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External Financing Costs and Banks' Loan Supply: Does the Structure of the Bank Sector Matter?

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Abstract

This paper investigates whether banks' loan supply depend on internally generated capital in a fashion that varies according to the size-structure of the bank sector. Banks may experience liquidity constraints if it is costly to raise uninsured funds and recent evidence suggests that external financing costs may be particularly high for small banks. Considering that retail loan markets are predominantly local in nature, this paper asks whether the potential significance of individual-bank constraints carry over to a regional level in a manner that affects the overall supply of bank credit to local loan markets. Panel data for US states is used to study how state-level loan supply covaries with cash flow in bank systems with different size-structures. Shifts in the demand for loans induced by the Tax Reform Act of 1986 is used to identify loan supply. The results produce strong evidence of state-level supply effects. It is shown that loan supply of bank systems with a high percentage of small banks depends pro-cyclically on banks' internal generation of capital and that no systematic covariation is present in bank systems with relatively few small banks.

JEL Classification Codes: G21, E5, E44.

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Nontechnical Summary

This paper investigates whether banks' loan supply depend on internally generated capital in a fashion that varies according to the size-structure of the bank sector. Informational imperfections may adversely affect banks' ability to raise uninsured finance (large CDs and borrowed funds). Recent evidence suggests that external financing costs may be particularly high for small banks, leaving them periodically liquidity constrained. A bank that finds it costly to issue ininsured liabilities may have difficulties expanding its balance sheet to finance new lending. Instead, new lending must be financed through the generation of internal capital, leaving new lending effectively conditioned on internal cash flows.

Considering that retail loan markets are predominantly local in nature this paper asks whether the potential significance of individual-bank constraints carry over to a regional level in a manner that affects the overall supply of bank credit to local loan markets. Panel data on US states is used to study how state-level bank loan supply covaries with bank cash flows in bank systems with different size-structures. If internal and external funds are perfect substitutes one would expect to see no systematic covariation between loan supply and cash flows.

I use shocks to loan demand induced by the Tax Reform Act of 1986 to identify loan supply, and changes in state branching laws as additional instruments. The results produce strong evidence of regional supply effects and that these vary with the structure of the bank sector. The aggregate loan supply of bank systems with a high percentage of small banks depends pro-cyclically on banks' internal cash flows. This is consistent with the proposition that such banks pay a premium for uninsured funds. In addition, a similar result obtains for bank systems with a relatively high proportion of liquid assets, supporting the proposition that liquidity constrained banks hold a buffer stock of liquid assets and that this variable may contain more information about the severity of constraints than bank size.

1 Introduction

Banks play an important role in the economy as financial intermediaries allocating credit to households and firms. In the last decades, a large body of research have pointed out that asymmetric information inherent in credit markets may adversely affect certain borrowers' ability to obtain bank credit, and hence may have an impact on the provision and distribution of bank finance.[1]

Informational imperfections, however, are also likely to affect banks' own cost of finance as banks have private information about the credit quality of their loan portfolio. This is especially pertinent to the uninsured external forms of finance that banks use, such as uninsured liabilities (large CDs and borrowed funds) and equity. Banks raise uninsured liabilities to help finance their lending operations and their access to such funds may have important implications for their supply of credit. Recently, Kashyap and Stein [1995, 1997] have presented evidence that small banks do not rely much on uninsured liabilities. They propose that adverse selection problems in the markets for uninsured funds are particularly severe for small banks, preventing them ready access to such funds, and causing them to cut back lending during periods of tight monetary policy.[2]

A bank that finds it costly to issue uninsured liabilities may have difficulties expanding its balance sheet to finance new lending. In this case, new lending must effectively be financed through the generation of internal capital. Hence, to the extent that uninsured funds are particularly costly to small banks, their lending may be conditioned on internal cash flows.[3]

The issue remains, however, as to whether such liquidity constraints are important at the macroeconomic level, that is, does the potential significance of individual-bank constraints have any effect at the aggregate level? And if so, given the evidence presented above, does the significance vary with the size-structure of the banking sector? Considering that retail bank loan markets tend to be local in nature, the existence of aggregate effects may have real implications for local borrow-

[1] Gertler [1988], Bernanke [1993], and Hubbard [1995] provide good surveys.

[2] Stein [1998] presents a theoretical model.

[3] Reliance solely on insured deposits to finance new lending may be difficult if deposits are not supplied inelastically. Alternatively, a bank may raise new equity capital, however, adverse selection problems in equity markets may prevent ready use of equity as a source of finance, see Myers and Majluf [1984] and Calomiris and Wilson [1998] for some empirical evidence.

ers.[4] Liquidity constrained banks may pass up nonnegative net present value projects in the local economy because they are unable to expand their balance sheet to finance new lending. Small firms are often believed to be relatively more dependent on bank finance and hence may be especially sensitive to movements in bank loan supply. If the size-structure of the bank sector matters, small firms may be disproportionately affected because small banks specialize in lending to this group of firms.

In this paper I work with a panel of US state-level bank data from 1970–90 to investigate whether liquidity constraints are important for banks' supply of commercial and industrial loans. In particular, I estimate the dependency of state-level loan supply on the internal generation of capital and investigate whether this dependency varies according to the size-composition of the state-level bank sector. Bank branching restictions, imposed by state regulators and widely upheld into the late 1980s, have supported the development of considerable differences in the structure of the US banking industry across states, making data on US states well-suited for a test of this hypothesis.

Essentially the framework of US states is a setting where retail lending is regional and interbank and wholesale money markets are supra-regional. These markets work to integrate regions by allocating resources towards areas with relatively strong loan demand. If, however, (some) banks have only limited access to these overall markets in a fashion that has repercussions on lending, liquidity constraints may play an significant role in the propagation of regional business cycle fluctuations by tying loan supply to cash flows.

It is not obvious that individual bank liquidity constraints will also be significantly present at the state level. If adverse selection effects periodically impair small banks' access to uninsured funds, larger banks may increase their loan supply accordingly and there may be no macroeconomic effect. Furthermore, informational problems may be partly overcome by the formation of "relationships" between small and larger banks located in the same geographic area. The latter may have better information about the loan portfolio of small banks located in the same retail market than other

[4] Section 2 summarizes empirical evidence on the geographical size of loan markets.

economic agents and hence may be willing to extend finance at "critical" points in time. Also, Houston et al. [1997] find evidence that bank holding companies establish internal capital markets. Hence a holding company with subsidiaries in different states may mitigate constraints by reallocating resources across subsidiaries. Alternatively, the observation that small banks are inactive in the markets for uninsured funds may not imply that they are liquidity constrained. Rather one may conjecture that small banks abstain from the use of such funds because they have easy access to insured deposits. If this is the case, there should be no systematic covariation between lending and the generation cash flows.

The empirical approach of the paper is as follows. I test for the aggregate significance of liquidity constraints by estimating the dependence of state-level bank loan supply on internally generated capital (cash flow). Under the null hypothesis that internal and external uninsured funds are perfect substitutes at the bank industry level, this dependence should be zero. Alternatively, if liquidity constraints matter, one would expect aggregate loan supply to vary *pro-cyclically* with variations in internal cash flows.[5]

Although the empirical literature on the determinants of bank lending concerns loan *supply*, many studies has run reduced form regressions of loan growth on a set of bank-specific variables.[6] Because observed bank lending is the outstanding amount of loans, it is essential to establish that results are not driven by variations in loan demand. Failing to control for demand, reduced-form regressions suffer from simultaneous equation bias. However, variables that shift loan demand only are often hard to find. An additional problem is that bank balance sheet variables, often used as regressors, are really endogenous.[7]

I estimate banks' supply of commercial and industrial loans by explicit use of variables that

[5] Similar tests are well-known from the literature testing for firm-level finance constraints. See for example Fazzari, Hubbard and Petersen [1988] and Hubbard and Kashyap [1992]. The present paper differs from these by considering frictions at the bank-level as opposed to the firm-level, by the explicit use of variables to identify loan supply and by studying the role of bank sector structure. Consumer finance constraints and bank lending are studied by Jappelli and Pagano [1989], Bacchetta and Gerlach [1997], and Ostergaard, Sørensen and Yosha [1998] among others.

[6] An exception is Driscoll [1997].

[7] Balance sheet variables are correlated with business cycle fluctuations and due to serial correlation, the use of lagged regressors is often not a satisfactory solution.

shift loan demand only. In particular, I run a Two-Stage Least Square (2SLS) regression of bank loan supply on internally generated capital, using variables that shift loan demand as instruments.[8] I use the Tax Reform Act of 1986 (TRA86) to identify loan supply. The TRA86 eliminated the Investment Tax Credit which was heavily used by certain industry sectors. This change, together with data on industry composition across states, is used to construct exogenous variables that shift the demand for commercial and industrial loans. In order to obtain more precise estimates, I employ state-level bank branching laws as an additional class of instruments.

The results confirm that loan supply depends significantly on the internal generation of capital in a pro-cyclically manner. Importantly, the strength of this dependency varies with the size-structure of the bank sector. Splitting the sample of states into three equal-sized groups according to the size-structure of state banking systems, the regressions produce strong evidence that loan supply in states with a high proportion of small banks depend disproportionately on the amount of internal funds generated. A similar dependency is found in systems with a high proportion of unit banks. The estimated dependency accounts for 37% – 46% of average bank lending to businesses. Banks that pay a premium for uninsured funds may keep a buffer stock of liquid assets to insure their loan portfolio from external shocks (Kashyap and Stein [1997]). In line with this proposition, I further find that loan supply covaries pro-cyclically with cash flows in bank systems that hold a relatively high proportion of liquid assets on their balance sheets. Drawing a parallel to the literature on bank capital constraints, I investigate whether loan supply of poorly capitalized bank systems depend disproportionately more on internal funds.[9] However, I find no systematic evidence of such an effect.

To the best of my knowledge, there are only few other papers that investigate bank lending at US state level. Driscoll [1997] examines the effect of changes in monetary policy on state income, and Samolyk [1994] investigates the link between bank health and state income growth.

The rest of the paper is organized as follows: Section 2 gives a short summery of the literature

[8] Essentially, this is a simultaneous system of equations comprising both loan demand and supply.

[9] The lending of poorly capitalized banks may depend more on internal cash ows, either due to a lemons problem in the markets for uninsured funds, or because binding capital regulations limit banks' ability to issue insured deposits. See for example Berger and Udell [1994] or Peek and Rosengren [1995a,b].

on the size of retail loan markets. Sections 3–4 outline the econometric model and approach of the paper and discusses relevant issues. Section 5 presents the results and section 6 concludes.

2 The geographic reach of bank loan markets

The state-level approach employed in this paper implicitly rests on the assumption that loans made by banks located in a particular state are extended to borrowers residing in that same state. This allows the use of other state-level variables to control for loan demand (see section 4.1).

Bank loan markets may be geographically limited in scope because banks specialize in lending to borrowers whose credit quality is costly to evaluate, for example small firms. Also, it is often more convenient for consumers and firms to establish transaction accounts with local banks, and a bank loan may be easier to obtain when the borrower is already a customer with the bank since the it can then use previously generated information to evaluate the credit quality of the borrower.[10] Furthermore, until the Riegle-Neal Act of 1994 interstate branching has been virtually non-existent in the United States.[11]

The empirical evidence on the geographic reach of US retail loan markets unanimously reject that markets are national. Hannan [1991] uses survey data from 1984-86 on commercial loan interest rates and several other loan characteristics to investigate the geographic scope of commercial loan markets. He rejects the existence of national markets and finds that loan interest rates are better explained by MSA-specifics variables.[12] Rhoades [1992] and Radecki [1998] study consumer loan markets and reach similar conclusions. Consumer and small business finance surveys confirm that the vast majority of households and small businesses conduct their banking business with a bank close to their home/workplace or place of establishment.[13]

The approximation of local bank markets with state boundaries therefore is reasonable at least

[10] See for example Fama [1985] and Osborne [1988].

[11] Although in principle state-chartered Federal Reserve nonmember banks were allowed to branch across state lines if state law permitted, only a few states allowed such practice, cf. Rollinger [1996].

[12] Hannan's data contains a wide range of both bank and loan sizes, including very large loans (over $150M).

[13] See Cole and Wolken [1995], and Radecki [1998].

until the early 1990s when interstate branching took off. The business of large money center banks, however, is likely to extend beyond state borders. Therefore, the states of New York and California are excluded from the sample of states.

3 Regression model

The importance of liquidity constraints for banks' loan supply is difficult to estimate consistently in a reduced form regression of lending on a list of contemporaneous and/or lagged balance sheet variables. Because the dependent variable is the amount of loans outstanding, a negative external shock will typically cause a simultaneous decrease in loan demand and borrowers' balance sheet position, and hence will be mirrored in banks' balance sheets. The balance sheet regressors are therefore likely to be correlated with the error term in the regression. To account for the endogeneity of bank balance sheet variables, the approach taken here is to estimate the dependency of loan supply of internal cash flows by 2SLS using variables that capture shifts in loan demand as instruments.

The existence of liquidity constraints is tested on the basis of the model (1) stated below for the period 1970–90. The parameter of interest is β_1. Under the null hypothesis of no constraints, internal and external capital are perfect substitutes, and β_1 is zero. Alternatively, if loan supply depends on the internal generation of capital, one would expect a positive value of β_1.

$$\Delta l^s_{it} = \lambda_i + \gamma_t + \beta_1 \Delta CF_{it} + \beta_2 \Delta r_{it} + \beta_3 \Delta SEC_{it} + \epsilon_{it}\,, \tag{1}$$

where

$E(\epsilon_{it}) = 0\,,$

$E(\epsilon_{it}\epsilon_{is}) = \omega_{i,ts}\ \ .$

The dependent variable, l^s_{it}, denotes the supply of commercial and industrial loans in state i at time t measured as the percentage growth rate. Internal cash flows scaled by total assets, CF_{it}, and the average loan interest rate, r_{it}, are both treated as endogenous variables. SEC_{it} is the

change in the ratio of liquid assets (securities) to assets. This variable captures changes in portfolio composition and is assumed exogenous. It is included because banks may use securities as a buffer to insulate lending against variations in deposits.[14] Finally, the equation includes a state and a time fixed effect. Preliminary Augmented Dickey-Fuller tests for the presence of a unit root in the state-level series reveal that the null of nonstationarity cannot be rejected for most states. Hence, the all variables are first difference for the regression.[15]

In the estimation of the above equation it is imperative to control for changes in the demand for bank loans because the amount of lending observed in the data is not loan *supply*. Rather it is the equilibrium level as cleared by the loan interest rate.[16] Changes instituted in the Tax Reform Act of 1986 can be used to construct variables that shift the demand schedule for bank loans and may serve as instruments for the endogenous right-hand side variables in (1).[17] In order to increase the precision of the coefficient estimates of (1), an additional class of variables is constructed from changes in state bank branching laws. Changes in branch regulations affect bank balance sheets and interest rates as documented in section 4.2. Furthermore, the timing of deregulations differed considerably across states, making this class of variables well-suited to enhance the variation among the regressors in the first-stage regressions. The inclusion of branching variables in the regressions indeed do help achieve more precise estimates, and do not alter coefficient estimates qualitatively (see table in appendix).

Even if one finds a positive relationship between loan supply and internally generated funds, it may be difficult to distinguish the effect of liquidity constraints from effects that arise from changes in borrowers' balance sheets. Banks may choose to restrict lending due to a deterioration in what they perceive as borrowers "credit quality". Because variations in borrowers' credit quality are

[14] Kashyap and Stein [1997] find that "small" banks in the bottom 95% of the size distribution hold higher ratios of cash and securities than larger banks, presumably reflecting their limited access to uninsured funds.

[15] At the 5% level a unit root cannot be rejected for 40 states for the business loans and cash flow variables, for 33 states for the securities ratio variable and for all 45 states for the interest rate variable.

[16] Bank liquidity constraints may exist without credit rationing, although rationing is not inconsistent with such constraints. However, as long as banks face an increasing marginal cost curve in the market for uninsured funds it may become prohibitively costly to finance desired new lending, see for example the models of Hubbard [1998] and Stein [1998].

[17] This is equivalent to estimating equation (1) in a system of equations with a supply and demand schedule, the demand schedule being of the form $l^d_{it} = \lambda^d_i + \gamma^d_t + \alpha'_1 \quad TRA86_{it} + \alpha_2 \quad r_{it} + \epsilon^d_{it}$.

likely to be correlated with changes in banks' cash flows, the two effects are potentially difficult to separate. In the present analysis, the instruments have the important property that they are very unlikely to be correlated with changes in borrowers' financial positions, both across states and time. Hence, the choice of instruments allows the separation of the balance sheet effect, and the effect of liquidity constraints and the results represent supply effects that are not driven by changes in borrowers' credit quality.[18]

4 Data and construction of instruments

4.1 The Tax Reform Act of 1986

Changes in the taxation of firms and individuals instituted in the Tax Reform Act of 1986 can be utilized to capture shifts in the demand for business loans. The Act contained several changes to the taxation of businesses. One major change was the repeal of the regular portion of the Investment Tax Credit (ITC) which provided for a 10% credit on investment.[19] The ITC was intended to stimulate investment in depreciable property such as plant and equipment with a useful life of at least three years.[20] Partly because the credit was directed towards long-term investment it was most heavily used by capital intensive firms, that is by firms in the manufacturing, construction, transportation and utility (MCTU) industries (Barker [1984]). For illustration, in 1980 the cost of investment qualifying for the ITC relative to total investment equaled 76.1% in the manufacturing industry and 86.2% in the construction, transportation and utilities industry groups taken together. On average for all industries, the fraction was 73.3%. These relative differences between industries remained constant during the sample period (see Barker [1984]). The repeal of the ITC provided an

[18] This effectively separates out the so-called balance sheet channel which concerns the impact of moral hazard and adverse selection problems on banks' lending to firms. Controlling for changes in borrowers' balance sheets is similar to controlling for investment opportunities as done in the literature on firm finance constraints where the inclusion of Tobin's Q in the regression is often used as such a control, see Fazzari, Hubbard and Petersen [1988].

[19] The repeal was retroactive, with an effective date of January 1, 1986.

[20] It was originally enacted in 1962, then repealed and restored in 1971 after which it remained in effect until the TRA86. Qualifying property mainly included tangible personal property "contained in or attached to a building such a machinery and equipment". It also included automobiles, delivery trucks, office equipment and farm equipment.

incentive for previously high-credit firms to increase their usage of debt finance. In general, firms should employ debt up to the point where the marginal benefit (pre-tax interest deductability of debt) equals the marginal cost (agency or bankruptcy cost). Tax shields such as the ITC decrease a firm's incentive to use debt finance when the probability of a reduction in the effective marginal corporate tax rate is high.

Investigating individual firms' debt-equity choice over the period 1977-86, MacKie-Mason [1990] finds that the ITC had a substantial effect on firms' use of debt when the likelihood of tax exhaustion is accounted for.[21]. Gordon and MacKie-Mason [1990] show that firms with large ITCs increased their debt-equity ratios more in response to the TRA86 than firms with small ITCs.[22]

Building on the above, a cross-sectional multiplicative variable capturing shifts in the demand for business loans can be created by multiplying a zero-one dummy variable for the TRA86 with the proportion of firms in the MCTU industries in each state. This fraction will proxy for the effect of the investment credit on the use of debt; $D_{86} \times R_{it}^{MCTU}$, where D_{86} takes the value of zero in all years prior to 1986. Hence, states with a high proportion of firms in these industries would have seen a relatively larger shift (increase) in the demand for debt following the 1986 repeal of the ITC. In order to maximize the variation in the regressors capturing shifts in loan demand, a second multiplicative dummy variable is created in a similar fashion, using the ratio of CTU-industries; $D_{86} \times R_{it}^{CTU}$. Because firm sizes differ, the number of employees in each industry is used to create the industry ratios rather than the number of establishments. To allow for a gradual response in the demand for loans (it may be costly for firms to change financial structure), a

[21] MacKie-Mason [1990] estimates the e ect of tax shields on rms' debt-equity ratio using data on public debt and equity. He models rms' decision-making process as a incremental process where the rm chooses rst between public and private nance, then between debt and equity. In the present setting, the repeal of the ITC would shift the demand for total debt (both public and private) since the TRA86 would a ect the marginal bene t of debt nance. The decision between private and public nance would generally be determined by considerations related to bankruptcy and agency costs, cf. MacKie-Mason [1989]. The above discussion assumes that the marginal cost curve for debt is constant around the time of the Tax Reform Act. However, as long as any changes in the MC-curve around the time of the TRA86 was the same for all industries, the repeal of the ITC would create a unique (relative) shift in demand of private debt for the MCTU industries

[22] Gordon and MacKie-Mason [1990] consider the total e ect of the TRA86, taking into account statutory changes in both corporate and personal tax rates and credits. They estimate that the incentive to use debt increased and nd that rms *did* on average increase the use of debt in the years following the Tax Reform, albeit by less than predicted.

TRA86 variable is constructed for each year between 1986 and 1988. Hence, $TRA86_{it}^{MCTU} = (D_{86} \times R_{it}^{MCTU}, D_{87} \times R_{it}^{MCTU}, D_{88} \times R_{it}^{MCTU})'$ and similarly for $TRA86_{it}^{CTU}$.

4.2 Banking and branching regulations

Bank branching restrictions have been in place in the US since the 1920s.[23] Besides prohibiting interstate branching, until the 1980s, the legislation in most states either completely prohibited branching *within* the state or restricted the geographical area in which a bank could open branches (for example to city or county boundaries). As late as 1985, 26 states imposed limitations on statewide branching. At the end of 1990, five states still upheld restrictions.[24] Interstate banking (as opposed to branching) through Bank Holding Companies was subjected to state law until 1995 and were only gradually permitted by individual states during the 1980s.[25]

Differences in states' willingness to allow branch networks has sustained the development of very differently structured bank systems across states. Where some states allowed only unit banking, other states permitted statewide branching which lead to more concentrated bank sectors. At the same time, the limited ability to diversify portfolios geographically created an close interdependency between the state economy and the health of local banks. As regulations were gradually relaxed during the 70s and 80s, deregulated bank sectors transformed. Changes in competitive pressures, geographic diversification and scale-economies on both the loan- and deposit-side affected loan losses and the cost of capital, and hence the loan interest rates charged. Jayaratne and Strahan [1998] find that relaxation of especially intrastate branching restrictions were the source of large improvements in bank efficiency by allowing better-run banks to capture a larger share of local markets. Low-cost banks grew faster than underperforming banks following deregulation, and state averages for loan losses and operating expenses fell. They show that much of these improvements were passed on to

[23] The McFadden Act of 1927 essentially prohibited interstate branching by subjecting the branching of national banks to state authority.

[24] Arkansas, Colorado, Illinois, Minnesota, and New Mexico.

[25] The Douglas Amendment to the Bank Holding Company Act of 1956 gave states the authority to lift the prohibition on interstate acquisitions. Maine was the first state to allow entry by out-of-state BHCs in 1975 and was followed by other states in the 1980s.

borrowers in the form of lower loan interest rates.[26]

Hence, deregulations of statewide branching and interstate banking laws would have had a direct effect on local loan interest rates and banks' balance sheets. I use a vector of variables capturing changes in state laws as exogenous instruments in the regression model. The timing of deregulations exhibit considerably variation across both states and time and provide useful variation in the regressors. Let BRANCH_{it} denote the time of deregulation in state i at time t. It is constructed as $\text{BRANCH}_{it} = (D^I_{it}, D^B_{it}, D^{IB}_{it}, D^I_{it} \times \text{off}_{it}, D^B_{it} \times \text{off}_{it}, D^{IB}_{it} \times \text{off}_{it})'$. D^I_{it} and D^B_{it} are two dummy variables which attain the value of 1 starting at the time of deregulation of restrictions on Bank Holding Company interstate acquisitions and intrastate branching respectively. Because liberalizations typically occurred in steps, I follow the practice of Jayaratne and Strahan [1996], [1998] and define deregulation to be the year in which the process was completed in order to capture the full impact on interest rates.[27] The dummy variable D^{IB}_{it} is the product of D^I_{it} and D^B_{it}, capturing the combined effect of both deregulations. Furthermore, three multiplicative variables are created by multiplying each zero-one dummy with the total number of bank offices in state i at time t; off_{it}. Establishing new offices, whether through de-novo branching or merger and acquisitions, takes time. Hence, in the short run, off_{it} can be treated as exogenous, although in the longer run, the number of offices is likely to be affected by demand and competitive conditions.[28]

Only the *once lagged* value of BRANCH is used in the regressions. This is to avoid any contemporaneous direct effect deregulations may have on loan supply beyond effects working through cash flows and the loan interest rate. It is shown in the table in the appendix that inclusion of $\text{BRANCH}_{i,t-1}$ in the regressions does not bias the coefficient estimates relative to regressions where only TRA86-variables are used as instruments, hence such direct effects do not appear to be serious.

[26] They estimate that average loan rates fell by three- fths of the reduction in loan losses and only nd small, generally statistically insigni cant, increases in bank pro tability after deregulation.

[27] Amel [1993], Jayaratne and Strahan [1996], [1998] and Rose [1989] provide information on the date and type of deregulations.

[28] The decision to liberalize branch restrictions in a state would be the outcome of a lengthy negotiation process involving several, often opposing, interest groups. Once enacted, deregulation typically took place in gradual steps over a number of years. Therefore, the time of deregulation do not coincide with business cycle shocks to loan supply or demand. Jayaratne and Strahan [1996], [1998] show that states generally did not deregulate on the upswing of a business cycle. See also Rose [1989].

4.3 Data

The data covers the period 1970–90. The upper end of the sample is restricted to 1990 because, starting in the early 1990s, the number of commercial banks with interstate branches gradually increased. Hence a longer sample may introduce measurement error in the data.[29]

Besides New York and California, the states of Delaware and South Dakota are also excluded from the sample. The banking industry in these states have been particularly profitable due to specialization in credit card loans and inclusion in the sample may bias the results. Finally, Alaska is excluded from the sample to avoid outliers, leaving 45 states in the sample.

All bank data are from the FDIC's Historical Statistics on Banking data base which contains data from the regulatory financial reported files by FDIC-insured commercial banks (*Call Reports*). The measure of business loan is total domestic commercial and industrial loans and leases. Internally generated cash flow is measured as the change in equity capital including loan loss reserves in percent of total assets. Reserves are included because capital requirements included reserves as part of primary capital during the sample period.[30] Capital requirements limit banks' ability to issue deposits and the change in equity capital hence captures the room available for balance sheet expansion. Equity capital is the sum of preferred and common stock, surplus, and undivided profits.[31]

The average real loan interest rates is constructed as total interest income on loans and leases in domestic offices divided by total domestic loans and leases minus inflation. The regression model allows loan interest rates to vary across states. Although all banks face the same monetary policy shocks (captured through the time fixed effect), state-level loan rates may differ because competitive structures in bank markets differ. Furthermore, to the extent that banks' perception of borrowers' credit quality is translated into loan interest rates, rates will fluctuate with the regional business

[29] The regressions were also run with the sample 1970{92 and this did not qualitatively alter the results.

[30] A similar measure of internally generated funds is also used by Houston et al. [1997]. From 1992, when the Basle capital standards were implemented, regulations ceased to count reserves as part of Tier 1 capital.

[31] An alternative measure of internal cash ow would be return-on-assets. The main di erence between the measure above and return-on-assets is that the latter excludes loan reserves and therefore fails to capture the amount available for expansion constituted by reserves. Hence, in cases where loan loss provisions are large, return-on-assets will considerably underestimate internal funds.

cycle in accordance with borrowers' balance sheet positions. To the extent state-specific loan rates fail to capture such changes, they enter the model through the error term. Limited data availability does not allow for the separation of interest income on business and other types of loans, hence r_{it} is the average interest rate on all loans. In the estimation of the regression model, however, this measurement error will not bias results because the interest rate is the dependent variable in the first stage regression and none of the exogenous variables serving as instruments are likely to be systematically correlated with that error. Liquid assets are measured by the sum of cash, securities and federal funds sold. The industry-level firm employment data used in the construction of the TRA86 instruments are taken from the Census County Business Patterns.

Furthermore, I use data from the FDIC Annual Reports to construct the ratio of banks in different size-categories. Prior to 1984 these figures include non-insured institutions in addition to FDIC-insured commercial banks. In the data available to me these non-insured banks cannot be separated out, with the result that the size-category data tend to contain a larger number of small banks than the FDIC Historical Statistics data base. Because the noninsured reporting banks tend to be small banks, the bias is likely to be limited in relative terms.

5 Regression results

Equation (1) is estimated with two-stage least squares. To account for the presence of heteroscedasticity and serial correlation, the covariance matrix is consistently estimated using the Newey-West [1987] estimator allowing for an AR(1) in the error-structure.

5.1 Does the size-structure of the bank sector matter?

Are loan supply more dependent on the internal generation of capital in bank systems with many small banks? To investigate this hypothesis, the sample of states were split into three equal-sized groups according to the average ratio of unit banks over the sample period. The ratio of unit banks is, by nature, one measure of the fraction of small banks. It is calculated as the number of unit banks relative to the total number of banks. As seen from table 1 the average unit bank ratio

in the "High" group is 71.2% compared to 35.2% and 19.5% in the "Middle" and "Low" group. Clearly, the size-structure of the bank sectors is very different across states. Table 1 shows that bank sectors with many unit banks are on average better capitalized compared with bank sectors in the two other groups. Further, they have lower cash flows caused by high charge-offs and/or low loan loss provisions. Unit bank states also charge higher interest rates on average and unit banks hold a significantly larger fraction of their portfolio as liquid assets in accordance with the buffer stock theory (Kashyap and Stein [1997]). The table also reports the average fraction of years in the sample for which intrastate branching restrictions were in place. As can be seen, this fraction varies considerably across groups, with states in the High group having restrictions in place for an average of 88% of the sample, against 63% and 33% in the Middle and Low group respectively.

Next, I split the sample into three equal-sized groups according to the ratio of unit banks in order to test for liquidity constraints. The first three columns in table 2 presents the results from a straightforward OLS regression of the change in loan growth on changes in internal cash flow, the average interest rate and liquid assets. As would be expected given the endogeneity of internal cash flow and the loan interest rate, the regressors are highly significant for all groups. Notice that there is no statistically significant difference in the group estimates. Variations in the ratio of securities to assets are significant with a sign consistent with the buffer stock hypothesis. In bank systems with many unit banks the ratio of liquid assets is negatively correlated with variations in lending. In bank systems with few unit banks, there is no systematic correlation.

The results form the 2SLS regression where TRA86 and lagged BRANCH variables are used as instruments are reported in the middle three columns in table 2 (column 4-6). They provide very strong evidence that state-level loan supply in states with a high ratio of unit banks move pro-cyclically with variations in internal cash flow. This systematic co-variation is absent in states with relatively few unit banks where internal cash flow is not a significant determinant of loan supply. Indeed, the estimated coefficient on the cash flow variable is significantly different in bank systems with a high versus low ratio of unit banks at the 5 percent level. The average loan interest rate is significant only in the group with the highest ratio of unit banks. For the low-ratio group

the estimated coefficient is negative and insignificant. The negative sign is likely to be the effect of branching deregulations. Branching restrictions have been deregulated much earlier in the sample in the Low and Middle group than in the High group. Changes in the competitive structure may have increased loan supply and/or put downwards pressure on interest rates. An additional cause may be that the measure of average loan rates used includes interest income received on consumer loans. Over the sample period banks in almost all states have steadily decreased the fraction of their loan portfolio allocated to consumer loans over the sample period, presumably as nonbank suppliers of consumer loans have captured a larger share of the market. To the extent consumer loan rates have decreased accordingly, interest income on this type of loans will have decreased.

The interpretation of the coefficient estimate of 15.12 in the high-ratio group is that a one percentage point increase in capital *relative to total assets*, generates a permanent increase in loan growth of 15.12 percent. This figure explains 37% of the average annual variation loan growth in the high-ratio group.[32] The remaining variation is explained by variables left out of the model, such as the variables on which banks' base their judgement of firms' credit quality. Another source of variation may be banks contracting lending to comply with capital regulations. The coefficient estimate in the middle-ratio group explains 46% of the average loan growth in that group. To assess the real impact on firms of small banks' limited access to wholesale funds one would need to consider loan availability from nonbank sources which may differ between states. Although that is beyond the scope of this paper, the results for the high and middle group do suggest that the dependency on internal funds is much more likely to hurt bank dependent firms seriously during periods of time where bank cash flows are low.

It is interesting to compare the 2SLS results to the results from the simple OLS regressions in the first three columns. Importantly, OLS underestimate the coefficient on internal cash flow for states with many unit banks, and overestimates the coefficient for states with few unit banks. This difference in bias between the high and the low group suggests that the 2SLS results are not a result

[32] To see this, note from table 1 that, on average, internally generated funds constitute 0.14 percent of total assets. Hence, actual average cash flows increased loan supply by 15.12*0.14 = 2.12 percent. On average during the sample, loan growth was 5.79 percent in the high-ratio group. Hence, the estimate of 15.12 explains 36.6% of the average variation in business loans.

of a low correlation between the instruments and the endogenous variables. Rather, it lends support to the suggestion that the instruments are uncorrelated with the error term in the regression.

The bottom half of table 2 reports the partial R^2s from the first stage regressions using TRA86 and the lagged BRANCH variables as instruments. In addition, the table shows the p-values from joint test of significance of the TRA86-instruments only. Importantly, the TRA86 variables are highly significant in the first-stage regressions for the cash flow variable, which is the variable of interest, in all groups. The TRA86-variables alone are less good at explaining the variation in average loan interest rates, which is perhaps not surprising given the earlier evidence that deregulation of branching laws appear to have had a negative impact on loan interest rates and hence is better captured by the BRANCH variables.

The last three columns in table 2 report the result from a 2SLS regression where states are split according to the fraction of "small" banks, where small is defined as asset-size below 100M. Again, there is considerable variation across groups, which small banks in the high-ratio group constituting over 93% of the total number of banks as opposed to 67% in the low-ratio group. The results are similar to the split by ratio of unit banks, and provide support to the hypothesis that aggregate liquidity effects are significant.[33]

The table in the appendix shows the regression results splitting states by the ratio of unit banks, using only the TRA86-variables as instruments. Comparison with table 2 reveals that use of the BRANCH-variables as additional instruments does not qualitatively change the coefficient estimates, but alone serve to improve the precision of the estimates.

The above results clearly establish that internal funds are a determinant of loan supply in states where the banking structure is dominated by small and medium-sized banks and hence suggest that liquidity constraints are significant at the state level as an important determinant of bank's loan supply.

[33] The pattern across groups is, however, less strong. This may be because the construction of the size-category data from the FDIC Annual Reports from which the ratios of small banks are computed, is not perfectly compatible with the construction of bank balance sheet and income data. As discussed in section 4.3, the FDIC Annual Reports include noninsured reporting banks.

5.2 Does the stock of liquid assets matter?

Small banks may attempt to insulate their loan supply from shocks to the liability side of their balance sheet by holding a buffer stock of cash and securities. Table 3 illustrates that states with high ratios of unit banks generally do hold higher stocks of liquid assets than bank systems with fewer unit banks.

The first three columns in table 4 report the estimated dependency of loan supply on internal cash flows when states are sorted according to the average stock of liquid assets (defined as the sum of cash, securities and federal funds sold). The results lend support to the hypothesis that the banks that are most likely to experience liquidity constraints attempt to mitigate this by holding liquid assets. Loan supply in the group with the lowest level of liquid assets are not dependent on internal cash flows and the difference between the high and low group are significantly different. The estimated coefficient is for the high group is 18.34 which accounts for 53.1% of average lending in these states. The high coefficient may suggest that the ratio of liquid assets contains more information about the severity of liquidity constraints than do bank size.

One might be worried about the endogeneity of the variable by which the groups are split. For example, the security holdings may be high during periods where the economy is booming, and lending and revenues are also high. It does not seem warranted, however, that the results are a product of such relations. First, the states in the high group hold *permanently* higher levels of liquid assets. Secondly, it may be observed from table 3 that lending is actually *lower* in the high-liquidity group. Finally, even if banks hold high levels of securities for the reason that there are no other profitable investment opportunities available (as may well be the case if branching is restricted), that fact does not explain why lending nevertheless varies pro-cyclically with internal funds. Hence, the results appear to harmonize best with an explanation involving liquidity constraints.

5.3 Does capitalization of the bank sector matter?

The results so far strongly support the proposition that liquidity constraints experienced by small banks have aggregate repercussions. The logic behind the proposition that small banks are more

likely to experience liquidity constraints would suggest that other variables containing information about the value of a bank's loan portfolio and future profitability should also affect the cost of uninsured funds. Hence, one may expect the lending of capital depleted banks to depend more on internal cash flows in a similar fashion.

To test for liquidity constraints the states are split according to capital ratio. The last three columns in table 4 report the results from a 2SLS regression. The results, however, do not provide systematic evidence that loan supply in poorly capitalized states is more dependent on the internal generation of funds. If anything, the results appear to reflect the fact that states with a high level of unit banks are on average better capitalized (see table 1). These results are perhaps not very surprising in the light of the relatively loose enforcement of capital regulations prior to the 1990s. During the 1970s regulators generally did not specify minimum capital requirements and mandatory capital ratio rules were adopted by US regulators only in the beginning of the 1980s. Minimum capital ratios regulations were adopted in the early 1980s. During this decade adequate capital ratios varied between 5–6 percent depending on bank size. There were also some variations in the definition of primary capital between bank regulators. (Federal Deposit Insurance Corporation [1997]). Even then, it is far from clear that standards were enforced in a fashion that may have had a significant effect on aggregate lending.[34]

6 Conclusion

The above analysis shows that the loan supply of bank sectors comprised of many small or highly liquid banks depends significantly on internally generated cash flows and capitalization. The results provide support for the notion that some banks have limited access to supra-regional markets for uninsured funds. Importantly, these capital markets frictions have significant effects at the regional level.

[34] In contrast, the introduction of the Basle risk-based capital rules has sparked a debate as to whether tougher regulation and enforcement was a contributing factor to the so-called \credit crunch" experienced in the early 1990s, see for example Peek and Rosengreen [1995b]. This period of time, however, is outside the sample period employed in this paper. Federal Deposit Insurance Corporation [1997] contains information on the regulation and enforcement of capital ratios.

The results suggest that shocks are transmitted through the bank sector in a way that depends on its structure. When retail lending is geographically local in nature, supra-regional interbank and wholesale markets help to allocate resources efficiently by transferring resources towards regions with relatively high loan demand. Banks' access to these markets help them to insulate their loan supply from external shocks. The pro-cyclical nature of banks' loan supply displayed by the results, may have serious consequences for the local economy, in that some banks may be prevented from financing positive net present value projects.

The analysis utilizes structural differences between bank markets in US states to draw general conclusions that are also of relevance to the current debate on the asymmetric transmission of economic shocks in Europe. To the extent that markets for uninsured funds in the Euro-zone are less integrated than in the US, one would expect the significance of regional supply effects to be even more pronounced in the EMU area.

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Table 1: Descriptive Statistics by Ratio of Unit Banks

	All states	Unit bank ratio in group		
		High$^{(i)}$	Middle	Low
		71.2%	35.2%	19.5%
Average value:				
C&I loans (growth rate)	6.50	5.79	6.14	7.57
		(2.59)	(1.52)	(3.06)
Internal cash flow (percent of assets)	0.20	0.14	0.22	0.24
		(0.05)	(0.09)	(0.12)
Average nominal interest rate (percent)	10.22	10.27	10.21	10.17
		(0.50)	(0.36)	(0.48)
Capital ratio (percent of assets)	7.72	8.07	7.69	7.4
		(0.58)	(0.67)	(0.49)
Fraction of sample where intrastate branching restrictions were in place		0.88	0.63	0.33
Percent of Assets:				
C&I loans	19.31	15.88	19.87	22.17
		(4.28)	(3.82)	(6.31)
Consumer loans	11.84	10.45	12.96	12.10
		(2.56)	(2.04)	(2.85)
Liquid assets	40.46	44.21	39.26	37.91
		(3.17)	(4.97)	(4.36)

Average 1971–90 value for all states and by group. Ratio of unit banks is the percentage of unit banks relative to the total number of banks. Internal cash flow is the percentage change in capital scaled by total assets. The loan interest rate is the average (real) interest income earned on all loans and leases. Capital ratio is primary capital (including loan reserves) relative to total assets. Ratio of unit banks is the percentage of unit banks relative to the total number of banks. Ratio of liquid assets is the stock of securities, cash and federal funds sold relative to total assets. The number of states in each group is 15. Standard deviation of state averages in parenthesis.

Table 2: Loan Supply by Size-Structure: 1970-90

	Ratio of Unit Banks[a]			Ratio of Unit Banks[a]			Ratio of Small Banks[b]		
		OLS			2SLS			2SLS	
	High	Middle	Low	High	Middle	Low	High	Middle	Low
Average group ratio:	71.16%	35.19%	19.52%	71.16%	35.19%	19.52%	93.37%	84.55%	67.43%
Regressors:									
Internal cash flow:	13.41***	11.46***	11.22**	15.12***	12.73***	1.23	11.57**	15.45***	–0.29
	(1.91)	(2.43)	(4.69)	(4.20)	(4.43)	(4.19)	(4.69)	(5.33)	(3.55)
Loan interest rate:	1.68***	1.58***	1.16**	9.09**	2.35	–2.95	–3.06	3.64	–5.06
	(0.19)	(0.26)	(0.47)	(4.17)	(4.71)	(6.48)	(4.51)	(4.89)	(6.49)
Liquid assets:	–0.42***	–0.51***	0.07	–0.47***	–0.32***	0.66	–0.36*	–0.20	0.69
	(0.13)	(0.10)	(0.33)	(0.16)	(0.11)	(0.42)	(0.19)	(0.12)	(0.44)
p-value (High vs. Low)[c]:		0.33			0.02			0.04	
First Stage Regressions, Internal cash flow[d,e]									
R^2:				0.15	0.12	0.13	0.11	0.05	0.20
p-value(TRA86):				0.00	0.01	0.00	0.02	0.41	0.00
First Stage Regressions, Loan interest rate[d,e]									
R^2:				0.06	0.11	0.08	0.11	0.05	0.07
p-value(TRA86):				0.36	0.27	0.21	0.10	0.25	0.12

Fixed e ects OLS and 2SLS panel regressions of loan growth on the regressors listed in column one (xed e ects estimates not reported). Loans are commercial and industrial loans made by commercial banks. Internal cash ow is the percentage change in capital scaled by total assets. The loan interest rate is the average (real) interest income earned on all loans and leases. Liquid assets is the change in cash, securities and federal funds sold relative to total assets. Group ratios are time-average across states in group. [a]Ratio of unit banks is of the percentage of unit banks relative to the total number of banks. States in \High" group are WY,MT,TX,NE,CO,KS,MN,OK,IL,WV,WI,ND,IA,MO,FL. [b]Ratio of small banks is the percentage of banks with assets below 100m relative to the total number of banks. States in \High" group are NE,KS,ND,MN,IA,MT,CO,OK,WY,MO,WI,GA,AL AR,KY. [c] p-value from Wald test of di erence between the internal cash ow estimate in the \High" and \Low" groups. [d]Group R^2 from rst stage regression of endogenous variable on all instruments (TRA86-and and BRANCH-variables). [e]p-value from a Wald test of joint signi cance of TRA86 variables in rst stage regression. *Signi cant at the 10% level, **Signi cant at the 5% level. ***Signi cant at the 1% level. Newey-West (1987) standard errors in parenthesis. Number of states in each group is 15. Number of observations in each group is 300.

Table 3: Descriptive Statistics by Ratio of Liquid Assets

	All states	Unit bank ratio in group		
		High$^{(i)}$	Middle	Low
		45.37%	40.40%	34.19%
Average value:				
C&I loans (growth rate)	6.50	6.22	6.77	6.51
		(2.46)	(3.56)	(1.17)
Internal cash flow (percent of assets)	0.21	0.18	0.19	0.25
		(0.07)	(0.09)	(0.12)
Average nominal interest rate (percent)	10.21	10.30	10.15	10.19
		(0.38)	(0.49)	(0.46)
Capital ratio (percent of assets)	7.72	8.24	7.63	7.28
		(0.46)	(0.50)	(0.54)
Ratio of unit banks (percent of total banks)	41.96	60.81	39.21	25.85
		(22.18)	(22.05)	(10.60)
Percent of Assets:				
C&I loans	19.30	16.11	18.06	23.74
		(3.67)	(3.72)	(5.78)
Consumer loans	11.84	11.59	11.99	11.93
		(2.61)	(3.16)	(2.33)

Average 1971–90 value for all states and by group. Ratio of liquid assets is the stock of securities, cash and federal funds sold relative to total assets. Internal cash flow is the percentage change in capital scaled by total assets. The loan interest rate is the average (real) interest income earned on all loans and leases. Capital ratio is primary capital (including loan reserves) relative to total assets. Ratio of unit banks is the percentage of unit banks relative to the total number of banks. The number of states in each group is 15. Standard deviation of state averages in parenthesis.

Table 4: Loan Supply by Liquid Assets and Capitalization: 1970-90

	Ratio of Liquid Assets[a]			Ratio of Capital[b]		
		2SLS			2SLS	
	High	Middle	Low	High	Middle	Low
Average group ratio:	45.37%	40.40%	34.19%	7.00 %	7.74%	8.41%
Regressors:						
Internal cash flow:	18.34***	5.82	3.90	5.31	25.53**	–3.74
	(6.18)	(10.87)	(2.71)	(5.28)	(10.37)	(2.58)
Loan interest rate:	9.09	1.99	–1.72	–1.37	–4.89	–0.78
	(7.79)	(6.90)	(6.29)	(7.996)	(6.98)	(2.99)
Liquid assets:	–0.53**	–0.18	0.54	(0.23)	(0.25)	(0.40)
	0.39	0.36	–0.25*	(0.37)	(0.36)	(0.13)
p-value (High vs. Low)[c]:		0.03			0.79	
First Stage Regressions, Internal cash flow[d,e]						
R^2:	0.12	0.08	0.24	0.17	0.05	0.19
p-value(TRA86):	0.05	0.51	0.00	0.01	0.51	0.00
First Stage Regressions, Loan interest rate[d,e]						
R^2:	0.09	0.02	0.12	0.05	0.09	0.17
p-value(TRA86):	0.46	0.97	0.01	0.23	0.48	0.04

Fixed e ects OLS and 2SLS panel regressions of loan growth on the regressors listed in column one (xed e ects estimates not reported). Loans are commercial and industrial loans made by commercial banks. Internal cash ow is the percentage change in capital scaled by total assets. The loan interest rate is the average (real) interest income earned on all loans and leases. Liquid assets is the change in cash, securities and federal funds sold relative to total assets. Group ratios are time-average across states in group. [a]Ratio of liquid assets is the stock of liquid assets relative to total assets. [b]Ratio of capital is the percentage of equity capital (preferred and common stock, surplus, and undivided pro ts) relative to total assets. [c]p-value from Wald test of di erence between the internal cash ow estimate in the \High" and \Low" groups. [d]Group R^2 from rst stage regression of endogenous variable on all instruments (TRA86-and and BRANCH-variables). [e]p-value from a Wald test of joint signi cance of TRA86 variables in rst stage regression. *Signi cant at the 10% level, **Signi cant at the 5% level. ***Signi cant at the 1% level. Newey-West (1987) standard errors in parenthesis. Number of states in each group is 15. Number of observations in each group is 300.

APPENDIX

TRA86 Instruments: Loan Supply by Ratio of Unit Banks

Unit Bank Ratio[a] :	High	Middle	Low
Average group ratio:	71.16%	35.19%	19.52%
Number of states in group:	15	15	15
Internal cash flow:	17.14**	11.99**	–0.73
	(7.35)	(5.82)	(6.38)
Loan interest rate:	9.48	10.89	–16.85**
	(6.30)	(11.42)	(7.13)
Liquid assets:	–0.48***	–0.29	0.92*
	(0.17)	(0.14)	(0.55)
p-value (High vs. Low[b]): 0.07			
First Stage Regressions[c,d]			
Internal cash flow, R^2:	0.04	0.07	0.11
Loan interest rate, R^2:	0.03	0.02	0.04

Fixed effects 2SLS panel regressions of loan growth on the regressors listed in column one (fixed effects estimates not reported). Loans are commercial and industrial loans made by commercial banks. Internal cash flow is the percentage change in capital scaled by total assets. The loan interest rate is the average (real) interest income earned on all loans and leases. Liquid assets is the change in cash, securities and federal funds sold relative to total assets. Group ratios are time-average across states in group. [a]Ratio of unit banks is of the percentage of unit banks relative to the total number of banks. [b] p-value from Wald test of difference between the internal cash flow estimate in the "High" and "Low" groups. [c]Group R^2 from first stage regression of endogenous variable on all instruments (TRA86-and and BRANCH-variables). [d]p-value from a Wald test of joint significance of TRA86 variables in first stage regression. *Significant at the 10% level, **Significant at the 5% level. ***Significant at the 1% level. Newey-West (1987) standard errors in parenthesis. Number of states in each group is 15. Number of observations in each group is 300.