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Abstract

Over the last 30 years cross-country financial integration has increased significantly. In this process many banks in developing and transition economies became foreign-owned. Using a panel data on banks in eleven Central and Eastern Europe economies we provide new evidence that foreign-owned banks react differently to monetary policy changes than domestic-owned banks not only during financial crises but also in normal times. We embed bank heterogeneity in a stylized DSGE model featuring monopolistic competition in the banking sector and show that such a pattern may be driven not only by a facilitated access to internal market within the financial conglomerate they belong to but also by their competitive advantages. While the first mechanism leads to a decrease of the responsiveness of the banking sector to the monetary policy, the second mechanism does not.

JEL classification: E44, E50, G21

Keywords: banks, bank ownership, bank lending channel, monetary policy

1 Introduction

Financial liberalization has led to an increased integration of financial markets over the last 30 years. The emerging and developing countries, however, entered this process with undercapitalized and weak banks. Thus, large shares of the financial sector in these countries are controlled by subsidiaries of foreign banks. Thus, the financial integration was accompanied by a development of asymmetric cross-border owner-subsidiary relationships.

In this paper we document that the lending by foreign-owned banks is less responsive to both tightening and loosening of host country monetary policy in emerging economies. Using a stylized DSGE model featuring competition in the banking sector we show that this pattern may stem either from a facilitated trading within the owner financial group or from the market segmentation that favors foreign-owned banks. These two causes entail different policy implications and call for further investigation. The first hypothesis implies that increased entry of foreign banks decreases the strength of the bank lending channel in the aggregate. The second hypothesis implies that the response of bank lending to monetary shocks in the aggregate may not change and the differentiated response mirrors market segmentation.

The first explanation of the relevance of bank ownership is that the foreign-owned banks may trade easily within the financial conglomerate they are a part of, which would make host country monetary policy less relevant for their operations. Foreign-owned banks could also be forced to transfer liquidity in the case of direct dependence, especially when the bank-owner is in trouble. We label this explanation as the *internal market hypothesis*.

We stress that there may be additional forces at work which, although producing the same aggregate pattern, have different implications for monetary and macroprudential policy and as such require further deepened consideration. We highlight three alternative explanations.

First, the foreign-owned banks may inherit credit relationships with subsidiaries of firms that are clients of their bank-owner in the foreign country. As there is selection into foreign expansion, it may be the case that foreign-owned banks lend to more productive companies. Such credit should be less sensitive to the changes of host country monetary policy because of implicit costs embedded in adjusting the terms of contracts. De Haas and Naaborg (2006) find that an acquisition of a domestic bank by a foreign bank leads to a bias in the subsidiary's lending towards large multinational companies.

Second, if foreign-owned banks have better screening technology then they grant credit to more reliable customers which can still service their liabilities under higher interest rates. In this world, domestic banks have larger shares of contracts that are prone to termination because of increase of interest rates. Note, however, that it immediately leads

to an asymmetry of the behavior of loans conditional on the stance of a monetary policy.

Third, foreign-owned banks may enjoy a technological advantage in marketing and other operations. If this is the case, then the foreign-owned banks can establish larger market shares by facing less flexible demand of loans or supply of deposits. Thus, they can be less responsive to local monetary policy because of servicing markets less sensitive to interest rates. All three scenarios have to do with a bank ownership heterogeneity translating directly into market segmentation. Thus, we call this group of hypotheses *market segmentation hypothesis*. Some partial evidence which can be rationalized in this way is presented in Havrylchyk and Jurzyk (2006) who show that acquisition increases profitability of the subsidiary banks.

If the differences in responses to host country monetary policy come from the internal market advantage then an increase in the share of foreign-owned banks weakens the bank lending channel. If, however, the different response of a foreign bank lending to policy shocks stems from market segmentation it brings in an additional concern. Namely, the more volatile conduct of monetary policy may affect competition to the detriment of domestic banks

We build a stylized DSGE model to generate a differential response in lending of domestic and foreign-owned banks and put the two hypotheses to race. Most importantly, we demonstrate that while the *internal market hypothesis* implies weakening of the bank lending channel, the *market segmentation hypothesis* does not. Despite its ability to reproduce observed differential loans response to monetary shocks, the model falls short of replicating the order of the magnitude of this difference.

2 Literature Review

The focus of this paper is the different lending behavior of foreign and domestic-owned banks. Specifically, how those differences affect the transmission mechanism of the monetary policy. A seminal contribution in this field is Peek and Rosengren (1997) who show that Japanese banks in the US contracted their lending significantly in response to a slump in Japanese stock market. This contraction generated a negative credit shock in the US market.

The emerging economies and transition countries have become a natural field for empirical studies of foreign-owned banks behavior. Empirical literature has found that the role of ownership plays important role during the time of financial distress. Most of the studies found out that there are significant differences in lending patterns between foreign and domestic banks. The former cutting their credit more than the latter (see Goldberg (2001), Adams-Kane et al. (2013), Mian and Khwaja (2006), Ongena et al. (2013) and Popov and Udell (2012)).

Empirical part of our research is most closely related to Claessens and Van Horen (2013) and Allen et al. (2013). While Claessens and Van Horen (2013) concentrate on global trends in foreign banking, our sample is limited to eleven CEE countries which exhibit similar institutional setting for monetary policy conduct due to legislative adjustments proceeding adhesion to the European Union. Allen et al. (2013) investigate directly owner-subsidiary links and how foreign and government ownership matters for systemic stability during financial crises. Apart from the different focus of our work, we apply a more recent time frame for our analysis.

de Haas and van Lelyveld (2010) and Wu et al. (2011) argue that observed differences between foreign and domestic-owned banks stem from the stronger links to the financial conglomerate of the former. Not only they can be forced to export temporarily their liquidity, they may also enjoy better diversification thanks to an access to extra funds from the conglomerate. This explanation does not capture the differences in a lending in tranquil times, though.

Our theoretical model borrows from the framework put forth in Gerali et al. (2010). This environment facilitates handling bank ownership heterogeneity because of the use of the analytically tractable monopolistic competition framework.

3 Empirical Analysis

In this section we document key facts regarding the role of foreign-owned banks in emerging market economies that lay ground for our theoretical model. We estimate a set of panel regressions to formally test differences in banks behavior that stem from differences in ownership. We use data on banks in eleven Central and Eastern Europe (CEE) countries. Due to the adhesion to the EU requirements they had to introduce a certain minimum set of regulations which also included adjustments in banking legislation.

3.1 Data

We construct our sample using bank-level and macroeconomic data. Our primary source of data is Bankscope, a commercial database provided by Bureau van Dijk. Bankscope provides a large set of standardized and comparable bank-level data in a form of a panel. The ownership data however, is not easily accessible. We collected the data on banks' ownership using Claessens and Van Horen (2013) publicly available data and investigating individual bank reports both available on Bankscope and outside this database.

Our sample with identified ownership structure includes 440 banks in CEE countries[1] active for at least one year between 1998 and 2012 (out of the total number of 514 banks registered in Bankscope) giving rise to a total number of 4008 bank-year observations. Our sample with identified ownership covers on average 97.25% of the volume of net loans reported in Bankscope. Tables 8 and 9 in the Appendix present data coverage of our sample broken down into individual countries and each year. Our sample is balanced both across time and countries.

Bankscope provides data on annual basis, however, Gambacorta (2005) compares results of estimation regarding bank lending channel on a sample of Italian banks using annual data from Bankscope and quarterly data and finds the result to be strikingly similar. A more recent example is Gennaioli et al. (2014) who use Bankscope data to provide new stylized facts on sovereign defaults and bank bonds holding. Schmitz (2004), comparing Bankscope data with the IFS data, finds that approximately 70 to 90% of total banking assets is covered by Bankscope for CEE countries. Mathieson and Roldos (2001) on the other hand estimate data coverage to be about 90% of the total banking assets in the CEE countries. The coverage of Bankscope data increases in time due to market concentration and data quality improvements.

Macroeconomic data including GDP, inflation and central bank monetary policy instruments were collected from Eurostat and central bank websites. We also use data on the

[1] Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia.

euro and the Swiss franc exchange rates to control for possible effects of foreign-currency denominated loans. The sample covers rich variation in the stance of monetary policy across countries. Between years 1998 and 2012 negative interest rate changes stood for about 60% of all covered cases. The pre-2008 sample is more balanced: negative changes correspond to 55% of all cases.

We document in detail the cross-section facts about foreign and domestic banks in Appendix A. We find that in our sample foreign-owned banks are larger than the domestic banks, have lower liquidity and solvency but are more profitable. We also find that the solvency and liquidity measures were decreasing in time in both groups. The average size of domestic banks declined sharply after 2002 which roughly corresponds to the end of the biggest wave of penetration of local markets by foreign banks. We also find that it were the domestic banks that suffered the largest profitability drop as a result of the financial crisis.

In Figure 1 we take a first, unconditional look at the data. We split the sample into domestic (*orange* bars) and foreign (*red* bars) and calculate average growth rates of credit for each category of banks. To avoid possible bias stemming from idiosyncrasy of the takeover episode, we excluded observations in the takeover year. There is significant heterogeneity of the average credit change. In the years preceding Financial Crisis we see that foreign-owned banks expanded their credit faster than domestic-owned banks. Then, between 2009 and 2011 the situation is reversed: foreign owned banks expand their credit more (or contract less) than domestic owned-banks. Of course, the unconditionally averaged data forgoes information embedded in individual bank lending history. Thus this exercise can should be treated as a general motivation for the analysis that follows: we observe on average different behavior of foreign-owned banks compared to domestic banks.

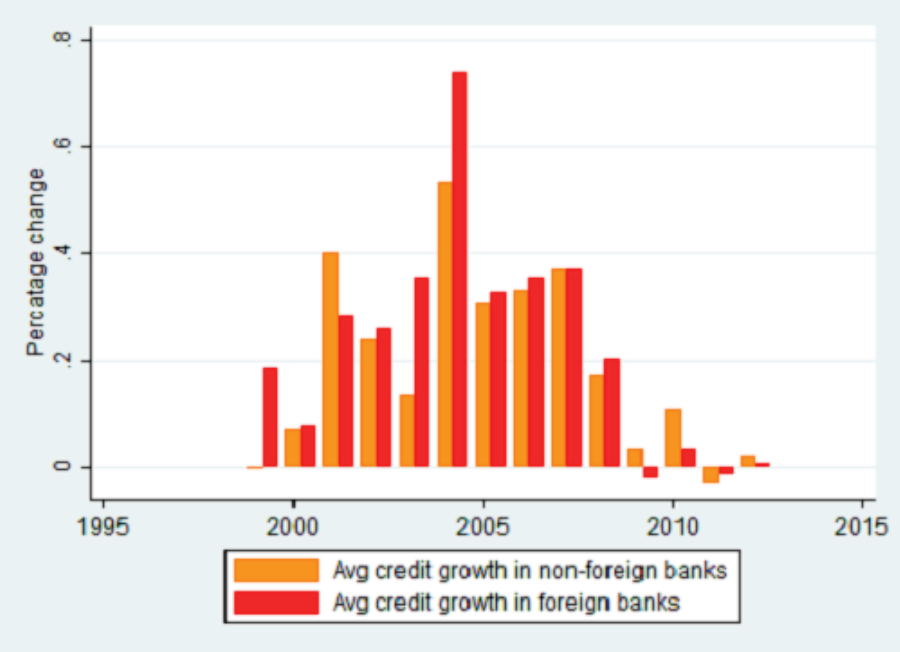

Figure 1: Aggregate growth of credit, by ownership (excluding observations of change in bank ownership)

3.2 Panel Estimation

We estimate model for the real rate of growth of loans of bank i in country j at time t, denoted ΔL_{ijt}. To test if there are differences between foreign and domestic banks reactions to monetary policy we employ (following Stein and Kashyap (2000)) the following model specification:

$$\Delta L_{ijt} = \beta_1 FGN_{it} + \beta_2 \Delta MP_{jt} + \beta_3 \Delta MP_{jt} * FGN_{ijt} + \beta_4 \text{Bank}_{it} + \beta_5 \text{Economy}_{jt} + \beta_0 \quad (1)$$

We introduce a foreign-owner dummy FGN_{it} that controls for the type of bank ownership. Our main variables of interest are: the change in the monetary policy instrument in country j in time t ΔMP_{jt} and its interaction with the foreign bank dummy $\Delta MP_{jt} * FGN_{it}$. Apart from the home-foreign ownership dummy we employ several bank controls $Bank_{it}$ of bank i in time t including size $Size_{it}$, liquidity Liq_{it}, solvency Sol_{it} and profitability $Prof_{it}$ and macroeconomic conditions $Economy_{jt}$ differing across countries j and time t by putting the GDP growth rate GDP_{jt} and the inflation rate π_{jt} to control for possible demand effects. The details on construction of all the variables are provided in Appendix A.

We estimate three versions of the model. For start we run a classical OLS regression.

We recognize however, that the estimates from the OLS might be biased due to an endogeneity problem. Firstly, our main variable of interest, the bank ownership, might not be exogenous to the credit policy of a bank. In theory, it is possible, that domestic-owned banks that exhibit faster growth of credit are more prone to be bought by a foreign owner. Secondly, bank-level control variables (size, solvency, liquidity and profitability) might also be endogenous to the credit growth and macro controls (GDP growth and inflation).

First we apply differences-in-differences approach, where we control for specific factors at the bank level and time fixed effects. Controlling for time fixed effects allows us to remove any possible trend or time-specific factors that may affect credit behavior of all the banks in a given year [2].

Some studies related to ours (Wu et al. (2011), Adams-Kane et al. (2013), Claessens and Van Horen (2013), Gambacorta (2005) and Brzoza-Brzezina, Chmielewski, and Niedzwiedzinska (2010) deal with endogeneity problem by employing one period lag for bank control variables. We follow this approach augmented by the difference GMM estimation[3] developed by Arellano and Bond (1991). These estimators are designed for dynamic "small-T, large-N" panels that may contain fixed effects and, separate from those fixed effects, idiosyncratic errors that are heteroskedastic and correlated within but not across individuals. In this estimation we allow dependent variable (ΔL_{ijt}) to be autocorrelated, contemporary bank controls ($Size_{it}$, Liq_{it}, Sol_{it} and $Prof_{it}$) to be endogenous and ownership (FGN_{ijt}) to be predetermined but not strictly exogenous. Macro controls (GDP_{jt} and π_{jt}), lagged bank controls ($Size_{it-1}$, Liq_{it-1}, Sol_{it-1} and $Prof_{it-1}$) and independent variable (ΔMP_{jt}) are treated as strictly exogenous and therefore in the estimation process are potential instruments for differenced variables that are not strictly exogenous.

In each specification to avoid spurious inference, we cluster the errors on a country level.

3.3 Results

3.3.1 Baseline Results

In Table 1 we present results of estimation of benchmark model from equation (1). The results confirm the existence of bank lending channel. Banks contract their credit action after an increase in monetary policy rate (and expand after a decrease in MP rate). The most important result is that foreign banks react differently than domestic banks to changes in the monetary policy tool. The reaction of their credit is more tamed (by more than a half). Interestingly, previous studies found that the very fact of banks being

[2] Formally we estimate bank and time-specific intercepts $\beta_0 = [\beta_i \quad \beta_t]$.

[3] We would like to thank the anonymous referee for suggesting this approach.

foreign-owned affects their credit granting behavior along the business cycle. Our results show that the differences come exclusively from reactions to the monetary policy tool (bank-lending transmission channel). This result is robust for excluding the period of financial crisis of 2008-2012. In Table 10 in the Appendix we show the same model re-estimated on the sample of years preceding financial crisis. The results are very similar both qualitatively and quantitatively.

Table 1: Determinants of bank lending, full sample

	OLS	D-in-D	GMM
FGN	-1.243	2.967	1.438
	(2.298)	(3.152)	(2.791)
MP	-1.582***	-1.734***	-1.332***
	(0.281)	(0.378)	(0.351)
FGN*MP	1.137***	0.930***	1.137**
	(0.342)	(0.228)	(0.499)
Size	-0.0416	-0.0160	2.292**
	(0.0630)	(0.277)	(1.008)
Liq	-0.0687	-0.353***	-0.713***
	(0.0479)	(0.0617)	(0.120)
Sol	-0.235**	-0.648**	-2.103***
	(0.0937)	(0.203)	(0.406)
Prof	1.581***	1.561***	1.756***
	(0.451)	(0.408)	(0.238)
GDP	2.204***	1.156***	0.825**
	(0.304)	(0.157)	(0.259)
Pi	-0.382	-1.099***	-1.027***
	(0.234)	(0.145)	(0.179)
L.Delta Net Loans			0.212***
			(0.0256)
L.Size			-2.221**
			(0.972)
L.Liq			0.754***
			(0.120)
L.Sol			2.081***
			(0.373)
L.Prof			-0.504
			(0.293)
Observations	2403	2403	2001

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.010$

We have also investigated the role of the monetary policy in the country of the bank owner. The results are displayed in Table 2 with a variable $MPinFGN_{ijt}$ that captures the variation in the monetary policy in the country of origin of the owner. Our main findings still hold. The difference GMM estimation found the foreign monetary policy to be also relevant for credit growth.

To conclude, we found that once we bring domestic monetary policy in the picture,

Table 2: Determinants of bank lending - including interactions with foreign monetary policy

	OLS	D-in-D	GMM
FGN	-1.108	2.993	1.203
	(2.265)	(3.156)	(2.749)
MP	-1.550***	-1.674***	-1.254***
	(0.294)	(0.384)	(0.341)
FGN*MP	1.013**	0.839***	1.003*
	(0.359)	(0.215)	(0.463)
MPinFGN	1.497	0.860	0.882*
	(0.947)	(0.643)	(0.472)
Size	-0.0371	-0.0129	2.295**
	(0.0645)	(0.276)	(1.004)
Liq	-0.0675	-0.353***	-0.712***
	(0.0474)	(0.0622)	(0.120)
Sol	-0.236**	-0.645**	-2.099***
	(0.0931)	(0.203)	(0.405)
Prof	1.603***	1.557***	1.748***
	(0.444)	(0.407)	(0.243)
GDP	2.106***	1.172***	0.841***
	(0.274)	(0.164)	(0.258)
Pi	-0.382	-1.093***	-1.019***
	(0.223)	(0.147)	(0.176)
L.Delta Net Loans			0.213***
			(0.0261)
L.Size			-2.221**
			(0.968)
L.Liq			0.753***
			(0.120)
L.Sol			2.074***
			(0.371)
L.Prof			-0.486
			(0.295)
Observations	2403	2403	2001

Standard errors in parentheses
* $p < 0.10$, **$p < 0.05$, *** $p < 0.010$

the significance of foreign ownership dummy, found in other studies, vanishes. The data suggest that it is the differential response to the domestic monetary policy that is differentiating foreign-owned banks from domestic banks.

3.3.2 Financial Crisis

Next we distinguish between reactions to monetary policy in normal times and in financial turmoil by estimating following equation:

$$\begin{aligned}\Delta L_{it} = {} & \beta_1 FGN_{it} + \beta_2 \Delta MP_{jt} + \beta_3 \Delta MP_{jt} * FGN_{ijt} + \beta_4 \text{Bank}_{it} + \beta_5 \text{Economy}_{jt} \\ & + \beta_5 Crisis * \Delta MP_{jt} + \beta_6 Crisis * \Delta MP_{jt} * FGN_{it} + \beta_0\end{aligned} \tag{2}$$

Table 3: Determinants of bank lending - including Financial Crisis

	OLS	D-in-D	GMM
FGN	-1.154	2.692	1.655
	(2.145)	(3.052)	(2.742)
MP	-1.628***	-1.904***	-1.307***
	(0.403)	(0.434)	(0.376)
FGN*MP	0.660**	0.735**	1.137*
	(0.273)	(0.241)	(0.571)
Crisis*MP	0.407	1.442	-0.131
	(1.162)	(0.810)	(0.555)
Crisis*MP*FGN	2.549***	0.987	0.0573
	(0.606)	(0.559)	(0.664)
Size	-0.0376	-0.0327	2.295**
	(0.0615)	(0.290)	(1.011)
Liq	-0.0725	-0.356***	-0.713***
	(0.0493)	(0.0627)	(0.120)
Sol	-0.236**	-0.651**	-2.105***
	(0.0918)	(0.206)	(0.406)
Prof	1.579***	1.561***	1.754***
	(0.453)	(0.413)	(0.235)
GDP	2.068***	1.144***	0.824**
	(0.244)	(0.161)	(0.258)
Pi	-0.456*	-1.079***	-1.038***
	(0.228)	(0.159)	(0.184)
L.Delta Net Loans			0.211***
			(0.0256)
L.Size			-2.225**
			(0.976)
L.Liq			0.756***
			(0.120)
L.Sol			2.085***
			(0.373)
L.Prof			-0.503
			(0.292)
Observations	2403	2403	2001

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.010$

where we include interactions of the crisis dummy that takes value one for the period 2008-2012 and zero otherwise with monetary policy instrument $Crisis * \Delta MP_{jt}$ and with both monetary policy instrument and foreign ownership dummy $Crisis * \Delta MP_{jt} * FGN_{it}$. We do not need to include crisis dummy itself, as we estimate the model with year fixed effects.

In the Table 3 we present results of the estimation of the benchmark model enriched with Financial Crisis dummies and their interactions as in presented in equation (2). We see that controlling for Financial Crisis does not change baseline results. The bank lending channel is still significant and of the same magnitude and the difference between domestic and foreign banks reaction to changes in the monetary policy rate is still significant and of

the same magnitude. Most importantly we find that during financial turmoil of 2008-2012 in the CEE countries bank lending channel did not change neither for domestic banks nor for foreign-owned banks. This further confirms our benchmark results and shows that the differences in reactions to the monetary policy instrument between domestic and foreign banks cannot be attributed to the idiosyncrasy of the financial crisis episode.

3.3.3 Monetary Policy Regimes

Our sample consists of countries with similar, albeit not identical monetary policy arrangements. While in the analyzed timeframe the majority of the countries followed an independent monetary policy interest rate setting rule, some countries had their exchange rate pegged to the euro and some did not enjoy an independent monetary policy at all, due to their presence in the common currency area. In this subsection we analyze how do different monetary policy regimes affect our findings from two previous sections. Our hypothesis is that banks, when deciding on their credit growth, take into account monetary policy rate regardless of what a monetary policy regime produced that interest rate. Our findings confirm this hypothesis.

In order to verify our hypothesis we run ten regressions. First, we expand our baseline model to include dummy variable $IndependentMP$. This variable takes value 1 for countries that in the given year enjoyed independent monetary policy regime and 0 otherwise. Results of this analysis are reported in column (1) of the Table 4. The monetary policy independence does not affect the growth of a credit at the bank level. Our main finding that foreign-owned banks reaction to monetary policy is more tamed compared to domestic-owned banks is also unaffected.

In column (2) of the Table 4 we present the results of a more detailed exercise. Additionally we include bank and time fixed effects. Including these variables allows us to capture the differences in mean credit growth in three dimensions: those stemming from the time invariant particular credit policies of each bank, characteristics of each country (like the monetary policy regime), and common, time-variant global shocks. Similarly to previous analysis, the choice of a monetary policy regime does not affect credit policy at the bank level significantly. Our main finding, that foreign-owned banks reaction to monetary policy is more tamed compared to domestic-owned banks, is also unaffected.

In column (3) of the Table 4 we re-run analysis from column (1) in greater detail. Instead of the dummy variable $IndependentMP$ we use two dummy variables $PeggedCurrency$ and $CommonCurrency$. The latter takes value 1 for the countries that in a given year were using the euro and 0 otherwise. The former takes value 1 for the countries that in a given year were in the ERM2 and 0 otherwise. Contrary to previous

analyses we find that the choice of a monetary policy regime has significant effects on the credit growth at the bank level. Banks in the common currency area experience credit supply growth that is on average 4.81 p.p. slower than the banks outside the common currency area. Our main finding however, that foreign-owned banks reaction to the monetary policy is more tamed compared to domestic-owned banks, is still unaffected.

In columns (4)-(5) we present the results of a more detailed analysis. Similarly to the analysis in column (2) we include time (column 4) and bank (column 5) fixed effects. We observe that the significance of a monetary policy regime found in column (3) vanishes in both cases.

In the next regression presented in column (6) we drop dummy variable $IndependentMP$ and include country fixed effects instead. This allows us to capture differences in the mean growth of credit at the bank level stemming from time invariant particular characteristics of the economy and institutions (like the monetary policy regime). Our main finding, that foreign-owned banks reaction to the monetary policy is more tamed compared to domestic-owned banks, is unaffected. In column (7) we also add time fixed effects. Our main finding is still unaffected.

In column (8) we take a somewhat different approach. Instead of looking at the institutional arrangements regarding the monetary policy conduct directly, as in analysis (1)-(7) we take a look at possible symptoms. Different degrees of freedom in setting interest rate (or exchange rate) lead to different volatilities in the local exchange rates, particularly versus the euro. Thus, we expand the set of independent variables to include yearly relative change in the exchange rate of the local currency versus the euro. The variable turns out to be significant. Local currency depreciation of a 1% leads to a decrease in the average growth of a credit at the bank level by 0.39p.p.. Extending the set of controls does not affect our key finding.

In column (9) we expand the analysis from column (8) by adding country and time fixed effects. We observe that the significance of the exchange rate found in column (8) vanishes.

In column (10) we further add the $IndependentMP$ dummy that was present in analysis (1) and (2). We find that when accounting for both institutional arrangements and their symptoms, we see significant effect of the latter and no significant effect of the former. Local currency depreciation against euro of a 1% leads to a decrease in the average growth of a credit at the bank level by 0.28 p.p.. Again, our main finding is still unaffected.

Interestingly, empirical literature contributions related to our paperl[4] do not take into

[4] Brzoza-Brzezina, Chmielewski, and Niedzwiedzinska (2010), Adams-Kane et al. (2013), Allen et al. (2013), Claessens and Van Horen (2013), Gambacorta (2005), Havrylchyk and Jurzyk (2006) and Wu et al. (2011).

account variables related to regimes of the monetary policy.

3.3.4 Robustness

To check robustness of our results we run several alternative specifications of our model. In the first we include government ownership dummy GOV_{it} and its interactions with the monetary policy tool and with the crisis dummy (see Table 11 in Appendix) . Contrary to previous studies[5] we find that public-owned banks neither differ in their credit granting behavior from private-owned domestic banks, nor do they differ in their reaction to monetary policy tool changes. Controlling for public banks we confirm robustness of our baseline results, namely that foreign-owned banks differ in their reaction to the monetary policy from private domestic banks.

Next, we take a close look at takeovers of domestic banks by foreign owners. Tables 12 and 13 show the results of estimations in which we address possible problem of ownership endogeneity. In the former we drop all observations in which bank became foreign-owned, while in the latter we drop all banks that became foreign owned. In the last specification we also drop variable FGN_{it} as it becomes co-linear with the sum of bank fixed-effects for foreign-owned banks. We find that our baseline results are robust both qualitatively and quantitatively.

In Table 14 we scrap monetary policy and look at possible differentials in bank lending dynamics that are due to local and the euro-zone growth rates. We find that both variables are significant but there is no differential we are after. This further confirms our baseline result that domestic and foreign-owned banks differ in their credit granting behavior precisely due to different reactions to the local monetary policy.

[5] Micco and Panizza (2006) for worldwide study of banks' lending behavior between 1995-2002 and Allen et al. (2013) for study of CEE banks between 1994-2010.

Table 4: Determinants of bank lending, accounting for different monetary policy regimes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
FGN	-1.280	3.059	-1.353	-1.313	2.984	-0.401	-0.557	-1.650	3.647	3.761
	(2.301)	(3.124)	(2.293)	(2.221)	(2.791)	(2.258)	(2.131)	(2.143)	(3.671)	(3.648)
MP	-1.578***	-1.677***	-1.583***	-1.946***	-1.609***	-1.605***	-1.816***	-1.688***	-1.629***	-1.546***
	(0.276)	(0.401)	(0.286)	(0.351)	(0.323)	(0.219)	(0.323)	(0.204)	(0.404)	(0.441)
FGN*MP	1.138***	0.921***	1.124***	1.137**	0.733**	1.164***	1.166***	1.103***	0.850***	0.826***
	(0.344)	(0.228)	(0.345)	(0.363)	(0.270)	(0.313)	(0.326)	(0.264)	(0.237)	(0.244)
Size	-0.0374	-0.00511	-0.0442	-0.0250	0.337	-0.0777	-0.0734	-0.0462	0.0339	0.0453
	(0.0608)	(0.292)	(0.0606)	(0.0489)	(0.266)	(0.0579)	(0.0503)	(0.0577)	(0.251)	(0.265)
Liq	-0.0697	-0.349***	-0.0775	-0.121*	-0.119*	-0.0907	-0.147**	-0.0749	-0.360***	-0.355***
	(0.0471)	(0.0621)	(0.0479)	(0.0545)	(0.0544)	(0.0499)	(0.0558)	(0.0495)	(0.0650)	(0.0651)
Sol	-0.236**	-0.665***	-0.240**	-0.211*	-0.575**	-0.262**	-0.253*	-0.265**	-0.649**	-0.670**
	(0.0923)	(0.201)	(0.0942)	(0.104)	(0.180)	(0.109)	(0.124)	(0.0972)	(0.225)	(0.223)
Prof	1.566***	1.590***	1.583***	1.192**	2.477***	1.700***	1.315**	1.603***	1.539***	1.573***
	(0.457)	(0.428)	(0.464)	(0.431)	(0.443)	(0.470)	(0.429)	(0.473)	(0.394)	(0.417)
GDP	2.204***	1.147***	2.178***	1.465***	2.204***	2.251***	1.310***	2.126***	1.412***	1.402***
	(0.305)	(0.151)	(0.302)	(0.294)	(0.345)	(0.338)	(0.160)	(0.259)	(0.313)	(0.315)
Pi	-0.385	-1.112***	-0.403*	-0.673***	-0.510	-0.515	-0.981***	-0.125	-0.914***	-0.924***
	(0.239)	(0.145)	(0.219)	(0.121)	(0.349)	(0.340)	(0.139)	(0.206)	(0.196)	(0.179)
Independent MP	0.478	-3.636								-4.377
	(1.562)	(2.362)								(2.554)
Pegged Currency			1.286	0.279	-0.232					
			(1.383)	(2.472)	(1.228)					
Common Currency			-4.851**	-2.734	-0.000355					
			(1.600)	(2.582)	(0.994)					
Change in EUR x-rate								-0.388**	-0.267	-0.275*
								(0.140)	(0.146)	(0.147)
Time Fixed Effects	No	Yes	No	Yes	No	No	Yes	No	Yes	Yes
Country Fixed Effects	No	No	No	No	No	Yes	Yes	No	No	No
Bank Fixed Effects	No	Yes	No	No	Yes	No	No	No	Yes	Yes
Observations	2403	2403	2403	2403	2403	2403	2403	2361	2361	2361
R^2	0.165	0.305	0.167	0.226	0.207	0.180	0.244	0.172	0.308	0.309

Standard errors in parentheses
* $p < 0.10$, **$p < 0.05$, *** $p < 0.010$

4 Sketch of the DSGE model

We proceed with a theoretical analysis building on Gambacorta and Signoretti (2014). The details of the derivations are explained in Appendix D. Here we discuss the most important equations and building blocks of the model.

There are two countries, Home (H) and Foreign (F). Each country is inhabited by two groups of agents in the private sector: households and entrepreneurs. Both groups are risk averse, households care about consumption and leisure while entrepreneurs are only concerned with consumption. Because of different rate of time preferences, entrepreneurs and impatient households borrow while patient households save. Entrepreneurs buy capital from capital producing firms and hire labor in the competitive market. There is a central bank that sets nominal interest rates. There is no fiscal government. The economies are connected solely through the linkages between the financial intermediaries, in a similar fashion as in the model in Kalemli-Ozcan et al. (2013). This structure facilitates isolating the impact of asymmetric financial integration on monetary policy transmission. Extension of the model to account for trade in goods is left for future research. For notational convenience, we will display only the equations for the Home country with the exception of the financial sector specification. The Foreign country is of measure ζ, the Home country is of measure $1-\zeta$.

In the Home country there is a unit mass of banks out of which a fraction μ is foreign-owned. Each bank comprises of two branches: wholesale that deals on the interbank market and collects deposits in a perfectly competitive market and a retail branch that grants loans. Banks from the Foreign country invest in a portfolio of shares of these banks in the Home country. As direct owners they make the decision about the balance sheet structure of their subsidiaries by deciding on the dividends stream they receive. Adjusting the dividends parameter incurs costs on the owner bank which can be thought of as minority shareholders rights etc.

There is a set of financial frictions at play. Both savings and borrowing can only be done via intermediaries. Borrowing is also subject to a borrowing constraint such that the amount borrowed is related to the valuation of entrepreneur's capital. We also postulate that due to product differentiation loans at different banks are imperfect substitutes.

4.1 Households and Entrepreneurs

Households discount future at a rate β_H. Each period the household decides about how much to consume $c_t(i)$, how much labor to supply $l_t^H(i)$ and how much to save via deposits at the bank $d_t(i)$ given the wage rate W_t and last period savings $d_{t-1}(i)$ to maximize expected stream of utilities. Households own banks and retail good packers and receive

their dividends and profits, respectively. Formally, household i solves:

$$\max_{c_t^H, l_t^H, d_t^H} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta_H^t \left(\log\left(c_t^H(i)\right) - \frac{l_t^H(i)^{1+\phi}}{1+\phi} \right) \tag{3}$$

$$\text{subject to: } c_t^H(i) + d_t^H(i) \leq w_t l_t^H(i) + \left(1 + r_{t-1}^d\right) d_{t-1}^H(i) + T_t^H. \tag{4}$$

with T_t^H being a transfer including dividends from the retail firms and the banking sector dividends, π_t - inflation and r_t^d nominal return on the deposits.

We assume that entrepreneurs maximize the utility of consumption discounted at a rate $\beta_E < \beta_H$. Entrepreneur i solves:

$$\max_{c_t^E, l_t^E, k_t^E, b_t^E} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta_E^t \log\left(c_t^E(i)\right) \tag{5}$$

$$\text{subject to: } y_t^E(i) = a_t^E \left(k_t^E\right)^{\alpha} \left(l_t^E(i)\right)^{1-\alpha}, \tag{6}$$

$$\frac{y_t^E(i)}{x_t} + b_t^E(i) + q_t^k(1-\delta) k_{t-1}^E(i) = c_t^E(i) + w_t l_t^E(i) + \left(1 + r_{t-1}^{bE}\right) b_{t-1}^E(i) + q_t^k k_t^E(j), \tag{7}$$

$$\left(1 + r_t^{bE}\right) b_t^E(i) \leq m^E E_t \left(q_{t+1}^k(1-\delta) k_t^E(i)\right). \tag{8}$$

In the above equations we have the production function, the budget constraint and the borrowing constraint all in real terms, respectively. l_t^E is demanded labor, k_t^E is chosen stock of capital, a_t^E is a TFP random variable. y_t is the quantity of the intermediate good produced, q_t^k is the price of capital. Parameter m^E measures the severity of the collateral constraint quality friction.

4.2 Price of capital and aggregate price level

The model features monopolistically competitive retail good packers that aggregate the goods produced by each entrepreneur to one final good and sell it at a markup. The optimization of retail good packers yields a Phillips curve featuring persistence with respect to inflation rate and its deviation from the steady state level. The borrowing constraint in the entrepreneur problem requires a way to determine the price of capital. It is postulated that there are competitive capital producers that make the investment decision. The relative price of capital q_t^k is a ratio of the nominal price of capital P_t^K and the aggregate price level P_t.

4.3 Banks

Each bank has two branches: wholesale and retail branch (for loans). The wholesale branch owns bank capital $K^b(j)$ and collects deposits from households on which it pays the interest rate set by the central bank r_t^{ib}. It also issues wholesale loans to retail branch commissioning a rate R_t^b. Following GNSS we assume that there exists a target value of the ratio of bank capital to loans ν (leverage ratio). This assumption is crucial to generate realistic interactions between real and financial sectors.

We differentiate banks by ownership $o \in \{dom, fgn\}$. Each of the banks has to obey the basic balance sheet identity:

$$B_t(o,j) = D_t(o,j) + K_t^b(o,j). \tag{9}$$

bank capital of domestic banks is financed from retained earnings:

$$K_t^b(dom,j) = (1-\delta_b) K_{t-1}^b(dom,j) + (1-\omega_H) J_{t-1}^b(dom,j), \tag{10}$$

while foreign-owned banks dividends stream is a choice variable of the owner bank:

$$K_t^b(fgn,j) = (1-\delta_b) K_{t-1}^b(fgn,j) + (1-\omega_t(fgn,j)) J_{t-1}^b(fgn,j), \tag{11}$$

with ω_H denoting the share of the earnings paid out to households by domestic banks in the Home country. The market for deposits is competitive with the quantity of deposits pinned down exactly by the choice of risk-free rate by the central bank. The key idea here is that the adjustment of the dividends stream acts implicitly as internal market for bank capital. We will postulate that adjusting the dividend stream parameter is costly for the reasons related to the stock market and minority shareholders rights. Formally, there will be a quadratic cost of adjusting the dividend parameter from its Home-country specific value ω_H:

$$Adj(\omega_t, \omega_H) = \frac{\kappa_\omega}{2}(\omega_t - \omega_H)^2. \tag{12}$$

In this sense, the foreign owner bank can mitigate the costs stemming from changes in monetary policy in the Home country trading a part of them against the costs of adjusting the dividends. Implicitly we postulate that the shareholders of the home banks are more dispersed and cannot enforce departures from the market-standard ω_H. This assumption allows us to capture the fact that the foreign owned banks enjoy more flexibility due to more concentrated ownership which can make decisions faster and also, most importantly, *forego* some of its dividends if circumstances so dictate.

The optimization problems of the foreign banks are identical, with one exception, to

the problems of domestic banks. Once the interbank market closes it decides about the allocation of the dividends taking into account how it may affect future streams, that is, if the dividends increase too much today, they will negatively affect the subsidiary profits next period (because of balance sheet structure distortion from the optimal value) weighted by the foreign households discount factor as displayed in the following equation.

$$Div_t^* = \max_{\omega_t(j)} \int_\mu \left(\omega_t(j) J(fgn, j) - \frac{\kappa_\omega}{2} (\omega_t(j) - \omega_H)^2 \right) dj + \beta^{H*} \mathbb{E} Div_{t+1}^*. \tag{13}$$

4.4 Wholesale branch

Wholesale branch solves:

$$\max_{d_t(o,j), b_t(o,j)} R_t^b B_t(o,j) - r_t^{ib} d_t(o,j) - \frac{\kappa_b}{2} \left(\frac{K_t^b(o,j)}{b_t(o,j)} - \nu \right)^2 K_t^b(o,j) \tag{14}$$

subject to the balance sheet identity for fixed and given bank capital. The function F is a loans adjustment cost function.We follow the assumption that it is a quadratic function in adjustment from the target leverage ratio ν^b and is multiplicative in the level of bank capital K_t^b.

The wholesale branch problem collapses to (scrapping the ownership index, we plug the balance sheet constraint into the target function and calculate the first order conditions):

$$R_t^b(o,j) = r_t^{ib} - \kappa_{Kb} \left(\frac{K_t^b(o,j)}{b_t(o,j)} - \nu^b \right) \left(\frac{K_t^b}{B_t} \right)^2, \tag{15}$$

which involves a time-varying markup over the central bank policy rate.

Loan branch The loan branch collects the wholesale loans and differentiates them at no cost generating monopolistic power over its own part j of the total loan variety which gives rise to the standard demand equation:

$$b_t^E(j) = \left(\frac{r_t^{bE}(j)}{r_t^{bE}} \right)^{-\varepsilon^{bE}} b_t^E. \tag{16}$$

with pricing equation involving a markup on the wholesale rate $R_t^b(j)$ which is proportional to the elasticity of substitution between loans of different banks.

The law of motion for profits of bank j reads:

$$J_t^b(j) = r_t^{bE}(j) b_t^E(j) - \frac{\kappa_{Kb}}{2} \left(\frac{K_t^b}{B_t} - \nu^b \right)^2 K_t^b(j) - Adj_t^B(j) \tag{17}$$

4.5 Central bank and monetary policy

It is assumed that the central bank follows an interest rate setting rule that features smoothing of rates in addition to tracking the deviations of inflation and product:

$$(1+r_t) = (1+r)^{1-\phi_R}(1+r_{t-1})^{\phi_R}\left(\frac{\pi_t}{\pi}\right)^{\phi_\pi(1-\phi_R)}\left(\frac{Y_t}{Y_{t-1}}\right)^{\phi_\pi(1-\phi_R)}\varepsilon_t^R. \tag{18}$$

4.6 Discussion

The dynamics of this class of models depends on parameter values to a lot extent due to the formulation of the balance sheet identity which introduces perfect substitutability between bank capital and bank deposits in financing loans. Thus, the leverage volatility quadratic costs introduce a trade-off between two types of financing for the bank. The modeling of bank capital and the financial contracts is, however, very simple. There are no different types of bank capital and the loans/deposits are made on a period-by-period basis. Before proceeding to simulation-based comparative exercises of the next section we go over the response of the homogeneous-banks version of the model to a monetary shock.

We plot the response of bank profits, bank capital, loans and deposits to a 1% standard deviation monetary shock on figure 2. The decrease of loans is intuitive. In this model the deposits also fell because of entrepreneurs reducing their labor demand and capital stock due to the tightening of the borrowing constraint. Despite the higher rate of return the households consume part of their deposits to smooth the negative income shock triggered by firms cutting production inputs. Because the drop in deposits is stronger than the drop in the loans, the initial bank profits rise to then fall sharply. The response of profits determines the path of bank capital - there is initial accumulation in the initial period and de-accumulation on the convergence to the steady state.

The increase in bank profits is driven by the preference parameters of the households and the entrepreneurs, especially how the hours worked changes are weighted in the utility function. The second component that contributes to our results is the tightness of the borrowing constraint. With more relaxed constraint the immediate effect of the change in interest rates on the loans would be weakened. Note, however, that due to parameter heterogeneity the results we present here are not directly comparable to the results of the next section.

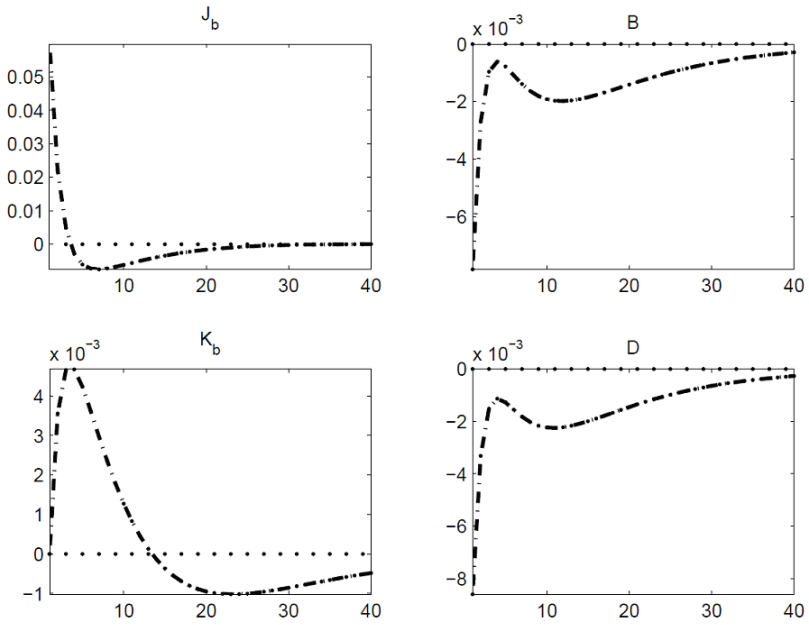

Figure 2: Response of banking variables to a 1% standard deviation monetary shock, homogeneous banks model

5 Simulations

We do several thought experiments, using a calibration borrowing from the literature to investigate the response of bank lending conditional on the composition of the banking sector (how many banks are foreign banks), and adjust some parameter of the model to mimic the *internal market* and industry competition hypotheses. We vary the parameters governing the bank balance sheet dynamics of the foreign-owned banks. The motivation for our exercise that can be found in the data is that the foreign-owned banks are on average more profitable (as documented in the descriptive statistics in Table 6, their profitability variable is on average 0.9 while for domestic banks it is 0.79), which in the monopolistic competition framework can be embedded as them servicing a different segment of the market with less-elastic demand. Further, the internal market hypothesis is supported by lower and less volatile leverage ratio of the foreign-owned banks which suggests access to additional smoothing mechanisms. This evidence is encapsulated in Tables 6 and 7.

First, we decrease the punishment for deviations of the target dividend ratio κ_ω which is to model the possibility of transfer liquidity from and to the bank owner in order to avoid excessive deviations from the target leverage ratio. Next, we decrease the target ratio of bank capital to bank loans for foreign-owned banks, allowing them to fund more loans with a given level of bank capital. Then, for each set of parameter values we look at the impulse response function to a monetary shock of the aggregate lending and its decomposition across types of ownership. These exercises correspond to internal market hypothesis.

Second, we introduce two sub-markets in the market for loans, each with different elasticities of substitution $\varepsilon^l_{bE} < \varepsilon_{bE} < \varepsilon^h_{be}$ picking the values of ε^l_{bE} and ε^h_{bE} such that under the assumption that the two sub-markets are penetrated proportionately by foreign-owned and domestic banks the dynamics of the model remain as in the homogeneous case corresponding to one elasticity ε_{bE} only to facilitate comparison.

Then, for each of the parameter combinations, we hit the economy with a 1% standard deviation monetary shock. We are interested in how the total volume of loans react to this shock and how the foreign-owned bank loans response differs from domestic bank loans response within a 1-year horizon (so, 1 period in our model). We also want to know how the two objects vary with the level of banking sector penetration μ. This exercise is aimed at answering two questions. Any dependence of the response of total loans on μ would constitute an indirect measure of the strength of the bank balance sheet transmission channel. The differential response of foreign and domestic banks would be a validation test for the model to replicate qualitatively our empirical findings.

5.1 Internal market hypothesis

On figure 3 we plot the response of total loans to a monetary shock under a low, $\mu = 0.05$ and high $\mu = 0.95$ penetration of the domestic banking system by foreign banks. What we find is that the response of loans is tamed when foreign-owned banks dominate the domestic banking system. Thus, the balance sheet transmission channel is weakened due to the more flexible adjustment of bank capital in the foreign owned banks. The model can also replicate a weaker response of the foreign banks but it fails to replicate the scale of the differential by one order of magnitude. Under the parametrization that corresponds to the results presented in this sub-section we managed to get the first-period response of foreign-owned banks loans to be weaker by about 30% than the reaction of domestic banks loans.

5.2 Market segmentation hypothesis

Now, we assume that the banks' balance sheet parameters are the same among the two types of banks. We postulate, however, that they manage to introduce some form of market segmentation, where foreign owned banks access more profitable segments of the market for loans. We assume that there are two markets for loans and each entrepreneur

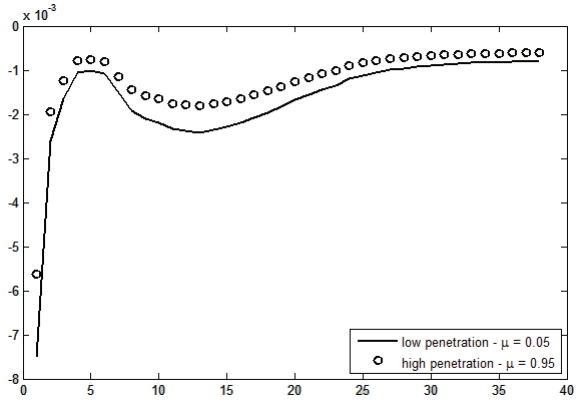

Figure 3: Response of total bank lending to a 1% standard deviation monetary shock.

is confined to pick from a portfolio from loans in one of the sub-markets. The size of each of the markets is fixed, γ_l for low-elasticity market and $\gamma_h = 1 - \gamma_l$ for the high elasticity market.

Then, we assume that a fraction $\mu^{\varepsilon_l} > 0.5$ of foreign banks operate in the low-elasticity market. In this way we introduce a skew in the composition of the foreign-owned banks loans portfolio such that out of the total measure of 1 of all banks $\mu\mu^{\varepsilon_l}$ are foreign-owned banks in the low elasticity market and $(1-\mu)\,\mu^{\varepsilon_l}$ is the measure of the domestic banks operating in the low-elasticity market etc. We keep γ_l fixed in our experiments as changing it would change the steady state of the model.

What we find is that switching from low to high penetration scenario makes almost no difference in the dynamics of the total loans after a monetary shock. We do observe, however, an increasing differential in the response of loans across two types of banks. As in the previous experiment, this differential is of the right direction but its magnitude is too low. What differs, though, is the level of profits (in the steady state with $\mu = 0.5$ and $\mu^{\varepsilon_l} = 0.8$ we found the foreign owned banks to have steady-state profits being 1.5 the profits of domestic banks. We document the response of total loans on figure 4. Under the parametrization that corresponds to the results presented in this sub-section we got the first-period response of foreign-owned banks loans to be weaker by about 15% than the reaction of domestic banks loans.

5.3 Discussion

As we can infer from our simulations, the bank heterogeneity encapsulated in different parametrization of the balance sheet and the segmentation of the market lead to qualitatively similar results when it comes to differences in banks' lending response to a monetary

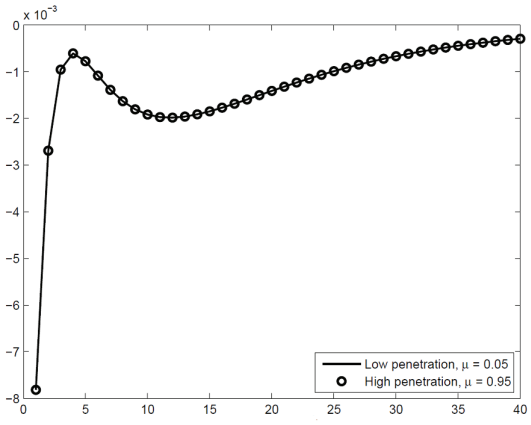

Figure 4: Response of bank lending to a 1% standard deviation monetary shock, market segmentation hypothesis, $\mu = 0.95$

shock. Lending by foreign-owned banks is less responsive to monetary policy. Either because a part of their loans is less sensitive to the change in the interest rates because of low demand elasticity, or because the bank capital adjustment is smoother.

The implications for the behavior of the total loans are different, though. If the main outcome of ownership heterogeneity is flexibility in adjusting the bank capital, then an increased presence of foreign-owned banks weakens monetary policy transmission channel. If, however, different ownership leads to bank customer heterogeneity then what we see is a different partition of the banking sector profits with little, if any, impact on total loans dynamics.

One caveat our approach is vulnerable to is the assumption on the type of competition in the banking industry. Monopolistic competition model implies that each bank separately is infinitesimally small. Thus, the strategic competition considerations on market shares etc. are absent in the individual bank problem. With our model we are only able to grasp exogenously assumed outcomes of the competition in the banking sector. The results do convey a clear message, though. The main driver of differences between foreign and domestic banks found in empirical literature does not necessarily follow from the access to additional source of financing.

6 Lessons for policy and directions for future research

We have documented that foreign-owned banks presence may pose additional challenges for policy makers not only during the times of financial turmoil. Using a variant of a DSGE model featuring monopolistic competition between banks we have demonstrated that the differential response to monetary policy stemming from different ownership does not have to be driven by flows between the subsidiary and the owner. If that was the case, then an increased presence of foreign owned banks would decrease the strength of the bank balance sheet transmission channel.

We argue that industry competition dynamics in the banking sector may also be driving the empirical patterns. If that is indeed the case then an increased presence of foreign-owned banks in the economy *does not* weaken the bank balance sheet transmission channel but may skew the impact of monetary policy within the banking sector negatively towards domestic owned banks. That is, an increasing penetration by foreign banks may up to some point yield competition concerns for the policy makers. If the weakest, least productive banks are not taken over by foreign banks then monetary policy may affect their profitability and sector concentration.

Our empirical results confirm that the bank ownership can be a worry for monetary policy makers in times of financial distress. Monitoring of bank-owner financial health can prove vital for assessing the risks present in the domestic banking sector.

We think it is worthwhile to approach the issue of foreign banks penetration and monetary policy in a dynamic industry competition model which we leave for future research. It would be interesting to analyze individual country data complementing the cross-country patterns. Possibly different individual experiences can be explained in greater detail by country-specific banking competition factors.

7 Appendices

A Data construction and definitions

Dependent Variable	
ΔL_{ijt}	Growth rate of Net Loans in bank i in country j in year t less Inflation rate in country j in year t multiplied by 100. To neutralize the impact of outliers this variable is winsorized at 5^{th} and 95^{th} percentile. Net Loans reported in local currency. Source of Net Loans: Bankscope. Source of Inflation: Eurostat.
Monetary Policy	
MP_{jt}	Monetary policy tool; yearly average of Repo Rate of the central bank in country j in year t less yearly average in year $t-1$. To neutralize the impact of outliers this variable has been cleaned from values lower than -10 (no observations were higher than +10). Source: ECB and central bank's websites.
$MPinFGN_{ijt}$	Foreign monetary policy tool; defined only for observations with $FGN = 1$; yearly average of Repo Rate of the central bank in a residence country of major foreign owner in year t less yearly average in year $t-1$. Source: ECB and central bank's websites.
$IndependentMP$	Independent Monetary Policy dummy; takes value 0 if a country is withing a Eurozone or in a currency peg and 1 otherwise.
Ownership	
FGN_{ijt}	Foreign ownership dummy. Takes value 1 if more than 50% of the shares of bank i in country j in year t are owned by a party located in country different than j. Source: Bankscope and individual banks' websites.
GOV_{ijt}	Government ownership dummy. Takes value 1 if more than 50% of the shares of bank i in country j in year t are owned by a government of country j. Source: Bankscope and individual banks' websites.
DOM_{ijt}	Private domestic ownership dummy. Takes value 1 if more than 50% of the shares of bank i in country j in year t are owned by a party located in country j other than the government. Source: Bankscope and individual banks' websites.
Bank Controls	
$Size_{ijt}$	Bank's size; Total Assets in bank i in country j in year t divided by the sum of Total Assets in all banks in country j in time t times 100; winsorized at 99^{th} percentile. Total Assets reported in local currency. Source: Bankscope.
Liq_{ijt}	Bank's liquidity; Liquid Assets divided by Total Assets in bank i in country j in year t times 100; winsorized at 99^{th} percentile and cleared from negative values. Total Assets and Liquid Assets reported in local currency. Source: Bankscope.
$Prof_{ijt}$	Bank's profitability; Operating Profit divided by Total Assets in bank i in country j in year t times 100; winsorized at 1^{st} and 99^{th} percentile. Total Assets and Operating Profit reported in local currency. Source: Bankscope.

$Deposits_{ijt}$	Growth rate of Total Deposits in bank i in country j in year t less Inflation rate in country j in year t multiplied by 100. To neutralize the impact of outliers this variable is winsorized at 5^{th} and 95^{th} percentile. Net Loans reported in local currency. Source of Net Loans: Bankscope. Source of Inflation: Eurostat.
Macro Controls	
GDP_{jt}	Growth rate of real GDP per capita in country j in year t. Source: Eurostat.
$EzoneGDP$	Growth rate of real GDP per capita in Eurozone in year t. Source: Eurostat.
Pi_{jt}	Inflation in country j in year t. Source: Eurostat.
$Crisis$	Financial Crisis dummy, takes value 1 for years 2008-2012.
Exchange Rates	
Change in EUR x-rate	Relative change of a yearly average local currency to Euro exchange rate in country j in year t. Source: Eurostat.
Change in CHF x-rate	Relative change of a yearly average local currency to Swiss Frank exchange rate in country j in year t. Source: Eurostat.

Table 6: Comparison of bank controls across countries and ownership

	Size DOM	Size FGN	Liquidity DOM	Liquidity FGN	Solvency DOM	Solvency FGN	Profitability DOM	Profitability FGN
BG	4.28	6.22	40.05	28.58	17.74	13.02	1.13	1.34
CZ	3.30	3.89	33.12	24.71	10.55	10.19	0.42	1.04
EE	2.12	8.22	35.42	26.96	16.62	15.70	0.61	0.24
HR	1.39	5.82	30.06	28.64	15.76	13.40	0.55	0.78
HU	6.73	2.89	35.05	29.35	9.90	11.68	0.91	0.91
LT	4.42	13.19	29.88	22.59	12.91	9.58	0.07	-0.07
LV	4.97	7.30	42.56	30.16	13.47	10.60	0.83	-0.13
PL	3.94	2.87	16.05	20.10	11.82	13.12	1.41	1.44
RO	4.70	4.24	34.98	30.73	18.21	13.01	0.96	0.74
SI	5.76	3.51	21.19	16.95	9.35	7.79	0.74	0.31
SK	5.31	6.42	39.55	30.13	21.12	10.15	0.39	0.85
Total	4.04	4.79	31.17	26.29	14.05	11.93	0.79	0.90

Table 7: Comparison of bank controls across years and ownership

	Size DOM	Size FGN	Liquidity DOM	Liquidity FGN	Solvency DOM	Solvency FGN	Profitability DOM	Profitability FGN
1998	5.89	4.78	38.09	42.69	16.88	12.05	0.14	0.93
1999	5.87	4.59	37.43	42.02	16.75	14.32	1.09	0.83
2000	5.83	4.62	41.97	40.54	17.73	13.27	1.22	1.12
2001	5.67	5.42	46.40	40.42	16.36	12.74	0.98	1.07
2002	5.18	5.75	42.12	38.20	15.45	13.05	1.48	1.65
2003	3.88	5.76	38.18	34.25	14.38	12.59	1.13	1.47
2004	3.50	5.30	33.59	31.66	13.26	12.74	1.60	1.46
2005	3.26	4.69	32.71	30.27	13.50	11.20	1.63	1.39
2006	3.09	4.82	30.27	28.23	13.03	11.48	1.41	1.20
2007	3.08	4.83	26.19	24.93	13.11	10.95	1.54	1.30
2008	2.84	4.50	21.46	19.42	13.81	11.11	0.53	0.89
2009	2.98	4.28	20.96	17.68	12.72	10.99	0.16	-0.16
2010	2.91	4.33	22.49	17.13	11.37	11.63	-0.23	0.24
2011	3.08	4.48	22.31	17.15	10.62	11.77	-0.81	0.40
2012	3.37	5.27	22.03	16.38	11.11	12.13	0.02	0.36
Total	4.16	4.88	32.35	27.87	14.21	12.02	0.79	0.92

B Data coverage

Table 8: Data coverage by country

	Number of bank-years		Sample coverage (in %)	
	ownership	net loans	in # of bank-years	in volume of net loans
BG	353	288	95.83	99.31
CZ	430	381	88.19	91.00
EE	114	97	91.75	99.25
HR	527	476	98.32	99.69
HU	448	455	84.40	98.50
LT	145	130	99.23	99.31
LV	310	229	98.69	98.76
PL	683	478	92.68	98.56
RO	437	344	92.44	99.57
SI	282	256	92.58	97.66
SK	279	246	93.09	95.49
Total	4008	3380	92.75	97.25

Table 9: Data coverage by year

	Number of bank-years		Sample coverage (in %)	
	ownership	net loans	in # of bank-years	in volume of net loans
1998	242	163	93.87	88.34
1999	242	168	91.67	89.22
2000	252	183	88.52	89.78
2001	244	176	86.93	87.29
2002	251	179	90.50	90.40
2003	266	188	94.68	93.31
2004	271	223	94.62	96.95
2005	282	251	95.22	96.70
2006	268	249	95.18	96.75
2007	266	253	93.28	96.95
2008	289	267	95.13	99.73
2009	282	283	91.52	98.43
2010	284	286	91.61	99.03
2011	284	272	93.75	97.65
2012	285	239	92.05	98.43
Total	4008	3380	92.75	97.25

C Estimation results - robustness checks

Table 10: Determinants of bank lending, 1998- 2007

	OLS	D-in-D	GMM
FGN	-0.294	2.864	1.399
	(3.156)	(3.573)	(4.326)
MP	-1.774***	-1.285***	-1.786***
	(0.405)	(0.338)	(0.409)
FGN*MP	0.897**	0.696	1.326*
	(0.290)	(0.391)	(0.621)
Size	0.0258	-0.399	2.108*
	(0.0751)	(0.407)	(1.095)
Liq	-0.219**	-0.333**	-0.913***
	(0.0773)	(0.119)	(0.180)
Sol	-0.337*	-1.120***	-2.872***
	(0.168)	(0.261)	(0.220)
Prof	0.807	0.354	1.274*
	(0.787)	(1.135)	(0.646)
GDP	3.349***	1.434**	2.915***
	(0.553)	(0.609)	(0.490)
Pi	-0.596***	-1.424***	-0.963***
	(0.164)	(0.227)	(0.107)
L.Delta Net Loans			0.132***
			(0.0286)
L.Size			-2.021*
			(1.028)
L.Liq			0.941***
			(0.162)
L.Sol			2.650***
			(0.223)
L.Prof			-0.135
			(0.631)
Observations	1305	1305	1011

Standard errors in parentheses
* p¡0.10, ** p¡0.05, *** p¡0.010

Table 11: Determinants of bank lending - government banks

	OLS	D-in-D	GMM
FGN	-1.809	0.345	0.0313
	(2.303)	(4.687)	(4.056)
GOV	-2.188	-7.680	-5.464
	(1.610)	(7.237)	(3.457)
MP	-1.777***	-1.676**	-1.474**
	(0.525)	(0.577)	(0.523)
FGN*MP	1.340***	0.879**	1.313*
	(0.284)	(0.272)	(0.668)
GOV*MP	0.588	-0.303	0.0828
	(0.860)	(0.943)	(0.777)
Size	-0.0288	0.0113	2.296**
	(0.0579)	(0.320)	(1.006)
Liq	-0.0639	-0.353***	-0.705***
	(0.0484)	(0.0609)	(0.118)
Sol	-0.226**	-0.655**	-2.084***
	(0.0968)	(0.208)	(0.424)
Prof	1.558***	1.539***	1.702***
	(0.456)	(0.415)	(0.249)
GDP	2.201***	1.143***	0.864***
	(0.301)	(0.166)	(0.258)
Pi	-0.384	-1.118***	-1.014***
	(0.236)	(0.156)	(0.173)
L.Delta Net Loans			0.212***
			(0.0270)
L.Size			-2.206*
			(0.982)
L.Liq			0.757***
			(0.124)
L.Sol			2.077***
			(0.380)
L.Prof			-0.511
			(0.305)
Observations	2403	2403	2001

Standard errors in parentheses
* p¡0.10, ** p¡0.05, *** p¡0.010

Table 12: Determinants of bank lending - without ownership change episodes

	OLS	D-in-D	GMM
FGN	-1.182	3.961	-0.907
	(2.328)	(3.422)	(2.644)
MP	-1.546***	-1.801***	-1.331***
	(0.275)	(0.412)	(0.377)
FGN*MP	1.197***	1.077***	1.126**
	(0.332)	(0.254)	(0.415)
Size	-0.0193	0.0878	2.203*
	(0.0680)	(0.316)	(1.036)
Liq	-0.0582	-0.323***	-0.689***
	(0.0528)	(0.0666)	(0.136)
Sol	-0.249**	-0.651**	-2.126***
	(0.0914)	(0.213)	(0.422)
Prof	1.580***	1.562***	2.014***
	(0.486)	(0.405)	(0.287)
GDP	2.188***	1.100***	0.785**
	(0.294)	(0.158)	(0.248)
Pi	-0.361	-1.043***	-1.023***
	(0.239)	(0.165)	(0.182)
L.Delta Net Loans			0.205***
			(0.0291)
L.Size			-2.130*
			(1.007)
L.Liq			0.724***
			(0.131)
L.Sol			2.051***
			(0.388)
L.Prof			-0.540
			(0.367)
Observations	2355	2355	1929

Standard errors in parentheses
* p¡0.10, ** p¡0.05, *** p¡0.010

Table 13: Determinants of bank lending - without ownership change banks

	OLS	D-in-D	GMM
MP	-1.827***	-1.909***	-1.502**
	(0.249)	(0.535)	(0.562)
FGN*MP	1.567***	1.105**	1.399***
	(0.417)	(0.421)	(0.423)
Size	0.0994	-0.156	1.976
	(0.0782)	(0.533)	(1.236)
Liq	-0.0630	-0.271***	-0.673***
	(0.0577)	(0.0816)	(0.152)
Sol	-0.246**	-0.591**	-2.113***
	(0.102)	(0.243)	(0.454)
Prof	1.348**	1.444***	2.096***
	(0.502)	(0.418)	(0.347)
GDP	2.285***	1.145***	0.997***
	(0.281)	(0.211)	(0.303)
Pi	-0.364	-1.099***	-0.994***
	(0.214)	(0.170)	(0.235)
L.Delta Net Loans			0.210***
			(0.0357)
L.Size			-1.818
			(1.194)
L.Liq			0.711***
			(0.138)
L.Sol			2.058***
			(0.407)
L.Prof			-0.882**
			(0.351)
Observations	1825	1825	1502

Standard errors in parentheses
* p¡0.10, ** p¡0.05, *** p¡0.010

Table 14: Determinants of bank lending - GDP growth rates without monetary policy

	OLS	D-in-D	GMM
FGN	-2.499	1.252	-1.427
	(1.868)	(3.353)	(0.959)
GDP	2.448***	1.121***	0.898*
	(0.447)	(0.320)	(0.413)
FGN*GDP	-0.424	0.0319	-0.139
	(0.314)	(0.398)	(0.377)
EzoneGDP	-1.100	1.660**	0.135
	(0.909)	(0.698)	(0.497)
FGN*EzoneGDP	1.503	0.844	0.792
	(0.845)	(0.778)	(0.721)
Size	-0.0283	0.0455	2.360**
	(0.0638)	(0.221)	(0.980)
Liq	-0.0658	-0.351***	-0.716***
	(0.0507)	(0.0657)	(0.119)
Sol	-0.216**	-0.626**	-2.103***
	(0.0940)	(0.213)	(0.397)
Prof	1.610***	1.463***	1.754***
	(0.460)	(0.425)	(0.277)
Pi	-0.369*	-1.076***	-0.881***
	(0.176)	(0.134)	(0.209)
L.Delta Net Loans			0.217***
			(0.0283)
L.Size			-2.269**
			(0.949)
L.Liq			0.752***
			(0.120)
L.Sol			2.077***
			(0.362)
L.Prof			-0.501
			(0.303)
Observations	2426	2426	2011

Standard errors in parentheses
* p¡0.10, ** p¡0.05, *** p¡0.010

D DSGE model

Households Standard intra-temporal condition for labor supply:

$$\frac{1}{c_t^H(i)} = \frac{l_t^H(i)^{\phi}}{w_t}, \tag{19}$$

and an inter-temporal condition for consumption choice:

$$\frac{1}{c_t^H(i)} = \beta_H \left(1 + r_t^d\right) \mathbb{E}_t \left[\frac{1}{c_{t+1}^H(i)}\right]. \tag{20}$$

Given those two conditions, deposits are determined via budget constraint that holds with equality:

$$c_t^H(i) + d_t^H(i) = W_t l_t^H(i) + \left(1 + r_{t-1}^d\right) d_{t-1}^H(i) + T_t^H. \tag{21}$$

Entrepreneurs

$$\frac{1}{c_t^E(i)} - \zeta_t^E(i) = \beta_E \mathbb{E} \frac{1 + r_t^b}{c_{t+1}^E(i)} \tag{22}$$

$$\mathbb{E}\left[\frac{\zeta_t^E(i)\, m^E q_{t+1}^k \left(1 - \delta^k\right)}{1 + r_t^b} + \frac{\beta_E}{c_{t+1}^E(i)} \left(q_{t+1}^k \left(1 - \delta^k\right) + r_{t+1}^k\right)\right] = \frac{q_t^k}{c_t^E(i)} \tag{23}$$

$$\frac{(1-\alpha)\, y_t^E(i)}{l_t^d(i)\, x_t} = w_t \tag{24}$$

$$r_t^k \equiv \frac{\frac{\partial y_t^E(i)}{\partial k_t(i)}}{x_t} \tag{25}$$

Banks - aggregation of loans The problem of entrepreneur i choosing his total loans $b_E(i)$ facing a continuum of banks indexed with j to allocate these loans among the continuum of banks is a standard cost-minimization problem:

$$\min_{b_E(i,j)} \int_0^1 r_b(j)\, b_E(i,j)\, dj \tag{26}$$

$$\text{subject to: } \left[\int_0^1 b_E(i,j)^{\frac{\varepsilon-1}{\varepsilon}} dj\right]^{\frac{\varepsilon}{\varepsilon-1}} = b_E(i) \tag{27}$$

For a given aggregate price r_b the entrepreneur optimally chooses the total amount of loans and its partition among monopolistically competitive banks. Note, we can write:

$$\left[\int_0^1 b_E(i,j)^{\frac{\varepsilon-1}{\varepsilon}}\,dj\right] = b_E(i)^{\frac{\varepsilon-1}{\varepsilon}}. \tag{28}$$

The first order condition of retail branch j gives the demand for loans at bank j charging $r_{bE}(j)$, given aggregate price for loans r_{bE}:

$$b_E(i,j) = \left(\frac{r_{bE}(j)}{r_{bE}}\right)^{-\varepsilon} b_E(i) \tag{29}$$

which we integrate on the both sides wrt to i to get:

$$b_E(j) = \left(\frac{r_{bE}(j)}{r_{bE}}\right)^{-\varepsilon} b_E. \tag{30}$$

With $r_{bE} = \left[\int_0^1 r_{bE}(j)^{1-\varepsilon}\,dj\right]^{\frac{1}{1-\varepsilon}}$ being the price index. Now, we have the two following equations (the first one is postulated to reflect the monopolistic competition assumption, the other follows):

$$b_E(i) = \left[\int_0^1 b_E(i,j)^{\frac{\varepsilon-1}{\varepsilon}}\,dj\right]^{\frac{\varepsilon}{\varepsilon-1}}, \tag{31}$$

$$r = \left[\int_0^1 r(j)^{1-\varepsilon}\,dj\right]^{\frac{1}{1-\varepsilon}}. \tag{32}$$

Let us postulate a within-ownership symmetric equilibrium such that a measure of foreign banks μ chooses $r_{f,bE}$ and a measure of domestic banks $1-\mu$ chooses $r_{h,bE}$. Without loss of generality we say the banks with $j \in [0,\mu)$ set $r_{f,bE}$. We than have that:

$$r_{bE} = \left[\int_0^1 r_{bE}(j)^{1-\varepsilon}\,dj\right]^{\frac{1}{1-\varepsilon}} = \left[\mu r_{f,bE}^{1-\varepsilon} + (1-\mu)\, r_{h,bE}^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}}. \tag{33}$$

Now, we use the demand equations to derive the index of quantities, by differentiating equation (30) with respect to j which yields:

$$b_E = \left(\mu b_{f,E}^{\frac{\varepsilon-1}{\varepsilon}} + (1-\mu)\, b_{h,E}^{\frac{\varepsilon-1}{\varepsilon}}\right)^{\frac{\varepsilon}{\varepsilon-1}}. \tag{34}$$

The last two equations are used in aggregation of individual demands and prices to aggregate demands and prices in the loans market.

Retailers Retail good producers buy the good produced by entrepreneurs, aggregate them to the final good and sell it with a markup subject to Rotemberg type of adjustment costs. The first equation is the definition of retailer profits, κ_p is the parameter governing the inertia of the aggregate price level. The second equation is the first order condition of the optimal pricing problem, can be thought of as a Philips curve.

$$J_t^R = y_t \left(1 - \frac{1}{x_t} - \frac{\kappa_p}{2}\left(\pi_t - \left(\pi_{t-1}^{\zeta_p}\bar{\pi}^{1-\zeta_p}\right)\right)^2\right) \tag{35}$$

$$1 = \varepsilon_t^y + \frac{\varepsilon_t^y}{x_t} - \kappa_p\left(\pi_t - \left(\pi_{t-1}^{\zeta_p}\bar{\pi}^{1-\zeta_p}\right)\right)\pi_t + \tag{36}$$
$$\beta^P \mathbb{E}_t\left[\frac{\lambda_{t+1}^P}{\lambda_t^P}\kappa_p\left(\pi_{t+1} - \left(\pi_t^{\zeta_p}\bar{\pi}^{1-\zeta_p}\right)\pi_{t+1}\right)\frac{y_{t+1}}{y_t}\right]$$

Capital good producers The role the capital good producers play in the model is twofold. First, their presence encapsulates the economy-wide investment equation and capital accumulation. Without loss of generality, this decision could be placed at the firm level as well. Next, and more importantly, it is a way of introducing the price of capital to the model hence facilitating the use of the collateral constraint on capital in a meaningful way.

$$k_t = (1-\delta_k)\,k_{t-1} + i_t\left(1 - \frac{\kappa_i}{2}\left(\frac{i_t}{i_{t-1}} - 1\right)^2\right) \tag{37}$$

$$1 = q_k\left(1 - \frac{\kappa_i}{2}\left(\frac{i_t}{i_{t-1}} - 1\right)^2\right) + \beta^E \mathbb{E}_t\left[\frac{\zeta_{t+1}^E q_{t+1}^k}{\zeta_t^E}\kappa_i\left(\frac{i_{t+1}}{i_t} - 1\right)\left(\frac{i_{t+1}}{i_t}\right)^2\right]. \tag{38}$$

Aggregation The aggregation conditions read:

$$Y_t = C_t + q_t^k \left(K_t - \left(1 - \delta^k\right) K_{t-1} \right) + \frac{\delta^b K_{t-1}^b}{\pi_t} \tag{39}$$

$$B_t = D_t + K_t^b \tag{40}$$

$$C_t = \int c_t^H (i) + c_t^E (i)\, di \tag{41}$$

$$B_t = b_{E,t} \tag{42}$$

$$D_t = d_t \tag{43}$$

$$K_t = k_t^e \tag{44}$$

$$Y_t = y_t^e \tag{45}$$

$$l_t^d = l_t^p. \tag{46}$$

E Calibration

In this section we discuss calibration of the model parameters. We calibrate the model using standard values for yearly data as this is the frequency micro data is reported in Bankscope. Let us start with the discussion of our calibration targets.

First, observe that the central bank rate pins down the rate of return on bonds. Thus, we wish to replicate a 6% p.a. value here, higher than the standard US value of 4% by two percentage points. This assumption determines the household discount factor β^H. We pick entrepreneurs patience to be captured by $\beta^E =$. We pick the inverse of the Frisch elasticity to be equal to 1. The capital share in the production function is set at $\alpha = 0.3$. The depreciation rate of physical capital is $\delta_k = 0.02$. The LTV ratio m^E is postulated to be equal to 0.35. We assume a markup in the goods market at 15% and the markup on the interbank rate to be about 40%. The monetary policy inertia we set at 0.8. The cost for managing bank capital is determined in the equilibrium to assure that the banks achieve their target balance structure. The multiplier on the quadratic cost of deviations from the optimal balance sheet structure κ_b is put at 10.The price stickiness parameter is set κ_p to 30. The elasticity of loans is equal to 4.

For the internal market hypothesis we increased the penalty multiplier κ_b in foreign banks to 100, we also postulate the target leverage to be $\nu_{fgn} = 0.045$ in foreign-owned banks while the domestic banks have it on $\nu_{dom} = 0.09$. The segmentation market hypothesis has $\varepsilon_l^H = 7$ and ε_l^L follows to map the steady state banking variables for the homogeneous elasticities baseline case. We set the country size parameter η to match the ratio of GDP of the Eurozone and Poland. Other parameters we keep symmetric apart

from the markup on the interbank market to be half of the one used for the Home country. We pick the penalty parameter κ_ω to allow for up to 10% deviations in the stream of the dividends in the policy simulations experiments.

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