model_2	Model_3	Model_4
VARIABLES	ξ_1	ξ_2	ξ_1	ξ_2
Log Concentration	0.34378	-0.06376	0.34378*	-0.06376
	(0.38020)	(0.25995)	(0.18814)	(0.05320)
Constant	-1.64981	0.14753	-1.64981*	0.14753
	(1.62445)	(1.11064)	(0.81913)	(0.22007)
Observations	75	75	75	75
Number of groups			5	5

Corporations

	(1)	(2)	(3)	(4)
	Model_1	Model_2	Model_3	Model_4
VARIABLES	ξ_1	ξ_2	ξ_1	ξ_2
Log Concentration	-0.39637*	-0.10057	-0.39637	-0.10057
	(0.18759)	(0.40466)	(0.27288)	(0.14388)
Constant	1.49996	0.22374	1.49996	0.22374
	(0.80099)	(1.72786)	(1.15165)	(0.61661)
Observations	90	90	90	90
Number of groups			6	6

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