International contagion and loan supply after Lehman

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abstract

Following the collapse of Lehman Brothers, local lending to French firms by foreign banks experienced a noticeable decline. We develop a tractable empirical framework based on the methodology proposed by Gan (2007) and Khwaja and Mian (2008) to control for borrower heterogeneity and identify the existence of a loan supply shock. We contribute to the existing literature by evidencing that analysing the intensive margin is not sufficient and by extending the analysis to the extensive margin. The decrease in lending by foreign banks remains significant after controlling for domestic banking factors, state intervention and aggregate demand for loans. It is stronger for banks from areas more affected by the crisis. We also add to the existing literature by illustrating shortly that this decline is not due to higher demand addressed to foreign banks. The conclusion therefore is that the cause of this decline is international financial contagion.

Résumé

Après la faillite de Lehman Brothers, les banques étrangères établies en France ont réduit leurs crédits aux entreprises. Afin de contrôler l'impact de l'hétérogénéité des emprunteurs et d'identifier un effet d'offre de crédit, nous proposons un cadre méthodologique simple basé sur la méthodologie proposée par Gan (2007) and Khwaja and Mian (2008). Nous contribuons à la littérature existante en montrant qu'il n'est pas suffisant d'analyser la marge intensive et en étendant l'analyse à la marge extensive. La baisse des crédits accordés par les banques étrangères reste significative après prise en compte des facteurs bancaires internes, des mesures de soutien public et de la demande globale de crédit. Par rapport à la littérature existante, nous ajoutons une analyse rapide pour montrer que cette baisse ne résulte pas d'une demande supérieure qui serait adressée aux banques étrangères. Cette baisse reflète donc une contagion financière internationale.

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Keywords

Financial crisis, International financial contagion, loan supply, bank-firm relationship, Lehman, Gan, Khwaja, Mian, differences-in-differences, fixed effects, extensive margin, credit register

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1. Introduction

Lending by foreign banks to firms established in France dropped following the collapse of Lehman Brothers on September 15, 2008. Foreign banks reduced lending -more precisely local claims- significantly more than their domestic counterparts, even after controlling for all firm-related effects and loan type, domestic banking factors, state intervention and aggregate loan demand. Since most of the existing literature uses data on cross-border loans, and since local claims are generally considered to have been less affected than cross-border claims during the crisis, this provides a generalization of previous results.

The crisis triggered by the collapse of Lehman Brothers may have affected loan demand and the credit worthiness of firms in host countries. Using data at the bank-firm level, we develop an empirical framework based on the methodology proposed by Gan (2007) and Khwaja and Mian (2008) to eliminate the demand and firm-related effects more effectively.

The decrease in lending by foreign banks was striking after the collapse of Lehman. Still, the majority of lending by foreign banks was to holdings, industry and support to firms; all sectors particularly affected by the crisis. Furthermore, foreign banks had lent relatively more on a short term basis and therefore had more opportunities to refuse to roll over loans. This illustrates the need to control for borrower and loan-type heterogeneity when attempting to identify a bank-related loan supply effect.

The crisis did not only affect banks directly, but the economy as a whole through other channels. Since the problems faced by banks and firms are correlated, it is impossible to infer bank-supply shocks from bank data only. The existing literature proposes an increasingly micro-econometric approach to resolve these issues, which justifies our choice of a micro-econometric approach at the bank-firm level.

The Gan-Khwaja-Mian approach has already been used to analyze international financial contagion through foreign banks' local lending (Schnabl, 2012, Albertazzi and Bottero, 2014). Here, we extend the analysis to the extensive margin. This enables us to eliminate or limit the selection biases caused by the focus on multiple banking firms and on the intensive margin.

More specifically, instead of the delta-log specification traditionally used in cross-section within-firm studies, we use the Davis and Haltiwanger (1992) specification to take into account observations with null values at the origin or the end, and a “quasi-log” specification that enables thus to take into account all observations, even with no changes, for the firms belonging to the econometric sample. Controls are also introduced to eliminate elements not corrected by the firm fixed effect.

Previous studies on international financial shock transmission were first introduced to make plausible assumptions about foreign bank lending supply, which could be considered exogenous with regard to domestic developments (Peek and Rosengren, 1997). This in turn made it possible to identify a domestic bank loan supply shock that was independent of domestic loan demand. This simplifying assumption is no longer relevant in the context of the recent global crisis.

Our approach is therefore, to some extent, symmetrical to that of Peek and Rosengren (1997). The first step required here is to identify a foreign bank's loan supply shock, disentangling it from simultaneous developments in demand, the credit worthiness of firms etc. The second step is to assess the extent to which this shock evidences international financial contagion.

Separate results for the intensive and extensive margins are presented first. The traditional specification on the intensive margin provides significant estimates of a decrease in lending by foreign banks. Therefore our results are not determined by the specific functional forms we use. As regards the extensive margin, foreign banks display more new relationships and more ending relationships. With the traditional approach, it is therefore not possible to draw general conclusion

on whether foreign banks decreased lending. This provides *ex post* support for the encompassing framework that we propose.

Using this encompassing framework, we show that the decrease in local loan supply by foreign banks following the collapse of Lehman is significant and lasting. In particular, our results are not driven by state support measures, or by the specific forms of lending used by foreign banks. We also provide more detailed results broken down by the area of origin of the parent bank. The decrease in lending was particularly strong for U.S. banks and for Euro periphery banks. This is consistent with contagion from banks in home countries hit by financial crises towards lending in the host country, rather than with a generalized flight-home behaviour.

Lastly, we discuss one limitation of the methodology, which eliminates the heterogeneity of individual firms but not the aggregate effect of this heterogeneity when it is correlated to bank characteristics. The demand addressed to foreign banks is likely to be lower than that addressed to domestic banks. Therefore, the econometric results are not driven by aggregate demand issues, that is not corrected by the individual fixed effects.

Thus, we contribute to the existing literature mainly by: (i) confirming existing results by showing that foreign banks decreased intensive margin lending, after controlling for firm fixed effects ; in addition, we show that this decrease was immediate, lasting and probably cumulative over time (ii) showing that two potential selection biases (the reliance on multiple banking firms and the traditional focus on the intensive margin) may affect studies based on the cross-section firm fixed-effect approach, a point apparently unnoticed in the literature (iii) evidencing empirically that foreign banks establish more new relationships during the crisis (iv) proposing consequently a framework encompassing the intensive and extensive margins, and showing that in such a framework foreign banks reduced local claims lending to a major industrial country after the failure of Lehman, although to a lesser extent than when considering only the intensive margin (v) controlling for state interventions (vi) showing that the decrease is stronger for banks from areas seemingly more affected by the crisis (vii) discussing that the cross-section firm fixed-effect methodology controls for individual demand but not for the aggregate demand addressed to specific banks, a point almost unnoticed in the literature (viii) illustrating shortly, however, that foreign banks in France faced lower -not higher- demand than their domestic counterparts, which makes the above results conservatives.

In addition: (a) we introduce in this methodology a series of minor technical improvements such as two-way clustering or the treatment of banking mergers (b) we use total loans, including undrawn credit lines, in addition to the usual drawn loans. Undrawn credit lines may reflect bank lending supply more directly (c) we propose interpretations of the “home bias” as a “parent bank bias”; to the best of our knowledge, these interpretations have not yet been advanced; however we do not benefit from sufficient data to test these interpretations explicitly.

These conclusions could be exploited by domestic and international authorities willing to prevent or remedy a "credit crunch". First, we document the transmission of a shock rather than a generalized flight-home behaviour. Thus, our results do not support limitations of international banking -without even taking into account obvious considerations such as capital allocation efficiency-. Rather, international regulations such as Basle III may help to limit international and domestic transmission of financial shocks in the future. On the other hand, our results provide support for public interventions aimed at ensuring proper access by firms to bank lending. It appears, in particular, that these interventions did not cause the relative decrease in foreign bank lending.

2. Background

The 2007-2008 financial crisis had erupted in the United States before contaminating other countries (IMF, 2009). The literature identifies three channels of international shock transmissions through banks: direct cross-border lending, lending by domestic banks affected by the decline in interbank cross-border lending, or local lending by foreign bank affiliates (Cetorelli and Goldberg, 2011a).

International syndicated loan supply decreased during the recent financial crisis (de Haas and van Horen, 2012, Gianetti and Laeven, 2012, Chui, Domanski, Kugler and Shek, 2010) and so did other forms of cross-border loans (de Haas and van Horen, 2013, Cetorelli and Goldberg, 2011a, Takats, 2010). International financial contagion may also affect domestic banks. During the crisis, banks more extensively exposed to the subprime markets rejected more loan applications (Puri et al. 2011).

Conversely, local lending by subsidiaries used to be more stable than direct cross-border lending during financial crises (Peek and Rosengreen, 2000b, de Haas and van Lelyveld, 2004, McCauley *et al.*, 2010). However, during the current financial crisis, foreign banks have reduced local loan supply (Popov and Udell, 2010, Jimenez et al, 2010, Aiyar, 2011, Cetorelli and Goldberg, 2011a). Conversely, Barba Navaretti et al. (2010) argued that the decrease in the local claims of foreign banks is less marked than the decline in local funding. In specific areas the retrenchment of foreign banks has been somewhat limited because they rely extensively on local funding (Kamil and Rai, 2010).

International banks benefit from improved access to international financial markets as they face less severe informational barriers (Detragiache and Gupta, 2007). They operate as internal capital markets governed by the support and substitution effects. The advocates of a stabilizing role of internal capital markets underline the support effect (the affiliate can rely on funding from the rest of the international banking group) and stresses that, during local financial crises in host countries, the internal capital market of multinational banks enable their subsidiaries to maintain credit supply (de Haas and van Lelyveld, 2010). Conversely, the substitution effect leaves the local affiliate more responsive to shocks on the local return of investments: if returns are higher elsewhere, the internal capital market facilitates the transfer of funds to more profitable projects abroad.

Contrary to earlier local crises, parent banks did not significantly support their subsidiaries during this global crisis (De Haas and van Lelyveld, 2011). During the current financial crisis, German parent banks competed with their affiliates for the use of internal funds (Duwel and Frey 2012). US parent banks increased borrowing from foreign affiliates to make up for a lack of funding availability in domestic repo markets, or other domestic shocks (D'Avino 2012, Cetorelli and Goldberg 2012). Crisis-affected banks increased liquidity transfers through internal capital markets and moved funds from traditional funding locations to other countries with greater importance for the parent bank revenue streams (Cetorelli and Goldberg 2011b). Beyond a mere homothetic reduction in foreign subsidiary lending, Hoggarth *et al.* (2010) and Gianetti and Laeven (2012) document a flight-home effect, *i.e.* an increasing home bias during the current financial crisis.

In the first studies on the international transmission of financial shocks, foreign bank lending supply could be considered exogenous with regard to domestic developments, which made it possible to identify a supply shock independent of domestic loan demand (Peek and Rosengren, 1997). However, in the context of the recent global crisis, this simplifying assumption is no longer relevant. The effects of an international shock (the collapse of Lehman) on lending supply are combined with negative effects on loan demand (through international trade, wealth effects…) and the creditworthiness of borrowers.

Our approach is therefore, to some extent, symmetrical to that of Peek and Rosengren (1997). Peek and Rosengren use the transmission of an international shock to identify a loan supply shock by foreign (Japanese) banks on the domestic (US) market. Here we identify a foreign bank's loan supply shock and disentangle it from simultaneous developments in demand, the credit worthiness of firms, etc. Then we assess the extent to which this shock evidences international financial contagion.

The crisis did not only affect banks, but the economy as a whole through other channels. For instance, Global trade has been affected since the collapse of Lehman (Levchenko, 2010). The literature also evidences a correlation between the problems faced by banks and firms - making it impossible to infer bank-supply shocks from bank data only - and proposes an increasingly micro-econometric approach to resolve these issues.

As pointed out by Udell (2009), disentangling a credit supply shock from simultaneous changes in credit demand is particularly difficult during a financial crisis. For instance, abnormal draw-downs on credit facilities may occur (Udell, 2009, Ivashina and Scharfstein, 2010). The demand for loans during economic downturns is likely to vary across industries (European Central Bank, 2011). Therefore, those banks that lend to industries where the decline in financing is limited are likely to display a lower decline in lending. Concluding that these banks have limited the decline in loan supply would be spurious.

Furthermore, the financial situation of borrowing firms is likely to deteriorate, potentially affecting risk and thus the willingness of banks to lend. More opaque small firms are likely to suffer from a larger lending decline in case of monetary tightening or economic downturn (Gertler and Gilchrist, 1994, Oliner and Rudebusch, 1996). This is likely to bias our results since foreign banks are prone to concentrate lending to larger firms (Berger *et al.*, 2001, de Haas and van Lelyveld, 2004, Mian, 2006).

In fact, the history of the academic literature on financial shocks and their effects on lending and firms may be characterised as a movement from macroeconomic analysis towards increasingly precise, microeconomic data. Indeed, the early empirical literature on the real effects of financial crises analyzes time-series correlations between macroeconomic data (e.g. Bernanke, 1983 and Bernanke and Blinder, 1992). But a simple decomposition by the size of borrower firms may dramatically change the results and their interpretation (*e.g.* Oliner and Rudebusch, 1996).

Using aggregate data prevents one from fully disentangling loan supply from loan demand effects. Specifically for loan supply, this methodology cannot disentangle the effect of bank ability or willingness to lend, on the one hand, from firm credit-worthiness, on the other. For instance, Ashcraft (2005) states that the contraction in bank lending observed by Bernanke (1983) "could reasonably have been caused by a decline in loan demand related to depressed business conditions or prompted by a deflation-induced deterioration in firm credit-worthiness".

In order to correct for correlations between bank and firm characteristics, Ashcraft (2006) uses bank data combined with macroeconomic or state-level data and perceives limited effects of financial constraints affecting banks on the real economy. Jimenez *et al.* (2010) go one step further and conclude that the estimation of banks' loan supply "requires an analysis at the individual loan level of contract information coupled with *both* firm and bank characteristics".

A similar pattern appears for research dedicated more specifically to the effects of foreign financial shocks on bank lending. Peek and Rosengren (1997) analyze the effects of Japanese market shocks and regulatory tightening on the lending of Japanese banks in the US. In their 2000 article, they no longer use overall US data but exploit the variation across geographically distinct US real estate markets in the US. Popov and Udell (2010) combine micro data on both banks and firms. Albertazzi and Marchetti (2010) and Schnabl (2012) eliminate firm-specific heterogeneity through fixed effects.

In addition to the technical considerations, micro data on banks and firms make it possible to improve analysis and policy-making. De Haas and van Horen (2013) argue that *micro data* make it possible to analyze the specific types of bank that reduced lending to specific types of borrowers.

3. Descriptive statistics

While the total number of banks decreased from 2006 to 2012, due to mergers of specialized financial firms or the regional banks of mutually-owned groups[1], the number of foreign banks increased until 2008, as a result of globalization and European integration. The number of firms increased by 25% from 2006 to 2012, due to natural growth and the real value decrease of the declaration threshold (constant in nominal terms). The number of bank-firm relationships increased accordingly. The average number of relationships for each firm remains almost constant over the period, at 1.29[2].

Table 1: banks, firms, and relationships (2006-2012)

	Jan. 06	Jan. 07	Jan. 08	Jan. 09	Jan. 10	Jan. 11	Jan. 12
Banks	674	641	609	573	560	534	518
of which foreign banks	*141*	*151*	*153*	*153*	*151*	*144*	*136*
Firms	1 562 485	1 682 626	1 787 366	1 839 076	1 859 710	1 916 735	1 957 024
Bank-firm relationships	2 018 991	2 176 590	2 310 752	2 383 412	2 404 289	2 471 163	2 522 822

Foreign banks account for only 1/8th of drawn loans, three percentage points below the pre-Lehman level, but their share of undrawn loans is more than a quarter, and even exceeded a third before the crisis (Table 2). Before the collapse of Lehman Brothers, lending by foreign banks was increasing more rapidly than domestic bank lending (Graph 1). Following the collapse, lending by foreign banks fell sharply and did not recover until 2011. At the beginning of 2012, levels were close to those experienced in mid-2007. On the contrary, domestic bank lending decreased slightly more than a year after the collapse and recovered quickly afterwards.

Foreign banks singled out by a higher relative supply of short-term loans (25 % against 20 % for domestic banks), especially factoring in very short maturity - around 60 days -. Short-term loans can be cancelled quickly by banks during crises, as documented by Kaminsky and Reinhart (2000) and Hoggart *et al.* (2010). Consequently, the structure of lending could partially explain the recent decrease in lending by foreign banks.

Table 2: Drawn credits and undrawn credit lines (Jan. 2006-Jan. 2012)

Euros billions	Jan. 06	Jan. 07	Jan. 08	Jan. 09	Jan. 10	Jan. 11	Jan. 12
Loans	763.7	828.2	933.6	988.1	998.4	1033.7	1 067.5
of which foreign banks	116.5	126.1	144.9	156.4	144.9	130.4	131.7
share of foreign banks	15.3%	15.2%	15.5%	15.8%	14.5%	12.6%	12.3%
Drawn credits	585.5	630.5	715.7	786.6	771.5	786.1	826.8
of which foreign banks	52.0	61.4	76.7	94.6	75.8	64.3	65.1
share of foreign banks	8.9%	9.7%	10.7%	12.0%	9.8%	8.2%	7.9%
Undrawn credit lines	178.1	197.7	217.9	201.5	226.9	247.6	240.8
of which foreign banks	64.5	64.7	68.2	61.8	69.1	66.1	66.6
share of foreign banks	36.2%	32.8%	31.3%	30.7%	30.5%	26.7%	27.7%

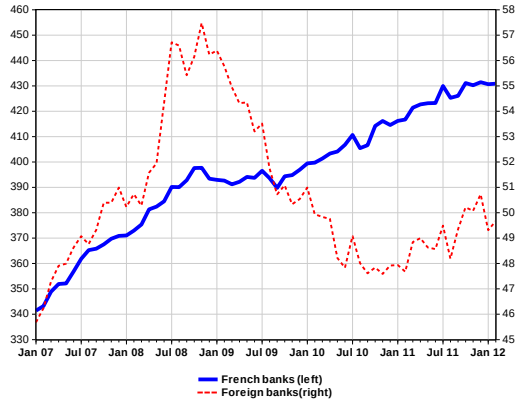
Foreign banks tend to grant loans to large firms while domestic banks are more likely to finance SMEs (Berger et al., 2001 on Argentina, Mian, 2006, on Pakistan). Here, the size structure is analyzed on the basis of six categories of firms. Real estate firms and holdings are considered separately, but it is sensible to assume that holdings are related to large firms.

[1] See Autorité de Contrôle Prudentiel and Commission Bancaire, *Rapports annuels*. The figures used here may differ from these reports, as we consider only those banks reporting loans to the Credit register

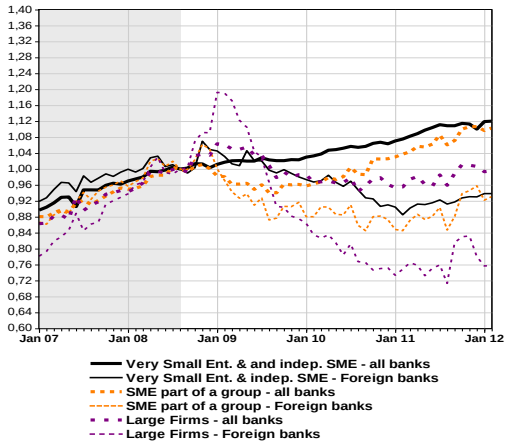
[2] Data sources are detailed in Appendix 1. We use local loans granted by banks established in France and submitted to the 1984 "Loi bancaire". The classification of banks as domestic or foreign depends on the location of the parent bank. For instance, all subsidiaries of BNPP are domestic. Nationality is extracted from the DECEI banking groups database, as of December 2008. By exception, we treat Dexia as domestic. Crisis management by the French authorities evidenced that they have a stake in Dexia, which means *a fortiori* that it is at least partially domestic. In the present section only, we treat banks of the FORTIS group as domestic.

While domestic banks lend similar amounts to large and very small firms, foreign banks lend five times more to the former. Loans to both real estate firms (not reported) and smaller firms rose continually (Graph 2)[3]. Both are size groups to which foreign banks lend relatively little. On the contrary, loans to holdings, not reported here, dropped sharply, potentially affecting foreign banks[4]. In order to focus on effects on the real economy, we exclude holdings from the main estimations.

Graph 1: Loans to firms (€ billions) Excluding holdings, real estate and finance



Graph 2 : Drawn loans - by firms' size (base 100=Aug. 2008) excluding holdings, real estate and finance



However, borrower size structure cannot account for the full decrease in foreign bank lending. Indeed, in each group, lending by foreign banks decreased more (or increased less) following the collapse of Lehman. Large firms are the only exception, until 2009, but afterwards a reversal occurs.

Table 3: Comparative Structure of lending - Drawn credits (Aug. 2008)

by firm size	Domestic banks	Foreign banks	by industry	Domestic banks	Foreign banks
Very small enterprises	18,1 %	3,3 %	Holdings	10,7 %	22,1 %
Independent SMEs	7,0 %	3,2 %	Support to firms	9,4 %	22,8 %
SMEs in a group	7,8 %	5,7 %	Real estate	35,5 %	23,4 %
Large firms	19,9 %	33,0 %	Trade and repair	10,7 %	9,4 %
Holdings	10,0 %	34,4 %	Industry	9,4 %	9,7 %
Real estate	37,2 %	20,4 %	Other firms	24,3 %	12,6 %

When compared to their domestic counterparts, foreign banks concentrated lending on holdings and support to firms. The specific orientation of foreign banks is likely to have affected their lending following Lehman's failure. Sectors in which foreign banks concentrate their lending, are characterized by a substantial drop in lending, while sectors in which they provide little lending, such as real estate, have experienced a persistent increase in drawn loans. However, in most sectors, the loans of foreign banks decrease by more than the average (detail not reported here).

Consequently, a bank-based analysis which would overlook the borrower firm dimension would be likely to overestimate the role of foreign banks' loan supply and therefore international contagion. The Gan (2007) and Khwaja and Mian (2008) methodology makes it possible to avoid such bias.

[3] Data collection on very small enterprises is affected by the 25 000 euros threshold. Therefore data on these firms are aggregated with data on independent SMEs, usually smaller than SMEs belonging to a group.
[4] Ivashina and Scharfstein (2010) show that the drop in US credit affected primarily loans for M&A.

4. Methodology

We present the methodology introduced by Gan (2007) and Khwaja and Mian (2008) in section 4.1. In section 4.2, we analyze the selection biases induced by the focus on multiple banking firms and on the intensive margin. We propose a tractable empirical framework to extend the analysis to the extensive margin. We address other technical issues (banking mergers, outliers, collapsing, two-way clustering…) in section 4.3. We discuss the controls in section 4.4. In section 4.5, we note that the Gan-Khwaja-Mian methodology controls for individual firm effects, but does not control for the aggregate effect of borrowing firms on one bank or a category of banks. This limitation has hardly been touched upon in the literature. We propose a basic approach to check for bias in the results.

4.1 The cross-section within-firm methodology

When analyzing loan supply, it is crucial to disentangle bank-related developments from firm-related issues. In order to disentangle these effects, we use the Credit Register to associate each lender with each borrower. A first methodology (*e.g.* Jimenez *et al.*, 2010) combines bank and firm data to analyze a rich set of effects for both banks and firms. However, as pointed out by Aiyar (2011), observable proxies for loan demand are likely to be contaminated by supply-side effects.

Therefore, we implement another approach, introduced by Gan (2007) and Khwaja and Mian (2008), and introduce firm fixed-effects to eliminate all firm-specific factors. This methodology is derived from panel-data econometrics, which includes a fixed effect for each firm over several years. Here we use a fixed effect for each firm over several banks, instead of several years. In the international banking literature, Schnabl (2012) uses this firm fixed-effects methodology, while Cetorelli and Goldberg (2011a) use a similar approach with country - rather than firm - fixed-effects.

The equation for bank *b* and firm *f* over *q* quarter(s) writes:

$$\text{Eq. 1} \quad \Delta L_{bfq} = \alpha_q . \mathbf{1}(foreign\_bank) + \sum_x \beta_x bank\_cont_x + \sum_p \gamma_p . \mathbf{1}(loan\_type_p) + \mathbf{1}(f) + \varepsilon_{\text{bfq}}$$

where **1**(*foreign_bank*) equals 1 if the bank is a branch or subsidiary of a parent company established abroad, and 0 otherwise. $1(f)$ are the firm fixed effects that characterize the methodology. The controls are discussed in section 4.4. As in Gan (2007), Khwaja and Mian (2008), Albertazzi and Marchetti (2010), Cetorelli and Goldberg (2011), Aiyar (2011, 2012) and Schnabl (2012), the dependent variable captures the changes in lending from before to after the event. We use regressors measured no later than August 2008 to avoid any endogeneity or overlapping issues. It must be highlighted that we do not use a panel but rather a cross-section approach. We estimate each equation 14 times: on one quarter from 2008.08 to 2008.11 (q=1), then on two quarters from 2008.08 to 2009.02 (q=2)… and eventually on 14 quarters from 2008.08 to 2012.02 (q=14). The coefficients are re-estimated over each period, hence the factor "q".

This approach is less ambitious than that of Jimenez *et al.* (no identification of firm-related effects, such as demand for credit), but may identify loan supply by banks more rigorously. Indeed, it does not only eliminate observable balance-sheet factors, but also all unobservable firm-related factors such as management and social relations, competitive environment, technological advances, etc. Firm fixed effects eliminate all biases related to firm size, sector of activity, the financial situation of the borrower and the effects related to international trade (Van Rijckeghem and Weder, 2001), which are likely to pass through specific firms, or to the specific behavior of foreign firms (Peek and Rosengren, 1997). The effects eliminated by the fixed effects include loan demand-related phenomena, but also firm-specific loan supply processes such as information asymmetries.

Heuristically, this methodology does not examine whether lending from bank *b* to firm *f* decreases, but whether this lending decreases more than the lending of other banks to the same firm *f*. Therefore, we use only those firms with at least one domestic bank and one foreign bank.

4.2 Selection biases: null values and multiple banking

Selection bias induced by multiple banking. The Gan-Khawja Mian methodology imposes strong restrictions on the selection of bank-firm observations. Specifically, firms must have multiple banking relationships. The literature implicitly assumes that these multiple banking firms are drawn randomly from the general population.

However, Aleksanyan *et al.* (2010) show that in France, firms that establish multiple banking relationships display *ex ante* specific characteristics, which are related more specifically to access to credit. Specifically, a synthetic measure of access to credit by a firm is a significant explanatory variable for the probability of this firm to establish multiple banking relationships. Therefore we cannot assume that multiple banking firms would be drawn randomly from the general population, as regards access to credit. Instead, we are required to check that the estimates are valid for a subsample of the population, following an approach proposed by Wooldridge.

To the best of our knowledge this issue has not been addressed by the literature yet, but it is clear that the selection of multiple banking firms[5] must be taken into account to assess estimates based on the cross-section fixed-effects methodology.

First though, we must tackle another selection problem which arises due to the methodology's usual specification. Indeed, the usual specification eliminates null values and focuses on the intensive margin. Since this issue has not been examined in the context of the cross-section fixed effects methodology, we present it in more detail. We then propose a specification that extends the sample used for the econometric estimations, and we ensure that it tackles the two selection biases.

Selection bias induced by the focus on the intensive margin. Studies using the cross-section fixed effects methodology usually focus on the intensive margin. They analyze developments of existing bank-firm relationships and exclude relationships with a null value at the origin (*i.e.* before the shock) or at the end of the period examined. For instance, Khwaja and Mian (2008) mainly use bank-firm relationships existing before the shock (the 1998 nuclear test in Pakistan), while Schnabl (2012) eliminates firms with a single banking relationship before the shock (the 1998 Russian crisis)[6].

However, Helpman *et al.* (2008) prove the regression estimates to be biased if null values are deleted. To some extent, this is a special case of the Heckman (1979) selection bias[7].

The seminal papers by Gan (2007) and Khwaja and Mian (2008) address the issue of extensive margin using two different approaches.

Khwaja and Mian measure the effect of a shock on the intensive margin, and complement that with limited dependent variable analyses of the extensive margin. Using this approach, it is possible to draw conclusion when results go unambiguously in the same direction for the intensive margin and for the two sides of the extensive margin ("entries" *i.e.* lending to new clients and "exits", *i.e.* continuing or not lending to existing clients). This is typically the case after the event studied by Khwaja and Mian. Indeed, after the 1998 nuclear tests in Pakistan and the subsequent decision by the authorities to restrict withdrawals of dollar-denominated deposits account, the banks more affected by a decrease in liquidity supply displayed a reduction in lending supply (intensive margin), a

[5] We call "multiple banking firms" the firms with at least one treated (*i.e.* foreign) and one non-treated (*i.e.* domestic) banks; these firms can be included in the sample used to compute the within-firm estimator.

[6] In a slightly different context, Aiyar (2011, 2012), who works at the bank level, omits banks that commenced or ceased operations during the period studied (2008 Q1 to 2009 Q3).

[7] Helpman *et al.* also show that the source of bias is not limited to the usual Heckman selection bias. Their methodology is fitted to their specific context with potential two-way relationships and a specific definition of the intensive and extensive margins, which may explain why, to the best of our knowledge, this methodology has never been used in the bank-firm literature.

reduction in the probability of lending to new clients (extensive margin – "entries") and a reduction in the probability of continuing lending to existing clients (extensive margin – "exits").

However, this approach does not allow a summation of the results to achieve a global quantitative assessment of both the intensive and extensive margins. Therefore, it is difficult, if possible, to draw a general conclusion when results go in opposite direction for the intensive margin and the two sides of the extensive margin. In the present study, we will show in section 5 that foreign banks displayed a reduction in lending after on the intensive margins and on "exits" after the Lehman failure, but were more dynamic for lending to new clients.

Gan implements a two-step Heckman selection model: a probit regression is used to estimate the extensive margin, and the results are integrated in the regression explaining loan growth. This approach is more likely to offer a global overview of the effect on both the intensive and extensive margins. However, Gan adopts a narrow definition of the extensive margin. Indeed she analyses the survival after the shock of pre-existing relationships (*i.e.* she examines "exits"), but does not examine new relationships (or "entries"). We will show in section 5.2 that foreign banks differ from their domestic counterparts as regards exits, but also as regards entries. More specifically, results on entries go in a direction opposite to the intensive margin. Therefore, in our specific case, this approach may not suffice to evidence unambiguously a supply effect.

In order to take into account both exits and entries, we implement very simple adaptations of the Gan-Khwaja-Mian methodology. To explain this choice, we first examine the theoretical effects of deleting null values in a firm fixed-effect framework.

In an earlier draft of thius study, we illustrated the effect of omitting the extensive margin> Specifically, we consider a firm which is always present in the sample with at least one domestic and one foreign bank, to underline that the selection bias induced by the focus on the intensive margin is distinct from the selection bias induced by the focus on multiple banking firms.

Although the *dummy variable* presentation of the fixed effect methodology offers a simpler presentation of the equation (see Equation. 1 above), the alternative *within transform* presentation provides better insight into the consequences of dropping one observation from the sample for a given firm. In the fixed effect approach, prior to the usual OLS regression, data for a given individual (here for a given firm) is demeaned. As pointed out above, lending from bank *b* to firm *f* is not examined directly, but is instead compared to the lending of other banks to the same firm *f*. Therefore, the value taken by each bank-firm observation is affected the omission of another bank-firm observation for the same firm. In this earlier draft, we show that omitting a bank-firm relationship because the relationships ends biases the estimation. Most obviously, this result can be extended to the omission of new relationships.

Specification of the left-hand side variable. In addition to these selection biases, a further reason for analyzing the extensive margin as well as the intensive margin is that we consider lending over three and a half years following the collapse of Lehman in order to assess whether the effect of the shock was a lasting one. This is longer than the one-year horizon used by Schnabl (2012) or the nine-month horizon used by Chodorow-Reich (2014). Over such a long horizon, new bank-firm relationships are more likely to be established than in an analysis over a shorter sample. Similarly, many existing bank-firm relationships are likely to vanish. We check these assumptions empirically in section 5.

We would therefore prefer to include the extensive margin and obtain the largest possible sample. There may be theoretical foundations, such as relationship banking, for a distinction between the intensive and the extensive margins. However, another plausible explanation for a focus on the intensive margin is the definition of the left-hand side variable as $Log(L_{bfq})-Log(L_{bf0})$. This definition is tractable, widely used, and therefore widely accepted. However, it excludes taking into account null values at the origin (i.e. $L_{bf0}=0$) or at the end (i.e. $L_{bfq}=0$).

We therefore propose two new specifications for the left-hand side. The first specification is the quasi-growth rate proposed by Davis and Haltiwanger (1992):

$$\delta L_{bfq} = \frac{L_{bfq} - L_{bf0}}{0.5 * (L_{bfq} + L_{bf0})}.$$

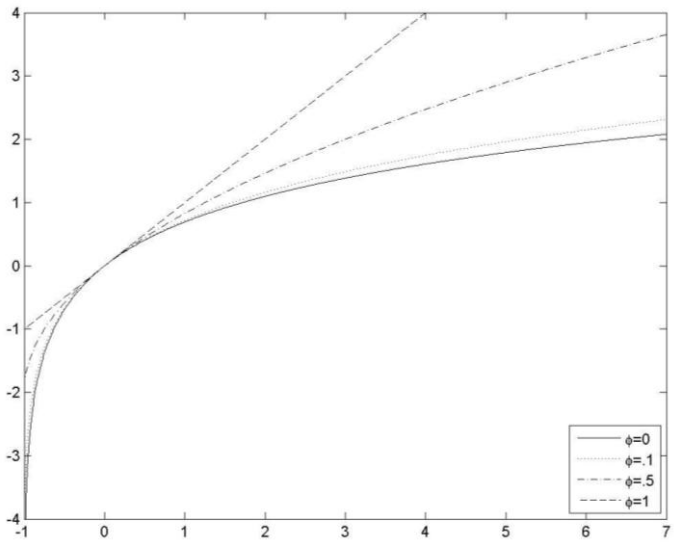
The numerator is the change in lending by bank *b* to firm *f* between period 0 (August 31, 2088) and quarter *q*. The denominator is the average lending by bank *b* to firm *f* over quarters 0 and *q*. This growth rate enables us to integrate the intensive and extensive margins. It is symetric about zero. It is approximately equal to the usual growth rate for small values, and it lies between -2 and +2.

The alternative specification of the left-hand side is derived from the traditional left-hand side:

$$Log(L_{bfq}) - Log(L_{bf0}) = Log(L_{bfq}/L_{bf0})) = Log\ \left(1 + \left(\ (L_{bfq} - L_{bf0})/L_{bf0}\right)\right)$$

In order to include observations with null outstanding lending at the origin (entries), we replace the denominator L_{bf0} with $\sum_b L_{bf0}$, which is total lending by all banks to firm *f*, at date 0 (August 31, 2008)[8]. It may have a strictly positive value even if L_{bf0} is null. With this denominator, we extend the analysis to those firms with at least one banking relationship before the shock, provided they establish another relationship after the shock (with a domestic bank if the first bank was foreign, and conversely). Contrary to Schnabl (2012), we do not require the firm to have multiple banking relationships already before the shock.

Graph 13: Quasi-logarithms transforms



In order to include observations with null outstanding lending at the end (exits), we replace the logarithm by another function $f_\varphi(.)$ with a finite value even if $\frac{(L_{bfq} - L_{bf0})}{\sum_b L_{bf0}} = -1$.

Like the usual logarithm, this transform treats large increases and decreases symmetrically and smoothes right outliers.

$$f_{\varphi}(\delta L_{bfq}) = \frac{1}{\varphi}\left[\left(1 + \delta L_{bfq}\right)^{\varphi} - 1\right]$$

with $\lim_{\varphi \to 1} f_\varphi(x) = x$

$\forall x > -1, \lim_{\varphi \to 0} f_\varphi(x) = \log(1 + x)$

and $f_\varphi(-1) = -\frac{1}{\varphi}$

We fix φ =0.1 : $\Delta L_{bfq} = f_{0.1}(\delta L_{bfq})$.

The Davis and Haltiwanger (DH) specification and the quasi-log specification are very similar to the usual growth rate for small changes. But both specifications differ noticeably for large values. As regards the DH specification, exits induce the value -2 and entries induce the value +2. As regards the

[8] Another option would be to use the firm's total assets as the denominator. We do not however, have data on total assets from smaller firms and specific firm categories. Using total assets would therefore bias the results, since foreign banks may have restricted their lending to a greater extent to small firms (de Haas and van Horen, 2012). More generally, using total assets may narrow the sample, while we need to widen it. Furthermore, total assets are measured as of December 2007 for most firms, while the shock occurs more than eight months later. Comparing lending at date 0 (end August 2008) directly to total assets eight months previously would induce inconsistencies.

quasi-log specification, exits induce the value -10 if the bank was the only one lending to the firm at the beginning, and large increases induce similar values in absolute terms. Consequently, the quasi-log may put more weight on the extensive margin. Also, the quasi-log takes into account bank-firm observations with no credit, neither at the origin nor at the end of a given period, provided the bank extended lending to the firm over another period. Conversely, the quasi-log requires total lending to the firm to be positive at the origin, whereas the DH specification does not.

Both specifications are rather unusual in the bank-firm literature. Therefore, a comparison with more traditional methodologies is required. In section 5.1, we compare these new specifications with the widely used $Log(L_{bfq})$-$Log(L_{bf0})$, which brings similar or more significant results. These comparisons show that these new specifications do not generate significant results artificially.

Effects of the improved specifications. In order to show that the estimates computed on this subsample are relevant for the whole bank-firm relationship population, we would need to prove that the subsample used for the estimation is representative - *i.e.* drawn randomly - from this population. In the present case, this would be rather unlikely. It is clear from section 2 that the lending structure of foreign banks is quite specific and that their customers are not drawn randomly from the general population.

However, following Wooldridge (2002), we propose a model for a subset of the general population. The standard econometric method (or more specifically in the present case, the fixed-effect regression estimator) may be valid under the condition that the sample used for regressions is drawn randomly from this subset of interest.

We wish to assess the effect of the collapse of Lehman Brothers on lending by foreign banks to domestic firms. Consequently, it is valid to restrict the sample to those firms that are likely to borrow from foreign banks. Indeed, those firms that actually borrowed from a foreign bank are not randomly drawn from the general population, as explained above, but they are by definition representative of the subset of firms likely to borrow from a foreign bank, which is our subset of interest. We must therefore examine whether the sample used to estimate the regressions is drawn randomly from the sample of firms that borrow from foreign banks. Unfortunately, the answer may be negative for the same reasons that apply in the case of the general population.

Still, this sample may constitute a subset of interest as defined by Wooldridge (see above). Indeed, 129 out of 140 foreign banks are included in our sample, which covers 100,000 out of the 120,000 firms borrowing from these banks for the total foreign bank lending recorded in the Credit Register (August 2008). This high coverage ratio is due to the fact that multiple banking and relationships with foreign banks are positively correlated, as noted by Alekasanyan *et al.* (2010).

However, surprisingly enough, the coverage ratio only reaches only 42% when considering the amount of lending (€62.6 billion in the econometric sample out of €148.5 billion lent by foreign banks in August 2008). The elimination of financial firms and financial holdings partly explains this low ratio. The elimination of financial firms is justified by the fact that we wish to focus on the effect on the real economy. Furthermore, financial firms are likely to be affiliates of lending banks. When lending included in the econometric sample is compared to lending to non-financial firms and non-financial holdings, the coverage ratio increases to 53%. Therefore, the adaptation we propose makes it possible to use a sample large enough to be considered representative of a subset of interest as defined by Wooldridge (2002).

4.3 Additional methodological issues

Cross-section and panels. The impact of the collapse of Lehman on foreign bank lending may also be analyzed in a panel fixed-effect framework (Albertazzi and Bottero, 2014). However, the structural break makes a panel study unlikely to be more informative than our cross-section approach (Aiyar, 2011, 2012). Furthermore, repeating the cross-section estimation over 14 samples provides

information (unavailable with panels) on the timing of the effects. This information is, in itself, interesting, and will also be used to assess bias in estimates of the impact of public support schemes.

Bank mergers cause not economically significant extreme values. Indeed, if bank B absorbs by bank A, loans from bank A would disappear, inducing abnormally low values, while loans from bank B would increase accordingly, inducing abnormally high values. At best, this may introduce noise and make the identification of parameters more difficult. Furthermore, if one bank is domestic and the other is not, this may bias the estimates of foreign banks' loan supply. Bank mergers seem to have been overlooked in the literature that applies the Gan-Khwaja-Mian methodology. Aiyar (2011, 2012) and Brei *et al.* (2013) use bank level data and implement corrections similar to those used here.

In the Banque de France FIB (Fichier des Implantations Bancaires) database, we identify 115 mergers likely to affect the analysis over the 2008-2012 period. Most mergers (96) are intra-group. These, and most of the others, take place between domestic banks, while 4 mergers take place between foreign banks. For these two categories of mergers, we "anticipate" the merger: we attribute the relationship with the firm to the absorbing bank over the whole period.

Two foreign banks were acquired by domestic banks: Fortis by BNPP in 2009, and Banque d'Orsay (WESTLB AG group) by Oddo in 2011. Conversely, AGF Private banking was acquired by Allianz Bank in 2010. We excluded firms borrowing from these banks, in order to avoid any bias. Since the bulk of the relationships concerned Fortis, which was in trouble over the period, this choice is conservative regarding a potential negative coefficient for foreign banks.

Collapsing and clustering. Most analyses implemented with the Gan-Khwaja-Mian methodology use a mix of clustering (on banks) and data collapsing (on firms), maybe due to the recent availability of software implementing two-way clustering, while many software packages can implement collapsing[9].

Here, regressions are two-way clustered to take into account the correlation between each firm and each bank (see Kloek, 1981, Moulton, 1986 and Angrist and Pischke, 2009, on clustering; Kézdi, 2004, on the validity of clustering for fixed effect estimators; Cameron *et al.*, 2011, for two-way clustering and Schaffer, 2005, for a program to implement fixed effects with two-way clustering). Contrary to the data collapsing procedure, two-way clustering makes it possible to analyze the timing of the effects.

Also, collapsing data prior to the shock may result in computing the LHS with data older than the regressors, especially when pre-shock data is time-averaged over a long period, such as in Gan (2007) and Khwaja and Mian (2008). This may induce the endogeneity of these regressors. Furthermore, collapsing is extremely conservative (Bertrand *et al.* 2004).

Outliers. In the present case, deleting "extreme" values is neither possible nor necessary. Specifically, eliminating left outliers (i.e. strong decreases) is not feasible. Indeed, as the horizon increases, the share of ending relationships increases. Since it is not possible to discriminate between an "abnormal" ending relationship and a normal one, eliminating the lower values would mean eliminating all ending relationships, and would rapidly exceed any plausible amount of winsorizing (see section 5.1). As a matter of fact, left-winsorizing would amount to a large extent to an intensive margin analysis. Consequently, cleaning could be implemented only on noteworthy increases, not on noteworthy decreases, which would be likely to bias the estimation.

It is clear from the above discussions that deleting specific values is likely to bias the estimates. Therefore, winsorizing should be implemented essentially to eliminate errors in data rather than simply to eliminate very high or very low values. In the present case, it is reasonable to assume that

[9] For instance, the STATA command *areg* does not offer two-way clustering. In the present case, we use the *xtivreg2* command programmed by Mark Schaffer (2005).

errors in data are of very limited magnitude. First, data is controlled and revised both by the declaring bank (which can revise its declaration over a one-year period) and by the Banque de France, which disseminates this data to the banking community and may use it to rate firms. This rating is used by banks to grant loans, by the regulator to assess banks' levels of risk, and by the Eurosystem to refinance loans. This data then is rigorously controlled and very high or very low values are likely to be justified as a result. Secondly, the quasi-log transform smooths extreme values, whether they are induced by real developments or by potential remaining errors.

Last but not least, dividing by $\sum_b L_{bf0}$ avoids outliers due to firm size or level of debt (interestingly, Schnabl, 2012 winsorizes the extreme 2% of loan size, meaning that loan size rather than errors induces outliers).

4.4 Controls

The Gan-Khwaja-Mian methodology controls for all firm-specific effects. Still, it is necessary to control for potential explanatory variables that are related either to banks, or simultaneously to banks and firms, such as loan types.

Loan types. Dummies for loan types (each bank-firm relationship can include different types of loans) are included in the equations. Another potential control that relates both to the bank and the firm is the length of the relationship, as of end August 2008. However, since we do not have homogenous data prior to January 2006, this cannot be measured completely. Nevertheless, robustness tests were implemented with a truncated length, and did not alter qualitatively the coefficient of interest.

Domestic banking factors. We control for domestic banking factors. Group-level data on international banking groups may be heterogeneous - and even sometimes unavailable - due to varying accounting and regulatory frameworks. However, these technical issues are not the main reasons for excluding external banking factors and concentrating on domestic banking factors. Our analysis only looks at whether international contagion took place, not why. For instance, the financial weakness of the parent bank may explain a decrease in lending by the subsidiary in France. A control for the capital ratios of international banking groups would be likely to catch this effect, but in the present case this effect, if present, is caught by the "foreign bank" dummy.

Our focus then is on bank ratios at the domestic level. First, the capital ratios of foreign banks established in France may differ from those of their domestic counterparts at the onset of the crisis. We control for the **bank's leverage ratio** rather than for its risk-weighted capital ratio since the latter is proved to be heterogeneously determined (BCBS, 2013) while the former is proved to be a more accurate indicator of bank resilience (Haldane, 2012, Acharya *et al.*, 2013). Brun *et al.* (2013) document that, in France, banks attribute heterogeneous risk weights to firms rated identically by the Banque de France.

We also include the ratio of **provisions on total assets** in the equations. Provisions make it possible to take risks into account, and they are likely to be measured more homogeneously than risk-weighted capital ratios. Indeed, for most banks in the sample, provisions are limited downwards by the regulator and upwards by fiscal authorities. On the other hand, we include the ratio of **non-performing loans on total assets**.

The literature on previous crises also points to more stable lending by local banks which relied to a greater extent on deposits than on financial markets. Therefore, we include the **share of deposits in total liabilities**. Since the risk borne by the bank at the onset of the crisis may also affect lending behavior after the shock, we also include the ratio of provisions for risks in total liabilities. Finally, we also control for return on assets.

Liquidity management is often centralized by foreign parent banks, inducing low levels of liquidity at the domestic level. Contrastingly, the French affiliates of some international banking groups may be responsible for the management of Euro liquidity for the whole group, inducing abnormally high

levels of liquidity. The usual liquidity ratios (such as cash and central bank accounts) observed at the domestic level may actually reflect the international organization of banking groups rather than domestic banking factors. These usual ratios are therefore not included in the equations. Nevertheless, domestic liquidity issues are considered through deposits.

Finally, in order to control for bank performance, we include banks' **return on assets**. We use return on assets rather than return on equity because R^2 is higher with return on assets, however if we were to use return on equity instead, the coefficient of interest is almost unchanged.

For all these bank controls where a merger took place, we use, where relevant, figures from the bank with the larger share before the shock.

The government reacted to the collapse of Lehman and the subsequent liquidity crisis with a series of ***public support schemes to assist banks***. Since these schemes may have been oriented towards domestic banks, they were likely to induce a relative bias against foreign banks' lending. Related concerns were raised by the World Bank (2009), Kamil and Rai (2010), Rose and Wiedalek (2011) and de Haas *et al.* (2012).

CDC/OSEO. Two public banking groups (OSEO and CDC or "Caisse des Dépôts et Consignations") with a mandate to support firms (mainly SMEs) saw their attributions and means of action reinforced at the end of 2008. Since both are domestic banks, this may bias the results. We therefore include two dummies for banks belonging to either banking group.

SFEF. The "Société de Financement de l'Economie Française" or SFEF was established in October 2008 to refinance banks. All main domestic banking groups took a share in the SFEF, and so did, subsequently, the main foreign banking groups as well as smaller domestic and foreign banks. The scheme was open to all banksWe include a dummy for banks participating in this process[10]. The SFEF issued its first bonds during the last quarter of 2008. The last issuance took place in September 2009 and the SFEF terminated its activities in January 2010.

SPPE. After the collapse of Lehman Brothers, the French government also established on October 20, 2008 the "Société de Prise de Participations de l'Etat" (hereinafter referred to as the SPPE) to inject capital into banks with systemic importance. The first injection of funds (€10.5 billion) took place in December 2008. It accounted for around 0.5% of total assets of the banks[11]. With the exception of Dexia, all banks benefiting from SPPE funding had redeemed by the end of the first quarter of 2011.

However, this scheme was not restricted *ex ante* to domestic banks. The European Commission (2008a), underscores that HSBC - the main foreign bank in our sample - was eligible but declined to benefit from it. The use of SPPE funding by a bank is endogenously determined. Indeed, conditions to benefit from the scheme included a commitment to increase lending[12]. Therefore, banks unwilling to increase lending may exclude themselves from the scheme.

$$\text{Eq. 2} \quad \Delta L_{bfq} = \alpha_q . \mathbf{1}(foreign_{bank}) + \sum_p \gamma_p . \mathbf{1}\left(loan_{type_{p0}}\right)$$

$$+\mu_{bq} . \text{cap}_{\text{ratio}_{b0}} + \delta_{bq} . \%_{\text{deposits}_{b0}} + \pi_{bq} \%provisions_{b0} + \rho_{bq} return\_on\_assets_{b0}$$

$$+\boldsymbol{\vartheta_1} . \mathbf{1}(oseo) + \boldsymbol{\vartheta_2} . \mathbf{1}(cdc) + \boldsymbol{\vartheta_3} . \mathbf{1}(dexia) + \boldsymbol{\vartheta_4} . \mathbf{1}(sfef) + \boldsymbol{\vartheta_5} . \mathbf{1}(sppe) + \mathbf{1}(f) + \varepsilon_{\text{bfq}}$$

[10] For the sake of simplicity, we assume that the sample of banks taking part in this process is fixed all over the period, while some banks entered in it only in a second time.

[11] As regards BNPP, this ratio is lower after taking into account the acquisition of FORTIS.

[12] Brei *et al.* (2013) note that such a commitment was specific to French and British recapitalizations schemes.

4.5 Aggregate effects of borrowing firms on banks

We control for individual heterogeneity affecting banks (using controls) and firms (using fixed effects). However, if firm-fixed effects eliminate all the individual heterogeneity of firms, they do not control for the aggregate effects of this heterogeneity. In fact, if confronted with higher aggregate demand, foreign banks with a given level of resources would need to be more selective than domestic banks with similar resources when granting loans to a given borrower, and we would conclude, *mutatis mutandis*, to the existence of a supply shock on foreign banks. This limitation of the cross-section fixed-effect approach is often overlooked in the literature.

Khwaja and Mian (2008) seem to note this point (see their footnote 7), but merely assume that lending to firm *f* "experiences a net [of other firms' demands] liquidity supply shock that is orthogonal to firm [*f*] credit demand". This is probably because this issue is not central to their reasoning, since in the main text they assume that each bank lends to one firm only.

This remains however a strong assumption in the general case. Since the Gan-Khwaja-Mian methodology is used to handle heterogeneity between firms borrowing from different categories of banks, it is likely that aggregate demand to different categories of banks differs. However, we show that in the present case, aggregate demand addressed to foreign banks was lower - not higher - than aggregate demand addressed to domestic banks. Our baseline results are therefore conservative.

5. Separate results on the intensive and extensive margins

In this section, we analyze the intensive and extensive margins separately. For the intensive margin, we show that the model's usual specification would conclude a significant decrease in lending by foreign banks. We also show that the introduction of the quasi-log function provides almost identical results to the more traditional logarithm. We analyze the extensive margin in order to evidence the limitations of an analysis focused on the intensive margin.

We systematically present results for drawn loans, on the one hand, and for all loans, on the other. Drawn loans are outstanding amounts actually borrowed by the firms. They correspond to the definition of lending in the bulk of the literature. They are registered on the bank's balance sheet and may therefore be particularly sensitive to shocks affecting these balance-sheets such as capital or liquidity ratio shocks. All loans include undrawn credit lines in addition to drawn loans. Since undrawn credit lines are not registered in the balance-sheet, they may be less sensitive to the shocks just described. They may however also reflect lending supply by the banks more directly. Undrawn credit lines cannot be considered alone (a decrease may point to a decrease in supply by banks or to draw-downs by firms). Consequently, we consider all loans instead.

5.1 Intensive margin

We examine the intensive margin to compare our specification with the more traditional ones. We then analyze the extensive margin and show that the specific behavior of foreign banks for exits and entries confirms *ex post* the need for our specifications. The focus of this preliminary analysis is on the dynamics of lending. We therefore concentrate the presentation on the dynamics of the coefficient of foreign banks, rather than a static presentation of all coefficients.

We identify the intensive margin by focusing on those firms with at least one foreign and one domestic bank at the origin and at the end of the period examined, and for these firms we eliminate bank-firm relationships that equal zero either at the origin or at the end. The rationale for this choice is that using the Gan-Khwaja-Mian methodology with the usual left-hand side variable $Log(L_{bfq})$-$Log(L_{bf0})$ would impose these restrictions.

The number of observations decreases by more than two thirds for the first quarter, when compared to the encompassing framework sample, while the number of banks decreases from 452 to 399.

Table 4 : Intensive margin – sample size and results for the coefficient on foreign bank dummy

				All loans				Drawn loans			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	firms	banks	observations	$Log(L_{bfq})$- $Log(L_{bf0})$	$(L_{bfq}-L_{bf0})/[.5.(L_{bfq}+L_{bf0})]$	$Log(1+d)$	$f_{\varphi}(d)$	$Log(L_{bfq})$- $Log(L_{bf0})$	$(L_{bfq}-L_{bf0})/[.5.(L_{bfq}+L_{bf0})]$	$Log(1+d)$	$f_{\varphi}(d)$
1	40 113	399	128 471	-0.052***	-0.046***	-0.012***	-0.012***	-0.046***	-0.038***	-0.009***	-0.009***
				(0.010)	(0.009)	(0.003)	(0.003)	(0.011)	(0.009)	(0.003)	(0.003)
2	36 176	395	115 466	-0.063***	-0.057***	-0.021***	-0.021***	-0.052***	-0.045***	-0.017***	-0.017***
				(0.016)	(0.013)	(0.004)	(0.004)	(0.019)	(0.015)	(0.004)	(0.004)
3	33 060	388	105 013	-0.069***	-0.063***	-0.023***	-0.024***	-0.054***	-0.051***	-0.020***	-0.020***
				(0.015)	(0.013)	(0.004)	(0.004)	(0.016)	(0.013)	(0.004)	(0.004)
4	30 516	386	96 415	-0.092***	-0.081***	-0.026***	-0.026***	-0.081***	-0.071***	-0.023***	-0.023***
				(0.019)	(0.017)	(0.004)	(0.004)	(0.022)	(0.017)	(0.005)	(0.005)
5	28 192	381	88 507	-0.105***	-0.091***	-0.027***	-0.027***	-0.105***	-0.087***	-0.028***	-0.028***
				(0.024)	(0.018)	(0.006)	(0.006)	(0.026)	(0.020)	(0.007)	(0.007)
6	25 846	380	80 957	-0.085***	-0.082***	-0.019**	-0.018**	-0.096***	-0.085***	-0.025***	-0.025***
				(0.029)	(0.022)	(0.009)	(0.009)	(0.028)	(0.022)	(0.007)	(0.006)
7	24 075	373	75 117	-0.116***	-0.103***	-0.036***	-0.036***	-0.119***	-0.094***	-0.035***	-0.036***
				(0.028)	(0.023)	(0.008)	(0.008)	(0.033)	(0.026)	(0.008)	(0.008)
8	22 272	371	69 279	-0.098***	-0.087	-0.030***	-0.030***	-0.121***	-0.098***	-0.033***	-0.034***
				(0.031)	(0.024)	(0.009)	(0.009)	(0.035)	(0.027)	(0.009)	(0.009)
9	20 790	367	64 258	0.116***	-0.101***	-0.033***	-0.033***	-0.121***	-0.099***	-0.035***	-0.035***
				(0.031)	(0.026)	(0.009)	(0.009)	(0.037)	(0.029)	(0.009)	(0.009)
10	19 132	361	59 011	-0.131***	-0.106***	-0.035***	-0.035***	-0.169***	-0.121***	-0.042***	-0.042***
				(0.037)	(0.031)	(0.011)	(0.011)	(0.038)	(0.030)	(0.010)	(0.010)
11	18 140	353	55 654	-0.134***	-0.106***	-0.034***	-0.034***	-0.133***	-0.093***	-0.035***	-0.035***
				(0.042)	(0.032)	(0.013)	(0.013)	(0.041)	(0.030)	(0.012)	(0.012)
12	17 141	348	52 201	-0.173***	-0.138***	-0.043***	-0.044***	-0.174***	-0.124***	-0.041***	-0.041***
				(0.042)	(0.033)	(0.013)	(0.013)	(0.040)	(0.031)	(0.012)	(0.012)
13	16 228	345	49 126	-0.129***	-0.106***	-0.039***	-0.038***	-0.132***	-0.098***	-0.038***	-0.038***
				(0.046)	(0.037)	(0.014)	(0.015)	(0.045)	(0.034)	(0.013)	(0.013)
14	15 182	341	45 943	-0.121**	-0.099**	-0.025	-0.026	-0.112**	-0.090**	-0.027*	-0.026*
				(0.051)	(0.043)	(0.017)	(0.017)	(0.049)	(0.040)	(0.015)	(0.015)

Fixed effects on firms.Two-way clustering on firms and banks. Regressors are those presented in section 4.5 (including SPPE).

The drop continues over time. From the first to the last quarter, the number of firms and observations decrease by an additional 60%, while the number of banks decreases from 399 to 341.

The usual *Log(L_{bfq})-Log(L_{bf0})* specifications bring significant results. Therefore our significant results are not induced by methodological choices. Also, the coefficients and standard errors are almost identical for $f_{\varphi}(d)$ and *Log(1+d)* : the quasi-log makes it possible to extend the analysis to the extensive margin but does not modify the analysis on the intensive margin. Although the coefficients remain significant over most sample lengths, the significance is lost for the longest sample with the two last specifications on all loans (columns 6 and 7), probably due to the decrease in sample size.

5.2 Extensive margin

We estimate logit equations on exits and entries respectively. The controls are the same as those included in the intensive margin equations. They include loan types, bank ratios, and bank dummies. We use bootstrap estimations[13]. Following Hall (1986), the number of iterations B is determined so that (B+1)α is equal to an integer (α is the size of the test). Under that condition, the magnitude of the error is $\frac{1}{\sqrt{nB}}$. We fix B=199.

For any period, exit (end of a bank-firm lending relationship) and entry (new bank-firm lending relationship) rates are significantly higher for foreign banks at the 1% level.

The logit equations take into account the number, but not the magnitude, of exits and entries. Therefore, it is difficult to assess the overall effect on the extensive margin, and *a fortiori* the global effect on the intensive and extensive margins. This supports *ex post* our adaptation of the Gan-Khwaja-Mian method to encompass the intensive and extensive margins and the magnitude of exits and entries.

This exit-entry result is also consistent with a structural interpretation. Domestic banks are more likely to establish long-term lending relationships, while foreign banks may prefer transaction-based lending.

Consequently, results on exits and entries empirically confirm our theoretical criticism of the panel approach on the intensive margin formulated in section 4.3. Namely, since foreign banks are characterized by more entries (and exits), a panel analysis that concentrates on the intensive margin is likely to omit the granting of new loans by these foreign banks and only take into account the progressive redemption of these loans. This is likely to bias the estimates of the effects of a shock on foreign bank lending downwards. (That is, upwards in absolute value and significance).

Table 5 : Extensive margin - Coefficients and t-stat for the foreign bank dummy.

	(1)	(2)
	New relationship "entry"	Ending relationship "exit"
1	0.171***	.331***
	(0.060)	(0.060)
2	0.249***	0.287***
	(0.058)	(0.053)
3	0.374***	0.286***
	(0.058)	(0.042)
4	0.333***	0.257***
	(0.057)	(0.042)
5	0.292***	0.226***
	(0.049)	(0.042)
6	0.203***	0.253***
	(0.049)	(0.039)
7	0.270***	0.273***
	(0.049)	(0.036)
8	0.257***	0.289***
	(0.049)	(0.035)
9	0.223***	0.291***
	(0.045)	(0.033)
10	0.213***	0.229***
	(0.047)	(0.039)
11	0.221***	0.358***
	(0.045)	(0.035)
12	0.119**	0.359**
	(0.048)	(0.034)
13	0.162***	0.335***
	(0.046)	(0.037)
14	0.157***	0.371***
	(0.044)	(0.034)

Logit. Exits and entries defined for all loans. Firms fixed effects. Regressors presented in section 4.5 (including SPPE). Bootstrap (199 iterations).

[13] Two-way clustering is not available for logit using usual softwares.

6. Main results: encompassing framework

We present the results using the integrated framework which encompasses the intensive and extensive margins. We run pre-shock placebo tests in section 6.2 and provide additional robustness tests in section 6.3. We examine aggregate demand issues in section 6.4.

6.1 Baseline results

Table 6: Changes in outstanding loans over 14 quarters after the Lehman failure

	All loans		Drawn loans	
	$(L_{bfq} - L_{bf0})/[.5.(L_{bfq}+L_{bf0})]$	$f_{\varphi}(d)$	$(L_{bfq} - L_{bf0})/[.5.(L_{bfq}+L_{bf0})]$	$f_{\varphi}(d)$
	(1)	(2)	(3)	(4)
Foreign bank	-0.137**	-0.142***	-0.103*	-0.123**
	(0.059)	(0.048)	(0.056)	(0.049)
Real estate leasing	-2.106***	-1.106***	-2.179***	-1.173***
	(0.122)	(0.090)	(0.125)	(0.097)
Other leasing	-2.571***	-1.383***	-2.675***	-1.505***
	(0.052)	(0.079)	(0.058)	(0.084)
Long term exports	-0.514	-0.257	-0.688**	-0.324*
	(0.315)	(0.178)	(0.288)	(0.193)
Long term others	-1.616***	-1.291***	-1.791***	-1.427***
	(0.047)	(0. 082)	(0.042)	(0.085)
Overdraft	-0.674***	-0.435***	-0.719***	-0.469***
	(0.048)	(0.044)	(0.047)	(0.047)
Commercial claims	-0.630***	-0.196***	-0.754***	-0.282***
	(0.060)	(0.038)	(0.082)	(0.047)
Factoring	-2.089***	-1.402***	-2.476***	-1.712***
	(0.070)	(0.074)	(0.061)	(0.088)
Other short term	-0.523***	-0.254***	-0.749***	-0.397***
	(0.047)	(0.039)	(0.051)	(0.044)
Undrawn credit lines	-0.430***	-0.226***	0.084**	0.140***
	(0.068)	(0.048)	(0.071)	(0.032)
Guarantees	-0.042	0.124***	-0.041	0.130***
	(0.026)	(0.030)	(0.027)	(0.031)
Bank leverage	-0.182	0.308**	-0.212	0.256*
	(0.260)	(0.150)	(0.241)	(0.142)
Bank Deposits ratio	-0.049	0.034	-0.014	0.055
	(0.059)	(0.045)	(0.054)	(0.043)
Bank provisions ratio	-1.442*	1.476	-1.066**	1.528*
	(0.822)	(1.057)	(0.580)	(0.866)
Bank return on assets	-1.747	-0.517	-1.669	-0.497
	(2.943)	(1.293)	(2.953)	(1.233)
Non-performing loans ratio	1.224	-1.378	1.475	-1.264
	(1.140)	(0.923)	(1.087)	(0.949)
SFEF	-0.140**	-0.115*	-0.101**	-0.111*
	(0.055)	(0.066)	(0.045)	(0.059)
SPPE	0.156***	0.167***	0.117**	0.157***
	(0.060)	(0.046)	(0.058)	(0.049)
R^2	0.5125	0.145	0.5453	0.158
Prob >F	0.0000	0.0000	0.0000	0.0000
Obs	328 746	383 793	318 242	380 402
Firms	95 481	99 935	93 425	98 819
Banks	432	452	428	452
Obs/firm min	2	2	2	2
Obs/firm max	49	62	49	62

Fixed effects on firms. Two-way clustering on firms and banks. Results for individual bank-specific dummies are not reported for confidentiality issues.

Results are provided for the longest period (fourteen quarters) in table 6. The coefficient of the dummy for foreign banks is negative and significant in all specifications. The relative decrease represents between 10 % and 14 % of lending.

However, this decrease is relative to lending by all banks to the given firm in column 2 and 4 (quasi-log specification), whereas it is relative to lending from only one bank to the firm in columns 1 and 3 (Davis and Haltiwanger specification). Since on average in this econometric sample, each firm has between three and four banking relationships, we would expect the coefficient to be three to four times greater in the Davis and Haltiwanger specification. The most likely explanation is that the Davis and Haltiwanger constrains the left-hand side variable to be equal to -2 (respectively +2) for exits (respectively entries) while the quasi-log specification may induce a left-hand side variable equal to -10 for exits, and a similar value in absolute terms for entries.

Table 7: Regressions of changes in outstanding loans from before to after the Lehman failure - coefficients and se for banks headquartered abroad – from 1 to 14 quarters periods

	All loans		Drawn loans	
	$(L_{bfq} - L_{bf0})/[.5.(L_{bfq}+L_{bf0})]$	$f_{\varphi}(d)$	$(L_{bfq} - L_{bf0})/[.5.(L_{bfq}+L_{bf0})]$	$f_{\varphi}(d)$
	(1)	(2)	(3)	(4)
1	-0.093**	-0.025	-0.050	-0.014
	(0.042)	(0.016)	(0.041)	(0.014)
2	-0.84*	-0.035	-0.030	-0.018
	(0.043)	(0.021)	(0.042)	(0.021)
3	-0.085*	-0.037	-0.033	-0.020
	(0.048)	(0.024)	(0.047)	(0.024)
4	-0.089*	-0.070***	-0.035	-0.048*
	(0.050)	(0.027)	(0.047)	(0.028)
5	-0.086*	-0.069**	-0.047	-0.051
	(0.049)	(0.032)	(0.044)	(0.032)
6	-0.103**	-0.089***	-0.061	-0.069**
	(0.049)	(0.033)	(0.046)	(0.033)
7	-0.105**	-0.085**	-0.077	-0.064*
	(0.052)	(0.035)	(0.048)	(0.035)
8	-0.110**	-0.103***	-0.085*	-0.076**
	(0.052)	(0.036)	(0.047)	(0.037)
9	-0.123**	-0.113***	-0.097**	-0.089**
	(0.049)	(0.039)	(0.046)	(0.041)
10	-0.137**	-0.124***	-0.113**	-0.104**
	(0.054)	(0.041)	(0.050)	(0.044)
11	-0.137**	-0.129***	-0.111**	-0.105**
	(0.057)	(0.043)	(0.053)	(0.044)
12	-0.142**	-0.133***	-0.104*	-0.103**
	(0.052)	(0.046)	(0.053)	(0.046)
13	-0.124**	-0.128***	-0.087	-0.102**
	(0.059)	(0.046)	(0.055)	(0.047)
14	-0.137**	-0.142***	-0.103*	-0.123**
	(0.059)	(0.048)	(0.056)	(0.049)

Fixed effects on firms. Two-way clustering on firms and banks. Regressors are those presented in section 4.4.

Most dummies for loan categories are significant. The highest negative coefficie0nt is factoring: the initial duration of such lending is very short (60 days) and banks can call these loans very quickly[14]. The effect of undrawn credit lines is negative in the "all loans" specifications (columns 1 and 2), reflecting the fact that banks called off part of these credit lines after the failure of Lehman. It is positive for the "drawn loans" specifications because of draw-downs by firms during the crisis.

[14] The usual interpretation of the coefficient as a percentage change does not apply for high values since it is based on the first order limited development, valid only for small values.

Guarantees have a positive effect in the quasi-log specification, which is also consistent with intuition. The implementation of guarantees is rare but induces strong increases in lending, which may be taken into account more efficiently with the quasi-log specification.

The bank leverage ratio has a positive and significant effect in the quasi-log specification, while the other bank variables are not significant. Surprisingly, the SFEF dummy displays a negative and significant coefficient, most likely due to endogenous selection of SFEF by banks with liquidity problems. The SPPE effect is positive and significant, as expected.

Table 7 displays the results for all loans (columns 1 and 2) and drawn loans (columns 3 and 4) over the 14 quarters. Only the coefficient and standard errors for the dummy on banks with international headquarters are presented. Over three years, the relative decrease in lending by foreign banks tends to widen, and statistical significance increased accordingly, implying lasting effects.

The Davis and Haltiwanger specification provides higher coefficient in absolute value over the first quarters, while the quasi-log specification provides higher coefficient over the last quarter. These results come from two opposite factors. On the one hand, any given decrease with the quasi-log specification is relative to total bank lending to the firm, whereas the same decrease with the Davis and Haltiwanger specification is relative to the lending of only one bank. Therefore, we expect the coefficient to be higher with the Davis and Haltiwanger specification: this is what we observe over the first quarters. On the other hand, the quasi-log specification put more weights on the extensive margin, which is increasingly predominant as the time sample lengthens. If the extensive margin contributes increasingly to the relative decrease in lending by foreign banks, then logically the quasi-log coefficient is higher in absolute value as the time sample lengthens.

There is a less marked decrease for drawn loans than for total loans. Consequently, this decrease is not significant before one year with the quasi-log specification and two years with the Davis and Haltiwanger specification. A likely explanation in the short-term is that drawn loans may be more sluggish than undrawn credit lines since a bank can withdraw an undrawn credit line, but must wait until maturity to refuse to roll over a drawn credit. Another short-term explanation is that at the very end of 2008 (i.e. during the second quarter, as defined from end August onwards), unusual draw-downs induced a shift from undrawn credit lines towards drawn loans. If foreign banks' lending to any given firm includes a higher proportion of undrawn loans - which is likely given the overall statistics - then foreign banks would be affected to a greater extent, proportionally, by the shift towards drawn loans.

Interestingly enough, the difference between the coefficient of foreign banks for all loans and for drawn loans increases over the first two years. This difference then does not only reflect short-term issues. An alternative explanation is that undrawn credit lines closely reflect the banks' willingness to extend lending, which may be lower for foreign banks in the medium-term, while drawn credit may more directly reflect capital or liquidity shortages, which may have been more severe for foreign banks in the first months of the crisis.

Using two different specifications (Davis and Haltiwanger and quasi-log), we have evidenced the bias induced by the traditional focus on the intensive margin. We have also shown that when taking into account the extensive margin, the decrease in lending supply by foreign banks is always significant for all loans and is significant when the time period is long enough for drawn loans.

The Davis and Haltiwanger specification puts less weight on the extensive margin, which may be considered as a limitation since our results point to the crucial role of this margin. Furthermore, the larger sample is obtained with the quasi-log specification (see Appendix 3). Therefore thie latter specification is more likely to handle the selection biases analyzed in section 4.2. From now on, we focus on this quasi-log specification.

Appendix 2 compares the main estimates (columns 2 and 4) with estimates computed when the SPPE dummy is excluded from the equations (columns 1 and 4). When adding the SPPE dummy, the

significance decreases already over the first quarter. Since the SPPE was not functioning at that time, this cannot be the cause for the loss of significance. The results with the SPPE dummy are therefore likely to underestimate the decrease in loan supply by foreign banks.

In specifications without the SPPE dummy (columns 1 and 3), a foreign bank's loan supply effect is already significant over the first quarter (i.e. from August to November 2008). Once again, capital injections by the SPPE only began in December 2008. This early relative decrease in loan supply by foreign banks then may not be attributed to the SPPE. To put it another way, what took place just after the collapse of Lehman Brothers was really a decrease in foreign bank loan supply, not an increase in lending of allegedly State-supported domestic banks.

Since we control for bank characteristics at the domestic level and for bank-oriented public support schemes, this decrease does not reflect banking issues at the domestic level or State support effects. We therefore conclude that it is due to international financial shock transmission.

6.2 Results by area

In order to better understand the shock transmission, we replace the dummy for banks with international headquarters with five dummies for banks with headquarters in five geographical localities: the United States, the GIIPS countries (Greece, Italy, Ireland, Portugal and Spain), the Euro core countries (eurozone countries excluding GIIPS and France), the non-euro countries (UK, Switzerland, Denmark and the Scandinavian countries) and the rest of the world.

The equation therefore writes:

$$\begin{aligned}\text{Eq. 3}\quad \Delta L_{bfq} &= \alpha_{1q}.\mathbf{1}(american\_bank) + \alpha_{2q}.\mathbf{1}(euro\_periphery\_bank)\\ &+ \alpha_{3q}.\mathbf{1}(euro\_core\_bank) + \alpha_{4q}.\mathbf{1}(other\_european\_bank)\\ &+ \alpha_{5q}.\mathbf{1}(other\_bank) + \sum_{p}\gamma_{p}.\mathbf{1}\left(loan\_type_{p0}\right) + \mu_{bq}.\text{cap\_ratio}_{b0}\\ &+ \delta_{bq}.\%\text{deposits}_{b0} + \pi_{bq}\%provisions_{b0} + \rho_{bq}return\_on\_assets_{b0}\\ &+ \boldsymbol{\vartheta_1}.\mathbf{1}(oseo) + \boldsymbol{\vartheta_2}.\mathbf{1}(cdc) + \boldsymbol{\vartheta_3}.\mathbf{1}(dexia) + \boldsymbol{\vartheta_4}.\mathbf{1}(sfef) + \boldsymbol{\vartheta_5}.\mathbf{1}(sppe) + \mathbf{1}(f)\\ &+ \varepsilon_{bfq}\end{aligned}$$

Since the number of observations is different for banks belonging to different areas, the significance must be compared with caution. The coefficients may be compared more directly, although the difference in coefficients cannot be tested.

The decrease is significant for banks from America, Euro Core, and GIIPS countries, but not for non-euro European banks nor for banks from the rest of the world (Table 8). This is consistent with the fact that the United States and the European Union suffered the greatest impact from the Lehman crisis and subsequent debt crisis, while banks in Asia and emerging economies may have been less directly affected. The decreases in lending by the American and GIIPS countries are similar. The decrease is significant but lower for the Euro core countries. Furthermore, the decrease deepens over the last year, consistent with the worsening of the situation due to the debt crisis.

These results are consistent with the hypothesis that banks affected to a greater extent by the collapse of Lehman Brothers and the subsequent euro crisis may have reduced lending by a proportionate amount. ***Home bias: interpretations and consequences***. Among the potential interpretations of our results, we have already rejected public support and banks' problems at the domestic level. Another interpretation could be that, contrary to previous “local” financial crises where multinational banks benefiting from access to international financial markets could dampen the effects of the crisis, the collapse of Lehman sent a shock through international financial markets, and multinational banks relying on market funding may have been more affected than banks with a local orientation.

Table 8 : results by area of origin of the parent bank

	All loans					Drawn loans				
	US banks	GIIPS banks	Euro core	Non euro	Other banks	US banks	GIIPS banks	Euro core	Non euro	Other banks
1	-0.041**	-0.061**	-0.027	0.004	-0.024	-0.018	-0.059*	-0.014	-0.008	-0.030
	(0.018)	(0.031)	(0.020)	(0.013)	(0.029)	(0.017)	(0.030)	(0.020)	(0.013)	(0.030)
2	-0.065**	-0.101**	-0.074***	0.024	-0.012	-0.030	-0.101**	-0.062**	0.036	-0.020
	(0.026)	(0.042)	(0.029)	(0.019)	(0.048)	(0.026)	(0.042)	(0.030)	(0.021)	(0.045)
3	-0.106***	-0.128**	-0.084**	0.029	0.037	-0.072**	-0.130**	0.069**	0.039	0.043
	(0.031)	(0.050)	(0.034)	(0.022)	(0.049)	(0.032)	(0.052)	(0.034)	(0.024)	(0.048)
4	-0.152***	-0.161***	-0.119***	0.008	0.025	-0.107***	-0.160**	-0.095**	-0.020	-0.040
	(0.036)	(0.064)	(0.038)	(0.026)	(0.056)	(0.038)	(0.065)	(0.038)	(0.028)	(0.055)
5	-0.171***	-0.176**	-0.122***	-0.009	-0.052	-0.132***	-0.164**	-0.094**	0.027	0.069
	(0.041)	(0.072)	(0.043)	(0.030)	(0.067)	(0.042)	(0.074)	(0.042)	(0.030)	(0.063)
6	-0.199***	-0.197***	-0.133***	0.005	0.040	-0.161***	-0.185**	-0.107**	0.025	0.067
	(0.042)	(0.074)	(0.049)	(0.031)	(0.069)	(0.044)	(0.076)	(0.048)	(0.032)	(0.066)
7	-0.199***	-0.191**	-0.132**	0.017	0.083	-0.162***	-0.175**	-0.111**	0.045	0.095
	(0.047)	(0.082)	(0.053)	(0.033)	(0.075)	(0.048)	(0.085)	(0.053)	(0.034)	(0.072)
8	-0.218***	-0.208***	-0.143***	0.013	0.074	-0.172***	-0.192***	-0.118***	0.043	0.098
	(0.050)	(0.084)	(0.056)	(0.035)	(0.079)	(0.050)	(0.086)	(0.055)	(0.036)	(0.080)
9	-0.214***	-0.193***	-0.150***	0.000	0.052	-0.177***	-0.179*	-0.128*	0.030	0.072
	(0.051)	(0.091)	(0.060)	(0.038)	(0.080)	(0.051)	(0.093)	(0.058)	(0.039)	(0.082)
10	-0.243***	-0.207***	-0.152***	-0.007	0.100	-0.204***	-0.200**	-0.135**	0.021	0.107
	(0.055)	(0.097)	(0.063)	(0.043)	(0.091)	(0.055)	(0.098)	(0.061)	(0.045)	(0.092)
11	-0.249***	-0.210***	-0.161***	-0.003	0.097	-0.206***	-0.187*	-0.135**	0.030	0.099
	(0.059)	(0.098)	(0.069)	(0.044)	(0.099)	(0.057)	(0.100)	(0.066)	(0.044)	(0.098)
12	-0.252***	-0.221**	-0.152**	-0.002	0.114	-0.197***	-0.207**	-0.130*	0.029	0.121
	(0.061)	(0.103)	(0.073)	(0.045)	(0.104)	(0.058)	(0.103)	(0.070)	(0.045)	(0.106)
13	-0.240***	-0.213**	-0.137*	-0.002	0.111	-0.189***	-0.202*	-0.111	0.025	0.125
	(0.064)	(0.108)	(0.075)	(0.046)	(0.107)	(0.060)	(0.109)	(0.072)	(0.047)	(0.106)
14	-0.250***	-0.232**	-0.153*	-0.011	-0.078	-0.200***	-0.219*	-0.134*	0.011	0.072
	(0.065)	(0.109)	(0.077)	(0.049)	(0.110)	(0.060)	(0.108)	(0.073)	(0.049)	(0.106)

Fixed effects on firms. Two-way clustering on firms and banks. Regressors are those presented in section 4.4.

However, this interpretation is not consistent with the fact that all the main domestic banks, including cooperative banking groups, benefit from access to international financial markets[15].

Another potential interpretation of our results might be that domestic banks are mainly universal, while many banks whose parent companies are established abroad may be built on a more market-oriented business model and may therefore have been more affected by the crisis. The results may result from the difference in the specific structures of domestic and foreign banks. Testing this hypothesis would require detailed information on the business model and structure of 500 domestic and foreign banks and is outside the scope of the present paper[16].

However, it is possible to take a first look at this hypothesis. First, the collapse of Lehman did impact banks' market financing but – with very few exceptions – it did not bring about bank runs on retail deposits. Universal banks should therefore, be in a better position because of their reliance on retail deposits. We control for the share of these deposits in total assets, at least at the domestic level: they are not significant and do not modify the general results (see Table 4).Furthermore, the decrease in lending from banks whose headquarters are in one of the Euro core countries is similar to that of U.S. banks, and the decrease for banks from GIIPS countries is even greater, while the main banking groups in the Euro core countries and GIIPS are mostly universal banks. These results then do not support the universal banking hypothesis.

SI ON PEUT! We cannot exclude the hypothesis that our results may partly reflect home bias, as documented for instance by Gianetti and Laeven (2012). As a matter of fact, since “home” is defined as the country of the parent company, the “home bias” may be as well a “parent bank bias”.

A first interpretation of a parent bank bias is the “beehive” hypothesis. If a beehive is endangered, the workers sacrifice themselves to save the queen, because only her can give birth to new workers and ensure the long term survival of the hive. The underlying ideas are that all entities within the banking group share the common goal of ensuring the survival of the group as a whole, and the parent company may hold specific assets or skills necessary to “resurrect” the group after a crisis.

Another interpretation could be that the parent bank holds the decision-making authority and may prioritize its own survival. Such an effect could be more marked in banking groups in which the parent bank is itself the main home retail bank. This could also explain why the transmission channel sometimes appears stronger for Eurozone banks than for U.S. banks.

An additional argument in favor of this hypothesis lies in the fact - already mentioned - that the collapse of Lehman affected financial markets but brought about almost no bank runs on retail deposits. Anecdotal evidence suggests that the balance of power in many banking groups has consequently turned from financial markets and international activities to more traditional domestic retail activities. Our results are consistent with this explanation. Investigating its relevance in greater detail is beyond the scope of this paper however, and is left to future research.

Since home bias, or parent bank bias, may also affect domestic banks, we could question whether our results reflect a decrease in foreign bank lending (the spread of the Lehman shock to the French economy) or an increase in domestic bank lending. The coefficients may be too high for a simple decrease in foreign bank lending, and may be explained by a combination of foreign decrease and domestic increase. Furthermore, almost all area coefficients are negative and significant.

[15] This may be a specificity of the French banking system. The 1984 “Loi bancaire” (Banking Act) imposed some centralization of cooperative banking groups at the national level, with two consequences. Therefore in France, even cooperative banks have regular access to international financial markets.

[16] One should note also that the distinction between universal banking and separated banking is not clear-cut. As pointed out by Cetorelli (2013), even US banks may integrate *de facto* (through their subsidiaries) activities that would be integrated more directly in a universal bank.

The Gan-Khwaja-Mian methodology can evidence a bank lending supply shock by eliminating any firm-related effects. However, this methodology is intrinsically comparative as regards banks, a point sometimes underestimated in the literature: here the results show that foreign banks reduced lending *when compared to* domestic banks.

Still, many elements point to a foreign bank lending supply shock hypothesis. Firstly, the growth rate of aggregate lending by domestic banks decreased following the collapse of Lehman, and even turned negative for some time (see Graph 1). Furthermore, the analyses presented in section 3 show that observable firm-related factors such as firm size or sector of activity did not have a major impact on domestic bank lending (see Graphs 5 and 7). Therefore the decrease in lending by domestic banks is likely to reflect a lending supply shock. To summarize: the relative lending supply shock by foreign banks is relative to a distinct negative lending supply shock by domestic banks. Our results therefore point largely to a negative lending supply shock by foreign banks, and not to an increase in lending by domestic banks, at least over the first quarters following the collapse of Lehman.

Also, State support schemes such as the SFEF and the SPPE were the main factors likely to result in a home bias for French banks specifically. The main conclusions hold when these effects are removed, providing an additional argument in favor of the transmission hypothesis to explain our results.

That lending supply decreases differ depending on the geographical origin of the parent bank is also consistent with the hypothesis that external shocks were transmitted to the domestic economy. Had all banks been affected to the same extent in spite of the geographical origin of the parent bank, the likelihood of "domestically-induced" shocks would have been greater.

6.3. Trends and placebo tests

To check that the decrease identified in the main results is not simply the continuation of a previous trend, we implement the basic regression on various pre-shock periods[17]. We use data beginning in January 2006, since homogenous data is not available prior to that date (in January 2006, the credit register collection threshold was lowered to €25,000).

Table 9: Pre-shock regressions (placebos)

	All loans		Drawn loans	
	basics	specific banks	basics	specific banks
Aug. 07 – Aug. 08	-0.025	-0.024	-0.009	-0.009
	(0.021)	(0.021)	(0.021)	(0.021)
Jan. 06 – Aug. 08	0.009	0.008	0.029	0.028
	(0.033)	(0.034)	(0.032)	(0.033)

Fixed effects on firms. Two-way clustering on firms and banks. Regressors are those presented section 4.5 (including SPPE)

We implement a basic regression, without domestic banking regressors. Domestic banking factors are not available at the beginning of the two periods examined here, but comparisons – not presented here – on the main results show that equations without banking regressors are more likely to identify a loan supply effect. Therefore, this approach is conservative. Domestic banking regressors will be added in future drafts.

We also estimate a regression using dummies for the two main public banks in France and Dexia, which were considered to be in trouble before the collapse of Lehman. We do not use dummies for the SFEF or the SPPE since these schemes were not implemented or even envisaged before Lehman.

[17] Homogenous data in the Credit register are available from Jan. 31rd, 2006. Data on banks' balance-sheet are available only as of June 30th, 2008. SFEF and SPPE were implemented after the failure. Consequently, we implement the basic regression and the regression with specific banks (CDC, OSEO and Dexia) only. Results not presented in this draft of the paper show these regressions are more likely to capture a decrease in lending by foreign banks than the equations including bank controls.

Before the failure, banks with international headquarters did not display a significant downward trend when compared to domestic banks (Table 6). A difference is observed for all loans between August 2006 and August 2007 only. Over the whole 2006-2008 period and over the last year preceding the collapse of Lehman, no significant downward trend can be identified.

6.4 Robustness

Table 10: robustness tests - coefficients for foreign banks and standard errors

	All loans			Drawn loans		
	no controls	No Loan type	no credit lines	no controls	No Loan types	no credit lines
1	-0.003	-0.236***	-0.244***	-0.016***	-0.237***	-0.252***
	(0.004)	(0.009)	(0.067)	(0.004)	(0.009)	(0.077)
2	-0.044***	-0.069***	-0.032	-0.040***	-0.064**	-0.022
	(0.004)	(0.026)	(0.022)	(0.005)	(0.028)	(0.022)
3	-0.073***	-0.083***	-0.033	-0.072***	-0.081**	-0.025
	(0.005)	(0.031)	(0.024)	(0.005)	(0.034)	(0.025)
4	-0.116***	-0.127***	-0.068**	-0.115***	-0.121***	-0.054*
	(0.006)	(0.037)	(0.028)	(0.006)	(0.039)	(0.028)
5	-0.133***	-0.131***	-0.066**	-0.130***	-0.131***	-0.058*
	(0.006)	(0.048)	(0.034)	(0.006)	(0.051)	(0.033)
6	-0.162***	-0.161***	-0.087**	-0.158***	-0.160***	-0.076**
	(0.007)	(0.050)	(0.035)	(0.007)	(0.053)	(0.034)
7	-0.183***	-0.158***	-0.083**	-0.184***	-0.157***	-0.072**
	(0.007)	(0.051)	(0.036)	(0.007)	(0.055)	(0.036)
8	-0.200***	-0.181***	-0.101***	-0.201***	-0.114***	-0.084**
	(0.007)	(0.053)	(0.038)	(0.007)	(0.058)	(0.038)
9	-0.217***	-0.194***	-0.111***	-0.217***	-0.193***	-0.098**
	(0.008)	(0.060)	(0.041)	(0.008)	(0.066)	(0.042)
10	-0.229***	-0.213***	-0.122***	-0.232***	-0.217***	-0.114**
	(0.008)	(0.059)	(0.044)	(0.008)	(0.066)	(0.044)
11	-0.240***	-0.220***	-0.127***	-0.243***	-0.221***	-0.115***
	(0.008)	(0.060)	(0.045)	(0.008)	(0.067)	(0.045)
12	-0.247***	-0.228***	-0.130***	-0.249***	-0.222***	-0.113**
	(0.008)	(0.064)	(0.048)	(0.008)	(0.070)	(0.047)
13	-0.241***	-0.226***	-0.126**	-0.242***	-0.224***	-0.112**
	(0.008)	(0.065)	(0.049)	(0.009)	(0.073)	(0.048)
14	-0.236***	-0.244***	-0.140***	-0.237***	-0.252***	-0.134**
	(0.009)	(0.067)	(0.050)	(0.009)	(0.077)	(0.050)
Obs	397 077	383 793	383 793	393 573	380 402	380 402
Firms	103 890	99 935	99 935	102 742	98 819	98 819
Banks	497	452	452	497	452	452

Fixed effects on firms. Clustering on firms in columns 1 and 4. Two-way clustering on firms and banks in the other columns. Regressors not specifically excluded are those presented in section 4.5 (including SPPE).

As a robustness check, we estimate the equations given in section 5.1 without controls (i.e we include no controls and no fixed effects). Results are presented in table 10: the significance tends to increase, which is consistent with our analyses on the effect of firm heterogeneity. We also estimate these equations without credit lines and guarantees, and without loan types: the coefficient of interest remains negative and significant.

Robustness: declaration threshold. Previous results are based on the simplifying assumption that when no information is registered in the credit register, the amount lent by a given bank to a given firm is null.

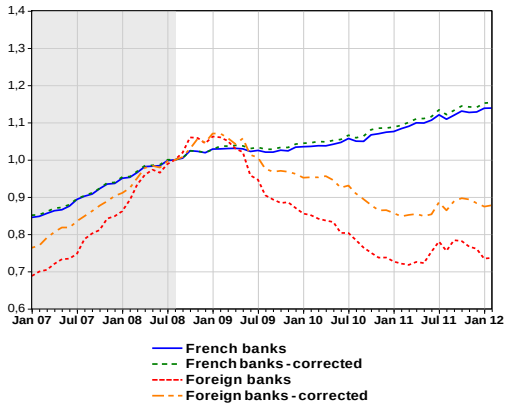
Although this assumption is plausible in many cases, it may not be true systematically. Indeed, the declaration threshold for the credit register in France is €25,000. The outstanding amount then lent then by a bank to a firm can reach €24,999 without being declared in the credit register.

As a robustness test, we take the extreme assumption that when no information is recorded in the credit register, the outstanding amount of lending by a bank to a firm is €24,999. Results are not presented here. The lending supply shock on foreign banks is still significant, except over the first few quarters and, for the all loans specification, for the longest period. The lack of significance for the first few quarters is related to the limited significance with the basic assumption of no lending when no information is recorded. The loss of significance over the longest period for the all loans specification may be related to the fact that over this longest period, results are determined mainly by the extensive margin. With the extreme assumption of €24,999, we may underrate the importance of this extensive margin.

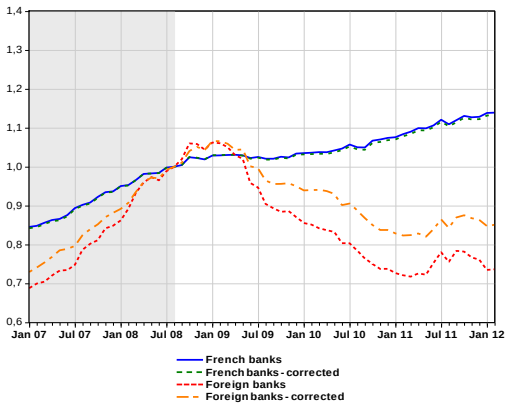
6.5 Aggregate loan demand

This somewhat new approach (first used in a study published in 2007) makes it possible to eliminate all firm-specific individual effects, whether they are demand-related or not (cf. balance-sheet channel) to identify a lender-specific shock. Since domestic explanations are discarded, we conclude, like Schnabl (2012), that this supply shock reflects the contagion of a well identified financial shock (the 1998 Russian crisis for Schnabl, the collapse of Lehman Brothers here). However, if foreign banks face higher aggregate domestic demand, this fixed-effect methodology will conclude, *mutatis mutandis*, a supply shock, as explained in section 4.5.

Graph 6 : Drawn loans
Correction for the industry
(base 100=Aug. 2008) excluding finance



Graph 7 : Drawn loans
Correction for firm size
(base 100=Aug. 2008) excluding finance



In order to evaluate the aggregate effect of borrower industry on foreign banks' lending, we compute re-weighted figures to correct for this variable (Graph 6). Corrected figures are computed with industry-specific growth rates from domestic (respectively foreign banks), weighted with the share of the borrowing industry for loans from all banks. This reduces the decrease in foreign bank lending by about half after two years, mainly due to holdings and real estate (detail not reported). Consequently, the industry structure of foreign banks' borrowers may have decreased rather than increased loan demand addressed to foreign banks, when compared to their domestic counterparts. The effect is similar when we correct for borrowers' size (Graph 7)[18]. Consequently, the main results are not due to general equilibrium issues at the domestic level and reflect international financial contagion.

[18] Size and sector of activity of borrowers may be correlated, especially since real estate and holdings are considered as categories of size. Consequently, the effects of size and sector of activity cannot be added.

7. Concluding remarks

This paper examines whether the financial crisis induced by the failure of Lehman Brothers spread to a major economy through local lending of foreign banks. For that prurpose, we develop a tractable empirical framework based on the approach proposed by Gan (2007) and Khwaja and Miam (2008).

The financial crisis triggered by the collapse of Lehman Brothers spread to a major industrial economy (France) and affected local loan supply to firms in the real economy. These results extend previous findings by Schnabl, 2012 and Albertazzi and Bottero (2014).

We implement the cross-section fixed effects approach introduced by Gan (2007) and Khwaja and Mian (2008) to eliminate the potential influence of firm-specific factors. We therefore eliminate most alternative explanations, such as varying loan demand by different categories of firm, the impact of trade linkages, the firms' balance-sheet channel and for banking issues at the domestic level.

We also control for public support schemes and document that these schemes did not induced the decrease in foreign bank lending. Rather the shock affecting firm financing was exogenous. From a policy point of view, this provides support for public interventions to ensure proper access to credit by firms in times of crisis.

In addition to the traditional domestic *versus* foreign analysis, we present results broken down by the geographical origin of the parent bank. This provides an additional argument in favour of the shock transmission hypothesis. First, an alternative interpretation would be an increase in domestic lending rather than a decrease in foreign lending. An increase in domestic lending would provide significant results for foreign banks from all areas: this is not what the geographic breakdown shows. Second, banks from area most affected by the failure of Lehman (USA and GIIPS countries) display a stronger decrease in lending, which is consistent with shock transmission rather than with a generalized flight-home. From a policy point of view, this supports international regulations such as Basle III to limit international as well as domestic shock transmission.

While the literature may identify a home bias but does not provide an explanation, we present hypotheses that offer explanations for the "parent bank bias" and provide more detailed results that support these possible explanations. One hypothesis is that the survival of the banking group as a whole is prioritized, and this is related to the survival of the parent bank. Another potential explanation is that the balance of power lies with the parent bank, which may also be the retail bank in the home country. Furthermore, the nature of the financial crisis may have reinforced the power of retail domestic activities within banking groups.

The maim innovation in the paper is methodological. We show that the traditional specification of the Gan-Khwaja-Mian methodology may be affected by selection biases related to the focus on multiple banking firms, on the one hand, and on the intensive margin, on the other hand. As regards the focus on multiple banking, we propose in the present paper to widen the sample so that this estimation sample is by itself economically significant.

The second potential bias may not prevent the identification of a supply shock when results go unambiguously in the same direction for the intensive margin and the two sides of the extensive margin (*i.e.* banks establishing relationships with new clients -"entries"- and continuing or not relationships with existing clients –"exits"-). This condition is likely to be met for many bank-specific supply shocks, but not for a shock specific to foreign banks. Indeed, these banks are often characterized by a specific behaviour on the extensive margin, with both more entries and more exits.

In order to eliminate or limit these biases, we develop a tractable empirical model that includes the extensive margin and we confirm analyses by Schnabl (2012) and Albertazzi and Bottero (2014).

We also analyse the extensive margin separately and ascertain that foreign banks are characterized by more exits and entries than domestic banks after the shock. This provides *ex post* support for the

encompassing approach. Although the traditional specification would not handle selection biases properly, results would also be significant with that specification. Therefore our results are not artificially determined by our specific methodological choices.

We correct for bank mergers, which is all the more necessary because we analyze data at the bank-firm level over a relatively long period (3.5 years). We are also likely to improve on some of the previous studies based on the Gan-Khwaja-Mian methodology by implementing two-way clustering at the bank-firm level.

We systematically present results for drawn loans on the one hand, and for all loans on the other. Drawn loans may be particularly sensitive to shocks affecting the banks' balance-sheets such as shocks to capital or liquidity ratios. We also present results for all loans including undrawn credit lines. Undrawn credit lines may reflect bank lending supply more directly.

Furthermore, we introduce a short analysis of aggregate demand, since the fixed-effects methodology can eliminate the effect of individual demand but not the aggregate demand effects, a point that appears to have been overlooked in the recent literature. The aggregate demand addressed to foreign banks may be *ex ante* higher than that addressed to domestic banks. Evrything else equal, foreign banks would then be in a relatively difficult position to extend lending to any given firm. This would induce bias in estimates computed with the cross-section with-firm methodology, a point apparently unnoticed yet. We check with basic computations that the here, the loan demand addressed to foreign banks is likely to be lower – not higher – than the demand to their domestic counterparts. Therefore, the econometric results are not driven by general equilibrium issues.

Many improvements may still be implemented. The correction of selection biases may be improved, *e.g.* by combining the quasi-log specification with a Heckman correction to correct for the possibility that a firm had not a single banking relationship before the shock, in which case it would be excluded from the quasi-log estimation. The quasi-log and the Davis and Haltiwanger specifications could be compared to each other, for instance using simulations. They could also be compared to a two-way Heckman approach to correct for “entries” and “exits”. The basic analysis of aggregate demand in section 6.4 could be refined, maybe using network analysis techniques. Here we keep a simple and tractable approach, which relies on fewer assumptions than the Heckman correction, for instance.

The economic analysis may be further extended to analyze branches *vs.* subsidiaries, or to take into account the economic developments in home countries. These developments are left for future research.

Appendix 1: data sources

The main database used in this study is the **Central Credit Register**. The Credit Register collects data on loans at the bank-firm level, i.e. every bank reports individual information on outstanding loans to every borrowing firm. Each month, lending to almost 2 million firms is reported by more than 500 banks. The number of bank-firm relationships in the database reaches 2.5 million per month.

Data on individual loans is not provided and outstanding amounts are aggregated at the bank-firm level. For instance, if a bank initially grants a long-term loan of €50,000 and later another long-term loan of €25,000 to the same firm, the aggregate outstanding amount (€75,000) is reported. Data on applications is not documented in the Credit Register.

Outstanding amounts are however detailed by loan types. The Credit Register distinguishes between *drawn loans* and *undrawn credit lines*. *Guarantees* are also reported as a specific item. As regards drawn loans, eights categories are detailed:

- *short-term loans* include overdrafts, commercial claims, factoring and other short-term loans,
- *medium- and long-term loans* include export loans and other medium- and long-term loans,
- *leasing* includes real estate leasing and other leasing.

In January 2006, the declaration threshold was lowered to €25,000. The threshold is measured for the sum of all lending to the firm by the declaring bank (e.g. if a bank provides a long-term loan of €20,000 and an overdraft of €6,000, the sum exceeds the declaration threshold).

Firms are identified by their SIREN (French business registration) number. Banks are identified by their *Code Interbancaire* (CIB).

In order to identify banking mergers, we use the Banque de France's ***Fichier des Implantations Bancaires***, and more precisely the *Fichier des situations*. Although this document mainly reports information on the location of bank affiliates, it also provides information on mergers. Banks are identified by their *Code Interbancaire*.

In order to check the robustness of the estimation and the potential impact of any specific characteristics of banks with international headquarters, we use data on banks' balance-sheets as of June 30, 2008. This data is taken from the ***Base des Agents Financiers*** compiled by the *Autorité de Contrôle Prudentiel*. Banks are identified by their *Code Interbancaire*.

Appendix 2: Selected additional results

Table A21.1: Changes in outstanding loans over 14 quarters after the Lehman failure

	All loans		Drawn loans	
	no SPPE	with SPPE	no SPPE	with SPPE
	(1)	(2)	(3)	(4)
Foreign bank	-0.292***	-0.142***	-0.264***	-0.123**
	(0.039)	(0.048)	(0.033)	(0.049)
Real estate leasing	-1.101***	-1.106***	-1.168***	-1.173***
	(0.090)	(0.090)	(0.096)	(0.097)
Other leasing	-1.383***	-1.383***	-1.506***	-1.505***
	(0.079)	(0.079)	(0.084)	(0.084)
Long term exports	-0.253	-0.257	-0.320	-0.324*
	(0.178)	(0.178)	(0.193)	(0.193)
Long term others	-1.288***	-1.291***	-1.425***	-1.427***
	(0.083)	(0. 082)	(0.086)	(0.085)
Overdraft	-0.434***	-0.435***	-0.469***	-0.469***
	(0.045)	(0.044)	(0.046)	(0.047)
Commercial claims	-.194***	-0.196***	-0.280***	-0.282***
	(0.038)	(0.038)	(0.046)	(0.047)
Factoring	-1.399***	-1.402***	-1.710***	-1.712***
	(0.073)	(0.074)	(0.088)	(0.088)
Other short term	-0.251***	-0.254***	-0.395***	-0.397***
	(0.039)	(0.039)	(0.044)	(0.044)
Undrawn credit lines	-0.226***	-0.226***	0.110***	0.140***
	(0.048)	(0.048)	(0.032)	(0.032)
Guarantees	0.123***	0.124***	0.129***	0.130***
	(0.030)	(0.030)	(0.030)	(0.031)
Bank leverage	0.255**	0.308**	0.206	0.256*
	(0.150)	(0.150)	(0.142)	(0.142)
Bank Deposits ratio	0.041	0.034	0.062	0.055
	(0.044)	(0.045)	(0.042)	(0.043)
Bank provisions ratio	1.463	1.476	1.516*	1.528*
	(1.040)	(1.057)	(0.854)	(0.866)
Bank return on assets	-1.310	-0.517	-1.240	-0.497
	(1.535)	(1.293)	(1.519)	(1.233)
Non-performing loans ratio	-1.418	-1.378	-1.301	-1.264
	(0.945)	(0.923)	(0.974)	(0.949)
SFEF	-.099	-0.115*	-0.095*	-0.111*
	(0.061)	(0.066)	(0.055)	(0.059)
SPPE		0.167***		0.157***
		(0.046)		(0.049)
R^2	0.145	0.145	0.158	0.158
Prob >F	0.0000	0.0000	0.0000	0.0000
Obs	383 793	383 793	380 402	380 402
Firms	99 935	99 935	98 819	98 819
Banks	452	452	452	452
Obs/firm min	2	2	2	2
Obs/firm max	62	62	62	62

Fixed effects on firms. Two-way clustering on firms and banks. Results for individual bank-specific dummies are not reported for confidentiality issues.

Table A2.2: Regressions of changes in outstanding loans from before to after the Lehman failure - coefficients and se for banks headquartered abroad

	All loans		Drawn loans	
	no SPPE	with SPPE	no SPPE	with SPPE
	(1)	(2)	(3)	(4)
1	-0.033***	-0.025	-0.017**	-0.014
	(0.009)	(0.016)	(0.007)	(0.014)
2	-0.073***	-0.035	-0.051***	-0.018
	(0.015)	(0.021)	(0.012)	(0.021)
3	-0.100***	-0.037	-0.077***	-0.020
	(0.019)	(0.024)	(0.015)	(0.024)
4	-0.135***	-0.070***	-0.112***	-0.048*
	(0.022)	(0.027)	(0.018)	(0.028)
5	-0.151***	-0.069**	-0.123***	-0.051
	(0.026)	(0.032)	(0.022)	(0.032)
6	-0.178***	-0.089***	-0.148***	-0.069**
	(0.029)	(0.033)	(0.026)	(0.033)
7	-0.194***	-0.085**	-0.166***	-0.064*
	(0.032)	(0.035)	(0.028)	(0.035)
8	-0.215***	-0.103***	-0.188***	-0.076**
	(0.033)	(0.036)	(0.029)	(0.037)
9	-0.232***	-0.113***	-0.204***	-0.089**
	(0.033)	(0.039)	(0.029)	(0.041)
10	-0.253***	-0.124***	-0.230***	-0.104**
	(0.036)	(0.041)	(0.032)	(0.044)
11	-0.271***	-0.129***	-0.245***	-0.105**
	(0.038)	(0.043)	(0.034)	(0.044)
12	-0.284***	-0.133***	-0.254***	-0.103**
	(0.039)	(0.046)	(0.034)	(0.046)
13	-0.284***	-0.128***	-0.257***	-0.102**
	(0.038)	(0.046)	(0.033)	(0.047)
14	-0.292***	-0.142***	-0.264***	-0.123**
	(0.039)	(0.048)	(0.033)	(0.049)

Fixed effects on firms. Two-way clustering on firms and banks. Regressors are those presented in section 4.4.

Appendix 3: Samples size

	Intensive margin			Intensive + extensive margins					
				All loans (Davis - Haltiwanger specification)			Drawn loans (Davis - Haltiwanger specification)		
	firms	banks	observations	firms	banks	observations	firms	banks	observations
1	40 113	399	128 471	67 856	415	218 211	65 653	413	209 302
2	36 176	395	115 466	72 050	421	234 045	69 963	421	224 942
3	33 060	388	105 013	75 082	422	245 687	72 975	420	236 388
4	30 516	386	96 415	77 738	424	255 613	75 571	423	245 975
5	28 192	381	88 507	80 050	429	264 649	77 920	428	254 810
6	25 846	380	80 957	82 250	429	273 455	80 131	427	263 406
7	24 075	373	75 117	84 326	425	282 261	82 172	424	271 825
8	22 272	371	69 279	86 031	428	289 175	83 820	426	278 731
9	20 790	367	64 258	87 882	428	297 000	85 623	425	286 004
10	19 132	361	59 011	89 678	429	304 592	87 393	427	293 252
11	18 140	353	55 654	91 702	431	312 754	89 412	428	301 243
12	17 141	348	52 201	93 063	431	318 050	90 959	428	307 376
13	16 228	345	49 126	94 177	431	323 336	92 068	428	312 698
14	15 182	341	45 943	95 481	432	328 746	93 425	428	318 242
	Quasi-log specification (constant sample)			452	99 935	383 793	452	98 819	380 402

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