Global Banking and the Balance Sheet Channel of Monetary Transmission*

Sami Alpanda[a] and Uluc Aysun[b]
[a]Canadian Economic Analysis Department, Bank of Canada
[b]University of Central Florida

The literature typically finds that the development of financial markets has decreased the ability of central banks to affect the real economy. This paper shows that this negative relationship does not hold between the balance sheet channel of monetary transmission and bank globalization—one aspect of financial development. The reason is that global banks are more sensitive to their borrowers' leverage. By affecting this leverage, monetary policy has a larger impact on global banks' lending and aggregate economic activity. We use bank-level Call Report data to find this disparity between more and less global banks.

JEL Codes: E44, E51, F31, F41.

1. Introduction

> However consistent may be the relation between monetary change and economic change, and however strong the evidence for the autonomy of the monetary changes, we shall not be persuaded that the monetary changes are the source of the economic changes unless we can specify in some detail the mechanism that connects the one with the other. . . . Our knowledge is at the moment too meager to enable us to do this at all precisely.
>
> (Friedman and Schwartz 1963, p. 59)

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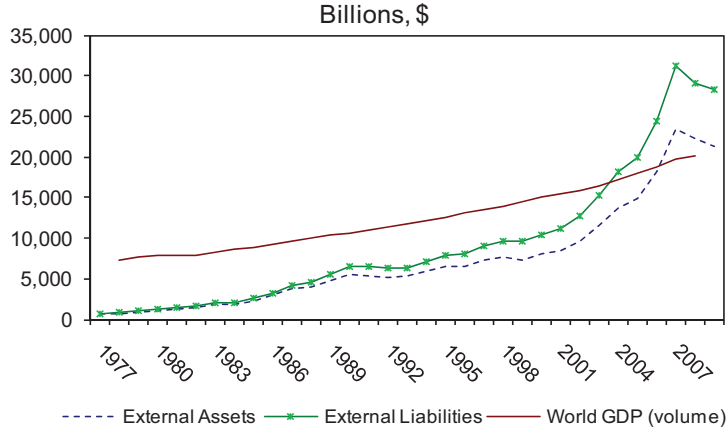
Most economists would now agree that one way that monetary policy can affect the real economy is through bank lending. The precise nature of the transmission mechanism, however, is unclear. The central bank's actions could affect either the supply of loans (the bank lending channel) or the demand for loans (the balance sheet channel). There has been extensive research on the lending channel; Bernanke and Gertler (1995) provide a useful overview. Research on the balance sheet channel is relatively scarce, however, primarily because of the difficulty in identifying the independent effects of this channel.

Recent changes in the financial system have increased the need to identify the nature of the transmission mechanism. Research that gauges the strength of the lending channel usually finds that the Federal Reserve's ability to affect the real economy through the lending channel has diminished over time (e.g., Ashcraft 2006; Kashyap and Stein 2000; Loutskina and Strahan 2009; Morgan, Rime, and Strahan 2004). This is mostly attributed to the recent financial innovations that have decreased banks' cost of raising loanable funds and insulated them from monetary policy. If the lending channel is the primary way in which central bank policy affects the real economy, then monetary policy will have a smaller effect on the economy in the future.

At the same time that financial innovation has altered banks' ability to raise funds, there has been a dramatic increase in the globalization of banking operations. Figure 1 shows, for example, that the growth in the external assets and liabilities of Bank of International Settlements reporting banks has considerably outpaced the growth in world GDP over the past decade.[1] These two events may be related. In a recent paper, for example, Cetorelli and Goldberg (2011) find that global banks, through their access to the funds of overseas affiliates, are more insulated from the liquidity constraints in the U.S. economy, which would cause the size of the lending channel to diminish. The focus in Cetorelli and Goldberg (2011) is on the constraints that affect the supply of loans.

[1]The components of total external assets and liabilities show that the majority of the trends in these variables are determined by loans and deposits and not by the holdings of securities. These data are only available after 1995 and therefore are not included in the graph.

Figure 1. Globalization of Banking



Notes: The data for the external assets and liabilities of banks were obtained from the Bank of International Settlements, and the World GDP volume is from the International Financial Statistics. The external assets and liabilities are converted to real dollars, and the world GDP volume is an index measure.

In this paper we instead focus on the balance sheet channel and use the growth in global banking as a means of investigating whether the transmission mechanism works primarily through the demand for loans. We empirically identify the balance sheet channel separately for more global and less global banks, and find a positive relationship between bank globalization and the strength of the balance sheet channel. Thus if the balance sheet channel is important, then financial development may not have an unambiguously negative effect on the ability of monetary policy to affect the economy. While financial development may be causing the lending channel to shrink, it may not be having the same effect on the balance sheet channel.

Our paper is related to two strands of literature. The first strand of literature investigates foreign direct investment in the financial sector. One of the main results in this literature is that more global/foreign banks are more sensitive to their borrowers' financial leverage since they typically extend loans with shorter maturity and do less relationship/house-bank lending (e.g., Berger et al. 2000, 2001; Buch 2005; Clarke et al. 2003). This result is consistent with

our findings. The second strand of the literature, in contrast, does not always provide empirical and theoretical support for our findings. This literature studies the role of internal capital markets for the credit growth of international and domestic subsidiaries of bank holding companies and identifies two counteracting effects of internal capital markets for subsidiaries' credit growth (Morgan, Rime, and Strahan 2004).[2]

On the one hand, parent bank holding companies allocate capital across countries/states depending on expected return and risk. This mechanism (referred to as the substitution effect in De Haas and van Lelyveld 2010) suggests that banks shift funds from countries/states with weaker balance sheets (perhaps, induced by monetary policy) to countries/states with strong balance sheets and thus provides a theoretical justification for our results. There are two sets of empirical studies that provide empirical evidence for this theory. First, the studies that focus on U.S. internal capital markets (e.g., Dahl, Shrieves, and Spivey 2002; Houston, Marcus, and James 1997) find that bank holding companies may be directing funds to their subsidiaries depending on the local conditions. Second, studies that focus on how internal capital markets operate internationally similarly find that local business cycles are positively correlated with global bank inflows.[3] This mechanism, for example, is used to explain how the recent crisis has spread to emerging-market economies (e.g., Cetorelli and Goldberg 2011; International Monetary Fund 2009).

On the other hand, if local conditions lead to a deterioration in the balance sheets of the subsidiaries, parent bank holding companies help their subsidiaries by allowing access to their internal capital markets in order to equate returns across countries/states. This mechanism, also known as the support effect, implies that global banks can be more insulated from local balance sheet conditions. There are empirical studies that provide evidence for this theoretical

[2]A majority of the papers in this literature find that internal capital markets (international and domestic) are functioning effectively (e.g., Dahl, Shrieves, and Spivey 2002; Cetorelli and Goldberg 2011; Houston, Marcus, and James 1997).

[3]See, e.g., Buch (2000), Dahl and Shrieves (1999), De Haas and van Lelyveld (2006, 2010), Goldberg (2002), Hernandez and Rudolph (1995), Jeanneau and Micu (2002), Martinez Peria, Powell, and Hollar (2002), Morgan and Strahan (2004).

explanation.[4] Our results show that the subsidiaries of global banks are more sensitive to local conditions (including those induced by monetary policy) and that monetary policy has a greater impact on this sensitivity. These results thus suggest that the substitution effect may be dominating the support effect. The more general implication is that the effect of bank globalization on monetary policy effectiveness may not be negative if the balance sheet channel of monetary transmission is taken into account.

We conduct our empirical analysis using bank-level data from the Call Reports of U.S.-chartered banks for the period 1986:Q2 to 2009:Q1. One advantage of having large cross-section data for every quarter is that we are able to use over 1 million observations in our estimations. To construct our data set, we follow Ashcraft and Campello (2007) and first compare the behavior of small banks that are affiliated with the same bank holding company, focusing on the differences in their lending. This enables us to neutralize the liquidity constraints that banks face and to measure the effects of the balance sheet channel of monetary transmission that are independent of the lending channel. The implicit assumption here is that banks that are affiliated with the same bank holding company have a similar access to internal capital markets. By focusing on the differences in their lending, we can effectively eliminate the effects of the lending channel. Second, in order to get a measure of the demand for loans, we proxy the strength of the balance sheets of borrowers seeking loans by using the income gap in the state that the bank operates in. The smaller banks which are the focus of this study have a strong tie with local small businesses (see Strahan and Weston 1998), allowing us to capture the effect that local economic conditions, strongly related to the balance sheet strength of small businesses, may have on bank lending. The third step in the construction of our data is to identify the more global and less global banks by using the loans-of-foreign-offices-to-total-loans ratios to gauge the scale of global operations.

[4]See, e.g., Crystal, Dages, and Goldberg (2002), Dages, Goldberg, and Kinney (2000), De Haas and van Lelyveld (2006, 2010), Goldberg (2002), Martinez Peria, Powell, and Hollar (2002), Peek and Rosengren (2000).

We use this constructed data set in a two-step estimation methodology, similar to that of Kashyap and Stein (2000), to estimate the strength of the balance sheet channel. First, we use cross-section data in each quarter to estimate the sensitivity of banks' loans (relative to the other banks affiliated with the same bank holding company) to state income gaps in that quarter. We then construct a time series from these sensitivities and include it as the dependent variable in a second-stage regression to measure the effects of monetary policy. We follow this two-step estimation strategy separately for more and less global banks. The estimation results demonstrate a stronger balance sheet channel for more global banks.[5]

The rest of the paper is organized as follows: Section 2 describes the methodology and the data used to explore the relationship between bank globalization and the balance sheet channel. Section 3 presents the main results and the robustness tests. Section 4 concludes.

2. Methodology and Data

In this section, we describe the empirical methodology that helps us identify the unique effects of the balance sheet channel and compare the strength of this channel that operates through more and less global banks, we describe how the data set is constructed, and we discuss the estimation results.

2.1 Identification Strategy

Using the constructed data set (described below), we measure the strength of the balance sheet channel for more and less global banks

[5]In this paper we are estimating the sensitivity of banks to the strength of balance sheets. We should point out, however, that the balance sheet channel of monetary transmission not only operates through monetary policy's effects on balance sheet sensitivities but also through its effect on the strength of the balance sheets themselves. Throughout this paper, we refer to the effect of monetary policy on balance sheet sensitivities as the balance sheet channel, following the usual terminology of the empirical literature (e.g., Angelopoulou and Gibson 2009; Ashcraft and Campello 2007; Gertler and Gilchrist 1994; Oliner and Rudebusch 1995).

by following five main steps. First, we identify small banks that are the subsidiaries of the same bank holding company. We then measure the deviation of the banks' loan growth from the mean value of loan growth measured across all the banks that are affiliated with the same bank holding company. Let lg_{ijt} denote the loan growth rate for bank i in period t and $\overline{\mathrm{lg}}_{jt}$ denote the average loan growth rate of the banks affiliated with the bank holding company j. The deviation of bank i's loans is then measured as

$$ld_{ijt} = \mathrm{lg}_{ijt} - \overline{\mathrm{lg}}_{jt}. \quad (1)$$

This provides a reasonable way to exclude the effects that a bank's liquidity constraints may have on its supply of loans. Indeed, to the extent that a parent bank holding company provides funds to its subsidiaries through internal capital markets, these subsidiaries are subject to the same liquidity constraints, and the variable ld_{ijt} captures these constraints (and any effect that monetary policy may have on these constraints). By measuring the difference between a given bank's loan growth and that of the average loan growth of all banks in the same bank holding company, we eliminate liquidity constraints from the factors that may affect the supply of loans.[6] We follow a similar approach in constructing the control variables and measure the deviation of a set of bank-specific variables from their bank holding company averages (denoted by cd_{ijt}).

Next, we identify the states in which banks operate and approximate the relative strength of balance sheets using a measure of overall economic activity in these states (denoted by bs_{ijt}). Note that by using this convention, we reasonably assume that balance sheets are stronger (weaker) in a state that is experiencing an expansion (recession).[7]

As a third step, we include the derived variables in the model below to measure the effect of balance sheet strength on the amount

[6] Ashcraft and Campello (2007) use a similar strategy to identify and control for the strength of internal capital markets.

[7] Alternatively, we measured bs_{ijt} as the deviation from bank holding company averages. Specifically, let $Ygap_{ijt}$ and $\overline{Ygap}_{jt}$ denote the income gap in the state in which bank i operates and the average income gap in the states in which all the affiliates of bank holding company j operate, respectively. We measured the relative strength of balance sheets as $bs_{ijt} = Ygap_{ijt} - \overline{Ygap}_{jt}$. The results were qualitatively similar.

of loans. Estimating this model separately for every quarter allows us to exclude the asymmetric effects that macroeconomic variables may have over time across banks.

$$ld_{ijt} = \alpha_t + \sum_{k=1}^{4} \beta_{kt} ld_{ijt-k} + \sum_{k=1}^{4} \gamma_{kt} bs_{ijt-k} + \sum_{k=1}^{4} \nu_{kt} cd_{ijt-k} + \varepsilon_{ijt}. \tag{2}$$

Notice that the coefficients of interest are γ_{kt}, and the overall effect of balance sheet strength on loan growth (balance sheet sensitivity) is measured as $\gamma_t = \sum_{k=1}^{4} \gamma_{kt}$. A positive value of γ_t, for example, would indicate that a bank lends more (relative to the other banks affiliated with its parent bank holding company) when the state in which it operates experiences an economic boom. After estimating equation (2) for every quarter, we stack the $\hat{\gamma}_t$ coefficients to construct a time series.

Fourth, to measure the strength of the balance sheet channel, we estimate the following time-series model:

$$\gamma_t = \lambda + \sum_{k=1}^{8} \varphi_k mp_{t-k} + \sum_{k=1}^{8} \varpi_k \Delta \ln(gdp)_{t-k} + \sum_{k=1}^{3} \xi_k qd_k + \omega T_t + \eta_t, \tag{3}$$

where mp_t, gdp_t, qd_k, and T_t denote the stance of monetary policy, gross domestic product, quarter dummies, and the time trend, respectively. The strength of the balance sheet channel in equation (3) is approximated with $\varphi = \sum_{k=1}^{8} \varphi_k$. By construction, an increase in mp_t indicates a tightening monetary policy throughout our estimations.

Finally, using the strategy discussed in the next section, we classify banks into two groups, more global banks and less global banks, and we compare the estimation results for these two sets of banks.

Similar to Ashcraft and Campello (2007) and Kashyap and Stein (2000), we use OLS with robust standard errors to estimate equations (2) and (3). Measuring the variables in equation (2) as deviations from bank holding company averages (averages across banks affiliated with the same bank holding company) is one way we control for a potential omitted-variables bias in our estimation results. Indeed, by doing so, we can effectively control for bank holding

company specific variables that are omitted from equation (2) and that may be correlated with bs_{ijt}. To further minimize these risks, we include bank-specific variables commonly used to control for bank-level financial constraints in equation (2) and restrict our sample as described below.

2.2 Data and Descriptive Statistics

In estimating equation (2), we use data from the Federal Reserve's Call Report of Condition and Income. These data are publicly available for every U.S.-chartered bank.[8] Table 6 in the appendix reproduces the definitions of the bank-specific variables that are included in our estimations. The bank-level data are available quarterly after 1976. However, since we use bank holding company data to classify banks into more and less global banks and since bank holding company data are only available before 1986, we use data from 1986:Q2 through 2009:Q1.

To effectively identify the balance sheet channel, we restrict our sample in several ways. First, in each quarter we only include insured, commercial banks that are not in the top 5 percent of the size (total assets) distribution in that quarter. This methodology provides a better way of measuring the balance sheet channel since monetary transmission is found to be operating mainly through smaller banks' loans (see Kashyap and Stein 2000). Second, we choose banks that have a parent (high holder) bank holding company which in turn has subsidiaries operating in at least two different states and that has at least one subsidiary that is in the top 10 percent of the size distribution. This restriction allows us to identify internal capital markets and the balance sheet channel. Third, in each quarter, we eliminate banks that do not have at least five lags of the total loans variable.

The database includes the identification number of the parent bank holding company (RSSD9348), which allows us to identify the subsidiaries of each bank holding company and measure the deviation of variables from their bank holding company averages

[8] U.S.-chartered banks are required to file this report at the Federal Financial Institution Examination Council (FFIEC). The data can be obtained from www.chicagofed.org/webpages/banking/financial_institution_reports/data_extraction_for_call_report_data.cfm.

as described above. To measure the dependent variable (quarterly loan growth), we use total loans and measure growth as log differences. The control variable vector cd_{ijt} includes the log of assets, the equity ratio, and the liquid-assets-to-total-assets ratio, which are also measured as deviations from their bank holding company averages. State-level personal income gaps are used as proxies for overall economic activity and the strength of balance sheets in a state. The total state personal income data are available quarterly for every U.S state and territory, and are obtained from the Bureau of Economic Analysis. The states' personal income gaps are calculated using a Hodrick-Prescott filter with a smoothing parameter equal to 1600.

In the baseline estimation of the second-stage regression (equation (3)), we measure the stance of monetary policy by using the nominal and real federal funds rates and the level of economic activity by the growth rate of real GDP. We also test the robustness of the baseline results by including different measures of the monetary policy stance.

2.2.1 Globalization

One unique feature of the Call Report data is that it allows us to classify banks as more global and less global. Specifically, the FFIEC 031 Consolidated Reports of Condition and Income for a Bank with Domestic and Foreign Offices include variables that can indicate the degree of foreign operations. To proxy the degree of globalization, we choose the ratio of loans of foreign offices (BHCK1764) to total loans (BHCK2122).[9] We use this ratio to classify banks as more (less) global in every quarter if its parent bank holding company has a relatively large (small) amount of foreign lending in that quarter. Specifically, we sort bank holding companies with respect to their foreign-to-total-loan ratios and classify banks that are affiliated with the bank holding company in the top 45 percent of this distribution as more global, exclude banks that are affiliated with the bank holding company that have intermediate ratios (10 percent), and classify banks that are affiliated with the bank holding company in

[9]Of course, banks also lend directly abroad (and not only through their foreign offices), but this amount is considerably smaller and thus is ignored.

the bottom 45 percent of this distribution as less global.[10] Banks that are affiliated with bank holding companies without any foreign lending are also classified as less global.

According to this classification strategy, therefore, we assume that if a bank holding company is more global, its subsidiaries are more global as well. The results obtained by using this convention, however, could be misleading if a bank's sensitivity to borrowers' leverage is determined independent of its parent bank holding company. There are two reasons why we follow this approach. The more practical reason is that the number of banks that lend abroad (directly or through subsidiaries) is very small. Although there are other variables (some of which are listed in the appendix) that could indicate whether banks are global or not, these measures are not continuous and thus do not indicate the degree of globalization. Second and more importantly, there appears to be a consensus in the finance literature (c.f. Akhavein, Berger, and Humphrey 1997; Berger, Kashyap, and Scalise 1995; Berger et al. 2005; Stiroh 2000) that using bank holding company level data, instead of bank-level data, is a more accurate way of analyzing important business decisions such as risk taking and sensitivity to balance sheets. These studies argue that the managers of subsidiaries typically coordinate activities to optimize the performance of the bank holding company. More closely related to our paper, De Haas and van Lelyveld (2010), for example, investigate the behavior of the forty-five largest bank holding companies in the world and find that the parent bank influences the decision of the local subsidiary (in own country and abroad) and has a considerable impact on local credit growth.

Some of the descriptive statistics of the data set, constructed using our classification strategy, are reported in table 1. Although more global bank holding companies are fewer in number than less global bank holding companies, they are considerably larger in size. Therefore, it is important to identify the effects of globalization on

[10] We also used 50 percent to classify the banks. Despite the increase in the number of observations, a large number of banks that were classified as more global in one quarter were often classified as less global in the next quarter. This pattern was seldom observed when 45 percent was used. Alternatively, measuring the foreign-to-total-loan ratios over the previous year to classify the banks generated similar groups of banks and thus very similar results.

Table 1. Descriptive Statistics

Period	Number of Banks		More Global Bank Holding Companies			Less Global Bank Holding Companies			Degree of Globalization			
	Total	Sample	Number	Size	Avg. No. of Affiliates	Number	Size	Avg. No. of Affiliates	<25%	25–50%	50–75%	75–100%
1986	15,750	9,527	181	5,834	12.6	1,026	1,232	10.8	921	105	121	60
1987	15,448	9,699	189	8,304	12.0	1,069	1,775	10.7	950	119	126	63
1988	14,909	9,531	175	8,490	10.5	1,162	2,031	10.4	1,043	119	131	44
1989	14,354	9,319	166	8,922	8.8	1,165	2,197	9.5	1,043	122	125	42
1990	13,959	9,127	227	11,550	7.3	1,233	3,012	8.7	1,100	133	151	76
1991	13,581	8,965	216	10,942	6.7	1,282	3,752	8.3	1,141	141	162	54
1992	13,136	8,679	212	11,296	5.7	1,388	3,858	8.8	1,242	146	133	80
1993	12,714	8,387	187	12,137	7.7	1,434	4,192	7.8	1,280	154	119	68
1994	12,190	8,144	183	13,533	7.6	1,178	4,522	7.3	1,026	152	122	61
1995	11,591	7,857	176	14,417	6.3	1,209	5,093	6.9	1,064	145	117	59
1996	11,186	7,736	168	15,545	7.1	1,281	4,929	6.0	1,104	177	95	74
1997	10,797	7,558	179	17,302	7.0	1,347	5,021	5.2	1,159	188	104	75
1998	10,325	7,315	154	19,642	6.1	1,451	5,455	5.7	1,329	122	107	47
1999	9,956	7,177	155	24,128	6.5	1,479	6,240	5.5	1,318	161	101	54
2000	9,656	6,984	148	29,149	5.6	1,520	6,319	5.1	1,346	174	86	62
2001	9,302	6,790	147	30,014	5.6	1,619	7,394	4.7	1,392	227	78	69
2002	8,998	6,620	131	33,071	5.3	1,744	8,775	4.6	1,524	220	74	57
2003	8,822	6,595	162	39,248	5.7	1,957	9,305	4.3	1,662	295	86	76

(continued)

Table 1. (Continued)

Period	Number of Banks		More Global Bank Holding Companies			Less Global Bank Holding Companies			Degree of Globalization			
	Total	Sample	Number	Size	Avg. No. of Affiliates	Number	Size	Avg. No. of Affiliates	<25%	25–50%	50–75%	75–100%
2004	8,665	6,514	167	47,535	4.8	2,133	10,149	4.7	1,836	297	92	75
2005	8,543	6,463	175	54,750	4.7	2,184	10,698	4.5	1,848	336	104	71
2006	8,498	6,412	117	39,220	4.7	897	8,584	4.4	766	131	73	44
2007	8,352	6,351	116	44,869	5.0	878	7,233	4.4	740	138	70	46
2008	8,119	6,221	114	48,549	5.3	870	8,065	4.2	667	203	62	52
2009	8,061	6,183	119	55,539	4.1	921	8,132	4.6	675	246	66	53

Notes: The table reports the number of banks and bank holding companies, and the size and number of affiliates of bank holding companies in our sample. The number of banks and bank holding companies denote the total number of different banks and bank holding companies in a given year. These numbers are not the sum of the quarterly observations in a given year. The size variable is total assets measured in millions. Both the size and the number of variables are measured as simple averages in a given year. The "Degree of Globalization" columns report the number of bank holding companies that have a foreign-loans-to-total-loans ratio under 25%, between 25% and 50%, between 50% and 75%, and over 75%.

the balance sheet channel that are independent of bank holding company size. One other bank holding company specific characteristic that may have an effect on the banks' sensitivity to balance sheets is the number of subsidiaries. Specifically, bank holding companies with more subsidiaries in different states could be more diversified and thus less sensitive to borrowers' balance sheets. Table 1 demonstrates that the number of subsidiaries of more and less global bank holding companies are not too different and thus may have limited effects on the estimation results.[11] Finally, we should note that the ratio of the total assets of more global bank holding companies to the total assets of all the banks was approximately 33 percent in our sample; thus, the asymmetric effects that monetary policy may have on more global banks can be economically significant.

The last four columns report the distribution of bank holding companies based on their foreign-loans-to-total-loans ratio. Notice that while a majority of the bank holding companies do not have any foreign loans or have a ratio of less than 25 percent, the number of banks that fall under the other quartiles is non-negligible. This feature of our data set allows us to test whether bank holding companies classified under these quartiles behave differently. In the sensitivity analysis section, we investigate the disparity between more and less global banks by further dividing more global banks into two groups. We are therefore able to compare the behavior of three groups of banks: less global banks, more global banks with a relatively low foreign-loans-to-total-loans ratio, and more global banks with a relatively high foreign-loans-to-total-loans ratio.

3. Results

Our first-stage results are summarized in table 2. As reported in the first and fourth columns, we find that the relative loan growth is, in general, positively related to the strength of balance sheets. Our more central result, however, is that the effect of balance sheets on loan growth is in general larger in magnitude and more significant for more global banks (average coefficient value is 1.08, and eighty-seven

[11] The results were similar when the number of subsidiaries of the parent bank holding company was included in the first-stage estimation.

Table 2. First-Stage Estimation Results

Year	Qtr.	γ^{MGB}	F-stat.	Num. Obs.	γ^{LGB}	F-stat.	Num. Obs.
1986	1						
	2	**0.05**	**4.58**	1026	**0.03**	**2.79**	6534
	3	**0.05**	**4.88**	1184	**0.02**	**4.66**	6147
	4	**0.07**	**6.58**	653	−0.39	1.40	7533
1987	1	**0.14**	**12.39**	1386	0.15	0.72	5561
	2	**0.19**	**17.08**	1329	**0.01**	**3.19**	6091
	3	−0.02	1.35	1164	0.04	0.48	6733
	4	**0.07**	**6.23**	937	0.13	0.96	8053
1988	1	**0.02**	**4.76**	1168	0.07	0.85	7858
	2	**0.81**	**7.21**	1062	**0.08**	**2.79**	8211
	3	**0.26**	**3.35**	1098	**0.13**	**3.09**	7672
	4	**0.13**	**11.40**	1006	**0.30**	**2.52**	8016
1989	1	**0.15**	**13.66**	1029	**0.21**	**2.50**	8081
	2	**0.10**	**8.56**	947	**0.01**	**6.42**	8397
	3	**0.18**	**16.15**	788	0.11	0.91	9104
	4	0.02	1.51	1016	**0.34**	**3.70**	8416
1990	1	0.01	0.60	1023	**0.07**	**4.10**	7793
	2	**0.14**	**12.92**	1016	**0.07**	**2.96**	7905
	3	**0.03**	**2.96**	1006	−0.06	1.09	7765
	4	**0.29**	**2.47**	666	**1.10**	**6.04**	8732
1991	1	**0.28**	**2.90**	818	0.25	1.15	8221
	2	**1.69**	**6.09**	768	**0.21**	**4.13**	8453
	3	**1.14**	**10.87**	881	**0.24**	**3.35**	7998
	4	**0.08**	**8.37**	900	**0.62**	**3.10**	7867
1992	1	**0.33**	**2.83**	900	**0.38**	**5.19**	7877
	2	**0.72**	**22.90**	854	**0.24**	**3.47**	8174
	3	**0.08**	**6.23**	851	**0.14**	**3.04**	8174
	4	**2.22**	**7.14**	739	**0.24**	**2.55**	8379
1993	1	**0.33**	**3.33**	1009	**0.29**	**2.44**	7681
	2	**1.17**	**5.39**	1336	**0.07**	**2.53**	6844
	3	**0.07**	**6.92**	1481	0.04	1.15	6575
	4	**1.47**	**11.14**	1399	**0.01**	**4.81**	6789
1994	1	**1.10**	**6.29**	980	**0.59**	**4.07**	7821
	2	**0.66**	**15.12**	1465	**0.07**	**2.88**	6556
	3	**0.53**	**3.27**	1399	**0.22**	**3.79**	6761
	4	**1.20**	**14.71**	1369	**0.02**	**0.10**	6891

(continued)

Table 2. (Continued)

Year	Qtr.	γ^{MGB}	F-stat.	Num. Obs.	γ^{LGB}	F-stat.	Num. Obs.
1995	1	**0.84**	**7.18**	831	**0.25**	**1.00**	8100
	2	**2.19**	**8.19**	871	**0.22**	**2.74**	8230
	3	**3.10**	**13.90**	1164	**0.35**	**2.76**	7421
	4	**0.44**	**16.57**	1270	**0.43**	**4.69**	6909
1996	1	**0.49**	**3.33**	1125	**0.21**	**2.80**	7309
	2	**0.67**	**3.04**	1023	0.27	1.45	7123
	3	**0.32**	**31.53**	1184	−0.15	0.50	6612
	4	**0.39**	**4.73**	1194	**0.01**	**2.89**	6491
1997	1	**2.98**	**9.61**	1353	**0.25**	**2.66**	5998
	2	**0.71**	**7.26**	1191	**0.50**	**3.64**	5849
	3	**1.36**	**4.36**	1155	0.34	1.68	5505
	4	**0.71**	**3.08**	983	**0.19**	**5.94**	6165
1998	1	**1.15**	**7.03**	894	**0.11**	**3.16**	6537
	2	**0.55**	**3.07**	996	**0.09**	**5.08**	6305
	3	**2.87**	**7.32**	947	**0.03**	**2.82**	6156
	4	**2.11**	**4.06**	999	**0.20**	**6.96**	5598
1999	1	**4.51**	**5.79**	828	**0.30**	**5.83**	6193
	2	−0.38	2.09	947	**0.30**	**3.02**	5859
	3	**1.27**	**2.89**	1075	0.45	2.33	5189
	4	**1.09**	**20.04**	1079	**0.64**	**4.61**	5022
2000	1	**2.43**	**9.78**	963	−0.02	1.26	5105
	2	**0.56**	**2.86**	1013	**0.61**	**4.00**	4798
	3	**2.14**	**5.18**	729	0.13	1.49	5087
	4	**0.46**	**3.09**	673	0.06	0.66	4966
2001	1	**2.37**	**12.71**	640	**0.72**	**3.60**	4984
	2	**0.66**	**5.08**	709	**0.69**	**3.09**	4343
	3	2.32	1.18	970	**0.98**	**3.03**	3599
	4	**2.03**	**7.43**	722	**0.65**	**6.44**	4026
2002	1	**2.84**	**18.81**	570	**0.52**	**5.37**	4240
	2	**4.86**	**15.29**	745	**0.18**	**4.44**	3682
	3	**0.09**	**3.16**	742	**0.08**	**2.52**	3599
	4	**0.80**	**3.12**	716	0.06	1.80	3552
2003	1	**1.68**	**12.95**	679	**0.13**	**3.67**	3840
	2	**0.91**	**24.52**	792	**0.21**	**3.56**	3515
	3	**0.96**	**14.06**	666	**0.15**	**3.28**	3729
	4	**0.37**	**2.60**	844	**0.75**	**3.32**	3115

(continued)

Table 2. (Continued)

Year	Qtr.	γ^{MGB}	F-stat.	Num. Obs.	γ^{LGB}	F-stat.	Num. Obs.
2004	1	**2.09**	**7.34**	518	**0.16**	**3.26**	3980
	2	**2.05**	**16.88**	726	**0.11**	**2.70**	3506
	3	**0.55**	**4.26**	458	**0.04**	**4.98**	4110
	4	**1.69**	**13.47**	643	−0.18	1.61	3673
2005	1	**4.42**	**12.98**	636	**0.19**	**2.56**	3654
	2	**1.49**	**11.12**	693	**0.25**	**2.95**	3227
	3	**0.94**	**3.66**	646	**0.78**	**4.44**	3245
	4	**2.54**	**7.07**	574	**0.08**	**3.59**	3403
2006	1	**2.15**	**5.12**	547	**0.17**	**6.99**	3468
	2	**0.41**	**3.00**	636	**0.19**	**2.95**	3282
	3	**0.68**	**8.90**	580	**0.60**	**2.69**	3496
	4	**1.09**	**20.82**	699	0.09	0.88	3227
2007	1	**1.08**	**7.42**	660	**1.59**	**2.93**	3450
	2	**2.13**	**11.75**	706	**0.59**	**2.83**	3450
	3	**0.33**	**10.56**	607	**0.95**	**2.88**	3738
	4	**2.80**	**12.88**	676	**0.52**	**2.80**	3422
2008	1	**2.62**	**5.01**	719	**0.07**	**3.93**	3329
	2	**0.78**	**6.43**	706	**0.21**	**4.79**	3189
	3	**1.05**	**6.91**	656	**0.28**	**3.50**	3255
	4	−0.31	0.76	653	−0.68	0.77	3031
2009	1	**−0.12**	**20.04**	504	**−0.08**	**3.13**	3310

Notes: This table displays the results from the estimation of the first-stage equation (equation (2)) by quarter. The reported coefficient values represent the aggregate effect of balance sheets on relative loan growth. MGB and LGB denote more and less global banks, respectively. "F-stat" columns report the F-statistics used to test the joint significance of the balance sheet coefficients. A bold font indicates that the coefficient is significant at the 5% level.

out of ninety-two coefficients are significant) compared with less global banks (average coefficient value is 0.25, and seventy-two out of ninety-two coefficients are significant). Table 3 displays the results from the estimation of the second stage (equation (3)). The reported coefficient values represent the aggregate effect of monetary policy (denoted by $\sum_{k=1}^{8} \varphi_k$) on balance sheet sensitivity (denoted by γ_t). The numbers in the parentheses are the F-statistics (corrected for

heteroskedasticity and autocorrelation) used to test the joint significance of the monetary policy coefficients. The sample period for each regression is 1986:Q2 to 2009:Q1; there are ninety-two observations for each regression. The estimates, with the exception of one, indicate that monetary policy has a significant, positive effect on balance sheet sensitivities. Specifically, the positive coefficients imply that balance sheet sensitivities increase (decrease) during tight (loose) monetary conditions. The results are similar when the stance of monetary policy is measured by nominal or real federal funds rates.

It is important to note at this point that invalid inferences can be made in the second-stage regression if the mean value of the first-stage coefficients are used in the second stage without accounting for their standard errors. This is more commonly known as the generated regressors problem. We report the estimation results from the model that accounts for first-stage measurement errors in the top panel of table 3.[12] Note that by including the measurement errors in the second stage, one gives more weight to years with more observations (and low measurement errors). In the sample there are a larger number of observations, and the coefficient standard errors are smaller for the 1970s and early 1980s. Giving larger weights to these years would be a drawback considering the activity level of monetary authorities during this period. A comparison of the estimates in the two panels, however, does not reveal any noteworthy differences between the coefficient values.

Comparing the results for the two groups of banks, we observe a stronger balance sheet channel for more global banks. Specifically, the coefficient values are larger (and mostly more significant) for more global banks. This disparity between the two groups of banks is higher when accounting for the first-stage measurement errors. A simple thought experiment uncovers the economic significance of these results. First, assume that there is a 100-basis-point decrease in the federal funds rate that is spread uniformly over the previous eight quarters. Second, assume that a certain state is experiencing a

[12]We accounted for the measurement error using a methodology similar to that of Gawande (1997). Although accounting for generated regressors is a more common practice, the methodology we use also accounts for the errors in measuring the regressand (as in our case).

Table 3. The Effect of Monetary Policy on Balance Sheet Sensitivity, MGV vs. LGB

	Whole Sample		MGB		LGB	
	Real FFR	**Nominal FFR**	**Real FFR**	**Nominal FFR**	**Real FFR**	**Nominal FFR**
Accounting for the Generated Regressors Problem	−0.09 (0.88)	−0.08 (1.91)*	−0.29 (8.81)***	−0.52 (10.86)***	−0.02 (0.58)	0.02 (0.560)
Not Accounting for the Generated Regressors Problem	−0.13 (1.35)	−0.09 (1.65)	−0.22 (4.10)***	−0.24 (2.44)**	−0.11 (1.32)	0.08 (1.08)
Number of Observations	92	92	92	92	92	92

Notes: This table displays the results from the estimation of the second-stage equation (equation (3)). The reported coefficient values represent the aggregate effect of monetary policy on balance sheet sensitivity. MGB and LGB denote more and less global banks, respectively. The numbers in parentheses are the F-statistics used to test the joint significance of the monetary policy coefficients. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. F-statistics have been corrected for heteroskedasticity and autocorrelation. The balance sheet sensitivity coefficients are estimated separately for more global and less global banks in the first stage. The results of the second-stage regressions for these two groups are reported in the columns MGB and LGB. The top panel accounts for the generated regressors problem by including the standard errors of the dependent variables that were measured in the first-stage regressions. The bottom panel does not account for the generated regressors problem. Real and nominal federal funds rates (FFR) are used to measure the stance of monetary policy.

one-standard-deviation increase in total personal income while the rest of country is not. The coefficient values of −0.29 (estimated for more global banks) and −0.02 (estimated for less global banks) then indicate that, in response to this drop in interest rates, the more global banks in this state will increase their loans by 29 percent more than the rest of the subsidiaries affiliated with their parent bank holding company. The corresponding increase for less global banks in the same state is only 2 percent. Given that the share of more global banks' loans, similar to asset size, is not small in our sample (approximately 37 percent), this disparity between the sensitivities to balance sheets also implies that the balance sheet channel may be operating mainly through more global banks.

3.1 Robustness

In this section we check the robustness of the results in table 3 and further investigate the nature of the relationship between bank globalization and the balance sheet channel. Specifically, we consider different measures for the monetary policy stance, control for size, investigate the relationship between globalization and the balance sheet channel in different sub-periods, check whether the strength of the balance sheet channel is positively related to the degree of globalization, exclude the largest subsidiary of the bank holding companies, and use a one-step estimation methodology. The results are summarized in table 4.

3.1.1 Different Measures of Monetary Policy Stance

Although real and nominal federal funds rates are often used to measure the stance of monetary policy in the literature, the variation in these variables can be explained by shocks to other variables in the economy such as output and prices. Acknowledging this endogenous component of monetary policy, researchers have constructed measures of monetary policy stance that capture the variation in monetary policy that is independent of other macroeconomic variables. In this section, we check whether the results in table 3 are robust to using the alternative indices constructed by Bernanke and Blinder (1992), Christiano and Eichenbaum (1992), Strongin (1995), and Bernanke and Mihov (1998) and to using the orthogonal shocks

Table 4. Robustness

		Real FFR	Nominal FFR	BB	CE	S	Borrowed R.	BM
Benchmark	MGB	−0.29	−0.52	−5.37	−2.26	−2.44	−1.64	−1.77
		(8.81)***	(10.86)***	(18.02)***	(23.86)***	(13.93)***	(20.95)***	(18.26)***
	LGB	−0.02	0.02	−0.49	−0.13	0.16	−0.10	−0.36
		(0.58)	(0.560)	(5.51)***	(2.55)***	(3.00)***	(2.77)***	(2.65)**
Accounting for Size	MGB	−0.29	−0.52	−5.37	−2.26	−2.44	−1.64	−1.77
		(8.81)***	(10.86)***	(18.02)***	(23.86)***	(13.93)***	(20.95)***	(18.26)***
	LGB	−0.03	−0.11	−0.58	−0.34	0.12	−0.23	−1.34
		(0.79)	(1.34)	(2.94)***	(1.97)*	(1.74)	(2.65)**	(1.86)*
Degree of Globalization	G1	−0.77	−0.56	−3.90	−0.25	−1.42	−0.19	−0.15
		(3.60)***	(2.53)**	(2.91)***	(2.06)**	(1.88)*	(1.80)*	(1.48)
	G2	−0.04	−0.01	−0.98	−0.05	−0.15	−0.08	−1.17
		(0.66)	(1.42)	(8.11)***	(7.51)***	(10.25)***	(9.72)***	(7.05)***
Excluding Crisis Periods	MGB	−0.30	−0.58	−6.60	−2.12	−5.45	−1.52	−0.87
		(8.36)***	(11.38)***	(14.17)***	(20.51)***	(27.51)***	(18.91)***	(17.31)***
	LGB-Size	−0.05	−0.10	−0.85	−0.03	−0.08	−0.18	−0.34
		(1.21)	(2.10)**	(5.10)***	(3.99)***	(9.63)***	(3.92)***	(11.31)***
Sub-Period 1994–2009	MGB	1.50	−0.15	−15.40	−1.01	−2.46	−0.76	−3.23
		(15.49)***	(17.24)***	(19.01)***	(8.88)***	(11.74)***	(7.89)***	(12.12)***
	LGB-Size	−0.18	−0.13	−5.23	−0.33	−0.11	−0.32	−0.63
		(6.42)***	(4.58)***	(7.16)***	(1.84)*	(1.73)	(2.49)**	(4.05)***

(continued)

Table 4. (Continued)

		Real FFR	Nominal FFR	BB	CE	S	Borrowed R.	BM
Sub-Period 1978–1993	MGB	−0.06	0.03	−27.43	−0.21	−0.81	−0.16	−0.28
		(3.15)***	(1.44)	(1.72)	(1.80)*	(1.62)	(1.93)*	(2.06)*
	LGB-Size	−0.05	0.04	−8.58	−0.39	−0.56	−0.09	−0.46
		(2.71)**	(2.67)**	(4.30)***	(5.44)***	(4.22)***	(5.16)***	(3.45)***
Excluding the Largest Subsidiary	MGB	−0.27	−0.56	−6.66	−2.21	−2.65	−1.69	−1.79
		(6.07)***	(9.39)***	(16.43)***	(20.33)***	(11.08)***	(22.81)***	(15.30)***
	LGB-Size	−0.04	−0.10	−0.51	−0.39	0.11	−0.30	−1.33
		(0.71)	1.12)	(2.89)***	(2.16)**	(1.68)	(2.39)**	(1.82)*

Notes: This table displays the results from the estimation of the second stage (equation (3)). The reported coefficient values represent the aggregate effect of monetary policy on balance sheet sensitivity. MGB and LGB denote more and less global banks, respectively. LGB-Size denotes the less global banks that are similar in size to more global banks. The numbers in parentheses are the F-statistics used to test the joint significance of the monetary policy coefficients. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. F-statistics have been corrected for heteroskedasticity and autocorrelation. In the second-stage regressions, the generated regressors problem is accounted for. The measures for monetary policy stance are the real and nominal federal funds rate (FFR), the Bernanke and Blinder (1992) index (denoted by BB), the Christiano and Eichenbaum (1992) index (denoted by CE), the Strongin (1995) index (denoted by S), the index constructed using the variation in borrowed reserves, and the Bernanke and Mihov (1998) index (denoted by BM).

to borrowed reserves as the measures of monetary policy stance. We follow the methodology described in these papers to extend these indices to 2009:Q1.[13]

The results are displayed at the top of table 4. The interpretation of the coefficient values in columns 3 to 7 are similar to the ones in table 3 (reproduced in columns 1 and 2 in table 4). For example, the coefficient value of 5.37 in column 3 indicates that if a state experiences a one-standard-deviation increase in total income and a negative, orthogonal 100-basis-point shock to the spread between the federal funds rate (spread over the previous eight quarters) and the long-term bond rate, a more global bank's loans increase by 5.37 percent more than the average growth rate of affiliates in other states. This impact of monetary policy is smaller for less global banks' lending (a relative 0.49 percent increase). Although smaller in magnitude, the differences between the coefficient values indicate a similar disparity between the sensitivity to the strength of balance sheets.

3.1.2 Accounting for Size

As described above, more global bank holding companies are, on average, larger than less global bank holding companies. Thus only controlling for bank size, as we do in our baseline estimations, can be an important drawback if bank holding companies' size has non-negligible effects on balance sheet sensitivities (perhaps since internal capital markets function differently for larger and smaller bank holding companies). Therefore, it is critical to test whether the different strengths of the balance sheet channel observed between the two groups of banks are due to the different sizes of their parent bank holding companies. In this section we control for bank holding companies' size by choosing random samples of less global bank holding companies, in each quarter, to replicate the size distribution of more global bank holding companies in that quarter. To do so, we determine the ranges of values for total assets that define five size groups of more global bank holding companies with equal number of observations in every quarter. We then randomly pick

[13]See Bernanke and Mihov (1998) for a description of how the indices are constructed.

less global bank holding companies until the number of less global bank holding companies in each size category equals the number of more global bank holding companies.[14] Given that the number of less global bank holding companies is significantly larger than the number of more global bank holding companies, we are able to draw at least 100 different random samples from the pool of less global bank holding companies in each quarter. After we obtain these random samples, we classify banks as less global if they are affiliated with the less global bank holding companies. Finally, we measure the strength of the balance sheet channel for these random samples of less global banks and compute the average of the estimates.

Table 4 displays the average of the coefficient values estimated by using the random draws of less global bank holding companies (and data from their affiliates). We also reproduce the benchmark estimation results for more global banks for convenience. The central result is that accounting for size does not change the disparity between more and less global banks' sensitivity to balance sheets, and thus globalization has an independent effect on the strength of the balance sheet channel. The coefficient values for less global banks, albeit larger than the coefficient values when there is no control for the size of the bank, are in general smaller than the coefficient values obtained for more global banks. This result implies that the balance sheet sensitivity of the subsidiaries of larger, less global bank holding companies may be less insulated from monetary policy shocks compared with the subsidiaries of smaller, less global bank holding companies.

3.1.3 Degree of Globalization

The measure for globalization used in this paper is a continuous variable. Using the two-step estimation strategy for more and less global

[14] As an alternative, we used a fixed interval of total asset values and determined the number of more global banks in each group. We then matched the number of banks in each asset size group by choosing less global banks with similar size. The results were similar, although we were not able to draw as many random samples. We also included the size of parent bank holding companies as control variables in equation (2) and obtained qualitatively similar results. We choose to use the exercise described above to account for the possibility that the relationship between size and the balance sheet channel may not be of a parametric form.

banks, however, does not allow one to take advantage of this feature of the data. Although it is possible to follow a one-step approach and include the degree of globalization as an interactive variable to measure the effects of globalization, the interpretation of the coefficient values is not straightforward and, more importantly, these values cannot be compared with our benchmark results. We instead break the sample of more global banks into two groups to facilitate a comparison with previous results. To do so, we rank more global bank holding companies according to their loans-of-foreign-offices-to-total-loans ratios and classify the affiliates of the top (bottom) 40 percent of these bank holding companies under group G1 (G2). The results in table 4 show that the magnitudes of the coefficients, measuring the impact of monetary policy, are in general larger for G1. Thus the results suggest that the strength of the balance sheet channel is positively related to the degree of globalization and that it mainly operates through its effects on banks that are affiliated with relatively more globalized bank holding companies.

3.1.4 Excluding Crisis Periods

The sample period covered in our baseline analysis includes periods marked by sharp drops in economic activity. Although the non-linear effects of these large perturbations can confound the analysis similarly for more and less global banks, the effects of these shocks on the two groups of banks can be asymmetric. For example, given their global scale of operations, it is possible for more global banks to shift their operations to markets that are less affected by the recession in the U.S. economy. Moreover, it is also difficult to identify the variation in policy rates that are not prompted by output drops during these periods and measure the strength of the balance sheet channel. To check the robustness of the baseline estimation results, we exclude the periods 1990:Q3 to 1991:Q1 and 2007:Q3 to 2009:Q1 and estimate equations (2) and (3). We also control for bank holding company size by using the methodology described above. The results in table 4, similar to the baseline results, indicate that the balance sheet channel is stronger for more global banks. A comparison with the baseline results, however, does not clearly show that more and less global banks are affected differently by the crisis episodes.

3.1.5 Historical Evidence

As discussed above, the rate of globalization of banks has increased considerably over the past fifteen years. This rapid globalization gives us a unique way of testing whether the disparity between the strength of the balance sheet channel for more and less global banks is due to the characteristics of these banks other than size (for example, clientele base). To test whether these characteristics are important, we first classify banks into two groups as before. In this section, however, we use the average foreign-office-lending-to-total-loans ratios over the period 1994–2009 to sort the bank holding companies and classify the banks as more and less global. We then estimate equation (2) similarly using data from more and less global banks. We proceed by using the same group of bank holding companies (more global and less global) that are sorted using data from 1994–2009 and collect data from the period 1978 to 1993 for the banks that are affiliated with these bank holding companies and label them as more and less global. For both sub-periods, we control for size using the methodology described above and estimate equation (2) separately for the two groups of banks.

The results displayed in table 4 show that the disparity between the strength of the balance sheet channel for the two groups of banks is only observed in the sub-period 1994–2009. The results from the earlier period, although mixed, do not point to noticeable differences between the coefficient values of the two groups. Since the share of global assets is relatively small in the earlier period, it is not surprising to find small differences in the impact of monetary transmission that operates through more and less global banks. Our results suggest that as the degree of globalization has increased, the disparity between the strength of monetary transmission that operates through the two groups of banks has increased as well.

It is important to note, however, that the methodology in this section is designed to account for the time-invariant, bank holding company specific characteristics that may affect our results and that it does not account for bank holding company specific variables that may have changed from one period to the other similar to globalization. But to the extent that these characteristics are related to size, our methodology is an effective way to capture the independent effects of globalization.

3.1.6 Excluding the Largest Subsidiary

In our baseline analysis we exclude, in each quarter, banks that are in the top 5 percent of the size distribution. This allows us to more effectively identify balance sheet effects, since smaller banks lend more locally and thus are more affected by local conditions. This methodology, however, does not eliminate all the largest subsidiaries of each bank holding company in our sample. This can be a caveat in our analysis if the difference in the size of the remaining subsidiaries is large, since we identify balance sheet effects by investigating credit growth of subsidiaries relative to the other subsidiaries. For example, a subsidiary of a bank holding company, not in the top 5 percent of the overall size distribution, can be much larger compared with the other subsidiaries of the bank holding company and can be less affected by local conditions since it does more out-of-state loans. To check the robustness of our benchmark results, we exclude the largest subsidiary of each bank holding company in our sample. The results reported in table 4 similarly indicate that the balance sheet channel is stronger for more global banks.

3.1.7 One-Step Estimation

The baseline, two-step empirical methodology that we follow helps us measure the impact of monetary policy on the average level of balance sheet sensitivities (across banks). Although this strategy, commonly used in the literature, provides a flexible way of parameterizing the model, it has three disadvantages. First, it does not allow us to exploit the large cross-section dimension of the data in investigating the effects of monetary policy on balance sheet sensitivities at the bank level. Second, the two-step approach imposes fewer restrictions and thus, as argued in Kashyap and Stein (2000), may lead to overparameterization. Third, and more importantly, a two-step approach does not allow us to fully measure how monetary policy interacts with balance sheets to affect the amount of lending and only allows us to measure the impact of monetary policy on the sensitivity to balance sheets—i.e., the second-order effects of monetary policy.

In this section we use a one-step estimation strategy to check the robustness of our benchmark results. In doing so, we estimate the following model:

$$ld_{ijt} = \alpha + \sum_{k=1}^{4} \beta_k ld_{ijt-k} + \sum_{k=0}^{8} \chi_k mp_{t-k} + \sum_{k=1}^{4} \gamma_k bs_{ijt-k} + \sum_{k=1}^{4} \sum_{m=k}^{k+7} \varphi_{km} bs_{ijt-k} mp_{t-m} + \sum_{k=1}^{4} \nu_k cd_{ijt-k} + \varepsilon_{ijt}, \quad (4)$$

where $\chi = \sum_{k=0}^{8} \chi_k$ and $\gamma^T = \sum_{k=1}^{4} \gamma_k$ measure the overall effect of monetary policy shocks and balance sheets on the relative amount of lending, respectively. The summation $\varphi = \sum_{k=1}^{4} \sum_{m=k}^{k+8} \varphi_{km}$ approximates the interaction of monetary policy and borrower balance sheets and thus is the focus of this section. In this formulation, a negative value of φ, for example, implies that the increase in loans, prompted by stronger balance sheets, would be smaller if there is a monetary tightening. We use OLS to estimate equation (4).[15]

The results displayed in table 5 are consistent with our benchmark results. Balance sheet sensitivities of loans extended, captured by $\gamma^T = \sum_{k=1}^{4} \gamma_k$, are positive and higher for more global banks across different measures of monetary policy stance. The coefficient value of 3.06 obtained by using the Bernanke and Blinder (1992) index and data from more global banks indicates that if the state in which a more global bank operates experiences an increase in economy activity by one standard deviation for four consecutive quarters, its loan growth is approximately 3.06 percent higher than the average growth for the other subsidiaries (in other states). This relative increase in loan growth is only 0.21 percent for less global banks. More importantly, we find that the impact of monetary policy is larger for more global banks. For example, the coefficient value of −1.05 reported in the third row, first column implies that the response of loan growth to an increase in economic activity would be approximately 1.05 percent lower if the federal funds rate to long-term bond spread is increased by 100 basis points in the previous eight quarters. This impact of monetary policy is estimated to be only −0.03 percent for less global banks. Notice that the overall

[15]Alternatively, we used generalized method of moments (GMM) as an estimation strategy to account for the potential endogeneity that may arise from including the lags of the dependent variable on the right-hand side. The results were similar.

Table 5. One-Step Estimation

	MGB					LGB				
	BB	**CE**	**S**	**Borrowed Reserves**	**BM**	**BB**	**CE**	**S**	**Borrowed Reserves**	**BM**
$\sum_{k=1}^{4} \gamma_k$	3.06	4.37	5.07	1.46	1.72	0.21	0.11	0.80	0.31	−0.09
	(6.113)***	(6.151)***	(6.117)***	(6.172)***	(6.079)***	(16.439)***	(16.691)***	(16.727)***	(16.689)***	(16.483)***
$\sum_{k=1}^{8} \chi_k$	−0.42	−0.03	−0.08	−0.03	0.03	0.33	0.01	−0.01	0.00	−0.06
	(0.30)	(0.30)	(0.28)	(0.31)	(0.34)	(0.84)	(0.81)	(0.83)	(0.84)	(0.83)
$\sum_{k=1}^{4} \sum_{m=k}^{k+7} \varphi_{km}$	−1.05	−0.45	−0.35	−0.27	−0.29	−0.03	−0.04	0.07	−0.02	0.03
	(6.53)***	(6.79)***	(6.72)***	(6.92)***	(6.71)***	(0.1998)	(0.2023)	(0.2022)	(0.2026)	(0.2009)
$\sum_{k=1}^{4} \beta_k$	0.0601	0.0608	0.0625	0.0623	0.0605	0.2465	0.2452	0.2468	0.2456	0.2468
	(0.4451)	(0.4442)	(0.4460)	(0.4466)	(0.4473)	(12.603)***	(12.658)***	(12.624)***	(12.678)***	(12.563)***
$\sum_{k=1}^{4} \nu_k^{\text{total assets}}$	−0.0177	−0.0180	−0.0180	−0.0179	−0.0180	−0.0307	−0.0305	−0.0306	−0.0305	−0.0307
	(2.4644)**	(2.4707)**	(2.4749)**	(2.4783)**	(2.4768)**	(6.6915)***	(6.7170)***	(6.7113)***	(6.7212)***	(6.6879)***
$\sum_{k=1}^{4} \nu_k^{\text{equity ratio}}$	−0.4736	−0.4742	−0.4741	−0.4748	−0.4748	−0.7135	−0.7153	−0.7148	−0.7154	−0.7136
	(2.5599)**	(2.5670)**	(2.5716)**	(2.5751)**	(2.5736)**	(7.0696)***	(7.0996)***	(7.0931)***	(7.1046)***	(7.0653)***
$\sum_{k=1}^{4} \nu_k^{\text{liquidity}}$	−0.0108	−0.2017	−0.6549	−0.0761	−0.1779	−0.3191	−0.1183	−0.4438	−0.3417	−0.4915
	(2.4644)**	(2.4711)**	(2.4753)**	(2.4785)**	(2.4772)**	(6.3351)***	(6.3588)***	(6.3504)***	(6.3608)***	(6.3302)***
R-Squared	0.11	0.10	0.10	0.10	0.10	0.15	0.16	0.15	0.15	0.15
No. Obs.	82,106	82,106	82,106	82,106	82,106	459,699	459,699	459,699	459,699	459,699

Notes: This table displays one-step estimation results (equation (4)). MGB and LGB denote more and less global banks, respectively. The numbers in the parentheses are the F-statistics used to test the joint significance of the monetary policy coefficients. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. The measures for monetary policy stance are the Bernanke and Blinder (1992) index (denoted by BB), the Christiano and Eichenbaum (1992) index (denoted by CE), the Strongin (1995) index (denoted by S), the index constructed using the variation in borrowed reserves, and the Bernanke and Mihov (1998) index (denoted by BM).

impact of monetary policy is insignificant in all the regressions. Since we are measuring loan growth as deviations from bank holding company averages, it is not unreasonable to expect that monetary policy would have an insignificant effect on this relative loan growth due to its symmetric effects across banks. The results also indicate, consistent with Kashyap and Stein (2000), that loan growth is negatively related to size, leverage, and liquidity, respectively.

4. Conclusion

An important challenge facing central banks is the need to understand how the development of financial markets alters the ways in which central banks can affect the economy. In this paper, we considered one aspect of financial development, bank globalization. The results suggest that the increasing global scale of banking operations may have raised the effectiveness of the Federal Reserve by strengthening the balance sheet channel of monetary transmission. The empirical results, obtained using a large bank-level data set, reveal a larger effect of monetary policy shocks on the leverage sensitivities of more global banks.

Overall, our results demonstrate a positive relationship between bank globalization and the strength of the balance sheet channel. These results, however, do not necessarily suggest a positive relationship between globalization and the strength of monetary transmission. Indeed, there are studies that find that the effect of globalization on the lending channel of monetary transmission is negative. Given the results in this paper, a natural next step is to develop methodologies to compare the strength of these two important channels of monetary transmission and investigate the effects that bank globalization may have on the overall strength of monetary policy. Loan-level data sets constructed by recent studies (e.g., Jiménez, Lopez, and Saurina 2009) provide one promising way of separating the effects of the lending and balance sheet channels. These data sets, although not utilized in this context, include loan-specific, bank-specific, and borrower-specific variables that can help one measure and compare the effects of banks' liquidity constraints and the strength of borrowers' balance sheets on the amount of lending.

Appendix. Definitions of Bank-Specific Variables

Table 6. Definitions of the Variables Used in Estimation

	Acronym	Description
ID	RSSD9001	The primary identifier of a bank.
Date	RSSD9999	The quarter for which the report was filed.
Bank Type	RSSD9331	A two-digit code indicating the type of entity. This is used to identify commercial banks.
Primary Insurer	RSSD9424	A code indicating the highest level of deposit-related insurance of the head office of a U.S. depository institution or U.S. branch of a foreign bank. This is used to determine whether a bank is insured or not.
MBHC Affiliation	RSSD9348	The five-digit code assigned to the principle holding company or the highest holding company in a tiered organization.
State in which the Bank Operates	RSSD9210	A two-digit code assigned to a state of the United States or a U.S. territory in which the entity is physically located or its mailing address.
Total Loans	RCFD1400	The aggregate gross book value of total loans (before deduction of valuation reserves).
Capital-Assets Ratio	RCFD3210, RCFD2170	The ratio of total equity capital (RCFD3210) to the sum of all assets (RCFD2170).
Liquidity	RCFD0390, RCFD1350, RCFD2146, RCFD0600, RCFD1754, RCFD3545	From 1986:Q2 through 1993:Q2 period, liquidity is the sum of total investment securities (RCFD0390), RCFD1350, and assets held in trading account (RCFD2146). From 1993:Q3 through 2009:Q1, liquidity is measured as the sum of RCFD1350, securities held to maturity (RCFD1754), and trading assets (RCFD3545).

(continued)

Table 6. (Continued)

	Acronym	Description
Indicators of Globalization	BHCK2122	Total loans and leases, net of unearned income.
	BHCK1763	Commercial and industrial loans to U.S. addresses.
	BHCK1764	Commercial and industrial loans to non-U.S. addresses.
	RSSD9209	The country code of the Foreign Call Family ID.
	RSSD9325	The type of foreign ownership of a U.S.-chartered entity.
	RSSD9329	The percentage of foreign ownership.
	RSSD9030	Physical place code.
	RSSD9031	Physical country code.

Notes: More detailed definitions of these variables can be obtained from the Federal Reserve Bank of Chicago web site by searching for the acronyms reported in the second column.

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