Financial Crises and the Transmission of Monetary Policy to Consumer Credit Markets

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Abstract

This paper explores one channel through which financial crises can alter the strength of the credit channel of monetary policy. Analyzing microdata on the universe of US credit unions and exploiting plausibly exogenous variation in exposure to ABS markets, I find that asset losses among lenders increase the sensitivity of their lending to the policy rate. A 10 basis point fall in the two-year Treasury yield generates a 0.86 percentage point increase in quarterly lending growth when assets are unchanged. However, the same policy rate change leads to a 1.15 percentage point increase for a credit union experiencing a one standard deviation asset loss. This is a more than 20% difference relative to median lending growth. Additionally, a 10 basis point policy rate reduction lowers the effect of a one standard deviation asset loss from a 3.20 to 2.91 percentage point decrease in lending growth. These findings suggest that monetary easing is more potent among lenders with recently weakened balance sheets and there exists an additional benefit of monetary easing which reduces the contractionary effect of asset losses.

Keywords: monetary transmission mechanism, financial crises, consumer credit, mortgages, high frequency identification
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I. Introduction

The collapse of asset-backed security (ABS) markets in 2008 significantly impaired the balance sheets of many creditors holding these assets. The inability of these lenders to extend credit to consumers and firms contributed to the severity of the Great Recession and amplified falls in consumption, employment, and output. American policymakers responded to the crisis with both conventional and unconventional monetary policy.[1] The goal of these programs was to stimulate bank lending by lowering the cost of capital (conventional policy) and to also combat balance sheet impairments preventing banks from lending (unconventional policy).

An important consideration for policymakers is whether monetary policy works any differently during a *financial* crisis. In particular, this paper explores if the credit channel of conventional monetary policy is more or less effective when banks suffer large asset losses. Empirically, this question is largely unexplored. Moreover, theory may not be the ideal starting point for this question as even simple models can give rise to opposing predictions regarding whether asset losses amplify or attenuate the effects of conventional monetary easing (two such examples are presented in section II). The answer is not only informative about financial crises, but speaks to the substitutability/complementarity of conventional and unconventional monetary policy. In this paper, I address this question empirically by analyzing the sensitivity of lending to conventional monetary policy and asset losses in a panel dataset of US credit unions.

I find that credit unions experiencing large balance sheet losses are relatively *more* responsive to conventional monetary policy. A credit union with no change in assets increases quarterly lending growth 0.86 percentage points in response to an exogenous 10 basis point decrease in the two-year Treasury yield. But this 10 basis point decrease induces a 1.15 percentage point rise in lending at a credit union experiencing a one standard deviation (1.65%) asset loss. This is a sizable difference compared to -1.38%, the median lending growth rate among credit unions through the sample.

There are two key identification issues that make causal inference challenging when analyzing the effect of changes in the cost of capital and assets losses on institution-level lending. First, there is endogeneity between the policy rate and lending. Changes to the policy rate are motivated by the economic environment and thus react to many factors that influence credit demand throughout the economy. To address this estimation issue for the policy rate, I instrument for changes in treasury yields with changes in the price of federal funds rate futures contracts within a narrow window of FOMC announcements (as

[1] Here, conventional monetary policy refers to policy directly targeting the cost of capital. Conventional monetary policy can target short rates such as the federal funds rate and one or two-year Treasury notes or longer rates such as ten-year Treasury yields. I also consider attempts to affect future interest rates (forward guidance) as conventional monetary policy. Unconventional monetary policy refers to policies such as large-scale asset purchases with the objective of stabilizing asset prices and balance sheets (e.g., MBS purchases under quantitative easing and TARP).

in Swanson and Williams, 2014; Gertler and Karadi, 2015; Nakamura and Steinsson, 2018; Wong, 2019, among others).

Second, it is also challenging to credibly identify variation in asset losses independent of loan demand and other shocks experienced by lenders. To overcome this, I exploit the unique institutional setting in which credit unions operate to identify a plausibly exogenous asset loss (similarly to Ramcharan, Van den Heuvel and Verani, 2016). The majority of credit unions providing consumer credit, natural person credit unions (NPCUs), are exposed to the ABS market through ownership of capital in corporate credit unions (CCUs).[2] The key identifying assumption is that credit unions with greater exposure to ABS losses do not also face borrowers whose loan demand is more cyclically sensitive. Both CCU exposure to the ABS market and the extent to which CCU losses were transmitted onto NPCU balance sheets varied significantly for a number of reasons plausibly unrelated to a given NPCU's local loan demand.

This exogeneity is mainly due to seemingly random variation in CCU exposure to ABSs and a limited ability on the part of NPCUs to adjust their exposure. While a number of CCUs had zero exposure to ABSs prior to the financial crisis, some had as much as 65% of their assets in ABSs. NPCU ownership of CCU equity is also subject to minimum duration requirements of up to 20 years, making these holdings quite sticky. Whether the CCU relies more on debt or equity financing also alters the pass-through of a given asset loss to equity-holders. Lastly, a credit union with a relatively smaller share of ownership will experience a smaller asset loss in dollar terms. Conditioning on credit union size, this is largely determined by the decisions of other credit unions on their position size. This means most of the variation in the value of this asset on NPCU balance sheets is due to variation in CCU financial structure and the performance of extremely different CCU portfolios.

This paper contributes to a line of literature exploring how heterogeneous characteristics of financial intermediaries affect the monetary transmission mechanism. Understanding these differential responses to monetary policy is important for successfully implementing policy. Forecasts of the consequences of policy changes based on aggregate data or a typical creditor/borrower can be misleading if there are significant differences in the responses of creditors and borrowers.

Most closely related to this paper are Kashyap and Stein (1995) and Kashyap and Stein (2000), which examine bank-level FDIC Call Report data. In the first, the authors find that smaller banks are more sensitive to conventional monetary policy. They expand on this finding in Kashyap and Stein (2000) when they observe that smaller banks tend to have less liquid balance sheets and that lower liquidity makes banks more responsive to monetary policy.[3] Specifically, moving from the 90th to 10th percentile of liquidity is associated with a

[2] Throughout this paper, I refer to the type of credit unions that provide consumer credit interchangeably as NPCUs or simply "credit unions".

[3] Kashyap and Stein (2000) define liquidity as the value of securities to total assets.

0.6-5.3 percentage point greater fall in lending growth in response to a 100 basis point rise in the federal funds rate. Together, our findings suggest that balance sheet impairment leads to greater sensitivity of bank lending to conventional monetary policy.

More recently, research has documented that the strength of the credit channel of monetary policy varies with economic conditions in many different ways. Tenreyro and Thwaites (2016) finds in aggregate time series data that conventional monetary policy stimulates less credit growth during a recession compared to an expansion. Using detailed balance sheet data from bank Call Reports, Wieland and Yang (2019) find that banks with lower loan origination growth in recent quarters are also less sensitive changes in monetary policy (as measured by the Romer and Romer (2004) shocks). Additionally, Scharfstein and Sunderam (2017), which this paper's empirical strategy most closely resembles, estimates that mortgage refinancing responds 58% less in counties with an additional standard deviation of market concentration compared to a county with average market concentration. I add to this literature by using rich cross-sectional variation in the timing and size of asset losses to document that at the micro-level balance sheets losses strengthen the influence of monetary easing.

This paper is also related to the literature studying balance sheet impairment and credit supply. Credit unions significantly curtailed their lending during the ABS market collapse. A one standard deviation fall in the value of its assets exposed to the ABS market is associated with a 0.23 percentage point decline in lending growth over the next four quarters (Ramcharan, Van den Heuvel and Verani, 2016). More generally, banks with relatively more illiquid assets on the balance sheets reduced lending more during the crisis (Cornett, McNutt, Strahan and Tehranian, 2011). The collapse of the ABS market also cutoff non-bank creditors from an important source of finance. In particular, the collapse of the asset-backed commercial paper market, on which captive auto lessors relied for liquidity to fund auto loans, explains 31% of the decline in 2009 car sales relative to 2008.

The above findings are of interest to policymakers as the credit supply channel is an important source of amplification during an economic downturn. Motivated by early work emphasizing the importance of the credit channel of monetary transmission (namely Bernanke, 1983; Bernanke and Gertler, 1985), empirical research has shown that contractions in credit supply can bring about significant losses in consumption, employment, and income. Ashcraft (2003) estimates an elasticity of a county's real income to loan supply of 10% within a year.[4]

Recent research suggests that the fall in consumer credit greatly contributed to the severity of the Great Recession. Reductions in household credit supply explain an important share of the decreases in output, employment, and consumption during the Great Recession (Mondragon, 2017; Midrigan and Philippon, 2016). Lower credit supply reduces

[4] The author identifies this effect via a natural experiment in which healthy subsidiaries of a defunct bank holding company are forced to close. Over the next 3 years, closure of a subsidiary causes a 2.5% decline in an average county's real income.

household consumption demand which in turn leads to reduced labor demand and employment. Mortgage lending in particular was a key channel through which the crisis was amplified. A reduction in mortgage supply lowers demand for housing and further reduces house prices. Declines in housing net worth stemming from house price decreases can depress consumption significantly; recent research estimates an elasticity of non-durable consumption to house prices on the order of 0.3-0.4% (Anenberg, Hizmo, Kung and Molloy, 2016; Berger, Guerrieri, Lorenzoni and Vavra, 2017; Mian and Sufi, 2014; Mian, Rao and Sufi, 2013).

The next section presents two simple models of financial intermediation to illustrate the ease with which one can generate opposing predictions of the effect of asset losses on lending's sensitivity to the policy rate. In section III, describes the data and relevant background information on the credit union industry. The identification strategy is explained in section IV. Section V presents the main empirical results documenting that asset losses increase the sensitivity of lending to monetary policy. This section also decomposes the response of lending along its extensive and intensive margins. Monetary easing primarily affects credit through the extensive margin and also induces changes in the composition of the types of loans offered by credit unions: a shift towards mortgage lending and away from other consumer credit products. Section VI presents several robustness checks. Lastly, section VII concludes.

II. Models of Financial Intermediation

It is not clear from economic theory whether asset losses will increase or decrease lending's sensitivity to the policy rate. In this section I present two simple models of financial intermediation to illustrate the ease with which we can obtain opposing predictions. Fundamental assumptions about the costs and constraints facing creditors determine this relationship. The two, key, differing assumptions of the models are ad hoc representations of channels present in more nuanced models.[5] Ambiguity regarding this prediction is compounded in more microfounded settings.

In light of this theoretical ambiguity, an empirical investigation has the possibility to shed light on this question where theory is agnostic. The findings of this paper can also be used as criteria for evaluating the empirical validity of models. The inability of a model to replicate the increased sensitivity to the cost of capital of lenders experiencing large asset losses suggests the model may not be useful for studying the credit channel of conventional or unconventional monetary policy.

The first model features a constraint on lending that varies with the size of the intermediary's balance sheet. In this setting, banks with better balance sheets are more sensitive to the cost of capital. The intuition behind this result is that weak balance sheets cause the

[5] E.g., Kiyotaki and Moore (1997); Gertler and Karadi (2011); Gertler and Kiyotaki (2011); Bernanke, Gertler and Gilchrist (1999); Christiano and Ikeda (2012).

lending constraint to bind and leave the bank unable to take advantage of a lower cost of capital. This prediction is at odds with the main findings of this paper.

In the second model, the bank faces frictions in raising funds. In particular, risk neutral external creditors perceive the bank as decreasingly likely to repay as the value of its "safe" assets decrease and thus require a risk premium. This model delivers predictions consistent with this paper: the lending of a bank with weaker balance sheets is more sensitive to the cost of capital. Intuitively, a fall in the (risk-free) policy rate lowers external creditors' sensitivity to repayment risk. Since the risk premium is inversely proportional to the probability of repayment, the change in the risk premium is relatively larger among banks with weaker balance sheets. These two models are useful to consider as they reproduce the effects of key mechanisms of widely-studied models of financial intermediation.[6]

A. A Monopolist with a Capacity Constraint

First, consider the profit-maximization problem of a monopolist bank with a capacity/lending constraint facing a linear demand for funds. The bank can borrow cash at the gross policy rate R. The financial intermediary is assumed to lend everything that it borrows (L). This bank also possesses "safe" assets B, the value of which define its maximum loan capacity.[7] The bank solves

$$\begin{aligned} \max_{L\geq 0} \quad & R^L L - RL \\ \text{s.t.} \quad & R^L = a - bL \quad \text{(inverse demand)} \\ & L \leq \bar{L}(B) \quad \text{(capacity constraint)} \end{aligned}$$

where $L(\cdot)$ is an increasing function.[8] The capacity constraint is an abstraction from regulations and rules that limit the extent to which financial intermediaries can engage in risky lending (e.g., collateral or capital requirements).

Restricting attention to equilibria where the non-negativity constraint is non-binding, if the capacity constraint is non-binding too, optimal lending L^* is characterized by

$$a - 2bL^* = R.$$

More generally, the equilibrium loan supply function is given by

$$L^*(R, B) = \min\left\{\frac{a-R}{2b}, \bar{L}(B)\right\}.$$

The prediction of interest from this model is that equilibrium loan supply exhibits increas-

[6]For example, the lending constraint can be compared to capital constraints and imperfect commitment to repay creditors could give rise to a similarly-behaved external finance premium.

[7]One could instead let B measure net worth.

[8]Note that this is equivalent to maximizing equity ($R^L L - RL + B$) as we are taking B as exogenous.

ing differences in $(-R, B)$. This is formalized below:

Proposition 1. *Equilibrium loan supply* $L^*(R, B) = \min\left\{\frac{a-R}{2b}, \bar{L}(B)\right\}$ *has increasing differences in* $(-R, B)$ *if* $\bar{L}(\cdot)$ *is an increasing function. That is,* $R' < R$ *and* $B' > B$*, imply*

$$L^*(R', B') - L^*(R, B') \geq L^*(R', B) - L^*(R, B).$$

The proof is in section B. in the appendix.[9]

Increasing differences implies that lending is more responsive to changes in the policy rate when balance sheets are stronger (B is larger). Improving the bank's balance sheet raises its lending capacity, *enhancing* the positive effects of lowering the cost of capital. Another interpretation of this result is that conventional and unconventional monetary policy are complements. Since unconventional monetary policy directly targets the value on assets held on financial intermediaries' balance sheets, we can think of unconventional monetary easing as an increase in B. We can rearrange in the inequality above to also see that this model suggests that empirically we should find a *negative* relationship between the cost of capital and the sensitivity of lending to assets.

B. Repayment Risk and External Finance Premium

In the second model, the bank no longer faces a capacity constraint but the price at which it can borrow depends on the value of its balance sheets. Risk neutral external creditors believe that the bank will fail to repay them with probability $\Delta(B)$ where $\Delta(\cdot)$ is a decreasing function of safe assets B. If the external creditor can borrow/lend at the gross policy rate R, no arbitrage requires that

$$\widetilde{R} = \frac{R}{1 - \Delta(B)}.$$

The intermediary pays the gross interest rate $\widetilde{R}$ to access external funds.

The intermediary chooses lending L to maximize profits:

$$\begin{aligned} \max_{L \geq 0} \quad & R^L L - \widetilde{R} L \\ \text{s.t.} \quad & R^L = a - bL \quad \text{(inverse demand)} \\ & \widetilde{R} = \frac{R}{1 - \Delta(B)} \quad \text{(no arbitrage).} \end{aligned}$$

[9]This result holds under a more general inverse demand function $R^L(L)$ with an additional assumption. What is necessary for this result is that equilibrium lending $L(R, B)$ is non-increasing in R. Applying the implicit function theorem to the monopolist's first-order condition with demand $R^L(L)$ shows $\frac{dL(R,B)}{dR} \leq 0 \Leftrightarrow L\frac{d^2 R^L(L)}{dL^2} + 2\frac{dR^L(L)}{dL} \leq 0$. This condition is satisfied by a number of demand functiosn (e.g., CES of the form $R^L(L) = \xi L^{-1/\sigma}$ for $\sigma \geq 1$.)

Rewriting the first-order condition characterizes equilibrium lending:

$$L^*(R,B) = \frac{a - R/[1-\Delta(B)]}{2b}.$$

Differentiating $L^*(R,B)$ with respect to R while assuming $\Delta(B)$ is a decreasing function leads to the following proposition:

Proposition 2. *Equilibrium loan supply* $L^*(R,B) = \frac{a-R/[1-\Delta(B)]}{2b}$ *has decreasing differences in* $(-R,B)$ *if* $\Delta(\cdot)$ *is a decreasing function. That is, if* $R' < R$ *and* $B' > B$*, then*

$$L^*(R',B) - L^*(R,B) \geq L^*(R',B') - L^*(R,B').$$

This model delivers the opposite prediction of the previous capacity constraint model. Here, the lower policy rate R is partially passed on to the bank by affecting its external creditor's cost of capital. When it is cheaper for the external creditor to obtain liquid resources to lend, the external creditor can tolerate an even higher default risk and still break even in expectation. Sensitivity to the cost of capital is greatest when default risk is high. Therefore, lending is most responsive to the cost of capital when balance sheets are weaker. We can also interpret this implication as stating that conventional and unconventional monetary policy are substitutes, rather than complements. This model predicts that we should find a *positive* relationship between the cost of capital and lending's sensitivity to asset losses.

III. Data and Estimation Approach

This section presents the baseline model estimated in section V, describes the data used in this paper's analysis, and discusses the institutional setting in which credit unions operate. The goal of the empirical analysis is to estimate the effect on lending of asset losses and changes to the policy rate as well as how these two forces interact.

Identifying these effects is challenging as it is likely that unobserved factors simultaneously affect both lending, assets, and the policy rate. To address these concerns, instruments for these endogenous variables are used to estimate their effects via two-stage least squares (TSLS). The baseline model of the second stage is

$$\begin{aligned} \Delta \ln L_{i,t} = \beta_1 \Delta R_{t-1} + \beta_2 \Delta \ln A_{i,t-1} + \beta_3 \left(\Delta R_{t-1} \times \Delta \ln A_{i,t-1}\right) \\ + \tau \text{ Year}_t + \gamma \text{ Quarter}_t + X_{i,t} + \kappa_i + \varepsilon_{i,t} \end{aligned} \tag{1}$$

where $\Delta \ln L_{i,t}$ is the quarterly difference in a logged loan originations for credit union i over periods t and $t-1$. The dependent variable is measured as the change in logged loan originations rather than the level of logged loan originations because this captures the stimulative effects of changes in the policy rate and total assets. The outcome of interest in this paper is how a credit union's lending behavior changes, which is reflected in the additional amount of loan originations relative to the previous quarter's following changes in the policy rate and assets.[10] The explanatory variables are the differences in the policy rate (ΔR_{t-1}) and credit union i's logged total assets $\Delta \ln A_{i,t-1}$ from period $t-2$ to $t-1$.The main analysis uses the two-year Treasury yield as the policy rate. Three endogenous regressors, ΔR_{t-1}, $\Delta \ln A_{i,t-1}$, and $\Delta R_{t-1} \times \Delta \ln A_{i,t-1}$, motivate the TSLS approach.

I instrument for the three endogenous regressors with five variables. First, the quarterly sum of changes in federal funds futures prices within a narrow window of FOMC announcements, $\Delta \widetilde{R}_{t-1}$, is a source of exogenous variation in the policy rate ΔR_{t-1}.[11] The other instruments are related to a unique asset owned by credit unions that, following Ramcharan, Van den Heuvel and Verani (2016), I refer to as "investment capital". Further on in this section, I explain why changes in the value of investment capital are plausibly unrelated to loan demand and are thus an appropriate instrument for total assets. Three variables together instruments for changes in assets $\Delta \ln A_{i,t-1}$: the change in the value of logged investment capital $\Delta \ln C_{i,t-1}$, the share of investment capital in total assets $\frac{C_{i,t-2}}{A_{i,t-2}}$, and the product of these two variables.[12] Lastly, I also use $\Delta \widetilde{R}_{t-1} \times \Delta \ln C_{i,t-1} \times \frac{C_{i,t-2}}{A_{i,t-2}}$ as an instrument for $\Delta R_{t-1} \times \Delta \ln A_{i,t-1}$. Of the three instruments associated with asset losses, we would expect $\Delta \ln C_{i,t-1} \times \frac{C_{i,t-2}}{A_{i,t-2}}$ to be more strongly correlated with $\Delta \ln A_{i,t-1}$ since it is essentially an imputed change in assets due to changes in investment capital, this helps reduce the chances of weak instruments/under-identification.

The coefficient on the interaction term, β_3, is the focus of the empirical analysis. We expect (and find) that $\beta_1 < 0$ and $\beta_2 > 0$. That is, an increase in the cost of capital or greater asset losses will lower total lending. The sign of β_3 characterizes whether or not asset losses make a credit union's lending more or less responsive to changes in the policy rate ΔR_{t-1}. If $\beta_3 > 0$, then the magnitude of the effect of the cost of capital on lending, $\beta_1 + \beta_3 \Delta \ln A_{i,t-1}$, is greater when a credit union's asset decrease in value $\Delta \ln A_{i,t-1} < 0$.

The baseline specification includes a year fixed effect to control for unobserved determinants of loan demand and supply that vary each year.[13] A quarter fixed effect helps control for seasonal variation in lending activity. The credit union fixed effect (κ_i) helps

[10]For the same reason, the preferred specification of Scharfstein and Sunderam (2017) is also in differences who study the effect of market power on bank lending's sensitivity to MBS yields. Additionally, there is significant autocorrelation in the levels of lending and comparatively little in differences. Therefore a dynamic panel with fixed effects would be the appropriate specification for a model estimated in levels, but this would introduce additional complications due to the incidental parameters problem which generally makes coefficient estimates inconsistent in these regressions.

[11]This measure of monetary surprises is in the style of Kuttner (2001). The shocks are summed over the course of a quarter, similarly to Cochrane and Piazzesi (2002), Tang (2015), and Wong (2019).

[12]Intuitively, this multidimensional approach is preferable to only using $\Delta \ln C_{i,t-1}$ since a 5% change would have a very different effect on total assets depending on whether 1 or 10% of assets consisted of investment capital.

[13]Note that this is not exactly a time fixed effect as the frequency of the data is quarterly. Unfortunately it is not possible to include a proper time fixed effect as I am interested in estimating β_1. Since the policy rate only varies across t, ΔR_{t-1} would lie in the span of the time fixed effect dummy variables.

control for NPCU-specific characteristics such as location, field of membership, attitudes towards risk, and any time-invariant unobserved characteristics. A credit union fixed effect encodes the credit union's field of membership, which most often reflects the field of employment of its members/borrowers. Therefore this specification implicitly compares the response of lending among credit unions whose borrowers face similar labor income risks but experience different asset losses at different times.

Next, I describe the exact data used to estimate equation (1). I also describe the credit union industry to lend credibility to the assumptions made to identify the causal effects of asset losses and changes in the cost of capital.

A. Credit Unions: Data and Background

The main dataset used in this analysis is constructed from the National Credit Union Administration's (NCUA) 5300 Call Reports. Every quarter since 2004, credit unions file detailed financial reports.[14] The NCUA data contain a variety of measures of lending activity. I use loan originations year-to-date (YTD).[15] Series are available for both total loan originations and for 30-year fixed-rate mortgages specifically. Both the volume and number of loan originations are available as well. This allows me to examine how both the intensive and extensive margins of lending respond to conventional monetary policy and asset losses.

"Investment capital", the asset used as an explanatory variable, is the sum of several variables. As in Ramcharan, Van den Heuvel and Verani (2016), I sum the value of paid-in capital and membership capital less special assessments levied by the NCUA. The first two are assets held by credit unions whose variation is plausibly unrelated to their respective local loan markets. The assessments, I will argue further below, are also plausibly unrelated to local loan demand. Fluctuations in these assessments are therefore exogenous shocks to the assets held by credit unions.

A number of other variables from the NCUA 5300 Call Reports are also useful as controls. For covariates related to the financial condition of the credit union, I use loan loss allowances and the net worth ratio. Measures related to the financial condition of borrowers are also present. Credit Unions can be classified as low-income credit unions (LICU) if more than 50% of their members are low-income, thus this variable can be included as a dummy. The data contain the number of members at each credit union every quarter. This is an excellent measure of credit union size in comparison to other natural measures

[14] Data are available back to 1994, but some credit unions only appear in the sample with a semi-annual frequency. The credit unions reporting every quarter tend to be larger than those that reported semi-annually, thus it appears that the missing quarterly observations are not missing random.

[15] The NCUA data contain two measures of lending activity. The first is YTD loan originations at the end of each quarter. The second measure is total loans outstanding. I prefer to analyze year-to-date loan originations because it more accurately reflects the creation of new loans. The stock of outstanding loans decreases when loans are paid off and increases when loans are acquired from a failing credit union.

such as total assets as the number of members varies less with local and aggregate business cycles.

Credit unions are formed around a shared association, primarily related to employment (e.g., IMF employees, teachers in the Duluth school district, or firefighters in Chicago).[16] The occupational and residential requirements of many credit unions make it difficult to substitute away from one credit union to another. This difficulty in substitution makes it less likely the marginal borrowers not receiving a loan switches to another credit union after theirs restricts its supply of credit. Importantly, conditioning on a credit union's field of membership helps control for employment-sector-specific shocks to borrowers – an important determinant of credit demand. This makes it possible to make comparisons of lending's sensitivity to the cost of capital among credit unions with similar borrowers.

Credit unions are an excellent financial institution to analyze as their lending is extremely local, substituting between credit unions is not easy, and they rely on a simpler model of financial intermediation compared to traditional banks. Credit unions operate in a three-tiered system, with credit unions in different places in the tier specializing in particular kinds of financial services. In the first tier are natural person credit unions (NPCUs) who provide consumer financial services. NPCUs are the type of credit union whose data are used in the empirical analysis. NPCUs operate on a simple model of deposit-funded lending. NPCUs are subject to strict regulations that limit them from taking on exposure to risky securities.[17]

To invest unloaned funds, NPCUs turn to corporate credit unions (CCUs) in the second tier of the credit union system. CCUs are owned by NPCUs and provide correspondent banking services exclusively to their member NPCUs.[18] CCUs are funded by deposits and equity owned by their members. Equity in CCUs is sold to their members in two forms: paid-in capital and membership capital. The former typically has a minimum duration of 20 years during which the NPCUs cannot sell its equity stake; the latter has a minimum duration of 3 years. At the third rung of the tier was the (now defunct) US Central Federal Credit Union that acted as a CCU for CCUs.

Unlike NPCUs, CCUs can invest in private-label ABS. While some CCUs fully avoided exposure to these securities that performed poorly during the financial crisis, others held as much as 65% of their assets in ABS in 2006.[19] During the 2007-2009 collapse of the ABS market, CCUs experienced nearly \$30 billion in total unrealized losses while having \$2.4 billion in retained earnings between all CCUs. During 2005-2010, \$5.6 billion of these losses were passed on to NPCUs through their equity positions in CCUs and an additional \$1.4

[16]See table 16 in section in section A. of the appendix for a break down of NPCU affiliations in Q1 2009.

[17]The Federal Credit Union Act defines the securities in which NPCUs can invest and prohibits the holding of many risky securities. NCUA regulation 12 C.F.R. §703.140. Section 703.140 permits a select few federal credit unions to make such investments.

[18]For example, securities safekeeping, electronic payment services, automated settlement. Outside the credit union system, small banks typically rely on large commercial banks for such services.

[19]See tables 17 and 18 for more information on CCU balance sheets.

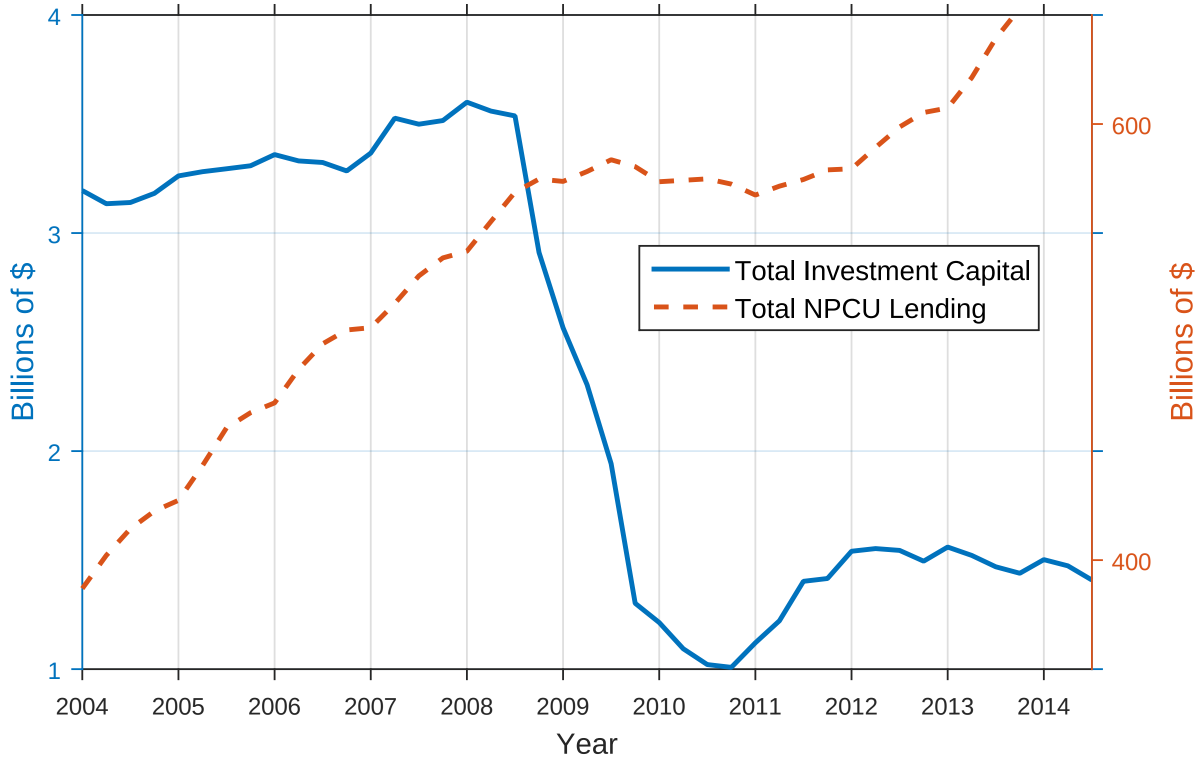

Figure 1: NPCU Investment Capital and Lending

Note: This graph plots the sum of all membership and paid-in capital at corporate credit unions owned by natural person credit unions less assessments levied by the NCUA (left y-axis). The right y-axis variable is total lending by all NPCUs. All data are quarterly.

billion in special assessments was levied on NPCUs by the National Credit Union Agency (NCUA) to cover CCU losses. These special assessments were charged in proportion to each NPCU's share of insured deposits relative to all deposits insured by the NCUA and thus their size is likely unrelated to local determinants of lending activity.[20]

Aggregate NPCU total lending growth slowed in 2008 and plateaued by 2009 until about 2012. Consistently, credit union lending grew by around $40 billion per year (see figure 1, right axis) prior to the ABS market collapse. The slowdown in lending growth coincides with the large decrease in the total value of all NPCU-owned investment capital (left axis). In the middle of 2008, as CCUs recorded large losses from ABS, investment capital fell sharply from about $3.5 billion to $1 billion. The ABS losses borne by the CCUs were large enough render several of them insolvent.[21]

[20]The main results of this paper are unchanged if investment capital is computed as only paid-in capital and membership capital.

[21]Additional summary statistics are available in tables 1 and 2 in section A. of the appendix.

B. County-Level Controls

Several county-level controls help account for other determinants of lending.[22] The controls chosen here have significant time variation as any fixed regional characteristic is accounted for in the regression analysis when including a credit union fixed effect.

First, I use county-specific unemployment rates from the Bureau of Labor Statistics to help control for local business cycles. Households in counties with higher unemployment may have a stronger desire to save rather than borrow if they fear losing their job. Additionally, all else equal, a credit union lending in a region with more unemployment may make fewer and smaller loans as it would prefer to not lend to those who are unemployed or face a higher probability of losing their job in the future. The BLS data covers counties in all American states and Puerto Rico [23]

The housing market is an important determinant of loan demand and also played a central role in the recent financial crisis. Given this, I include both measures of local house prices and mortgage delinquency rates in several specifications. The house price measure is the CBSA-level Federal Housing and Finance Agency House (FHFA) Price Index.[24] This quarterly index is available for many credit unions, but not for those located outside of metropolitan and micropolitan statistical areas. To provide a measure for these more rural regions, I instead use the FHFA's state-level index for non-metropolitan areas. House prices are related not only to mortgage demand for purchasers, but rising prices also encourage use of home equity loans and may overall increase loan demand by increasing illiquid wealth. Mortgage delinquency is measured as the fraction of outstanding mortgage debt that is delinquent with a county.[25]

Importantly, these county-level controls are uncorrelated with the asset loss implied by changes in investment capital $\Delta \ln C_{i,t-1} \frac{C_{i,t-2}}{A_{i,t-2}}$ (see table 21 in the online appendix). This supports the identifying assumptions that investment capital losses are plausibly exogenous with respect to local loan demand.

IV. Identifying the Causal Effect of Asset Losses and Monetary Policy

If one were to estimate (1) with OLS, the coefficients would likely be biased. First, the FOMC influences the policy rate with the explicit intention of reacting to macroeconomic developments that related to loan demand (e.g., declines in national income or a reduction in credit supply). Second, a credit union's assets are very closely related to its lending. Loans comprise a significant portion of a credit union's assets – typically 60%. Moreover,

[22]Their summary statistics are in table 3 in the appendix.

[23]The NCUA dataset includes NPCUs in all American states, many in Puerto Rico, and several in Guam, the US Virgin Islands, and American Samoa.

[24]Specifically, I use the quarterly all-transactions indexes which is estimated with both sales and appraisal data.

[25]This data is aggregated to the county-level from individual records data in the Federal Reserve Bank of New York's Consumer Credit Panel. I thank John Mondragon for generously sharing this data.

we would expect many shocks (such as a rise in delinquencies) to simultaneously affect the accumulation of many assets including loans.

To obtain consistent estimates of the coefficients of (1) I instrument for the three endogenous regressors with five instrumental variables. The instruments related to the policy rate are constructed from the change in federal funds futures contract prices within a narrow window of FOMC announcements. The instruments related to asset losses are constructed from measures of each credit union's investment capital. The key identifying assumption for these instruments are that they are exogenous with respect to aggregate macroeconomic phenomena and local determinants of loan demand. In what follows, I discuss why these are reasonable assumptions.

A. Asset Losses

Heterogeneity in the relative size and timing of investment capital losses identifies the effect of asset losses on lending as well as lending's sensitivity to the policy rate. The identifying assumption here is that credit unions relatively more exposed to movements in ABS prices do not tend to have loan demand that is also more sensitive to ABS price movements. The interaction term is also identified if these same borrowers do not become relatively more responsive to conventional monetary easing when ABS prices decline.

Why is it plausible that fluctuations in a credit union's investment capital value and not systematically related to local determinants of loan demand? Minimum duration requirements of up to 20 years on paid-in and membership capital make it impossible for credit unions to close these positions until long after they are created. This makes it more likely that when we observe a decrease in investment capital value that this is truly a valuation effect and not the result of liquidating a position. This makes the number of investment capital "shares" relatively sticky. Thus much of variation in investment capital is due changes in the value of the assets owned by the CCUs to which a credit union is exposed and the determinants of the pass-through of asset losses to different CCU equity holders.

One source of heterogeneity in changes in CCU asset value is that CCUs assembled extremely different portfolios, which may be attributed to management idiosyncrasies (Ramcharan, Van den Heuvel and Verani, 2016). CCUs varied greatly in their exposure to the the private-label ABS markets. In the beginning of 2006, one CCU had as much as 41% of their assets in private-label MBS while some had zero exposure.[26] As a result, the performance of CCU investments varies dramatically. Even during the Great Recession, some CCUs experienced growth in the value of their assets while some CCUs were rendered insolvent by their asset losses.[27]

[26] Table 17 reports these measures for all CCUs in Q1 2006 and shows that there was significant variation in private-label ABS exposure.

[27] Within-county variation in investment capital losses among credit unions during the ABS market collapse

Differences in each NPCU's choice of CCUs introduces additional variation to investment capital growth. Prior to the crises, high-grade ABS were generally regarded as extremely safe assets. It is unlikely that particularly risk-seeking NPCUs selected risky CCUs. In fact, the NCUA has successfully argued in court that the risks of many ABS were misrepresented to managers at CCUs. This suggests CCUs and NPCUs did not anticipate the size and extent of the ABS losses. Moreover, to the extent that this risk-seeking behavior is time invariant, the inclusion of a credit union fixed effect rules out this NPCU characteristic as a source of omitted variable bias. A placebo test in section C.4 also gives evidence that the pre-crisis lending behavior of credit unions was not systematically different for NPCUs that went on to experience large asset losses compared to those that did not.

Lastly, the financial structure of each CCU affects the extent to which asset losses are charged against its equity. Suppose two CCUs own the same assets, but one is primarily financed by debt (deposits) and the other by equity. The debt-financed CCU has less equity to absorb the same asset loss; its equity investors thus experience a relatively greater decline in investment capital value compared to shareholders of the equity-financed CCU. Additionally, the each NPCU's relative share of ownership of a CCU, which depends on the decisions of many other NPCUs, influences which shareholders experience larger losses. Heterogeneity in the financial structure of a CCU is an additional source of variation in the ABS-related losses borne by NPCUs, plausibly unrelated to determinants of local loan demand.

B. Conventional Monetary Policy

Identifying the effect of monetary policy on lending also presents potential identification challenges. In this paper, I use high frequency data on federal funds futures contract prices near FOMC announcements to construct an instrument for quarterly changes in two-year Treasury note yields.[28] The idea is that this instrument captures surprise changes in the stance of monetary policy unrelated to contemporaneous economic events. Below I describe potential sources of bias and motivate this paper's hybrid high frequency identification and instrumental variables approach.

Bias. In contrast to time series analyses with aggregate data, simultaneity is an unlikely source of potential bias in an analysis of microdata as the Federal Open Market Committee (FOMC) is not setting the policy rate in response to individual credit unions or counties. However, both observed and unobserved determinants of lending are likely related to the

is displayed in figure 7. To get a sense of cross-county variation, the average investment capital loss within each county during the same time frame is reported in figure 6.

[28] I also include inter-meeting policy rate announcements. The dates and federal funds futures rate surprises (computed as in Kuttner, 2001) are those used in Tang (2015).

aggregate conditions that motivate the FOMC to engage in monetary easing. Therefore omitted variable bias remains a source of endogeneity.

For ease of exposition, consider the problem estimating the coefficient β when the true model of interest is

$$L_{i,t} = \beta R_{t-1} + \gamma F_{t-1} + \eta_{i,t} \tag{2}$$

where $L_{i,t}$ is a measure of lending activity at a creditor i at time t, R_t is the policy rate, F_t is an unobserved, time-varying determinant of loan demand (e.g., expectations of future income, labor or housing market conditions, developments in financial markets, etc.), and $\eta_{i,t}$ is white noise uncorrelated with R_{t-1}. Suppose also that

$$R_t = \pi F_t + \nu_t$$

The above captures the idea that the FOMC sets the policy rate in response to factors the econometrician does not directly observe.

If we regress $L_{i,t}$ on R_{t-1} in an attempt to estimate equation (2), our OLS coefficient is asymptotically biased:

$$\begin{aligned}
\text{plim}(\hat{\beta}) &= \frac{\text{Cov}(L_{i,t}, R_{t-1})}{\sigma_R^2} \\
&= \beta + 0 + \frac{\text{Cov}(\gamma F_{t-1}, R_{t-1})}{\sigma_R^2} \\
&= \beta + \gamma\pi.
\end{aligned}$$

Suppose that the latent factor F_{t-1} is positively related to lending. If the FOMC takes this factor into consideration when setting the policy rate, it is reasonable to expect that when F_t decreases, the FOMC would desire to lower R_t to counteract the contractionary effect of F_t on lending. More generally, one would expect γ and π to have the same sign. Therefore we would tend to overestimate β in this misspecified regression. By similar reasoning, one would expect inconsistent estimation of coefficients in the baseline specification (1) using OLS.[29]

There are three ways to obtain consistent estimates of an interaction term such as β_3 of equation (1). First, one could omit the policy rate as a regressor (but still include the

[29] Note that it is less straightforward to anticipate the direction of the bias of OLS estimate of the interaction term. The bias on the interaction term in the baseline specification, equation (1) is positive if $\mathbb{E}(\Delta R_{t-1} \times \Delta \ln A_{i,t-1} \times \varepsilon_{i,t}) > 0$. Suppose there is an omitted factor in $\varepsilon_{i,t}$ that is positively related to lending growth (the dependent variable). Decreases in this omitted factor may be something that would motivate the FOMC to lower interest rates and may also be negatively related to assets. If the policy rate and asset growth comove positively with the omitted factor, we would expect $\mathbb{E}(\Delta R_{t-1} \times \Delta \ln A_{i,t-1} \times \varepsilon_{i,t} | \varepsilon_{i,t} < 0) < 0$ but also $\mathbb{E}(\Delta R_{t-1} \times \Delta \ln A_{i,t-1} \times \varepsilon_{i,t} | \varepsilon_{i,t} > 0) > 0$. Thus in principle, this bias could go either way. But if the sample disproportionately contains time periods during which omitted factors are decreasing lending (i.e., $\varepsilon_{i,t} < 0$ often), then it is more likely that the OLS estimates of the interaction term are downward biased. This is most likely the case in this paper given that my sample comes from Q3 2004 to Q4 2011. Analysis of the first-stage also finds evidence consistent with a downward bias.

interaction term) as in Wieland and Yang (2019) and include a time fixed effect to absorb these time-varying factors. However, if the pure effect of the policy rate on lending and the *relative* change in this effect in the presence of asset losses is of interest, this cannot be discerned from this method.

Second, one could estimate exogenous innovations in the policy rate from a structural vector autoregression (SVAR). This is a measure also taken by Wieland and Yang (2019) who recover the structural residuals from a SVAR in the style of Romer and Romer (2004). However, one disadvantage of this approach when using post-ZLB data is that a binding ZLB would lead to mismeasurement of the structural shocks in the standard Romer and Romer (2004) or Christiano, Eichenbaum and Evans (1996) SVAR.[30]

This paper employs a third approach: high frequency identification of monetary policy shocks. This approach uses high frequency data on federal funds futures contracts near FOMC announcements to construct a measure of monetary policy surprises. This method addresses the original omitted variable bias problem, the concerns raised with the first two approaches, and is more appropriate when the model involves financial variables.

The underlying assumption of high frequency identification is that movements in the futures prices in a narrow window around FOMC announcements are only due to unexpected changes in the stance of monetary policy. The key idea is that the pre-announcement price has already incorporated other relevant news about the economy and that no other news within the window affects the post-announcement price. See figure 2 below for an example of futures prices on an FOMC announcement day.

Construction of Monetary Surprises. Federal funds futures contracts have durations in increments of months; the shortest is the one-month contract. Monthly futures contracts pay out the average of the effective federal funds rate over the contract period. On the d^{th} day of a contract that settles at the end of a month with M days, its price should reflect market expectations of the federal funds rate for the remaining $M - d$ days. More precisely,

[30] E.g., consider the approach of Christiano, Eichenbaum and Evans (1996) for recovering exogenous monetary policy innovations and let

$$R_t = \max\left\{\sum_{j=1}^{J} B_{R,j} Y_{t-j} + u_t,\ 0\right\}$$

denote the true interest rate equation of a VAR where R_t is the policy rate and Y_t is a vector of macroeconomic aggregates. In principle, it is possible to consistently estimate the VAR coefficients, including $B_{R,j}$, using data from the pre-ZLB period. However, it is still not possible to recover the reduced-form shocks – let alone the structural shocks – during the post-ZLB period even with consistent coefficient estimates. If we subtract the fitted values $\hat{R}_t = \sum_{j=1}^{J} B_{R,j} Y_{t-j}$ from the observed values of R_t, we are computing

$$\hat{u}_t = (R_t - \hat{R}_t) = \max\{u_t,\ -\hat{R}_t\}.$$

When the lower bound on the nominal rate is binding, this formula does not return u_t but instead $-\hat{R}_t$. This is problematic for identification when using $\hat{u}_t$ as an instrument for the policy rate or as an independent variable in a regression. In ZLB-era data, $\hat{u}_t$ directly depends on determinants of $\hat{R}_t$, which are typically macroeconomic aggregates likely to be endogenous with respect to the outcome variable of interest (e.g., lending).

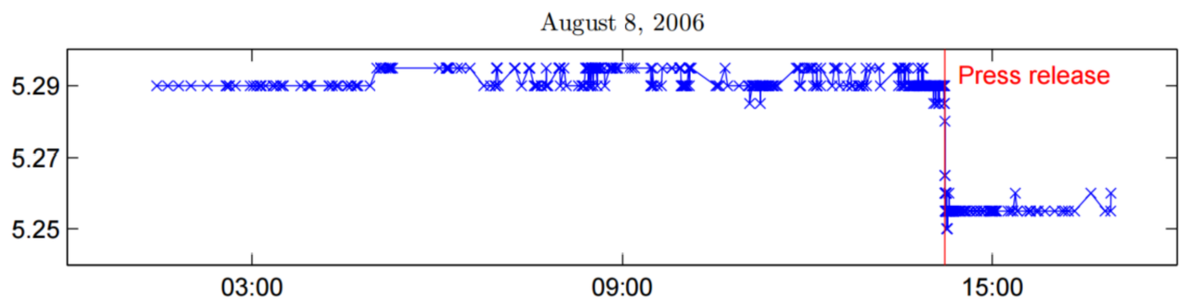

Figure 2: Federal Funds Futures Surprises

Note: This graph is from Gorodnichenko and Weber (2016). The plot displays tick-by-tick prices for federal funds futures contracts traded on the Chicago Mercantile Exchange Globex electronic trading platform on a day where an FOMC announcement occurred (the vertical line). The FOMC began their practice of announcing their target rate following each meeting as of February, 1994. This announcement usually takes place at 2:15 p.m. Eastern Time.

at time t, the futures price f_t for the contract should be

$$f_t = \frac{d}{M}\bar{R} + \frac{M-d}{M}\mathbb{E}_t\widehat{R}$$

where $\bar{R}$ is the average effective federal funds rate over the days leading up to the FOMC announcement at time t and $\widehat{R}$ is the average rate for the rest of the month.[31] As in Kuttner (2001), differencing the futures prices and adjusting for how far we are into the current month gives the monetary policy shock

$$\mu_t = \mathbb{E}_t\widehat{R} - \mathbb{E}_{t-\Delta t}\widehat{R} = \frac{M}{M-d}(f_t - f_{t-\Delta t}).$$

The shocks I use are exactly those from Tang (2015). As in Wong (2019) and similarly to Piazzesi and Swanson (2008) , I sum these shocks over the course of a quarter to match the frequency of the NCUA data.

Ideally, one would compute the surprises in the futures rate within a 30 minute window surrounding FOMC announcements.[32] The monetary surprises of this paper are constructed using a daily window. The crucial assumption that no other factors influence the change in futures prices over the window becomes less credible as the window grow

[31] Here I've assumed that there is no risk premium to economize on notation. This would be the case in an efficient market with risk-neutral investors. Otherwise it would appear additively in the price above. In practice, we can more realistically assume that the risk premium does not change over the announcement period. It would then be differenced out the in the computation of the monetary surprise. Assuming a constant risk premium at this high of frequency is a standard assumption, employed in Nakamura and Steinsson (2018); Gertler and Karadi (2015); Wong (2019) for example. Nakamura and Steinsson (2018) use a term structure model to show that this assumption is a good approximation of reality. Piazzesi and Swanson (2008) also give evidence that the Kuttner (2001) method of constructing monetary surprises does not appear contaminated by a constant or time-varying risk-premium.

[32] Standard practice for an intraday window is to compute the difference in futures prices 10 minutes before and 20 minutes after an FOMC announcement.

larger. In practice, however, moving from a 30 minute to daily window does not lead to biased estimates but only larger standard errors from increased noise (Gürkaynak, Sack and Swanson, 2005; Nakamura and Steinsson, 2018). This suggests the other factors within the daily window affecting futures prices are not closely related to the *unanticipated* policy changes.[33] This means we can expect increased noise over a daily window but it is unlikely that we now violate the identification assumptions.

One could also use high frequency Treasury yield data as in Gilchrist, López-Salido and Zakrajšek (2015) instead of futures prices. One reason to prefer constructing the monetary surprise using federal funds futures is that as the underlying Treasury bond's maturity increases, it is increasingly possible that the change in the yield reflects changes in the term premium rather than expectations.[34] Another concern noted in Piazzesi and Swanson (2008) is that although shorter-term assets such as federal funds futures contracts have smaller time-variation in their term premia, the presence of a constant term premium could contaminate futures surprises constructed based on the difference between the realized target rate and the target rate forecast by futures contracts prior to the announcement. However, Piazzesi and Swanson (2008) also show that the Kuttner (2001) construction of monetary surprises appears purged of term premia. Therefore, I find it more conservative to adhere to the Kuttner (2001) manner of constructing surprises from futures contract prices.

Another advantage of high frequency identification is that its identifying assumptions are more credible in models containing financial variables. As discussed in Gertler and Karadi (2015), the timing-based assumptions of Christiano, Eichenbaum and Evans (1996) are less likely to hold for financial variables, which can react quickly to actual and anticipated policy rate changes. Especially during the Great Recession, the FOMC likely considered asset prices, financial market liquidity, overall credit availability and many other financial factors that respond rapidly to changes in the policy rate.

Choice of Policy Rate. I instrument for the quarterly change in the two-year, nominal, on-the-run, Treasury rate with the quarterly monetary surprises. Why is this particular yield a good choice of policy rate? There are several reasons.

First, one and two-year Treasury rates are more closely related to other important interest rates than the federal funds rate itself. In particular, Gertler and Karadi (2015) instrument for the federal funds rate with futures surprises and find that it does not have a major effect on Moody's Baa spread or the 30-year mortgage spread. But the one and two year yields do have economically and statistically significant effects on these rates. This

[33] This is not too surprising if we think the effect of other *unanticipated* news is generally not related to unanticipated FOMC policy moves.

[34] Hanson and Stein (2015) suggests that the term premium response is a significant portion of the reaction of Treasury yields around FOMC announcements. For another helpful discussion of the findings of Hanson and Stein (2015) in the context of high-frequency identification, see Gertler and Karadi (2015).

suggests that short-term Treasury rates are more relevant channels for the transmission of monetary policy to the financial sector.

Second, the two-year Treasury rate is well-suited to capture the effects of forward guidance (i.e., announcements regarding the future path of the federal funds rate). The two-year yield is preferable to the one-year as two years is about the horizon at which the FOMC's forward guidance policy operates (Bernanke, Reinhart and Sack, 2004; Gürkaynak, Sack and Swanson, 2005; Swanson and Williams, 2014; Hanson and Stein, 2015). As the federal funds rate neared the ZLB in 2008, the FOMC increasingly relied on asserting commitment to maintain low rates as a means of monetary stimulus.[35]

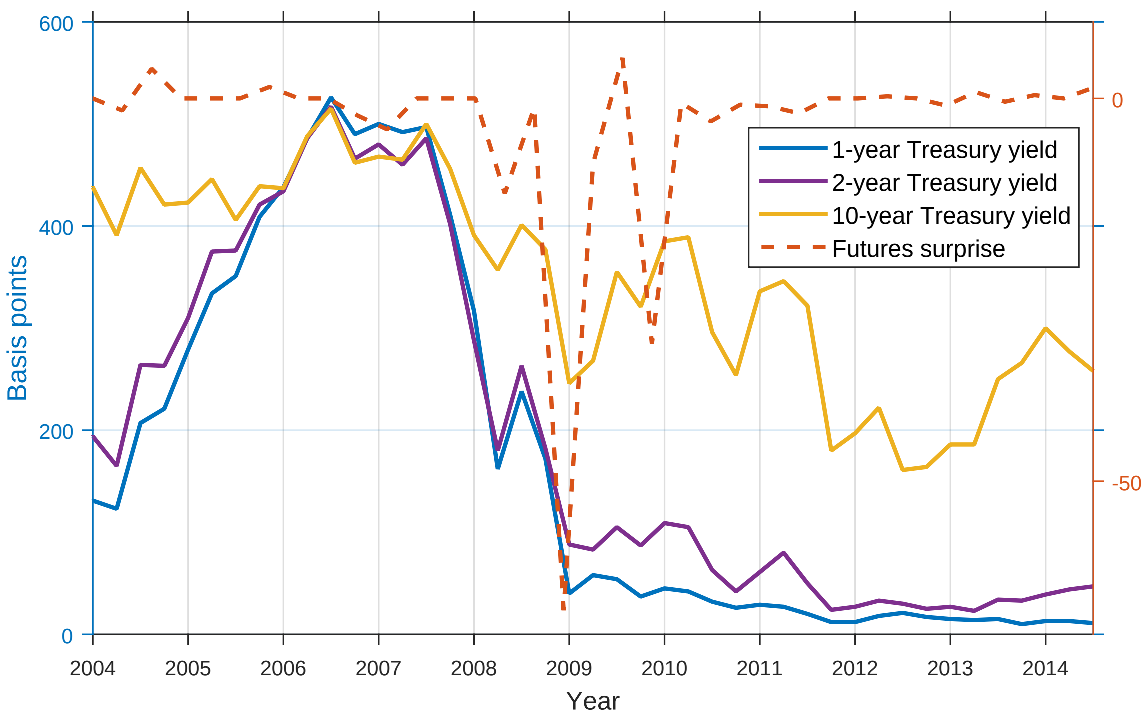

Figure 3: Treasury Yields and Futures Surprises

Note: This graph plots (on-the-run) yields for one-year, two-year, and ten-year Treasury notes as solid lines (left y-axis). The right y-axis variable is the sum of federal funds futures price shocks over the quarter. All data are quarterly.

Even prior to 2008, the FOMC's influence on expectations of future rates was the central channel through which conventional monetary policy operated. Gürkaynak, Sack and Swanson (2005) decompose the effect of monetary policy surprises (in the style of Kuttner, 2001) on Treasury yields into two factors: surprises due to changes in the current rate target and those related to the path of future monetary policy ("target" and "path" factors,

[35] Gertler and Karadi (2015) conceptually prefers the two-year rate for the same reasoning. They find that the one-year yield performs better in terms of a higher F-statistic and obtain their main results using this measure as the two-year yield appears to be a weak instrument in their application. However, weak instruments do not appear to be a problem in my sample, therefore I use the two-year rate.

respectively). They find that FOMC announcements mainly operate through changes in expectations (the path factor). Therefore, as in Swanson and Williams (2014); Gertler and Karadi (2015); Hanson and Stein (2015), I assume changes in the two-year nominal Treasury yield embody both the target and path surprises.[36]

Lastly, distinguishing between nominal and real yields does not appear important for estimation. Using TIPS data, a number of studies (e.g., Gilchrist, López-Salido and Zakrajšek, 2015; Gertler and Karadi, 2015; Hanson and Stein, 2015; Nakamura and Steinsson, 2018) show there is little inflation response to monetary policy surprises. Most of the response to FOMC announcements is borne out by the nominal rates.

As in Gertler and Karadi (2015), I truncate my sample at the end of 2011.[37] Even after the federal rates rate target reached zero in December of 2008, the ZLB was not a constraint on the FOMC's ability to influence the two-year rate until 2012 at the earliest (Swanson and Williams, 2014; Gilchrist, López-Salido and Zakrajšek, 2015).

V. Results: The Effect of Asset Losses on Monetary Policy Transmission

This section presents the main results which investigate how the response of an individual credit union's lending to conventional monetary easing is altered by asset losses. These regressions estimate the effect of changes in the policy rate and asset losses on a variety of measures of loan originations. Results of estimating the baseline model

$$\begin{aligned} \Delta \ln L_{i,t} = \beta_1 \Delta R_{t-1} + \beta_2 \Delta \ln A_{i,t-1} + \beta_3 \left[\Delta R_{t-1} \times \Delta \ln A_{i,t-1}\right] \\ + \tau \text{ Year}_t + \gamma \text{ Quarter}_t + \kappa_i + X_{i,t} + \varepsilon_{i,t} \end{aligned} \tag{1}$$

are discussed for both the total volume of all loan originations and originations of fixed-rate 30-year mortgages. Table 9 summarizes the economic meaning of the regression results discussed within this section. A cutoff rule is applied for each subsample associated with a given dependent variable to remove outliers.[38] Throughout, I two-way cluster standard errors by year-quarter (time) and state. It is especially important to cluster by time as

[36] Swanson and Williams (2014) also verify, with intraday Treasury yield data, that the response of the two-year Treasury yield to monetary surprises sufficiently summarizes the effect of monetary policy compared to decomposing the response of the two-year yield into target and path factors. Also, Gertler and Karadi (2015) encounter weak instruments when using both the decomposed target and path factor as instruments. Given this, I prefer not to decompose the response of the two-year Treasury yield.

[37] An additional reason one may have to make this same truncation when studying credit unions is that a number of corporate credit unions that became insolvent during the crisis were officially shut down in 2012 and a number of new regulations were introduced by the NCUA affecting both corporate and natural person credit unions that affected incentives to raise or acquire paid-in and membership capital.

[38] Generally the omitted observations come are those of credit unions that are extremely small or in extremely poor financial health. The most extreme 5% of changes in logged loan originations for each different measure, large or small, are dropped. That is, the 2.5% largest and 2.5% smallest are omitted. I drop credit unions whose logged changes in total assets is in the most extreme 1%. Lastly, I impose the same 5% cutoff rule to logged changes in investment capital and the net worth ratio. I also drop credit unions below the 7.5$^{\text{th}}$ percentile of members.

one independent variable (the policy rate) only varies over time. The inclusion of this variable rules out the possibility of including a time fixed effects. This means that it is likely the error term contains unobserved factors that only vary over time. While these latent factors are assumed uncorrelated with the instrumental variables, which implies estimator consistency, the standard errors will overstate the statistical significance if we do not allow for the residuals to be correlated within each time period. It is also reasonable that there are unobserved NPCU-specific or region-specific characteristics varying over time that also influence lending growth. Therefore I also cluster along the state dimension, which allows for an even more general correlation structure than also clustering by credit unions alone.

The key finding is that asset losses ($\Delta \ln A_{i,t-1} < 0$) increase the positive effect of conventional monetary easing ($\Delta R_{t-1} < 0$) on loan origination growth. Using data on the number of loan originations for both of these groups, I also find that the extensive margin plays a central role and that conventional monetary easing induces substitution towards fixed-rate 30-year mortgages and compared to other types of loans. Next I describe these results in more detail and augment the baseline specification with additional controls. Additional robustness checks are documented in section VI.

A. Total Lending

Tables of the regression results discussed throughout this section are available in section C.1 of the appendix. Column 1 of table 4 displays estimates for the baseline model (which includes year, quarter, and credit union fixed effects) estimated for total loan originations. Generally the estimates of β_1 and β_3 are significant at the 1% and 5% levels (respectively).The estimate of β_2 is statistically insignificant in these specifications when total lending is the dependent variable. Overall the coefficients remain similar with the inclusion of credit union and county-specific control variables and are no less precisely estimated.

The β_2 estimates do become significant when clustering standard errors by *state* and time rather than *credit union* and time. The former may be preferable as it allows for a more general correlation structure – specifically that unobserved determinants of lending within a region are correlated across time. But 50 clusters is the near the minimum number generally accepted as adequate for assuming that estimation yields a good approximation of the asymptotic covariance matrix, meaning one could under or overestimate the standard errors with too few clusters. Given this, I find it more conservative to cluster by credit union and time as these standard errors are most often (but not always) larger throughout the main results. Given this, I also discuss the economic implications of assets losses under the possibility that β_2 is the causal effect of assets losses when there is no change in the policy rate.

The first finding is that conventional monetary easing increases total lending growth ($\beta_1 < 0$). A 10 basis point decrease in the policy rate, holding fixed a credit union's assets, leads to an additional 0.86 percentage points of lending growth. This is large compared to the median growth rate of -1.38%. Asset losses, on the other hand, reduce lending ($\beta_2 > 0$). A one standard deviation asset loss ($\Delta \ln A_{i,t-1} =$ -1.65%) reduces total lending growth 3.20 percentage points.

The positive interaction term implies that asset losses reduce the sensitivity of lending to the policy rate ($\beta_3 > 0$). The same 10 basis point reduction in the policy rate leads to a 1.15 percentage point rise in loan origination growth when a credit union experiences a 1.65% asset loss. This is 29 additional basis points compared to the response of lending when assets are unchanged. The positive interaction term also implies monetary easing can do more than offset the destructive effects of asset losses on lending growth, it can also reduce a credit union's sensitivity to asset losses. A 1.65% asset loss lowers lending growth by 2.91 percentage points, instead of 3.20, when the policy rate also falls 10 basis points as opposed to when it is unchanged. This number is exclusive of the offsetting, direct effect of lowering the policy rate. The combined effect of a 10 basis point reduction in the policy rate and a 1.65% asset loss lowers lending growth 2.05 percentage points.

How important is this additional benefit of monetary easing? We can compute the amount of the stimulative effect of monetary policy due to its ability to reduce sensitivity to asset losses as

$$\frac{(\beta_3 \Delta \ln A_{i,t-1})\Delta R_{t-1}}{(\beta_1 + \beta_3 \Delta \ln A_{i,t-1})\Delta R_{t-1}}.$$

About 28% of stimulated lending growth is due to the reduced sensitivity of lending to asset losses for 1.65% asset loss. The relative role of this channel is increasing (at a decreasing rate) in the magnitude of the asset loss as $\beta_3 > 0$. To get a sense for how much this role varies, one can compute that a reduced sensitivity to asset losses accounts for 51% and 67% of the stimulative power of conventional monetary policy when asset losses are 5% and 10%, respectively. Thus the importance of this channel is increasing in the severity of the financial crisis.

Another way to gain a sense of how strongly the policy rate and asset losses influence lending is to compute the implied policy rate change necessary to undo a typical asset loss. If during one quarter a credit union has a 1.65% asset loss, it takes an exogenous 29 basis point change to undo this loss. This may appear small, but there are two useful caveats to consider. This is the necessary policy action to offset only one quarter's worth of asset losses. Additionally, we cannot immediately compare this to the typical 25-50 basis point movements in the federal funds target rate as it is likely that only a small portion of those announced target changes are typically exogenous. The average negative quarterly futures surprise is -0.10 and the first stage of the estimation suggests that this is associated with a 15 basis point decrease in the two-year Treasury rate. This suggests it takes roughly twice the typical policy rate change induced by surprises during FOMC announcements to undo the effects of a typical asset loss.

Adding Additional Controls. Columns 2-7 of table 4 add additional controls to the baseline specification. Columns 2-4 augment the baseline specification to include the county-level unemployment rates, growth in log house prices, and the mortgage delinquency rate. Generally the point estimates become slightly larger upon including these variables. Due to data limitations, about 15,000 observations are lost when including the mortgage delinquency rate. These observations tend to come from credit unions in more rural communities, where credit unions tend to be smaller. The higher point estimates may be due to this selection towards larger credit unions, which tend to be more responsive to monetary easing (I discuss this in further detail in a robustness check in section A). The coefficients on these controls are statistically insignificant.

Columns 5-7 add to the baseline specification by conditioning on several time-varying credit union characteristics. These variables do not have a statistically significant effect on the volume of lending. The first characteristic is the logged number of a credit union's members ($\ln members_{i,t-1}$), which reflects the size of a credit union. An advantage of this measure (compared to deposits or total assets) is that it has less cyclical variation. The net worth ratio, $\frac{\text{Net Worth}_{i,t-1}}{\text{Assets}_{i,t-1}}$, reflects the financial health of the credit union. This ratio is measured as net worth to total assets and captures how well-capitalized a credit union is.[39] The difference of logged loan loss allowances ($\Delta \ln \text{LLA}_{i,t-1}$) reflects perceived repayment risk. Loan loss allowances are cash set aside to cover future losses on loans. Therefore, this variable reflects a credit union's expectations of near-term lending conditions and default probabilities.

First Stage and OLS. The first stage of the TSLS estimation and the OLS analogs of the main results overall support the validity of the identifying assumptions. These estimates, along with the standard statistics testing for over and under-identification with multiple endogenous regressors, are displayed in section C.2 of the appendix.

Table 10 reports the first-stage estimation results associated with the baseline specification for total lending.[40] As one would expect, the coefficient on the federal funds futures surprises is positive when the dependent variable is the change in the two-year Treasury yield; it is also highly statistically significant. Column 2 shows that there is no statistically significant effect of investment capital on assets when it constitutes 0% of assets. The two interacted instruments and the share of investment capital in total assets are all statistically

[39] In the NCUA data, net worth is defined as the sum of undivided earnings, regular reserves, appropriation for non-conforming investments, other reserves, uninsured secondary capital, and net income. This ratio is one of two used to regulate credit unions and banks. A ratio exceeding 6% implies adequate capitalization, to be well-capitalized it must exceed 7%. The average ratio for the panel I consider is 13%. The corresponding ratios for bank holding companies are 4% and 5% (respectively).

[40] The first stage of the TSLS estimation consists of essentially the same three regressions across all specifications discussed in this paper. The excluded instruments change when additional controls are added and the sample varies slightly based on data availability for the dependent variable. Point estimates for the first stage are similar, as one would expect, across the other specifications. The implications of test statistics are unchanged across specifications too

significant. This column implies that the average change in investment capital (-1.25 percentage points) is associated with a 0.44 percentage point decrease in total assets.[41] Lastly, the third column shows that the triple interaction term is positively related to the interaction between the Treasury yield and the change in assets with statistical significance at the 10% level.

Tests for weak, under, and over-identification are in table 11. With multiple endogenous regressors, two separate tests are used to detect weak and under-identification. This is in contrast to the single endogenous regressor case in which only a single statistic (the first-stage F-statistic) is necessary to test for both weak and under-identification (Stock and Yogo, 2005). Overall the tests are indicative of valid instruments.

In the context of multiple endogenous regressors, under-identification refers to a zero correlation between the instruments and the endogenous regressors. Because standard errors are two-way clustered by credit union and year-quarter, the heteroskedasticity-robust Kleibergen-Paap Lagrange multiplier is the appropriate test statistic for assessing if the instruments are correlated with the endogenous regressors. Under-identification is rejected at the 0.01% level.

Testing for weak identification specifically is also important as a nonzero but weak correlation between the instruments and endogenous regressors can bias TSLS estimates significantly towards their OLS analogs. With i.i.d. standard errors, the statistic for testing for weak identification is the Cragg-Donald Wald statistic. Critical values for the heteroskedasticity-robust analog, the Kleibergen-Paap Wald statistic, are not available. Standard practice is to compare this statistic to the Cragg-Donald Wald critical values even though the implied p-values are not asymptotically correct (Bazzi and Clemens, 2013). The null hypothesis of this test is that the maximal bias due to instrument weakness exceeds 10%. The obtained statistic of 5.26 recommends rejecting weak identification at the 20% level.

While the weak identification test does not lend much support to the absence of weak instruments, comparing the TSLS estimates to the biased OLS estimates (see table 12 in the appendix) suggests that at worst TSLS estimates understate the magnitude of the three coefficients of interest. Weak instruments bias TSLS estimates towards their OLS counterparts. Thus the fact that the magnitude of the coefficients is either smaller (the case for the policy rate and changes in assets) or the opposite sign (the interaction term) recommends treating the TSLS estimates as lower bounds in terms of magnitude.

B. Mortgage Lending

Next I restrict attention to originations of fixed-rate 30-year mortgages. Mortgages are approximately 35% of credit union lending by volume, the largest lending category among

[41] This is computed using the statistically significant interaction terms in the first stage, the average federal funds futures shock of -0.04 and the average, and the average share of investment capital in total assets (0.78%).

credit unions.[42] Overall I find that mortgage lending is much more sensitive to both asset losses and changes in the policy rate on average, but the relative effects on sensitivity of one of these shocks to the other is similar compared to total lending.

Given the central role of housing and mortgage markets in the Great Recession, it is valuable to be able to consider this variety of lending separately. A reduction in mortgage credit supply in particular can reduce demand through two channels. First, restricted credit supply in general will lead to lower consumption expenditures. But housing is special in that housing net worth comprises a substantial share of most household's net worth.[43] Thus an initial fall in demand can lead house prices to fall and reduce the wealth of households already owning a home. In addition to the pure wealth effect of this loss, the lost collateral value of one's home can limit access to finance a further depress consumption (Berger, Guerrieri, Lorenzoni and Vavra, 2017; Mian, Rao and Sufi, 2013).

The estimation results in table 5 suggest that monetary policy significantly affects mortgage lending and that asset losses can significantly alter this sensitivity. A 10 basis point reduction in the policy rate predicts a 4.44 percentage point fall in mortgage origination growth. The impact of this policy on mortgage growth rises to 5.88 percentage points when a credit union has a one standard deviation (1.65%) asset loss. In absolute terms, this rise in the growth rate of 1.44 percentage points is much larger than the 0.29 gain estimated for total lending. However, the relative effect is similar: this same asset loss increases the response to the policy rate by about 30%.

Asset losses do not have a statistically significant effect on the volume of mortgage lending growth. However, as the next section discusses in detail, asset losses do have a large and significant impact on the *extensive* margin of mortgage lending. It is plausible that asset losses, which bring a credit union closer to its regulatory capital minimums, could induce the credit union to be more cautious in its lending. A credit union may become more willing to deny loan applications of riskier low-income borrower who typically demand smaller mortgages and accept a potentially lower-return but safer high-income borrowers. This change in borrower composition could offset the fall in loan volume induced by originating fewer, but larger mortgages.

C. Extensive vs. Intensive Margins

Decomposing the response of lending into the number and size of loans suggests that lending primarily responds to both changes in the policy rate and asset losses along the extensive margin. Table 6 reports regressions of the logged quarterly difference in the number of new loan originations of all types in columns 1-4 and those for the the logged change in the average size of the loans originated in columns 5-8. The same controls as well as year, quarter, and credit union fixed effects are used as in the previous analyses. Table

[42] See figure 5 in section A. of the appendix.

[43] See figures 4 and 5 in section A. of the appendix.

7 reports analogous regressions for the number and average size of all fixed-rate 30-year mortgages originated.

Table 6 suggests that both margins are important, especially the intensive margin, for total lending. Here a 10 basis point decrease in the policy rate leads to a 0.32 and 0.69 decrease in the growth rate in the volume and size of loans, respectively. In contrast to total lending, the response of mortgage lending is borne out almost entirely by the extensive margin (table 7). The extensive margin appears to account for the entire response of mortgages and the point estimates for mortgage sizes are much smaller. A 10 basis point decrease is associated with a 4.34 rise in the growth rate of the number of mortgage originations.

Asset losses affect total and mortgage lending along the extensive margin and only affect the sensitivity of the extensive margin to changes in the policy rate. The coefficients are large and significant for both the extensive margin of total and mortgage lending. The interaction term is also only statistically significant for the extensive margin and the point estimate is small for average mortgage size.

What can rationalize these stark differences in the role of the intensive margin for total and mortgage lending? One explanation is that monetary easing induces substitution towards mortgages and away from other forms of lending. If this were the case, a shift towards issuing fewer loans overall but larger ones like mortgages could make the intensive margin overall appear more important. Table 19 in the online appendix shows that this composition change does in fact occur. A 10 basis point policy rate reduction increases the share of mortgage originations in the total volume of loan originations by 2.80 percentage points. Interestingly, this response is also strengthened by asset losses.

It is also plausible that there are two offsetting effects from conventional monetary easing or asset losses on loan size. Following a fall in the policy rate, a credit union may offer larger loans than it would have otherwise. But it may also lend to more people who seek smaller loans that would have otherwise not received them. If these marginal borrowers were low-income/wealth they may seek smaller, easier to repay loans. A credit union may perceive these borrowers as too risky unless the cost of capital is sufficiently low or their balance sheet sufficiently strong. Therefore we cannot entirely rule out that the intensive margin does not respond in a meaningful way as borrowers may receive larger loans than they would have otherwise even though the average size of loans made by the credit union does not change.

D. Mortgage Interest Rates

Another important stimulative effect of conventional monetary policy is to lower the interests rate paid by private borrowers. Using data on the common interest rate charged on fixed-rate 30-year mortgages, I find not only do decreases in the policy rate translate to lower mortgage rates, but that asset losses also amplify this channel (see table 8).[44] These signs are also predicted by the second model discussed in section II.[45]

Interest rate pass-through is incomplete, a feature also found in FDIC Call Report data by Scharfstein and Sunderam (2017) between MBS yields and interest rates on refinanced mortgages. I find that a 10 basis point reduction in the policy rate leads to a 1.74 basis point decrease in the mortgage interest rates charged by credit unions, holding assets fixed. The same conventional monetary easing also leads to a larger 2.70 basis point reduction when a credit union experiences a 1.65% asset loss.

In most of the specifications, the strong, positive effect of asset losses on mortgage interest rates is statistically significant. Thus not only can asset losses induce a credit crunch in the sense of restricting the quantity of credit supplied, but another contractionary effect could also be increasing interest rates. With no changes in the policy rate, a 1.65% asset loss leads credit unions to increase mortgage interest rates 3.56 basis points. With 10 basis points of monetary easing, the same asset loss only causes a 2.61 basis point rise in mortgage interest rates. There are significant compared to the average quarterly change of 2.35 basis points.[46]

VI. Robustness

This section discusses additional evidence supporting the main results of the previous section. First, I include additional interactions between the policy rate and county and credit union characteristics. Estimates of the interaction between asset losses and the policy rate are little-changed suggest that asset losses are a relatively important determinant of the efficacy of the transmission of monetary policy. Another natural question is whether the effects on lending are quickly reversed or even offset soon after changes in the policy rate or asset losses. I find that the effects of both of these shocks are extremely persistent and can depress lending for up to two to three years. Lastly, to assuage concerns that there may have been a time-varying, unobserved characteristic of credit unions that led them to both be exposed to large investment capital losses and have decreased lending growth, I perform a placebo test. This test verifies that pre-crisis lending growth is not predicted by a credit union's subsequent investment capital losses during the recession. Finally, this section concludes with a discussion of how the effects estimated in the previous section could differ under general equilibrium and limitations of external validity.

[44] The common rate is the modal rate charged on new originations within the quarter.

[45] In general, if a model (1) is consistent with the signs found for $\{\beta_1, \beta_2, \beta_3\}$ in the main analysis of the volume of lending and (2) has an equilibrium interest rate that depends negatively on the equilibrium quantity of loans, then it must be that the coefficients for the regression with mortgage rates on the left-hand-side will have the opposite sign.

[46] The signs of these effects are to be expected in a model when equilibrium lending is negatively related to the equilibrium interest rate.

A. Alternative Sources of Sensitivity

The main findings are robust to the inclusion of additional interactions terms and overall asset losses are a relatively important determinant of the sensitivity of lending to monetary policy. I augment the baseline specification to include both the credit union and county-level control variables discussed earlier as well as interactions of these variables with the change in the policy rate. I instrument for these interactions for each control $X_{i,t}$ with the product of the control and the futures surprises (i.e., $X_{i,t} \times \Delta\widetilde{R}_{t-1}$). The robustness of the coefficient on the interaction of asset losses and the policy rate and its statistical precision in spite of the inclusion of these additional interactions suggests that the main results are not spuriously driven by these other determinants of loan demand.

Regression results for total lending and mortgage lending (for volume, number, and average size of originations) are available in table 13. The unemployment rate and house price growth do not appear to affect the sensitivity of credit union lending to monetary policy. On the other hand, the credit union characteristics do appear to affect lending's sensitivity to the policy rate. The first finding is that larger credit unions, measured by the log number of members, is associated with greater sensitivity to monetary policy. This is in contrast to Kashyap and Stein (1995), which found smaller banks, measured by total assets, to be more sensitive to the policy rate.[47]

Generally asset losses have a larger effect on the sensitivity of lending to monetary policy, but credit union size does appear to be an important determinant overall. Using the point estimates for the interaction between the policy rate and asset losses from these regressions, we can compare the additional impact of a 10 basis point policy rate decrease in the presence of a one standard deviation asset loss and increase in members. A one standard deviation increase in logged credit union members (1.46) corresponds to an additional 0.25 and 0.99 percentage points of total and mortgage lending growth (respectively) in response to a 10 basis point decrease in the policy rate. A 1.65% is associated with 0.20 and 1.53 additional growth for total and mortgage lending in response to the same shock. Size appears slightly more important in affecting sensitivity but the additional stimulative effect associated with asset losses on mortgage lending's response is more than 50% greater. Along the extensive margin, a standard deviation increase in size leads to 0.10 and 0.86 additional percentage points of total and mortgage lending growth (respectively) following a 10 basis point policy rate reduction. The additional stimulative benefits associated with a 1.65% asset loss are 0.20 and 1.21, respectively.

[47] This difference may stem from my use of log members to measure size compared to their measure based on total assets. It is also possible that the relationship between size may be nonlinear, with lenders the size of large banks less sensitive compared to small banks, small banks more sensitive, and extremely small lenders less sensitive than small banks. Large credit unions are more similar in size to banks considered small in Kashyap and Stein (1995). The smallest credit unions, which are quite small compared to most small banks, may behave differently from small banks/large credit unions. It could also be that if the variation in assets they used to identify the effects on monetary policy was more related to valuation effects/asset losses than fundamental changes in "size", then their measure could have reflected asset losses rather than size.

A lower net worth ratio is associated with enhanced sensitivity to the policy rate. This result is similar to the main findings of this paper and Kashyap and Stein (2000) in that it suggests by another measure of balance sheet quality, more financially impaired lenders are more sensitive to conventional monetary policy.[48] Following a 10 basis point drop in the policy rate, a one standard deviation (4.68 percentage points) decline in the net worth ratio is associated with 0.15 and 0.51 percentage points greater volume of total and mortgage originations (respectively). Along the extensive margin, growth in the number of mortgage originations responds with 0.54 further percentage points to this same monetary policy shock at a credit union with net worth one standard deviation lower.

Changes in loan loss allowances appear to influence the effect of monetary policy on the average size of loans. This variable is also related to asset losses and a credit union's financial health in that an increase suggests the credit unions anticipates *future* losses on assets. A standard deviation increase in log loan loss allowances (1.75) is correlated with 0.23 additional percentage points of average loan size growth. Section C presented evidence suggesting monetary easing affects the intensive margin of total lending by also stimulating a shift in loan composition towards mortgages. The findings of this section are consistent with perceptions of greater loan losses amplifying the composition switch towards mortgages in response to monetary easing.

While these additional findings have interesting implications for the determinants of lenders' responsiveness to asset losses and changes in the policy rate, we should remain slightly skeptical of these estimates. This is because we do not have reasons to believe that the unemployment rate, size, net worth, etc. are exogenous with respect to lending – unlike investment capital. However, these findings suggest it may be worthwhile for future research to more rigorously explore how, for example, expectations of loan losses differentially affect the stimulative power of conventional and unconventional monetary policy.

B. Persistence

To analyze the persistence of monetary policy shocks and asset losses, I separately estimate the baseline the baseline model for eleven additional horizons. Specifically, the dependent variable in these regressions is now $L_{i,t+\tau} - \ln L_{i,t-1}$, where $\tau =$ indicates the number of quarters ahead to which we are looking ($\tau = 0$ corresponds to the one-quarter horizon used in the main analysis). Overall, the effects of monetary easing persist about 1-2 years and the impact of asset losses persists about 2-3 years.

Generally the effect of policy rate changes on lending grows over the first year. For total lending, the largest effects are near the end of the 2$^{\text{nd}}$ year. While a positive impact for

[48]In contrast to the quarterly asset losses considered in the main analysis, net worth reflects more of a summary of overall financial health. Therefore it more accurately describes the history of many balance sheet shocks rather than a recent, single asset loss.

mortgage lending persists for about the same amount of time, the effect begins to diminish after the 1st year. We see a similar pattern of growing effect sizes for asset losses as well, with the response of mortgage lending now beginning to diminish after about two years. Interestingly, most of the effect on mortgage size manifests about a year after the asset loss. Lastly, the interaction term persists for about 2 years as well. This suggests monetary easing can shape a credit union's response to asset losses for long time (and vice versa).

C. Placebo Test

To give further evidence supporting the identifying assumption that investment capital losses are unrelated other determinants of lending, I perform a placebo test. One concern is that an unobserved characteristic of credit unions caused them to have high exposure to investment capital losses and also diminished lending growth. This could be the case if credit unions differ in their risk aversion and were aware that some CCUs were riskier than others. To the extent that this is a fixed characteristic, this addressed by the inclusion of a credit union fixed effect. But if, for example, preferences towards risk changed among credit unions shortly before the crisis, this could mean that the instruments based on investment capital are not truly exogenous with respect to lending.

Continuing with this example of attitudes towards risk, one might expect that credit unions that developed a greater appetite for risk to have to have significantly increased lending in the years leading up to the crisis. Additionally, if they were aware that investment capital was also a risky investment, they may have also had a stronger preference to seek exposure to this asset. This would be problematic for identification if this new preference for risk also led these credit unions reduce lending during the crisis. A reason why lending might fall during the crisis is less risk averse credit union may prefer to lend to riskier borrowers who loan demand fell relatively more during the financial crisis. In equilibrium this could result in lower lending among these credit unions.

This scenario gives us a testable prediction: lending growth was systematically different in the run-up to the crisis among credit unions that experienced different-sized asset losses. The expected sign is not obvious. It is possible that uncertainty was lower in the boom and therefore risk averse credit unions had a relatively stronger incentive to lend. It could also be that lower risk aversion led these credit unions to lend more aggressively if they were less worried about default risk overall.

To this end, I estimate a series of cross-sectional regressions of pre-crisis lending on asset losses during the Great Recession, instrumenting for these asset losses with changes in investment capital during the Great Recession.[49] The second stage of these regressions

[49]The full set of instruments used in these regressions are the log change in investment capital losses, the initial ratio of investment capital to total assets, and the interaction of these terms.

have the form

$$\Delta \ln L_i^{PC} = \beta \Delta \ln A_i^{TGR} + \phi \text{ FOM} + \lambda \text{ County} + \nu_i \tag{3}$$

where PC and TGR denote pre-crisis and the Great Recession, respectively. I consider a variety of windows for measuring defining the pre-crisis and Great Recession periods, which I describe in detail in section C.4 of the appendix alongside the regression results. Since the regression is cross-sectional I can no longer include a credit union fixed effect. However, I can exploit within county and with field of membership variation by including fixed effects for these characteristics.

In support this paper's identification strategy, I find that future asset losses, instrumented for by investment capital losses, do not predict pre-crisis lending growth. Generally, the point estimates for the coefficients on future asset losses are small and statistically insignificant. Overall, this finding lends greater credibility to the assumption that investment capital is unrelated to other determinants of a credit union's lending.

D. General Equilibrium

A natural concern for a partial equilibrium regression analysis is that "local" general equilibrium effects could offset the model's predicted results. Specifically, one might worry that the marginal borrowers who do not receive a loan after their credit union experiences an asset loss are able to easily obtain credit elsewhere. If this is the case, then the estimated model would overstate the total effect on credit. Fortunately, these local general equilibrium effects are unlikely to be a significant concern for three reasons.

First, it is difficult to substitute between credit unions. Many credit unions have strictly enforced membership requirements. Members typically have to live within a certain county and/or have a particular employer (or be related to such a person). The difficulty in qualifying for membership at a different credit union makes it less likely that a potential borrower, already a member at one credit union, would be able to switch to another.

Second, it is unlikely members found it desirable to switch from credit unions to banks. Credit unions consistently offer more favorable rates to borrowers than banks.[50] This makes it less likely that the marginal borrower not receiving a loan at a credit union would instead obtain it from a bank. The competitive rates offered by credit unions make it reasonable that the marginal borrower may find it more profitable to wait out the credit crunch and then obtain a loan from their credit union. Overall, credit would decline and not merely shift to different providers. In fact, the market share of credit unions in auto and housing loans markets rose during and after the crisis (Ramcharan, Van den Heuvel and Verani, 2016). This suggests that this sort of substitution away from credit unions was

[50] Credit unions are not-for-profit institutions and use their profits to offer higher deposit interest rates and lower interest rates on loans.

not significant.

Recent work gives evidence that bank-borrower relationships are very persistent. These findings suggest, that at least over the course of a year or two, general equilibrium effects are unlikely to undo the predicted partial equilibrium effects of negative shocks to factors of credit supply. Chodorow-Reich (2014) finds that within syndicated lending, client-supplier relationships are extremely persistent for lead lenders and also persistent for non-lead lenders. This relationship is even stronger for smaller firms. Since most NPCU member business loans are for small businesses, NPCU borrowers would likely face similar difficulties in switching lenders. **?** also finds that a one-standard deviation fall in projected lending, as forecasted by pre-crisis county market share and national trends, for a particular lender predicts a 17% fall in county-level small business loan originations during 2009-2010.

Third, most people tend to live nearby the banks from which they borrow.[51] Whatever frictions prevent households from borrowing at distant banks likely slow the process of searching for a new lender. If households apply to one bank for a loan but are denied, they must recommence a possibly costly search.

In the "global" sense of general equilibrium, one would expect that the contraction in credit supply induced by asset losses would serve as an amplification rather than dampening channel. Contractions in consumer credit are associated with lower demand for durables and non-durables, housing prices, employment, and overall economic activity. In accordance with the financial accelerator literature (e.g., Bernanke, Gertler and Gilchrist, 1999), this decline in real economic activity further depresses asset prices, weakens creditor balance sheets, and further amplifies the initial decline in credit supply. With respect to this general equilibrium concern, it is likely that the estimated model understates the full general equilibrium effect of asset losses.

E. External Validity

Credit unions an important provider of consumer credit in the US. Therefore, this paper directly studies a major source of consumer credit. In terms of assets, credit unions appear small relative to many banks. As of March 2015, Credit unions owned \$1.2 trillion in assets while US banks owned \$15.8 trillion.[52] The average credit union owned \$185 million in assets in March 2015 while the average US bank owned \$ 2.5 billion.

By volume, credit unions provide 9.2% of consumer loans as of May 2015.[53] Banks and savings institutions accounted for 39.2% of non-revolving consumer consumer credit,

[51] Amel, Kennickell and Moore (2008) find that the majority of households in the Survey of Consumer Finances obtain mortgages from banks within 25 miles of their home.

[52] This figure is from the Q1 2015 US Credit Union Profile produced by CUNA.

[53] This figure is from the May 2015 *Monthly Credit Union Estimates* produced by the Credit Union National Association (CUNA). Additionally, credit unions have consistently provided about 9-11% of consumer credit since the late 1980's.

financial companies another 20%, and the remaining 31.6 % of the market share goes to non-financial corporations. Although credit unions only owned 4.3% of US housing loans by value in 2010, they owned 17.6% of the *number* US housing loans at this same time. Additionally, credit unions accounted for 24.1% (by number) of auto loans.[54] Because credit unions are responsible for a large number of consumer loans, this means that studying the determinants of NPCU-supplied consumer credit speaks to the financial resources of a large population.

Credit unions and banks comove together and appear similar in a number of ways. Total US consumer credit and the amount owned by credit unions has a correlation coefficient of 0.87.[55] Credit unions and banks have consistently had similar net worth to assets ratios; as of March 2015 this ratio was 10.8 % for credit unions and 11.2 % for US banks on average.[56] The regulatory minimum for adequate capitalization under this ratio is 6% for credit unions and 4% for banks. The stricter capital requirements credit unions face may make them more sensitive to asset losses compared to a similar bank.

Lending at credit unions is also more local. Credit unions are formed around a common association and thus members tend to live in the same region, often the same county. This is in contrast to banks which tend to draw on larger populations for depositors and lenders. Credit unions also tend to have fewer branches, making their lending confined to a much more narrow market. In March, the average credit union had only three branches while the average US bank had fifteen.[57] A potential limit for generalizing the findings of this study to banks is that in general equilibrium bank borrowers may be able to more easily switch to a different credit provider. Banks do not impose the same membership requirements and are generally at a competitive disadvantage compared to credit unions in terms of their interest rates. However, the evidence cited in the previous section regarding the local nature of banking suggests it is possible that policy rate changes and asset losses among banks could lead to reductions in the total amount of credit supplied.

VII. Conclusion

This paper examined panel data on credit unions and found that asset losses are associated with a reduced sensitivity of lending to the federal funds rate. The effects of monetary policy are identified with the help of federal funds rate futures surprises. Variation in an asset unique to credit unions, investment capital, is used in constructing instruments for asset losses.

The main finding is that credit supply responds more to monetary easing among creditors experiencing an asset loss. A corollary to this finding is that conventional monetary

[54] Market share calculations not made available in CUNA are computed from Flow of Funds data.
[55] Computed from monthly Flow of Funds data spanning January 2004 to May 2015.
[56] These figures are from the Q1 2015 US Credit Union Profile produced by CUNA.
[57] Source: Q1 2015 US Credit Union Profile produced by CUNA.

easing also reduces the sensitivity of lending to asset losses. This is on top of the direct stimulative effect of lowering the cost of capital. Dampening the negative effects of asset losses on lending is an additional benefit of conventional monetary easing during a financial crisis. This particular benefit accounts nearly 30% of the stimulative effects of reducing the policy rate for typically asset losses, and the role of this channel grows with the size of asset losses. This suggests that conventional monetary policy is a useful tool for not only stimulating lending, but also for mitigating a consumer credit crunch brought about by asset losses.

Mortgage lending is relatively more sensitive to both the policy rate and asset losses. The benefit from monetary easing of reduced sensitivity to asset losses from monetary easing is especially large for mortgages as well. Asset losses also lead to larger mortgage interest rates, but the pass-through of policy rate changes to mortgage rates is also higher for credit unions experiencing an asset loss.

Breaking down the response of lending into its intensive and extensive margins for both total and mortgage lending suggest that monetary easing primarily operates along the extensive margin of lending but it can also induce compositional changes in the types of loans provided. Mortgage lending responds almost entirely to the policy rate along the extensive margin. The intensive margin appears most important when considering the response to total lending to the policy rate. But, monetary easing induces substitution away from other forms of consumer credit (student, auto, and credit card loans, mainly) and towards fixed-rate 30-year mortgages. This can largely account for the seeming importance of the intensive margin for total lending. Credit unions do not offer larger loans within lending categories but switch to providing types of loans which are generally larger.

Robustness checks support the importance of the interaction between asset losses and conventional monetary policy and the identifying assumptions used to estimate their effects. It appears that asset losses are a relatively important determinant of sensitivity to monetary policy compared to other regional and credit union characteristics. Additionally, both asset losses and monetary policy have persistent effects on credit union lending. It takes slightly more than a year for loans originations to return to their pre-shock level following either a policy rate change or asset loss. Lastly, a placebo test provides evidence that investment capital losses during the Great Recession were unrelated to pre-crisis lending growth. This suggests credit unions that ended up experiencing these losses did behave in a systematically different way prior to the crisis.

Another implication of these findings is that conventional and unconventional monetary policy are substitutes, rather than complements. Here unconventional monetary policy refers to policies that directly affect the asset held on lenders balance sheets (such as purchases of MBS). The harmful effects of asset losses do suggest that there is an important role for unconventional monetary policy in countering a credit crunch. However, the greater sensitivity of lenders with asset losses to conventional policy suggests that these two different types of policies are substitutes and not complements. That is, both perform better in the absence of the other. Conventional monetary policy can better stimulate lending after lenders experience asset losses. Symmetrically, unconventional policy that directly targets balance sheets has a large effect on lending in the presence of interest rate increases. Outside of financial crises, another implication is that because strong balance sheets make lending less responsive to changes in the cost of capital, larger *increases* in the cost of capital may be necessary if the goal of policymakers is to reign in a credit boom.

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Appendix

A. Summary Statistics

Table 1: NPCU Summary Statistics (Levels)

	25%	Median	75%	Mean	St. Dev.	Obs.
Assets (mil. \$)	6.77	19.05	60	102.1	564.84	166,932
Invest. cap. (mil. \$)	-1.73	-0.58	1.65	-1.25	10.79	166,932
$\frac{\text{Investment cap.}}{\text{Assets}}$ (%)	0.56	0.81	0.96	0.78	0.67	166,932
	Panel A: Total Loans YTD					
Volume (mil. \$)	3.44	38.96	46.99	42.95	203.26	166,932
Number	393	2,202	2,952	2,997	12,975	159,389
Average size (\$)	5,783	8,996	13,374	11,410	18,893	159,389
	Panel B: Fixed Rate Mortgages YTD					
Volume (mil. \$)	1.28	28.21	34.67	25.91	82.13	79,569
Number	13	155	206	157	390	79,504
Average size (mil. \$)	0.07	0.10	0.15	0.14	1.78	79,023

Table 2: NPCU Summary Statistics ($100 \times \ln \Delta$)

	25%	Median	75%	Mean	St. Dev.	Obs.
Assets	-1.45	0.56	2.69	0.67	3.74	166,932
Invest. cap.	-1.73	-0.58	1.65	-1.25	10.79	166,932
	Panel A: Total Loans YTD					
Volume	-9.73	-1.38	8.28	-0.41	25.04	166,932
Number	-26.68	-0.3	270.31	15.24	199.14	150,317
Average size	-7.56	-0.97	6.85	0.08	16.96	150,121
	Panel B: Fixed Rate Mortgages YTD					
Volume	-15.85	5.35	28.77	4.29	48.36	70,886
Number	-16.75	6.66	27.2	3.58	45.01	70,575
Average size	-7.05	0	8.46	1.00	21.48	70,602

Note: Statistics in table 1 and for asset and investment capital in table 2 are computed for the subsample used in the baseline regression for which the growth in the volume of total loan originations is the dependent variable. Statistics in panels A and B of table 2 use the actual subsamples for the respective regressions of each independent variable). The top table gives levels and percentages while the bottom table gives logged differences ($\times$100). The data span Q3 2004 to Q4 2011. The volumes and numbers of mortgages are seasonally adjusted.

Table 3: Additional Summary Statistics

	25th %	Median	75th %	Mean	St. Dev.	Obs.
	Panel A: Panel Data					
$\frac{\text{Loans out.}}{\text{Assets}}$ (%)	47.74	60.34	71.82	59.09	16.99	166,932
Net worth ratio (%)	10.02	12.33	15.75	13.48	4.68	166,932
$100 \times \Delta \ln \text{LLA}_{i,t-1}$	-6.44	0.68	9.15	1.56	34.19	166,576
Members	1,415	3,294	9,168	11,833	51,079	166,932
Mortgage int. rate (basis points)	550	600	661	617	109	104,862
Δ Mortgage int. rate (basis points)	-3.00	0.00	0.00	-2.35	45.98	102,572
UR (%)	4.40	5.6	7.6	6.24	2.54	165,096
$100 \times \Delta \ln$ house prices	-0.73	0.49	1.51	0.4	2.52	165,438
Mortgage (%) delinquency rate	1.15	1.91	3.42	2.57	2.21	152,629
	Panel B: Aggregate Time Series Data					
Assets (bil. $)	483.97	607.11	664.63	568.14	138.33	30
Loans out. (bil. $)	306.23	391.66	456.11	377.01	106.07	30
Loans orig. (bil. $)	52.90	112.91	175.12	122.70	69.35	30
Members (mil.)	53.08	76.36	78.92	65.84	17.63	30
ΔR_t	-0.29	0.00	0.25	-0.05	0.54	30
$\Delta \widetilde{R}_t$	-0.02	0.00	0.00	-0.04	0.14	30

Note: These statistics are computed from the subsample used in the main regression analysis. The net worth ratio is the ratio of the sum of undivided earnings, regular reserves, appropriation for non-conforming investments, other reserves, uninsured secondary capital, and net income relative to total assets. Above $\Delta \ln LLA_{i,t-1}$ denotes lagged changes in loan loss allowances, which are funds set aside to absorb possible losses on loans. Panel B gives statistics for total assets, loans outstanding, loan originations, and members associated with US credit unions. The last two rows give statistics for the policy rate (the two-year treasury yield in percentage points) and the quarterly federal funds futures surprises.

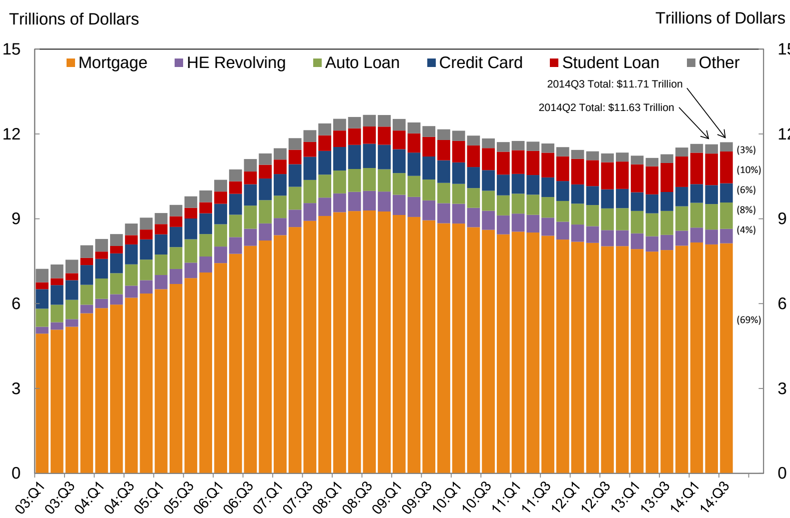

Figure 4: Composition of US Household Debt

Note: This graph plots the total debt balance of US households over time. Debt is broken down into mortgages, home equity revolving lines of credit, auto loans, credit card loans, student loans, and all other remaining types of debt. Source: FRBNY Quarterly Report on Household Debt and Credit (November 2014). The data used in constructing this graph are from the FRBNY Consumer Credit Panel/Equifax.

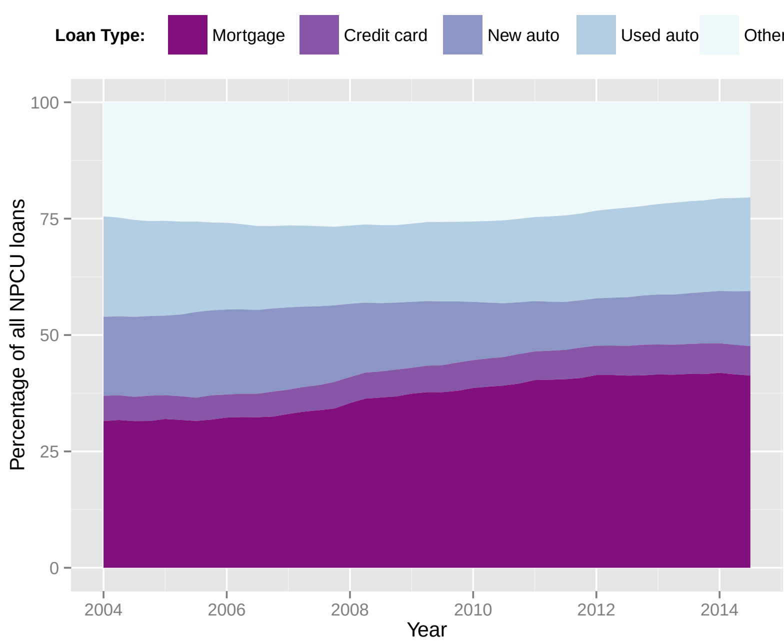

Figure 5: NPCU Lending Composition

Note: This graph shows the percentage of NPCU lending comprised of mortgage loans, credit card loans, new auto loans, used auto loans, and "other" loans. The "other" loans consist of home equity lines of credit (9.9% in March 2015), member business loans (7.4% in March 2015), and other unsecured personal loans (4.3% in March 2015).

B. Proof of Proposition 1

Proposition 1 *Equilibrium loan supply* $L^*(R,B) = \min\left\{\frac{a-R}{2b}, \bar{L}(B)\right\}$ *has increasing differences in* $(-R,B)$ *if* $\bar{L}(\cdot)$ *is an increasing function. That is, if* $R' < R$ *and* $B' > B$*, then*

$$L^*(R',B') - L^*(R,B') \geq L^*(R',B) - L^*(R,B).$$

Proof. Let $R' \leq R$ and $B' > B$. There are three possible cases for the effect of decreasing the interest rate from R to R' given balance sheet value B and capacity function $\bar{L}(\cdot)$:

$$L^*(R',B) - L^*(R,B) = \begin{cases} \frac{R-R'}{2b} & : \bar{L}(B) \geq \frac{a-R'}{2b} \\ \bar{L}(B) - \frac{a-R}{2b} & : \bar{L}(B) \in \left(\frac{a-R}{2b}, \frac{a-R'}{2b}\right) \\ 0 & : \bar{L}(B) \leq \frac{a-R}{2b} \end{cases}.$$

We can examine the effect of lowering B' to B on the difference in lending under each of the three cases above.

Case 1 If $\bar{L}(B') \leq \frac{a-R}{2b}$, since $\bar{L}(B) < \bar{L}(B')$, lowering interest rate has the same effect for either B or B':

$$L^*(R',B') - L^*(R,B') = L^*(R',B) - L^*(R,B) = 0.$$

Case 2 If $\bar{L}(B') \in \left(\frac{a-R}{2b}, \frac{a-R'}{2b}\right)$, then

$$\begin{aligned} L^*(R',B) - L^*(R,B) &= \max\left\{0, \bar{L}(B) - \frac{a-R}{2b}\right\} \\ &\leq \bar{L}(B') - \frac{a-R}{2b} \\ &= L^*(R',B') - L^*(R,B') \end{aligned}$$

and lending rises more in response to monetary easing when B is higher.

Case 3 If $\bar{L}(B') \geq \frac{a-R'}{2b}$ and $\bar{L}(B) < \frac{a-R'}{2b}$:

$$\begin{aligned} L^*(R',B) - L^*(R,B) &= \max\left\{0, \bar{L}(B) - \frac{a-R}{2b}\right\} \\ &\leq \max\left\{0, \frac{a-R'}{2b} - \frac{a-R}{2b}\right\} \\ &= \frac{R-R'}{2b} \\ &= L^*(R',B') - L^*(R,B'). \end{aligned}$$

Lending increases more following a fall in R when B is higher. If instead both $\bar{L}(B') \geq \frac{a-R'}{2b}$ and if $\bar{L} \geq \frac{a-R'}{2b}$, the response of lending is the same for either B or B':

$$L^*(R',B) - L^*(R,B) = \frac{R-R'}{2b} = L^*(R',B') - L^*(R,B').$$

Thus in every case, we have

$$L^*(R', B') - L^*(R, B') \geq L^*(R', B) - L^*(R, B),$$

$\square$

C. Tables

C.1 Main Results

Table 4: Total Lending (volume)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ΔR_{t-1}	-8.58***	-8.86***	-9.45***	-10.20***	-8.56***	-9.46***	-10.15***
	(3.07)	(3.14)	(3.52)	(3.75)	(3.15)	(3.60)	(3.81)
$\Delta \ln A_{i,t-1}$	1.94	1.76	1.93	1.9	1.4	1.47	1.43
	(1.24)	(1.23)	(1.33)	(1.45)	(0.98)	(1.02)	(1.13)
$\Delta R_{t-1} \times \Delta \ln A_{i,t-1}$	1.78**	1.82**	1.98**	2.10**	1.69**	1.90**	2.01**
	(0.77)	(0.77)	(0.88)	(0.94)	(0.73)	(0.83)	(0.88)
$\text{UR}_{i,t-2}$		-0.06	-0.06	0.08		-0.05	0.1
		(0.18)	(0.18)	(0.17)		(0.17)	(0.16)
$\Delta \ln(\text{House Prices}_{i,t})$			-10.86	-9.81		-10.25	-9.41
			(20.07)	(18.23)		(21.38)	(19.18)
$\text{Mort. Delinq.}_{i,t-1}$				0.04			0.01
				(0.14)			(0.13)
$\ln \text{Members}_{i,t-1}$					-0.74	-0.48	-0.6
					(1.67)	(1.76)	(1.99)
$\frac{\text{Net worth}_{i,t-1}}{\text{Assets}_{i,t-1}}$					0.17	0.15	0.13
					(0.36)	(0.38)	(0.44)
$\Delta \ln(\text{LLA}_{i,t-1})$					0.12	0.19	0.2
					(0.26)	(0.26)	(0.28)
Observations	166,932	165,104	163,775	150,628	166,553	163,401	150,293

Note: The dependent variable is the quarterly difference of logged total year-to-date loan originations. Coefficients and standard errors (in parentheses) are multiplied by 100. Every regression includes quarter, year, and credit union fixed effects; standard errors are two-way clustered by credit union and year-quarter. The sample period is Q3 2004 to Q4 2011. Statistical significance: 0.1*, 0.05**, and 0.01***.

Table 5: Mortgage Lending (volume)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ΔR_{t-1}	-44.35***	-45.32***	-44.55***	-45.57***	-43.49***	-43.70**	-45.20***
	(15.79)	(16.46)	(16.92)	(15.28)	(16.07)	(17.25)	(15.78)
$\Delta \ln A_{i,t-1}$	3.24	3.03	3.58	0.66	3.65	3.95	1.54
	(4.16)	(4.02)	(4.12)	(3.95)	(3.36)	(3.39)	(3.31)
$\Delta R_{t-1} \times \Delta \ln A_{i,t-1}$	8.78**	8.96**	8.91**	8.55**	8.69**	8.82**	8.60**
	(3.46)	(3.50)	(3.62)	(3.40)	(3.58)	(3.76)	(3.56)
$\text{UR}_{i,t-2}$		0.26	0.11	0.72		0.09	0.63
		(0.80)	(0.75)	(0.85)		(0.70)	(0.80)
$\Delta \ln(\text{House Prices}_{i,t})$			-71.83	-84.25		-68.92	-83.45
			(85.08)	(79.24)		(85.08)	(78.51)
Mort. $\text{Delinq.}_{i,t-1}$				-0.71			-0.61
				(0.55)			(0.50)
$\ln \text{Members}_{i,t-1}$					6.81	7.45	3.18
					(8.76)	(8.94)	(9.59)
$\frac{\text{Net worth}_{i,t-1}}{\text{Assets}_{i,t-1}}$					0.2	0.26	-0.84
					(1.42)	(1.43)	(1.53)
$\Delta \ln(\text{LLA}_{i,t-1})$					-0.89	-0.72	-0.88
					(0.99)	(1.02)	(0.99)
Observations	70,886	70,210	69,767	63,908	70,845	69,726	63,873

Note: The dependent variable is the quarterly difference of logged total year-to-date originations of 30-year fixed-rate mortgage loans. Coefficients and standard errors (in parentheses) are multiplied by 100. Every regression includes quarter, year, and credit union fixed effects; standard errors are two-way clustered by credit union and year-quarter. The sample period is Q3 2004 to Q4 2011. Statistical significance: 0.1*, 0.05**, and 0.01***.

Table 6: Total Lending: Extensive vs. Intensive Margins

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Number of Loans				Loan Size			
ΔR_{t-1}	-3.18	-4.02	-3.23	-3.97	-6.93***	-6.73***	-7.03***	-6.83***
	(2.28)	(2.53)	(2.37)	(2.59)	(2.01)	(2.27)	(2.08)	(2.33)
$\Delta \ln A_{i,t-1}$	1.98**	1.71*	1.39**	1.22	0.36	0.2	0.38	0.14
	(0.96)	(1.03)	(0.67)	(0.75)	(0.96)	(0.98)	(0.83)	(0.87)
$\Delta R_{t-1} \times \Delta \ln A_{i,t-1}$	1.25*	1.32*	1.17*	1.23*	0.92	0.83	0.95	0.84
	(0.66)	(0.69)	(0.60)	(0.64)	(0.61)	(0.65)	(0.60)	(0.64)
$\text{UR}_{i,t-2}$		0.1		0.13		0.08		0.08
		(0.13)		(0.12)		(0.15)		(0.16)
$\Delta \ln(\text{House Prices}_{i,t})$		-2.71		-2.84		-7.25		-7.57
		(13.10)		(13.39)		(9.29)		(9.69)
Mort. $\text{Delinq.}_{i,t-1}$		-0.01		-0.05		0.01		0.01
		(0.11)		(0.10)		(0.09)		(0.09)
$\ln \text{Members}_{i,t-1}$			-2.11	-1.98			1.42	0.84
			(1.37)	(1.62)			(1.49)	(1.77)
$\frac{\text{Net worth}_{i,t-1}}{\text{Assets}_{i,t-1}}$			0.24	0.19			-0.01	-0.1
			(0.27)	(0.31)			(0.28)	(0.27)
$\Delta \ln(\text{LLA}_{i,t-1})$			-0.06	-0.09			-0.1	-0.11
			(0.29)	(0.32)			(0.16)	(0.17)
Observations	150,317	134,970	150,017	134,713	150,121	134,671	149,829	134,421

Note: The dependent variable in columns 1-4 is the quarterly difference of the logged number of total loan originations YTD. The dependent variables in columns 5-8 is the quarterly difference of logged average loan size (of those originated YTD). Coefficients and standard errors (in parentheses) are multiplied by 100. Every regression includes quarter, year, and credit union fixed effects; standard errors are two-way clustered by credit union and year-quarter level. The sample period is Q3 2004 to Q4 2011. The sample period is Q3 2004 to Q4 2011. Statistical significance: 0.1*, 0.05**, and 0.01***.

Table 7: Mortgage Lending: Extensive vs. Intensive Margins

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Number of Loans				Loan Size			
ΔR_{t-1}	-44.35***	-45.57***	-43.49***	-45.20***	-43.40***	-43.80***	-42.42***	-43.37***
	(15.79)	(15.28)	(16.07)	(15.78)	(14.61)	(14.32)	(14.66)	(14.63)
$\Delta \ln A_{i,t-1}$	3.24	0.66	3.65	1.54	5.29*	3.45	4.99*	3.51
	(4.16)	(3.95)	(3.36)	(3.31)	(3.20)	(2.98)	(2.58)	(2.57)
$\Delta R_{t-1} \times \Delta \ln A_{i,t-1}$	8.78**	8.55**	8.69**	8.60**	8.96***	8.69***	8.74***	8.62***
	(3.46)	(3.40)	(3.58)	(3.56)	(3.10)	(3.00)	(3.15)	(3.12)
$\text{UR}_{i,t-2}$		0.72		0.63		-0.05		-0.06
		(0.85)		(0.80)		(0.69)		(0.66)
$\Delta \ln(\text{House Prices}_{i,t})$		-84.25		-83.45		-107.49		-105.55
		(79.24)		(78.51)		(86.88)		(86.86)
Mort. $\text{Delinq.}_{i,t-1}$		-0.71		-0.61		-0.47		-0.45
		(0.55)		(0.50)		(0.45)		(0.43)
$\ln \text{Members}_{i,t-1}$			6.81	3.18			7.5	4.63
			(8.76)	(9.59)			(7.70)	(8.64)
$\frac{\text{Net worth}_{i,t-1}}{\text{Assets}_{i,t-1}}$			0.2	-0.84			0.88	0.17
			(1.42)	(1.53)			(1.00)	(1.08)
$\Delta \ln(\text{LLA}_{i,t-1})$			-0.89	-0.88			-0.77	-0.66
			(0.99)	(0.99)			(0.78)	(0.79)
Observations	70,886	63,908	70,845	63,873	70,575	63,568	70,533	63,532

Note: The dependent variable in columns 1-5 is the quarterly difference of the logged number of 30-year fixed-rate mortgage originations YTD. The dependent variables in columns 6-10 is the quarterly difference of logged average 30-year fixed-rate mortgages (of those originated YTD). Coefficients and standard errors (in parentheses) are multiplied by 100. Every regression includes quarter, year, and credit union fixed effects; standard errors are two-way clustered by credit union and year-quarter. The sample period is Q3 2004 to Q4 2011. The sample period is Q3 2004 to Q4 2011. Statistical significance: 0.1*, 0.05**, and 0.01***.

Table 8: Mortgage Interest Rates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ΔR_{t-1}	9.07***	8.58***	8.89***	8.49***	9.18***	9.07***	8.87***
	(2.95)	(3.33)	(3.22)	(3.16)	(3.08)	(3.34)	(3.40)
$\Delta \ln A_{i,t-1}$	-1.84*	-1.82*	-1.91*	-1.05	-1.75**	-1.80**	-1.17
	(1.06)	(1.04)	(1.04)	(0.92)	(0.81)	(0.81)	(0.73)
$\Delta R_{t-1} \times \Delta \ln A_{i,t-1}$	-3.08***	-3.02***	-3.11***	-2.78***	-3.09***	-3.13***	-2.88***
	(0.83)	(0.87)	(0.83)	(0.87)	(0.86)	(0.87)	(0.92)
$\text{UR}_{i,t-2}$		0.32	0.29	0.26		0.27	0.24
		(0.29)	(0.28)	(0.31)		(0.27)	(0.31)
$\Delta \ln(\text{House Prices}_{i,t})$			-17.07	-14.54		-16.61	-13.27
			(19.65)	(19.24)		(20.12)	(19.91)
Mort. $\text{Delinq.}_{i,t-1}$				0.11			0.09
				(0.14)			(0.14)
$\ln \text{Members}_{i,t-1}$					-6.41***	-6.43**	-5.93**
					(2.43)	(2.50)	(2.51)
$\frac{\text{Net worth}_{i,t-1}}{\text{Assets}_{i,t-1}}$					(0.21)	(0.24)	0.01
					(0.39)	(0.39)	(0.38)
$\Delta \ln(\text{LLA}_{i,t-1})$					-0.57	-0.66*	-0.71*
					(0.40)	(0.40)	(0.37)
Observations	99,950	98,824	98,019	89,771	99,819	97,889	89,650

Note: The dependent variable is the quarterly difference of the typical interest rate charged on newly-originated fixed-rate 30-year mortgages in basis points. Every regression includes quarter, year, and credit union fixed effects; standard errors are two-way clustered by credit union and year-quarter. The sample period is Q3 2004 to Q4 2011. Statistical significance: 0.1*, 0.05**, and 0.01***.

Table 9: Summary of the Main Results' Economic Meaning

	Panel A: Effects of Policy Rate Changes		
	Effect of ΔR alone $\beta_1 \Delta R$	Effect of ΔR with $\Delta \ln A$ $(\beta_1 + \beta_3 \Delta \ln A)\Delta R$	Median growth rate $100 \times \mathbb{E}\Delta \ln L_{i,t}$
Total loans (volume)	0.86	1.15	-1.38
Total loans (number)	0.32	0.52	-0.3
Total loans (size)	0.69	0.69	-0.97
Mortgages (volume)	4.44	5.88	5.35
Mortgages (number)	4.34	5.82	6.66
Mortgages (size)	–	–	0.00

	Panel B: Effects of Asset Losses		
	Effect of $\Delta \ln A$ alone $\beta_2 \Delta \ln A$	Effect of $\Delta \ln A$ with ΔR $(\beta_2 + \beta_3 \Delta R)\Delta \ln A$	Both $\beta_1 \Delta R + \beta_2 \Delta \ln A$ $\beta_3(\Delta R)(\Delta \ln A)$
Total loans (volume)	-3.20	-2.91	-2.05
Total loans (number)	-3.27	-3.06	-2.74
Total loans (size)	–	–	0.69
Mortgages (volume)	-5.35	-3.90	0.54
Mortgages (number)	-8.73	-7.25	-2.91
Mortgages (size)	–	–	–

	Panel C: Policy Implications	
	Policy rate change to offset $\Delta \ln A$ (basis points) $\left(\frac{-\beta_2 \Delta \ln A}{\beta_1 + \beta_3 \Delta \ln A}\right)$	Response to policy rate due to altered sensitivity $\left(\frac{\beta_3 \Delta \ln A}{\beta_1 + \beta_3 \Delta \ln A}\right)$
Total loans (volume)	-28.79	25.5%
Total loans (number)	-62.32	39.3%
Total loans (size)	–	–
Mortgages (volume)	-9.09	24.6%
Mortgages (number)	-15.00	25.4%
Mortgages (size)	–	–

Note: This table presents a summary of the economic implications of the main analysis for each category of lending considered. The values presented here are associated with the baseline specification (column 1 of the regression tables). Panel A reports the estimated effect of a 10 basis point decrease in the policy rate (ΔR) first with no changes in assets and then with $\Delta \ln A = -1.65$ (the standard deviation of log assets). The third column of panel A gives the average growth rate in log points of the different types of lending over the sample. Panel B presents the effects of a 1.65 log point asset loss with and without a 10 basis point decrease in the policy rate. The third column of panel B reports the estimated total effect of both the policy rate change and asset losses. It is useful to compare these total effects to the effects of ΔR and $\Delta \ln A$ alone. Lastly, panel C present policy-relevant calculations. First, it reports the predicted change in the policy rate necessary to offset this typical asset loss. In column 2 it gives the share of the effect any policy rate change due to the reduced sensitivity to a typical asset loss.

C.2 First Stage and OLS

Table 10: First Stage Regressions

Dependent variable:	(1) ΔR_{t-1}	(2) $\Delta \ln A_{i,t-1}$	(3) $\Delta R_{t-1} \times \Delta \ln A_{i,t-1}$
$\Delta \widetilde{R}_{t-1}$	1.50***	-1.07	5.88***
	(0.46)	(0.81)	(1.54)
$\Delta \ln C_{i,t-1}$	-0.23*	0.12	-0.03
	(0.14)	(0.35)	(0.29)
$\frac{C_{i,t-2}}{A_{i,t-2}}$	0.14	8.65**	1.59
	(0.53)	(3.44)	(2.43)
$\frac{C_{i,t-2}}{A_{i,t-2}} \times \Delta \ln C_{i,t-1}$	-1.38	28.87***	11.60
	(2.22)	(7.97)	(15.99)
$\Delta \widetilde{R}_{t-1} \times \Delta \ln C_{i,t-1} \times \frac{C_{i,t-2}}{A_{i,t-2}}$	-72.65	-421.57*	1073.26*
	(199.20)	(224.39)	(575.31)
Observations	166,932	166,932	166,932
R^2	0.60	0.24	0.18
F-statistic	29.44	6.29	4.33

Note: The dependent is given by the first row. Coefficients and standard errors (in parentheses) are multiplied by 100 in columns 2 and 3. Every regression includes quarter, year, and credit union fixed effects; standard errors are two-way clustered by credit union and year-quarter. The sample period is Q3 2004 to Q4 2011. Statistical significance: 0.1*, 0.05**, and 0.01***.

Table 11: Testing of TSLS Assumptions

	Value	Null Hypothesis
Kleibergen-Paap LM Statistic	14.25***	H_0: under-identification (instruments
p-value	0.0026	uncorrelated with regressors)
Cragg-Donald Wald Statistic	12.28	H_0: weak identification (instruments
Kleibergen-Paap Wald Statistic	5.26	weakly correlated with regressors)
Hansen J Statistic	1.038	H_0: *not* over-identified (instruments
p-value	0.5952	uncorrelated with error term, excluded
		instruments correctly excluded)

Note: This table reports test statistics for testing the TSLS identifying assumptions. The 5%, 10%, and 20% critical values for the Cragg-Donald Wald statistic are 9.53, 6.61, and 4.99 (respectively) Stock and Yogo (2005). Critical values for Kleibergen-Paap rank Wald statistic are not tabulated as they vary across applications. Standard practice is to compare the statistic to the associated Cragg-Donald Wald critical value even though the implied p-value is not asymptotically correct (Bazzi and Clemens, 2013).

Table 12: OLS Estimates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Total Lending (volume)				Mortgage Lending (volume)			
ΔR_{t-1}	-1.44	-1.36	-1.43	-1.33	-1.35**	-1.41***	-1.33**	-1.38***
	(0.92)	(0.87)	(0.91)	(0.86)	(0.56)	(0.49)	(0.55)	(0.48)
$\Delta \ln A_{i,t-1}$	0.11***	0.10**	0.11***	0.10**	-0.03	-0.04	-0.03	-0.04
	(0.04)	(0.04)	(0.04)	(0.04)	(0.03)	(0.03)	(0.02)	(0.03)
$\Delta R_{t-1} \times \Delta \ln A_{i,t-1}$	-0.08	-0.08	-0.09	-0.09	-0.08	-0.07	-0.08	-0.07
	(0.07)	(0.07)	(0.07)	(0.07)	(0.06)	(0.05)	(0.06)	(0.05)
$\text{UR}_{i,t-2}$		-0.31*		-0.30*		-0.20*		-0.20*
		(0.18)		(0.18)		(0.12)		(0.12)
$\Delta \ln(\text{House Prices}_{i,t})$		20.40**		20.63**		10.18*		10.43*
		(9.60)		(9.61)		(5.50)		(5.56)
Mort. $\text{Delinq.}_{i,t-1}$		-0.09		-0.1		-0.01		-0.01
		(0.09)		(0.09)		(0.06)		(0.06)
$\ln \text{Members}_{i,t-1}$			-3.37***	-3.78***			0.64	0.25
			(1.02)	(1.17)			(0.52)	(0.68)
$\frac{\text{Net worth}_{i,t-1}}{\text{Assets}_{i,t-1}}$			0.05	0.07			0.11	0.11
			(0.08)	(0.08)			(0.09)	(0.10)
$\Delta \ln(\text{LLA}_{i,t-1})$			0.07	0.2			-0.17	-0.13
			(0.27)	(0.28)			(0.17)	(0.16)
Observations	166,932	150,628	166,553	150,293	150,121	134,671	149,829	134,421

Note: This table gives the analogous OLS estimates of table 4. The dependent variable is the quarterly difference of logged total year-to-date loan originations. Coefficients and standard errors (in parentheses) are multiplied by 100. Every regression includes quarter, year, and credit union fixed effects; standard errors are two-way clustered by credit union and year-quarter. The sample period is Q3 2004 to Q4 2011. Statistical significance: 0.1*, 0.05**, and 0.01***.

C.3 Alternative Sources of Sensitivity

The table below augments the baseline specification by interacting the additional control variables with the policy rate. I instrument for these additional interactions with the control variable (X) multiplied by the federal funds futures surprises ($\Delta\widetilde{R}_{t-1} \times X$).

Table 13: Sensitivity to the Policy Rate

	(1)	(2)	(3)	(4)	(5)	(6)
	Total Lending			Mortgage Lending		
	Volume	Number	Size	Volume	Number	Size
ΔR_{t-1}	6.11	2.66	2.81	16.41	13.71	-3.67
	(4.01)	(2.99)	(4.85)	(30.67)	(29.70)	(6.63)
$\Delta \ln A_{i,t-1}$	1.16	**1.09***	-0.09	1.25	**3.24***	-0.3
	(0.86)	(0.64)	(0.87)	(2.84)	(1.93)	(0.70)
$\Delta R_{t-1} \times \Delta \ln A_{i,t-1}$	**1.18***	0.82	0.47	**6.95****	**6.35****	0.52
	(0.67)	(0.51)	(0.69)	(3.31)	(2.92)	(0.80)
$\text{UR}_{i,t-2}$	0.12	**0.17***	0.08	0.78	0.15	0.01
	(0.25)	(0.10)	(0.16)	(0.65)	(0.53)	(0.14)
$\Delta \ln(\text{House Prices}_{i,t})$	9.23	11.49	-4.86	-19.30	-27.86	16.63
	(14.46)	(9.75)	(10.43)	(66.75)	(75.99)	(17.43)
$\text{Mort. Delinq.}_{i,t-1}$	0.02	-0.01	0.00	-0.46	-0.51	0.11
	(0.15)	(0.10)	(0.08)	(0.41)	(0.34)	(0.13)
$\ln \text{Members}_{i,t-1}$	-2.79	**-2.84***	-0.16	-2.44	-0.68	0.18
	(1.76)	(1.46)	(1.66)	(8.52)	(7.33)	(1.43)
$\frac{\text{Net worth}_{i,t-1}}{\text{Assets}_{i,t-1}}$	0.41	0.30	0.01	-0.15	1.06	-0.15
	(0.35)	(0.28)	(0.28)	(1.30)	(0.84)	(0.34)
$\Delta \ln(\text{LLA}_{i,t-1})$	0.23	-0.03	-0.28	-1.88	-1.31	-1.00
	(0.31)	(0.34)	(0.21)	(1.61)	(1.13)	(0.65)
$\Delta R_{t-1} \times \text{UR}_{i,t-2}$	-1.11	-0.15	-0.85	-1.58	-1.88	-0.05
	(0.70)	(0.29)	(0.57)	(1.62)	(1.33)	(0.23)
$\Delta R_{t-1} \times \Delta \ln(\text{House Prices}_{i,t})$	-34.70	**-50.66****	8.85	**-140.70****	**-249.12*****	**53.45****
	(24.34)	(22.11)	(17.47)	(69.72)	(67.14)	(26.05)
$\Delta R_{t-1} \times \text{Mort. Delinq.}_{i,t-1}$	**0.76****	0.34	**0.42***	1.17	-0.62	**0.82*****
	(0.37)	(0.25)	(0.26)	(1.30)	(1.03)	(0.23)
$\Delta R_{t-1} \times \ln \text{Members}_{i,t-1}$	**-1.87*****	**-0.87****	**-1.01*****	**-6.61*****	**-5.60*****	-0.06
	(0.50)	(0.39)	(0.28)	(2.40)	(2.08)	(0.27)
$\Delta R_{t-1} \times \frac{\text{Net worth}_{i,t-1}}{\text{Assets}_{i,t-1}}$	**0.37*****	0.10	**0.21***	**0.78*****	**1.12*****	0.04
	(0.06)	(0.10)	(0.12)	(0.25)	(0.20)	(0.13)
$\Delta R_{t-1} \times \Delta \ln(\text{LLA}_{i,t-1})$	0.35	0.17	-1.08	-8.77*	-5.67	**-2.98***
	(1.23)	(1.12)	(0.85)	(5.07)	(5.03)	(1.61)
Observations	150,293	134,713	134,421	63,873	63,532	63,611

Note: The dependent variables are the quarterly difference of logged, year-to-date, loan originations for total lending (columns 1-3) and fixed-rate 30-year mortgage lending (columns 4-6). Coefficients and standard errors (in parentheses) are multiplied by 100. Every regression includes quarter, year, and credit union fixed effects; standard errors are two-way clustered by credit union and year-quarter. The sample period is Q3 2004 to Q4 2011. Statistical significance: 0.1*, 0.05**, and 0.01***.

C.4 Placebo Tests

This robustness check tests if asset losses during the Great Recession are associated with greater sensitivity to the policy rate prior to 2004. Asset losses in the Great Recession ($\Delta^{4\delta} \ln A_{i,\tau}$) vary only in the cross-section and are constructed for four different periods. I instrument for this variable with measures analogous to the three instruments in the main analyses. But instead of using lagged investment capital changes or ratios to total assets, I compute these measures during the same period as asset losses during the great recession. Control variables with limited availability during this period are dropped in these regressions.

Table 14: Placebo Test: Policy Rate Sensitivity

	(1)	(2)	(3)	(4)
$\tau =$	2009		2010	
$\delta =$	1	2	1	2
ΔR_{t-1}	-87.34	-112.22	-106.22	-44.74
	(194.21)	(142.85)	(73.01)	(40.59)
$\Delta^{4\delta} \ln A_{i,\tau}$	0.53	0.73	0.64	0.11
	(2.08)	(0.95)	(0.72)	(0.15)
$\Delta R_{t-1} \times \Delta^{4\delta} \ln A_{i,\tau}$	7.43	6.67	4.16	0.77
	(24.06)	(10.41)	(3.28)	(1.10)
$\text{UR}_{i,t-2}$	0.10	0.03	0.09	-0.55
	(1.02)	(0.65)	(0.95)	(0.55)
$\ln \text{Members}_{i,t-1}$	0.26	0.76	0.14	0.02
	(5.81)	(5.76)	(4.83)	(4.64)
$\Delta \ln(\text{LLA}_{i,t-1})$	0.01	0.02	-0.01	-0.05
	(0.02)	(0.04)	(0.05)	(0.04)
Observations	60,108	60,028	29,377	29,362

Note: The dependent variable is the difference of logged year-to-date total loan originations from 1994 Q1 to 2003 Q4. Different from the baseline specification, the covariates related to assets and investment capital are measured once for each credit union for several windows during the Great Recession. Above, $\Delta^{4\delta}$ denotes a difference across δ years. Coefficients and standard errors (in parentheses) are multiplied by 100. Every regression includes year, quarter, and credit union fixed effects; standard errors are two-way clustered by credit union and year-quarter. Statistical significance: 0.1*, 0.05**, and 0.01***.

The next part considers cross-sectional regressions of the annual growth rate of pre-crisis lending on asset losses during the crisis (instrumented for with changes in investment capital, the ratio of investment capital to total assets, and the interaction of these variables). As before, the columns specify the timeframe during which losses in the Great Recession are measured. The goal of this analysis is to verify that credit unions that ended up having larger losses did not tend to either have lower lending growth to begin with or were expanding lending rapidly prior to the bursting of the housing bubble.

Table 15: Placebo Test: Pre-Crisis Lending

	(1)	(2)	(3)	(4)
$\tau =$	2009		2010	
$\delta =$	1	2	1	2
	Panel A: Pre-Crisis Lending 2004-2005			
$\Delta^{4\delta} \ln A_{i,\tau}$	-0.51	-0.23	0.25	0.11
	(0.78)	(0.34)	(0.74)	(0.39)
Observations	5,348	5,322	4,773	4,755
	Panel B: Pre-Crisis Lending 2005-2006			
$\Delta^{4\delta} \ln A_{i,\tau}$	1.38	0.75*	-0.55	0.31
	(0.90)	(0.39)	(1.13)	(0.58)
Observations	5,494	5,479	4,889	4,875
	Panel C: Pre-Crisis Lending 2006-2007			
$\Delta^{4\delta} \ln A_{i,\tau}$	-0.39	0.01	0.34	0.06
	(0.70)	(0.27)	(0.32)	(0.28)
Observations	5,519	5,524	4,915	4,911

Note: The dependent variable is the annual difference of logged year-to-date total loan originations over 2005, 2006, and 2007 (panels A, B, and C, respectively). Asset losses, and the corresponding instruments, are measured over several window periods. Above, $\Delta^{4\delta}$ denote a difference across δ years. Coefficients and standard errors (in parentheses) are multiplied by 100. Every regression includes county and credit union field of membership fixed effects; standard errors are clustered by state. Statistical significance: 0.1*, 0.05**, and 0.01***.

Internet Appendix (Not for Publication)

D. Additional Summary Statistics

Table 16: Field of membership

Field of membership	NPCUs	Field of membership	NPCUs
Associational		Multiple common bonds	
Faith-based	257	Primarily educational	341
Fraternal	56	Primarily military	67
Other	104	Primarily federal, state, local government	428
Occupational		Primarily chemical	61
Educational	196	Primarily petroleum refining	44
Military	21	Primarily primary and fabricated metals	54
Federal, state, local government	274	Primarily machinery	37
Occupational – manufacturing		Primarily transportation equipment	38
Chemicals	33	Primarily other manufacturing	227
Petroleum refining	13	Primarily finance	73
Primary and fabricated metals	37	Primarily healthcare	177
Machinery	28	Primarily transportation	101
Transportation Equipment	13	Primarily communications and utilities	172
Other	171	Primarily faith-based	73
Occupational – services		Other	
Finance	52	Single common bond – other	13
Healthcare	101	Multiple common bond – other	209
Transportation	22	Non-federal credit union (state chartered)	3,094
Communications and uitilities	101	Community credit union	1,182
Total			7,870

Note: Most credit unions are formed around a common association and mainly transact with people affiliated with the credit union's particular association. This table shows the number of credit unions associated with each field of membership in Q1 2009.

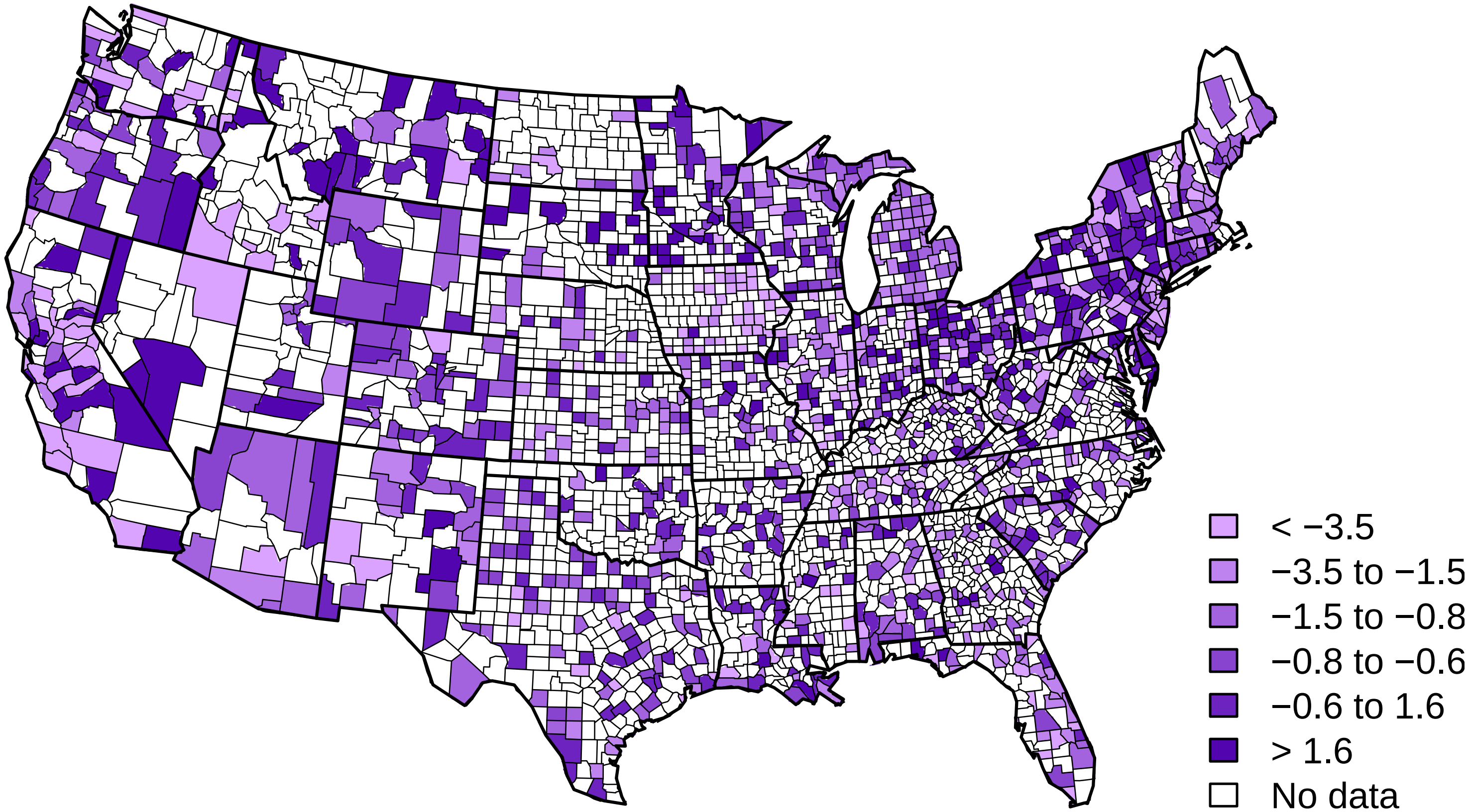

Figure 6: Average Change in Investment Capital Value During 2008 Q4

Note: This graph plots the within-county average logged change in investment capital (multiplied by 100) from the beginning to the end of 2008 Q4. The subsample used for generating this plot is the same used to estimate the baseline specification for the logged change in total lending. That is, the same outlier credit unions are omitted from this subsample. The variation in color across across counties indicates that credit unions in different regions typically experienced very different investment capital losses.

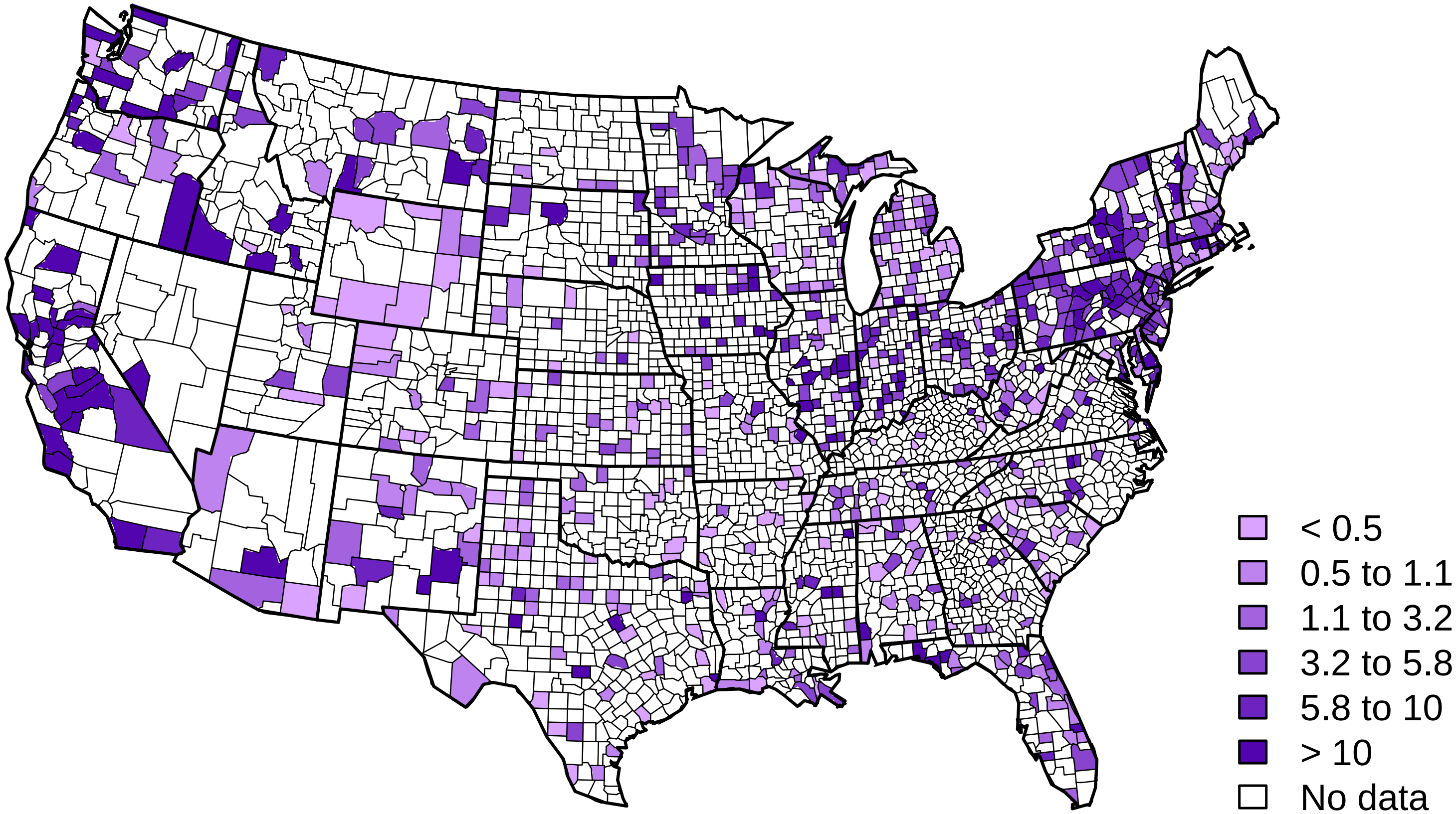

Figure 7: Standard Deviation of Changes in Investment Capital Value During 2008 Q4

Note: This graph plots the within-county standard deviation of logged changes in investment capital (multiplied by 100) from the beginning to the end of 2008 Q4. The subsample used for generating this plot is the same used to estimate the baseline specification for the logged change in total lending. That is, the same outlier credit unions are omitted from this subsample. The prevalence of darker shades indicates that there was significant within-county variation in investment capital losses. Fewer counties report data here as there is no standard deviation to report for counties with only one credit union in the subsample.

Table 17: March 2006 Corporate Credit Union Balance Sheets

Name	Assets (bil. \$)	Equity (mil. \$)	$\frac{\text{Equity}}{\text{Assets}}$ (%)	$\frac{\text{NS Liabilities}}{\text{Assets}}$ (%)	$\frac{\text{GMBS}}{\text{Assets}}$ (%)	$\frac{\text{PIMBS}}{\text{Assets}}$ (%)	$\frac{\text{OABS}}{\text{Assets}}$ (%)	$\frac{\text{ABS}}{\text{Assets}}$ (%)
Western Corporate	26.84	824.77	3.07	31.16	2.43	40.98	21.47	64.89
Southwest Corporate	8.94	235.02	2.63	9.81	1.77	15.96	24.86	42.59
TriCorp	0.50	16.51	3.32	24.88	1.88	0.00	0.07	1.95
Members United	4.76	211.48	4.45	10.68	3.72	0.50	33.77	37.99
VaCorp	0.90	32.30	3.59	16.87	10.67	0.00	0.00	10.67
Southeast Corporate	3.44	122.37	3.56	11.32	5.96	9.83	15.46	31.26
Mid-Atlantic Corporate	2.15	71.92	3.34	9.29	2.63	0.46	0.01	3.10
Empire Corporate	3.44	151.66	4.41	8.40	1.37	16.07	18.82	36.25
Eastern Corporate	1.17	57.92	4.93	10.05	10.37	0.72	5.32	16.41
LICU Corporate	0.01	1.46	27.19	0.18	0.00	0.00	0.00	0.00
Kentucky Corporate	0.38	18.47	4.85	5.45	0.00	0.00	0.00	0.00
Corporate One	3.02	110.65	3.66	23.31	4.06	4.71	31.78	40.55
Midwest Corporate	0.17	6.95	4.03	10.55	0.00	0.00	0.54	0.54
Northwest Corporate	0.88	32.36	3.69	15.63	1.22	7.87	6.29	15.38
Constitution Corporate	1.57	41.29	2.62	8.99	0.79	26.82	22.52	50.13
US Central	35.87	856.78	2.39	23.73	6.55	21.52	42.44	70.51
System United Corporate	2.28	87.44	3.83	15.39	8.73	3.23	8.90	20.86
West Virginia Corporate	0.24	8.43	3.47	12.76	0.00	0.00	0.00	0.00
Catalyst Corporate	1.38	47.46	3.43	6.61	1.28	0.00	1.53	2.81
First Corporate	0.78	31.25	4.03	27.96	6.53	0.00	4.04	10.57
Iowa Corporate Central	0.25	15.95	6.43	16.63	0.16	0.00	0.34	0.50
First Carolina Corporate	1.59	80.16	5.04	13.55	5.28	0.00	4.19	9.46
Corporate America	0.86	29.91	3.49	14.92	9.82	0.00	5.11	14.92
Louisiana Corporate	0.20	6.61	3.36	16.10	4.64	1.50	3.13	9.27
C. Credit Union Fund, Inc.	0.24	9.30	3.88	14.22	0.05	0.00	0.97	1.02
Kansas Corporate	0.36	16.05	4.44	18.87	5.22	0.00	0.21	5.43
Volunteer Corporate	0.89	25.36	2.83	9.54	9.66	1.68	1.16	12.50
Central Corporate	1.99	92.07	4.62	12.78	0.35	1.95	9.29	11.58
Missouri Corporate	0.61	38.55	6.34	10.03	0.00	0.00	0.00	0.00
Corporate Central	1.37	58.47	4.28	50.07	8.21	0.00	3.53	11.74
Treasure State Corporate	0.18	6.64	3.62	12.08	0.00	0.00	0.00	0.00
Mean	3.46	107.92	4.67	15.22	3.66	4.96	8.57	17.19
Standard deviation	7.75	204.08	4.28	9.30	3.62	9.68	11.79	19.81

Note: This table reports balance sheet characteristics of corporate credit unions. "NS liabilities" refers to non-share and non-equity liabilities, "GMBS" are government and agency mortgage-related issues, "PIMBS" are privately-issued mortgage-related issues, "OABS" are other asset-backed securities", and "ABS" is the sum of GMS, PIMBS, and OABS.

Table 18: December 2009 Corporate Credit Union Balance Sheets

Name	Assets (bil. $)	Equity (mil. $)	$\frac{\text{Equity}}{\text{Assets}}$ (%)	$\frac{\text{NS Liabilities}}{\text{Assets}}$ (%)	$\frac{\text{GMBS}}{\text{Assets}}$ (%)	$\frac{\text{PIMBS}}{\text{Assets}}$ (%)	$\frac{\text{OABS}}{\text{Assets}}$ (%)	$\frac{\text{ABS}}{\text{Assets}}$ (%)
Western Corporate	21.11	-8580.16	-406.45	46.21	2.89	0.00	12.94	15.83
Southwest Corporate	7.92	-1118.02	-141.11	0.59	0.94	0.00	14.42	15.36
TriCorp	0.95	0.93	0.98	0.13	1.23	0.00	0.01	1.24
Members United	8.37	-1139.81	-136.22	2.94	1.67	0.00	7.17	8.83
VaCorp	1.44	-0.97	-0.68	0.39	4.99	0.00	0.00	5.00
Southeast Corporate	3.33	-101.77	-30.52	0.88	5.10	0.00	6.06	11.16
Mid-Atlantic Corporate	3.82	4.53	1.19	1.30	0.13	0.00	3.22	3.34
Eastern Corporate	0.84	19.63	23.24	1.70	20.71	0.00	5.36	26.07
Kentucky Corporate	0.44	-2.01	-4.54	0.19	0.00	0.00	0.00	0.00
Corporate One	3.30	-206.41	-62.57	3.94	4.28	0.00	45.04	49.31
Midwest Corporate	0.19	-0.01	-0.04	0.22	0.00	0.00	7.73	7.73
Constitution Corporate	1.29	-209.30	-162.05	2.01	2.50	0.00	10.38	12.89
US Central	35.07	-6675.66	-190.33	43.36	3.06	0.00	35.59	38.65
System United Corporate	2.47	-98.19	-39.82	2.03	5.85	0.00	14.02	19.87
West Virginia Corporate	0.24	-1.16	-4.76	1.06	0.00	0.00	0.00	0.00
Catalyst Corporate	2.52	-0.39	-0.15	0.16	7.13	0.00	0.00	7.13
First Corporate	0.95	-16.14	-16.91	0.25	15.76	0.01	3.11	18.88
Iowa Corporate Central	0.09	5.42	61.28	0.16	0.19	0.07	0.03	0.29
First Carolina Corporate	1.78	-24.60	-13.81	6.16	11.95	0.00	7.50	19.46
Corporate America	2.19	51.58	23.58	8.83	49.95	0.00	0.87	50.81
Louisiana Corporate	0.16	-2.40	-15.09	3.30	14.20	0.04	0.78	15.02
Kansas Corporate	0.34	0.20	0.60	5.39	12.85	0.02	0.04	12.91
Volunteer Corporate	1.55	0.32	0.20	14.94	12.56	0.00	5.36	17.93
Central Corporate	2.97	-19.23	-6.49	3.61	9.66	0.00	1.25	10.92
Missouri Corporate	0.90	-0.07	-0.08	3.16	0.00	0.00	0.00	0.00
Corporate Central	1.77	61.85	34.95	6.63	12.48	0.00	24.09	36.58
Treasure State Corporate	0.37	0.05	0.13	0.05	0.00	0.00	0.00	0.00
Mean	3.94	-668.59	-40.20	5.91	7.41	0.01	7.59	15.01
Standard Deviation	7.52	2045.43	95.23	11.70	10.36	0.02	11.24	14.43

Note: This table reports balance sheet characteristics of corporate credit unions. "NS liabilities" refers to non-share and non-equity liabilities, "GMBS" are government and agency mortgage-related issues, "PIMBS" are privately-issued mortgage-related issues, "OABS" are other asset-backed securities", and "ABS" is the sum of GMS, PIMBS, and OABS. Empire Corporate merged with Mid-States Corporate to form Members United in mid-2006. Northwest Corporate was acquired by Southwest Corporate in 2007. In mid-2007 Member United merged with Central Credit Union Fund, Inc.. These items were not available for LICU Corporate in December 2009.

E. Additional Regressions

Table 19: Share of Mortgages in New Loan Originations

	(1)	(2)	(3)	(4)
ΔR_{t-1}	-27.97**	-27.22**	-28.30**	-31.28**
	(12.00)	(12.38)	(13.03)	(14.76)
$\Delta \ln A_{i,t-1}$	2.56	3.08	2.98	3.28
	(2.90)	(2.34)	(2.28)	(2.42)
$\Delta R_{t-1} \times \Delta \ln A_{i,t-1}$	6.28**	6.24**	6.47**	7.59**
	(2.64)	(2.78)	(2.85)	(3.11)
$\ln \text{members}_{i,t-1}$		9.97*	9.99*	13.24**
		(5.20)	(5.12)	(5.36)
$\frac{\text{Net worth}_{i,t-1}}{\text{Assets}_{i,t-1}}$		0.24	0.16	0.23
		(0.99)	(0.99)	(1.18)
$\Delta \ln \text{LLA}_{i,t-1}$		-0.48	-0.46	-1.01
		(1.03)	(1.05)	(1.09)
$\text{UR}_{i,t-1}$			0.22	0.19
			(0.52)	(0.75)
$\Delta \ln \text{ZHVI}_{i,t-1}$				-8.00
				(7.70)
Observations	70,844	70,805	70,129	50,810

Note: The dependent variable is the quarterly difference of the share of fixed-rate 30-year mortgage originations in the total volume of loan originations. Coefficients and standard errors (in parentheses) are multiplied by 100. Every regression includes quarter, year, and credit union fixed effects; standard errors are two-way clustered by credit union and year-quarter. The sample period is Q3 2004 to Q4 2011. Statistical significance: 0.1*, 0.05**, and 0.01***.

Table 20: Time Fixed Effects

	(1)	(2)	(3)	(4)	(5)	(6)
	Total Lending			Mortgage Lending		
	Volume	Number	Size	Volume	Number	Size
$\Delta \ln A_{i,t-1}$	0.67	4.35	0.81	3.15	3.73	0.16
	(1.68)	(3.76)	(0.66)	(3.83)	(3.51)	(1.57)
$\Delta R_{t-1} \times \Delta \ln A_{i,t-1}$	0.94	4.89	-0.05	17.31*	11.96	2.79
	(5.61)	(10.86)	(3.16)	(10.06)	(8.47)	(4.46)
Observations	166,932	150,317	150,121	70,886	70,575	70,602

Note: The dependent variables are the quarterly difference of logged, year-to-date total loan originations. Coefficients and standard errors (in parentheses) are multiplied by 100. Every regression includes time (year-quarter), NPCU, and county-time fixed effects; standard errors are two-way clustered by credit union and year-quarter. The sample period is Q2 2004 to Q4 2011. Statistical significance: 0.1*, 0.05**, and 0.01***.

Table 21: Investment Capital Corr. with Regional and Credit Union Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)
$\text{UR}_{i,t-2}$	-0.21				-0.12	-0.13
	(0.26)				(0.29)	(0.24)
$\Delta \ln(\text{House Prices}_{i,t})$		4.37			0.76	-7.64
		(9.43)			(9.75)	(10.35)
$\text{Mort. Delinq.}_{i,t-1}$			-0.21		-0.16	-0.15
			(0.13)		(0.11)	(0.09)
D.ln.abs				-0.02		-0.04
				(0.07)		(0.08)
Observations	98,824	99,063	90,927	48,164	89,771	43,555
R2	0.12	0.11	0.12	0.13	0.12	0.13

Note: The dependent variable is the product of the quarterly logged difference in investment capital and the share of investment capital in total assets. The timing differences of the dependent variable and the independent variables are the same as in the main regressions. Coefficients and standard errors (in parentheses) are multiplied by 10,000. Given this scaling, the economic magnitude of these coefficients is extremely small and the correlations are close to 0. Every regression includes year, quarter, and credit union fixed effects; standard errors are two-way clustered by credit union and year-quarter. The sample period is Q2 2004 to Q4 2011. Statistical significance: 0.1*, 0.05**, and 0.01***.

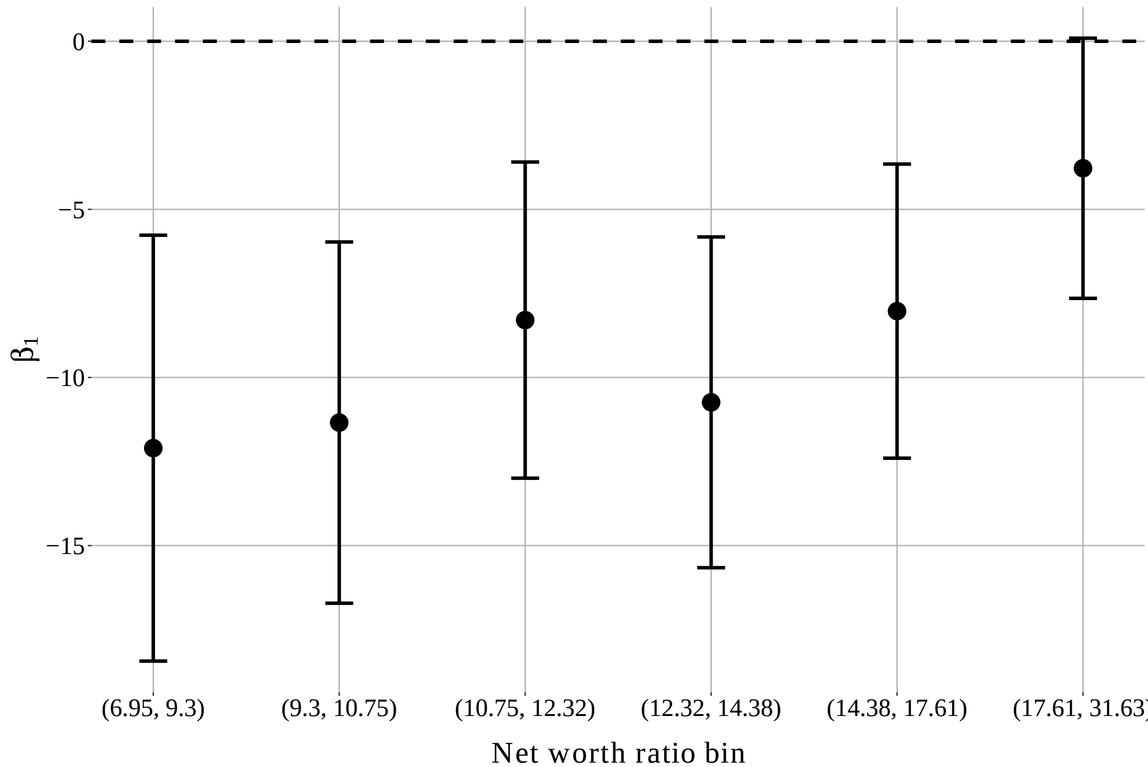

Figure 8: A Nonlinear Breakdown of Policy Rate Sensitivity By Net Worth

Note: This graph plots point estimates for the effect of changes in the policy rate on lending conditional on a credit union having its net worth within a particular range. The bars denote the 90% confidence interval. The net worth ratio bins split the sample into six equally-sized quantiles by net worth ratio. This is one of the key ratios on which credit union capital adequacy is regulated. The units for the net worth groups are reported in percentage points. **Regression details:** The dependent variable is the quarterly logged difference in total loan originations year-to-date. Coefficients are multiplied by 100. Each regression includes year, quarter, and credit union fixed effects; standard errors are two-way clustered by credit union and year-quarter. The sample period is Q2 2004 to Q4 2011. This regression is identical to the baseline regression except that (1) there are additional endogenous regressors as the policy rate is interacted with dummies for the credit union's net worth ratio bin at time $t-1$ and (2) interactions of the futures surprises with the bin dummies are added to the set of instruments.

The coefficients on $\Delta \ln A_{i,t-1}$ and $\Delta R_{t-1} \times \Delta \ln A_{i,t-1}$ are 0.53 and 1.57, respectively. The coefficient on the interaction term is significant at the 5% level. Compared to the main results, which estimate a value between 1.7-2, this is smaller. This is consistent with part of the effects of asset losses on sensitivity to the policy rate operating through decreased net worth and greater proximity to regulatory minimums. However, the large and significant coefficient suggests that there is still a significant part of the effect of asset losses on sensitivity that is distinct from their effect on regulatory ratios. This could be due to greater external costs of finance as in the 2$^{\text{nd}}$ model considered in section II. Future research may find it worthwhile to better explore the exact channels through which asset losses affect lending and its sensitivity to the policy rate.

Table 22: Mortgage Subsample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Total Lending (volume)				Mortgage Lending (volume)			
ΔR_{t-1}	-15.06***	-14.83***	-14.89***	-15.36***	-44.35***	-44.55***	-43.49***	-45.20***
	(5.12)	(5.35)	(5.13)	(5.16)	(15.79)	(16.92)	(16.07)	(15.78)
$\Delta \ln A_{i,t-1}$	2.09	2.12	1.76	1.18	3.24	3.58	3.65	1.54
	(1.33)	(1.31)	(1.11)	(1.17)	(4.16)	(4.12)	(3.36)	(3.31)
$\Delta R_{t-1} \times \Delta \ln A_{i,t-1}$	2.65**	2.62**	2.56**	2.48**	8.78**	8.91**	8.69**	8.60**
	(1.22)	(1.26)	(1.24)	(1.26)	(3.46)	(3.62)	(3.58)	(3.56)
$\text{UR}_{i,t-2}$		-0.22		-0.03		0.11		0.63
		(0.26)		(0.26)		(0.75)		(0.80)
$\Delta \ln(\text{House Prices}_{i,t})$		-3.15		-2.33		-71.83		-83.45
		(28.38)		(27.53)		(85.08)		(78.51)
Mort. $\text{Delinq.}_{i,t-1}$				-0.18				-0.61
				(0.16)				(0.50)
$\ln \text{Members}_{i,t-1}$			-1.98	-3.41			6.81	3.18
			(2.83)	(2.95)			(8.76)	(9.59)
$\frac{\text{Net worth}_{i,t-1}}{\text{Assets}_{i,t-1}}$			0.42	0.22			0.2	-0.84
			(0.43)	(0.50)			(1.42)	(1.53)
$\Delta \ln(\text{LLA}_{i,t-1})$			0.17	0.32			-0.89	-0.88
			(0.43)	(0.46)			(0.99)	(0.99)
Observations	70,886	69,767	70,845	63,873	70,886	69,767	70,845	63,873

Note: The dependent variable is the quarterly difference of the volume of total loan originations (columns 1-4) and that of fixed-rate 30-year mortgages (columns 5-8). The sample in columns 1-4 is restricted to be the exact sample for which the main mortgage volume estimates are computed. Larger credit unions tend to have positive mortgage loan originations consistently each quarter and report them. It is not clear if these missing observations are due to failures to report, underreporting of a small volume, or a lack or mortgage lending. This suggests part of the reason the mortgage coefficients are so large is the selection of the this sample towards larger credit unions. This is not surprising as, noted in the regressions that assess other determinants of policy rate sensitivity, credit unions with more members tend to be more responsive to monetary easing. The coefficients for total lending nearly double within this subsample. Coefficients and standard errors (in parentheses) are multiplied by 100. Every regression includes quarter, year, and credit union fixed effects; standard errors are two-way clustered by credit union and year-quarter. The sample period is Q3 2004 to Q4 2011. Statistical significance: 0.1*, 0.05**, and 0.01***.

Table 23: Persistence: Total Lending (dependent variable: $\ln L_{i,t+\tau} - \ln L_{i,t-1}$)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$\tau =$	0	1	2	3	4	5	6	7	8	9	10	11
						Panel A: Volume						
ΔR_{t-1}	-8.58***	-18.02***	-14.60*	-20.76**	-5.04	-22.48**	-20.21**	-22.60*	-12.12	-5.26	-7.45	-11.27
	(3.07)	(6.66)	(8.00)	(8.34)	(6.15)	(11.03)	(9.97)	(13.41)	(9.11)	(16.65)	(9.97)	(9.57)
$\Delta \ln A_{i,t-1}$	1.94	6.74**	7.91**	5.62	3.61	8.12*	7.30*	10.82**	6.93*	12.45**	8.60*	8.30**
	(1.24)	(2.76)	(3.42)	(4.07)	(2.64)	(4.27)	(4.38)	(5.03)	(4.09)	(5.25)	(4.65)	(4.14)
$\Delta R_{t-1} \times \Delta \ln A_{i,t-1}$	1.78**	5.25***	5.23***	4.11*	1.37	5.24*	4.54	7.57**	4.03*	3.80	3.38	4.61*
	(0.77)	(1.85)	(1.74)	(2.37)	(1.39)	(2.89)	(3.00)	(3.70)	(2.34)	(3.71)	(2.90)	(2.59)
Obs.	166,932	166,818	165,978	165,837	165,034	164,789	163,943	163,738	162,955	162,714	161,895	161,705
						Panel B: Number						
ΔR_{t-1}	-3.18	-6.37*	-5.62*	-5.32	-0.97	-12.59*	-7.86	-8.84	-1.83	-0.23	-1.81	-4.53
	(2.28)	(3.57)	(3.38)	(5.98)	(3.86)	(7.21)	(5.97)	(8.93)	(6.44)	(10.90)	(4.74)	(6.46)
$\Delta \ln A_{i,t-1}$	1.98**	3.45**	2.78	4.10*	2.51	7.89**	2.26	6.75*	5.25	8.48**	3.16	6.55*
	(0.96)	(1.69)	(2.32)	(2.15)	(2.33)	(3.43)	(2.85)	(3.68)	(3.57)	(4.14)	(2.99)	(3.35)
$\Delta R_{t-1} \times \Delta \ln A_{i,t-1}$	1.25*	2.20**	1.98**	1.73	0.91	4.05**	1.89	3.54	1.76	1.98	1.38	3.19*
	(0.66)	(0.98)	(0.93)	(1.52)	(1.15)	(2.02)	(1.65)	(2.41)	(1.81)	(2.54)	(1.52)	(1.80)
Obs.	150,317	149,784	149,102	149,032	148,369	148,294	147,620	147,670	147,010	146,785	146,101	145,913
						Panel C: Size						
ΔR_{t-1}	-6.93***	-10.75***	-11.36***	-11.55**	-5.29*	-8.86	-15.89**	-16.28**	-11.39**	-4.88	-7.29	-8.54
	(2.01)	(3.28)	(4.27)	(4.59)	(3.02)	(5.66)	(7.18)	(7.93)	(4.54)	(5.98)	(6.49)	(6.88)
$\Delta \ln A_{i,t-1}$	0.36	1.22	1.91	1.19	-0.29	-1.73	2.97	4.39	0.46	2.50	2.38	1.00
	(0.96)	(1.45)	(1.87)	(2.12)	(1.64)	(2.02)	(2.86)	(2.96)	(2.02)	(2.57)	(3.16)	(3.65)
$\Delta R_{t-1} \times \Delta \ln A_{i,t-1}$	0.92	2.55***	2.85**	1.63	0.27	0.52	2.91	4.73**	2.37**	1.72	1.96	1.76
	(0.61)	(0.88)	(1.25)	(1.41)	(0.91)	(1.56)	(1.82)	(2.06)	(1.05)	(1.52)	(1.79)	(1.78)
Obs.	150,121	149,592	148,909	148,828	148,152	148,087	147,400	147,436	146,777	146,540	145,855	145,668

Note: The dependent variables are the quarterly difference of logged, year-to-date total loan originations. The first column corresponds to the baseline regressions. Moving further to the right, the horizon over which the change in lending is measured increases by a quarter. Coefficients and standard errors (in parentheses) are multiplied by 100. Every regression includes time (year-quarter), NPCU, and county-time fixed effects; standard errors are two-way clustered by credit union and year-quarter. The sample period is Q3 2004 to Q4 2011. Statistical significance: 0.1*, 0.05**, and 0.01***.

Table 24: Persistence: Mortgage Lending (dependent variable: $\ln L_{i,t+\tau} - \ln L_{i,t-1}$)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$\tau =$	0	1	2	3	4	5	6	7	8	9	10	11
	Panel A: Volume											
ΔR_{t-1}	-44.35***	-71.03***	-77.40***	-71.71**	-26.55	-54.06*	-73.86***	-52.71	-27.27	-20.24	-29.77	-27.74
	(15.79)	(17.08)	(23.88)	(29.86)	(29.64)	(29.94)	(28.55)	(37.52)	(39.29)	(35.77)	(29.02)	(25.96)
$\Delta \ln A_{i,t-1}$	3.24	11.53***	16.11***	14.74***	11.99**	13.11*	17.86***	21.41***	16.28***	14.99**	8.52	12.74*
	(4.16)	(4.26)	(4.80)	(5.29)	(5.50)	(7.00)	(6.21)	(7.14)	(6.22)	(7.48)	(6.78)	(6.86)
$\Delta R_{t-1} \times \Delta \ln A_{i,t-1}$	8.78**	17.35***	20.76***	14.02**	7.52	10.14	14.41**	16.63**	10.83	9.49	8.20	9.52
	(3.46)	(3.89)	(5.22)	(6.28)	(5.95)	(7.14)	(6.70)	(7.39)	(7.31)	(7.77)	(6.33)	(6.36)
Obs.	70,886	66,144	64,303	64,577	64,542	62,782	61,944	62,425	62,564	61,038	60,383	61,026
	Panel B: Number											
ΔR_{t-1}	-43.40***	-72.66***	-76.92***	-62.30**	-42.62*	-72.02***	-75.89***	-61.13**	-45.33**	-24.71	-20.90	-31.11*
	(14.61)	(16.35)	(21.69)	(24.62)	(25.28)	(26.26)	(24.47)	(25.02)	(21.86)	(23.26)	(18.57)	(18.28)
$\Delta \ln A_{i,t-1}$	5.29*	14.43***	17.03***	16.68***	10.70**	13.18**	16.76***	16.33***	10.46**	9.11	4.22	8.49
	(3.20)	(4.39)	(4.91)	(4.84)	(5.46)	(6.21)	(5.70)	(6.17)	(5.24)	(6.29)	(5.62)	(6.23)
$\Delta R_{t-1} \times \Delta \ln A_{i,t-1}$	8.96***	18.48***	20.79***	13.95**	10.24*	13.99**	17.40***	16.75***	12.96***	8.60*	4.53	8.43*
	(3.10)	(3.91)	(4.82)	(5.52)	(5.72)	(6.29)	(6.06)	(5.68)	(4.51)	(4.97)	(4.25)	(4.79)
Obs.	70,575	65,389	63,543	63,750	63,567	61,932	61,106	61,589	61,648	60,258	59,630	60,205
	Panel C: Size											
ΔR_{t-1}	-1.93	3.44	-2.51	-12.43	5.81	7.97	2.16	3.35	3.48	-3.99	-8.88	-5.37
	(3.84)	(8.43)	(5.51)	(11.97)	(11.58)	(12.23)	(9.28)	(15.46)	(14.42)	(14.74)	(11.62)	(13.80)
$\Delta \ln A_{i,t-1}$	0.42	0.06	1.43	0.78	4.24**	3.66	4.84**	7.13**	6.15**	8.49***	6.47**	6.29*
	(0.91)	(2.27)	(1.74)	(2.77)	(1.87)	(2.41)	(2.38)	(2.97)	(2.49)	(3.03)	(3.14)	(3.31)
$\Delta R_{t-1} \times \Delta \ln A_{i,t-1}$	0.64	-0.69	1.19	1.54	0.25	-1.04	-1.80	1.62	0.79	3.02	3.97	3.48
	(0.85)	(2.11)	(1.22)	(2.04)	(2.34)	(2.40)	(1.98)	(3.44)	(3.02)	(3.32)	(2.80)	(3.05)
Obs.	70,602	65,531	63,724	63,908	63,848	62,190	61,326	61,753	61,918	60,513	59,838	60,375

Note: The dependent variables are the quarterly difference of logged, year-to-date fixed-rate 30-year mortgage originations. The first column corresponds to the baseline regressions. Moving further to the right, the horizon over which the change in lending is measured increases by a quarter. Coefficients and standard errors (in parentheses) are multiplied by 100. Every regression includes time (year-quarter), NPCU, and county-time fixed effects; standard errors are two-way clustered by credit union and year-quarter. The sample period is Q3 2004 to Q4 2011. Statistical significance: 0.1*, 0.05**, and 0.01***.