Shocks Abroad, Pain at Home?

Bank-Firm Level Evidence on Financial Contagion during the Recent Financial Crisis

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Abstract

We study international contagion during the recent financial crisis through the international market for wholesale liquidity and through foreign bank ownership. To identify its impact, we analyze bank- and bank-firm- level data – enabling estimations that include comprehensive sets of bank- and firm- fixed effects – from Eastern Europe. Countries there were not immediately affected by the Western banking crisis, but their banking sectors are populated both with domestic banks that before the crisis were borrowing from international capital markets and with foreign owned banks that are mostly headquartered in Western Europe.

We find that compared to other domestically operating banks, these internationally-borrowing and foreign banks eventually cut back more on lending on average, and that the impact is stronger when funded relatively less with retail deposits. In contrast, when we analyze firm-level effects that allow controlling for firm fundamentals (demand), we find that only firms borrowing from foreign banks suffer negative real effects on average, but that smaller firms have relatively better real outcomes. Firms borrowing from internationally-borrowing banks do not face worse real effects on average, except for the less capitalized firms.

In sum, the results suggest the presence of an international bank lending channel through foreign ownership, and an interaction between a firm balance-sheet channel and an international bank lending channel through international wholesale liquidity. Our findings have therefore important implications for both theory and policy.

Keywords: contagion, international transmission, foreign banks, international wholesale liquidity, bank lending channel, firm balance-sheet channel.

JEL: G21, F23, F36.

1. INTRODUCTION

The international bank lending channel has gained substantial prominence during the recent crisis. The U.S. and Western Europe suffered their worst banking crises since the 1930s with international wholesale liquidity evaporating and Western banks suffering important capital losses, followed by a severe economic recession in developed countries. The main channel by which banks affect the economy at large is through a reduction in credit availability – the so-called bank lending channel. Globalization of the financial system, in particular of European banks, both through extended operations on international interbank markets and through foreign bank ownership, has dramatically increased over the last two decades and potentially could internationally transmit shocks through the banking sector, in turn generating an international bank lending channel.[1]

We analyze in this paper the international bank lending channel, exploiting the 2007-08 crisis shock through two key transmission channels: International wholesale bank liquidity and foreign bank ownership. In particular we analyze the following questions: Does the financial crisis spread through international bank linkages? Do banks that relied more on international wholesale liquidity cut more the credit availability for firms? Do problems at the parent bank propagate in domestic markets via subsidiaries through the internal capital market affecting subsidiary lending? Do local subsidiaries owned by foreign banks cut credit availability for firms, and does it depend on the subsidiary balance-sheet strength? Are there real effects for firms? Are there heterogeneous effects across firms, importantly across firm

[1] See Cetorelli and Goldberg (2010), Kalemli-Ozcan, Papaioannou and Peydró (2010), Cetorelli and Goldberg (2011), and Kalemli-Ozcan, Papaioannou and Peydró (2011).

size and net worth? Ultimately, is a globalized banking sector a shock propagator or a shock absorber?

For identification, we analyze banks and firms located across Eastern European countries. In these countries banks were not directly affected by the Western banking crisis but there were a substantial proportion of both domestic banks borrowing from internationally wholesale banking markets before the crisis and foreign owned banks that were mainly headquartered in Western Europe.[2] Crucially for identification, we can access: (1) A bank-level measure of international wholesale liquidity dependency and a comprehensive world-wide bank-ownership dataset to analyze bank-level transmission of the international contagion; (2) A corresponding dataset of bank-firm relationships matched with both bank and firm balance-sheet data that can circumvent the typical shortcomings that plague the identification of the bank lending channel (i.e., to convincingly control for borrower fundamentals), and that allow the analysis of both the real effects of credit unavailability and the heterogeneity of the impact across firms.

The final data set used in the analysis ultimately connects *five databases*. The bank-level variable on bank borrowing on international wholesale liquidity markets comes from *Dealogic*. Foreign bank ownership is derived from a comprehensive world-wide bank-ownership dataset compiled by *Claessens and van Horen (2011)*. The latter two databases are used in conjunction with *Bankcope* that records complete bank balance sheet data on many European banks. *Amadeus* records balance sheet information on European non-financial

[2] EBRD Regional Economic Prospects (Oct 2011): "The countries in central Europe and, to a more limited extent, the Baltics and south-eastern Europe regions, depend the most on the eurozone […] as source of both longer-term FDI inflows and shorter-term external debt funding. As the outlook for the eurozone worsens substantially, […] this channel will contribute to weaker growth." "Large shares of the banking systems […] are comprised of subsidiaries of eurozone banks. As these [parent banks] face funding and recapitalization pressures stemming from the sovereign debt crisis, their subsidiaries are likely to receive less support and therefore extend less private credit in the transition countries, bearing on credit growth."

firms; and – making the connection between banks and firms – *Kompass* records bank-firm connections for a subset of European non-financial firms, both large and small.

We analyze the final matched sample of banks and firms in the Eastern European countries and select the data from 2005 to 2009 to have sufficient coverage before and after the 2007-08 financial crisis. We analyze changes in bank lending and changes in firm real outcomes through difference-in-differences via banks' borrowing before the crisis (or not) from international wholesale markets and foreign (or domestic) bank ownership. We control for unobservable fundamentals with bank fixed effects in the bank-level analysis and with firm fixed effects in the firm-level analysis. Given the likely existence of a regular domestic bank lending channel and a firm balance-sheet channel we also allow for differential effects of bank and firm balance-sheet characteristics during the crisis, and also control for country*year fixed effects. Though we cannot control for time-varying unobservable firm fundamentals by including firm*time fixed effects, ours is the first paper in the literature – as far as we are aware – that includes firm fixed effects in the international bank lending channel literature when analyzing more than one country.[3]

We find that compared to other domestically operating banks, these internationally-borrowing and foreign banks eventually cut back more on lending on average, and the impact is stronger when funded relatively less with retail deposits. In contrast, when we analyze firm-level effects that allow controlling for firm fundamentals (demand), we find that only firms borrowing from foreign banks suffer negative real effects on average, but smaller firms have relatively better real outcomes. Firms borrowing from internationally-borrowing banks do not face worse real effects on average, except for the less capitalized firms.

[3] Two exceptions we discuss shortly are Puri, Rocholl and Steffen (2011) for German saving banks and Schnabl (2011) for Peruvian banks.

In sum, the results suggest the presence of an international bank lending channel through foreign ownership, and an interaction between a firm balance-sheet channel and an international bank lending channel through international wholesale liquidity. Our findings have therefore important implications for both theory and policy.

Our empirical evidence is broadly consistent with theoretical work on the international contagion and bank lending channel (Allen and Gale (2000) and Morgan, Rime and Strahan (2004); Bernanke and Blinder (1988); Bernanke and Gertler (1989); Holmstrom and Tirole (1997); Stein (1998)). In particular our paper contributes to a nascent literature that empirically analyzes international contagion through the banking sector during the recent crisis. Cetorelli and Goldberg (2010) and Kalemli-Ozcan, Papaioannou and Perri (2011) for example analyze contagion during the recent crisis at the country-level with the international banking data from the Bank for International Settlements. Their results suggest that there is an international contagion channel of international banking. Allen, Hryckiewicz, Kowalewski and Tümer-Alkan (2011), Amiti and Weinstein (2011) and Popov and Udell (2010) analyze international contagion employing bank level data finding broadly similar results.[4]

As far as we are aware our paper is the first paper in the literature in the international contagion/ bank lending channel literature that analyzes firm-level performance. Moreover, we analyze differential effects across different types of firms and, in addition, we analyze more than one country. Two papers analyze the international bank lending channel with borrower-level data in one country. Puri, Rocholl and Steffen (2011) analyze household loan applications during the recent crisis following German saving banks exposure to U.S. subprime assets, and Schnabl (2011) analyze Peruvian bank lending to firms after the 1998

[4] A seminal paper in this regard that predates the recent crisis is by Peek and Rosengren (2000). See also de Haas and van Lelyveld (2010).

LTCM-Russian crisis. Both studies have access to precise loan-level data (loan applications in the first case and credit register data in the second paper) which allow a very precise identification of credit supply, but differently from this paper they do not analyze real effects nor heterogeneous effects across borrowers. This is important as the bank lending channel implies real effects through changes in bank credit availability and the heterogeneous firm effects calls for a testing of the interaction between the international bank lending channel and the firm balance-sheet channel. Moreover, Puri, Rocholl and Steffen (2011) do not analyze the two international channels that we analyze in this paper (international liquidity and foreign bank ownership) and Schnabl (2011) does not analyze the recent financial crisis.

A recent paper by de Haas and van Horen (2012) starts from a list of the large banks from advanced countries and constructs for each bank-country pair a dependent variable that captures the change in syndicated cross-border lending, which is typical for very large firms, after the collapse of Lehman. They find that banks that experienced a funding shock cut back lending more, but not differentially across countries. de Haas and van Horen (2012) then also look at firm borrowing and show that banks with the funding shocks cut back lending more to relatively smaller firms. In contrast to their paper we do not study cross-border syndicated lending between relatively large banks and firms, but local bank lending by internationally-borrowing and foreign owned banks and we also study the real effects of changes in lending on firm performance.[5]

Our paper also contributes to the literature of the bank lending channel in general (Bernanke and Blinder (1988); Bernanke and Blinder (1992); Kashyap and Stein (2000);

[5] De Haas and Van Horen (2011) also focus on cross-border syndicated lending. They use country and bank fixed effects to isolate the impact of bank-borrower closeness variables. They find that during the crisis banks continued to lend more to countries to which they are geographically close, where they had a network of domestic lenders and where they had more past experience.

Khwaja and Mian (2008); Jiménez, Ongena, Peydró and Saurina (2011)) and on the recent crisis (Chari, Christiano and Kehoe (2008), Cohen-Cole, Duygan-Bump, Fillat and Montoriol-Garriga (2008), Huang (2009), Ivashina and Scharfstein (2010)). We provide the first evidence for the recent crisis on firm-level real effects of international banking contagion. We therefore contribute to this literature by analyzing the potency and implications of the international bank lending channel.

Importantly, and in contrast to other studies, we rely on documented bank – firm relationships to identify the impact of the different shocks that affected different banks on individual firm financial and operating performance across multiple countries.

Our paper also contributes to the literature on the differences between domestic and foreign banks in emerging markets. Giannetti and Ongena (2009) and Bruno and Hauswald (2008) find that foreign bank presence benefits the real economy, while Gormley (2010) finds negative effects of foreign bank entry. Foreign banks are found to be more inclined to lend to large firms with foreign owners (Mian (2006), Berger, Klapper, Martinez Peria and Zaidi (2008) and Berger, Klapper and Udell (2001)). On the other hand, foreign banks may induce domestic banks to increase lending to opaque firms (Dell'Ariccia and Marquez (2004)) and benefit all firms by indirectly enhancing credit access (Giannetti and Ongena (2011)) and spurring competition (Claessens, Demirgüç-Kunt and Huizinga (2001)). Our paper contributes by studying the heterogeneous impact on firm performance of the international bank lending channel, running through the international market for wholesale liquidity and through foreign bank ownership.

The paper proceeds as follows. Section 2 discusses the data and the bank shocks we analyze. Section 3 presents and discusses the results. Section 4 concludes highlighting the policy implications.

2. DATA AND SHOCKS

2.1. Databases

The final data set used in the analysis connects five databases: We glean the bank-level variable on bank borrowing on international wholesale liquidity markets from *Dealogic* and foreign bank ownership from a comprehensive world-wide bank-ownership dataset compiled by *Claessens and van Horen (2011)*. Banks' financial statements are from *Bureau van Dijk Bankscope*, financial information for the firms is from *Bureau van Dijk Amadeus*, and importantly *Kompass* provides the bank – firm connections that are crucial to our investigation (see also Giannetti and Ongena (2011) and Ongena and Şendeniz-Yüncü (2011) for a description in detail of this dataset). In all cases we take the prime bank – firm connection.

We obtain yearly information on balance-sheet items for all banks and firms from the first two databases for the period 2005 to 2009 for fourteen countries in Eastern Europe, i.e., Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Lithuania, Poland, Romania, Serbia and Montenegro, Slovakia, Slovenia, Turkey, and Ukraine. To assure the representativeness of banks we require financial statements for at least two out of five years. We end up with 208 different banks that are connected with 43,847 different firms. Tables 1 and 2 provide the distribution of banks and firms by country.

2.2. Shocks Affecting Banks

To identify bank shocks we rely on the combination of bank type and time. We distinguish between three types of banks: Domestic International, Domestic Local and

Foreign banks. Domestic banks have majority domestic ownership (i.e., combined equity shares of more than fifty percent), while Foreign banks have majority of foreign ownership. We take the crisis years to be 2008 and 2009, and we define Domestic International banks to be those that are observed to fund themselves on the international capital markets prior to the crisis (in particular between 2004 and 2007), while Domestic Local banks are not obtaining any funds there (we henceforth drop the "Domestic" label).

As liquidity on the international capital markets dried up more than the domestic local funding through retail deposits for example one would expect the International banks, the crisis shock was stronger for International than for Local banks and, hence, International banks can be expected to cut lending more. To the extent that the headquarters in the home country of the Foreign banks would re-allocate liquidity away from Eastern Europe to the home (or other more important) market during the crisis years (Cetorelli and Goldberg (2011)) or to the extent that headquarters are mainly in Western Europe where the banking crisis hit strongly, also banks that are Foreign (in 2007) suffer a stronger shock than Local banks and, hence, can be expected to cut lending more. We match foreign banks with their parents and have both local and headquarter balance-sheet information from Bankscope.

Tables 1 and 2 also provide the distribution by bank type. Of the 208 banks, 24 are International, 71 are Local, while the remaining majority, i.e., 113, are Foreign. And of the 43,847 firms, 6,891 are connected with an International bank, 6,483 with a Local Bank, and 30,473 with a Foreign bank.

3. RESULTS

3.1. Bank Loan Growth

3.1.1. Loan Growth by Bank Type

Do domestic internationally-borrowing and/or foreign banks curtail lending more or less during the financial crisis than domestic local banks? A graph of the mean and median loan growth by bank type suggests they may cut lending by more (Figure 1). However, to answer this question more precisely we estimate the following specifications:

$$\begin{aligned} &Loan\ Growth_{bt} = \\ &International_{b2007} + International_{b2007} * Crisis_t + Foreign_{b2007} + Foreign_{b2007} * Crisis_t + \\ &Crisis_t + fixed\ effects + \varepsilon_{bt}, \end{aligned} \quad (1)$$

where *Loan Growth* is the yearly growth in loans by bank *b* in year *t* (*t* goes from 2005 to 2009), *International* is a dummy that equals one during the crisis years (i.e., 2008 and 2009) if the bank was borrowing on the international capital market in 2007 and equals zero otherwise, *Foreign* is a dummy that equals one during the crisis years if the bank was foreign (majority) held in 2007 and equals zero otherwise, and *Crisis* is a dummy that equals one for *t* equal to 2008 and 2009 and equals zero otherwise. As set of fixed effects we include consecutively: (1) no fixed effects, (2) bank fixed effects, (3) bank and year fixed effects, and (4) bank and country*year fixed effects. The standard errors are double clustered by bank and year. The descriptive statistics for all bank variables are in Table 3.

The estimates are in Table 4. As the dependent variable is the loan growth (i.e., the log change in loans) by bank the estimated coefficients are straightforwardly interpretable. Prior to the crisis years (2008 and 2009), international banks expanded their lending by 11.5** percentage points more than local banks,[6] the benchmark group, while foreign banks expanded their lending only by 2.6 percentage points more than this group (this difference with the local domestic banks is also not statistically significant). Given that the mean loan growth across all bank-year observations equals 25 percent (see Table 2), these differences are sizeable and economically meaningful.

During the crisis years 2008 and 2009 lending by local banks contracted by 20.2** and 19.6** percent, respectively, while the interaction terms with the crisis years indicate that the international banks not only expanded their lending more prior to the crisis years but during the crisis years also contracted it more, by 19.3*** percentage points more in 2008 and another 21.4*** percentage points more in 2009. Foreign banks contracted it by 2 and 13.9*** percentage points more than local banks. These estimated differentials are potentially biased, however, as we do not control adequately enough (yet) for bank and country heterogeneity.

In Models 2 to 4 we therefor consecutively saturate the specifications with bank, bank and year, and bank and country*year fixed effects to account for all observed and unobserved bank and time-variant country heterogeneity. The estimated contractions in lending decrease somewhat but still equals 9.3* and 13.2** percentage points for international banks and 2 and 10.7** percentage points for foreign banks. In sum, international and foreign banks contract their lending more than local banks during the crisis years.

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[6] As in the Tables, ***, **, and * indicates statistical significant at the 1, 5, and 10 percent level, respectively.

3.1.2. Loan Growth by Bank Type and Bank Characteristics

We now investigate if loan growth by bank type is further differentiated by bank characteristics before and during the second crisis year.[7] That is in equation (1) we add interactions with bank characteristics. The specifications we now estimate are:

$$\begin{aligned} &\textit{Loan Growth}_{bt} = \\ &\textit{International}_{b2007} * \textit{Crisis}_t * d(\textit{Bank Characteristics}_{b2007}) + \textit{Foreign}_{b2007} * \textit{Crisis}_t * \\ &d(\textit{Bank Characteristics}_{b2007}) + \textit{Crisis}_t * d(\textit{Bank Characteristics}_{b2007}) + \textit{Bank} \\ &\textit{Characteristics}_{bt-1} + \textit{fixed effects} + \varepsilon_{bt}, \end{aligned} \tag{2}$$

where the *Bank Characteristics* we feature are: Size which is the logarithm of assets, Liquidity which is liquid over total assets, Deposits which is demand deposits over total liabilities, and in robustness we replace Size by Market Share which is the percent share of national lending. The bank characteristics are taken in the previous year while in the interactions we construct from every characteristic a dummy variable *d(.)* which equals one for banks with the indicated characteristic above the median in 2007, and equals zero otherwise. Vienna Initiative equals one if the foreign bank participates in this initiative, and equals zero otherwise. In robustness we also include Loan Growth, again taken in the previous year. *Crisis* is a dummy that equals one for *t* equal to 2009, and equals zero otherwise. We include bank and country*year fixed effects in all specifications and standard errors are double clustered by bank and year.

[7] To keep specifications parsimonious we focus on the later-crisis-year interactions. Results are similar and mostly unaffected if we include the first crisis year (2008). This is also the case in the later reported firm performance regressions.

The estimates are in Table 5. Model 1 includes the interactions for international banks, Model 2 for foreign banks, Model 3 for both bank types, and Model 4 adds past loan growth, while Model 5 replaces Size by Market Share.

Focusing on the estimates in Model 3 we find that international banks that prior to the crisis were above-median liquid and below-median financed with retail deposits contract lending by 18.2*** and 16.4*** percentage points more (than local above-median liquid and below-median retail-deposit-financed banks), while for foreign banks the corresponding additional contraction equals 9.2** and 8.8* percentage points. Foreign banks that participated in the Vienna Initiative contract their lending much less than any other banks in 2009 (but the interpretation of the point estimate needs to account for the fact that only foreign banks participated in this Initiative and that the estimate is for a below-median sized, liquid, and retail deposit-taking bank, and for the fact that adding past loan growth overturns this estimate).

Overall, the estimates suggest that the extra contraction in lending by international and foreign banks that we observe during the crisis years (compared to local banks) is further differentiated according to liquidity and deposit-taking prior to the crisis.

3.2. Firm Performance

3.2.1. Firm Performance by Bank Type

Given that we have observed so far that internationally-borrowing and foreign banks curtail their lending more during the financial crisis than domestic local banks, the next question we want to try to answer is: Are firms that have relationships with these domestic internationally-borrowing or foreign banks affected more in their performance during the financial crisis than other firms (that have relationships with domestic local banks)? Again we

construct a graph of the mean and median operational revenue growth of the 43,847 firms in our sample by bank type (Figure 2). Now the answer to the question does not seem so obviously present in the graph, but of course the variation in growth may also be due to the combination of firm heterogeneity and bank-type matching. Hence to try to answer this question more carefully we next investigate if firm performance is differentiated by bank type before and during the crisis years with panel estimations. The specifications we now estimate are:

$$\begin{aligned} &Firm\ Performance_{bit} = \\ &International_{b2007} + International_{b2007} * Crisis_t + Foreign_{b2007} + Foreign_{b2007} * Crisis_t + \\ &Crisis_t + fixed\ effects + \varepsilon_{bit}, \end{aligned} \quad (3)$$

where the dependent variable varies for each firm *i* for which we know its bank connection to bank *b*. As firm performance variables we analyze the yearly firm operational revenue growth or the yearly firm asset growth. *Crisis* is a dummy that equals one for *t* equal to 2008 and 2009 and equals zero otherwise. We include no fixed effects, or firm, industry * year, and country * year fixed effects. The standard errors are clustered by firm. The descriptive statistics for all firm variables are in Table 6.

The estimates are in Table 7. Models 1 and 3 suggest that firm operational revenue and asset growth dropped precipitously during the crisis years. For firms connected with local banks, revenue growth dropped by 12.6*** and 36.5*** percentage points in 2008 and 2009, respectively, and asset growth by 12.4*** and 21.4*** percentage points. However, at first sight firms connected with international and foreign banks do not any worse than firms

connected to local banks. But these estimated differentials are potentially biased, however, as we may not control adequately enough for firm, year and country heterogeneity.

In Models 2 and 4 we therefor saturate the specification with firm, industry*year, and country*year fixed effects to account for all observed and unobserved firm, and time-variant industry and country heterogeneity. The estimates suggest that firms connected to foreign banks in 2009 face a 2.3** and 1.9** percentage points lower revenue and asset growth than firms connected with domestic banks (both local, as these banks are the benchmark group, and international as the estimated coefficients on the interactions of international and crisis do not differ statistically significantly from zero). Given that the mean revenue and asset growth across all firm-years equals 3 and 9 percent, respectively, these additional declines in growth for firms of foreign banks are economically large.

3.2.2. Firm Performance by Bank Type and by Firm Characteristics

Finally, we investigate if firm performance is differentiated by bank type and by firm characteristics before and during the second crisis year. The specifications we now estimate are:

$$\begin{aligned} &Firm\ Performance_{bit} = \\ &International_{b2007} * Crisis_t * d(Firm\ Characteristics_{b2007}) + Foreign_{b2007} * Crisis_t * \\ &d(Firm\ Characteristics_{b2007}) + Crisis_t * d(Firm\ Characteristics_{b2007}) + Firm \\ &Characteristics_{bt-1} + fixed\ effects + \varepsilon_{bt}, \end{aligned} \tag{3}$$

where the firm performance variables are again the yearly firm operational revenue growth or the yearly firm asset growth. The *Firm Characteristics* we feature include Size,

which is the logarithm of assets, Solvency, which is the assets over equity, and Liquidity which is the current over total assets. The firm characteristics are taken in the previous year while in the interactions we construct from every firm characteristic a dummy variable *d(.)* which equals one for firms with the indicated characteristic above the quartile value in 2007, and equals zero otherwise.[8] *Crisis* is a dummy that equals one for *t* equal to 2009, and equals zero otherwise. We saturate all specifications with firm and country*year effects. The standard errors are clustered by firm.

The estimates are in Table 8. The dependent variable in Models 1 to 7 is firm operational revenue growth, in Models 8 to 14 it is firm asset growth. In Models 1 to 3 and 8 to 10 we interact above-quartile firm size, solvency and liquidity with International, in Models 4 to 6 and 11 to 13 with Foreign, and with all firm characteristics and both bank type at once in Models 7 and 14.

Results are interesting. Take the estimates from Models 7 and 14 for example. Above-quartile solvent firms connected with international banks grow 5.9*** and 6.7*** percentage points more in revenue and assets than similar firms with local banks, which grow 4.5*** and 2.3** percentage points more than below-quartile solvent firms. Hence international banks curtail lending and their less solvent firms incur stunted growth as a consequence, consistent with a firm balance sheet channel in which firm balance sheet strength determines whether firms can obtain substitute financing when current funding evaporates.

All firms below-quartile in size, solvency and liquidity connected with foreign banks grow 2* and 2.3** percentage points less in revenue and assets in 2009 than similar firms connected with local banks. This finding is consistent with foreign banks curtailing lending

[8] We use quartile values as for solvency for example especially low values may determine the decision of banks to continue lending.

more during the crisis than local banks. At the same time foreign-bank firms that are above-quartile in size grow 6.4*** and 4.4*** percentage points less than similar local-bank firms. Hence the picture that arises is one in which foreign banks may re-allocate funding towards smaller firms that may have more growth opportunities.

4. CONCLUSION

The recent banking crisis which was followed by a strong and persistent recession in all developed countries makes it essential to understand international contagion through the globalized banking system. In this paper we analyze two key channels that may have played a crucial role during the recent crisis, i.e., the international market for wholesale liquidity channel and the foreign bank ownership channel.

To identify the potency of either channel, we analyze banks and firms located across Eastern European countries. In these countries banks were not directly affected by the Western banking crisis but there were a substantial proportion of both domestic banks borrowing from internationally wholesale banking markets before the crisis and foreign owned banks that were mainly headquartered in Western Europe.

Crucially for identification, we can access: (1) A bank-level measure of international wholesale liquidity dependency and a comprehensive world-wide bank-ownership dataset to analyze bank-level transmission of the international contagion; (2) A corresponding dataset of bank-firm relationships matched with both bank- and firm- balance-sheet data that can circumvent the typical shortcomings that plague the identification of the bank lending channel (i.e., to convincingly control for borrower fundamentals), and that allow the analysis of both the real effects of credit unavailability and the heterogeneity of this impact across firms.

We find that compared to other domestically-operating banks, the internationally-borrowing and foreign banks (eventually and on average) cut back more on lending, and that the impact is stronger when these banks are funded relatively less with retail deposits. In contrast, when we analyze firm-level effects (controlling for firm fundamentals, i.e., firm demand) we find that only firms borrowing from foreign banks suffer negative real effects on average, that but smaller firms have relatively better real outcomes. Firms borrowing from internationally-borrowing banks do not face worse real effects on average, except for the less capitalized firms.

In sum, the results suggest the presence of an international bank lending channel through foreign ownership, and an interaction between a firm balance-sheet channel and an international bank lending channel through international wholesale liquidity. Our findings have therefore important implications for both theory and policy.

Our paper also highlights the need to study firm-level data. On the one hand our results indicate that despite the contraction in loan growth by internationally-borrowing and foreign banks, the average customers of international-borrowing banks are unaffected in their real performance. On the other hand, the impact on firm performance depend on bank and firm characteristics, suggesting the need for theoretical models to incorporate both bank and firm heterogeneity, and cautioning policymakers from basing interventions on too broad generalizations.

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Table 1

Number of Banks by Bank Type in Sample Countries

Country	Domestic International Banks	Domestic Local Banks	Foreign Banks	Total Number of Banks	*Share in Percent*
Bosnia-Herzegovina	0	5	7	12	*5.8%*
Bulgaria	4	4	7	15	*7.2%*
Croatia	0	16	10	26	*12.5%*
Czech Republic	0	8	9	17	*8.2%*
Estonia	0	2	2	4	*1.9%*
Hungary	1	1	14	16	*7.7%*
Lithuania	2	1	5	8	*3.8%*
Poland	2	8	15	25	*12.0%*
Romania	1	3	12	16	*7.7%*
Serbia and Montenegro	0	12	8	20	*9.6%*
Slovakia	0	0	12	12	*5.8%*
Slovenia	5	5	6	16	*7.7%*
Turkey	9	6	6	21	*10.1%*
Total Number of Banks	24	71	113	208	*100%*
Share, in Percent	*11.5%*	*34.1%*	*54.3%*	*100%*	

Notes: Domestic *International* (*Local*) Banks are banks that (do not) borrow internationally prior to 2008. *Foreign* Banks are majority-owned by foreigners. Only banks with more than two observations during the sample period 2005-2009 are retained in the sample.

Table 2

Number of Firms by Bank Type in Sample Countries

Country	Firms with Domestic International Banks	Firms with Domestic Local Banks	Firms with Foreign Banks	Total Number of Firms	*Share in Percent*
Bosnia-Herzegovina	0	20	8	28	*0.1%*
Bulgaria	46	7	641	694	*1.6%*
Croatia	0	2,023	12,545	14,568	*33.2%*
Czech Republic	0	0	1,585	1,585	*3.6%*
Estonia	0	0	799	799	*1.8%*
Hungary	1,007	23	3,685	4,715	*10.8%*
Lithuania	4	2	66	72	*0.2%*
Poland	1,088	557	6,772	8,417	*19.2%*
Romania	385	1,570	1,726	3,681	*8.4%*
Serbia and Montenegro	0	1,210	166	1,376	*3.1%*
Slovakia	0	4	440	444	*1.0%*
Slovenia	2,543	879	1,391	4,813	*11.0%*
Turkey	191	4	5	200	*0.5%*
Ukraine	1,627	184	644	2,455	*5.6%*
Total Number of Firms	6,891	6,483	30,473	43,847	*100%*
Share, in Percent	*15.7%*	*14.8%*	*69.5%*	*100%*	

Notes: Domestic *International* (*Local*) Banks are banks that (do not) borrow internationally prior to 2008. *Foreign* Banks are majority-owned by foreigners. Only firms that have a connections with banks with more than two observations during the sample period 2005-2009 are retained in the sample.

Table 3

Bank Variables : Definition, Unit, and Descriptive Statistics

Variable	Definition	Unit	Obs.	Mean	Median	St.Dev	Min.	Max.
Loan Growth	the log change in total bank loans	-	1,066	0.25	0.22	0.27	-0.52	1.26
International	= 1 if domestic bank is observed to fund itself on the international capital markets in 2007; =0 otherwise	0/1	1,066	0.17	0.00	0.37	0	1
Foreign	= 1 if bank is majority foreign held in 2007; =0 otherwise	0/1	1,066	0.52	1	0.50	0	1
Size	the log of bank assets	-	1,066	14.17	14.21	1.67	9.99	18.28
Market Share	the percent share of national lending	-	1,066	0.05	0.02	0.07	0.00	0.36
Liquidity	liquid over total assets	-	1,059	0.25	0.22	0.15	-0.05	0.75
Deposits	demand deposits over total liabilities	-	1,039	0.57	0.60	0.21	0.00	0.96
d(Size)	= 1 for banks with Size above the median in 2007; =0 otherwise	0/1	1,064	0.52	1	0.50	0	1
d(Market share)	= 1 for banks with Market Share above the median in 2007; =0 otherwise	0/1	1,066	0.55	1	0.50	0	1
d(Liquidity)	= 1 for banks with Liquidity above the median in 2007; =0 otherwise	0/1	1,060	0.49	0	0.50	0	1
d(Deposits)	= 1 for banks with Deposits above the median in 2007; =0 otherwise	0/1	1,041	0.51	1	0.50	0	1

Table 4

Loan Growth by Bank Type Before and During Crisis Years

Model Independent Variables	(1)	(2)	(3)	(4)
International	0.115**			
	(0.039)			
International * 2008	-0.193***	-0.180***	-0.180***	-0.093*
	(0.000)	(0.005)	(0.005)	(0.085)
International * 2009	-0.214***	-0.188***	-0.190***	-0.132**
	(0.001)	(0.005)	(0.007)	(0.037)
Foreign	0.026			
	(0.327)			
Foreign * 2008	-0.020	-0.026	-0.023	-0.020
	(0.320)	(0.469)	(0.534)	(0.650)
Foreign * 2009	-0.139***	-0.142***	-0.139***	-0.107**
	(0.000)	(0.001)	(0.001)	(0.022)
2008	-0.202**	-0.210**		
	(0.018)	(0.030)		
2009	-0.196**	-0.208**		
	(0.025)	(0.037)		
Constant	0.324***	0.977***	0.768***	0.109
	(0.000)	(0.000)	(0.000)	(0.202)
Bank Fixed Effects	no	yes	yes	yes
Year Fixed Effects	no	no	yes	no
Country * Year Fixed Effects	no	no	no	yes
Number of Observations	1,066	1,066	1,066	1,066
R2	0.265	0.487	0.568	0.682

Notes: The table reports the estimation results of ordinary least squares models. The dependent variable in all models is the yearly loan growth by bank (of which the below 1 percent and above 99 percent are removed). The sample period runs from 2005 to 2009. For each variable in the specification the table reports the estimated coefficient, statistical significance level and p-value (below in parentheses). In all estimations standard errors are double clustered by bank and year. ***, **, * indicate significance at 1%, 5% and 10% level, two-tailed.

Table 5

Loan Growth by Bank Type and by Bank Characteristics Before and During the Second Crisis Year

Model	(1)	(2)	(3)	(4)	(5)
Independent Variables					
International * 2009	-0.049	-0.024	-0.053	-0.024	-0.006
	(0.442)	(0.389)	(0.492)	(0.696)	(0.920)
International * 2009 * d(Size)	-0.028		0.001	-0.023	
	(0.505)		(0.994)	(0.726)	
International * 2009 * d(Market Share)					-0.042
					(0.450)
International * 2009 * d(Liquidity)	-0.124***		-0.182***	-0.190***	-0.178***
	(0.005)		(0.000)	(0.000)	(0.001)
International * 2009 * d(Deposits)	0.098***		0.164***	0.163***	0.143***
	(0.000)		(0.000)	(0.000)	(0.001)
Foreign * 2009	-0.079**	-0.078*	-0.081	-0.070	-0.099**
	(0.012)	(0.071)	(0.134)	(0.325)	(0.033)
Foreign * 2009 * d(Size)		0.031	0.031	0.013	
		(0.416)	(0.608)	(0.821)	
Foreign * 2009 * d(Market Share)					0.050
					(0.359)
Foreign * 2009 * d(Liquidity)		-0.041	-0.092**	-0.066	-0.056
		(0.365)	(0.031)	(0.136)	(0.105)
Foreign * 2009 * d(Deposits)		0.026	0.088*	0.086**	0.079**
		(0.448)	(0.059)	(0.015)	(0.028)
Foreign * 2009 * Vienna Initiative		1.562***	1.569***	-0.457***	-0.455***
		(0.000)	(0.000)	(0.003)	(0.003)
2009 * d(Size)	0.020	-0.010	-0.010	-0.018	
	(0.237)	(0.658)	(0.803)	(0.693)	
2009 * d(Market Share)					-0.022
					(0.522)
2009 * d(Liquidity)	0.069***	0.079***	0.127***	0.110***	0.105***
	(0.000)	(0.005)	(0.000)	(0.007)	(0.005)
2009 * d(Deposits)	-0.023	-0.027	-0.089*	-0.083**	-0.082**
	(0.163)	(0.423)	(0.052)	(0.013)	(0.012)
Size	-0.359***	-0.363***	-0.363***	-0.459***	-0.460***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Liquidity	0.315***	0.328***	0.320***	0.408***	0.401***
	(0.008)	(0.005)	(0.006)	(0.000)	(0.000)
Deposits	-0.192**	-0.190**	-0.195**	-0.197*	-0.195*
	(0.018)	(0.022)	(0.018)	(0.079)	(0.074)
Loan Growth				0.102	0.100
				(0.191)	(0.192)
Constant	4.509***	4.976***	4.993***	7.006***	7.017***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Bank Fixed Effects	yes	yes	yes	yes	yes
Country * Year Fixed Effects	yes	yes	yes	yes	yes
Number of Observations	1,022	1,022	1,022	807	807
R2	0.776	0.775	0.777	0.828	0.828

Notes: The table reports the estimation results of ordinary least squares models. The dependent variable in all models is the yearly loan growth by bank (of which the below 1 percent and above 99 percent are removed). The sample period runs from 2005 to 2009. International and Foreign Bank type are determined in 2007. Bank characteristics are: Size is the logarithm of assets, Liquidity is liquid over total assets, Deposits is demand deposits over total liabilities, and Market Share is the percent share of national lending. All bank characteristics are taken in the previous year. d(.) is a dummy variable which equals one for banks with the indicated characteristic above the median in 2007, and equals zero otherwise. Vienna Initiative equals one if the foreign bank participates in this initiative, and equals zero otherwise. For each variable in the specification the table reports the estimated coefficient, statistical significance level and p-value (below in parentheses). In all estimations standard errors are double clustered by bank and year. ***, **, * indicate significance at 1%, 5% and 10% level, two-tailed.

Table 6

Firm Variables : Definition, Unit, and Descriptive Statistics

Variable	Definition	Unit	Obs.	Mean	Median	St.Dev	Min.	Max.
Growth Operational Revenue	the log change in total assets	-	196,631	0.03	0.04	0.60	-13.94	16.39
Growth Total Assets	the log change in operational revenue	-	200,018	0.09	0.05	0.44	-9.99	11.90
International	= 1 if the firm is connected with an International bank; =0 otherwise	0/1	219,235	0.16	0	0.36	0	1
Foreign	= 1 if the firm is connected with a Foreign bank; =0 otherwise	0/1	219,235	0.69	1	0.46	0	1
Size	log of assets	log	208,752	13.70	13.63	1.95	1.39	20.72
Solvency	assets over equity	%	202,441	42.04	39.80	26.73	0	100
Liquidity	current over total assets	%	201,072	1.68	0.93	3.79	0.00	99.17
d(Size)	= 1 for firms with Size above the 25 percentile in 2007; =0 otherwise	0/1	219,130	0.25	0	0.43	0	1
d(Solvency)	= 1 for firms with Solvency above the 25 percentile in 2007; =0 otherwise	0/1	211,605	0.25	0	0.43	0	1
d(Liquidity)	= 1 for firms with Liquidity above the 25 percentile in 2007; =0 otherwise	0/1	212,305	0.25	0	0.43	0	1

Table 7

Firm Performance by Bank Type Before and During Crisis Years

Model	(1)	(2)	(3)	(4)
Dependent Variable	Operational Revenue Growth		Asset Growth	
Independent Variables				
International	0.010		-0.016	
	(0.682)		(0.586)	
International * 2008	-0.040	0.001	-0.040	-0.004
	(0.380)	(0.939)	(0.386)	(0.659)
International * 2009	0.026	-0.003	0.042	-0.009
	(0.593)	(0.782)	(0.299)	(0.322)
Foreign	-0.016		-0.023	
	(0.442)		(0.401)	
Foreign * 2008	0.005	-0.015	0.008	-0.009
	(0.831)	(0.108)	(0.786)	(0.163)
Foreign * 2009	0.051	-0.023**	0.025	-0.019**
	(0.206)	(0.033)	(0.512)	(0.019)
2008	-0.126***		-0.124***	
	(0.000)		(0.000)	
2009	-0.365***		-0.214***	
	(0.000)		(0.000)	
Constant	0.129***	-0.125***	0.169***	0.033***
	(0.000)	(0.000)	(0.000)	(0.000)
Firm Fixed Effects	no	yes	no	yes
Industry * Year Fixed Effects	no	yes	no	yes
Country * Year Fixed Effects	no	yes	no	yes
Number of Observations	188,320	188,320	192,223	192,223
R2	0.107	0.369	0.070	0.365

Notes: The table reports the estimation results of ordinary least squares models. The dependent variable in Models 1 and 2 is the yearly firm operational revenue growth, in Models 3 and 4 the yearly firm asset growth (of which the below 1 percent and above 99 percent are removed). The sample period runs from 2005 to 2009. For each variable in the specification the table reports the estimated coefficient, statistical significance level and p-value (below in parentheses). In all estimations standard errors are clustered by firm. ***, **, * indicate significance at 1%, 5% and 10% level, two-tailed.

Table 8

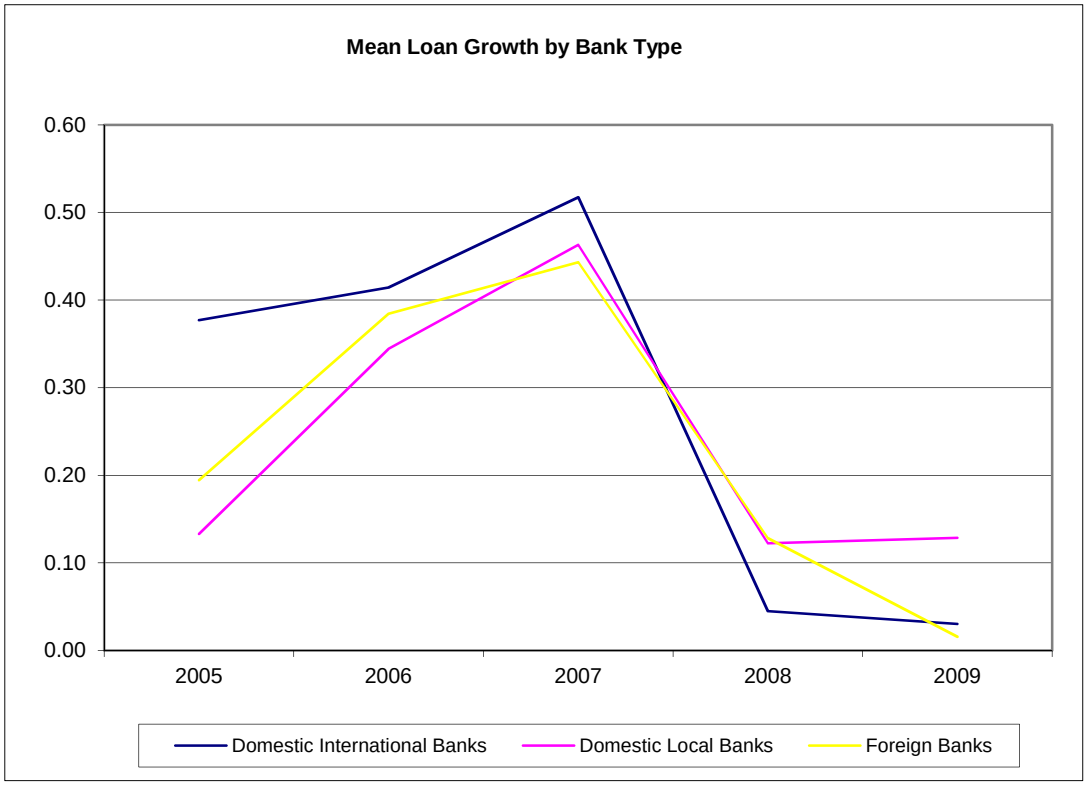
Firm Performance by Bank Type and by Firm Characteristics Before and During the Second Crisis Year

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Dependent Variable	Operational Revenue Growth							Asset Growth						
Independent Variables														
International * 2009	0.004	-0.000	-0.004	-0.013	-0.008	-0.006	0.005	-0.002	0.002	-0.005	-0.015*	-0.010	-0.005	0.004
	(0.733)	(0.976)	(0.767)	(0.232)	(0.482)	(0.600)	(0.722)	(0.797)	(0.847)	(0.590)	(0.060)	(0.195)	(0.556)	(0.723)
International * 2009 * d(Size)	0.067***						0.010	0.053**						0.002
	(0.003)						(0.750)	(0.010)						(0.909)
International * 2009 * d(Solvency)		0.040**					0.059***		0.056***					0.067***
		(0.016)					(0.007)		(0.000)					(0.000)
International * 2009 * d(Liquidity)			0.008				0.025			0.000				-0.001
			(0.672)				(0.310)			(0.975)				(0.954)
Foreign * 2009	-0.016	-0.018*	-0.018*	-0.035***	-0.018*	-0.015	-0.020*	-0.017**	-0.018**	-0.018**	-0.030***	-0.022***	-0.017**	-0.023**
	(0.115)	(0.082)	(0.066)	(0.001)	(0.080)	(0.152)	(0.073)	(0.027)	(0.016)	(0.025)	(0.000)	(0.007)	(0.041)	(0.026)
Foreign * 2009 * d(Size)				-0.076***			-0.064***				-0.052***			-0.044***
				(0.000)			(0.010)				(0.000)			(0.001)
Foreign * 2009 * d(Solvency)					-0.000		0.027					-0.011		0.023
					(0.998)		(0.134)					(0.479)		(0.100)
Foreign * 2009 * d(Liquidity)						0.012	0.021						0.002	0.001
						(0.461)	(0.281)						(0.836)	(0.951)
2009 * d(Size)	-0.036***			0.026*			0.012	-0.041***			0.001			-0.004
	(0.001)			(0.094)			(0.586)	(0.000)			(0.880)			(0.670)
2009 * d(Solvency)		0.065***			0.071***		0.045***		0.039***			0.054***		0.023**
		(0.000)			(0.000)		(0.003)		(0.000)			(0.000)		(0.020)
2009 * d(Liquidity)			0.002			-0.005	-0.030*			0.000			-0.001	-0.009
			(0.866)			(0.682)	(0.068)			(0.949)			(0.904)	(0.380)
Constant	0.003***	0.012***	0.006***	0.007***	0.012***	0.005***	0.020***	0.093***	0.099***	0.096***	0.095***	0.100***	0.096***	0.099***
	(0.424)	(0.001)	(0.073)	(0.039)	(0.000)	(0.134)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Firm Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Country * Year Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Number of Observations	188,227	183,126	184,026	188,227	183,126	184,026	179,779	192,223	186,719	187,168	192,223	186,719	187,168	182,844
R2	0.364	0.365	0.364	0.364	0.365	0.364	0.365	0.363	0.362	0.363	0.363	0.362	0.363	0.363

Notes: The table reports the estimation results of ordinary least squares models. The dependent variable in Models 1 to 7 is the yearly firm operational revenue growth, in Models 8 to 14 the yearly firm asset growth. The sample period runs from 2005 to 2009. International and Foreign Bank type are determined in 2007. Firm characteristics are: Size is the logarithm of assets, Solvency is the assets over equity, and Liquidity is the current over total assets. All firm characteristics are taken in the previous year. d(.) is a dummy variable which equals one for firms with the indicated characteristic above the 25 percentile value in 2007, and equals zero otherwise. For each variable in the specification the table reports the estimated coefficient, statistical significance level and p-value (below in parentheses). In all estimations standard errors are clustered by firm. ***, **, * indicate significance at 1%, 5% and 10% level, two-tailed.

Figure 1

Mean and Median Loan Growth by Bank Type



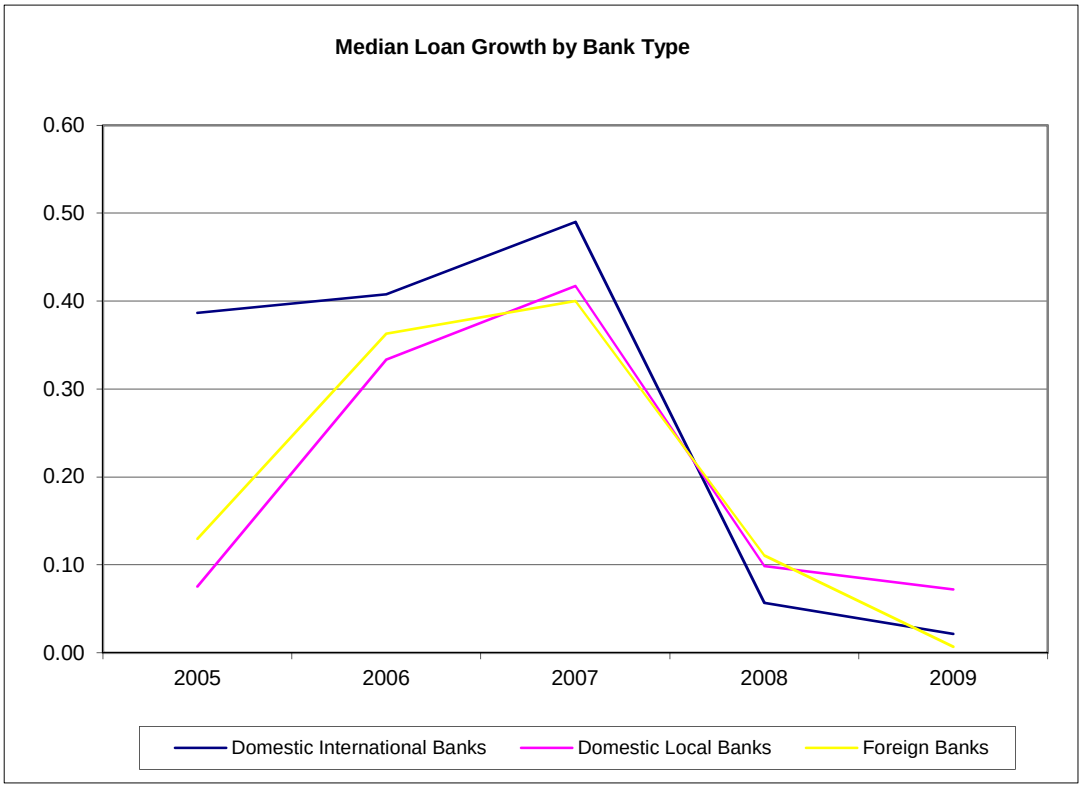


Figure 2

Mean and Median Firm Operational Revenue Growth by Bank Type