Funding Frictions and Credit Supply: Evidence from Savings and Loan Associations

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Abstract

Deposits are the cheapest source of funding for financial intermediaries. How do funding frictions curtail credit supply in the economy? I leverage a unique setting where deposit rate ceilings reduced inflow of deposits at financial intermediaries from 1960s–1980s. Using financial report data from savings and loan associations (S&Ls) and banks, I develop a novel method to measure the binding constraints of deposit interest rate ceilings. My findings document that deposit rate ceilings induced downward shifts in credit supply in the mortgage market. A 100-basis-point increase in the binding constraint of deposit rate ceilings is associated with 8.22% annualized decline in mortgage growth among S&Ls. This is in contrast to commercial banks which experienced smaller contraction in mortgage lending due to access to alternative funding.

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1 Introduction

Existing theories suggest that funding frictions strongly influence banks' lending activities. As key financial intermediaries in the economy, banks rely on deposits as their primary source of funding, with deposits accounting for over 80% of their liabilities in the US. Challenges in raising deposits, referred to as funding frictions, can hinder lending activities and have broader consequences for the economy. A decrease in credit supply can particularly restrict business investment and consumer spending, resulting in slower economic growth (Duquerroy, Matray and Saidi, 2022; Darmouni, 2020).

Despite theoretical conjectures, empirical evidence remains limited. One reason is difficulty in quantifying funding frictions in an empirical setting (cite). Another obstacle arises from the confounding factors on credit demand and supply. Macroeconomic conditions that influence banks' funding ability often affect both supply and demand dynamics in the financial system. This dual impact complicates the identification of specific causal relationships.

In this paper, I explore the causal relationship between funding frictions and credit supply using a historical natural experiment. I achieve this by introducing a novel measure of funding frictions based on deposit rate ceilings set by a discontinued law known as Regulation *Q*. I further ask how varying degrees of flexibility in funding structure influence the transmission of funding frictions to credit supply. By exploring the dynamics of credit supply, this study enriches ongoing research on credit crunches (Brunnermeier, 2009) and expands our understanding of banks' role on local economic conditions (Mian, Sufi and Verner, 2020).

Funding frictions emerged as banks faced deposit rate ceilings set by Regulation Q. Throughout the 1960s to 1980s, these deposit rate ceilings remained consistently below Fed funds rate, primarily due to the high inflation. As a result, banks found themselves unable to offer competitive deposit rates, making other investment options more attractive. This scenario led to outflows of deposits, creating funding frictions in the banking sector.

The varying effects of deposit rate ceilings among banks enables me to measure funding frictions across different institutions. This variation stems from an exogenous shift-share mechanism. While the adjustments in deposit rate ceilings (the shift) were uniform across all banks, they differed for each type of deposit. The deposit compositions of banks (the share) were unique for each institution and remained stable over time. Whenever the ceiling for a particular type of deposit was adjusted, it affected banks differently due to variations in their deposit product shares. This combined effect induces significant variation in funding frictions across different banks.

I propose a novel measure to quantify funding frictions within the banking sector. This measure captures the level of restrictions that rate ceilings imposed on banks' deposit rate offerings. It outperforms existing measures in the literature (Iyer et al., 2014; Watanabe, 2007), which often encounter endogeneity issues due to their simultaneous impact on local credit demand and supply. Unlike these measures, deposit rate ceilings had no direct effect on local credit demand, as they were set at the national level. This distinctive feature allows for a clear identification of the effects of funding frictions on credit supply.

Using this measure, I analyze credit supply shifts in mortgage lending among savings and loan associations (henceforward, S&Ls). S&Ls were a type of bank with a rigid funding and lending model, highly vulnerable to funding frictions caused by deposit rate ceilings. Relying solely on retail deposits for funding, S&Ls were exclusively involved in mortgage lending, originating around 40% of total mortgages in the US from the 1960s to the 1980s. Any adjustments in deposit rate ceilings directly impacted the lending activities of S&Ls, subsequently influencing credit supply in mortgages. In fact, as shown in Figure 1,mortgage growth in the S&L sector decreased during periods of tightening deposit rate ceilings under Regulation Q. At its peak, S&Ls reduced their aggregate mortgage assets by 4% when funding frictions equated to a 400-bps tightening of deposit rate ceilings.

Funding frictions had a pronounced effect on local mortgage supply among S&Ls in the cross-section. To uncover this relationship, I utilize a two-stage regression model. In the first stage, I regress deposit growth on the funding friction measure. Then, in the second stage, I regress mortgage growth on the fitted value of deposit growth. According to my preferred specification, funding frictions, equivalent to a 100-basis point tightening in deposit rate ceilings, resulted in a 10% reduction in mortgage supply at S&Ls over the subsequent year. These results are both statistically and economically significant and remain robust across various constructions of funding measures.

In contrast to S&Ls, the impact on commercial banks was mild because of their access to alternative funding sources. Although both S&Ls and commercial banks relied on retail deposits, commercial banks had added flexibility through access to wholesale funding, which was exempt from Regulation Q. Repeating the analyses for commercial banks, I find that a 100-bps tightening in deposit rate ceilings led to a 0.9% contraction in mortgage supply. When deposit rate ceilings became binding, commercial banks increased their utilization of wholesale funding to offset the decrease in deposits, thereby mitigating the downward impact on mortgage supply.

Finally, I present a model of credit supply in mortgage lending to provide theoretical support to the empirical findings in this paper. I introduce a static two-period model to illustrate the observed correlation between deposit rate ceilings under Regulation Q and bank deposit levels.

Literature review This paper contributes to the research on bank credit crunch by showing that flexibility of funding structure can mitigate funding frictions. Regulation, along with monetary policy, often affect both credit supply and demand in the financial system, making identification a challenge. To overcome this, researchers rely on various natural experiments and enriched datasets in the international setting. Jiménez et al. (2012) analyze supervisory data with loan applications from Spain and find that tighter monetary policy reduced loan granting from banks. Iyer et al. (2014) study the credit supply effects of the unexpected freeze of the European interbank market with Portuguese inter-bank market. Using bank share of lending as instrumental variable, Watanabe (2007) documents that Japanese banks cut back bank lending in response to a large loss of bank capital due to binding capital requirements. This paper provides another approach to tackle the identification challenge. I rely on a clean setting from the S&L industry to control for credit demand in the cross-section.

Moreover, investigating the impact of bank funding frictions on local mortgage supply enhances our comprehension of banks' function in local economic conditions. Existing literature has documented the effects of credit supply on local economic conditions such as productive capacity Mian, Sufi and Verner (2020), my findings indicate that funding frictions have broader implications beyond mere credit supply, potentially influencing the wider local economy.

This paper contributes to the literature on the banking regulation in the U.S. A string of literature focuses on the policy effects of Regulation *Q* (Wojnilower, 1980, 1985; Koch, 2015; Bordo and Haubrich, 2010). Using the commercial bank sector, Koch (2015) finds supporting evidence that Regulation *Q* acted as credit supply shifter on total bank loans. Focusing on the S&L industry and the mortgage lending market, my finding provides another piece of evidence that deposits flowed out of financial institutions whenever deposit rate ceilings became binding, contracting lending in mortgages.

The remainder of the paper is organized as follows. Section 2 provides the institutional background surrounding Regulation Q and depository institutions. Section 3 proposes a measure of funding frictions. Section 4 discusses the data. Sections 5-7 present the empirical results of funding frictions on mortgage supply. Section 8 develops a model of credit supply in mortgage lending. Section 9 concludes.

2 Institutional background

Regulation *Q*'s deposit rate ceilings introduced funding frictions among depository institutions, offering a mechanism to identify its impact on credit supply. This study examines two distinct types of depository institutions with differing funding structures: savings and loan associations, and commercial banks. The impact is significant in the mortgage market, where these institutions played pivotal roles as primary originators.

2.1 Regulation Q

Regulation Q imposed deposit rate ceilings from 1960s to 1980s, resulting in outflow of deposits. The deposit rate ceilings created funding frictions among banks. This unique setting affected banks' credit supply but was independent of credit demand, providing a clean identification.

The Federal Reserve law imposed interest rate ceilings on deposits at commercial banks, as well as thrift institutions which include S&L's, mutual savings banks, and credit unions. It was established under the Banking Acts of 1933 and fully abolished in 2011 under the Dodd-Frank Wall Street Reform. Before 1966, deposit rate ceilings constrained the interest rates paid by depository institutions for only a few short intervals. Between mid-1960s and mid-1980s, rate ceilings were bindings on at least some categories of deposit liabilities, most of which were savings and small time deposits (time deposits less than $100,000 in denomination). Wholesale deposits, which are large time deposits with at least $100,000 in denomination, were exempt from Regulation Q in 1973. Shortly after that, the Fed gradually phased out Regulation Q by introducing new, deregulated deposit products. By March of 1986, the Fed lifted rate ceilings on all deposits except for demand deposits (Acolin et al., 2016). Prohibition of interest payment on demand deposits remained in place until the Dodd-Frank reform in 2011.

2.2 Savings and Loan Associations (S&Ls) and commercial banks

The difference in funding structure between S&Ls and commercial banks offers an opportunity to compare effects across depository institutions. S&Ls relied solely on retail deposits, while commercial banks had alternative funding sources. Deposit rate ceilings affected both institutions, with S&Ls being more impacted due to their reliance on retail deposits.

S&Ls are a major type of depository institutions with a focus on financing the housing market. Unlike commercial banks, S&Ls had relatively simple balance sheets in the Great Inflation era. On the asset side, S&Ls conducted businesses *only* in mortgage lending whereas banks had other loans such as commercial and industrial loans. On the liability side, S&Ls predominately relied on retail deposits. That is, passbook savings and small time deposits. Relative to commercial banks, few S&Ls issued wholesale deposits which were exempt from Regulation Q. Though more than 30% of the S&Ls went bankrupt during the S&L crisis in late 1980s (White, 1993), S&Ls experienced stable growth and had substantial market share in both mortgage and deposit markets in the Great Inflation era.

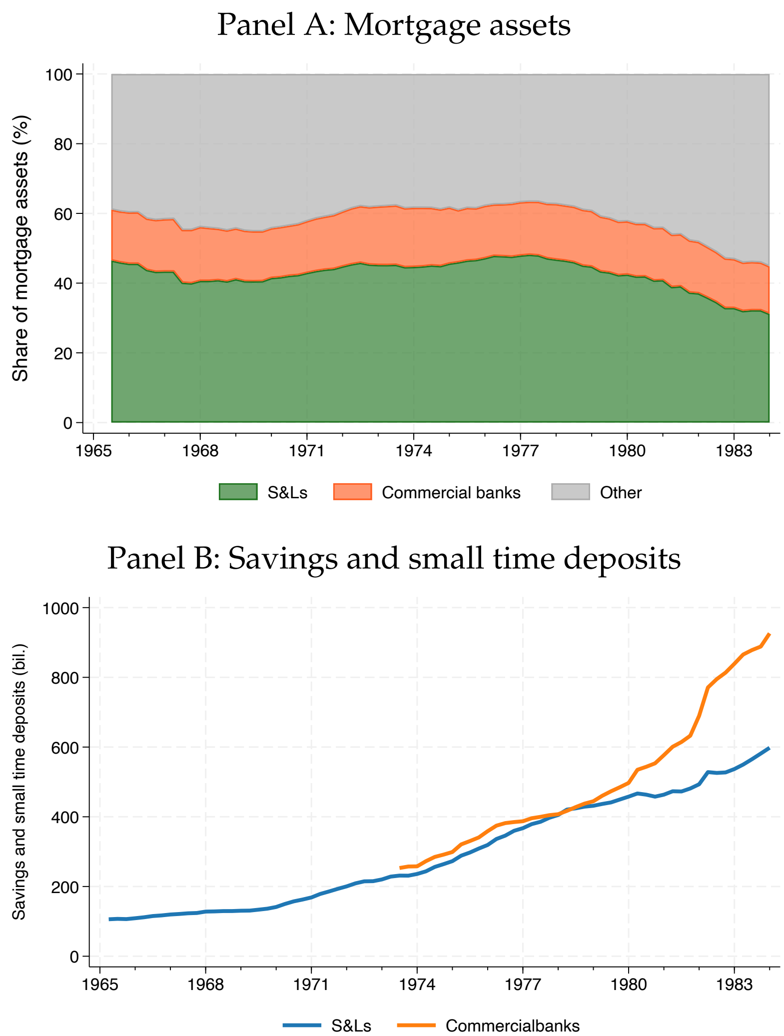
Figure 1 Panel A plots the share of mortgage assets by owners over time. On average, 40% of the mortgage assets were funded by deposits and held on balance sheets in S&Ls from 1965 to 1983. Commercial banks added another 10% of market share. Together, commercial banks and S&Ls accounted for more than half of the mortgage lending in the U.S. in the Great Inflation era. Panel B plots the amount of savings and small time deposits at S&Ls and commercial banks over time. S&Ls and banks dominated the retail deposit market and had roughly equal share of savings and small time deposits prior to 1980.

2.3 Mortgage lending before 1980s

This paper explores the dynamics of credit supply within the mortgage market, where depository institutions historically originated and held the majority of mortgages in the US. Mortgage lending represented the sole focus of S&L's lending activities, so impact on funding frictions on S&Ls had a significant impact on the local mortgage market.

The U.S. mortgage market and deposits were interconnected in the Great Inflation era. The mortgage industry was drastically different from the one we currently have. Deposit-taking institutions were not only the originators but also the owners of mortgage assets. Securitization, a common process to fund mortgages nowadays, started in 1960s but was not popular until late 1980s. As a results, majority of the residential mortgages were funded by deposits and held on the balance sheets of commercial banks or S&Ls (Acolin et al., 2016; Green and Wachter, 2005). The supply of mortgage lending (asset side of the balance sheets) fluctuated with the amount of deposits (liability side of the balance sheets) in the banking system.

Figure 1: Mortgage assets and retail deposits



Notes: This figure shows the mortgage assets and retail deposits held at S&Ls and commercial banks from 1965 to 1984. Panel A plots the share of one-to-four-family residential mortgages in the U.S. Panel B plots the total amount of savings and small time (denomination $\leq$ \$100,000) deposits held at S&Ls and commercial banks. Data come from the Z1 Financial Accounts, Bank Call Reports, and the S&L Financial Reports.

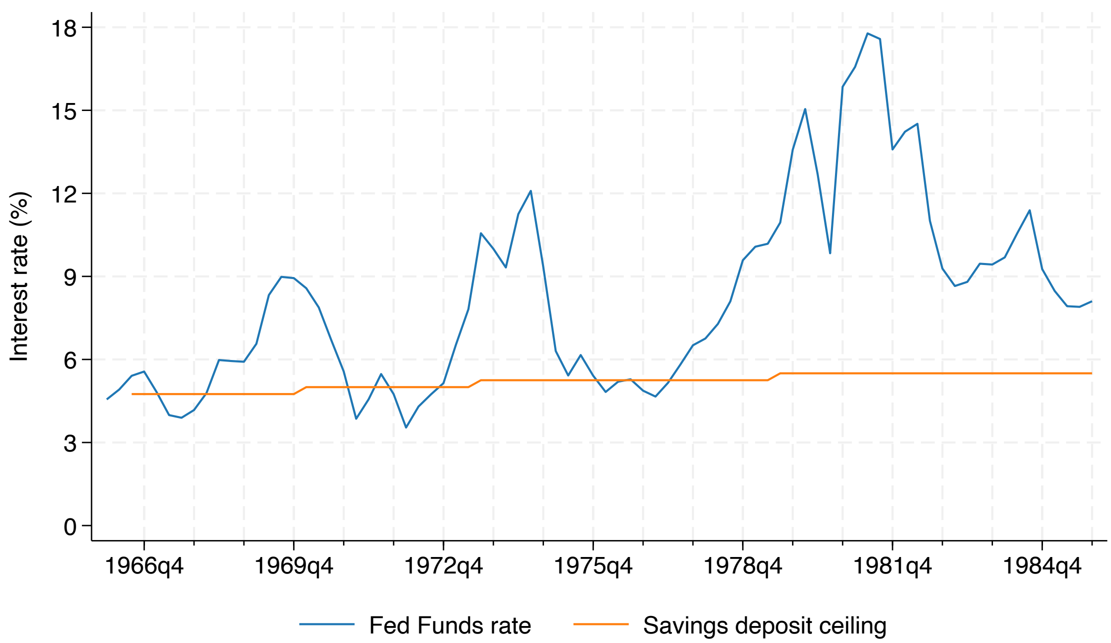
3 Measurement of funding frictions

I propose a new measure for funding frictions, which I call a binding constraint because it captures the level of restriction imposed by rate ceilings on banks' deposit rate offerings. This measure satisfies both relevance and exclusion restriction conditions.

3.1 Intuition

The supply of deposits depends on attractiveness of alternative investment relative to the deposit rates. When deposits become less attractive, funds that would have flowed into deposits are diverted to other forms of investment. An example is the large influx of dollars to Money Market Funds between 1979 and 1980 (of Governors of the Federal Reserve System, n.d.). The growth rate of savings and small time deposits at S&Ls slowed down as shown in Figure 1 Panel B. Less deposits funding, absent other liabilities, generates contraction in mortgage lending from the asset side.

Figure 2: Fed funds rate and deposit rate ceiling under Regulation *Q*



Notes: This figure plots the Fed funds rate and the interest rate ceiling on savings deposits over time. Fed funds rates are from the Federal Reserve. Deposit rate ceilings are from Gilbert (1986) and Ruebling et al. (1970).

For illustration purposes, suppose the Fed funds rate is the return on alternative investment. Figure 2 plots the evolution of Fed funds rate and deposit rate ceiling on passbook savings over time. The gap between the Fed funds rate and the ceiling reaches as high as 12%. Whenever Fed funds rate surpasses the ceiling, ceiling becomes bindings and households transfer funds from deposits to other forms of investments. In practice, alternative investments include Money Market Funds, public equity, wholesale deposits, among others.

S&Ls have no alternative funding besides retail deposits on the liability side and predominately invest in mortgages on the asset side. Whenever the gap between ceiling and alternative return widens, it contracts the entire liability side and by extension on the asset side. Hence, S&Ls provides a clean setting to study the effects of deposit rate ceilings on mortgage lending. Commercial banks, on the contrary, have access to alternative funding through wholesale deposits which are exempt from Regulation Q. As a result, banks are less constrained by deposit rate ceilings under Regulation Q.

3.2 Measurement method

The measure for funding frictions is the weighted average of the differences between market rates and deposit rate ceiling, with deposit shares in each deposit type serving as the weights. This measure represents the extent to which banks could offer higher deposit rates in the absence of rate ceilings, providing a precise quantification of funding frictions.

Using the deposit composition data from commercial banks and S&Ls, I construct a variable to measure the binding constraint of deposit rate ceiling.

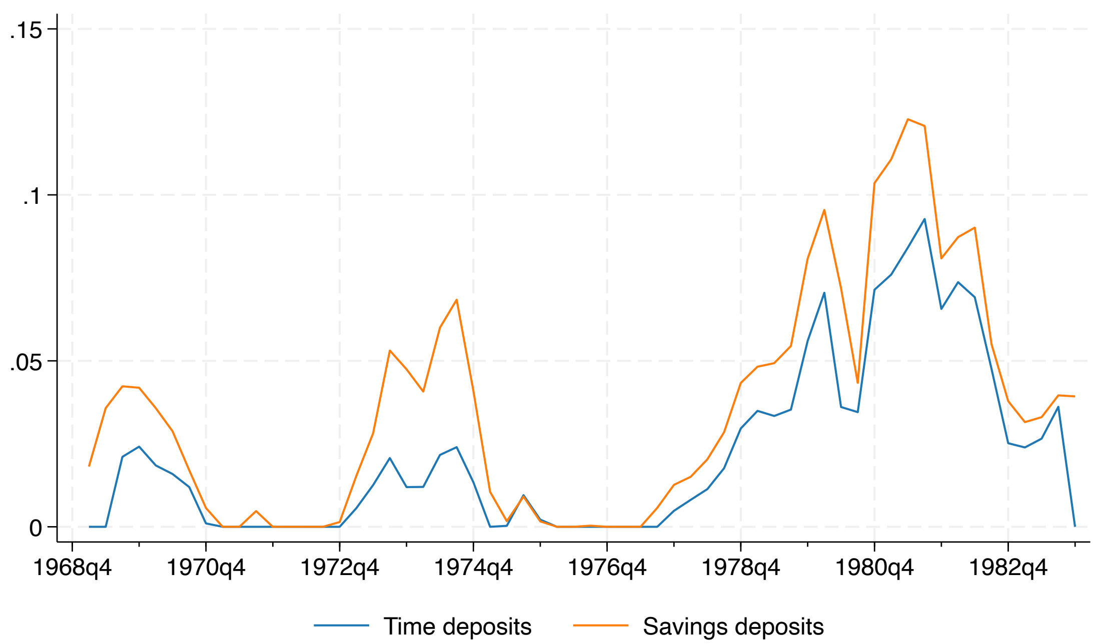
$$BindingConstraint_{i,t} = \frac{\sum_j Deposits_{i,t,j} \times \max[0, MaturityMatchedTreasury_{t,j} - Ceiling_{t,j}]}{TotalDeposits_{i,t}} \tag{1}$$

The measurement $BindingConstraint_{i,t}$ captures how much higher institution i could pay on deposit interest rate at time t absent Regulation Q. The subscript j indicates deposit products. For example, j can be passbook savings or the 6-month Money Market Certificate. $Ceiling_{t,j}$ is the maximum rate allowed on deposit product j at time t and is set to be infinity if project j is exempt from Regulation Q. $MaturityMatchedTreasury_{i,j}$ serves as the proxy for rate that banks/S&Ls would have paid if deposit rate ceilings did not exist.

It is the Treasury rate with matching maturity as product j. If deposit product j does not have maturity, e.g., passbook savings, I use the Fed funds rate instead. The measurement is in the interest rate unit and can be viewed as the gap between the counterfactual rate and the actual rate paid by institutions. A higher value in $BindingConstraint_{i,t}$ implies the institution is more constrained by deposit rate ceilings under Regulation Q.

The variation in $BindingConstraint$ is driven by differential exposure to deposit rate ceilings. On one hand, rate ceilings vary by deposit products. On the other hand, institutions differ in the exact deposit composition. Thus, whenever the Fed changes the ceiling rate for a particular deposit product, institutions with higher share of that deposit product are impacted more than those with lower share.

Figure 3: Binding constraints of deposit rate ceilings under Regulation Q



Notes: This figure plots the binding constraints of deposit rate ceilings on regulated savings and time deposits. Binding constraints are computed as the gap between the ceiling rate and the Treasury rate with matching maturity. Treasury rates are from the Federal Reserve. Deposit rate ceilings are from Gilbert (1986) and Ruebling et al. (1970).

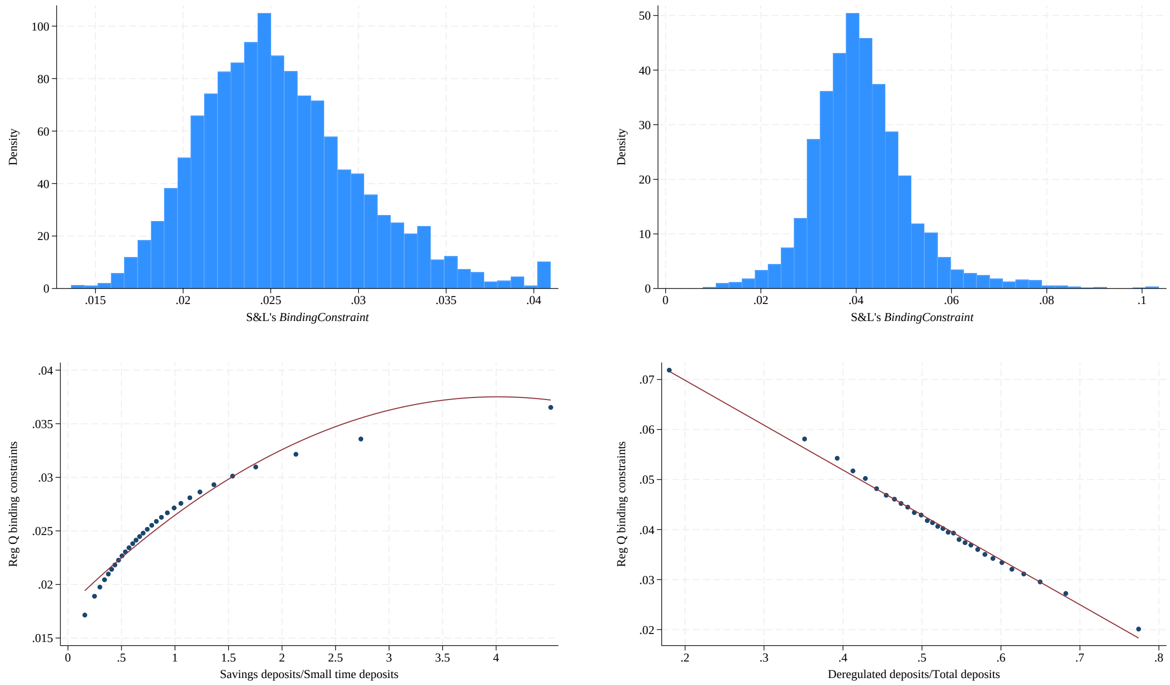
Before 1976, savings to small time deposit ratio was the main driver of the variation in $BindingConstraint$. Figure 3 shows that the binding constraints, measured as the gap between rate ceiling and the maturity matched Treasury rate, were consistently higher for savings deposit than for time deposits. Institutions with more savings deposits were more constrained by Regulation *Q* before 1976. Figure 4 Panel A plots the histogram of *BindingConstraint* in 1974Q4 for all S&Ls. The binned scatter plot shows a clear quadratic relationship between savings to small time deposit ratio and the binding constraint measurement. The phase-out of Regulation *Q* started in 1976 with the introduction of a series of deregulated deposit products. The deregulation of savings deposits started in 1976Q2 with the introduction of Negotiable Order of Withdrawal (NOW) Accounts in New England. In 1978Q2, institutions started to offer the 6-month Money Market Certificates, a type of small time deposits but exempt from deposit rate ceilings. After the onset of deregulation, the fraction of deregulation deposits became the main driver of variation in the measurement of *BindingConstraint*. Figure 4 Panel B plots histogram of *BindingConstraint* in 1980Q4 for all S&Ls. The binned scatter plot below demonstrates that institutions with higher fraction in deregulated deposits were less constrained by the deposit rate ceilings.

3.3 Validity of the funding friction measurement

The measure, which I call a binding constraint, is a valid proxy for funding frictions because it satisfies both relevance and exclusion restriction conditions. The measure directly affects deposit growth, satisfying the relevance condition. Under a standard shift-share approach, the measure affects credit supply only through deposit growth, satisfying the exclusion restrictions.

Figure 4: Variation in the binding constraint of deposit rate ceilings

Panel A: Before deregulation (1974Q4) Panel B: After deregulation (1980Q4)



Notes: This figure shows the variation of binding constraint measurement among S&Ls in 1974Q4 (Panel A) and 1980Q4 (Panel B). The Reg *Q* binding constraint measurement for S&L is computed according to Equation (1). The top graphs plot the histogram of the binding constraint variable. The bottom graphs show the binned scatter plots of the binding constraint variable against the savings to small time deposit ratio in Panel A and the fraction of deregulated deposits in Panel B.

4 Data

To construct the measure of funding frictions and explore its impact on credit supply, I need detailed data on deposit breakdown and lending activities at the institution level. I obtain such data from regulatory reports on savings and loan associations and commercial banks from 1974 to 1983.

Deposits and mortgage lending data come from two sources: the Bank Call Reports and the S&L Financial Reports. The Bank Call Reports are available through the Wharton Research Data Services (WRDS) back to 1976. Historical Bank Call Reports prior to 1976 can be obtained through a FOIA request from the Federal Reserve. S&L Financial Reports from 1969 to 1983 are hosted at the National Archives and are available to the public free of charge.

Commercial banks file Call Reports with the Federal Reserve. I follow Drechsler, Savov and Schnabl (2017) to extract balance sheets information for individual banks at the quarterly level from 1969 to 1983. While basic financial variables such as total deposits and real estate lending are well-populated going back to 1969, detailed information on the deposit composition such as the split between small and large time deposits, an essential variable to the construction of the measurement of binding constraints, do not exist until 1975. Hence, the sample period for the commercial bank analysis is from 1975 to 1983.

Much like the commercial banks, S&Ls are required to file financial reports on a regular basis with their regulatory agency at the time, the Federal Home Loan Bank Board (FHLBB). There are two sets of semi-annual S&L Financial Reports. The reports filed in even-numbered quarters include balance sheet information similar to the Bank Call Reports but with less details on the deposit composition. The reports filed in odd-numbered quarters specifically focus on the deposits. They include the dollar amount of deposits and interest rates offered on new deposits by category and maturity. To combine both sets of S&L Financial Reports, I interpolate the assets and mortgage lending data in the odd quarters and deposit composition data in the even quarters.

I aggregate bank and S&L balance sheet data at the Core Based Statistical Areas (CBSAs) level. I use the 2020 delineation files from the Census Bureau.

I obtain the deposit rate ceilings under Regulation Q from Gilbert (1986) and Ruebling et al. (1970), and cross check with various issues of *Federal Reserve Bulletin*. Other data used in this paper are the Treasury and Fed funds rate data, and the Flow of Funds data, all of which are available from the Federal Reserve website.

Table 1 presents the summary statistics for my dataset at the CBSA level. The full sample for S&Ls is from 1969 to 1983. The beginning of the sample period is determined by the availability of the deposit composition data and it aligns well with the start of the Great Inflation in mid-1960s. There is a major revision to the S&L financial reports between 1983 and 1984, making it impossible to construct a consistent time series on mortgage lending at the individual institution level. Hence, I set the ending period of the sample to be 1983, right before the onset of S&L crisis in 1986. On average, S&Ls have 81% of their assets in mortgages and a deposits-to-assets ratio of 87%. The average annualized mortgage growth rate is 11.1%. I compute mortgage growth as log changes at the quarterly level with seasonal adjustments, then multiply them by 4 to obtain the annualized rates. The rate ceiling binding constraint measure *BindingConstraint* is computed according to Equation (1) at the CBSA level. The mean of *BindingConstraint* is 1.7 percentage point with a standard deviation of 1.5 percentage point for S&Ls throughout the full sample period.

Table 1: CBSA-level summary statistics

	S&Ls: 1969–1983		S&Ls: 1975–1983		Banks: 1975–1983	
	Mean (1)	St.Dev. (2)	Mean (3)	St.Dev. (4)	Mean (5)	St.Dev. (6)
No. of institutions	4.698	14.810	4.569	13.523	11.976	27.643
Assets (mil.)	505.116	2781.059	676.576	3444.885	1763.279	15006.073
log(Assets)	11.351	1.607	11.735	1.551	12.496	1.489
log(Deposits)	11.213	1.593	11.597	1.538	12.354	1.456
log(Mortgages)	11.142	1.613	11.505	1.568	10.755	1.585
Deposits/Assets	0.873	0.051	0.873	0.056	0.870	0.056
Mortgages/Assets	0.814	0.087	0.797	0.102	0.193	0.078
Δ log(Mortgages)	0.101	0.272	0.086	0.301	0.113	0.240
Δ log(Deposits)	0.111	0.245	0.099	0.270	0.093	0.151
Rate ceiling binding constraint	0.017	0.015	0.017	0.015	0.013	0.012
Fraction of deposits:						
Demand	0.000	0.002	0.000	0.003	0.300	0.098
Savings	0.361	0.180	0.268	0.123	0.246	0.092
Small time ($\leq$ 100K)	0.617	0.171	0.693	0.128	0.333	0.119
Wholesale	0.023	0.055	0.039	0.068	0.120	0.074
Deregulated	0.189	0.291	0.321	0.318	0.285	0.196
Market concentration:						
Deposit HHI	0.254	0.175	0.254	0.178	0.277	0.199
Mortgage HHI	0.348	0.215	0.345	0.213	0.360	0.222
Observations	46,211		27,205		31,297	

Notes: This table shows the summary statistics of S&Ls and commercial banks. The data are at the CBSA-quarterly level. Mortgage growth is annualized and seasonally adjusted. The measurement of deposit rate binding constraint is computed at the CBSA-level according to Equation (1). The HHI scores are computed at the CBSA level and include both S&Ls and commercial banks. The sample covers the years 1969–1983 for S&Ls and 1975–1983 for commercial banks.

For a comparison between S&Ls and commercial banks, Columns (3)–(6) present summary statistics from 1975 to 1983 for both types of depository institutions. Both banks and S&Ls have similar average asset size and deposit to assets ratio. Unlike S&Ls which have

80% of their assets in mortgages, commercial banks only have 18% of assets in mortgage lending with an average growth rate of 11.5%. The mean of the binding constraint measurement is 1.4 percentage point at commercial banks, slightly lower that that of the S&Ls. In terms of deposit composition, 12% of the total deposits in commercial banks are in wholesale deposits (time deposits that are greater than $100,000 in denomination) which are exempt from Regulation *Q*. Savings and small time deposits account for 25% and 34% of the deposits in commercial banks. For S&Ls, the fraction of wholesale deposits is much lower with an average of 3.8%, indicating that S&Ls had limited access to alternative funding when deposit rate ceilings became binding. S&Ls predominately rely on retail deposits, with 69% of total deposits in small time deposits and 27% in savings deposits.

Deregulated deposits are deposits not subject to Regulation *Q* during the sample period. They include wholesale deposits starting from 1970, deregulated savings deposits products such as Negotiable Order of Withdrawal (NOW) Accounts and Money Market Deposits Accounts (MMDAs) starting from 1976Q2, and deregulated small time deposit products such as Money Market Certificates (MMCs) and Small Saver Certificates starting from 1978Q2. On average, 19% of the deposits are deregulated at S&Ls in the full sample and 32% in the sub-sample. Banks have less deregulated deposits with a mean of 28% in the sub-sample period.

The last two rows provide information on market concentration. The Herfindahl-Hirschman Index (HHI) on deposits and mortgages are computed at the CBSA level and include both S&Ls and commercial banks. Moreover, throughout the sample period, prohibition on interstate banking remained in place for most states. [1] Only 15 states allowed unrestricted branching within state prior to the end of the sample period (Strahan et al., 2003; Demyanyk, Ostergaard and Sørensen, 2007). Thus, spillover effects from lending activities outside of the metropolitan area where the institution is located are less of a concern.

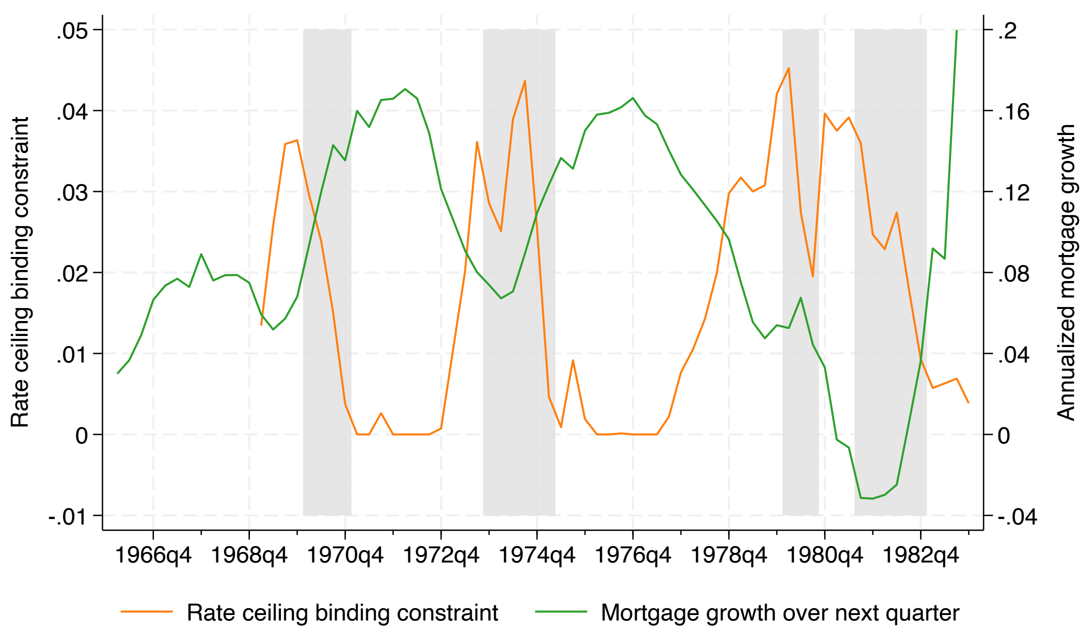
[1] Interstate banking was permitted in New York in 1982, and Connecticut and Massachusetts in 1983.

5 Aggregate trend in mortgage supply

I construct the funding friction measure at the national level. As funding frictions increased, there was a slowdown in aggregate credit supply for mortgages. While the aggregate trend offers preliminary insights, macroeconomic conditions may introduce endogeneity issues.

Figure 5 plots the aggregate mortgage growth and the binding constraint measurement *BindingConstraint* of the S&L sectors over time. Annualized mortgage growth (right axis) is computed from quarter t to $t + 1$. The binding constraint measurement (left axis) is at time t and can be viewed as the difference between the actual deposit interest rate and the counterfactual rate in which Regulation Q do not exist. Shaded areas denote the NBER recessions.

Figure 5: Mortgage growth and rate ceiling binding constraint at S&Ls



Notes: This figure plots the mortgage growth (right axis) and the binding constraint measure of deposit rate ceilings (left axis) in the aggregate S&L sector from 1966 to 1983. The binding constraint measurement is computed according to Equation (1). Mortgage growth is log changes at the quarterly level with seasonal adjustments. I multiply the growth rate by 4 to obtain the annualized rate. Shaded areas denote the NBER dated recessions.

S&L mortgage growth declined in periods when rate ceilings became more binding under Regulation Q. When rate ceilings did not bind in 1971 and 1976, S&Ls expanded their mortgage lending at a growth rate of as high as 17%. By contrast, S&Ls shrank their mortgage assets on the balance sheets by 4% in 1981 when the ceiling rate binding constraint reached 4%. The latter period coincides with the peak of Fed funds rate after Volcker took office. By and large, there is a strong negative relationship between mortgage growth and the rate ceiling bindingness measurement in the S&L sector.

One concern is that the negative correlation in the time series is due to regular business cycles. As shown in Figure 5, interest rate drops during recessions, loosening the constraint imposed by the rate ceilings. It is difficult to disentangle the effects of *BindingConstraint* from the effects of business cycle by looking at the aggregate pattern. Hence, it is crucial to investigate the effects in the cross section.

6 Credit supply among S&Ls and commercial banks

I conduct cross-sectional analyses to address endogeneity concerns arising from the aggregate trend. Specifically, I employ a two-stage regression specification and show that funbding frictions equivalent to a 100-bps tightening in deposit rate ceilings, led to a 10% contraction in mortgage supply at S&Ls. Yet, the impact was less pronounced in commercial banks.

6.0.1 Analysis on S&Ls

Turning to the cross-sectional analysis, I run the following two-stage least squares regression analysis at the CBSA - quarter level.

$$\begin{aligned}
1^{\text{st}}\text{ stage: } \Delta\log(Deposits_{c,t+1}) &= \alpha + \beta_1 BindingConstraint_{c,t} + \beta_2 DepHHI_{c,t} + \eta MtgHHI_{c,t} \\
&\quad + \boldsymbol{\phi}\mathbf{X_{c,t}} + FE + \epsilon_{c,t}, \qquad (2)\\
2^{\text{nd}}\text{ stage: } \Delta\log(Mortgages_{c,t+1}) &= \alpha + \gamma_1 \Delta\log(\widehat{Deposits}_{c,t+1}) + \gamma_2 MtgHHI_{c,t} \\
&\quad + \boldsymbol{\varphi}\mathbf{X_{c,t}} + FE + \epsilon_{c,t}, \qquad (3)
\end{aligned}$$

where the two outcome variables are the annualized deposit and mortgage growth at S&Ls in CBSA c from time t to $t+1$. The instrumental variables for deposit growth are the deposit ceiling binding constraint measure, as well as the deposit HHI score. Herfindahl–Hirschman Index $HHI_{i,t}$ controls for the local market concentration. The two instrumental variables only affect the deposit side of the S&L business and thus have no direct impact on the mortgage side. The coefficient of interest in the first stage is β_1 and it captures the effects of binding constraint on deposit growth. The coefficient γ_1 captures the marginal propensity to lend for every percentage point increased in deposit funding. The vector $\mathbf{X_{c,t}}$ include CBSA characteristics such as asset size, mortgage-to-asset ratio, and deposit-to-asset ratio. In all specifications, I include the time or state $\times$ time fixed effects. The fixed effects absorb any time-varying characteristics that are shared by all CBSAs in the same state, especially factors correlated with the business cycle or state-specific regulations.

Table 2 presents the results for all S&Ls. The sample period is from 1969Q1 to 1983Q4. Standard errors are clustered at the S&L and quarter levels. The first three columns present the regression results from the first stage whereas the last three columns present results from the second stage. Columns (2) and (5) includes the S&L controls. Columns (3) and (6) replace time fixed effects with time $\times$ state fixed effects to control for state-specific characteristics. Across all specification, the coefficients on $BindingConstraint$ are negative and highly significant, indicating that CBSAs with higher level of binding constraint are associated with lower deposit amount. The coefficients on $\Delta \log(\widehat{Deposits}_{c,t+1})$ are statistically insignificant from 1, implying that deposit growth increases mortgage growth roughly one-for-one. This is consistent with the business model of S&Ls since more than 80% of assets are mortgages in S&Ls. Combining the results from both stages, a 100-basis-point increase in the binding constraint of the ceiling rate is associated with $8.9\% \times 0.924 = 8.22\%$ decline in annualized mortgage growth. The coefficients on the HHI scores are positive and significant, indicating that banks in areas with lower competitions were able to expand their deposits or mortgage lending more rapidly.

Next, I run the following reduced form regression of mortgage growth on the binding

Table 2: Mortgage growth at S&Ls 1969–1983

	First stage			Second stage		
	(1)	(2)	(3)	(4)	(5)	(6)
BindingConstraint(%)	−0.080***	−0.071***	−0.093***			
	(0.022)	(0.022)	(0.028)			
Deposits HHI	0.118***	0.077**	0.096**			
	(0.036)	(0.033)	(0.037)			
$\Delta\log(\widehat{\text{Deposits}})$				1.017***	1.007***	0.930***
				(0.102)	(0.106)	(0.126)
Mortgage HHI				0.015	0.023***	0.015*
				(0.010)	(0.008)	(0.009)
S&L controls:						
Log(Assets)		−0.018***	−0.020***		0.002	0.001
		(0.003)	(0.004)		(0.002)	(0.003)
Mortgages/Assets		−0.078	−0.071		−0.544***	−0.602***
		(0.074)	(0.083)		(0.082)	(0.083)
Deposits/Assets		−0.710***	−0.702***		0.056	0.058
		(0.129)	(0.127)		(0.120)	(0.147)
Time FE	Yes	Yes	No	Yes	Yes	No
Time × State FE	No	No	Yes	No	No	Yes
Obs.	45,305	45,304	45,139	45,305	45,304	45,139
Adj-R^2	0.06	0.08	0.12			
F-stat				145.05	67.36	54.12
p-val				0.00	0.00	0.00

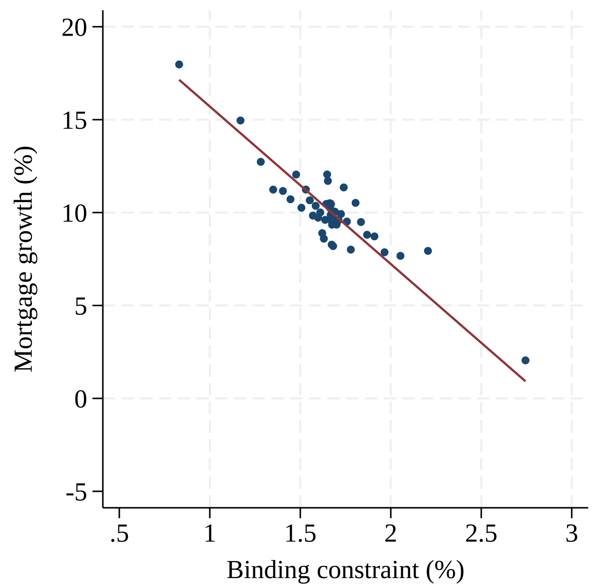
Notes: This table presents the regression results from Equations (2) and Equations (3). The sample is at the CBSA level and includes all S&Ls from 1969 to 1983. *BindingConstraint* is computed according to Equation (1) and then multiplied by 100 so that the unit is in percentage points. The dependent variables deposit growth (first stage) and mortgage growth (second stage) are annualized and seasonally adjusted. Standard errors are clustered at the CBSA-quarter level.

constraint measure:

$$\Delta\log(Mtg_{c,t+1}) = \alpha + \beta_1 BindingConstraint_{c,t} + \beta_2 DepHHI_{c,t} + \beta_3 MtgHHI_{c,t} + \boldsymbol{\phi}\mathbf{X_{c,t}} + FE + \epsilon_{c,t}, \quad (4)$$

where FE is the time × state fixed effects. The rest of the variables are defined the same way as in the two-stage least squares regression. Figure 6 shows the binned scatter plot of the reduced-form estimates. The binned scatter plot groups quarter-CBSA pairs into 50 bins by binding constraint measure and plot the average mortgage growth within each bin. The slope for the fitted line is −8.01, roughly the same magnitude as the calculation in the 2SLS analysis.

Figure 6: Reduced form results, 1969–1983



Notes: This figure shows the binned scatter plot from Equations (4). The sample is at the CBSA level and includes all S&Ls from 1969 to 1983. The binned scatter plot groups quarter-CBSA pairs into 50 bins by binding constraint measure and plot the average mortgage growth within each bin. The binding constraint measure is computed according to Equation (1) and then multiplied by 100 so that the unit is in percentage points. The dependent variables mortgage growth is annualized and seasonally adjusted.

6.0.2 Comparison between S&Ls and commercial banks

One hypothesis is that access to alternative funding can mitigate the effects of rate ceilings on mortgage lending. Wholesale deposits are a major form of alternative funding at depository institutions and are exempt from Regulation *Q* since 1970. To test this hypothesis, I include the wholesale deposit share in the controls and estimate Equations (2) and (3) for both S&Ls and commercial banks.

Table 3 presents the results. The sample period for this analysis is from 1975 to 1983. As before, standard errors are clustered at the CBSA-quarter level. I include time $\times$ state fixed effects across all specifications. Columns (1)-(2) use S&L data whereas Columns (3)-(4) use commercial bank data. From the first stage results in Columns (1) and (3), deposit rate ceilings have a negative and significant impact on deposits growth at S&Ls but no effect at commercial banks. It implies that commercial bank substituted retail deposits with wholesale deposits when rate ceiling became more binding. From the second stage,

Table 3: Mortgage growth at S&Ls and commercial banks 1975–1983

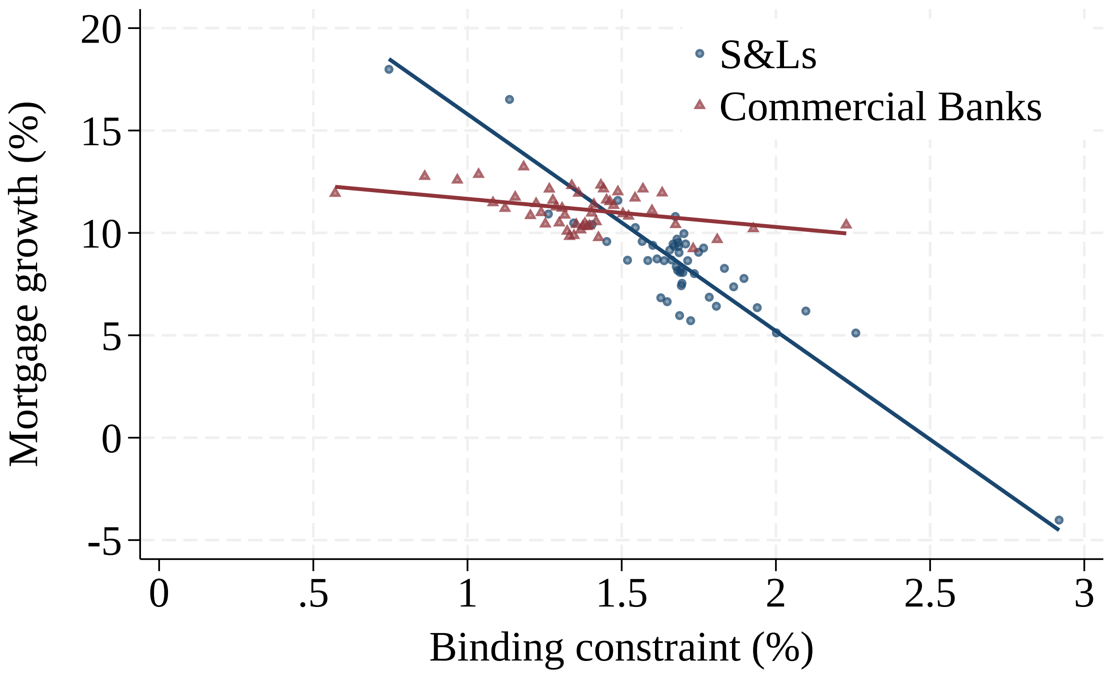
	S&Ls		Commercial banks	
	(1)	(2)	(3)	(4)
BindingConstraint	−10.622***		−0.233	
	(3.119)		(0.440)	
$\Delta\log(\widehat{\text{Deposits}})$		0.880***		1.691
		(0.144)		(1.874)
Market concentration:				
Deposits HHI	0.130***	0.021	0.034	0.040
	(0.036)	(0.025)	(0.025)	(0.065)
Mortgage HHI	−0.059**	0.008	−0.016	0.002
	(0.025)	(0.018)	(0.021)	(0.032)
Institution fundamentals:				
Log(Assets)	−0.025***	−0.003	−0.022***	0.015
	(0.007)	(0.004)	(0.006)	(0.042)
Mortgages/Assets	−0.029	−0.630***	−0.008	−0.510***
	(0.118)	(0.133)	(0.045)	(0.069)
Deposits/Assets	−0.898***	−0.072	−0.616***	0.464
	(0.225)	(0.190)	(0.133)	(1.154)
Time × State FE	Yes	Yes	Yes	Yes
Observations	28,551	28,551	32,893	32,893
Adj-R^2	0.13	0.67	0.15	0.39
Weak ID F-stat	11.60		0.28	

Notes: This table presents the regression results from Equations (2) and Equations (3). The sample is at the CBSA level and includes all S&Ls and commercial banks from 1975 to 1983. *BindingConstraint* is computed according to Equation (1) and then multiplied by 100 so that the unit is in percentage points. The dependent variables deposit growth (first stage) and mortgage growth (second stage) are annualized and seasonally adjusted. Standard errors are clustered at the CBSA-quarter level.

deposit growth increases mortgage growth roughly one-for-one at S&Ls but more than one-for-one at commercial banks. This is due to the fact that mortgages made up 80% of total assets at S&Ls but only 17% at banks. To interpret the results, we need to multiply the two coefficients. On average, a 100-basis-point increase in the binding constraint of the ceiling rate is associated with an $11.6\% \times 0.871 = 10.1\%$ decline in annualized mortgage growth at S&Ls, compared to $0.3\% \times 2.849 = 0.9\%$ at commercial banks. The results support that hypothesis that access to alternative funding helps banks mitigate the effects of rate ceilings imposed by Regulation Q.

Figure 7 shows the binned scatter plots of the reduced-form estimates from Equation (4). The S&L result in blue is similar to the one in Figure 6, despite a much shorter sample

Figure 7: Mortgage growth in the local market



Notes: This figure shows the binned scatter plots from Equations (4). The sample is at the CBSA level from 1969 to 1983. Blue dots use S&L data whereas red triangles use commercial bank data. The binned scatter plots group quarter-CBSA pairs into 50 bins by binding constraint measure and plot the average mortgage growth within each bin. The binding constraint measure is computed according to Equation (1) and then multiplied by 100 so that the unit is in percentage points. The dependent variables mortgage growth is annualized and seasonally adjusted.

period. The slope for the fitted line is -10.00% for S&Ls. This is in contrast to commercial bank result which has a flatter fitted line with a slope of -1.68%.

7 Use of alternative funding in commercial banks

The impact of funding frictions on commercial banks was less pronounced due to their access to alternative funding. When deposit rate ceilings became binding, commercial banks increased their utilization of wholesale funding to offset the decrease in deposits, thereby mitigating the negative impact on credit supply.

To test whether commercial banks increased wholesale funding when deposit ceilings became binding, I run the following regression using the commercial bank data.

$$\Delta \log(WholesaleDep_{c,s,t+1}) = \alpha + \beta_1 BindingConstraint_{c,s,t} + \boldsymbol{\phi}\mathbf{X_{c,s,t}} + State \times TimeFE_{s,t} + \epsilon_{c,s,t}, \tag{5}$$

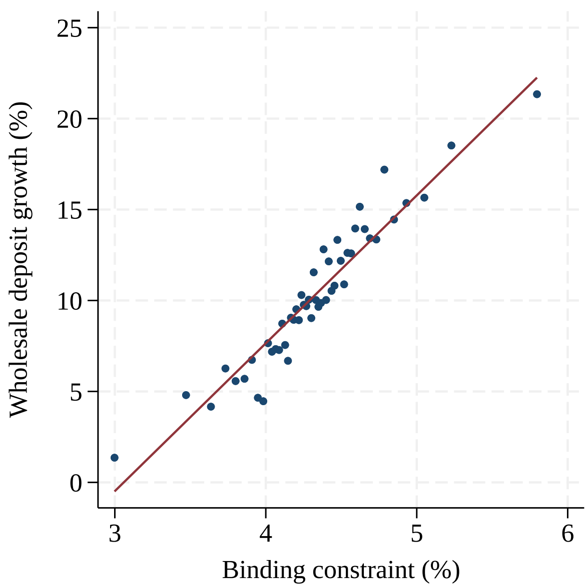
where the dependent variable is the growth rate of wholesale deposits over the next quarter and the main independent variable is the funding friction measure. Table 4 presents the results. On average, when effect deposit rate ceilings declined by 100 bps, commercial banks increased their intake of wholesale funding by 8%, offsetting the drop in retail deposits.

Table 4: Wholesale deposit usage in commercial banks

Panel A: Regression table

	(1)	(2)	(3)	(4)
BindingConstraint	7.622***	7.787***	7.902***	8.129***
	(0.751)	(0.837)	(0.842)	(0.902)
Time × State FE	Yes	Yes	Yes	Yes
Fundamentals		Yes	Yes	Yes
Market HHI			Yes	Yes
Demographic				Yes
Observations	32,924	32,919	32,897	32,811
R^2	0.22	0.23	0.23	0.23

Panel B: Binned scatter plot



Notes: Panel A presents the regression results from Equations (5). Panel B shows the binned scatter plot from Column (4). The sample is at the CBSA level and includes all commercial banks from 1975 to 1983. *BindingConstraint* is computed according to Equation (1) and then multiplied by 100 so that the unit is in percentage points. The dependent variable wholesale deposit growth is annualized and seasonally adjusted. Standard errors are clustered at the CBSA-quarter level.

8 A model of credit supply in mortgage lending

To provide theoretical support to the empirical findings, I introduce a static two-period model to illustrate the observed correlation between deposit rate ceilings under Regulation Q and bank deposit levels.

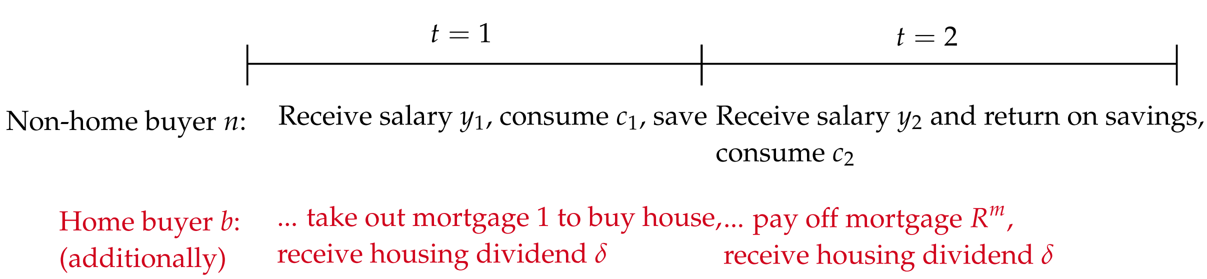
8.1 Environment

For simplicity, the economy lasts for two periods, $t = 1, 2$ and there is no risk on asset returns. The economy consists of two sectors: a continuum of households with measure 1 and N financial intermediaries.

Households Households have two options of savings. They can deposit their savings at a financial intermediary with rate R^d, or invest in alternative investment with rate R^a. A fraction ρ of the households are home buyers with ρ determined in equilibrium. I assume no default on mortgages in this economy.

Figure 8 shows a diagram of the timeline of the household sector. Let n denote non-home buyers and b denote home buyers. In each period, households receive salary y_t, where y_t is a random draw from a probability distribution and varies across households. All households consume and save in $t = 1$ and consume the rest of their assets in $t = 2$. Additionally, home buyers b take out mortgage to buy house (price normalized to 1) in $t = 1$ and pay off mortgage R^m in $t = 2$. In return, home buyers receive a housing dividend δ in each period.

Figure 8: Household timeline



In $t = 1$, households decide how to invest their savings. Households endogenously allocate $\eta \in (0, 1]$ of savings into deposits and $1 - \eta$ into alternative investments. I assume households will always choose a positive amount of deposits regardless of interest rate. Deposits provide liquidity and convenience for households whereas alternative assets do not. This is consistent with the money in the utility theory. The savings allocation $\eta = f(R^a - R^d)$ is a decreasing function in the interest rate spread between the alternative assets and deposits.

The households' problem is to maximize utility in both periods:

$$\max_{c_1^n, c_2^n, c_1^b, c_2^b} (1-\rho) \overbrace{\left[U(c_1^n, 0) + \beta U(c_2^n, 0)\right]}^{\text{Non-home buyer}} + \rho \overbrace{\left[U(c_1^b, \delta) + \beta U(c_2^b, \delta)\right]}^{\text{Home buyer}}, \tag{6}$$

where utility $U(\cdot)$ is a function of consumption and housing dividends. Discount factor is β. Households are subject to the usual budget constraints:

$$\text{Non-home buyer: } c_2^n = y_2 + (y_1 - c_1^n)(\eta R^d + (1-\eta)R^a), \tag{7}$$

$$\text{Home buyer: } c_2^b + R^m = y_2 + (y_1 - c_1^b)(\eta R^d + (1-\eta)R^a). \tag{8}$$

Financial intermediary There are N financial intermediaries and they Cournot compete in both deposit and mortgage markets. When $N = 1$, the financial sector is monopolistic. When there is an infinite amount of financial intermediaries, the two markets are perfectly competitive.

Table 5: Financial institution balance sheet

Assets	Liabilities
Mortgages m_i (rate $R^m(M_{-i} + m_i)$)	Deposits d_i (rate $R^d(D_{-i} + d_i)$)
Reserves r_i (policy rate R^f)	

Table 5 presents the balance sheet of a financial institution i in this economy. On the liability side, intermediary chooses deposits amount d_i. Deposit interest rate D^d is determined in equilibrium and is subject a deposit rate ceiling $\overline{R}$. On the asset side, intermediary originates mortgages m_i with rate R^m determined in equilibrium. Intermediary must hold a nonnegative amount of reserve r_i with the central bank. The reserve pays a policy rate R^f that is exogenous to the model.

Institution i maximizes profits in $t = 2$, subject to the reserve requirement and the deposit rate ceiling $\overline{R}$.

$$\max_{d_i, r_i, m_i} \overbrace{R^m(M_{-i} + m_i)m_i + R^f r_i}^{\text{Assets}} - \overbrace{R^d(D_{-i} + d_i)d_i}^{\text{Liabilities}}, \tag{9}$$

$$\text{Subject to } r_i = d_i - m_i \geq 0, \quad R^d(D_{-i} + d_i) \leq \overline{R}. \tag{10}$$

Market clearance To reach equilibrium, both deposit and mortgage markets have to clear.

$$\text{Deposits: } \sum_{i=1}^{N} d_i = \overbrace{\eta(1-\rho)(y_1 - c_1^n)}^{\text{Non-home buyer}} + \overbrace{\eta\rho(y_1 - c_1^b)}^{\text{Home buyer}} \tag{11}$$

$$\text{Mortgages: } \sum_{i=1}^{N} m_i = \rho \tag{12}$$

8.2 Equilibrium Definition

A stationary equilibrium consists of: *(i)* a measure of home buyers ρ; *(ii)* household's policy choices on consumption $[c_1^n, c_2^n, c_1^b, c_2^b]$ and savings allocation η; *(iii)* Financial intermediary's policy choices on deposits d_i, mortgage origination m_i and reserves r_i; and *(iv)* interest rate schedules on deposits R^d and mortgages R^m, such that

1. Policies $[c_1^n, c_2^n, c_1^b, c_2^b]$ and η solve household's problem outlined in Equation (6) for both home and non-home buyers.

2. Policies $[d_i, m_i\, r_i]$ solve financial intermediary' problem outlined in Equation (9) for each institution i.

3. Deposit and mortgage markets clear in the economy.

4. Financial intermediary's reserve requirement and deposit rate ceiling are satisfied.

9 Conclusion

Macroprudential regulation has profound impact on the economy. To study one aspect of it, this paper revisits the effects of deposit rate ceilings, a widely used macroprudential policy in the Great Inflation era. I show that deposit rate ceilings induce credit supply shifts in mortgage lending at S&Ls. Access to alternative funding is valuable to depository institutions as it can alleviate the binding constraints from interest rate ceilings. Finally, it is important to note that results in this paper document the shifts in credit supply in mortgages. Whether or not it has welfare implication on home ownership remains an open question and will be interesting for future work.

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