Centralized versus Decentralized Banking: Bank-level evidence from U.S. Call Reports

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Abstract

This paper demonstrates that decentralized banking has been the primary model of banking in the US since the mid-90s. This evidence is obtained by using a large number of bank-level observations from US Call Reports. The ownership structure that I infer from these data allow me to use a unique identification strategy to determine the independent effects of subsidiary-specific and owner-specific financial conditions (decentralized and centralized effects, respectively) on subsidiaries' lending. The results show that subsidiaries financial conditions were, in general, more important for lending decisions than those of its owners. In other words, decentralized banking is more pronounced than centralized banking. Considering a broad set of factors that have a systematic effect on financial markets, I also find that the effects of these push factors on subsidiary lending mainly feed through the financial conditions of the subsidiaries and not their owners.

Keyword(s): Call report data; centralized banking; decentralized banking; global push.

JEL Classification: E44; F32; G15; G21

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1. Introduction

How independent are subsidiaries from their parent bank holding companies? Research on internal capital markets, on the one hand, reveals that bank holding companies can wield considerable power over their subsidiaries by providing or retracting funding through their internal networks/capital markets. Studies such as Buch et al. (2016), Campello (2002), Cetorelli and Goldberg (2012a, 2012b), De Haas and Lelyveldb (2010), and Houston et al. (1997) support this claim and provide evidence for the effective functioning of internal capital markets. Numerous studies show that this effect of parent banks on their affiliates is supportive in nature.[1] Overall, these findings support the claim that decision making processes in banking are more centralized. On the other hand, some studies, albeit mostly international in scope, find that subsidiaries have become more independent through local funding and decision making (e.g. Avdjiev and Takáts, 2014, and Fiechter et al., 2011). These findings, conversely, favor decentralized banking. It should be noted, however, that while the pros and cons of centralized and decentralized banking are well-documented (e.g. Stein, 2002; Berger et al, 2001, 2005; Takats, 2004; Liberti and Petersen, 2018; Liberti, 2009), there is no well-defined basis to compare the relative strength of these two models of banking and to determine how they have fared over time. This is what I attempt to do in this paper.

Determining whether banking is becoming more centralized or decentralized is crucial for financial stability and the policies that attempt to enhance this stability. Specifically, large banks have been put under great scrutiny after financial crises as they have been deemed too big and too interconnected to fail. If banking is predominantly centralized and large banks' financial conditions and their reactions to global credit shocks influence the lending decisions of its wide

[1] See, Crystal et al. (2002), Dages, et al. (2000), De Haas and van Lelyveld (2006), Goldberg (2002), Martinez Peria et al., (2002), Peek and Rosengren (2000).

network made up of subsidiaries and other affiliates then this justifies the higher scrutiny they receive. If, on the other hand, banking is becoming more decentralized, the systematic risk that large banks pose for financial markets would be overestimated and the likelihood of a crisis prompted by a large bank failure would decrease. It is therefore critical to compare the strengths of centralized and decentralized decision making in banking and to track these forces over time.

In this paper, I take a step in this direction by focusing on the lending behavior of banks/subsidiaries that are owned by large bank holding companies. I test whether the lending behavior of these banks are influenced by their own financial conditions or those of their owners. Of course, the systematic risk that large banks pose does not solely manifest itself through its subsidiaries' lending. The exposures of these institutions to other bank and non-bank financial institutions through their balance sheets and off-balance sheet items play an important role. Comprehensive and historical data on cross-bank exposures, however, is not available to the best of my knowledge. By contrast, lending behavior of large banks' subsidiaries are reported extensively in Federal Reserve's Call Reports of Condition and Income at the quarterly frequency. This is the database that I use in my analysis. One key advantage of my analysis is that uses a large number of bank-level observations dating back to 1987Q1. Using this database, I link subsidiaries with their parent bank holding companies, I obtain financial indicators for the two institutions, and I compare the strength of centralized and decentralized banking. This comparison reveals that decentralized banking in the US has been the primary form of banking since the Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994.

When comparing to two forms of banking, I face an identification challenge. The identification is confounded by the fact that the financial conditions of the subsidiaries and their owners may affect subsidiary lending simultaneously. It is, therefore, difficult to identify the

independent effects of these two channels of transmission to lending. To measure the independent effects of the decentralized aspects of banking, I use a strategy that relies on the effective functioning of internal capital markets. Specifically, I compare the lending behavior of subsidiaries that are owned by the same bank holding company and I match this relative lending with the relative financial conditions of the sister subsidiaries. I then test whether changes in a subsidiary's financial structure or health, relative to its sisters, significantly affects its relative lending. In so doing, I am able to shut-down any effects that bank holding companies may have on their subsidiaries through their loanable fund provisions or withdrawals through internal capital markets.

To identify the strength of centralized banking I use a different strategy that relies on the link between local macroeconomic conditions and bank balance sheets. I follow this strategy by first identifying banks/subsidiaries that operate in the same state but are owned by different bank holding companies. I then measure the lending growth of these banks relative to each other and match this variable with the relative financial conditions of their owners. In doing so, I also control for banks' financial conditions. This strategy allows me to control for any symmetric effects that local factors may have on bank lending and put the focus on the impact of bank holding companies on subsidiary lending, i.e., the strength of centralized banking. I choose this strategy since there is well-documented evidence that links the health of banks, especially those that are smaller, to the local conditions, such as the strength of borrower balance sheets and macroeconomic growth, in the state that they operate (e.g. Ashcraft and Campello, 2007; Strahan and Weston, 1998; Berger and Black, 2010). This evidence together with the nature of the data provides a unique opportunity to suppress the decentralized influence on lending when measuring the degree of influence that feeds through centralized decision making.

The sample period that I use has two natural breaking points: Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994 that deregulates inter-state banking and the 2008 financial crisis and the ensuing recession. Given these break points, I split my sample period into three separate time periods: 1987Q1 to 1994Q4, 1995Q1-2007Q4 and 2010Q1-2017Q4. Splitting the whole sample period into smaller subperiods also proves to be favorable for the dynamic panel estimator that I use (the system GMM estimator of Arellano and Bover, 1995). The results demonstrate a strong support for decentralized banking in the two subperiods following the Riegle-Neal Act. Prior to this (1987-1994), I find that the two types of banking are equally important. I reach these conclusions by using financial indicators of bank (and bank holding company) capital adequacy, asset quality, profitability and liquidity. For the post-2009 period, the results corresponding to these specific aspects of bank structure/performance indicate that while only the changes in bank holding companies' asset quality (measured by the change in nonperforming loans-to-total-loans ratio) influences the lending of its subsidiaries, all subsidiary-specific characteristics are a significant determinant of its lending. Although, bank holding company's financial health is a more significant determinant of subsidiary lending between 1995 and 2007, the strength of this centralized effect is not as strong as decentralized effects (the importance of subsidiaries' financial health). In the earlier period, 1987-1994, all financial indicators for each type of banking have a significant effect on lending.

Following the 2008 crisis, there has been a growing literature on the importance of global push effects in banking (e.g. Rey, 2015, Miranda-Agrippino and Rey, 2015; Cerutti et al., 2015). The common finding is that shocks that affect global financial markets cause a common reaction in the banking system (a simultaneous retrenching or expanding of lending for example). If these global shocks are transmitted to lending through bank holding companies' financial health (centralized banking in my analysis) then this would weaken the central inference that I drew so

far: banking has become more decentralized after 1994. The opposite result, if global shocks are transmitted through decentralized banking, would reinforce the earlier conclusions. To compare the strength of these two transmission channels, I obtain 10 series that are commonly used to capture global push factors such as global volatility perception, risk spreads, and monetary stance. The results show that global push factors have affected bank lending mostly through banks' financial conditions (decentralized banking) after 1994. Similar to earlier results, global push factors' have an equally significant interaction with bank and bank holding company balance sheets before 1995. The interaction of global push factors with bank holding company balance sheets is mostly insignificant after this period, especially between 1995 and 2007. The more general inference here is that while internal capital markets of bank holding companies may be functioning effectively, bank holding companies do not protect/insulate their subsidiaries from global shocks by channeling funds through these internal networks.

My findings, therefore, demonstrate a contrast to those on the supportive nature of internal capital markets. They are, however, consistent with numerous studies, albeit mostly global in perspective, revealing a trend towards decentralization (e.g., Avdjiev and Takáts, 2014; Fiechter et al., 2011). While it is outside the scope of this paper to search for the determinants of this trend, I should point out some postulations in studies such as Claessens (2017) and Fiechter et al. (2011). The growing importance of decentralized (or regional) banking in the world according to these studies is due to the transformation of bank bankruptcy resolution and its effects on large bank holding companies with a global presence. Specifically, while former models of bankruptcy resolution consider the whole network of large bank holding companies during the bankruptcy process (a universal model), more recent models consider the banks independent of its owners'

financial condition (a territorial model).[2] Also, after 2008, large bank holding companies with an international presence, most of the parent banks in my analysis, have deleveraged due to stricter regulatory requirements. Their subsidiaries, however, have continued to lend throughout this period. Third, banks have increasingly gained access to external funding thereby decreasing their reliance on their parent with the expansion of credit markets in the past 30 years. Finally, the ownership structure in banking can be highly diffused (see, Cetorelli and Goldberg, 2016), consisting of multiple layers of ownership, which would further weaken the link between a subsidiary and its owners.[3]

There is also evidence suggesting that decentralization may carry a momentum. Studies such as Skrastins and Vig (2019) and Stein (2002), for example, find/show that the ability to produce soft information (qualitative features of the borrower and the contract that cannot be quantified) increases as the banking structure becomes more decentralized. Mocetti et al. (2017), Brynjolfsson and Hitt (1998) and Bresnahan et al. (2002) relate this mechanism to information technology. As opposed to hard (quantifiable) information, soft information does not get passed up through the hierarchy of ownership and thus the greater availability and reliance on soft information further detaches a subsidiary's lending decisions from its owners.

2. Identification

To identify the independent effects of centralized and decentralized drivers of bank lending, I follow a strategy that relies on internal capital markets or rather how banks are linked

[2] Conlon and Cotter (2019) and Karamichailidou and Mayes (2016) provide an extensive review of the differences between a single point entry bankruptcy resolution (a more universal approach that focuses on the parent bank) and a multiple points entry resolution (a more territorial approach that focuses on the subsidiaries). The authors point out the growing emphasis on subsidiaries for internationally active banks in the past decade. For banks that only lend domestically, especially in the US and after 2008, bankruptcy resolution follows a single point entry model.

[3] The evidence suggests that management practices within banks' internal network have remained symmetric with a high degree of information sharing and common risk management practices. This indicates that the decentralization of banking is not due to management practices (e.g. Avdjiev and Takáts, 2016).

with their parent bank holding companies through these markets. When measuring the strength of decentralized banking, i.e., how banks' own financial condition shapes its lending decisions independent of its parent bank holding company, I compare the lending behavior of banks that are affiliated with the same bank holding company. Specifically, I measure the deviation of bank *i*'s loan growth, $lg_{i,t}$, from the average loan growth of its sister subsidiaries denoted by $\overline{lg}_{i,t}^{dc}$ such that,

$$lg_{i,t}^{dc} = lg_{i,t} - \overline{lg}_{i,t}^{dc} \quad (1)$$

where $lg_{i,t}^{dc}$ denotes the relative loan growth of bank *i*. This variable will be the independent variable in my estimations. To determine how banks' financial condition affects its relative loan growth rate, I investigate how $lg_{i,t}^{dc}$ is related to various financial ratios of the bank. These ratios, too, are measured in relative terms. When measuring the impact of a bank's liquidity on its lending for example, I measure the change in its liquidity ratio relative to the average change in liquidity across its sister subsidiaries.

This formulation allows me to shut down the effects of any provisions or loans provided to the bank by its parent and solely focus on the relative financial health of the bank as a determinant of its lending. The implicit assumption here is that the subsidiaries have similar access to its parent's internal capital markets and that the changes in a parent bank holding company's financial condition would affect its affiliates symmetrically. Of course, this procedure is only reasonable if banks are small enough that their access to internal capital markets of its parent is much greater than its access to external financial markets. This is the reason why I solely focus on the lending behavior of banks that are owned by bank holding companies and not bank holding companies owned by other bank holding companies.

The dynamic panel model that I estimate to measure the strength of decentralized banking can be represented as follows:

$$lg_{i,t}^{dc} = \alpha + \sum_{k=1}^{4} \beta_k^{dc} lg_{i,t-k}^{dc} + \sum_{k=1}^{4} \gamma_k^{dc} bfr_{i,t-k}^{dc} + \sum_{m=1}^{4} \vartheta_m^{dc} c_{m,t-1}^{dc} + \varepsilon_{i,t}^{dc} \quad (2)$$

Here $bfr_{i,t-k}^{dc}$ denotes the relative change in banks' financial ratio and $c_{m,t-1}^{dc}$ is a vector of control variables populated by the lagged financial ratios of the parent bank holding company. The latter variables are included to control for any bank holding company specific effects that may still remain after purging any bank holding company specific effects from lending. Notice that I include four lags of bank's financial ratio in equation (2). This is a common approach in the credit channel of monetary transmission literature (e.g., Kashyap and Stein, 2000; Ashcraft and Campello, 2007) and it accounts for the possibility that the loan amount in a given period could be an installment of a loan contract formulated in the past and thus could be related to the banks' past financial condition. In the literature, including four lags is a common way of capturing this staggered effect.[4]

To identify the strength of centralized banking, I follow an identification strategy that is akin to yet different from the one described above. To hone in on the centralized drivers of lending, I compare the lending behavior of subsidiaries that are located in the same state but are owned by different bank holding companies. The reason is that banks in the same state, especially those that are small, face similar pull conditions such as strength of borrower balance sheets and local economic activity. By comparing the lending behavior of banks in the same state, therefore, I suppress any of these local pull effects that may affect lending. To execute this strategy, I redefine my dependent variables as,

[4] Research on monetary transmission typically includes 8 lags of the monetary policy stance variable. While I do not study monetary transmission, I did replicate my analysis with 8 lags. The results, available upon request, were qualitatively similar.

$$lg_{i,t}^{c} = lg_{i,t} - \bar{lg}_{i,t}^{c} \quad (3)$$

where the relative loan growth variable, $lg_{i,t}^{c}$, now measures the difference in the lending growth of bank *i* and the average lending growth, $\bar{lg}_{i,t}^{c}$, of all banks operating in the same state as bank *i* but are owned by different bank holding companies.

In this part of my analysis, the strength of centralized banking is captured by how a parent bank holding company's financial conditions affect lending. More specifically, the main independent variable, $bhcfr_{i,t-k}^{c}$, is measured as the change in the financial ratio of a bank *i*'s parent relative to the average change in the financial ratio of all parent bank holding companies that have an affiliate in the same state as bank *i*'s state. The model that includes these variables is given by,

$$lg_{i,t}^{c} = \alpha^{c} + \sum_{k=1}^{4} \beta_{k}^{c} lg_{i,t-k}^{c} + \sum_{k=1}^{4} \gamma_{k}^{c} bhcfr_{i,t-k}^{c} + \sum_{m=1}^{4} \vartheta_{m}^{c} c_{m,t-1}^{c} + \varepsilon_{i,t}^{c} \quad (4)$$

where the control variable vector $c_{m,t-1}^{c}$ includes bank-specific financial ratios and it accounts for any bank-specific effects that may be related to lending behavior.

3. Data and Estimation

The data that I use in my estimations are obtained at the quarterly frequency from the Federal Reserve's Call Reports of Condition and Income for the 1987Q1-2017Q4 period. These reports are publicly available for every U.S. chartered bank and bank holding company. While reports are available for commercial banks for earlier periods, I use 1987Q1 as the starting point since I will be using bank holding company data.

To construct my dataset, I follow several steps. First, I include only commercial banks that are a part of a tiered organization under a bank holding company. This eliminates all stand-alone banks, and charter types such as government agencies, credit unions, and savings and loan associations. Second, I use banks' financial statements to obtain the amount of loans they have

outstanding and to construct various performance and structural indicators. The latter set of variables are the main focus of my estimations and they capture firms' capitalization, asset quality, profitability and liquidity.

I measure bank capitalization with the capital to assets ratio, where capital is measured as the sum of perpetual preferred stock, common stock undivided profits and capital reserves and cumulative foreign currency translation adjustments. To gauge the quality of banks' assets, I use the ratio of total nonaccrual loans and finance receivables to total loans. While there are alternative variables that can capture asset quality (such as loans that are still accruing but are past due for specific time periods), nonaccrual loans was the most commonly-reported variable in my sample (across firms and the different time periods I investigate). This is also true for the other variables that I use.[5] To measure the profitability of a bank I use the ratio of its net interest income (total interest income minus total interest expense) to its total assets. Measuring banks' liquidity across a longer time period is not as straightforward as liquid assets have been reported under different items at different times. The details of how I construct a liquidity ratio is detailed in Appendix A. I should note, however, that this ratio roughly captures the share of investment securities and trading assets in total assets. Appendix A also summarizes the acronyms and definitions of all variables used in my estimations. All ratios in my estimations are measured as changes over the same quarter of the previous year and loan growth, the dependent variable, is measured as log differences of total loans over the same period.

As a third step, I link banks with their parent bank holding companies by using a five digit bank holding company identifier that specifies the regulatory high-holder of a commercial bank. I then construct the structural and performance ratios described above for bank holding companies.

[5] Structural and performance ratios are reported explicitly after 2011 for example. My approach summarized above is more consistent with the more historical data that I use.

These ratios, unlike the bank-specific ratios that help me measure the strength of decentralized decision making, will help me infer the strength of centralized banking.

As a final step, I identify the states that banks operate which allows me to further purge the effects of centralized banking of the effects of decentralized banking. Specifically, I compare the lending behavior of banks, with different parent bank holding companies, that operate in the same state. As explained above, doing so allows me to control for any state-specific pull factors such as the strength of borrower balance sheets and local economic activity when quantifying the influence of a parent on its subsidiary's lending.

Table 1 reports some statistics that describe that dataset that I use in my estimations. In this dataset (spanning 1987Q1-2018Q4), there are a total of 11,309 different owners and 15,740 different banks, respectively. This sample only includes banks with owners and bank holding companies that own reporting banks. The average owner in my sample approximately has 5 subsidiaries and 4 times the assets of these banks. Notice also that the inferences in this paper are drawn from a large number of observations. The table also reports statistics related to the 4 variables that I will use to gage the strength of centralized and decentralizes banking. These statistics exhibit only a weak relationship between the subsidiaries' variables and those of their owners. The next section will more rigorously analyze whether this observation is consistent with weak centralized banking. The statistics also show that the owner and bank specific variables have different means and standard deviations. It is, therefore, important to account for these differences in my estimations if I am to compare the economic significance/strength of centralized and decentralized banking.

In my baseline estimations, I focus on the post-2008 period. I do, however, use data from earlier periods to determine how the strengths of centralized and decentralized banking have

evolved over time. In so doing, I split the pre-2008 period into two subperiods: 1987Q1-1994Q4 and 1995Q1-2007Q4, where the beginning period, 1987Q1, is determined by data availability. I choose this strategy because the Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994 that phases out the obstacles to inter-state banking in the US has direct consequences for the two channels I investigate in this paper. Also, splitting the pre-2008 period into shorter time periods is advantageous for the estimation method that I discuss below.

To estimate my models I use the difference GMM dynamic panel estimator of Arellano and Bover (1995).[6] This estimator accounts for fixed and random effects in the panel and corrects for hetereoskedasticity and serially correlated errors, and it is advantageous because not all independent variables need to be exogenous. The estimator, however, loses power as the time dimension expands. Breaking the sample period into smaller sub-periods as described above makes the estimator more useful for my analysis. In the two-step estimation process, the endogenous variables in levels are instrumented with the lags of their first differences. In most of my estimations, I use the first lag off all right-hand-side variables as instruments. I also apply Windmeijer's finite-sample correction since the two-step estimation yields downward biased standard errors.

4. Results

In this section, I report the baseline results obtained from the estimation of equations (2) and (4) above. I measure the strength of centralized and decentralized effects and I compare these two effects across time. I measure the impact of global push shocks on centralized and decentralized banking.

[6] I use the steps in Roodman (2009) to execute this methodology in STATA.

4.1. Baseline results

The results obtained from my baseline estimations are reported in Tables 2 and 3. Table 2 reports the results for decentralized banking. The variables listed in the columns are the main independent variables in my estimations and they help capture the strength of decentralized banking. The coefficients of these variables reported in the first row are all significant and they imply that banks with more adequate capital, higher asset quality, higher performance and more liquidity lend more than its sister subsidiaries (subsidiaries affiliated with the same bank holding company). Notice here that since asset quality is measured by the share of nonaccrual (nonperforming) loans, the negative coefficient value implies that as asset quality increases loans increase.

To understand the economic significance of the coefficients in the first row, it is useful to visualize the following scenario: Assume that a bank's capital-to-assets ratio increases by 1 percent (on an annual basis) in each of the past 4 quarters and that the same ratio does not change for the bank's sister subsidiaries during the same time period. The coefficient value of 6.181 reported for bank adequacy then implies that its loans in the next quarter grow by 6.181 percent more than the average loan growth across its sister subsidiaries. The same thought experiment applies to the other three features of banking that are listed in the columns. The control variable coefficients, as expected, are mostly insignificant. This implies that the comparison of lending within a bank holding company organization mostly shuts down the effects of centralized banking and it allows me to identify the independent effects of decentralized banking. In these estimations, there is no evidence for second-order serial correlation in the error term or for the invalidity of the

instruments.[7] This observation holds for the all the other estimations I conduct throughout the paper.

Turning to the results reported in Table 3, results from the estimation of decentralized banking mechanism, the only bank holding company specific feature that impacts its subsidiary's lending is asset quality. The coefficient value for asset quality has a different implication. For a better understanding, let's continue with our thought experiment but now assume that we are comparing the lending behavior of a bank, say bank *i*, with all the other banks that operate in the same state, say state *s*. Assume also that the latter are owned by bank holding companies that different from the owner of bank *i*. The asset quality coefficient of -23.543 then implies that if the owner of bank *i* experiences a 1 percent increase (on an annual basis) in its share of nonaccrual loans in the past 4 quarters and for the rest of the owners of banks in state *s* the share of nonaccrual loans stays the same, bank *i*'s loan growth in the following quarter is 23.543 percent less than the average loan growth of all other banks (banks with owners) in state *s*.

While the value of the coefficient discussed above appears large, one must be cautious in drawing conclusions for economic significance from this result. The magnitude of the coefficient could be determined by the relatively low volatility of bank holding companies' nonaccrual loans. I account for this possibility next when I compare the strength of centralized and decentralized banking. Before I do so, I should note that the control variables in Table 3 are also insignificant. This implies that controlling for state specific effects such as local economic conditions and borrower balance sheets allows me to purge the impact of centralized banking from any decentralized effects.

[7] I use the Hansen test statistic rather than the Sargan test statistic since the latter is not robust to heteroscedasticity and autocorrelation in large panels such as the one I use in this paper.

4.2. Economic significance and a historical comparison

In this section, I compare the strength decentralized and centralized banking effects. To level the playing field in this comparison I account for the different volatility of decentralized and centralized banking variables. This strategy is crucial for the comparison if, for example, banking variables are much more volatile than bank holding company variables (or vice versa) since estimations with bank data would yield smaller coefficients. The small magnitude, indicating the effect of a unit change in a bank variable on lending, however, does not imply that decentralized effects are inconsequential as the banking variable has higher volatility.

To account for the potential disparity in volatility levels, I normalize the decentralized and centralized banking variables by their standard deviations so that the coefficients measure the percent change in lending prompted by a one-standard-deviation change in the main independent variable. The estimation results corresponding to this adjustment are summarized in Table 4. In this table, I only report the main independent variable coefficients for simplicity as the control variables are insignificant for the most part and the evidence from diagnostic statistics are similar. Table 4 shows that the only significant centralized banking variable, asset quality, has a quantitatively similar, albeit larger, effect on lending than its decentralized counterpart, whereas centralized effects are much larger when asset quality is not normalized. This suggests that the share of nonaccrual loans is more volatile for banks than it is for bank holding companies.

The results in Table 5 demonstrate the diminishing effects of centralized banking over the past 3 decades. The results also show, in general, that both effects, centralized and decentralized effects have weakened over the three periods I analyze. A comparison of the earlier period (1987-1994) with the latter period (post-2009) reveals not only that centralized effects are more significant in the earlier period but also the magnitudes of the significant coefficients for the most

part are larger during this period. The evidence is mixed for the period that follows the Riegle-Neal Act of 1994. Specifically, while the coefficients of centralized banking are more significant compared to the post-2009 period, they are smaller in magnitude, compared to both the earlier period and post-2009. Also, the results for decentralized banking during the 1994-2007 period show that while lending is more closely related to performance and liquidity, they are more loosely related to capital adequacy and asset quality compared to the post-2009 period. This observation could be related to the two counteracting effects of the Riegle-Neal Act on centralized banking. One the one hand, the lifting of inter-state banking reinforces centralized decision making. On the other hand, the restriction of inter-state mergers and acquisitions that result in high market concentration within the country and the state limits the scope and scale of centralized banking.

Notice in Table 5 that while the coefficients of capital adequacy and liquidity are all positive, the coefficient of asset quality switches to positive in two estimations and the coefficient of performance switches to negative for centralized banking between 1995 and 2007. These results could potentially reflect global financial market conditions that may be influencing lending decisions. In a high performing/loose global financial market, banks (or bank holding companies) may more aggressively search for yield which simultaneously increases lending (or the lending of their subsidiaries) and the share of nonaccrual loans. In such an environment, banks may also borrow more aggressively (at a higher cost) to finance a growing demand for loans, which in turn generates a negative relationship between net interest income (my measure for profitability) and loan growth. These mechanisms would apply in reverse and generate the same relationships when global financial conditions are tighter.

It is, therefore, critical to investigate how the comparison of centralized and decentralized banking is influenced by global financial conditions. This is the topic I turn to next. Before I do

so, I should mention that the two mechanisms I analyze in this paper are related to pull and push effects in banking literature (e.g., Avdjiev et al., 2019; Fratzscher, 2012; Houston et al., 2012). These effects are defined more broadly in the literature relative to my definitions of centralized and decentralized banking effects as they include conditions and features of the economy and the financial market outside of the bank. While I have controlled for local conditions when measuring the impact of centralized banking, so far I did not account for global financial push factors that may impact bank lending. I do this in the next section. Doing so will allow me to compare centralized and decentralized banking when the latter is defined more broadly to include global push factors.

4.3. Global push factors

I approximate global financial conditions by using 10 variables. These variables, listed in Table 6 and defined in Appendix A, are commonly used in the literature on global push effects (e.g. Miranda-Agrippino and Rey, 2015; Cerutti et al., 2015). The 3 month Treasury–EuroDollar spread (TED) is a common measure of credit risk in the interbank market. The Baa-Aaa, Gilchrist and Zakrajsek (2012) GZ and EBP spreads capture the same risk in corporate bond markets, with the latter measuring the excess bond premium that predicts the likelihood of a US recession over the next year. The federal funds rate and the shadow rate are included to account for push effects that are generated by US monetary policy. For the latter measure I use the Krippner (2013) series that is derived by using a two factor model with latent variables and risk factors. This series predicts the nominal federal funds rate in the absence of a zero lower bound.

In addition to these, I include measures that signal conditions in US equity markets. The VIX index and its more narrowly defined version, VXO index, measure market's expectations for volatility over the next month, and the MSCI index measures returns to US equity. Finally, I

include US real GDP to capture push effects generated by broader economic conditions. All push factors, except the two volatility measures and the US real GDP are measured in each quarter as the change over the same quarter of the previous year. The volatility measures and US real GDP are log differenced over the same quarter of the previous year. The Gilchrist-Zakrajsek indices and the Krippner shadow rate are obtained from the authors' websites. The remaining data are from the Federal Reserve Bank of St. Louis, FRED database.

I incorporate push effects into my empirical analysis by through the following two equations:

$$lg_{i,t}^{dc} = \alpha + \sum_{k=1}^{4} \beta_k^{dc} lg_{i,t-k}^{dc} + \sum_{k=1}^{4} \gamma_k^{dc} bfr_{i,t-k}^{dc} + \sum_{k=1}^{4} \mu_k^{dc} bfr_{i,t-k}^{dc} * p_t + \sum_{m=1}^{4} \vartheta_m^{dc} c_{m,t-1}^{dc} + \varepsilon_{i,t}^{dc} \quad (5)$$

$$lg_{i,t}^{c} = \alpha^{c} + \sum_{k=1}^{4} \beta_k^{c} lg_{i,t-k}^{c} + \sum_{k=1}^{4} \gamma_k^{c} bhcfr_{i,t-k}^{c} \sum_{k=1}^{4} \mu_k^{c} bhcfr_{i,t-k}^{c} * p_t + \sum_{m=1}^{4} \vartheta_m^{c} c_{m,t-1}^{c} + \varepsilon_{i,t}^{c} \quad (6)$$

where p_t represents the push variable and the coefficients μ_k^{dc} and μ_k^{c} measure the impact of the push factor on decentralized banking, in equation (5), and on centralized banking, in equation (6), respectively. Specifically, the interactive terms in equation (5) and equation (6) allows me to determine how the sensitivity of a bank's lending to its financial structure/performance and those of its parent bank holding company is related to global push effects, respectively.

The results obtained from the estimation of equation (5) are reported in Table 6. The interactive variable coefficients for capital adequacy indicate that when there is a higher credit market risk or higher growth in equity markets, banks with more adequate levels of capital lend more. By contrast, these banks lend less when there is a monetary tightening or an increase in interbank borrowing spreads. The interactive coefficients represent the effects of a 100% change in the push factor on lending. The coefficient value of -29.140 for the interaction of TED and

Capital Adequacy then implies that if the Euro-Dollar spread increases by 1 percent, a bank experiencing a 1 percent change in its capital adequacy ratio (relative to its sister subsidiaries) curtails its lending by 0.29 percent more than its sister subsidiaries.

Turning to asset quality, I find that global push factors have no significant effects on how bank loans react to asset quality. In other words, banks' exhibit the same sensitivity to asset quality irrespective of whether global credit market conditions are positive or negative. This cannot be said about performance and liquidity. The results show high performing banks curtail their lending by more when they perceive a higher corporate credit risk. Conversely, their lending, relative to low performing banks, expand by more when there is higher macroeconomic volatility, higher interbank borrowing spreads and when there is monetary tightening. These results reveal a dichotomy in banks' reaction to credit risk. Specifically, if the risk originates in the demand side of credit markets, high-profit banks decrease their lending relative to low-profit banks. They do the opposite if the risk is related to the supply side of credit markets or the macroeconomy. While banks with higher liquidity, demonstrate a retraction of loans in response to an increase in corporate bond spreads similar to high-performing banks, they decrease their loans by more when they perceive higher supply side and macroeconomic risks unlike high-performing banks.

Table 6 reports the results obtained from the estimation of equation (6). These results, especially when compared with those in Table 7, reveal that push effects mostly feed through decentralized banking. Specifically, push factors affect banks' lending only through only the asset quality of its parents. Push factors have almost no effect when they interact with the remaining features of parent bank holding companies. The importance of bank holding companies' asset holdings in these findings is consistent with the earlier findings (for both post-2009 and pre-2007). This implies that bank holding companies restrict the lending of their subsidiaries only if they are

suffering a rise in bad loans and that they do not retract/recall loanable funds from their subsidiaries when they have capital or liquidity shortages or when they are not performing as well.

More broadly, the results also imply that bank holding companies are not able to insulate the subsidiaries within their network through internal capital markets as these subsidiaries are vulnerable to global shocks.

Table 8 compares the effects of push factors on centralized and decentralized banking in the three sub-periods I analyze. The table reports the standardized coefficients to compare the relative impacts and only reports coefficients that are significant. The results show that the main inference drawn from the post-2009 period, the relative irrelevance of push-centralized banking interaction, also applies to the 1995-2007 period. During the latter period, the interactive variable coefficients corresponding to asset quality coefficients are insignificant. In contrast to these two sub-periods, decentralized banking appears to have been an important channel through which push effects were transmitted to bank lending between 1987 and 1994, demonstrating the mitigating effects of the Riegle-Neal Act on the strength of this transmission. A comparison of the coefficients in the two panels does not reveal whether push effects predominantly feed through centralized or decentralized banking, albeit centralized banking coefficients are more often larger in magnitude.

4.4. Internal capital markets

One goal of this paper is to determine whether bank holding companies use their internal capital markets to alter the lending behavior of its subsidiaries by channeling or withdrawing funds to and from these institutions. Ideally, one would utilize bilateral data on these internal transfers to reach this goal. These data, to the best of my knowledge, are not available publicly. Nevertheless, there are aggregate data that can signal the efficiency of internal capital markets.

These data, when matched with the lending behavior of subsidiaries, demonstrate a weak link between owners and subsidiaries and reinforce the case against centralized banking in the US.

Table 9 reports this weak link. In the table, balances due to and from the owner represent the intercompany transaction balances due to and from subsidiary banks of the bank holding company, respectively. These data are reported for each bank holding company. Therefore, while the data are at the bank holding company level, they are aggregated over all the subsidiaries of the bank holding company. The acronyms corresponding to these variables are reported in Appendix A. Net transfers here are measured as the difference between balances due to the owner and the balances due from the owner. The data are available only after 2003 and thus this is the reason why use 2003 as the starting point of the pre-crisis period.

The statistics reported in the table show that internal capital markets are not a large source of funding for the subsidiaries as they are a small fraction of the assets. This is more evident in the earlier period. More critically, the table shows that the correlations of subsidiaries' annual loan growth rate and the annual change in the net transfers to the owner (as a fraction of the subsidiaries' assets) are low. The correlations of these net transfers with the lending deviations described by equations (1) and (3) are even lower. Although these two observations are qualified by the fact that they are at the aggregate level, they do reinforce the main message of my paper: the owners' influence on its affiliates' lending may be negligible and that centralized banking may be weaker form of banking in the US.

5. Conclusion

This paper compared the strength of centralized and decentralized banking and demonstrated that decentralized banking has been the primary form of banking in the US since the mid-90s. This conclusion is reached by using a large number of bank-level data obtained from the

US Call Reports of Condition and Income. These data allowed me to determine the owners of subsidiaries and the states where these banks operate. Using this information in a unique identification strategy, I identified the independent effects of subsidiary-specific and owner-specific financial conditions on subsidiaries' lending. The results from a system GMM estimator showed that subsidiaries financial conditions were, in general, more important for lending decisions than those of its owners. In other words, decentralized banking is more pronounced than centralized banking. The findings indicated, however, that this observation characterizes the period after the Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994, and that the strength and significance of the two models of banking were similar prior to the 1995.

Considering a broad set of factors that have a systematic effect on financial markets and bank lending (what is more commonly referred to as push factors), I found evidence that reinforced my main conclusions. Specifically, I found that the effect of push factors on subsidiary lending mainly feed through the financial conditions of the subsidiaries and not their owners.

Due to the lack of data, I inferred the strength of centralized and decentralized banking by measuring the sensitivity of lending to subsidiary and bank holding specific factors. A more direct approach would be to test how bank holding companies' transfer/withdrawal of loanable funds affects its subsidiaries' lending. An identification scheme, similar to that in this paper, would then allow one to determine whether subsidiaries obtaining more funding from its parent lends more than the other subsidiaries. Also, one could determine whether the subsidiaries of a bank holding company facing an adverse financial conjecture restrict their lending by more than other subsidiaries. This would be a much needed analysis to settle the debate on the effectiveness of and risks associated with internal capital markets but it would require bilateral data on the flow of

funds between a bank and its owner. These data, to the best of my knowledge, are not publicly available.

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Appendix A. Data

Data	Variable	Acronym	Description
Call Report data. Source: Federal Reserve's Call Reports of Condition and Income			
	Bank 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
	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
	BHC Affiliation	RSSD9348	The five-digit code assigned to the principle holding company or the highest holding company in a tiered organization.
	State	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, RCFD2122, RCFD2123	The aggregate gross book value of total loans, before deduction of valuation reserves (RCFD1400) before 2012. After 2011, the sum of total loans and leases net of unearned income (RCFD2122) and unearned income on loans (RCFD2123).
	Assets	RCFD 2170	The sum of all assets.
	Equity	RCFD3210	The sum Perpetual Preferred Stock and Related Surplus, Common Stock, Surplus, Undivided Profits and Capital Reserves, Cumulative Foreign Currency Translation Adjustments, less Net Unrealized Loss on Marketable Equity Securities.
	Liquidity	RCFD0390, RCFD1350, RCFD2146, RCFD0400, RCFD0600, RCFD1754, RCFD3545	From 1987Q1 through 1993Q2 period, liquidity is the sum of U.S. Treasury and Government Agency securities (RCFD400, RCFD600), investment securities (RCFD0390, RCFD1350), and assets held in trading account (RCFD2146). From 1993Q3 trhough 2012Q4, liquidity is measured as the sum of RCFD1350, securities held to maturity (RCFD1754), and trading assets (RCFD3545).
	Nonaccrual loans	RCFD1403, RCFD1407, RCFD1607, RCFD1608	Before 2012 the sum of total loans and financial receivables, nonaccrual (RCFD1403) and total loans and financial receivables, past due 90 days still accruing (RCFD1407). After 2011, sum of commercial and industrial loans, nonaccrual (RCFD1608) and commercial and industrial loans, past due 90 days still accruing (RCFD1607).
	Net interest income	RIAD4074	The difference between total interest expense and total interest income.
	Balances due to owner	BHCK4833, BHCK4834	Sum of balances due from subsidiary banks of the bank holding company (BHCK4833) and balances due from nonbank subsidiaries of the bank holding company (BHCK4834).
	Balances due from owner	BHCK5043, BHCK5045	Sum of balances due to subsidiary banks of the bank holding company (BHCK5043) and balances due to nonbank subsidiaries of the bank holding company (BHCK5045).
Global push factors			
	TED spread		The spread between 3-Month LIBOR based on US dollars and 3-Month Treasury Bill
	Baa-Aaa spread		The difference between Moody's seasoned Baa and Aaa corporate bond yields
	GZ spread		Gilchrist and Zakrajsek (2012)
	EBP spread		Gilchrist and Zakrajsek (2012)
	Shadow rate		Krippner (2013)
	US real GDP		Real gross domestic product, chained 2012 Dollars, seasonally adjusted.
	VIX		Chicago Board Options Exchange volatility index
	VOX		Vanguard Communication Services Index Fund ETF Shares
	MSCI		Morgan Stanley Capital International, USA index
	Federal funds rate		The effective federal funds rate. Interbank overnight rate.

Notes: The corresponding acronyms for bank holding companies are marked by BHCK instead of RCFD. I used the RCON (domestic call only) series instead of the RCFD (domestic and foreign call) for the banks that report their variables under only RCON.

Table 1. Descriptive statistics

Number of owners		11,309	
Number of subsidiaries		15,740	
Total number of observations		579,884	
Average # of subsidiaries per owner		5.19	
Average ratio of assets (subsidiaries/owners)		0.26	
Main variables in deviational form		Mean	Std. Dev.
Total Capital Ratio	owners	0.142	0.231
	subsidiaries	0.102	0.090
Loan loss reserves / Gross Loans	owners	0.004	0.007
	subsidiaries	0.013	0.023
Net interest margin	owners	0.034	0.075
	subsidiaries	0.026	0.013
Liquid Assets / Total Assets	owners	0.248	0.266
	subsidiaries	0.256	0.236
Correlation of owner and subsidiary variables			
Total Capital Ratio		0.0068	
Loan loss reserves / Gross Loans		0.2666	
Net interest margin		0.0003	
Liquid Assets / Total Assets		0.0247	

Notes: This table reports statistics that describe the dataset used in my estimations. The sample therefore only includes banks with owners and bank holding companies that own reporting banks. The statistics in the table describe the whole sample period (1987Q1-2017Q4).

Table 2. The strength of decentralized banking, post-2009

	Bank capital adequacy	Bank asset quality	Bank performance	Bank liquidity
Decentralized banking variable	6.181	-6.419	15.393	4.967
	(0.048)**	(0.078)*	(0.008)***	(0.041)**
Dependent variable lags	0.692	0.666	0.708	0.741
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
BHC capital adequacy	-0.003	0.003	0.005	0.008
	(0.825)	(0.810)	(0.566)	(0.793)
BHC asset quality	0.654	1.546	-0.500	1.947
	(0.539)	(0.414)	(0.470)	(0.362)
BHC performance	0.027	-0.039	0.001	-0.022
	(0.498)	(0.636)	(0.968)	(0.847)
BHC liquidity	0.025	-0.155	0.026	-1.835
	(0.000)***	(0.613)	(0.000)***	(0.177)
Number of observations	8,230	4,136	8,288	3,050
Hansen test	0.624	0.650	0.186	0.791
AR2 test	0.716	0.390	0.472	0.518

Notes: This table reports the results obtained from the estimation of equation (2). Capital adequacy, asset quality, performance and liquidity of both owners and subsidiaries are captured by the total capital to assets ratio, total nonaccrual loans and finance receivables to total loans ratio, net interest income to total assets ratio and the liquid assets to total assets ratio, respectively. The numbers in parentheses and the statistics reported for the Hansen test are the p-values. AR2 test row reports z-values. *, **, *** significant at 10%, 5%, 1%, respectively.

Table 3. The strength of centralized banking, post-2009

	BHC capital adequacy	BHC asset quality	BHC performance	BHC liquidity
Push factor	0.913	-23.543	-0.672	0.001
	(0.442)	(0.000)***	(0.255)	(0.683)
Dependent variable lags	0.631	0.572	0.612	0.591
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Bank capital adequacy	-0.924	-0.462	-0.158	-0.217
	(0.230)	(0.495)	(0.771)	(0.707)
Bank asset quality	0.305	-1.211	-0.042	0.190
	(0.442)	(0.112)	(0.841)	(0.412)
Bank performance	-3.083	0.531	-2.770	-1.613
	(0.277)	(0.866)	(0.290)	(0.531)
Bank liquidity	0.119	-1.153	4.981	-5.900
	(0.992)	(0.945)	(0.650)	(0.652)
Number of observations	3,421	3,507	3,549	3,569
Hansen test	0.786	0.900	0.851	0.560
AR2 test	0.754	0.931	0.248	0.136

Notes: This table reports the results obtained from the estimation of equation (4). Capital adequacy, asset quality, performance and liquidity of both owners and subsidiaries are captured by the total capital to assets ratio, total nonaccrual loans and finance receivables to total loans ratio, net interest income to total assets ratio and the liquid assets to total assets ratio, respectively. The numbers in parentheses and the statistics reported for the Hansen test are the p-values. AR2 test row reports z-values. *, **, *** significant at 10%, 5%, 1%, respectively.

Table 4. Economic significance

	Decentralized	Centralized
Capital adequacy	0.103	
	(0.048)**	
Asset quality	-0.133	-0.142
	(0.078)*	(0.000)***
Performance	0.053	
	(0.008)***	
Liquidity	0.105	
	(0.041)**	

Notes: This table reports the estimated coefficients of the ratios that are the main independent variables in equations (2) and (4). The coefficients represent the percentage point response of lending to a one standard deviation change in the corresponding ratio. Capital adequacy, asset quality, performance and liquidity of both owners and subsidiaries are captured by the total capital to assets ratio, total nonaccrual loans and finance receivables to total loans ratio, net interest income to total assets ratio and the liquid assets to total assets ratio, respectively. The numbers in parentheses are the p-values *, **, *** significant at 10%, 5%, 1%, respectively.

Table 5. The evolution of centralized and decentralized banking across time

	Capital adequacy	Asset quality	Performance	Liquidity
2009-2017				
Decentralized	0.103	-0.133	0.053	0.105
	(0.048)**	(0.078)*	(0.008)***	(0.041)**
Centralized		-0.142		
		(0.000)***		
1995-2007				
Decentralized	0.062		1.131	0.233
	(0.000)***		(0.000)***	(0.000)***
Centralized	0.048	0.006	-0.098	0.008
	(0.044)**	(0.053)*	(0.048)**	(0.077)*
1987-1994				
Decentralized	0.177	0.443	0.622	0.092
	(0.018)**	(0.000)***	(0.056)*	(0.015)**
Centralized	0.375	-0.465	0.133	0.594
	(0.005)***	(0.000)***	(0.000)***	(0.022)**

Notes: This table reports the estimated coefficients of the ratios that are the main independent variables in equations (2) and (4) for the three time periods in column 1. The results corresponding to decentralized are the coefficients of the subsidiary-specific ratios in equation (2). The results corresponding to centralized are the coefficients of the owner-specific ratios in equation (4). The coefficients represent the percentage point response of lending to a one standard deviation change in the corresponding ratio. Capital adequacy, asset quality, performance and liquidity of both owners and subsidiaries are captured by the total capital to assets ratio, total nonaccrual loans and finance receivables to total loans ratio, net interest income to total assets ratio and the liquid assets to total assets ratio, respectively. The numbers in parentheses are the p-values *, **, *** significant at 10%, 5%, 1%, respectively.

Table 6. Global push factors – decentralized banking interaction

	Capital Adequacy	Capital Adequacy* Global-push	Asset Quality	Asset Quality* Global-push	Performance	Performace* Global-push	Liquidity	Liquidity* Global-push
ted	6.813	-29.140	-0.600	-28.763	-21.441	109.545	3.750	-43.410
	(0.010)**	(0.076)*	(0.004)***	(0.105)	(0.013)**	(0.000)***	(0.559)	(0.000)***
vix	2.820	-0.144	-7.374	-0.252	12.681	0.442	-0.905	-0.427
	(0.043)**	(0.242)	(0.007)***	(0.622)	(0.461)	(0.001)***	(0.523)	(0.064)*
vxo	3.116	-0.086	-7.374	-0.265	11.350	0.174	-0.252	-0.380
	(0.107)	(0.379)	(0.007)***	(0.646)	(0.198)	(0.001)***	(0.137)	(0.109)
us gdp	-13.714	7.792	-33.758	15.779	-34.376	18.289	-6.436	4.939
	(0.154)	(0.149)	(0.479)	(0.218)	(0.077)*	(0.018)**	(0.180)	(0.229)
us equity	2.789	0.109	7.022	-0.801	-25.731	1.842	-9.091	0.750
	(0.084)*	(0.002)***	(0.044)**	(0.888)	(0.014)**	(0.007)***	(0.006)***	(0.035)**
baa-aaa	4.696	15.477	0.725	-10.260	-11.389	-156.380	0.957	-13.062
	(0.084)*	(0.025)**	(0.011)**	(0.768)	(0.016)**	(0.001)***	(0.076)	(0.000)***
ffr	4.484	-23.430	-4.968	154.713	4.353	-149.877	2.172	-6.954
	(0.045)**	(0.067)*	(0.075)*	(0.171)	(0.001)***	(0.002)***	(0.277)	(0.115)
ebp_oa	3.723	3.226	-11.429	-56.676	4.679	-59.494	2.444	-21.128
	(0.111)	(0.177)	(0.016)**	(0.439)	(0.027)**	(0.246)	(0.221)	(0.010)**
gzspr	5.026	3.468	-4.265	-4.011	-16.830	-130.478	0.323	-14.232
	(0.086)*	(0.008)***	(0.013)**	(0.991)	(0.061)*	(0.000)***	(0.062)*	(0.008)***
shadow rate	2.908	-0.305	-30.486	-19.762	9.272	16.356	-0.172	-3.599
	(0.257)	(0.461)	(0.096)*	(0.674)	(0.316)	(0.136)	(0.061)*	(0.083)*

Notes: This table reports the results obtained from the estimation of equation (5). Capital adequacy, asset quality, performance and liquidity of both owners and subsidiaries are captured by the total capital to assets ratio, total nonaccrual loans and finance receivables to total loans ratio, net interest income to total assets ratio and the liquid assets to total assets ratio, respectively. The push factors listed in column1 are the Treasury–EuroDollar spread (TED), the VIX and VOX volatility indices, US real GDP growth rate, Baa-Aaa coporate bond spreads, federal funds rate, the two bond premium measures of Gilchrist and Zakrajsek (2012) (ebp-oa and gzspr) and the Krippner (2013) shadow rate. The numbers in parentheses are the p-values *, **, *** significant at 10%, 5%, 1%, respectively.

Table 7. Global push factors – centralized banking interaction

	Capital Adequacy	Capital Adequacy* Global-push	Asset Quality	Asset Quality* Global-push	Performance	Performace* Global-push	Liquidity	Liquidity* Global-push
ted	-0.132	-12.532	-15.312	61.989	-0.794	22.519	0.002	-0.015
	(0.280)	(0.261)	(0.001)***	(0.240)	(0.225)	(0.456)	(0.856)	(0.832)
vix	1.783	0.181	-21.515	-1.739	-0.308	0.064	0.005	0.000
	(0.351)	(0.364)	(0.000)***	(0.391)	(0.103)	(0.305)	(0.494)	(0.543)
vxo	1.143	0.155	-15.190	-1.170	0.190	0.094	0.005	0.000
	(0.571)	(0.417)	(0.003)***	(0.332)	(0.509)	(0.422)	(0.432)	(0.476)
us_gdp	4.857	-1.858	-70.207	29.597	-13.810	4.940	0.002	0.000
	(0.893)	(0.719)	(0.145)	(0.019)**	(0.099)*	(0.095)*	(0.751)	(0.742)
us_equity_msci	-2.024	0.227	9.172	-1.344	-4.852	0.271	-0.004	0.000
	(0.265)	(0.274)	(0.003)***	(0.849)	(0.418)	(0.362)	(0.810)	(0.805)
baa_aaa_spread	0.892	-8.696	-0.985	111.634	1.001	17.223	0.001	-0.001
	(0.137)	(0.185)	(0.007)***	(0.020)**	(0.123)	(0.134)	(0.853)	(0.827)
ffr	1.175	-9.696	-24.360	188.214	0.037	11.844	0.005	-0.062
	(0.411)	(0.581)	(0.000)***	(0.058)**	(0.200)	(0.206)	(0.610)	(0.590)
ebp_oa	0.259	9.425	-9.906	-100.685	0.101	4.596	0.002	0.007
	(0.798)	(0.329)	(0.000)***	(0.007)***	(0.424)	(0.486)	(0.512)	(0.528)
gzspr	-0.778	-4.119	-9.823	46.722	0.979	6.610	-0.001	-0.008
	(0.427)	(0.578)	(0.001)***	(0.289)	(0.122)	(0.141)	(0.869)	(0.865)
shadow rate	2.928	0.940	0.946	9.138	-2.118	0.809	-0.001	-0.003
	(0.461)	(0.515)	(0.000)***	(0.000)***	(0.736)	(0.819)	(0.761)	(0.797)

Notes: This table reports the results obtained from the estimation of equation (6). Capital adequacy, asset quality, performance and liquidity of both owners and subsidiaries are captured by the total capital to assets ratio, total nonaccrual loans and finance receivables to total loans ratio, net interest income to total assets ratio and the liquid assets to total assets ratio, respectively. The push factors listed in column1 are the Treasury–EuroDollar spread (TED), the VIX and VOX volatility indices, US real GDP growth rate, Baa-Aaa coporate bond spreads, federal funds rate, the two bond premium measures of Gilchrist and Zakrajsek (2012) (ebp-oa and gzspr) and the Krippner (2013) shadow rate. The numbers in parentheses are the p-values *, **, *** significant at 10%, 5%, 1%, respectively.

Table 8. A historical comparison of push factors' effects

	2009-2017				1995-2007				1987-1994			
Panel A: Global push factor - bank (pull effects) interaction	Cap. Adequacy *Global-push	Asset Quality* Global-push	Perf.* Global-push	Liq.* Global-push	Cap. Adequacy *Global-push	Asset Quality* Global-push	Perf.* Global-push	Liq.* Global-push	Cap. Adequacy *Global-push	Asset Quality* Global-push	Perf.* Global-push	Liq.* Global-push
ted	-0.206		0.074	-0.332	0.092	-0.390	-0.838			-0.460		
vix			0.044	-0.289		0.214		0.223	0.455	-1.102		
vxo			0.019			0.227		0.213	0.500	-0.629		-0.371
us_gdp			0.144		1.860		7.303	0.250	0.784		0.176	
us_equity_msci	0.047		0.110	0.365	0.614	0.067	3.520	0.444		1.562		-0.024
baa/aaa_spread	0.254		-0.253	-0.234		-0.135				-1.170		-0.676
ffr	-0.078		-0.121			-0.164		-0.111	0.134	-0.332	-2.057	
ebp_oa				-0.501	-0.009	-0.013					3.333	
gzspr	0.116		-0.369	-0.516	-0.048	0.033			-0.662			0.478
shadow rate				-0.109	-0.243	-0.156		-0.125		-0.349	-1.705	
Panel B: Global push factor - BHC (push effects) interaction												
ted									-0.351			1.092
vix									0.193	-0.399	0.792	1.674
vxo									0.389	-2.799	1.054	2.222
us_gdp		0.393	1.232						-1.412			0.574
us_equity_msci										2.323	-0.963	-2.072
baa/aaa_spread		0.442								-2.886	1.759	
ffr		0.088					-0.025			2.047	0.930	0.867
ebp_oa		-0.503						0.008	0.579	-0.921	-1.100	-0.522
gzspr									1.007	-1.998		-1.180
shadow rate		0.098								1.336	0.763	0.716

Notes: This table reports the results obtained from the estimation of equations (5) and (6) for the three periods listed in row 1. The coefficients represent the percentage point response of lending to a one standard deviation change in the corresponding ratio. Only the significant coefficients are reported. Capital adequacy, asset quality, performance and liquidity of both owners and subsidiaries are captured by the total capital to assets ratio, total nonaccrual loans and finance receivables to total loans ratio, net interest income to total assets ratio and the liquid assets to total assets ratio, respectively. The push factors listed in column1 are the Treasury–EuroDollar spread (TED), the VIX and VOX volatility indices, US real GDP growth rate, Baa-Aaa coporate bond spreads, federal funds rate, the two bond premium measures of Gilchrist and Zakrajsek (2012) (ebp-oa and gzspr) and the Krippner (2013) shadow rate.

Table 9. Internal capital markets

	Whole sample	2009-2017	2003-2007
Balances due to the owner / Assets	0.0194	0.0594	0.0004
Balances due from the owner / Assets	0.0355	0.1095	0.0006
Correlation of loans and net transfers	-0.0349	0.0279	-0.0403
Correlation of net transfers and lending deviations (decentralized)	-0.0002	0.0000	-0.0002
Correlation of net transfers and lending deviations (centralized)	-0.0023	0.0054	-0.0029

Notes: Balances due to and from the owner are the intercompany transaction balances due to and from subsidiary banks of the bank holding company, respectively. Net transfers are measured as the difference between balances due to the owner and the balances due from the owner as a fraction of the subsidiary's assets. The lending deviations in row 4 and 5 are measured as described in equations (1) and (3), respectively.