International Shock Transmission after the Lehman Brothers Collapse: Evidence from Syndicated Lending[†]

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After Lehman Brothers filed for bankruptcy on September 15, 2008, cross-border bank lending contracted sharply. While lending declined by 58 percent *on average*, the magnitude of the reduction varied considerably between destination countries. Why? Disparities in the adjustment of economic activity and credit demand played a role, but a curtailment of the supply of cross-border lending may have contributed too.

During the crisis, many banks faced substantial shocks to their capital and access to long-term debt. Such balance-sheet constraints may have induced them to deleverage abroad and thus transmit shocks across borders. In this paper, we exploit heterogeneity in international banks' funding constraints to examine whether this was indeed the case and whether shocked banks retrenched from different types of countries and firms compared to nonshocked banks.

To do so we combine detailed data on syndicated lending by 75 banks to 59 countries with three exogenous measures of bank-funding constraints. We find that these bank-specific funding shocks contributed to the curtailment of cross-border credit after the demise of Lehman Brothers. In addition, while shocked banks reduced cross-border credit more, they differentiated between countries in much the same way as less constrained banks. We find, however, that

shocked banks restricted their credit more to small borrowers.

This paper contributes to the small but emerging literature on the transmission of bank-funding shocks across borders.[1] A first strand of this literature studies how funding shocks to parent banks affect the lending of their foreign subsidiaries. In a seminal contribution, Peek and Rosengren (2000) show how the drop in Japanese stock prices in 1990, combined with binding capital requirements, led Japanese bank branches in the United States to reduce credit. Popov and Udell (forthcoming) provide evidence that less capitalized western European banks reduced the credit supply of their eastern European subsidiaries during the early stages of the recent crisis. Cetorelli and Goldberg (2011a) find that US banks with high precrisis exposure to asset-backed commercial paper became more constrained when *off*-balance sheet became *on*-balance sheet commitments. This affected their foreign affiliates through an internal real-location of funds.

A second strand of the literature looks at the impact of funding shocks on cross-border lending. Using bilateral country-level data, Cetorelli and Goldberg (2011b) show that during the recent crisis, banking systems that depended a lot on short-term US dollar funding curtailed cross-border lending more. Using bank-level data, Schnabl (forthcoming) shows how international banks transmitted the shock of the 1998 Russian default by reducing their cross-border lending to banks active in Peru. More generally, Giannetti and Laeven (2012) find that during crisis times, international banks' home bias increases and that this is especially true for banks that rely more on nondeposit fund-

[1] Liquidity shocks can also constrain domestic lending. See Khwaja and Mian (2008) and Ivashina and Scharfstein (2010) for evidence for Pakistan and the United States, respectively.

ing. We contribute to this literature by studying the adjustment in cross-border credit due to shocks to international banks' capital and bond funding. Our comprehensive yet detailed dataset allows us not only to estimate the impact of funding shocks on cross-border lending but also to analyze whether funding-constrained banks retrenched from different types of countries and firms compared to less constrained banks.

I. Data and Methodology

A. *Data*

To develop an identification strategy that isolates the causal impact of funding shocks on cross-border lending, we need data that cover lending to various countries by individual banks (to exploit within-bank variation) and lending by various banks to individual countries (to control for credit demand at the country level). In addition, data should ideally also contain the underlying deals. We use information on syndicated loans that fulfills these requirements.

Syndicates—groups of financial institutions that jointly provide large loans—are a key conduit of cross-border debt finance to both developed and emerging countries. Balance-sheet constraints may have become particularly binding in this market as the secondary market for syndications, which largely depended on structuring collateralized loan obligations, dried up during the crisis.

Our data source is Dealogic Loan Analytics from which we download all syndicated loans to private borrowers worldwide during January 2000–September 2009. We split each loan into the portions provided by the syndicate members and use these portions to reconstruct for each bank the volume and country distribution of its cross-border lending.[2] We focus on the 75 largest banks from high-income countries, which jointly have a share of over 90 percent of the cross-border syndications market. For each bank we calculate lending to individual destination countries in the precrisis period (July 2006–June 2007) and the period after the Lehman Brothers collapse (October 2008–September 2009). We

disregard the period July 2007–September 2008; i.e., the early stage of the crisis.

In addition, we create three bank-level funding-shock measures. First, we use the WDCI (Write Down versus Capital Infusion) function that Bloomberg introduced during the crisis. WDCI includes, inter alia, losses related to subprime mortgages, structured finance products, and credit-defaults swaps. Losses due to regular operating activities are excluded to the extent that they can be separated from investments in subprime assets.

For each bank we calculate the log of crisis-related write-downs during 2007:II–2008:II (*Write-downs*). Write-downs were unexpected, recorded before the Lehman Brothers bankruptcy, and pertained mainly to mortgage and real estate portfolios. We therefore treat *Write-downs* as exogenous to lending to foreign firms after the Lehman Brothers default. We expect that in the presence of minimum capital requirements, large unexpected write-downs limit subsequent lending if these capital requirements are binding (Peek and Rosengren 1995) or expected to become binding (Chami and Cosimano 2010).

Second, we use Thomson Financial to calculate for each bank the (log) amount of long-term bonds (> 1 year) issued *before* the crisis and that matured *after* the Lehman Brothers collapse (2008:III–2009:II). Banks with maturing loans were more constrained compared to similar banks that had rolled over their long-term debt just before the crisis. As banks made decisions about bond issues before the onset of the crisis, the variable *Maturing bonds* is exogenous to the crisis period (see Almeida et al. 2011).

Third, we use Bloomberg to calculate the log change in the ratio between the market and book value of each bank's equity during July 2007–September 2008. This change influenced the prospective costs and ease of raising new equity. We therefore use Δ*Market-to-book* as a third proxy for funding constraints after Lehman Brothers' downfall.

B. *Methodology*

We compare, in a cross-sectional setting, each bank's lending volume in the year after the Lehman Brothers collapse to its lending in the year before the crisis. Our first dependent variable is *Sudden stop*, a dummy variable that is 1 for each bank-country pair where a bank

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[2] See De Haas and Van Horen (2011) for more information about data construction.

completely stopped lending during the crisis (but where it was active before). The second—*Volume*—is the log difference of (1 plus) the amount of cross-border lending by a bank to a country between the post-Lehman Brothers and the precrisis period.

We then test whether these changes in the supply of cross-border lending can be explained by the exogenous shocks *Write-downs*, *Maturing bonds*, and *ΔMarket-to-book*.[3] We use country-fixed effects to control for changes in credit demand at the country level and therefore focus on differences *across* banks *within* a destination country. This approach is based on Khwaja and Mian (2008), who control for credit demand through firm-fixed effects in firm-level regressions. We also control for the following precrisis bank characteristics (based on BankScope data): size, solvency, wholesale funding, profitability, and loan quality.

To control for the fact that during a crisis banks are more likely to continue lending to a country that is "close" (De Haas and Van Horen 2011), we also include three bilateral closeness variables. First, the geographical *Distance* between a bank's headquarters and destination country. Second, *Experience*, which equals the number of syndicated loans that a bank provided to a country since 2000 and that had matured before the crisis. Third, *Domestic lenders*, measured as the proportion of domestic banks in a country with whom the bank had cooperated before the crisis.

Our cross-sectional baseline specification is

$$(1) \quad \Delta L_{ij} = \beta_1 \cdot F_i + \lambda' \cdot X_i + \gamma' \cdot C_{ij}$$

$$+ \varphi_j + \eta_{ij},$$

where ΔL_{ij} is *Sudden stop* or *Volume* and subscripts i and j denote banks and destination countries, respectively; β_1 is a coefficient; λ' and γ' are coefficient vectors; F_i is a funding-shock variable; X_i is a matrix of bank-level controls; C_{ij} is a matrix of closeness variables; φ_j is a vector of country-fixed effect coefficients; and η_{ij} is the error term.

We also estimate *firm-level* regressions on a sample of firms that before the crisis borrowed

from at least two banks in our dataset and that borrowed at least once during the crisis. The dependent variable is *Drop-out probability*, the probability that bank i—a precrisis creditor of firm k—decided not to participate in a syndicated loan to firm k during the crisis. We now include firm fixed effects to more precisely control for credit demand.

We use ordinary least squares (OLS) for *Volume* regressions and a linear-probability model for the *Sudden stop* and *Drop-out probability* regressions. Standard errors are heteroskedasticity-robust and clustered by bank. Results are robust to clustering at the country level.

II. Results

Table 1 provides baseline regression results. We find that funding shocks had a negative impact on the supply of cross-border lending during the crisis. Columns 1–3 show how international banks with higher subprime losses, more maturing bonds, and sharper declines in their market-to-book ratio were more likely to fully cut credit to a country (compared to less constrained but otherwise similar banks lending to the same country). Columns 4–6 show that funding-constrained banks also reduced their overall credit supply faster than less constrained banks.

The economic magnitude of these supply-side effects is substantial. For example, a one standard deviation increase in write-downs or maturing bonds increases the probability of a full lending stop with 3.8 and 4.5 percentage points, respectively (compared to a mean probability of 42 percent). Likewise, a one standard deviation decline in the market-to-book ratio leads to an increase in the probability of a sudden stop of 3.7 percentage points.

The results for the (unreported) control variables show that larger and more solvent banks were in a better position to keep lending. Moreover, banks reduced their lending less to nearby borrowers and to countries where they had more precrisis experience and where they had cooperated more with domestic banks (cf. De Haas and Van Horen 2011).

Table 2 shows regression estimates to assess whether banks that faced more severe funding constraints not only withdrew *more* from abroad but also withdrew *from different types of countries* compared to less constrained banks. We

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[3] The three funding measures are not highly correlated with pair-wise correlation coefficients of 0.3 or less.

Table 1—Bank Funding Shocks and International Crisis Transmission

	Sudden stop			Volume		
	(1)	(2)	(3)	(4)	(5)	(6)
Write-downs	0.006**			−0.049***		
	(0.050)			(0.001)		
Maturing bonds		0.016***			−0.084***	
		(0.006)			(0.009)	
Δ market-to-book			−0.144**			0.880**
			(0.041)			(0.023)
Precrisis bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Bilateral closeness controls	Yes	Yes	Yes	Yes	Yes	Yes
Destination country FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,338	1,260	1,130	1,315	1,238	1,112
R^2	0.38	0.39	0.38	0.30	0.30	0.31

Notes: This table shows estimates to explain the decline in cross-border lending from bank i to destination country j after the Lehman Brothers default. *Sudden stop* is a dummy that is 1 if bank i stopped lending to country j after the default. *Volume* is the log change in 1 plus the amount of cross-border lending by bank i to country j in the post–Lehman Brothers period compared to the precrisis period. *Write-downs* is the log of total crisis-related write-downs by bank i during 2007:II–2008:II. *Maturing bonds* is the log of the amount of long-term bonds (> 1 year maturity) issued by bank i before the crisis that matured during 2008:III–2009:II. Δ*market-to-book* is the log change in the market-to-book ratio of bank j during July 2007–September 2008. We use a (linear probability) OLS model and an OLS model for the *Sudden stop* and *Volume* regressions. Standard errors are heteroskedasticity robust and clustered by bank. Robust p-values appear in parentheses.

***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

expect that constrained banks in particular may have "fled to quality" to reduce unsafe lending, for instance by mainly curtailing credit to countries with risky macroeconomic or institutional environments.

To analyze the relationship between funding shocks and destination-country characteristics, we continue to include country fixed effects while sequentially interacting *Write-downs* with various proxies for institutional and macroeconomic country risk (see Table 2 for variable definitions and sources). The dependent variable is *Volume*.

We find that while funding-constrained banks reduced cross-border credit more—see the first line—the interaction terms indicate that they did so in much the same way as less-constrained banks. Interestingly, however, we find that funding-constrained banks are particularly sensitive to their prior lending experience in a country. Such precrisis lending experience partially shields countries from the negative impact of shocks to their creditors.

Lastly, Table 3 presents firm-level regressions to investigate whether funding-constrained banks not only withdrew from the same type

of countries but also from the same type of borrowers (compared to less affected banks). In line with a flight to quality, we expect that funding-constrained banks rationed credit more to smaller, less transparent borrowers.

The odd columns confirm our earlier result that constrained banks reduce lending more. All else equal, constrained banks display a higher probability of dropping out of a syndicate, although the coefficients are imprecisely estimated for *Write-downs* and Δ*Market-to-book*. Reassuringly, the size of the coefficients for these *firm-level* "sudden stop" effects corresponds closely to the coefficients in the *country level* regressions (as reported in columns 1–3 of Table 1).

In the even columns, we interact the funding shock with a dummy variable *Large firm* that is 1 for firms of above-median size (proxied by the total amount of syndicated borrowing between January 2000 and July 2007). We find that compared to less-constrained banks, constrained banks reduced their lending more to relatively small borrowers. The disparity between the supply-side effects on small versus large borrowers is considerable. For large firms, the probability that a bank with high

TABLE 2—INTERNATIONAL CRISIS TRANSMISSION AND DESTINATION-COUNTRY CHARACTERISTICS

	Volume						
	Experience (1)	Legal difference (2)	Emerging market (3)	Weak institutions (4)	Weak contract enforcement (5)	Large current account deficit (6)	FX reserves to GDP (7)
Write-downs	−0.078***	−0.054***	−0.047***	−0.045***	−0.048***	−0.044***	−0.048***
	(0.000)	(0.004)	(0.003)	(0.004)	(0.005)	(0.003)	(0.004)
Write-downs × X	0.011**	0.011	−0.004	−0.009	−0.003	−0.025	−0.005
	(0.029)	(0.577)	(0.790)	(0.597)	(0.876)	(0.137)	(0.926)
Precrisis bank controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bilateral closeness controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Destination country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,315	1,315	1,315	1,315	1,315	1,315	1,315
R^2	0.30	0.31	0.30	0.30	0.30	0.30	0.30

Notes: This table shows estimates to explain the decline in cross-border lending from bank i to destination country j after the Lehman Brothers default. The dependent variable is *Volume. Experience* is the number of loans provided by bank i to country j since 2000 that had matured by July 2006. *Legal difference* is a dummy variable that is 1 if the legal origin of the bankruptcy law in the home country of bank i is different from the legal origin in destination country j (La Porta et al. 1998). *Emerging market* is a dummy that is 1 if the destination country is not a high-income OECD country. *Weak institutions* is a dummy that is 1 if the quality of governance in destination country j is weaker than in the median country (Kaufmann, Kraay, and Mastruzzi 2010). *Weak contract enforcement* is a dummy that is 1 if the costs of using the judicial or administrative system in country j to collect overdue debt is above the median cost level (Doing Business database). *Large current account deficit* is a dummy that is 1 if the destination country's current account showed a deficit of more than 6 percent of GDP in 2007 (IMF). *FX reserves to GDP* measures official FX reserves as a percentage of GDP in 2007 (IMF). We use an OLS model with heteroskedasticity robust standard errors clustered by bank. Robust *p*-values appear in parentheses.

   ***Significant at the 1 percent level.
   **Significant at the 5 percent level.
   *Significant at the 10 percent level.

subprime write-downs did not reengage with a firm was only 29 percent of the probability that the bank would stop lending to a small firm. These numbers are 42 and 18 percent in case of shocks from maturing bonds or reduced market-to-book ratios, respectively.

III. Discussion

In the wake of the Great Recession, the virtues and vices of financial globalization—and of cross-border banking in particular—are being reevaluated. On the one hand, international banks may reduce macroeconomic volatility in recipient countries if the size, strength, and diversified nature of their balance sheets make them relatively stable sources of credit in the case of local shocks. On the other hand, as the 2007–09 crisis has shown, the financial strength of international banks can quickly dwindle if they assume large and concentrated risks in a few highly correlated markets. This may impede their role as stable providers of cross-border credit and can cause financial crises to spread across borders, potentially exacerbating output declines in destination countries.

This paper shows that international banks that had to write down subprime assets, refinance large amounts of long-term debt in an illiquid market, and experienced sharp declines in their market-to-book ratio, transmitted these shocks across borders by reducing their cross-border lending. Moreover, at the firm level we find that these shocked banks restricted their lending especially to small borrowers.

Our results do not bode well for firms, such as in many countries in emerging Europe, that depend on cross-border lending from Western European banking groups. The 2007–09 crisis merged almost seamlessly into the 2010–12 Eurozone crisis and the transmission mechanisms highlighted in this paper appear to be at the core of the current crisis too. Large and unexpected write-downs now stem from exposures to sovereign risk in the eurozone periphery. In addition, banks are once more experiencing difficulties in rolling over maturing bonds. Our findings suggest that both types of balance-sheet shocks will translate into substantial reductions in cross-border lending, hurting smaller companies with few alternative funding options in particular.

<div align="center">Table 3—International Crisis Transmission: Firm-Level Evidence</div>

	Drop-out probability					
	Write-downs		Maturing bonds		Δ market-to-book	
	(1)	(2)	(3)	(4)	(5)	(6)
Funding shock	0.005	0.007**	0.013*	0.019***	−0.118	−0.208**
	(0.139)	(0.029)	(0.052)	(0.003)	(0.162)	(0.010)
Funding shock × Large firm		−0.005***		−0.011***		0.171***
		(0.008)		(0.002)		(0.005)
Precrisis bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Bilateral closeness controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,671	1,671	1,572	1,572	1,472	1,472
R^2	0.16	0.16	0.17	0.17	0.16	0.16

Notes: This table shows estimates to explain the variable *Drop-out probability*, the probability that bank i discontinued lending to firm k after the Lehman Brothers default. The sample includes all firms that borrowed from at least two different lenders in our sample during the precrisis period. The funding variables are defined in the Notes to Table 1. *Large firms* are firms with an above-median aggregate syndicated borrowing volume during January 2000–July 2007. We use a linear probability model. All specifications include a dummy that indicates whether bank i acted as an arranger for firm k in the past. Standard errors are heteroskedasticity robust and clustered by bank. Robust p-values appear in parentheses.

***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

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