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# The Effect of Monetary Tightening on Local Banks

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**ABSTRACT**

This study shows that during Paul Volcker's drastic monetary tightening in the early 1980s, local banks operating in only one county reduced loan supply much more sharply than local subsidiaries of multi-county bank holding companies in similar markets, after controlling for bank (and holding company) size, liquidity, capital conditions, and, most important, local credit demand. The study allows cleaner identification by examining 18 U.S. "county-banking states" where a bank's local lending volume at the county level was observable because no one was allowed to *branch* across county borders. The local nature of lending allows us to approximate and control for the exogenous component of local loan demand using the prediction that counties with a higher share of manufacturing employment exhibit weaker loan demand during tightening (which is consistent with the interest rate channel and the balance-sheet channel of monetary policy transmission).The study sheds light on the working of the bank lending channel of monetary policy transmission.

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## 1. Introduction

On October 6, 1979, the newly appointed Federal Reserve Chairman, Paul Volcker, drastically escalated the Fed's anti-inflation efforts, and the monetary tightening cycle entered a new phase (see Walsh, 2004, for a review of the history). In the next two years, by targeting nonborrowed bank reserves, the Fed allowed nominal interest rates to climb at some point to over 20 percent per annum. Two back-to-back policy-induced recessions followed, in particular in the manufacturing-intensive "rust belt" areas. The American banking sector at that time was fragmented geographically, with numerous small local community banks populating the country. Facing tighter monetary conditions, many banks had to cut back on lending, which could further exacerbate the downturn of the local economy they were serving. This feedback mechanism is referred to as the bank lending channel of monetary policy transmission (Kashyap and Stein, 2000).

Regarding the effect of Volcker's monetary tightening on bank lending, we notice that local community banks seemed be affected much more than those banks whose operations were not restricted to a single U.S. county. How much did the geographic isolation of local community banks contribute to the credit crunch? Would things have evolved differently if the banks had been operating across county and state borders at that time? The answers to these questions can help us better understand the working of the bank lending channel of monetary policy transmission and how banking market consolidation may change it.

This drastic and unprecedented monetary tightening, totally unexpected, and unseen for a second time so far, provided an interesting "experiment" for us to study how the geographic isolation of local community banks affects the sensitivity of loan supply to monetary policy, because it was unlikely that some banks foresaw this sudden policy change and made a choice to expand geographically in advance. An important empirical innovation of this study is to draw evidence from some special "county-banking states" existing at that time (which accounted for one-third of U.S. gross domestic product). In these U.S. states, because of certain banking regulations (that phased out in the late 1980s), no banks were allowed to set up *branches* outside their home counties, but bank holding companies were allowed to own local subsidiaries in multiple counties. Uniquely, local lending data at the county level were available for a multi-county holding company as well because it was not allowed to consolidate its subsidiary operations into one entity. Exploiting (1) this special regulatory setting and (2) the drastic monetary tightening event, and (3) noting that neither of these two interesting conditions can be found in a more recent period, this study examines whether single-county local banks reacted any differently to the common monetary conditions, (1) versus nonlocal banks (i.e., local subsidiaries of the multi-county bank holding companies) (2) versus banks operating in similar markets, and (3) other things being equal (for example, various measures of bank size, liquidity conditions, local credit demand, etc.).

Local banks are more likely to be influenced strongly by local market conditions, relative to the bank holding companies that diversify their operations geographically.[1] In the 1980s geographic expansion could be thought of as a financial innovation that allowed banks to hedge and insure against risks across regions. Within a holding company, subsidiaries operating in different geographic markets can provide mutual insurance to each other, because it is convenient for the holding company to move loanable funds across subsidiaries to support those relatively short of liquidity (Holod and Peek, 2006). Other things being equal, subsidiaries of multi-county bank holding companies could be considered financially stronger than stand-alone local banks (Houston, James and Marcus, 1997; Houston and James, 1998; Campello, 2002; Ashcraft, 2003).

[1] Chionsini, Foglia, and Reedtz (2003), using confidential Italian data, find that diversification of loan portfolios across sectors or geographic regions reduces credit risks (unexpected credit losses in a value-at-risk model) because of the diversification of idiosyncratic risks. Ogden, Rangan, and Stanley (1989) find that geographic diversification can reduce a mortgage portfolio's foreclosure-risk exposure by 50% to 90%, when compared to geographically undiversified ones. Corgel and Gay (1987) show similar results. Using Italian data, Acharya, Hasan, and Saunders (2002) provide evidence that geographical diversification of loan portfolios results in an improvement in the risk-return trade-off but only for banks with low levels of risk.

Indeed, Hankins (2006) shows that bank mergers are motivated by the opportunity for operational hedging across regions.

To understand how geographic diversification affects banks, we need to note that a national monetary policy, through the interest-rate channel and the balance-sheet channel, can have an asymmetric impact on different geographic areas (Carlino and DeFina, 1998, Peersman and Smets, 2005, both provide evidence). Some areas are more heavily affected than others. A banking organization that operates in multiple local economies may face very different loan demand, loan performance, and liquidity situations, in each local market, subject to local borrower conditions (see Ashcraft and Campello, 2007, for evidence). The manufacturing sector's demand for credit is more pro-cyclical because the demand for durable manufactured goods is pro-cyclical. Being more capital-intensive, the manufacturing sector also naturally desires less investment when interest rates are high. Higher interest rates also increase debt service, erode cash flows, depress collateral values, and thus reduce the creditworthiness of borrowers and increase the external finance premium. All loans — industrial, consumer, and real estate — are affected. Industrial towns are more strongly affected by monetary tightening, not only through its direct impact on manufacturing companies, but also through its indirect effect on local individuals and real estate properties, whose creditworthiness and collateral values are compromised because of slower income and employment growth in the local economy of these industrial towns.

Note that both loan *supply* and *demand* are affected by the monetary tightening and the local market conditions. Banks located in recession areas may lose capital, may face greater liquidity risks, and may have to reduce loan supply (i.e., the bank lending channel); in the meantime, local borrowers may demand less credit (i.e., the balance-sheet channel). Theoretically, the ability to move funds across geographic borders can both dampen and exacerbate the effects of monetary policy, with the net effect depending mainly on how the supply of loans (by the banking sector) and the demand for loans (by the real sector), respectively, react to monetary policy (Morgan, Rime, and Strahan, 2004), or in other words, whether the bank lending channel or the balance-sheet channel dominates.

On the supply side, the bank holding companies, with more diversified geographic exposure, may be able to help their local subsidiaries smooth out the effects of monetary shocks by moving loanable funds through their internal markets to where credit is most needed but in short supply. When return on capital is higher in recession regions (because local banks facing capital and liquidity problems reduce the supply of credit), geographically diversified banks, in pursuit of higher profit, can and are willing to pick up the lending slack and dampen local lending volatility. Ashcraft (2006), for example, finds that aggregate lending's response to monetary policy is *weaker* in states where bank holding companies control more market shares than do stand-alone banks. Stand-alone local banks, however, because of their lack of external sources of funding, may have to reduce support to local borrowers. Becker (2007), for example, shows that local loan supply is determined mostly by local deposits, and this correlation is stronger in markets where banks are small and where intrastate branching is restricted.

On the other hand, the opportunity for geographic diversification is also capable of exacerbating volatility. A multi-county holding company, because of its diverse geographic presence, may move loanable funds among its subsidiaries in pursuit of maximized returns on capital. A typical two-region real business cycle (RBC) model (e.g., Backus, Kehoe, and Kydland, 1995) will suggest that when a region receives a negative shock in the real sector, the return of bank lending declines (for both local and nonlocal banks), and with capital mobility, investment will tend to flow out of the region. After a contractionary monetary shock, multi-county bank holding companies may swiftly move loanable funds away from counties experiencing deeper recessions (if this is associated with lower returns to capital and more collateral damage) into counties in relatively better shape.[2] More specifically, they may move funds away from manufacturing-intensive local markets to more service-oriented counties, since the former is more

[2] Lang and Nakamura (1995) and Bernanke, Gertler and Gilchrist (1996) both show that there is a flight to quality after tightening of monetary policy, as banks allocate more credit to firms with fewer problems of asymmetric information.

affected by the national monetary tightening. A local bank, however, has to stay with its customers through good times and bad regardless of their balance-sheet conditions (Strahan, 2006), which may dampen the shocks, particularly when the bank is located in a recession region.

Despite the strong policy interests (cf. Group of Ten (2001) and English (2002)) in understanding how geographic diversification (and isolation for that matter) and banking sector consolidation affect the transmission of monetary policy — in particular, the bank lending channel, i.e., how monetary policy affects bank loan supply — rigorous empirical evidence is hard to come by because of the lack of disaggregated micro data.

This paper's contribution is mainly empirical. Previous studies usually could not observe local lending volumes by individual banks. However, in the county-banking states examined in this study — where the only form of geographic expansion is through holding company subsidiaries —we luckily have both of the necessary elements for micro-research: (a) the coexistence of local and nonlocal banks (i.e., subsidiaries of multi-county bank holding companies) in the same local markets very narrowly defined at the county level, and (b) the availability of local lending data because of the restrictions on formal branching across county borders.

Also, in county-banking states, the restrictions on cross-county branching had imposed an upper cap on the potential size of banks and bank subsidiaries operating there, since the potential market size is fixed. In Kashyap and Stein's (2000) samples, however, "small banks" may stay small for some unobservable reasons that are difficult to control for (e.g., as the authors point out, bank owners with lower risk aversion prefer running a smaller but entrepreneurial organization and lending to more cyclical and risky borrowers).

Our study is similar to Campello's (2002) in that we both use bank holding company affiliation status to distinguish two groups of banks. However, the local nature of lending in county-banking states helps us better disentangle the influence of loan supply and demand.[3] Ashcraft and Campello (2007), by comparing lending of subsidiaries belonging to the same bank holding company but operating in different states (a much broader geographic unit than a county[4]), show that local demand factors affect lending independent of the bank lending channel. We adopt a similar, but more refined approach. Because of the special regulatory requirements, we know that in the county-banking states, loans recorded under a bank (subsidiary) are mostly made to borrowers in the same county where the bank is headquartered. Then the *exogenous* component of the local credit demand can be reasonably inferred and approximated by the interaction between county-level industrial structure and national monetary policy conditions, because the interest-rate channel and the balance-sheet channel of monetary policy transmission predicts that counties with a high share of manufacturing would exhibit more pro-cyclical credit demand when facing the same national monetary policy.

Furthermore, the difference of the borrower bases across local and nonlocal banks is unlikely to drive our results. In county-banking states, local subsidiaries of multi-county holding companies are unlikely to differ much from stand-alone local banks in business model, organization, and philosophy, because the local subsidiaries are managed relatively independently and soft information can be actively used in evaluating loan applications, as is the case in stand-alone local banks (cf. Whalen, 1982; Blackwell, Brickley, and Weisbach, 1994). Also, Ashcraft (2006), based on data available since 1993, shows that the size mix of borrowers does not differ significantly across stand-alone banks and bank holding company affiliates.

To summarize, this empirical study separates banks into two groups: the "local banks"

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[3] Researchers usually study credit channels (either lending or balance-sheet channels) using the data of banks and firms separately because of the difficulty in matching the two sets of data. For the bank lending (narrow credit) channel, Kashyap and Stein (2000) study banks and show that less liquid banks reduce lending when the Fed tightens money. For the balance-sheet (broad credit) channel, Gertler and Gilchrist (1993, 1994) find that small firms and more leveraged firms shed inventory and redundant labor during tight money periods, whereas such effects are not found in boom times or in large firms with access to the bond market. Bernanke and Gertler (1995) provide a good review of the literature on the credit channel of monetary policy transmission.

[4] According to Forni and Reichlin (1997), county factors explain 31.3% of output fluctuations in the U.S., more important than state factors (23.2%).

that limit their operations to only one county, and the “nonlocal banks” that are subsidiaries of holding companies that operate in multiple counties. Both groups of banks operate in the same local county markets. The study then shows that during Paul Volcker’s monetary tightening in the early 1980s, local banks’ lending responded much more strongly than that of nonlocal banks, after controlling for size, liquidity, capital, and most important, local credit demand. Such a result suggests that a multi-bank holding company operating across county borders may be able to help smooth out the impact of monetary policy tightening within its internal capital market and allow those subsidiaries experiencing liquidity problems to shrink loan volumes less sharply than stand-alone local banks experiencing similar problems.

Importantly, the local nature of lending in “county-banking states” allows us to approximate exogenous local loan demand using the prediction that counties with a higher share of manufacturing employment indeed demand less credit during tightening when these industrial towns are in worse shape (which is consistent with the prediction of the interest-rate channel and the balance-sheet channel of monetary policy transmission). Finally, the study also finds that the disadvantage of local banks was smaller in counties that employed more manufacturing workers, because of the more pro-cyclical local loan demand in these places. Therefore, a poor supply of credit as a result of a bank’s geographic isolation mattered less in the more manufacturing-oriented counties during monetary tightening.

The rest of the paper is organized as follows. Section 2 introduces the study’s empirical methodology: how county-banking states are identified and why it is important, how local banks are defined, and how the regressions are specified. We spend significantly more time in this section because this study’s contribution lies in its unique empirical design that exploits some special regulatory settings. Section 3 discusses the regression results, how we control for local credit demand, bank size, bank liquidity, and capital conditions, etc. Section 4 concludes the paper with a brief discussion of policy implications.

# 2. Empirical Methodology

## 2.1. County-Banking States and Local Banks

The breakdown of a bank's lending volume by borrowers or by local geographic units, such as a county, is usually not disclosed to the public. In the United States, lending volume at the bank level only, without geographic breakdown, is reported to the regulatory agencies, and information on how the lending is allocated across geographic areas is not in the public domain. If we compare two banks' aggregate lending volumes without observing their respective different "local markets," it is quite possible that the differences we observe are driven by demand-side instead of supply-side factors. For example, bank lending in Michigan could be more sensitive to monetary policy than in Oklahoma, but it may be explained by the Michigan economy's more pro-cyclical demand for credit.

In this study, we minimize the concern by restricting the sample to the so-called "county-banking states," i.e., to states and years where a bank was *not* allowed to branch outside its home county. In these states, we are confident that loans recorded under a bank or a bank subsidiary are made to borrowers most likely located within a certain county, for which we can approximate local credit demand. In contrast, after statewide branching is allowed, county-level lending volumes become unobservable to researchers, because now the loan volumes reported may include operations in multiple counties.

Based on the historical information on banking regulations compiled by Amel (1993), we identify the deregulation year when a state started to allow banks to formally branch across county boundaries. Then we identify 18 states and 1,587 counties where, as of the beginning of 1985, branching deregulations had *not* taken place and county banking was still practiced. These include Arkansas, Colorado, Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Montana, Nebraska, North Dakota, Oklahoma, Oregon, Tennessee, Texas, Wisconsin, and Wyoming.

Most of them are located in the central United States, including almost all of the Great Lakes, Plains, and Rocky Mountain states. These county-banking states contributed to 32.5% of U.S. GDP in 1985. As shown in Table 1, as of the beginning of 1985, none of these county-banking states allowed branch expansions across county boundaries. During 1985, three states deregulated, and then another three followed during 1987. We therefore end the sample in 1986, in order to create a relatively balanced panel data set, although many states kept their county-banking laws intact till as late as 1994 (e.g., Arkansas).

[insert Table 1 about here]

A bank is defined as a "nonlocal bank" if it is a subsidiary of an ultimate bank holding company (BHC) that operates in multiple counties; otherwise it is defined as a "local bank."[5] If the parent BHC operates within a single county only, its subsidiaries are considered not different from "local banks" and are defined as such. When a BHC controls multiple subsidiaries in the same county, we aggregate their lending volumes and attribute the total volume to a same "aggregated" nonlocal or local bank. This procedure also helps us avoid the problem of adjusting for mergers and acquisitions. If a merger takes place within a county, then the adjustment we use is equivalent to that suggested by Peek and Rosengren (1995), in which merged banks are treated as a single bank throughout the sample (as if the merger had taken place at the beginning of the period). Note that a merger (in the sense that two entities are legally consolidated into one single

[5] Limitations certainly exist for such a definition. For example, we do not distinguish between banking organizations with a different level of geographic diversification; some holding companies clearly stretch farther geographically to more regions than do others, and some holding companies operate in a set of regions that exhibit business cycles less synchronized with one another; and their subsidiaries may benefit more from such a wider geographic diversification than do those affiliated with a holding company that operates only in two neighboring and closely related counties. Nevertheless, in our sample, because of the county-banking restriction, the largest distinction that sets one group of banks apart from the other is whether a bank belongs to a holding company that operates in multiple counties. The stand-alone banks that operate in only one county are clearly 'local,' and comparing them with the rest of the banks is already very informative in identifying whether geographic isolation affects bank lending behavior. If anything, our definition causes only underestimation of the effect we uncover.

entity) across county borders was not allowed in the county-banking states.

Panel A of Table 2 provides summary statistics of the main characteristics of local banks versus nonlocal banks (i.e., subsidiaries of multi-county bank holding companies).

[insert Table 2 about here]

## 2.2. Empirical Model

The study covers an interesting 10-year period from 1977 to 1986, a full monetary cycle that witnessed dramatic swings in policy stance unseen in the relatively calm and moderate 1990s but that largely escaped the wave of bank failures in the late 1980s. [6] The sample period thus can be used as an exogenous experiment for us to examine, in a relatively healthy and stable banking sector, individual banks' differential responses to monetary policy.

The regression models of this study rely heavily on interaction terms to identify the effects of bank geographic isolation on the sensitivity of bank lending to monetary shocks. The interaction terms help shed light on the research hypotheses by differentiating between local banks and nonlocal banks, between monetary tightening and loosening periods, and between counties and time periods that inherently experience more or less demand for credit.

The main regression is specified as follows, where banks are indexed by subscript i, years by t, and counties by k.

[6] We begin the sample in 1977, partly for data availability reasons. Banking data from the Federal Reserve Bank of Chicago are available since 1976, but industrial structure data from County Business Patterns (CBP) become available from year-end 1977. Note that one year is lost to form the annual difference growth-rate series. Note also that the sample period ends before the Fed announced the strength-of-support doctrine in 1987, which explicitly required holding-company parents to unconditionally prop up stressed subsidiaries. After 1987, even when a bank holding company does not gain extra strength through geographic diversification, it has to prop up subsidiaries in trouble, and thus, it becomes more difficult to tell whether it is geographic diversification of the holding company or simply the obligation to support that provides strength to the subsidiaries.

$$\Delta\left(Loan_{i,t}\right) = \beta_0 + \overbrace{\beta_1\left(Local_{i,t}\right) + \beta_2\left(Local_{i,t} \times Money_t\right)}^{\text{Supply Side: Bank Lending Channel}} + \overbrace{\beta_3\left(Local_{i,t} \times Money_t \times Manufacture_{k,t-1}\right)}^{\text{Interaction of Supply with Demand}}$$
$$+ \overbrace{\gamma_1\left(Manufacture_{k,t-1} \times Money_t\right) + \gamma_2\left(Manufacture_{k,t-1}\right)}^{\text{Demand Side: Interest Rate Channel and Balance Sheet Channel}}$$
$$+ \delta_1\left(MarketShare_{i,t-1}\right) + \delta_2\left(MarketConcentration_{k,t-1}\right) + \overbrace{\sum State + \sum_t Year_t}^{\text{Fixed Effect}} + \overbrace{\varepsilon_{i,t}}^{\text{Clustered by County}\times\text{Year}}$$

The dependent variable is the real annual growth rate of total loans[7] at bank i in year t, calculated by taking the December to December log difference in total loans outstanding and adjusting for national consumer price index inflation. We use annual data for the study because the Volcker monetary tightening was unusually large and persistent compared with the more subtle and temporary innovations usually seen in the relatively calm and moderate 1990s; therefore, examining annual changes without going into the quarterly details can already cleanly capture the banks' responses to a certain monetary policy condition. Ashcraft (2006, pp.760) explains other technical details on why data on annual changes are preferred to higher frequency data. In simple terms, our empirical tests, like Ashcraft's (2006), heavily rely on interaction terms (between the monetary policy measure and certain variables of interest to us); had we use quarterly data, we would have had to include in the regressions at least four lags of the monetary policy measure and each would have had to be interacted with any one of the variables of interest.

The regression is estimated using a standard ordinary least squares (OLS) technique, on a sample of nearly 70,000 bank-year observations. The standard errors of the coefficients are adjusted for clustering of residuals by county × year; i.e., bank-level lending volumes within a county in a certain year are not considered to be independent from each other.

Variable definition and sources are described in Section 2.3 and are also summarized in the paper's Appendix. Below we briefly explain the motivations behind the inclusion of the main

[7] To create a consistent time series of loan growth, following Kashyap and Stein (2000), total loan is defined as RCFD1400 (Total loans and leases, gross) plus RCFD2165 (Lease financing receivables) prior to 1984, and RCFD1400 after. Growth rate (log difference) values greater than 100% or smaller than 100% are truncated as outliers, which constitute only 0.72% of the original sample observations.

explanatory variables. The interaction terms need particular attention.

- **Local Bank (dummy variable):** This variable captures whether local banks' lending grows more slowly than nonlocal banks, regardless of monetary policy conditions. Morgan and Samolyk (2003), for example, show that geographic isolation reduces banks' ability to make loans (i.e., lowers their loan-to-asset ratios).
- **Local Bank × Monetary Policy Stance:** This interaction term between the local bank dummy variable and the contemporaneous measure of the monetary stance (averaged over a year) helps identify whether local bank lending, compared with that of nonlocal banks, is more sensitive to monetary policy, as will be indicated by a positive coefficient (note that a lower, negative value for the monetary policy indicator is associated with tighter monetary policy).
- **County Manufacturing Share × Money Policy Stance:** The fluctuations in loan volumes reflect credit demand as well as supply. This interaction term between a county's manufacturing employment share and the national monetary policy stance can capture some exogenous fluctuations in a county economy's *demand* for bank credit, resulting from the prediction of the interest-rate channel and the balance-sheet channel of monetary policy transmission that geographic areas with a greater share of manufacturing employment are more affected by national monetary policy. (Carlino and DeFina, 1998; Peersman and Smets, 2005; Braun and Larrain, 2005, provide evidence on the asymmetric impact of a common monetary policy.) The coefficient should carry a positive sign if this hypothesis is true.
- **Local Bank × Money Policy Stance × Manufacturing Share:** Interpreted together with the coefficient on "Local Bank × Money Policy Stance," the coefficient on this triple interaction term can tell us whether the found difference between local and nonlocal banks in monetary policy sensitivity also varies across counties with a different level of manufacturing employment ratio. The coefficient should carry a negative sign if

geographic isolation of local banks matters less in the more manufacturing-intensive counties, where *demand* for credit is lower during tightening.

- **(Lagged) Local Bank Market Concentration:** Competition among banks may affect lending. Boyd, De Nicolò, and Al Jalal (2005) show that bank concentration is inversely correlated with loan-to-asset ratio. Adams and Amel (2005) find that the impact of monetary policy on loan originations is weaker in more concentrated markets. The lack of competition is measured by the Herfindahl-Hirschman Index (HHI) of concentration at the county market level. [8]
- **(Lagged) Market Share:** Banks endowed with a relatively larger initial market share in a local market may find it more difficult to expand its customer base further, assuming that banks tend to pursue the easier customers first. Thus, in general, they grow more slowly because of the increasing marginal cost of acquiring the more difficult customers.
- **State and Year Dummy Variables:** To control for state-specific and year-specific factors, we include year and state dummy variables in the regressions. The measure of monetary policy stance needs to be not directly included in the regression except when interacted with other variables, because the year dummy variables already capture any year-specific factors, including the general effects of national monetary policy, as well as other national economic conditions.

## 2.3. Data Sources and Descriptions

### 2.3.1. Volcker Monetary Tightening

We use the Boschen-Mills narrative index as the main measure of monetary policy stance. Boschen and Mills (1995), based on their reading of FOMC directives and related records, classify monetary policy conditions into of five categories, according to the changing importance

[8] In 1980, the average HHI in the sample is 0.41, which was considered concentrated. Note that local markets with an HHI below 0.18 are deemed to be served by enough banks to assume that conditions are very competitive. HHIs at the county level remained rather constant over time, which corroborated other previous studies, e.g., Dick's (2006) findings that banking sector consolidations did not usually take place within a local market but more in the form of geographic diversifications and expansions.

that policymakers assigned to controlling inflation versus real growth: −2 (strongly contractionary), −1 (mildly contractionary), 0 (Neutral), 1 (mildly expansionary), and 2 (strongly expansionary). Exhibit 1 uses this indicator to portray the evolution of the monetary policy stance during the 10-year sample period 1977-1986. Note that, in the regressions, we average the monthly ratings over a calendar year to measure monetary stance in a certain year.

There were large swings in monetary policy during these 10 years, which formed a full monetary cycle starting from tightening and ending with gradual easing after inflation was successfully tamed. Starting from late 1979, in particularly after October 1979, the new Fed Chairman, Paul Volcker, sharply escalated monetary tightening to combat runaway inflation (see Walsh, 2004 and Lindsey, Orphanides, and Rasche, 2005, for a review). He changed the operation procedure to target nonborrowed reserves and allowed interest-rate levels to climb at some point to over 20 percent. This move was unexpected and a surprise because, at that time, it was generally believed to be impossible for the Fed to initiate a highly restrictive monetary policy considering the current political and economic environments and expectations.[9] It was highly unlikely that some banks foresaw a drastic policy change and made the decision to expand geographically well in advance. Over the next two years, monetary policy on the tightening side deviated considerably from what a Taylor rule would have prescribed based on the growth and inflation forecasts made at that time. (However, in hindsight, based on new information, it was found that the output gap was overestimated in the 1970s.) In comparison, during 1985 and 1986 the monetary stance was widely considered particularly loose (Kashyap, Lamont, and Stein, 1994).

[insert Exhibit 1 about here]

[9] Prior to the drastic tightening, the Greenbook assessed that a recession had already started by the second quarter of 1979 and expected that inflation would soon decelerate. FOMC members were split between the hawks and doves; in particular, the discount rate vote on September 18 was split 4 to 3, with Governors Partee, Rice, and Teeters dissenting on the dovish side (see Lindsey, Orphanides, and Rasche, 2005, for a review of the circumstances surrounding the event).

We also use the fed-funds-rate-based Bernanke-Mihov index (as portrayed in Exhibit 2) to test the robustness of our results. Bernanke and Mihov (1998) created the index using a flexible VAR model based on more specific assumptions about Fed operating procedures, which controls for the endogeneity of federal funds rates to economic conditions. Such measures based on fed funds rates, however, are considered noisy and not very appropriate for this study's sample period (Kashyap and Stein, 2000), [10] which mainly coincides with Paul Volcker's tenure (August 1979 to August 1987), when fed funds rates were not always the target of open market operations and were strongly volatile as a result of the targeting of aggregate supplies of bank reserves. However, since the Volcker monetary tightening was unusually drastic, there was not much disagreement between the two alternative measures in identifying this very large shock.

[insert Exhibit 2 about here]

### 2.3.2 Banking Sector Data

The main source for our bank financial data is the Consolidated Reports of Condition & Income (known as Call Reports).[11] Observations are excluded for states where and years when banks were allowed to branch across county boundaries. As a result of this exclusion rule, loans recorded under a bank were most likely made to local residents and businesses located in the county where the bank had its headquarters. Although county-banking restrictions effectively imposed a ceiling on how large a bank could grow, Panel B of Table 2 shows that the size distribution of banks in the county-banking states was quite representative of the national sample.

[10] According to Kashyap and Stein (2000), "Both conventional wisdom as well as the formal statistical analysis of Bernanke and Mihov (1998) suggests that the funds rate may be particularly inappropriate during the high-volatility Volcker period," because Volcker was mainly targeting bank reserves rather than the funds rate in conducting his monetary policy. The Boschen-Mills index is usually considered a better indicator of the monetary policy stance during this period.

[11] The data are compiled by the Federal Reserve Bank of Chicago and cover all commercial banks and savings banks regulated by the Federal Reserve System, Federal Deposit Insurance Corporation, and the Office of the Comptroller of the Currency.

Nonlocal banks were, on average, larger than the local banks, but the size distribution of the nonlocal banks was skewed by a small number of very large banks. Below the 90th percentile, the distribution of nonlocal banks was usually only several-fold larger than that of their local bank competitors (whereas in Kashyap and Stein [2000] "large banks" were about *100* times larger than the "small banks").

Note also that those very large banks above the 90th percentile tended to cluster in a small number of metropolitan centers (e.g., Harris County (Houston), as is also documented in Brickley, Linck, and Smith (2003); or Cook County (Chicago), where the Continental Illinois Bank was headquartered); as a result, in a typical county outside the large urban centers, a nonlocal bank's size was usually only twice as large as those of *local banks*. Later in the regressions we explicitly control for holding company size, as well as a bank's or bank subsidiary's own size, to show that our results are not driven by the size difference between local and nonlocal banks.

Market share of nonlocal banks in a county is also a measure of banking market integration. Counties with greater loan market share controlled by holding companies that operate across county or even state borders are considered better integrated into the state and the national banking markets. Table 3 describes the time-varying bank market integration history in the sample, by state and year. Although nonlocal banks were increasing their market share over time, local banks continued to play very significant roles.

[insert Table 3 about here]

### 2.3.3. County-Level Industrial Structure

We obtain industrial structure data from the County Business Pattern database. Manufacturing employment share is defined as the share of workers employed in the manufacturing sector. In our sample, on average, 23% of workers were employed in the manufacturing sector and the share declined gradually over time, consistent with the national average. Manufacturing intensity varied across counties (a standard deviation of around 15%), with the Great Lakes states recording the highest manufacturing employment share in the nation and the Rocky Mountain states the lowest.

## 3. Empirical Results

### 3.1. Local Banks' Lending Is More Sensitive to Monetary Tightening

In Table 4, regression results are reported on what determines loan volume fluctuations across banks during Paul Volcker's monetary tightening in the early 1980s. Section 2.2 earlier explains the regression specifications. Column (1) reports results of a baseline stripped-down regression that has not considered variations in local credit demand across counties, while Columns (2) and (3) report results that adjust for such variations using interaction terms involving information on local industrial structure. More specifically, in Column (2) we use an interaction term "County Manufacturing Share × Money Policy Stance" to control for the variations in local credit demand across counties. In Column (3), we also add a triple interaction term "Local Bank × Money Policy Stance × Manufacturing Share" to take into account the interplay between supply-side and demand-side factors.

[insert Table 4 about here]

First of all, the negative coefficient on the local bank dummy indicates that the local banks' lending grows about 1.2% more slowly annually than that of nonlocal banks (i.e., subsidiaries of BHCs that operate in multiple counties), averaged over the whole monetary cycle, after controlling for their initial local loan market share. (Note that banks with a smaller initial share tend to grow faster, other things being equal.)

However, the growth differential between local and nonlocal banks varies markedly across the monetary cycle. The coefficient on the interaction term "Local bank × Monetary policy stance" is significantly positive, which suggests that local banks' lending is more sensitive to monetary contraction than that of nonlocal banks. In other words, the growth differential between local and nonlocal banks is significantly wider during monetary tightening than during monetary loosening. [12]

The size of the coefficient in Column (2) implies that in a mildly *contractionary* environment (i.e., Boschen-Mills index = −1) a local bank's lending grows more slowly by on average of 2.1% (=1.20+0.92) annually than lending in a similar nonlocal bank, other things being equal (e.g., initial market share, local credit demand). In a mildly *expansionary* environment (i.e., Boschen-Mills Index = 1), in contrast, the differential can be as small as only 0.3% (= 1.20−0.92). At the peak of Volcker tightening, which is marked by a Boschen-Mills index value of −2, a 3.0% difference (= 1.20+0.92*2) in loan growth rates can be attributed to local bank status. Note that the median real loan growth rate during our sample period is merely 0.76% for nonlocal banks and 0.11% for local banks. This cyclical pattern in cross-sectional variations is consistent with Dell'Ariccia and Garibaldi's (2005) and Craig and Haubrich's (2006) findings that the heterogeneity in loan growth and the reallocation of credit across banks is more intensive under unfavorable economic conditions.

In Column (2), the coefficient on "Manufacturing share × Monetary policy stance" is significantly positive, which confirms that loan volumes in counties with a higher share of manufacturing employment are indeed more sensitive to a change in monetary policy. This result is consistent with theories on the interest-rate and the balance-sheet channel of monetary policy transmission and confirms our previous assumption that the interaction term between the local share of manufacturing employment and the national monetary policy stance can well capture the exogenous component of a county's *demand* for loans. A back-of-the-envelope calculation based

[12] Note that Ashcraft (2003) finds that the benefits of holding-company affiliation appeared only after the formal announcement of the Federal Reserve's source-of-strength doctrine in February 1987. Our results suggest that the effects had been present since a much earlier time.

on the coefficients suggests that after a switch of monetary stance from mildly expansionary to mildly contractionary, bank loan growth slows down, on average, by 3.3 percentage points in a county with high manufacturing employment, compared with only 1.4 percentage points in a county with low manufacturing employment. The results clearly confirm that monetary tightening has more negative consequences for counties with high manufacturing employment. Note that all types of loans are affected in an industrial town during a monetary tightening. Manufacturing activities have a direct impact on demand for commercial and industrial loans, and a decline in manufacturing activities also affects demand for real estate and consumer loans through slower local income growth and a higher unemployment rate, which compromises the creditworthiness and collateral values of local borrowers.

In Column (3), results are reported for a regression that includes a triple interaction term "Local bank × Money Stance × Manufacturing Share." The coefficients are found to be significantly negative, which suggests that the gap between local and nonlocal banks is less pronounced when a county employs more people in manufacturing. The size of the coefficient suggests that in a mildly contractionary environment (Boschen-Mills index = −1), in a county with 14.7% of workers in manufacturing (the 25th percentile county, representative of Great Plains states such as Arizona or Oklahoma), a local bank's lending grows 2.5% more slowly than that of a nonlocal bank, other things being equal, whereas in a county with 33.8% of workers in manufacturing (the 75th percentile county, representative of Great Lakes states such as Michigan), a local bank grows only 1.8% more slowly, not very different from their normal speed. The regression results indicate that when manufacturing employment share exceeds 23% in a county, the difference in lending pro-cyclicality between local banks and nonlocal banks becomes statistically indistinguishable from zero. Such counties account for about half of the sample.

Such a differential effect across counties of high and low shares of manufacturing employment can be explained by the difference in local credit demand. In manufacturing-intensive counties, during monetary tightening, the demand for industrial loans decreases directly because of the conventional interest-rate channel, while the demand for individual and real estate loans declines because of the associated lower employment and income growth that compromises local borrowers' creditworthiness and the value of their collateral. As a result of weaker loan demand in these industrial towns, the supply-side constraints of local banks are less likely to be binding. The results are also suggestive evidence on the opportunities for bank holding companies to reallocate liquidity from low loan-demand counties to high loan-demand counties or, more precisely, from relatively more manufacturing-intensive counties to more service-intensive counties during monetary contractions, and in the opposite direction during monetary expansions. On the other hand, the relatively stable loan volume of local banks in manufacturing-intensive counties can be explained by their lack of outside lending opportunities when the local demand for loans is low (e.g., in manufacturing-intensive counties during periods of tight money).

Our results on the difference between local and nonlocal banks cannot be considered robust before controlling for their size differences. Local banks are not always smaller than the local subsidiaries of multiple-county bank holding companies: in county-banking states, bank sizes for both local and nonlocal banks are capped by the size of the host county's economy (i.e., no banks are allowed to branch outside their home counties). However, if we consider a holding company as a well-coordinated entity and consider that the local banks are competing against the holding companies instead of the individual subsidiaries, then local bank status seems to be associated with smaller size. To control for the difference in bank size, we use three alternative measures. The first one measures an individual bank's or subsidiary's own size; the second one considers the size of a holding company as the real "size" of its local subsidiaries; the last measure uses market share (i.e., relative size) to take into account size differences in local economies across counties and the special regulatory restrictions that link the potential size of banks to local market size. Values for the first two measures are converted to 1993 constant U.S. dollars, and all three measures are lagged by one year when included in the regressions.

The results based on the three alternative measures are reported in Columns (4), (5), and

(6), respectively. We find that after controlling for size in various ways, being a local bank still means stronger sensitivity to monetary policy. Further, we find that, other things being equal, holding company size has no significant effect on a subsidiary's response to monetary policy; (somewhat surprisingly) the own size of a bank or bank subsidiary has a *positive* effect on the sensitivity; and larger market share is associated with a weaker response to monetary policy. The results seem to favor the explanation that a dominant bank (measured by relative size) in a concentrated local market, regardless of its *absolute* size, is more willing to maintain stable lending in bad times, expecting that it can recoup the rents in good times through more secured banking relationship, against the alternative explanation that larger banking organizations can prop up lending because of better access to wholesale funding. Indeed, in the summary statistics presented in Table 2, we also notice that nonlocal banks are as dependent on deposit funding (vs. wholesale funding) as the local banks.

In Column (7), we use the Bernanke-Mihov measure to replace the Boschen-Mills measure of monetary policy stance and re-estimate the regression, to test for the robustness of the results. We inflate the Bernanke-Mihov index by a factor of 20 to make it roughly comparable in scale with the Boschen-Mills index. The rank correlation coefficient between the Bernanke-Mihov index and the Boschen-Mills index during the sample period is 0.79. Not surprisingly, the main empirical results discussed above remain robust to this alternative measure of the monetary policy stance.

### 3.2. Robustness Tests: Controlling for Other Factors

We conduct additional tests to examine the robustness of our findings by looking into a bank's liquidity and capital conditions, as well as the subsidiary's size distribution within the bank holding companies. The regression results are reported in Table 5 and discussed below.

[insert Table 5 about here]

### 3.2.1. Controlling for Liquidity and Capital Conditions

The lending view of monetary policy transmission believes that a central bank influences commercial banks' lending by controlling the liquidity available to them. This mechanism characterizes our sample period very well, because Volcker targeted nonborrowed bank reserves instead of the fed funds rate. Facing monetary tightening and outflow of insured deposits, banks need either to cut back on loans or to draw down on their liquid assets, but doing the latter can create liquidity risks. Empirical research in general shows that banks pursue a counter-cyclical liquidity policy to hedge risks (e.g., Aspachs, Nier, and Tiesset, 2005). Kashyap and Stein (2000) find that less liquid banks are more sensitive to monetary shocks and that such a relationship is stronger among smaller banks. If local and nonlocal banks differ in their liquidity condition, then their differential responses to monetary shocks might be driven by this difference, as opposed to their local or nonlocal bank status.

To control for this, in Column (1) we include an interaction term between a bank's liquid asset ratio (lagged by one year to avoid endogeneity) and the contemporaneous measure of the monetary policy stance. Liquid assets include fed funds sold, securities purchased under agreements to resell, securities held to maturity, and trading assets. [13] Further, since Van den Heuvel's (2001) theory suggests that less capitalized banks may be more sensitive to money tightening, in Column (2) we also examine the effect of bank capital condition as measured by the capital-to-asset ratio[14].

Like Kashyap and Stein (2000), we find that more liquid banks are less affected by the

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[13] Following Kashyap and Stein (2000), the measure of a bank's liquidity is computed as RCFD0400 + RCFD0600 + RCFD0900+RCFD0380+ RCFD1350, prior to 1984. Between 1984 and 1992, it is computed as RCFD0390 + RCFD1350+ RCFD2146. Cash in vaults is not counted as liquidity because a greater portion of it is stored for purposes of reserve requirements. The balance-sheet liquidity ratio is defined as the ratio of liquidity to total assets.

[14] During the sample period, the Federal Reserve set minimum capital requirements based on a primary capital-to-total-asset ratio of about 6% (Keeley, 1988). Risk-weighted capital requirements were enacted much later following the 1988 Basel Accord.

monetary tightening. We also find that better-capitalized banks are more immune. However, our previous results on local vs. nonlocal banks remain robust: the coefficient on “Local bank × Monetary policy stance” remains significantly positive, and the size of the coefficient only gets larger (partly because local banks are typically associated with higher liquidity ratios and higher capital-to-asset ratios).

We also control for a bank's liquidity management potential due to financial market innovations.[15] Loutskina (2005) shows that banks with more single-family home mortgages in their loan portfolios can better withstand monetary shocks, because it is easier to securitize home mortgages as a result of the liquid market created by federal agencies. In 1980, about 10% of single-family home mortgage loans were securitized, whereas in 1985 the ratio reached nearly 25%. During the same period, less than 5% of multifamily residential mortgage loans were securitized. A bank with more home mortgages on its balance sheet, therefore, is effectively more liquid (Estrella, 2002).

In Column (3), results are reported for a regression that includes an interaction term between the monetary policy stance and the ratio of home mortgages in a bank's loan portfolio (lagged by one year). The results, however, show that lending by banks with a higher home mortgage ratio is actually more sensitive to monetary policy (although the result is not statistically significant), probably because the cyclical demand for home mortgages dominates the supply-side factor. More important, our previous results still hold: local banks are significantly more sensitive to monetary policy.

### 3.2.2. Can Holding Companies Help Their Subsidiaries Live with a Lower Liquidity Ratio?

We suspect that a multi-county bank holding company may be able to use liquid assets

[15] The previous literature also suggests other risk management techniques that can help shield bank lending from monetary shocks. Purnanandam (2007) shows that banks using more interest-rate derivatives for hedging purposes respond less to interest-rate shocks. The data he uses are not available prior to 1985. Cebenoyan and Strahan (2004) show that banks engaging in loan purchases and sales activities can better withstand monetary shocks; the data, however, are available only between 1987 and 1993.

more efficiently than local banks, if liquidity needs are not perfectly correlated across regions.[16] A bank may need to reduce lending volume when experiencing deposit outflows, but a bank can address the situation by rebalancing its asset portfolio, e.g., selling off its liquid asset holdings and avoiding cutting loan volume (Bernanke and Blinder, 1992). Banks typically have more active control on their asset portfolio composition than on the deposit supply, which is influenced more exogenously by the interest rate and local market conditions. In unreported results we do not find any statistically significant difference between local and nonlocal banks in their ability to retain deposits after a monetary contraction. Therefore, the more likely explanation for the difference between local and nonlocal banks in loan volume fluctuations might be found in a bank's liquid asset ratio, i.e., in how a bank allocates its assets between liquid assets and loans.

Banks hold about a third of their total assets in liquid securities. In our sample, local banks, on average, hold more liquid assets than nonlocal banks, regardless of monetary policy stance, consistent with Demsetz and Strahan's (1997) finding that smaller banks take fewer risks. We focus instead on the *change* in the level of the liquidity ratio and examine whether the gap between local and nonlocal banks *grows wider* when monetary policy is tightened. In Column (4), we use the annual percentage point *change* of a bank's liquidity ratio as the dependent variable, to study the determinants of the fluctuations of a bank's liquidity position.

The results show that, during monetary tightening, local banks build up their liquidity buffers significantly *more* than do nonlocal banks, as evidenced by the significantly negative coefficient on the interaction term "Local Bank × Money." The results suggest that subsidiaries of a multi-county holding company can afford to lower their liquidity ratio during monetary

[16] Ehrmann and Worms (2004) argue that the existence of bank networks is important for banks' reactions to monetary policy. Based on German data, they find that small banks access the interbank market indirectly through the large head institutions of their respective network organizations. The interbank flows within these networks allow smaller banks to manage their funds in a fashion that helps them keep their loan portfolios with nonbanks relatively unaffected after a monetary contraction. Also, Carletti, Hartmann, and Spagnolo's (2007) theory shows that this diversification effect is stronger when the relative cost of refinancing is high, which should suggest that local banks need to hold more liquid assets, particularly during monetary tightening.

tightening because when facing an unexpected liquidity shock, they may expect support from fellow subsidiaries located in other geographic areas (and liquidity shocks are not perfectly correlated across geographic regions), whereas local banks have to hoard securities and other liquid assets to prepare for such situations; inevitably, they would have to cut back on loans to achieve this.

**3.2.3. Does a Subsidiary's Share in the Holding Company Matter?**

Within a bank holding company, the lead subsidiary that accounts for 70% of the group's total assets should not expect support from a small subsidiary that accounts for only 5% of the group's assets as much as the other way around. We revise the definition of a "Nonlocal Bank" to take this into account: now a lead subsidiary that accounts for more than 50% of the holding company's total assets is considered a "Local Bank," because this lead subsidiary is less likely to receive substantial support from other smaller subsidiaries and should behave in a way similar to a stand-alone local bank (of similar size). This new definition reclassifies about 17% of previously "nonlocal banks" into the "local bank" category, and what remains as "nonlocal banks" under the new definition are those smaller subsidiaries that are not the dominant lead banks of their holding companies. The new definition is more comparable to Campello's (2002), in which only smaller subsidiaries are included in the comparison. Column (5) reports regression results based on this new definition. Our previous results still hold, and the size of the effects is stronger: the smaller subsidiaries, as predicted, indeed benefit disproportionately more than the larger lead subsidiaries.

We also consider the possibility that those tiny community banks, by their large numbers, are driving the regression results. If the growth differential between nonlocal banks and local banks exists mainly in the much smaller size group, the effect on aggregate lending could be much smaller than the coefficients appear to indicate. In Column (6), we thus estimate the regression based only on larger banks (both local and nonlocal banks) that control more than 10% of a county's loan market. Only half of the banks or bank subsidiaries in the sample exceed this threshold. The new regression results excluding those tiny banks show that even local banks of substantial size (controlling >10% of local market share) respond more strongly to monetary shocks than do nonlocal banks of similar size.

## 4. Discussions

Our study is closely related to the literature that attempts to identify the bank lending channel of monetary policy transmission by studying the heterogeneous response to monetary policy by individual banks that differ in liquidity condition (e.g. Kashyap and Stein (2000)), the use of interest rate swaps or loan sales to manage risks (e.g., Purnanandam (2007), Cebenoyan and Strahan (2004)), and holding company affiliation (Campello (2002) and Ashcraft (2003)).

This study's innovation is mainly empirical. It exploits a special regulatory setting to pin down a bank's borrower base to a very narrow local geographic unit — a county — and then to allow proper control of variations in local credit demand using the prediction of the interest-rate channel and the balance-sheet channel of monetary policy transmission that manufacturing-intensive industrial towns are more affected by a national monetary tightening independent from banking sector conditions.

This study draws evidence from 18 U.S. county-banking states over a 10-year period (1977-1986) and shows that (a) other things being equal, local banks' loan supply exhibits stronger sensitivity to monetary policy, compared with that of nonlocal banks (i.e., local subsidiaries of multi-county bank holding companies), and (b) the difference is smaller in counties where the share of manufacturing employment is larger, because weak loan demand in these counties during recessions tend to make loan supply weakness less relevant.

As Cecchetti (1995) notes (in discussing the bank lending and balance-sheet channels of monetary policy transmission), "With the introduction of interstate banking and the development of more sophisticated pools of loans, it is only the balance sheet effects that will remain." The two findings uncovered from historical experience may suggest that without the banking sector's increasing consolidation and small local banks' declining market share since the 1980s, bank loans would have been much more sensitive to monetary policy and the bank lending channel of monetary policy would have been much more effective, particularly considering the increasing share of nonmanufacturing employment in the U.S. economy, which has raised the importance of credit supply during monetary tightening.

Banks' geographic diversification may reduce the efficacy of monetary policy operations,[17] but it also buffers the banking system against many other unfavorable shocks, in particular those isolated shocks specific to certain regions only. Calomiris (1993), comparing the historical experiences of the U.S. and Canada, suggests that the banking market fragmentation in the U.S. in the early part of the 20th century destabilized the banking system by creating small, poorly diversified banks that were vulnerable to bank runs and portfolio shocks. One of the comparative advantages of financial institutions versus market finance is their ability to provide intertemporal smoothing (Allen and Gale, 1997). Larrain (2006) shows that a developed banking sector helps smooth out industrial volatility by conducting counter-cyclical lending. Many factors (e.g., a bank's funding structure) can determine whether a bank is able to avoid pro-cyclicality in lending and to insulate its borrowers against negative shocks.[18] The results of this paper may suggest that the declining share of local banks in the U.S. banking sector could have contributed to the stabilization of the financial sector and may help central bankers better focus on price stability when making monetary policy.

[17] Empirical studies have shown that in recent periods, the correlation between changes in the fed funds rate and subsequent quarters' real GDP growth has reached near zero (Kuttner and Mosser, 2002; Estrella 2002; Boivin and Giannoni 2002; Taylor 1995), leading to the notion that monetary policy has become less effective. There have been many explanations. The results of this study provide one new potential explanation for the trend: that the declining share of geographically isolated local banks may have contributed to it.

[18] Berlin and Mester (1999) show that access to core deposits with inelastic rates permits a bank to make contractual agreements with borrowers that are infeasible if the bank must pay market rates for funds, and such access insulates a bank's costs of funds from exogenous shocks, allowing it to insulate its borrowers against exogenous credit shocks. Gatev and Strahan (2006) and Gatev, Schuermann, and Strahan (2006) both show that transactions deposits help banks hedge liquidity risk from unused loan commitments and that, as a result, users of credit lines could consider banks with better access to core deposit more reliable.

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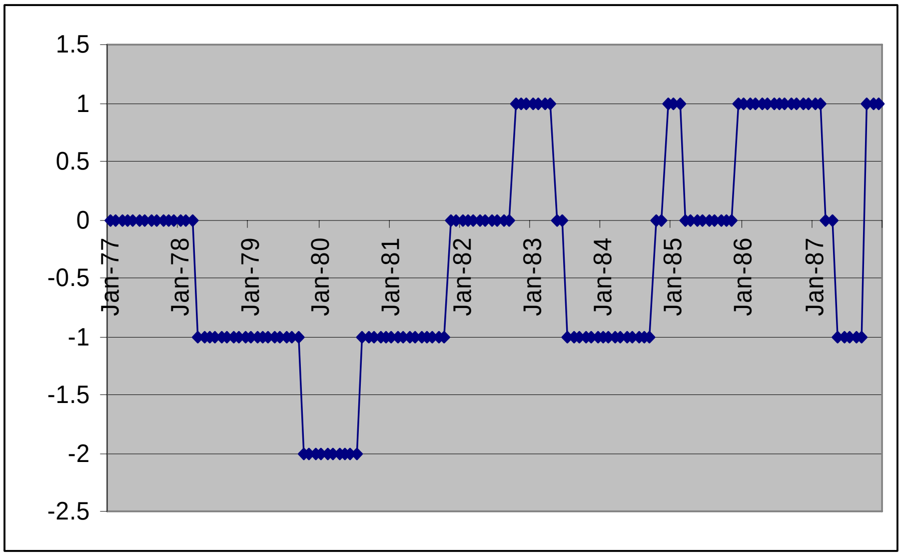
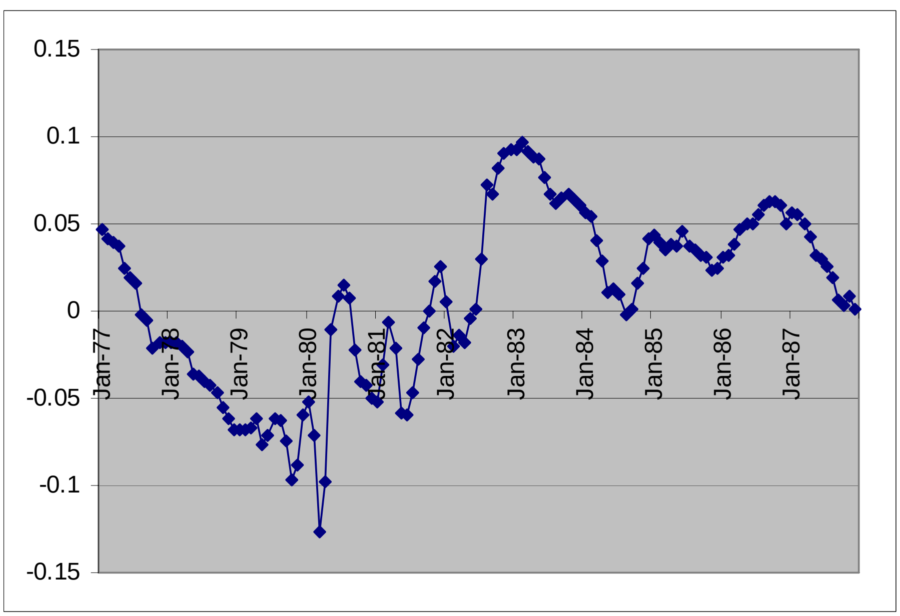
## Exhibit 1: Boschen-Mills (1995) index of monetary policy stance

Boschen and Mills (1995), based on their reading of FOMC documents, rate Fed policy as being in one of the following five categories: -2 (strongly contractionary), -1 (mildly contractionary), 0 (Neutral), 1 (mildly expansionary), and 2 (strongly expansionary). Exhibit 1 uses this measure to portray the evolution of the monetary policy stance during the sample period of this study.




## Exhibit 2: Bernanke-Mihov (1998) index of monetary policy stance

Bernanke and Mihov (1998) create the index based on a flexible VAR model that nests similar models in the previous literature, but based on more specific assumptions about Fed operating procedures. This index thus controls for the endogeneity of federal fund rates to economic conditions. More positive (negative) values indicate a loose (tighter) monetary policy stance. In the regressions, we inflate the index by a factor of 20 to make it comparable in numerical scale with the Boschen-Mills index.



# Tables 1: Timeline of branching deregulations

This table documents the timeline of branching deregulations in the county-banking states. The second column, "deregulation date," indicates the date when a state first legalized bank branching across county boundaries, prior to which "county banking" was practiced. As of the beginning of 1985, none of the 18 states in our sample had allowed branching across county boundaries. The third column briefly summarizes the changes initiated by the deregulations. See Amel (1993) for details. The fourth column, "MBHC date," indicates the date when formation of multi-bank holding companies (MBHC) was first legalized in a state. N/A indicates that MBHCs have always been legal. The fifth column briefly summarizes the changes of restrictions initiated by the statutory changes. For details also see Amel (1993).

| State | Deregulation date | Changes of branching restrictions | MBHC date | Changes of restrictions |
|---|---|---|---|---|
| Arkansas | 01/01/94 | (06/28/85) may take over out-of-county failed banks → Allowed into contiguous counties | 02/05/71 | Grandfathered BHCs |
| Colorado | 08/01/91 | Within 3,000 feet →Statewide by merger | N/A | No limitations |
| Illinois | 09/01/88 | →Contiguous counties | 01/01/82 | Prohibited → Home and contiguous regions |
| Indiana | 07/01/89 | Countywide→ Allowed into contiguous counties | 07/01/85 | Prohibited→BHC (10% cap) |
| Iowa | ?/?/2001 | | N/A | 8% cap |
| Kansas | 04/30/87 | →Statewide by merger | 07/01/85 | Prohibited → BHC (9% cap) |
| Kentucky | 07/13/90 | →Statewide by merger | 07/14/84 | Prohibited→3 banks in five years |
| Michigan | 03/01/87 | →Statewide by merger | 04/??/71 | Prohibited→No limitations |
| Minnesota | 08/01/87 | →Allowed in seven-county Minneapolis-St. Paul area | N/A | No limitations |
| Montana | 01/01/90 | →Statewide by merger, or de novo in adjoining county | N/A | No limitations |
| Nebraska | 03/04/85 | (03/31/83) can take over failed bank→ Statewide by merger | 09/01/83 | Grandfathered→ (03/31/83) failed banks→9% cap |
| North Dakota | 07/05/87 | →Statewide by merger | N/A | No limitations |
| Oklahoma | 03/16/88 | →Statewide by merger | 10/10/83 | 11% cap |
| Oregon | 03/12/85 | Restricted for city of less than 50,000 population in which another bank is located → statewide | N/A | No limitations |
| Tennessee | 04/19/85 | Countywide→ Previously operated as an affiliate of a BHC → Statewide (03/08/90) | N/A | Unlimited→ (03/03/74) five years old or same county, 16.5% cap→ (04/18/85) five-year limit waived if in a county of >200,000 residents |
| Texas | 10/26/88 | Countywide→ Statewide | 08/18/70 | Prohibited → No limitations |
| Wisconsin | 08/01/89 | 25miles→Statewide | N/A | No limitations |
| Wyoming | 04/09/88 | May take over failed banks→ Statewide by merger | N/A | No limitations |

# Table 2: Summary Statistics

## Panel A: Bank characteristics (Nonlocal vs. Local Banks)

| | Median | | Mean | |
|---|---|---|---|---|
| | Local | Nonlocal | Local | Nonlocal |
| Total Assets (000') | 36,961 | 91,256 | 74,530 | 508,858 |
| Total Loan (000') | 19,223 | 52,194 | 40,318 | 292,772 |
| County Market Share | 0.096 | 0.195 | 0.173 | 0.235 |
| Real Loan Growth Rate (%) | 0.109 | 0.762 | 0.928 | 2.049 |
| Loan to Asset Ratio | 0.539 | 0.576 | 0.527 | 0.568 |
| Deposit to Asset Ratio | 0.896 | 0.892 | 0.884 | 0.873 |
| Capital to Asset Ratio | 0.082 | 0.072 | 0.087 | 0.075 |
| C&I Loan Ratio | 0.185 | 0.261 | 0.213 | 0.278 |
| Real Estate Loan Ratio | 0.309 | 0.345 | 0.324 | 0.357 |
| Home Mortgage Ratio | 0.157 | 0.170 | 0.189 | 0.198 |
| Liquidity Ratio | 0.352 | 0.287 | 0.363 | 0.297 |
| Fed Funds Purch. Ratio | 0.000 | 0.003 | 0.009 | 0.026 |
| Fed Funds Sold Ratio | 0.046 | 0.042 | 0.061 | 0.061 |
| Lending Rate (%) | 11.89 | 11.91 | 11.68 | 11.89 |
| Deposit Rate (%) | 6.24 | 6.29 | 6.05 | 6.25 |
| Net Interest Margin (%) | 5.48 | 5.48 | 5.65 | 5.64 |

## Panel B: Distribution of bank size (total loan in thousands of 1993 constant USD)

**Note:** "National sample" includes banks chartered in any U.S. states, while the statistics on local and nonlocal banks are based on banks from the county-banking states only. The Kashyap and Stein (2000) study examines the national sample of banks.

| Size distribution percentile | Year 1978 | | | Year 1985 | | |
|---|---|---|---|---|---|---|
| | Nonlocal | Local | National Sample | Nonlocal | Local | National Sample |
| 1% | 4,605 | 1,775 | 2,165 | 3,975 | 1,761 | 1,974 |
| 5% | 13,530 | 4,127 | 4,885 | 8,027 | 3,937 | 4,520 |
| 10% | 17,808 | 5,897 | 7,227 | 11,833 | 5,647 | 6,746 |
| 25% | 34,261 | 10,640 | 13,417 | 21,777 | 9,934 | 12,654 |
| 50% | 67,311 | 21,552 | 28,355 | 47,352 | 19,068 | 26,947 |
| 75% | 163,148 | 42,734 | 62,077 | 112,997 | 37,326 | 62,527 |
| 90% | 428,143 | 85,091 | 161,102 | 313,848 | 70,704 | 176,463 |
| 95% | 1,262,502 | 132,399 | 332,421 | 697,836 | 107,225 | 438,528 |
| 99% | 6,027,880 | 387,841 | 1,821,513 | 5,080,295 | 297,450 | 2,615,301 |
| No. Obs. | 644 | 7,550 | 13,955 | 1,385 | 5,633 | 12,642 |

## Table 3: Time-varying banking market integration

The table documents the evolution of banking market integration over time in county-banking states as bank holding companies acquired more and more out-of-county assets. Ratios in the table are loan market shares of nonlocal banks in state i in year t. The discrete changes of the ratio in Illinois during 1980 and 1981 were caused by the temporary entry into and exit from local bank status of the two largest banks in the state: Continental Illinois Bank (local during 80 and 81), and First Chicago Corp (local during 81). N/A indicates that in state i and year t banks were allowed to branch across county borders and the bank market integration measure we use was not applicable.

| State | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 |
|---|---|---|---|---|---|---|---|---|---|---|
| Arkansas | 0.09 | 0.08 | 0.08 | 0.08 | 0.09 | 0.09 | 0.13 | 0.33 | 0.36 | 0.43 |
| Colorado | 0.67 | 0.66 | 0.68 | 0.67 | 0.71 | 0.72 | 0.72 | 0.73 | 0.74 | 0.74 |
| Illinois | 0.03 | 0.53 | 0.57 | 0.27 | 0.07 | 0.62 | 0.64 | 0.63 | 0.63 | 0.66 |
| Indiana | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.30 | 0.62 |
| Iowa | 0.27 | 0.28 | 0.28 | 0.29 | 0.32 | 0.33 | 0.36 | 0.40 | 0.42 | 0.44 |
| Kansas | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.18 | 0.20 |
| Kentucky | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.11 | 0.30 | 0.52 | 0.62 |
| Michigan | 0.65 | 0.68 | 0.70 | 0.73 | 0.75 | 0.77 | 0.78 | 0.84 | 0.85 | 0.87 |
| Minnesota | 0.57 | 0.58 | 0.58 | 0.60 | 0.62 | 0.66 | 0.68 | 0.70 | 0.71 | 0.71 |
| Montana | 0.56 | 0.56 | 0.56 | 0.59 | 0.67 | 0.69 | 0.69 | 0.68 | 0.69 | 0.69 |
| Nebraska | 0.09 | 0.14 | 0.14 | 0.18 | 0.19 | 0.19 | 0.30 | 0.36 | N/A | N/A |
| North Dakota | 0.34 | 0.34 | 0.34 | 0.35 | 0.34 | 0.42 | 0.43 | 0.43 | 0.42 | 0.41 |
| Oklahoma | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.09 | 0.26 | 0.29 | 0.34 |
| Oregon | 0.32 | 0.34 | 0.37 | 0.68 | 0.64 | 0.65 | 0.65 | 0.72 | N/A | N/A |
| Tennessee | 0.43 | 0.43 | 0.43 | 0.42 | 0.44 | 0.47 | 0.56 | 0.41 | N/A | N/A |
| Texas | 0.51 | 0.56 | 0.58 | 0.60 | 0.65 | 0.71 | 0.74 | 0.75 | 0.74 | 0.73 |
| Wisconsin | 0.44 | 0.45 | 0.46 | 0.48 | 0.49 | 0.52 | 0.55 | 0.60 | 0.62 | 0.68 |
| Wyoming | 0.44 | 0.43 | 0.46 | 0.52 | 0.54 | 0.53 | 0.55 | 0.62 | 0.63 | 0.64 |

## Table 4: Local banks' lending is more sensitive to monetary policy

**Note:** The dependent variable is the real annual growth rate of loans (%) at the bank level. "**Local**" is the dummy variable for local banks; "**Money**" is the Boschen-Mills monetary policy stance index, except in Column (7) in which the Bernanke-Mihov index is used; for both indices, lower, negative values indicate tighter monetary policy; "**Manufacture**" is a county's manufacturing employment share; three measures of **"Size"** are used: one measures a bank or subsidiary's own size, another uses holding-company size as the size of its subsidiary; yet another uses local market share (i.e., relative size). **"HHI"** is the Herfindahl index measure of county-level market concentration; **"Market share"** is a bank's loan market share in a county. The symbol **"×"** indicates interaction between two variables. Year and U.S. state dummy variables are included, but their coefficients are not reported for the sake of brevity. Standard errors reported in parentheses are adjusted for heteroskedasticity and clustering of residuals by county×year. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, ***, respectively. More details on the regression specification definitions and data sources of the variables can be found in Section 2 of the paper.

| | Basic regression | Control for demand | Effect differs across counties | Control for size | | | Bernanke-Mihov measure |
|---|---|---|---|---|---|---|---|
| | | | | Own size | Holding company size | Market share | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Local Bank | -1.20***<br>(0.23) | -1.20***<br>(0.23) | -1.23***<br>(0.23) | -1.21***<br>(0.23) | -1.24***<br>(0.23) | -1.30***<br>(0.23) | -1.57***<br>(0.21) |
| **Local × Money** | **0.93***<br>(0.25)** | **0.92***<br>(0.25)** | **1.82***<br>(0.44)** | **2.32***<br>(0.47)** | **2.34***<br>(0.60)** | **1.67***<br>(0.44)** | **1.63***<br>(0.40)** |
| Local × Money × $Manufacture_{t-1}$ | | | -3.70***<br>(1.42) | -3.84***<br>(1.42) | -3.80***<br>(1.42) | -3.66**<br>(1.42) | -6.12***<br>(1.37) |
| Size × Money | | | | 0.40***<br>(0.11) | 0.12<br>(0.09) | -2.20***<br>(0.57) | |
| $Manufacture_{t-1}$ | | 1.71**<br>(0.70) | 1.59**<br>(0.70) | 1.47**<br>(0.70) | 1.56**<br>(0.70) | 1.38***<br>(0.70) | -1.12**<br>(0.57) |
| $Manufacture_{t-1}$ × Money | | 5.34***<br>(0.64) | 4.92***<br>(0.65) | 4.44***<br>(0.65) | 4.78***<br>(0.65) | 4.50**<br>(0.66) | 3.21***<br>(0.49) |
| $HHI_{t-1}$ | 7.03***<br>(0.77) | 6.69***<br>(0.78) | 6.71***<br>(0.78) | 5.96***<br>(0.82) | 6.49***<br>(0.81) | 6.78***<br>(0.78) | 6.72***<br>(0.78) |
| Market $Share_{t-1}$ | -11.81***<br>(0.56) | -11.89***<br>(0.56) | -11.90***<br>(0.56) | -11.18***<br>(0.58) | -11.69***<br>(0.58) | -12.93***<br>(0.67) | -11.90***<br>(0.56) |
| Observations | 68896 | 68678 | 68678 | 68678 | 68678 | 68678 | 68678 |
| Adj. R-squared | 0.144 | 0.146 | 0.146 | 0.146 | 0.146 | 0.146 | 0.145 |

## Table 5: Robustness tests

**Note:** The dependent variable is the real annual growth rate of loans (%) at the bank level, except in Column (4) in which annual percentage-point change in the liquidity ratio is the dependent variable. "**Local**" is the dummy variable for local banks; "**Money**" is the monetary policy stance index; "**Manufacture**" is a county's manufacturing employment share; **"Liquidity"** is the liquid asset ratio of a bank; **"Capital"** is the capital to asset ratio; **"Mortgage"** is the home mortgage loan to total loan ratio; **"HHI"** is the Herfindahl index measure of county-level market concentration; **"Market share"** is a bank's loan market share in a county. The symbol **"×"** indicates interaction between two variables. Column (5) counts as "local banks" those lead subsidiaries that account for more than 50% of a holding company's total loans. Column (6) excludes from the regression small banks that supply less than 10% of their relevant local county loan market. Year and U.S. state dummy variables are included, but their coefficients are not reported for the sake of brevity. Standard errors reported in parentheses are adjusted for heteroskedasticity and clustering of residuals by county×year. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, ***, respectively. More details on the regression specification definitions and data sources of the variables can be found in Section 2 of this paper.

| | Control for | | | Dependent variable: ΔLiquidity | Size distribution | |
|---|---|---|---|---|---|---|
| | Liquid Asset Ratio | Capital to Asset Ratio | Home Mortgage Ratio | | Lead subs. = local bank | Excl. fringe banks |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Local Bank | -1.20***<br>(0.23) | -1.17***<br>(0.23) | -1.23***<br>(0.23) | 0.14<br>(0.09) | -0.73***<br>(0.25) | -0.15<br>(0.23) |
| **Local × Money** | **2.07***<br>(0.44)** | **2.33***<br>(0.44)** | **1.83***<br>(0.44)** | **-1.01***<br>(0.19)** | **2.13***<br>(0.47)** | **1.56***<br>(0.41)** |
| Local × Money × $Manufacture_{t-1}$ | -3.84***<br>(1.42) | -3.78***<br>(1.40) | -3.70***<br>(1.42) | 0.71<br>(0.60) | -3.58**<br>(1.52) | -3.11**<br>(1.27) |
| Liquidity × Money | -3.55***<br>(0.76) | | | | | |
| Capital × Money | | -43.85***<br>(5.88) | | | | |
| Mortgage × Money | | | 0.54<br>(0.72) | | | |
| $Manufacture_{t-1}$ | 1.61**<br>(0.70) | 1.37**<br>(0.70) | 1.54**<br>(0.70) | 0.47*<br>(0.27) | 1.63**<br>(0.70) | 2.25***<br>(0.68) |
| $Manufacture_{t-1}$ × Money | 4.79***<br>(0.65) | 4.32***<br>(0.64) | 4.78***<br>(0.67) | 0.29<br>(0.27) | 5.01***<br>(0.65) | 5.10***<br>(0.63) |
| $HHI_{t-1}$ | 6.48***<br>(0.78) | 5.64***<br>(0.78) | 6.72***<br>(0.78) | -1.56***<br>(0.31) | 6.45***<br>(0.78) | 6.70***<br>(0.74) |
| Market $Share_{t-1}$ | -11.70***<br>(0.56) | -11.02***<br>(0.55) | -11.91***<br>(0.56) | 2.19***<br>(0.22) | -11.66***<br>(0.55) | -7.72***<br>(0.59) |
| Observations | 68678 | 68678 | 68678 | 68678 | 68678 | 35099 |
| Adj. R-squared | 0.146 | 0.151 | 0.146 | 0.066 | 0.145 | 0.171 |

## Appendix: Variable Definition Table

| Variable | Definition | Data Source |
| --- | --- | --- |
| Total loan | Following Kashyap and Stein (2000) total loan is defined as RCFD1400 (Total loans and leases, gross) plus RCFD2165 (Lease financing receivables) prior to 1984, and RCFD1400 thereafter. | Call Report |
| Real loan growth (%) | Natural log difference of total loan between year t and year t-1, adjusted for consumer price inflation; in percentage term. Values greater than 100% or smaller than -100% are truncated as outliers, which constitute only 0.72% of the original sample observations. | Call Report |
| Local bank dummy | Dummy variable for local banks, which are NOT affiliated with any bank-holding companies that own subsidiaries in multiple counties | Call Report |
| Money | Measure of monetary policy stance; a positive, higher (negative, lower) value indicates a more expansionary (contractionary) policy stance. | either Boschen and Mills (1995), or Bernanke and Mihov (1998) |
| ΔLiquidity ratio | Following Kashyap and Stein (2000), the measure of a bank's liquidity is computed as RCFD0400 + RCFD0600 + RCFD0900+RCFD0380 + RCFD1350, prior to 1984. Between 1984 and 1992, it is computed as RCFD0390 + RCFD1350+ RCFD2146. The balance-sheet liquidity ratio is defined as the ratio of liquidity to total assets.<br>The change of liquidity ratio is defined as the liquidity ratio (%) at year t minus the liquidity ratio (%) at year t-1. | Call Report |
| Capital | Equity to total asset ratio | Call Report |
| Manufacture | Manufacturing employment to total employment ratio, in a county | County Business Patterns |
| Market share | Loan market share of a bank in a county | Call Report |
| HHI | Herfindahl measure of market concentration at the county market level | Call Report |
| Home mortgage | Home mortgage loan to total loan ratio | Call Report |