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Banking Integration and Fragmentation in the Interest Rate Channel

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Abstract

At the forefront of the economic consolidation of the euro area, banking integration came to a stall following the beginning of the 2008 crisis. Since then European banks started retrenching their asset holdings within national borders, effectively reducing the scale of their European operations. This paper explores the link between banking integration and fragmentation in the interest rate channel in the eurozone. Using a rolling VAR, I estimate the overtime evolution of the interest rate pass-through across European countries, and then I relate this evidence to banking integration dynamics. The results support the existence of a statistically significant and negative link between banking integration and cross-country differentials in the interest rate channel.

JEL Codes: E31; E44; E52; F36.

Keywords: Monetary policy, banking integration, financial fragmentation.

1 Introduction

The traditional literature on optimal currency areas identifies financial integration as integral to the economic prosperity of a currency union. Looking at Europe, significant steps have been taken in the last two decades to consolidate national financial markets in a pan-European system for credit provision and banking intermediation. The degree of European[1] banking integration reached its peak in 2007, before the beginning of the financial turmoil; since then, however, euro area banks started cutting their international exposure across Europe, and as a matter of fact, retrenching their operations within national borders.

In this paper, I explore how banking integration cutbacks affected the euro area monetary policyÕs transmission mechanism. To the extent that monetary policy pass-through is determined by banks'

[1] Here and later in this paper I refer loosely to Europe when meaning the Eurozone.

characteristics having country specificity, pan-European banking integration is expected to have rendered more homogeneous across countries the way monetary policy shocks are transmitted to the economy. Today, empirically establishing a link between banking integration and fragmentation in the interest rate channel is of significant policy relevance, as financial fragmentation is one of the most severe threats to the recovery of the Eurozone. The analysis developed in this paper uses a two-step estimation procedure. Starting with a rolling VAR, estimated over a sequence of overlapping time spells, I use standard recursive identification to track the evolution in the dynamic effect of monetary policy shocks on bank lending rates. Then, a time varying index of fragmentation in monetary policy transmission is obtained from the cross-country dispersion of the estimated impulse response functions. Finally, this variable is regressed on a measure of European banking integration, derived as the sum of Eurozone banks' cross-European claims. Empirical evidence shows that banking integration significantly reduces fragmentation in the interest rate channel, while results are robust to a number of alternative specifications and changes in parameters.

The reminder of the paper is organised as follows: in the next section, I review the existing literature on the topic; then, I move to the empirics, describing in detail how I measure the interest rate channel across euro area members and how to construct a measure of its dispersion. Next, I assess the relationship between banking integration and fragmentation in the interest rate channel for a sample of Eurozone economies. The final sections are devoted to discussing results and presenting conclusions.

2 Related literature

Just before and right after the introduction of the euro, economists and policymakers devoted substantial efforts to the characterisation of the interest rate channel in the newly born currency union. In 1999, the European Central Bank (ECB) launched a major research project, the Monetary Transmission Network, aimed at assessing the interest rate channel in the eurozone. A substantial share of the literature produced in this research effort is reviewed by Angeloni et al. (2002), who draws a rich and composite picture of the transmission channel in the eurozone. Country differences in the interest rate channel exist and are partially explained by market and institutional frameworks, characterising different financial sectors with national specificity. The introduction of the euro and the following process of financial integration significantly reduced country wedges in monetary policy pass-through (Sander and Kleimeier (2004) and Boivin et al. (2008)) even if, to a lower extent, heterogeneity persisted both in terms of lending spreads (Adam et al. (2002)) and interest rates stickiness (Mojon (2000), Sørensen and Werner (2006) and Van Leuvensteijn et al. (2008)). These wedges can be explained by a number of institutional and structural factors, such as firms' and households' behaviours, financial depth, risk attitude, taxation and legal systems (Mojon (2000), Cottarelli and Kourelis (1994), Cecchetti (1999)).

From a theoretical standpoint, the literature has stressed the importance of banking integration in reducing country dispersion in interest rate stickiness, mainly through increased banking competition. Klein (1971) and Monti (1972) present a model where lending interest rates depend on corresponding demand elasticity, implying a tight relationship between bank interest rates dynamics and competition among intermediaries. The Monti-Klein model provides a theoretical basis for a vast empirical literature establishing a link between banking competition and lending rate stickiness: using a panel of developed economies Borio and Fritz (1995) and Cottarelli and Kourelis (1994) identify competition within the banking system as one of the key determinants of intermediaries' lending rates response to policy shocks; Van Leuvensteijn et al. (2008) find similar results using loans level data. Hannan and Berger (1991) establish that, especially in periods of contractionary monetary policy dynamics, intermediariesÕ response to policy shocks is more sluggish in concentrated markets. Asymmetric adjustments in interest rates are also found by Mojon (2000), Scholnick (1996), Enders and Granger (1998) and Sander and Kleimeier (2001), while Sander and Kleimeier (2004), use pass-through measures as an indicator for eurozone banking market integration to argue that European financial markets are still fragmented.

If a connection between banking integration and dispersion in the interest rate channel is, to a certain extent, implicit in all the reviewed work, clearly supportive evidence of such link is still missing in the literature, and this paper aims at filling this gap. Moreover, the existing literature characterises interest rate pass-through mainly using autoregressive distributed lag or cointegrating specifications, while this paper focuses on vector auto regression (VAR) models, permitting an assessment with richer overtime dynamics and allowing a focus on unexpected monetary policy shocks. More in detail, I follow the traditional literature on the identification of unexpected monetary policy shocks in a VAR framework (Christiano et al. (1994), Stock and Watson (2001)) but focusing on the pass-through from policy to lending rates, instead of indicators of economic activity. The overtime evolution in the interest rate pass-through is characterised by estimating a time varying VAR, where the time dimension is introduced by implementing the estimation on a number of overlapping time spells. It should be noted that this is a different approach with respect to some existing literature on time varying VARs, which instead focus on an explicit identification of an autoregressive process for the estimated coefficients (Primiceri (2005), Justiniano and Primiceri (2006), Del Negro and Primiceri (2013)). The reason for this choice is that the relationship that this paper aims at characterising does not fit within the standard framework developed by Primiceri (2005). Such framework typically assumes coefficients to follow a stable Markov process, thus implicitly ruling out the possibility for estimated parameters to be determined by other factors. On the other hand, the use of a rolling VAR allows the determination of a time varying index of monetary policy fragmentation that can be related, in a second estimation, with a number of regressors, including bank cross-European integration. This is the approach followed by this paper.

3 Empirics

3.1 Measuring fragmentation in the interest rate channel

Referring to the traditional literature on the identification of monetary policy shocks within a VAR context and following the seminal work by Christiano et al. (1994), for a generic courtly j or the eurozone, I use the recursiveness assumption for the assessment of the dynamic effect of unexpected monetary policy shocks on bank lending rates. The baseline model takes the typical form:

$$\Pi(L)Y_{jt} = \alpha_j + e_{jt} \quad (1)$$

Where $\Pi(L)$ is lag polynomial operator of order L, which I assume equals to four for the baseline model, Y_{jt} is a vector of relevant variables for the analysis, e_{jt} is a serially uncorrelated disturbance error orthogonal to Y_{jt} and having defined covariance matrix. Variables included in Y_{jt} are the log of industrial production and of the core price index, the ECB policy rate (EONIA), representing the weighted average of all overnight unsecured lending transactions in the interbank market, and bank lending rates to non-financial corporations for credit lines up to one year. The benchmark identification scheme is recursive via Cholesky. The variables are ordered in the following way: industrial production, core inflation, EONIA and bank lending rates. This implies that output and prices are assumed not to be affected coincidentally by policy rates, while final lending rates are assumed to be responsive to contemporaneous shocks in all the other variables. Model 1 is estimated independently for each country of the EA-12 block on monthly frequency from January 2003 to October 2012. All series are from the ECB database. Time variation is introduced using overlapping time spells of fixed length. For the baseline specification, I consider 36 observations for each data window, while later in the paper I test results' resilience to different sample sizes. This gives rise to 77 impulse response functions for each country, describing the dynamic response of bank lending rates to monetary policy shocks. Once such estimates are obtained, I define monetary policy pass-through by considering, alternatively, the maximum and aggregate response of lending rates to shocks in the EONIA within a given number of months Q. The first of such measures is defined as follows:

$$z^1_{jt} = max[\psi_{jt}]_{q=0:Q} \tag{2}$$

Where, for a generic country j, z^1_{jt} is the measure of pass-through, ψ_{jt} is the IRF of the lending rate to unexpected shocks in the EONIA rate as estimated by model 1. The above measure is computed over the time sample $t \in T$, where T is the set of overlapping time spells.

The second measure consists in the cumulative response of bank lending rates to a shock in the EONIA; this corresponds to the integral of the relevant impulse response function from the time of the shock to a defined month Q:

$$z^2_{jt} = \int_0^Q \psi_{jt} \, \mathrm{d}x \tag{3}$$

The identification of the interest rate pass-through via z^1_{jt} or z^2_{jt} for each country j in the sample allows an assessment of the cross-country dispersion in the same measure. To do so, I consider the standard deviation of z^1_{jt} and z^2_{jt} across European countries. These two new variables, called h^1_{jt} and h^2_{jt}, characterise the dispersion in the interest rate channel among eurozone members, measured alternatively as the max and commutative dynamic responses of bank lending rates to unexpected shocks in the EONIA. For each time spell $t \in T$, I interpret h^1_{jt} and h^2_{jt} as measures of the cross-country fragmentation in the interest rate channel in the eurozone.

3.2 Banking integration and the interest rate channel

The second step of the analysis is to compare the measures of dispersion computed in the previous paragraph with banking integration. I quantify pan-European banking integration by considering banks' claims held in European countries different from the one of residence, as a share of domestic GDP. Calling this new variable e_{jt} then in each time spell $t \in T$, the cross-European exposure of eurozone banks is:

$$\gamma_t = \sum_{j=1}^{J} e_{jt} \tag{4}$$

Where J is the set of countries in the Eurozone considered in the analysis. The index is computed using averages over each time spell t, for making it comparable with IRFs computed over the same period. European bank foreign claims by counterpart location are obtained from the Bank of International Settlements (BIS) database. This series considers bank cross-border claims and local claims of foreign affiliates in euro. This series is available with quarterly frequencies; monthly observations are obtained using low-pass filter interpolation. When possible, interpolation should be avoided in empirical work; however, two aspects specific to this analysis are likely to minimise its consequences in terms of measurement error. First, bank foreign exposure is very persistent even on quarterly frequencies; second, I consider averages computed over each time spell, limiting the impact of interpolation on the final quality of the data.

Finally I compare h^1_{jt} and h^2_{jt} with banking integration, by estimating the following linear model:

$$h_t = a + \beta\gamma_t + \delta c_t + \eta_t \tag{5}$$

where h_t is alternatively the log of h_t^1 or h_t^2, γ_t represents the log of the measure for banking integration and c_t is a vector of controls. Few considerations are worth stressing about equation 5. First, the dependent variable, h_t, is a noisy measure of monetary policy pass-through. This is because this variable is constructed by considering estimated IRFs that are *per se* stochastic and dependent on the estimation precision for the initial VARs. To this extent, the error term in equation 5 might be decomposed in two stochastic terms: $\eta_t = \xi_t + \mu_t$, where μ_t is the standard OLS error term related to the estimation of equation 5 and ξ_t is an additional stochastic component due to the measurement error in the regressand. A further consideration should be made about the relationship between ξ_t and μ_t; the measurement error originating from the estimation of the initial VARs is affected by the number of observations included in each time spell used for estimation. The larger is the number of observations in each overlapping time window; the higher is the precision of the estimated VAR coefficients and resulting IRFs, implying a lower ξ_t. However, the larger is the number of observations included in each time sample; the smaller is the overall number of time spells, and as a matter of fact, reducing precision in the estimation of equation 5, thus increasing μ_t. It is evident then that there is a trade-off between precision in the first and second estimation, which is implicit in the structure of the data given this methodology. Despite the fact that moving observations from within to across time spells can affect the overall size of η_t, and to the extent there is no reason to think this trade-off to have a linear effect on the overall error, inference on β made with estimated moments of η_t, would yield a conservative assessment of its statistical significance. In other words, when making inferences on β with an OLS estimation of 5, we take into account the measurement error produced in the first step VAR estimation. This means that the variance inflation of η_t caused by ξ_t will increase the probability of a type-II error, effectively delivering a conservative assessment of the significance level for the estimated coefficient β. A side consequence, but one with limited practical implications, of having a regressand measured with error is that measures of goodness of fit based on the share of explained variance by the fitted model, such the R-squared, cannot be regarded as reliable.

A second consideration concerns possible identification issues. If $E(\gamma_t, \eta_t) = 0$ is verified, equation 5 is identified and the OLS estimator of β consistent. This translates into two additional conditions: $E(\gamma_t, \xi_t) = 0$ and $E(\gamma_t, \mu_t) = 0$. Excluding the correlation between the two components of η_t, I assume the first condition to hold, as no compelling reason exists to support dependence between the measurement error in h_t and regressors in 5. This is a common assumption in the literature estimating models for dependent variables measured with error. Assuming $E(\gamma_t, \mu_t) = 0$ is more restrictive, violation of this assumption and resulting identification problems could arise for two reasons. The first is simultaneity in the relationship between banking integration and fragmentation in the interest rate channel. The second is the presence of one or more missing relevant regressors correlated with γ_t. I will focus primarily on this latter issue in this paragraph while considering the former in the section concerned with robustness controls. This is because I consider it less plausible that differentials in interest rate stickiness could *per se* determine fluctuations in banking integration. The issue of a missing relevant regressor is, on the other hand, more likely to arise. One of the determinants of financial fragmentation in the eurozone after the crisis started could be found in sovereign credit risk. Divergent paths for government default probabilities are at the basis of significant disruption in the interest rate channel in some countries of the eurozone. At the same time, sovereign credit risk divergence can also be thought of as a major determinant of banks' retrenchment in domestic operations.

More generally, I consider a number of factors that might relate to both the cross-European homogeneity in the interest rate channel and banking integration. The first of such variables is sovereign credit risk. I measure common variation in European sovereign default risk considering the principal component of ten year bond yield spreads with respect to the German Bund for all euro area countries considered in the analysis. The second control captures distress in the interbank market. This is measured by the average monthly use of the ECB's Marginal Lending Facility as a percentage of the average use over the entire time sample. The marginal lending facility represents a last resort financing instrument for banks that are not able to access interbank lending, between weekly Main Refinancing Operations (MROs). The third control assesses the overall bank capital strength measured via capital asset ratios. All these variables are from the ECB data warehouse. A final but less severe estimation issue relates to the presence of autocorrelation in both dependent and independent variables of equation 5. Serial correlation in the error term in this case is due mechanically to the use of overlapping time spells and it can easily be corrected with the use of Newey-West standard errors.

4 Results

I compute lending rate stickiness by estimating 77 VAR models for each country of the EA-12 block; estimation is performed on overlapping time spells including 36 observations. The interest rate pass-through is defined as the integral or the maximum of IRFs over the first 4 months after an unexpected monetary policy shock. All results shown below are obtained with consideration of these assumptions.

Figure 3 plots the evolution of bank pan-European claims of Eurozone intermediaries: banking integration in Europe steadily increased up to the beginning of the crisis in 2007. Since then, European intermediaries retrenched their positions within national borders. Figures 1 and 2 track the evolution of financial fragmentation across euro area members. 90 percent confidence bands are obtained via bootstrapping. Differences in interest rate stickiness across members of the Eurozone appear to decrease from the beginning of the time sample up to the crisis in 2008; since then, fragmentation has increased. Finally, Figure 4 plots the relationship between fragmentation in the interest rate channel and banking integration. A clear downward sloping relation is observable between the two variables.

These figures suggest a role for the distress of the European interbank lending market following the 2008 crisis in determining monetary policy fragmentation. In the wake of the sovereign crisis, interbank cross-country lending virtually halted. This essentially isolated banks of the euro periphery from fluctuations in the EONIA rate, which is the target of the ECB's monetary policy action. In this framework, standard monetary policy action affecting the EONIA was effective only on banks of the euro core region, while intermediaries in troubled economies could finance themselves only by directly accessing weekly MROs auctions, or on a daily basis and at higher rates by accessing the ECB marginal lending facility. The freeze in cross-European bank lending is also a major determinant of the observed drop in banking integration as shown in Figure 4, as cross-country bank lending is a relevant share of European intermediaries' foreign claims. This initial evidence suggests banking integration and financial fragmentation are intimately related in European financial markets.

4.1 Baseline regression models

In Table 1, I show estimation results for model 5 when pass-through is characterised by integrating IRFs over time. In Table 2, the same models are estimated when only IRFs' maxima are considered.

The first equation represents the baseline model in which dispersion in the interest rate pass-through is regressed on its own lag and banking integration. The coefficient of this variable is negative and significant suggesting that higher banking integration reduces fragmentation in the interest rate channel of monetary policy. The estimated coefficient varies depending on the model specification; considering the one incorporating the larger number of controls, a one percent increase in the index of banking integration causes a 0.3 percent decrease in the dispersion of the interest rate channel across euro area members. In the remaining columns of Table 1, I consider equations 2 through 4, and simultaneously, the following, additional regressors: a variable measuring interbank market distress, the principal component of European sovereign credit default risk and euro area banks' capitalisation measured by the equity ratio. The introduction of these controls is aimed at testing the results obtained with the baseline model against the possibility of the omission of relevant regressors affecting both dependent and independent variables. Regardless of the model considered, however, banking integration appears to be a statistically relevant determinant of the dispersion in the interest rate channel. In Table 2, I show similar results of Table 1 when pass-through is measured with the max of the relevant IRF. Results are consistent with the previous evidence: a negative and statistically significant relationship exists between the dispersion in the interest rate channel and the index for banking integration. In this case however, the marginal effect is almost double in magnitude.

Findings presented in this paragraph support the prior that the degree of bank cross-country integration relates negatively to the degree of similarity in interest rate stickiness. I argue that the link identified results from a causal relationship, as major common factors possibly affecting both regressors and the regressand are considered in the baseline model. In the following paragraph, I test the stability of this finding against a number of competing specifications, including the use of instrumental variables.

5 Robustness

This paragraph considers an alternative specification and three robustness exercises. The alternative specification is explained in detail in the next section, and the three robustness controls are the following: First, I re-estimate the model, excluding the crisis period. Then, I test the baseline model against modifications in the length of the overlapping time spells and of the interval of integration for the IRFs. Finally, I consider a more solid identification strategy based on the characterisation of an instrument for banking integration.

5.1 An alternative specification

In the main, empirical part of this paper, I provided evidence of the relationship between banking integration and fragmentation in the interest rate channel at an aggregate level. In this paragraph, I provide evidence at a desegregated level. If the empirical question I tried to answer in the previous section was how banking integration contributes to reduce differentials in interest rate pass-through across euro area members, here I will try to answer the question of how the presence of euro area banks in the financial sector of a generic country j affects the way monetary policy shocks are transmitted in this country, with respect to the rest of the currency union. These two questions are intimately related.

To answer this question, I construct a new variable measuring the difference in the dynamic response to a monetary policy shock in a generic country j of the Eurozone, with respect to the (average) in the rest of the currency union. This variable is defined as follows:

$$zd_{jt} = |z_{jt} - \bar{z}_{Jt}| \tag{6}$$

where z_{jt} measures the cumulative response of country j lending rates to a shock in the EONIA rate. $\bar{z}_{Jt}$ is the arithmetic average of all z_{it} for countries of the Eurozone (set J) different from j. zd_{jt} then measures the absolute deviation at time t of the cumulative IRF of country j with respect to the average of all other countries of the Eurozone. This variable expresses how different the interest rate channel is in a generic country j with respect to other countries of the currency union.

I regress zd_{jt} on a variable that measures the total exposure by euro area banks in country j, weighted by the area GDP. This regressor measures the overall presence of euro area banks in a generic country j of the Eurozone and thus the penetration of the domestic banking sector by other European intermediaries. Data also comes from the BIS. I consider the following model

$$\Delta zd_{jt} = \lambda \Delta zd_{jt-1} + \beta^1 \Delta\gamma^1_{jt} + \alpha_j + \delta_t + \xi_{jt} \tag{7}$$

The use of a country and time fixed effect in 7 account for possible trends in the dependent variable and common shocks. Regression results for the corresponding panel estimation of euro area members are reported in Table 4. The model is estimated on the time sample 2003-2008 for reasons that will be clarified in the next paragraph. The same considerations about measurement error in the dependent variable apply in this case.

The three specifications reported in Table 4 include an autoregressive component and country fixed effects. In the last specification, I replace country invariant controls with a time fixed effect. Regardless of the model considered, the relative (to a country GDP) presence of other European intermediaries in the domestic banking market, has a negative effect on the (absolute) deviation of the interest rate channel with respect to the model of the rest of the eurozone. Quantitatively, a one percent increase in the presence of European banks in a national banking market reduces the deviation of the interest rate pass-through in this country, with respect to the eurozone average of 1.4 percent. In other words, this result suggests that the higher the presence of foreign European banks in a national financial sector of a generic country of the eurozone, the more the interest rate pass-through in this country is similar to the average of all other members of the eurozone.

5.2 Excluding the crisis

The EONIA is considered in this study and elsewhere as an indicator of monetary policy stance in the euro area, but it is a reliable one? Since the introduction of the euro and up to the beginning of the crisis, the ECB used open market operations (mainly Main Refinancing Operations, MRO) to target the desired level at which a bank can finance itself in the secondary market (EONIA). Following the interbank market freeze in October 2008, the ECB shifted from variable rate tenders with minimum bid rate to fixed rate tenders and unlimited amounts. This was meant to provide all necessary liquidity to banks unable to borrow in the interbank market. The consequence of this policy action in conjunction with the financial distress following the 2008 crisis was twofold: 1) only banks with a high level of creditworthiness were still able to borrow in the interbank market while the vast majority of banks in distress were not; and, as a consequence of this, 2) the interbank rate fell significantly, with respect to the rate of the main refinancing operations. This is because the provision of unlimited liquidity within the framework of MRO operations transformed the MRO rate into the effective cap for the EONIA, practically substituting the marginal lending facility.

As a matter of fact, since the beginning of the crisis two different types of banks, with higher and lower credit standards, financed themselves at two different interest rates. The first group was able to access the interbank lending market, at the EONIA rate, while the second was only directly accessing the ECB marginal lending facility or through the weekly MROs. To the extent that these two categories during the 2010 European debt crisis acquired a geographical connotation –with only banks from euro-core countries being able to access interbank lending, and with only those latter banks being likely to adjust their lending rates in response to EONIA fluctuations– the results obtained in the previous analysis could be driven by the inclusion of the crisis in the time sample. In fact, fragmentation in the interest rate channel could be mechanically driven by the fact that banks in troubled economies responded limitedly to movements in the EONIA with respect to intermediaries in core economies of the Eurozone. While this is consistent with the existence of a relationship between banking integration and monetary policy fragmentation, as cross-border lending in the interbank market affects banking integration measured via intermediariesÕ foreign claims, there is a case for re-assessing this target relationship while excluding the crisis period to establish its validity in tranquil times.

Table 3 presents regression results for the baseline model presented above, but restricts the analysis up to the beginning of the crisis (summer 2008). Regression results confirm the existence of a negative relationship between dispersion in interest rate pass-through and banking integration. In the first model of Table 3, heterogeneity in interest rates pass-through is regressed on bank cross-country exposure, without considering additional controls. In this case, the coefficient is -.87, suggesting that a one percent increase in banking integration produces a 87 basis point decrease in the standard deviation of cross-European interest rate stickiness. This value decreases when other controls are considered in the model. All regressions presented the key regressor, namely banking integration, to be negative and significant, thus confirming results previously found over the longer time sample.

5.3 Variation in parameters

Results presented so far are produced on the basis of two assumptions concerning the length of the overlapping time spells (36) and the number of periods following a monetary policy shock used to characterise interest rates pass-through (4). These assumptions are not arbitrary; however, an exact determination of these two parameters on the basis of economic reasoning is not obvious, leaving their choice with a certain degree of discretion. In this paragraph, I test the robustness of results obtained so far when these two parameters change. To do so, I determine *confidence interval-like* sets for the estimated coefficients of model 5, where the variation is not due to the stochastic component of the dependent variable but by the variation in the two parameters assumed to be fixed so far. The idea is to verify the variation (sensitiveness) of coefficients estimated in equation 5 when the length of the overlapping time spells considered for the estimation of initial VARs and the interval of integration for the IRFs change.

The practical implementation of this robustness exercise is similar to bootstrapping, where each iteration is not driven by a stochastic, zero mean error term but by a different combination of one the two parameters that determine the dependent variable in model 5. If a considerable number of possible permutations of these parameters produce relatively similar results, we can argue that such results are robust to the assumptions made. Following this procedure, in Table 5, first column, I consider how the coefficient resulting from the relationship between banking integration and dispersion in pass-through varies when the number of observations included in each time spell passes from 30 to 48. Main figures in Table 5 correspond to the medians of all coefficients obtained following such exercise; upper and lower fifth percentiles are shown in squared brackets. In the second model of Table 5, I instead consider variation in the integration interval for the IRFs. In this case, I consider how the estimated coefficients vary when such interval changes from 2 to 12 months. In the third model of Table 5, the variation in the size of the overlapping spells and the length of the interval of integration for the IRFs are considered together. In all cases considered, the relationship between dispersion in interest rate stickiness and banking integration stays negative. Results presented in Table 5 suggest that the negative relationship identified in the previous analysis is not dependent on parameters needed for the estimation of financial fragmentation.

5.4 Instrumental variables

So far, I excluded the possibility that banking integration and interest rate pass-through could be related in a simultaneous equations framework. In this paragraph, I drop this assumption considering the possibility that European banks' cross-country exposure could be directly determined by country-specific interest rate stickiness. The identification strategy presented here relies on the characterisation of an instrument for banking integration pre-determined, thus exogenous, to shocks affecting interest rate stickiness in each time spell t. Let us start considering the key regressor in model 7: γ^1_{jt} contains all euro area bank claims in a generic country j. The BIS dataset allows a further distinction between claims on the basis of maturity. Let us consider claims with over two years of maturity; these could include loans and bonds. The second category can adjust relatively fast to market conditions, however the first is typically persistent, as loans issued by European banking institutions are, for the vast majority, held to maturity. This is due to the fact that the practice of loans securitisation is relatively rare among European intermediaries. Should it be possible to eliminate marketable loans and bonds from all claims having over two yearsÕ maturity, we will be left with claims that can be considered as pre-determined with respect to fluctuations in interest stickiness within 24 months. To construct this series, which unfortunately is not available in the BIS database, I regress bank foreign claims with over two years maturity on public foreign claims. Residuals from this regression represent a new series containing long-term private claims, orthogonal to fluctuations in public assets.

To the extent that this new series represents fluctuations in long term private claims, uncorrelated with adjustments in public bonds holdings, I interpret it as a proxy for private assets held to maturity, and thus predetermined to country-specific coincident shocks. It should be noted, in fact, that this series has been filtered of not only fluctuations on public claims, but also of the correlation between private and public assets. Assuming that a hypothetic shock to a countryÕs interest rate stickiness could affect both banks' public and private claims in that country, the resulting series can be considered as effectively orthogonal to every country-specific shock in the interest rate channel.

I re-run model 7 comparing lending rate stickiness measured with VARs models, estimated on a time spell comprising 23 monthly observations (from t to $t+23$) with this new instrument for banking integration, constructed from bank private sector claims with over 24 monthsÕ maturity. Following the above reasoning, identification should be achieved in so far as the instrument is pre-determined and thus orthogonal with respect to shocks in time t to $t + 23$.

Regression results are reported in Table 6; in all regressions considered, covering different time samples and controls, banking integration is negative and significant, thus confirming results previously found in this paper; the estimated elasticity varies from -2.1 to -5.2 percent depending on the time sample used for estimation.

6 Conclusions and policy implications

This paper presented evidence of the negative link existing between banking integration and fragmentation in the interest rate channel. Within the Eurozone, a one percent decrease in banking integration, measured with banks cross-European claims on the euro areaÕs GDP, produces .3 percent decrease in fragmentation in the interest rate channel across Eurozone members. When an instrument is used for the identification of banking integration, the estimated elasticity of banks pan-European claims in reducing the difference in interest rate stickiness, with respect to the average in the euro area, is above 5 percent. This empirical evidence represents a contribution to our understanding of the monetary transmission channel across members of the Eurozone and it provides hints for policy action targeting a reduction in fragmentation in the interest rate channel in Europe. Finally, the results presented in this paper shed some new light on the role of European banks in reducing wedges in interest rate stickiness across euro area members, and they draw the attention to some important implications of the process of retrenchment in European banking integration.

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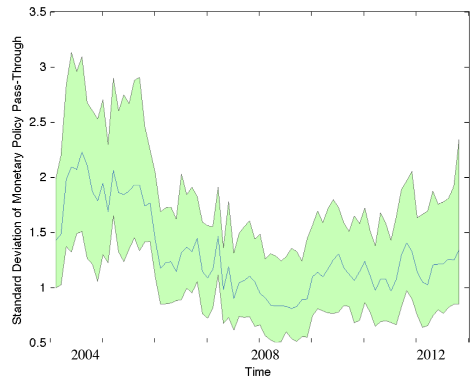
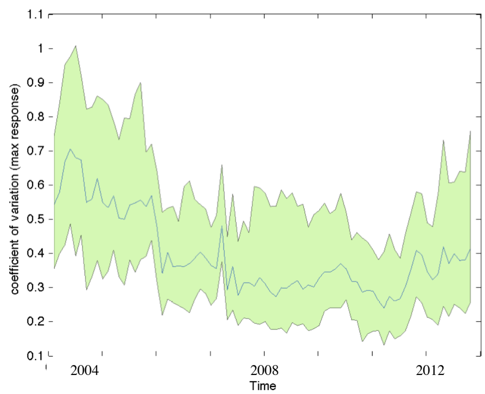
Figure 1: Heterogeneity in interest rate passthrough - cumulative IRFs response.



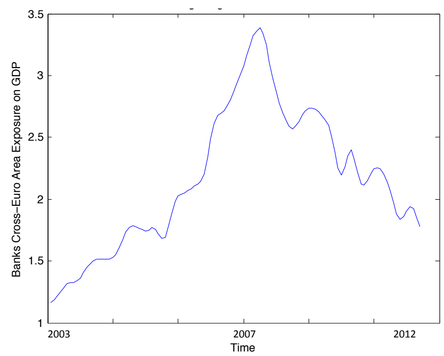
Notes: This Figure shows the overtime evolution of the index of monetary policy passthrough. This is computed as the standard deviation of integral of country IRFs following an unexpected monetary policy shock in the EONIA rate. Ninety percent Confidence bands obtained via bootstrapping.

Figure 2: Heterogeneity in interest rate passthrough - max IRFs response.



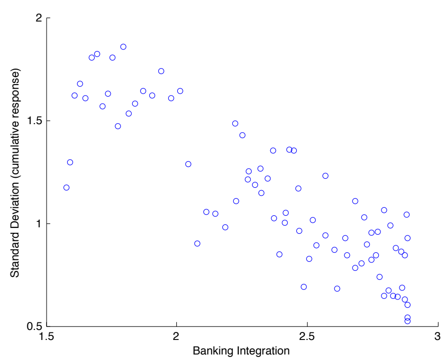
Notes: This Figure shows the overtime evolution of the index of monetary policy passthrough. This is computed as the standard deviation of maxima of country IRFs following an unexpected monetary policy shock in the EONIA rate. Ninety percent confidence bands obtained via bootstrapping.

Figure 3: Evolution of banking integration for euro area members.



Notes: This Figure plots the overtime evolution of the index of banking integration computed in this paper. This index is constructed by considering the sum of euro area's banks external claims in other countries of the Eurozone on the overall GDP of the currency union. Banking integration in Europe steadily increased up to the beginning of the crisis. Since then European intermediaries retrenched their positions within national borders.

Figure 4: Banking integration and Interest rate passthrough in the eurozone 2003-2012.



Notes: This scatter plots the relationship existing between banking integration and fragmentation in the interest rate passthrough.

Table 1: Banking integration and Interest rate passthrough (cumulative response) 2003-2012.

	(1) P. Disp.	(2) P. Disp.	(3) P. Disp.	(4) P. Disp.	(5) P. Disp.	(6) P. Disp.
Banking Integration	-1.425**	-0.646**	-0.754**	-0.623**	-0.724**	-0.323**
	(0.187)	(0.135)	(0.146)	(0.136)	(0.134)	(0.132)
L.Passthrough Disp.		0.580**	0.585**	0.585**	0.553**	0.507**
		(0.0798)	(0.0766)	(0.0742)	(0.0730)	(0.0739)
Interbank Distress			0.0254			-0.107**
			(0.0170)			(0.0239)
Sovereign Risk				0.0717		0.184**
				(0.0610)		(0.0775)
CA Ratio					0.743**	1.843**
					(0.190)	(0.350)
Constant	1.273**	0.579**	0.688**	0.563**	-0.656**	-2.984**
	(0.151)	(0.113)	(0.130)	(0.115)	(0.324)	(0.622)
Observations	78	77	77	77	77	77
Time Sample	01/03-10/12	01/03-10/12	01/03-10/12	01/03-10/12	01/03-10/12	01/03-10/12
Spells Width	36	36	36	36	36	36
Int. Interval for IRF	1-4	1-4	1-4	1-4	1-4	1-4

The dependent variable is the standard deviation of the interest rate passthrough across 11 Euro area countries (the initial Euro 12 block excluding Luxembourg and Estonia and including Greece). Passthrough is measured as the integral of the IRF of lending rates within 4 (1-4) lags from a monetary policy shock. Banking integration is computed as the share of bank foreign assets (in countries included in this sample) on GDP. Sovereign risk is the principal component of sovereign spreads included in the sample. Interbank distress is measured in terms of volumes of the ECB Marginal Lending Facility with respect to the overall average computed over the time sample considered. CA ratio is banks' capital asset ratio. All variables are computed as averages over the period corresponding to the time window for which passthrough is computed (36 months). Standard error in parenthesis. Monthly frequency from 2003m1 to 2012m10. Newey-West standard errors, optimal lag length based on the Newey-West (1994) plug-in procedure set to 19.

* $p < 0.10$, ** $p < 0.05$

Table 2: Banking integration and Interest rate passthrough (max response) 2003-2012

	(1)	(2)	(3)	(4)	(5)	(6)
	P. Disp.	P. Disp.	P. Disp.	P. Disp.	P. Disp.	P. Disp.
Banking Integration	-2.002**	-1.079**	-0.917**	-1.177**	-1.135**	-0.765**
	(0.210)	(0.212)	(0.352)	(0.250)	(0.242)	(0.337)
L.Passthrough Disp.		0.669**	0.663**	0.648**	0.649**	0.557**
		(0.135)	(0.145)	(0.151)	(0.136)	(0.158)
Interbank Distress			-0.0381			-0.137**
			(0.0720)			(0.0527)
Sovereign Risk				-0.306**		-0.157
				(0.122)		(0.131)
CA Ratio					0.535	2.094**
					(0.876)	(0.876)
Constant	0.383**	-0.439**	-0.602*	-0.369*	-1.328	-4.468**
	(0.180)	(0.175)	(0.349)	(0.212)	(1.460)	(1.539)
Observations	78	77	77	77	77	77
Time Sample	01/03-10/12	01/03-10/12	01/03-10/12	01/03-10/12	01/03-10/12	01/03-10/12
Spells Width	36	36	36	36	36	36
Int. Interval for IRF	1-4	1-4	1-4	1-4	1-4	1-4

The dependent variable is the standard deviation of the interest rate passthrough across 11 Euro area countries (the initial Euro 12 block excluding Luxembourg and Estonia and including Greece). Passthrough is measured as the max of the IRF of lending rates within 4 (1-4) lags from a monetary policy shock. Banking integration is computed as the share of bank foreign assets (in countries included in this sample) on GDP. Sovereign risk is the principal component of sovereign spreads included in the sample. Interbank distress is measured in terms of volumes of the ECB Marginal Lending Facility with respect to the overall average computed over the time sample considered. CA ratio is banks' capital asset ratio. All variables are computed as averages over the period corresponding to the time window for which passthrough is computed (36 months). Standard error in parenthesis. Monthly frequency from 2003m1 to 2012m10. Newey-West standard errors, optimal lag length based on the Newey-West (1994) plug-in procedure set to 19.

* $p < 0.10$, ** $p < 0.05$

Table 3: Banking integration and Interest rate passthrough 2003-2008

	(1) Passthrough Disp.	(2) Passthrough Disp.	(3) Passthrough Disp.	(4) Passthrough Disp.
Banking Integration	-0.877**	-0.495**	-0.499**	-0.354**
	(0.0929)	(0.158)	(0.144)	(0.0693)
L.Passthrough Disp.		0.565**	0.556**	0.551**
		(0.0944)	(0.115)	(0.128)
Interbank Distress			0.138	
			(0.245)	
CA Ratio				10.26
				(7.764)
Constant	0.699**	0.378**	0.608	-17.37
	(0.0636)	(0.119)	(0.503)	(13.36)
Observations	28	28	28	28
Time Sample	01/2003-09/2008	01/2003-09/2008	01/2003-09/2008	01/2003-09/2008
Spells Width	36	36	36	36
Int. Interval for IRF	1-4	1-4	1-4	1-4

The dependent variable is the standard deviation of the interest rate passthrough across 11 Euro area countries (the initial Euro 12 block excluding Luxembourg and Estonia and including Greece). Passthrough is measured as the integral of the IRF of lending rates within 4 (1-4) lags from a monetary policy shock. Banking integration is computed as the share of bank foreign assets (in countries included in this sample) on GDP. Sovereign risk is the principal component of sovereign spreads included in the sample. Interbank distress is measured in terms of volumes of the ECB Marginal Lending Facility with respect to the overall average computed over the time sample considered. CA ratio is banks' capital asset ratio. All variables are computed as averages over the period corresponding to the time window for which passthrough is computed (36 months). Standard error in parenthesis. Monthly frequency from 2003m1 to 2008m9. Newey-West standard errors, optimal lag length based on the Newey-West (1994) plug-in procedure set to 19.

* $p < 0.10$, ** $p < 0.05$

Table 4: Banking integration and interest rate passthrough 2003-2008: euro-area bank claims and difference in dynamic response to monetary policy shocks.

	(1) D.$\lvert IRF_j - IRF_{eu}\rvert$	(2) D.$\lvert IRF_j - IRF_{eu}\rvert$	(3) D.$\lvert IRF_j - IRF_{eu}\rvert$
D. Euro B. Penetration	-2.264**	-2.471*	-1.371*
	(.761)	(0.910)	(0.748)
LD.$\lvert IRF_j - IRF_{eu}\rvert$	-0.404**	-0.409**	-0.429**
	(0.051)	(0.049)	(0.034)
D.Interbank Distress		-9.323	
		(9.442)	
D.PC Euro Spreads		0.825	
		(0.686)	
Constant	0.001	0.006	0.006
	(0.003)	(0.012)	(0.012)
Country FE	Yes	Yes	Yes
Spell FE	No	No	Yes
Observations	231	231	231
Countries	11	11	11
Time Sample	01/2003-09/2008	01/2003-09/2008	01/2003-09/2008
Spells Width	36	36	36
Int. Interval for IRF	1-4	1-4	1-4

Robust standard error in parenthesis. Panel model in first differences with country FE. The dependent variable is the absolute value of the difference between the integral of the IRF of leaning rates following a shock in the EONIA rate, for a generic country j minus the average for all other countries of the Eurozone. 11 countries are considered in this sample. These include the Euro 13 block with the exclusion of Estonia and Luxembourg for data limitations. The first independent variable is the total amount of claims of euro-area banks in country j on country j GDP. This measures the penetration of country j banking sector by other euro-area banks. Variables are in logs. The introduction of spell fixed effects makes redundant all country invariant controls.

* $p < 0.10$, ** $p < 0.05$

Table 5: Banking integration and Interest rate passthrough (cumulative response) 2003-2012: robustness analysis

	(1) Passthrough Disp.	(2) Passthrough Disp.	(3) Passthrough Disp.
L.Passthrough Disp.	0.5996*	0.5869*	0.6522*
	[0.4581,0.7309]	[0.5193,0.7390]	[0.4553,0.8788]
Banking Integration	-0.3220*	-0.6170*	-0.396*
	[-0.5685,-0.1994]	[-0.7262,-0.1970]	[-0.8085,-0.0657]
Constant	1.2264*	2.3234*	1.3934*
	[0.7550,2.0789]	[0.7388,2.9403]	[0.3614,3.1851]
Time Sample	01/2003-10/2012	01/2003-10/2012	01/2003-10/2012
Sample Width	30 to 48	36	30 to 48
IFR Integration Interval	1-4	1-2 to 1-12	1-1 to 1-12

In this table the model relating dispersion in the interest rate passthrough and banking integration in tested against different specifications for the dependent variable. In the first model different sample width for the overlapping time spells are considered, in the second different interval of integration for the IRF are considered, in the third both sample width ad intervals of integrations are considered. In squared brackets the 90 percent confidence interval for the estimated coefficient when the sample size of the time spells varies from 30 to 48 months, and integration of IRF is computed from the 1st to the 4th month after the shock (first model). In the second model the confidence interval (in squared brackets) is computed considering the variation in the integration interval from 1 to 12 months after a monetary policy shock. In the third model both the previous variations are considered simultaneously. Bootstrapped like significance level for coefficients * $p < 0.10$.

Table 6: Banking integration and interest rate passthrough (cumulative response): IV

	(1) D. Foreign B. Penetration	(2) D.$\lvert IRF_j - IRF_{eu}\rvert$	(3) D.$\lvert IRF_j - IRF_{eu}\rvert$
D. Foreign B. Penetration^{iv}	.0281*	-2.181**	-5.389**
	(0.010)	(0.941)	(2.330)
LD.$\lvert IRF_j - IRF_{eu}\rvert$		0.001	0.121*
		(0.767)	(0.057)
Constant	0.006**	-0.354	-0.281
	(0.001)	(0.394)	(0.376)
Country FE	Yes	Yes	Yes
Time FE	No	Yes	Yes
Observations	1529	726	121
Countries	11	11	11
Time Sample	01/2003-10/2012	01/2003-10/2012	01/2003-08/2008
Spell Width	23	23	23
Int. Interval for IRF	1-4	1-4	1-4

Robust standard error in parenthesis. Panel model in first differences. The first column shows the instrument relevance, the second and third model test the instrument significance in the target relationship. In equation two and three the dependent variable is the absolute value of the difference between the integral of the IRF of lending rates following a shock in the EONIA rate, for a generic country j minus the average for all other countries of the Eurozone. 11 countries are considered in this sample. These include the Euro 13 block with the exclusion of Estonia and Luxembourg for data limitations. The instrumented variable is first difference of the total amount of foreign banks' claims in each country j, scaled by the country GDP. The instrument is total amount of foreign banks non public sector claims with maturity of over two years. In regression two and three, the dependent variable is compared with the instrument at time $t-1$ with respect to the first observation in the time spells, used for computing dispersion the interest rate channel. Thus it can be considered predetermined with respect to the regressand. Year fixed effect capture common sources of variation in the series.

* $p < 0.10$, ** $p < 0.05$