From Wall Street to Main Street: The Impact of the Financial Crisis on Consumer Credit Supply

Rodney Ramcharan* Stéphane Verani Skander J. Van den Heuvel [1]

Abstract

This paper studies how the collapse of the asset backed securities (ABS) market during the financial crisis of 2007-2009 affected the supply of credit to the broader economy using a new dataset that describes unique interbank relationships within the credit union industry—a key supplier of consumer credit. We find that ABS related losses at correspondent credit unions are associated with a large contraction in the supply of consumer credit, especially among those downstream credit unions that began the crisis with lower capital asset ratios. We also find that this contraction in credit supply may have restricted the availability of mortgage credit, and spilled over into the market for consumer durables such as automobiles. These results show how movements in the prices of financial assets can affect the real economy.

[1]All authors are at the Federal Reserve Board. Corresponding Author*: Rodney.Ramcharan@frb.gov. stephane.h.verani@frb.gov and skander.j.vandenheuvel@frb.gov. The authors thank Maxim Massenkoff and Jeremy Oldfather for excellent research assistance. The authors are also grateful to seminar participants at the Federal Reserve Bank of Boston, Federal Reserve Board, FIRS, IMF, NBER Monetary Economics Meeting, NBER Risks of Financial Institutions Meeting and the NCUA for comments. We also thank Jose Berrospide, Giovanni Favara, Diana Hancock, Rustom Irani, Stephen LeRoy, Anil Kashyap, Ralf Meisenzahl, Alberto Rossi, Wayne Passmore, Joe Peek, Andre Shleifer, Amit Seru, Amir Sufi and James Wilcox for helpful comments. We are also indebted to John Worth and David Shetler for the data. The views expressed in this paper are solely the responsibility of the authors and should not be interpreted as reflecting the views of the Board of Governors of the Federal Reserve System or of anyone else associated with the Federal Reserve System.

Introduction

Most narratives broadly agree that the proximate cause of the 2007-2009 financial crisis centered around the collapse of the housing bubble in the United States. Mortgages and other loans were securitized into asset backed securities (ABS), which were held on the balance sheet of banks and distributed widely throughout the financial system. Falling house prices and rising mortgage defaults then led to sharp declines in the price of mortgage and other types of ABS, igniting concerns about the liquidity and solvency of the banking sector (Brunnermeier (2009), Keys, Mukherjee, Seru and Vig (2010), Shleifer and Vishny (2011)).

Less well understood however, is how the financial crisis—initially centered in the ABS market—might have led to the Great Recession. There is already powerful evidence that household leverage during the boom in conjunction with falling house prices during the bust may have depressed consumer demand, helping to engender the relatively slow recovery in output growth, employment and consumption (Mian and Sufi (2011)). But the ABS related balance sheet losses incurred by the financial sector may have also led to a fundamental post crisis disruption in credit intermediation, contributing to the recession and slow economic recovery. The goal of this paper then is to study how the financial crisis and in particular, the collapse of the ABS market, might have affected the supply of credit to consumers. We also use microeconomic data from the housing and automobile markets to measure better the real consequences of this credit shock.[2]

The traditional challenges to inference in any such analysis center around measurement and identification issues.[3] In the case of the latter, economic theory does suggest that illiquidity in one corner of the banking sector, and large realized balance sheet losses could engender a contraction in the aggregate supply of credit and economic activity (Allen and Gale (2000), Diamond and Rajan (2005, 2011), Shleifer and Vishny (2010)). However, the decline in house prices and household net worth, as well as the general economic uncertainty accompanying the financial crisis could themselves reduce the demand for credit among consumers, leading to an

[2] Chodorow-Reich (2013) also use detailed micro data to studying in this case how distress in the banking system might have affected employment, measured at the firm level. At the more aggregate level, Ivashina and Scharfstein (2010) examine the impact of the crisis on credit supply in the syndicated loan market; Cornett et. al. (2010) look more broadly at credit in the banking system, while Puri et.al (2011) focus on the international spillovers from the US crisis.

[3] Empirical research in this area has followed a diverse set of strategies to overcome these challenges. See for example, Khwaja and Mian (2008), Paravisini (2008), and Peek and Rosengren (1997).

observationally similar reduction in bank lending and economic activity.

Measuring the impact of the crisis on the balance sheet of individual banks can be equally difficult. Financial institutions are typically connected in many ways: contractual relationships, as well as exposures to similar assets, markets and counterparties (Khang et. al (2010)). Because of these connections, an institution might be exposed to the ABS market both through its direct holdings of these securities on its balance sheet, as well as indirectly through the counterparties with whom the institution interacts. These unobserved indirect exposures can be equally important in shaping lending decisions.

To address these measurement and identification challenges, we use a new dataset that describe unique institutional features of the credit union industry in the United States. This industry competes with banks and features prominently in consumer credit, serving about 90 million people in the US.[4] In the aggregate, credit unions account for about 25 percent of auto financing and around 11 percent of all consumer installment credit in the United States. And at the end of 2010, total assets in the credit union system were about 1.4 times larger than the combined assets of those banks that traditionally specialize in consumer lending—community banks and smaller neighborhood banks.[5]

The credit union system has traditionally been self-contained and structured into three tiers. This unique structure is at the cornerstone of our identification strategy. The contractual relationships that define this structure allowed the shocks emanating from the collapse of ABS prices to diffuse onto the balance sheet of credit unions in a manner that is precisely measurable, and plausibly unrelated to local economic conditions or the local demand for credit. Therefore, this structure can help in understanding how the transmission of shocks within a financial network might affect local lending.

At the bottom of the three tiered system are natural person credit unions (NPCUs), which are organized around individuals with a common bond or field of membership.[6] NPCUs operate in the model of traditional local banking, specializing in making loans to and taking deposits from geographically proximate consumers and small businesses within this common bond. Most NPCUs have virtually no direct exposure to financial products such as ABS, and to realize scale

[4] Credit unions require a special exemption to originate business loans in excess of 12.5 percent of total assets.
[5] The importance of credit unions relative to banks tend to decline when including the assets of the larger banks, those whose portfolios include a greater share of commercial and investment lending.
[6] Examples of fields of membership include: university employees; local government workers; corporate employees; members of religious institutions, and residents living within a specific radius of some towns.

economies in the provision of financial services, NPCUs pool membership and paid in capital—henceforth investment capital—to create larger retail corporate credit unions (CCUs)—the next step up in the tier. Investment capital is perpetual capital and is intended to cover losses at CCUs in excess of earnings and reserves.[7] Above the retail CCUs is a single wholesale CCU that aggregates financial services within the credit union system relative to the rest of the financial system.

Retail corporate credit unions operate as correspondent banks for their member NPCUs, and do not provide credit to the general population. The basic model within the CCU system relies on investing deposits from member NPCUs in financial securities in order to manage liquidity within the industry. At the peak of the boom in 2006, ABS accounted for about 90 percent of the balance sheet of the typical CCU. The collapse of the ABS market in 2007-2009 led to the failure of the four largest CCUs as well as the single wholesale CCU.[8]

The resulting CCU ABS losses were in turn charged against investment capital held on the asset side of the balance sheet at member NPCUs in proportion to each NPCU's relative investment capital contribution to the CCU. These relative contributions reflect contractual relationships that preceded the financial crisis by decades in many cases, and are not likely to be related to local economic conditions. The regulator also assigned CCU losses to each NPCU based on its deposit share—an explicit and observable loss assignment rule that also aids identification. Furthermore, unlike banks, because most NPCUs lend within a narrow geographic area, controlling for local economic conditions can reduce considerably the potential for biased estimates due to latent credit demand.

Our results can be easily summarized. A one standard deviation decline in investment capital over the period 2007-2010 is associated with a 2.3 percentage point or 0.1 standard deviation decline in loan growth over the same period. This estimate suggests that the $7 billion in CCUs losses passed onto NPCUs through 2010 may have engendered upwards of a $50 billion contraction in credit supply. These results are robust to a number of spatially disaggregated controls, like house price dynamics and pre crisis consumer leverage, which absorb any systematic variation in latent credit demand that might correlate with investment capital balance

[7] The paid in and membership capital contributed by NPCUs to absorb losses at CCU are distinct from the capital that NPCUs use in order to meet their own capital requirements.
[8] As prices fell and the ABS market became illiquid, there was a total of only $2.4 billion in retained earnings available to cover about $30 billion in unrealized losses in the ABS market.

sheet losses at NPCUs. The point estimate is also little changed when controlling for NPCU and CCU measures of risk taking before the crisis.

To understand better the mechanisms underlying the contraction in credit, we exploit the cross-sectional differences in the way that NPCUs responded to these balance sheet shocks. In particular, theories of banking that emphasize bank capital's role as a buffer against adverse shocks would predict that those NPCUs that entered the crisis with more capital relative to assets may have been better able to insulate lending from the balance sheet losses associated with CCUs (Bhattacharya and Thakor (1993), Diamond and Rajan (2000), Peek and Rosengren (1995), Shleifer and Vishny (2010)). We indeed find that the pre-existing capital-asset ratio of a NPCU significantly dampened the impact of investment capital write-downs onto lending.

But to address further concerns about biased estimates arising from latent credit demand, we construct an instrument based upon CCU losses over 2007-2010. The institutional structure of the system would suggest that CCU investment decisions, and the resulting losses during the crisis are likely conditionally orthogonal to latent credit demand in a given county. We weight these losses by each NPCU relative investment shares in its CCU circa 2000. These shares are observed well before the boom and bust, and reflect the variation in pre-existing contractual exposures that are plausibly unrelated to the level or change in credit demand around the financial crisis. CCU losses during the crisis likely shifted NPCU credit supply through both actual and expected investment capital write-downs. And the IV estimate, which captures the variation in both actual and expected investment capital changes, is considerably larger than OLS, suggesting that these ABS losses may have had a powerful effect on shifting consumer credit supply.

We also analyze the impact of this lending contraction at the extensive margin using micro data from the housing and automobile market. Data on mortgage credit applications for example, which allows us to hold constant key applicant-level demographic and economic observables, show that those NPCUs with relatively less capital were far more likely to restrict mortgage credit availability at the extensive margin in response to investment capital losses. This contraction in credit availability was also disproportionately aimed at those applicants seeking the most leveraged mortgages. We also use a proprietary dataset that matches each car sold in the United States to the credit supplier, and demonstrate that NPCUs may have also pulled back significantly on automobile credit in response to their investment capital losses.

Taken together, these results suggest that the collapse in the price of financial securities backed by housing may have led to a sizeable contraction in credit availability in the real economy, impacting markets well beyond the housing sector, and perhaps helping to contribute to the Great Recession and the slow economic recovery. This paper proceeds as follows. Section 2 describes the data and institutional details; Section 3 presents the main results; Sections 4 studies the impact of the shock on the housing and automobile markets; we conclude in Section 5.

2. Institutional Background and Data

2.1 Institutional Background

Measurement and identification problems render it difficult to estimate the impact of the collapse of the ABS market on broader credit supply. Financial institutions are typically connected in many ways: Contractual relationships, as well as exposures to similar assets, markets and counterparties. And there is no readily available way to measure the full exposure of a financial intermediary to the ABS market (Khang et. al (2010)). Even if it were possible to measure an institution's direct and indirect exposure to the ABS market, financial institutions and their clients might be subject to the same aggregate shocks—the general economic uncertainty during the crisis, or the decline in credit demand during the subsequent recession. These common shocks in turn make it difficult to interpret any statistical relationship between the collapse of ABS prices and credit growth.[9]

The credit union system is an important supplier of consumer credit (Tables 1A-1C, and Table 2) and the institutional structure of this system, depicted in Figure 1A, helps in addressing these thorny measurement and identification issues. Natural person credit unions (NPCUs) generally have no direct exposure to financial products such as ABS, and instead operate in the model of traditional local banking: They fund themselves primarily through customer deposits

[9] For instance, a bank might curtail lending because of contagion effects emanating from the interbank market: one bank's distress from exposure to the ABS market might affect the balance sheet of another bank as in Allen and Gale (2000), forcing the latter bank to also restrict lending. But because these banks operate in the same markets or are members of the same network, they are also subject to common shocks—general economic uncertainty during the crisis and depressed credit demand among clients—that might also lead to an observationally identical decline in credit growth. This in turn makes it difficult to identify whether any observed decline in credit growth reflects a contraction in credit supply due to ABS related balance sheet shocks or instead some unobserved common shock.

and make loans to geographically proximate consumers and small business within a narrow field of membership. Firemen in a given county; employees of a specific corporation; or residents that live within a particular radius of a town might for example form a NPCU in order to use relationship based financial services (Table 3). Only in a handful of cases, primarily among the larger credit unions like Navy Federal, does lending extend beyond the hyper local. These institutional features suggest that local economic conditions and the field of membership are likely to be key determinants of potential credit demand for a given NPCU—information that we observe in our dataset.

To realize scale economies in the provision of payments, settlements, custodial services as well as liquidity management, NPCUs pool membership and paid in capital—investment capital—to create larger retail corporate credit unions (CCUs), which are the next step up in the tier. Figure 1B is an example of a credit union network. Membership and paid-in capital—investment capital—are intended to cover losses in excess of earnings at CCUs and are recorded as investments on the asset side of an NPCU's balance sheet. Also on the asset side of the NPCU balance sheet are the deposit accounts that NPCUs maintain at CCUs in order to manage liquidity. While the business model of NPCUs center on traditional relationship banking, corporate credit unions operate in the traditional correspondent bank mold: They do not make loans to the general population, but focus exclusively on providing financial services to their NPCU members. A single wholesale credit union—the now defunct US Central—further aggregates these financial services among the retail CCUs vis-à-vis the rest of the financial system.

Given their role as financial service providers to NPCUs, CCUs shrink and grow their balance sheets based on the needs of their member NPCUs. To this end, CCUs were active in the "AA" and "AAA" rated private label ABS market, and in the fall of 2008 there were approximately $63 billion of mortgage-backed securities in the CCU system.[10] Once the collapse in the ABS market began, expected losses were on the order of $30 billion, while there were only $2.4 billion in retained earnings within the CCU system to cover these losses. The four largest CCUs along with US Central eventually failed.

[10] At the time, regulations barred CCUs from investing in securities rated below AA. CCUs generally passed on profits from trading in ABS to their member NPCUs in the form dividends on share deposits, or through subsidies on fees for settlement and other services.

This institutional setup allowed the shocks emanating from the collapse in the asset backed securities (ABS) market on Wall Street to diffuse onto the balance sheet of local NPCUs in a manner that is precisely measurable and based on transparent institutional rules that are plausibly unrelated to local credit demand. As Figure 1B indicates, losses at a given CCU are primarily transmitted onto the balance sheet of its member NPCUs in proportion to each NPCU's initial investment capital stake.[11]

These initial stakes reflect contractual arrangements that precede the crisis by decades in many cases, and are relatively sticky. Federal regulations require membership capital to have a minimum duration of 3 years, either in the form of term certificates that have a minimum duration of three years, or adjustable balances with a minimum withdrawal notice of three years (www.ncua.gov). Paid in capital accounts typically have a 20 year minimum duration, and in terms of satisfying losses in excess of retained earnings at CCUs, are senior to membership capital. This stickiness would have made it difficult for NPCUs to adjust rapidly their investment capital position in a CCU either during the boom or in anticipation of the collapse. Instead, as Figure 2 indicates, NPCUs readily adjust their "regular" deposits in CCUs, and these deposits fell during the first few months of the crisis until they were guaranteed by the government.

In addition to writing down investment capital, the regulator, the National Credit Union Association (NCUA), also levies special assessments on NPCUs to cover the CCU ABS related losses. These assessments are proportional to a NPCU's insured deposits relative to total system deposits, and offer another source of conditionally exogenous variation in the assignment of CCU losses onto the balance of NPCUs.

In what follows, we use both these sources of variation: the depletion of investment capital and special assessments to measure more accurately a NPCU's total balance sheet exposure to CCU ABS losses. We also obtain similar results when using separately these different loss assignment rules.[12] In sum then, the variation in losses to contributed investment capital on the balance sheets of NPCUs and assessments provide a powerful and rare opportunity to study how the collapse of the ABS market might have affected credit supply to the broader economy during the Great Recession.

[11] From Figure 1B: If NPCU A (B) contributes \$1(\$3) to the \$4 of investment capital at CCU AB, then a \$1 loss at CCU AB translates into a \$0.25 (\$0.75) depletion of investment capital held on the balance sheet of NPCU A(B).

[12] Estimates of ABS related losses and conservatorship costs made at the end of 2010 were about \$15 billion. At that time, about \$7 billion in losses had already been passed onto NPCUs primarily through the depletion of investment capital (\$5.6 billion), as well as via special assessments (\$1.4 billion).

That said, the fact that a NPCU's decision to become a member of a particular CCU is not random but largely driven by historic and geographic factors suggests that common geographic trends could be a source of bias. For example, NPCUs in booming areas could have increased deposits at their associated CCU, inducing the latter to expand its balance sheet through holdings of ABS (Figure 2). The subsequent collapse in the ABS market could in turn coincide with a bust in the previous boom areas, leading to an independent contraction in credit growth at the member NPCUs. In this case, a positive correlation between the decline in lending growth and the depletion in investment capital would in fact be explained by latent geographic economic trends and the actions of NPCUs.

It is also possible that the additional profits that a CCU might have earned before the crisis from trading in the ABS market could affect the lending behavior of affiliated NPCUs. For example, those NPCUs affiliated with a CCU earning high returns from trading in ABS may themselves lend more aggressively during the boom. Large losses at the CCU during the bust could then chasten the affiliated NPCU management, making them more risk averse, and rendering the quiet life more attractive. This could in turn lead to a pattern of more subdued post crisis lending that is motivated by reasons distinct from the impact of investment capital related balance sheet losses.

Clearly then, some of these pre-existing differences across NPCUs could also shape their lending response to the balance sheet shock emanating from CCU failures, and in the empirical section, we focus on these issues. But from examining the lending profiles of NPCUs that were connected to CCUs that failed relative to those NPCUs that were connected to CCUs that did not fail, there appears to be little difference in the lending focus across these two groups. NPCUs, regardless of CCU affiliation, generally concentrated on automobile and housing related loans during the boom (Figure 3).

Why Did CCUs Fail?

While we condition on a large number of observables and construct several different tests to address these identification concerns, the institutional details surrounding the failure of the largest CCUs can also help guide the interpretation of the statistical evidence. Most notably, preliminary investigations into the CCU failures suggest that the actions of individual NPCUs

may have played little role in shaping CCUs' investment decisions. Instead, these investigations have identified corporate governance and management failures at the failed CCUs[13]; idiosyncratic shocks, such as the change in management in 2004 at WesCorp—the largest retail CCU—which led to excessive optimism and an aggressive growth strategy at WesCorp built around ABS[14] [15]; as well as regulatory deficiencies that allowed CCU portfolios to become overly concentrated in ABS.[16]

In addition, the regulator (NCUA) has successfully argued in court that the risks associated with the ABS products sold to the industry were misrepresented by the various investment bank purveyors. An implication of this legal theory is that CCUs bought ABS related products during the boom independent of any economic developments at local NPCUs, but based instead on incorrect information provided by the investment banks (www.ncua.gov).

Furthermore, the statistical evidence in the next section show that house price growth during the boom is unrelated to investment capital growth during the boom. We also show that NPCU lending growth during the housing boom is uncorrelated with their subsequent investment capital losses during the bust. We should also emphasize that because the government guaranteed all NPCU deposits at CCUs soon after the first CCU ABS losses were realized, no NPCU initiated a run on deposits at CCUs that could have led to fire sales and cascading losses at CCUs. That is, these regulatory interventions ensured that the CCU ABS losses during the crisis were not endogenously amplified by the behavior of NPCUs.

---

[13] Members United, one of the failed CCUs, had volunteers spread across two states helping to manage its $7 billion investment portfolio. Members United also relied heavily on monoline insurers to provide credit enhancement for its non-agency MBS portfolio; these enhancements turned out to be largely worthless during the crisis (www.cutimes.com). U.S. Central, the failed wholesale credit union, "doubled down" on the crisis, setting up the first off-balance sheet asset backed commercial paper conduit only weeks before the ABCP market unraveled.

[14] For example, Board minutes from WesCorp, the largest CCU failure, suggest that overly optimistic economic forecasts and modeling assumptions led senior management to ignore the risk of failure up until the final hours before failure, with the CEO stating that "We don't expect the credit losses to exceed our reserves and undivided earnings. Additionally, no member [NPCU] capital will be impacted by our estimate of other than temporary losses." (www.cujournal.com).

[15] Dwight Johnston, WesCorp's previous CEO who served for 26 years observes that: "It took me 26 years to get to $18 billion, and Siravo [the new CEO at the time] got to $32 billion in seven years. When I was CEO, we always were careful to stay within our capabilities." (http://www.garp.org/risk-news-and-resources/risk-headlines/story.aspx?newsId=50222).

[16] The Inspector General's inquest notes that CCUs operated under lax regulations on exposure limits, allowing CCUs to build highly concentrated portfolios of privately-issued RMBS.

2.2 Data

We collected data from the National Credit Union Association (NCUA) call report database for the universe of NPCUs and CCUs, spanning 2005 first quarter through the final quarter of 2010, encapsulating the boom in house prices, as well as much of the financial crisis. The call report does not provide information on the membership relationship between NPCUs and CCUs, and we obtained these confidential data separately from the NCUA based on its census of these relationships performed in late 2009.[17]

In 2005 Q1, there were about 7500 NPCUs and 26 CCUs in the database, and Table 4A summarizes some basic balance sheet statistics for NPCUs at the peak of the boom in 2006 Q4. The average NPCU had an equity to asset ratio of around 18 percent, and held a portfolio of loans valued at around $65 million. For the average NPCU, investment capital—membership and paid-in capital to CCU and held on the asset side of the balance sheet—expressed as a share of an NPCU's own capital—the liabilities side of the balance sheet—was 6 percent; this share is equivalent to about one percent of total assets. These summary statistics also indicate that NPCUs had virtually no direct exposure to investment securities. The average share of investment securities was around 2 percent, with a median of 0.

In contrast, these investment assets dominated the balance sheet of corporate credit unions (CCU). Table 4B summarizes the fraction of each corporate's balance sheet devoted to investment securities averaged at the peak of the boom in 2006. Table 4B indicates that CCUs engaged in no direct lending to consumers, but transacted mainly in financial assets to manage liquidity for their NPCU members. These securities, primarily a mix of agency (Fannie Mae and Freddie Mac) and private label ABS, accounted for about 88 percent of the average CCU balance sheet, ranging from a low of 71 percent to a high of 96 percent.

Table 5 indicates that geography is an important factor in explaining the pattern of contractual linkages between NPCUs and CCUs. CCUs emerged in the mid-1970s, and were initially required to serve NPCUs only within a specific state or geographic region. These geographic restrictions were relaxed in the mid-1990s, and since then, some NPCUs have joined more than one CCU. Using data from the NCUA's 2009 census of connections between NPCUs

[17] In the aggregate, the call report dataset that we have access to capture about $2.5 billion of the $5.6 billion depletion in investment capital during the 2005-2010 sample period officially reported by the NCUA. We capture fully the $1.4 billion in assessments that were charged by the NCUA.

and CCUs, Table 5 computes the fraction of NPCUs in each state that is connected to a specific CCU; for concision, Table 5 shows the top three CCU connections for each state. These tabulations indicate that most NPCUs within a state tend to be members of the state or regional CCU. For example, 99 percent of the NPCUs in Iowa are members of Iowa CCU, while 97 percent of the NPCUs in Kansas have joined the Kansas CCU. Also, the big differences between the largest and second largest shares suggest that in many instances few NPCUs appear to have secondary CCU affiliations.

Among the member NPCUs of each CCU, Table 6 reports the median of several balance variables observed at the peak of the boom in 2006. The fact that the pattern of economic activity tends to vary across states, along with the historic geographic specialization of CCUs suggest that there might be some heterogeneity across the pool of NPCUs that each corporate credit union serves. This is evident primarily for asset size and lending growth. WesCorp served mainly NPCUs in California, where the scale of lending is larger than in more rural states like Iowa. As a result, the median member NPCU of WesCorp is about 4.5 times larger than the median NPCU that belongs to Iowa Corporate. Median lending growth in the former is also nearly twice that of the latter.

However, the basic business model of NPCUs across CCUs is relatively similar. There is for example little variation in the median total equity to assets ratio (leverage ratio) or the ratio of cash to assets held on the balance sheet of NPCUs across different CCUs. Likewise, regardless of CCU membership, the median ratio of investment securities on the balance sheet of NPCUs was close to zero in 2006, while these institutions predominantly funded themselves through local deposits.

3. Main Results: Investment Capital and Credit Growth

The arguments outlined earlier suggest that in a cross-section of NPCUs observed over the crisis, investment capital losses should be associated with a decline in credit growth. We will first test this cross-sectional prediction, correcting for obvious demographic and economic fundamentals that might directly bear on the local demand for credit. Building on well-known theoretical arguments, we also examine how the lending response to these investment capital losses might vary with NPCU characteristics such as capital and liquidity, observed just before

the crisis. However, although NPCUs lend locally, and relatively disaggregated geospatial controls can help correct for local credit demand, there are inherent limitations to these exercises in establishing causality. Therefore, in the next sub-section, we turn to the variation in ABS-related losses incurred at the CCU level, as well as institutional features of the loss assignment rule to provide the most powerful evidence that investment capital losses might be associated with a contraction in consumer credit supply.

3.1. Investment Capital and Credit Growth: The Basic Regressions

To focus the analysis on the crisis period, we use data from the onset of the crisis, 2007, through the end of 2010. For both 2007 and 2010, we then compute the average level of loans made by an NPCU and the average level of its investment capital; we then log difference the time averaged data across the two periods in order to construct the change in lending and investment capital over the crisis period. The cross-section specification regresses the log change in loans on the log change in investment capital. The cross-section regressions always include the log level of loans in 2007 to absorb any persistent factors affecting loans during this period, as well as field of membership and state fixed effects.

Column 1 of Table 8 reports the investment capital coefficient estimated using only the 2007 log level of loans and the aforementioned fixed effects as controls. There is a large and significant positive association between the change in lending over the crisis and the change in investment capital. A one standard deviation decrease in investment capital over this period is associated with a 2.3 percentage point drop or 0.1 standard deviation decrease in lending between 2007 and 2010 (p-value=0.00).

To gauge the dollar value implications of this estimate, for each NPCU we multiply its percent change in investment capital by 0.0213—the estimate in column 1. This product yields the implied percent change in lending at that NPCU given its change in investment capital over the crisis. Multiplying this implied change in lending at the NPCU by its average level of loans in 2007 yields each NPCU's predicted dollar value change in lending over the period associated with the observed shock to investment capital. Taking the sum across all NPCUs suggests that the $1.2 billion decline in investment capital observed in the subsample used in column 1 is

associated with a $9 billion decline lending.[18] That is, every dollar decline in investment capital implies a $7.5 decline in lending.

Given that investment capital write downs and assessments during this period are around $7 billion, this multiplier suggests that these costs might imply a $52.5 billion dollar contraction in lending—about 66 percent of the "missing" $80 billion in credit implied by the pattern of new lending in Table 7.[19] Available upon request are cross-section results based upon the peak to trough change (2007 Q1- 2010 Q4). This approach captures about $2.4 billion of the investment capital losses, and implies a multiplier closer to 11. This evidence suggests then that these losses likely had a sizeable impact on lending. Of course, other lenders could have compensated for some of this contraction, muting the aggregate effects of this credit supply contraction, and we discuss the potential for substitution in Section 4.

Omitted variables that are both correlated with investment capital losses over 2007-2010 and also shape the local demand for credit are the main threat to causal inference. Column 2 thus controls for a number of county level characteristics that might affect the demand for consumer credit using county level data from the American Community Survey over the period 2006-2009. These controls include the log of the median income in the county, the percent of urban population in the county, population density, the Gini coefficient to help measure income inequality within the county, the poverty rate and the percent of the population that is African American. After controlling for state and corporate fixed effects, these county level socio-economic variables have little independent explanatory power for NPCU credit growth. And the point estimate on the investment capital variable in column 2 remains little changed.

That said, there is an enormously powerful geographic element to the post crisis recession (Hill, Fogli and Perri (2012)). Those regions that suffered the steepest declines in house prices and had the most leveraged households before the crisis appeared to suffer the biggest subsequent slumps in economic activity (Mian, Rao and Sufi (2011)). At the same time, the

[18] Note that the investment capital levels in the cross-section are computed as 2007 and 2010 averages—not the peak to trough change. Also, the call report dataset that we have access to capture about $3.9 billion of the official $7 billion depletion in investment capital during the 2005-2010 sample period. Of this, about 250 credit unions either failed or merged between 2007Q1 and 2010 Q4, helping to account for the fact that we observe the $1.2 billion in the cross-section out of the $3.9 billion available in the panel.

[19] The size of the multiplier might reflect the fact that many credit unions find it difficult to raise capital and often depend on retained earnings. And the multiplier suggests that the industry as whole might target a 9 percent capital asset ratio. The multiplier for banks might be of a similar magnitude, as banks have also traditionally evinced a deep reticence to raise capital (Hanson, Kashyap and Stein (2011), and as Adrian and Shin (2010) reports, banks also actively adjust their balance sheets in response to changes in net worth.

depletion of investment capital also varied geographically (Figure 5). Wescorp, based in California, was the largest CCU and the collateral backing its investment portfolio of private label residential mortgage backed securities was heavily skewed towards California (Countrywide was a major originator of these loans). Wescorp's NPCU members, also mostly based in California, suffered some of the largest declines in investment capital after Wescorp's failure. At the same time, California was also one of the epicenters of the boom and bust, and it remains possible that these results might be driven by some latent demand variable, perhaps related to the housing boom and bust.

Available upon request are specifications which drop Wescorp members from the sample and control for pre and post crisis changes in local credit demand in a number of different ways within a panel context. Also, the correlation between the run up in house prices at the county level (2005-2006) and the subsequent change in investment capital between 2007 and 2010, computed at the county level, is statistically insignificant, intimating that these results are unlikely to be driven by the housing boom and bust.[20]

We also regress the change in investment capital on house price growth at the zip code level during the boom (2005-2007) and find no significant relationship. Likewise, available upon request are results that regress the average change in investment capital during the bust (2009-2010) on lending growth during the boom (2006-2007).[21] The point estimate is 0.47 (p-value=0.94), suggesting that the cross sectional variation in lending behavior among NPCUs during the boom is not significantly related to their investment capital losses during the bust. In addition, while Florida was another epicenter of the housing boom and bust, NPCUs in Florida do not appear to have suffered systematically steeper declines in investment capital (Figure 5). In contrast, some upper Midwestern counties—areas not usually associated with the housing boom—experienced sharp investment capital declines.

These pieces of evidence give us some confidence that the real estate fueled lending boom at the NPCU level may not have led to the subsequent CCU ABS related losses. But column 3 directly controls for both the average change in house price change within the county during the boom, as well as over the crisis using the Core Logic House Price Index (HPI) house

[20] In a regression of the percent change in investment capital (2010Q4-2007Q1) on the average percent change in county house prices during the boom (2005-2006), the point estimate of the latter variable is 1.937 (p-value=0.41); state fixed effects are the other controls.

[21] The log level of investment capital, the log of assets in 2006, and state and field of membership fixed effects are the other controls in this cross-section regression; standard errors are clustered at the state level.

price index. Also, because household leverage during the boom may have shaped the local adjustment to the housing shock, column 3 also controls for county level data on household leverage, observed in 2006, from Mian, Rao and Sufi (2011). These data are available for a subsample of counties, and the investment capital coefficient again remains little changed.

These county level observables may only partially control for latent credit conditions, and the choices and preferences of NPCUs themselves could be a source of bias. For example, it is possible that the investment decisions of the CCUs might reflect the risk preferences of the NPCUs that invest in them. In this case, NPCUs could both be making risky loans and encouraging their CCUs to take on more risk. If areas where riskier loans were made then had larger subsequent declines in credit demand, then CCU losses could be correlated with a decline in local credit demand at downstream NPCUs.

In addition, a NPCU's deposits at CCUs could also be an important omitted variable. During the boom, those NPCUs facing relatively high credit demand from their field of membership, such as those in subprime neighborhoods, may have relatively fewer deposits at CCUs relative to those NPCUs facing weaker loan demand. Credit demand in turn fell sharply during the collapse among some borrowers, and to the extent that NPCU deposits at CCUs are correlated with investment capital losses, then these estimates could be biased. To be sure, in contrast to loss absorbing investment capital, NPCU deposits at CCUs were quickly guaranteed by the government at the onset of the crisis, and NPCUs realized no losses via this type of CCU exposure (Figure 4).

Nevertheless, column 4 controls for a number of NPCU variables observed just before the crisis. These variables include: loan growth; deposit growth; investment capital growth; and the growth in deposits at CCUs, all averaged over the period 2005-2006. Column 4 also controls for log size, measured in terms of assets; leverage ratio and the cash to assets ratio, all observed in 2006. Including these balance sheet variables does little to alter the point estimate on the change in investment capital over the crisis. [22]

Adding to these NPCU level controls, column 5 directly controls for risk taking by CCUs during the boom: the share of private label mortgage backed securities in the CCU MBS

[22] In results available upon request, we allow these balance sheet variables to vary over time within a panel setting to control for the fact that deposits generally flowed from distressed commercial banks to safer NPCUs during the crisis. These flows combined with the inability of NPCUs to raise external equity, could then mechanically reduce NPCU capital ratios and constrict their ability to lend (Wilcox (2011)).

portfolio in 2007, the share of investments in total assets, as well as the capital to asset ratio of the CCU—all observed in 2007. The investment capital point estimate remains significant at conventional levels and little changed.

Across a range of specifications, the evidence in Table 8 suggests that investment capital losses during the crisis might have engendered a sizeable contraction in consumer credit. But there are limits to the efficacy of this approach in controlling for latent credit demand, and we next turn to the cross-sectional heterogeneity in the lending response to these investment capital losses to assess better the plausibility of these results. In what follows, we use the specification in column 5, which controls for both key NPCU and CCU observables, as the baseline specification.

3.1.2 Investment Capital and Credit Growth: Cross-sectional heterogeneity

If investment capital losses shifted NPCU credit supply, then theories that build on capital's role as a buffer against adverse shocks would predict that those NPCUs that entered the crisis with more capital relative to assets may have been better able to insulate lending from these balance sheet losses (Bhattacharya and Thakor (1993), Diamond and Rajan (2000), Peek and Rosengren (1995), Shleifer and Vishny (2010)).[23] However, the impact of these balance sheet shocks on credit production might also hinge on balance sheet liquidity. Liquidity provisioning to NPCUs is a key function of CCUs. And the prospect of further losses at CCUs as well as the growing uncertainty surrounding the overall solvency of the CCU system could also induce a contraction in credit supply and cash hoarding among NPCUs as a precaution against future liquidity needs (Holmstrom and Tirole (1998) and Caballero and Simsek (2012).

These arguments suggest that if indeed these results are not an artifact of latent credit demand, but instead reflect a contraction in credit supply due to balance sheet shocks, then there are likely to be important cross-sectional differences in the way that NPCUs responded to these balance sheet shocks. To focus on these cross-sectional differences, we compute the regulatory capital to asset ratio in 2006—the height of the boom and before any ABS losses were envisaged—and interact the capital-asset ratio with the change in investment capital observed

[23] There is some evidence that bank capital might be an empirically important buffer against balance sheet shocks. (Berger and Udell 1994; Hancock, Laing, and Wilcox 1995).

over the crisis. The capital-asset ratio also directly enters quadratically to absorb any independent non-linear effects it might have on lending; we also control for the standard set of NPCU and CCU variables from column 5 of Table 8.

From column 1 of Table 9, the pre-crisis capital-asset ratio appears to significantly dampen the impact of investment capital shock on lending. For a NPCU whose capital-asset ratio is at the 25th percentile, 12.8 percent, a one standard deviation decrease in investment capital is associated with a 2.29 percentage point drop in lending growth over the crisis. But for a NPCU at the 75th percentile, a capital-asset ratio of 19.96 percent, a similar drop in investment capital is associated with a 1.6 percentage point drop in lending growth.

To understand whether these results are instead driven by the cross-sectional variation in liquidity, column 2 interacts the investment capital variable with the share of cash assets in 2006. Again, this latter variable also enters quadratically. The point estimate on the interaction term between the capital-asset ratio and the change in investment capital remains little changed. Column 3 considers the potentially confounding role of size. NPCU capital asset ratios tend to vary with size. At the bottom quartile of the distribution of NPCU assets, observed in 2006, the average capital asset ratio is 21.5 percent, while at the top quartile the average is just 13.6 percent. It is therefore possible that this cross sectional heterogeneity could be driven by asset size.

Column 3 of Table 9 addresses this concern, interacting the change in investment capital with a indicator variable for whether the NPCU is in the bottom quartile of assets, measured in 2006. The role of capital as a buffer in shaping the transmission of the investment capital losses onto lending remains unchanged. All this suggests that alternative latent demand explanations for these correlations might be somewhat unlikely, but we now turn to the variation in ABS-related losses at the CCU level to allow better a causal interpretation.

3.2. Investment Capital and Credit Growth: Identification

3.2.1. Corporate Losses

Using the variation at the source of the shock, in this case CCU losses over 2007-2010, as an instrument for changes in investment capital can yield estimates of investment capital that are

unlikely to be biased by latent credit demand. (Peek and Rosengren (2000)). This approach is motivated by the fact that the change in investment capital between 2007 and 2010 reflects both the initial amount invested as well as the overall losses incurred by the associated CCU during the crisis. But although we have included the growth in investment capital in 2005-2006 and measures of local fundamentals in the NPCU's county, the initial amount invested in a CCU could still be related to latent credit demand.

However, CCU losses incurred during the crisis are likely orthogonal to these latent NPCU variables, especially when conditioning on direct measures of CCU risk taking, like the size of its private label MBS portfolio. That said, these CCU losses are assigned to a NPCU based on the latter's relative investment capital contribution. And unfortunately, the variation in relative contributions could itself reflect the local cumulative effects of the housing boom in the years immediately preceding. For example, those NPCUs in areas with a booming housing market could have acquired investment capital at a faster rate than NPCUs in areas less affected by the housing boom. This former group of NPCUs would then both have a greater exposure to the CCU losses during the bust, and at the same time face a greater contraction in loan demand relative to those NPCUs less affected by the housing boom.

To construct an instrument immune from this concern, we collected new data on NPCU relative investment shares in CCUs circa 2000—the earliest date available—and compute each NPCU's potential exposure to CCU losses during the crisis based on these 2000 relative investment shares. Because these shares are observed well before the boom and bust, they reflect pre-existing exposures and are plausibly unrelated to the level or change in credit demand around the financial crisis.

The first stage regression, reported in column 1 of Table 10, regresses the change in investment capital at an NPCU on the NPCU's associated CCU net income computed over 2007-2010 and weighted by the 2000 NPCU relative investment share. The regression also includes the baseline controls from column 5 of Table 8. From column 1, a one standard deviation decrease in the share weighted CCU net income is associated with a 4.4 percentage point or 0.04 standard deviation decline in the change in investment capital (p-value=0.00).

But in addition to determining current investment capital write-downs, these CCU losses could also shift NPCU credit supply by shaping expectations of future investment capital write downs and assessments. During the sample period, there was considerable uncertainty about the

full extent of these ABS-related losses as well as the pace at which these losses were to be passed through onto the balance sheet of NPCUs. For example, the decision to buffer the transmission of these CCU losses onto investment capital write downs through the use of special assessments to be paid over a decade came only in late 2009. Moreover, the expected value of these future assessments fluctuated significantly over the sample period, from a high of around $20 billion when first proposed to around $12 billion by end of 2010.[24] Therefore, a NPCU exposed to large CCU ABS-related losses might curtail lending not only because of the actual investment write downs, but also in anticipation of large future write-downs and assessments.

The reduced form regression in column 2, which directly regresses NPCU lending growth on the weighted CCU net income, combines these various channels through which weighted CCU income might affect NPCU credit supply. The point estimate is large, positive and highly statistically significant. A one standard deviation increase in weighted CCU net income is associated with a 1.25 percentage point decline in loan growth over the period.

Column 3 presents the coefficient obtained from instrumenting the change in investment capital with weighted CCU net income. The IV estimate weights these credit supply mechanisms by the relative power of the instrument in explaining the variation in both actual and expected investment capital write downs, and is significantly larger than the OLS estimates (Angrist, Graddy and Imbens (2000). The implication is that the more powerful is weighted CCU income in explaining expected investment capital write downs, then the more representative will the IV estimate be of both the role of actual and expected investment capital write downs in shifting the NPCU credit supply curve.[25]

The cross-sectional heterogeneity in the capital-asset ratios of NPCUs in 2006 can further help in interpreting the IV estimate. We have already seen that the capital-asset ratio in 2006 dampened the impact of actual investment capital write-downs on lending. So if indeed large CCU losses affected NPCU credit supply by also shaping expectations of future investment capital write downs and assessments, then we might expect the NPCU pre-crisis capital-asset

[24] These estimates fluctuated in part because of the uncertainty over the value and pace of asset recovery at the CCUs. For example, in 2009 the NCUA began to securitize into US government backed bond issuances some of the non-performing ABS assets held by the loss-making CCUs, with the proceeds from the sale of these bonds intended to help offset the CCU losses (www.ncua.gov). But these bonds only sold gradually, and in some instances at a discount from their offering price.

[25] Available upon request are statistically similar, though larger estimates when using CCU net income weighted by 2007 contractual shares.

ratio to have an especially large impact in dampening the direct reduced form impact of CCU losses on NPCU lending.

The reduced form specification in column 4 thus interacts weighted CCU net income with the NPCU capital-asset ratio in 2006. The interaction term is large and statistically significant. A one standard deviation decrease weighted CCU net income is associated with a 0.95 percentage point drop in lending for a NPCU at the 25th percentile capital-asset ratio. But for a NPCU at the median ratio, a similar change in CCU net income is associated with only a 0.43 percentage drop in lending.

The results in the IV specification in column 5 also suggest that concerns about future write downs stemming from CCU losses might have played an important role in shaping credit supply. As in column 3, the direct impact of investment capital instrumented by CCU net income remains larger than OLS. But the relative importance of the capital-asset ratio in dampening the impact of investment capital on lending is also much larger when using the CCU net income instrument. For a NPCU whose capital-asset ratio is at the 25th percentile, the impact of a one standard deviation decrease in investment capital on lending is about 90 percent larger than for a NPCU at the 75th percentile capital-asset ratio. Recall that the equivalent OLS point estimates in column 1of Table 9 suggests an impact only 30 percent smaller.

In addition to actual and investment capital losses, CCU losses could also affect NPCU credit supply through the resulting disruption in financial services. Large losses at a CCU could portend its failure, raising the prospect of a costly disruption in the availability of liquidity for the associated downstream NPCUs, and prompting these institutions to curtail lending in anticipation of these future disruptions. However, as distress in the CCU system mounted during the crisis, many NPCUs received liquidity support from the Federal Reserve's discount window for the first time; these borrowings totaled about $40 billion in 2008 alone, perhaps rendering this channel less compelling.[26]

In results available upon request, we investigate this liquidity channel further, running reduced form specifications that interact weighted CCU net income with a dummy variable that equals one if the CCU failed. We also run IV specifications that interact the change in investment capital with this dummy. In both cases, the interaction terms are not significant. All this suggests that expectations about future investment capital write-downs, as embedded in

[26] http://www.federalreserve.gov/

CCU net income, might have been important in explaining NPCU credit supply, helping to explain the larger IV estimates.

3.2.2 Local Lending and Special Assessments

Rather than relying on the variation in CCU losses for identification, we now focus on the local lending business model of most NPCUs to aid identification. That is, most NPCUs lend locally, and those located in the same county are likely to experience the same shocks to credit demand in the cross section. Regressing the difference between lending growth for NPCU "i" and the average lending growth in the county excluding "i", on the difference between the change in investment capital for NPCU "i" and the county average, again excluding "i" can purge those shocks to credit demand that affect NPCUs in the same county similarly (Ashenfelter and Rouse (1998)).

In like vein, those NPCUs serving the same field of memberships are also likely to experience similar demand shocks. Public school teachers for example across the country could have collectively suffered from local government cutbacks during the crisis, and NPCUs serving teachers could experience a similar shock to credit demand that is different from those NPCUs serving health care workers. This suggests that repeating these "twin" differenced regressions based on the NPCU field of membership also provides a further robustness check. In both cases, available upon request, the coefficient on the "differenced" investment capital change is positive and significant.

Finally, the institutional structure of the credit union system provides a further identification check that does not depend on either relative investment capital shares, losses at specific CCUs or local lending. The investment capital variable reflects both the direct CCU losses, as well as the special assessments charged by the NCUA to offset the system wide CCU losses. But most importantly, these special assessments were not charged based on a NPCU's CCU affiliation, but in proportion to the relative size of each NPCU, as determined by its share of insured deposits in the system. Hence, once we condition on a NPCU's relative share of deposits, this assignment rule for CCU losses are unlikely to be driven by NPCU risk taking, the behavior of its CCU associate during the boom or latent credit demand. Column 6 thus replaces the change in overall investment capital, with the log of each NPCU's total assessment during

the period 2007-2010. A one standard deviation increase in log assessments is associated with 3 percentage point or 0.12 standard deviation decline in lending growth, reinforcing the idea that CCU balance sheet losses incurred at arm's length from NPCUs might have had a significant impact on NPCU credit extension.

4. The Impact of the Shock

We have seen evidence that the contraction in NPCU credit supply due to CCU ABS related losses might have been at least on the order of $50 billion. A natural question then is how this contraction in credit supply affected the supply of credit at the extensive margin. To address this question, we now provide evidence on the impact of NPCU investment capital write downs on the extension of new housing and automobile credit using mortgage loan applications from HMDA as well as a dataset on county level automobile purchases, respectively. Moreover, while it is well-nigh impossible to completely exclude latent credit demand explanations, these explanations now face a stiffer test—they have to explain not just the correlation between investment capital and loan growth, but these other correlations, some of which are obtained when conditioning on detailed individual level socio-economic characteristics.

4.1 Mortgage Applications and the Extensive Margin

This subsection uses data from the Home Mortgage Disclosure Act dataset (HMDA) on mortgage applications to investigate the impact of investment capital changes on mortgage credit at the extensive margin. HMDA reporting requirements apply to select financial institutions and this leaves a sample of around 3 million home mortgage applications received by about 4,000 NPCUs over the period 2005-2010 (Data Appendix). Across a relatively broad geographic spectrum, we are thus able to examine whether a decline in investment capital at a NPCU affected the probability of rejecting a loan application.

Using application level data also allows us to condition on key applicant level observables: the race and gender of the applicant; the amount requested; the applicant's income, whether the property is in a low income census tract; quarter and year dummies both for when the application was made, as well as when the NPCU made a decision on the application; we also include NPCU fixed effects. This rich set of applicant level controls makes it difficult to attribute

any correlation between investment capital changes and the probability of rejection to omitted local economic factors or compositional changes in the applicant pool. And in any event, the CCU ABS related losses and the resulting changes in investment capital at the NPCU level, were "silent" events, not widely known to the general public, and not likely to influence the composition of loan applications at a given NPCU.[27]

The dependent variable in Table 11A equals 1 if an application was rejected in the current quarter, and 0 if approved. Column 1 models this loan denial decision for the full sample of 2.8 million loan applications using a simple linear probability model. Consistent with the previous results, the point estimate on the one quarter lag investment capital variable is negative but imprecisely estimated in this case—additional lags are superfluous and these specifications are available upon request. The other covariates appear plausible. There is for example a large negative association between applicant income and the denial probability; similarly, applications for properties in low income census tracts or applications requesting larger loan amounts are more likely to be denied.

We have already seen that capital-asset ratios before the crisis may have played an important role in buffering the impact of investment capital losses on lending, and column 2 continues this theme, interacting the investment capital variable with the capital-asset ratio in 2006. The cross-sectional heterogeneity in capital-asset ratios appears important. Both the change in investment capital and the interaction term are individually and jointly significant. After a one standard deviation decrease in investment capital, the probability of rejection increases by about 0.3 percent for a NPCU at the 25th percentile of the capital-asset ratio. But for a NPCU at the median ratio, the probability of rejection increases by only 0.13 percent.

However, rather than limiting credit availability uniformly for all types of borrowers in response to investment capital shocks, the most leveraged institutions in column 2 may have also become more conservative in their lending practices, disproportionately denying credit to the riskier borrowers (Rajan (1994), Ramcharan (2012)). Column 3 investigates this hypothesis. The specification uses a triple interaction term, interacting the change in investment capital, the

[27] According to the business news database Factiva, news coverage of U.S. Central, WestCorp, Continental and Southwest between 2008 and 2010 was about one tenth of the news coverage of the six largest bank failures during the same time period, excluding Washington Mutual. These failed commercial banks include IndyMac, Bancorp Inc, Colonial Financial Services Inc., Downey Financial Corp, BankUnited Financial Corp, Guaranty Federal Bancshares Inc, and AmTrust Financial Corporation, which have roughly the same size as the five failed CCUs in terms of combined assets.

capital-asset ratio in 2006 and a proxy for the applicant's riskiness: the applicant's leverage, defined as the ratio of the requested loan amount to the applicant's income. This variable is included linearly, as well as interacted separately with the change investment capital.

The coefficients in column 3 imply that facing an investment capital write down, rejection rates rise most sharply for those borrowers seeking the most leveraged loans. And this type of screening appears strongest at NPCUs with smaller capital-asset ratios. For example, at a NPCU at the 25th percentile capital-asset ratio, a one standard deviation decline in investment capital is associated with a 0.7 percentage point increase in the probability of rejection among applicants at the 25th percentile loan-income ratio. But for applicants at the median loan-income ratio, the impact of a one standard deviation decline in investment capital on the rejection probability is about 20 percent larger.[28]

4.2 Automobiles and the Extensive Margin

Credit Unions are major players in the automobile market, accounting for about a quarter of all cars financed in the United States. In this subsection we use proprietary data from Polk to investigate the impact of investment capital losses on the extension of automobile credit by NPCUs. For each county and quarter from 2008-2010 the dataset matches each new car financed in the United States with the lender—credit supplier-automobile matched data are unavailable for previous years. The dataset also provides information on the make and model of the vehicle financed, which helps us identify the approximate purchase price of each car from Kelley Blue Book. We use these data to compute the total number and value of new cars financed by each credit union over the period 2008-2010.

Column 1 regresses the growth in the number of cars financed by a NPCU on the growth in investment capital the previous period. All regressions use year and quarter fixed effects to help absorb aggregate shocks such as Cash for Clunkers, and NPCU level fixed effects, which help absorb local time invariant shocks (Mian and Sufi (2012)). From column 1 of Table 11B,

[28] The results in Table 11A also suggests that those credit unions associated with distressed CCUs did not systematically "gamble for resurrection" by originating a greater number of riskier loans *ex-post* (as in Hellman, Murdock and Stiglitz (2000)). It remains possible that borrowers thought credit unions associated with distressed CCUs might "gamble for resurrection" *ex-ante*, thereby increasing the number of mortgage applications by subprime borrowers at those credit unions and biasing our estimates. This, however, seems highly implausible given credit unions' field of membership requirement precludes mortgage applications from non-members, and news about the failure of the five largest CCUs did not spread widely (footnote 29).

there is a large positive association between the change in investment capital and the number of cars financed by a credit union. A one standard deviation decrease in investment capital is associated with a 2.1 percentage point or 0.04 standard deviation drop in the number of cars financed. Results are similar when using the change in the approximate value of the cars financed as the dependent variable, and these are available upon request.

Column 2 interacts the change in investment capital with the capital-asset ratio in 2006. For a given change in investment capital, there is again significant evidence that more leveraged institutions contracted credit at the extensive margin more forcefully. A one standard deviation decrease in investment capital is associated with a 3 percentage point drop in car sales growth the next quarter for a NPCU at the 25^{th} percentile capital-asset ratio; the impact is about 17 percent smaller for a NPCU a the median ratio.

A contraction at the extensive margin for credit at NPCUs need not have aggregate impacts, as other types of lenders—banks, or captive auto company financing arms—could step in to meet credit demand. However, the collapse in the commercial paper market—a key source of financing capacity for the captive auto company financing arms—and the distress in the banking system during this period could limit these substitution effects.

To gauge the extent of substitution, we compute the total number of cars sold in each county in each period, regardless of the source of financing. We also compute the sum of investment capital taken across all NPCUs headquartered in the county for each period. If substitution to other lenders fully offsetted the impact of the NPCU credit contraction, then changes in investment capital should be unrelated to changes in car sales at the county level. Likewise, if there is no substitution, then we would roughly expect the investment capital coefficient in column 3 to be about a quarter of the magnitude in column 1, since credit unions finance about 25 percent of car sales.

Column 3 regresses the change in the total number of cars sold—irrespective of lender—on the change in investment capital at the county level. The estimated coefficient on investment capital is significant and about 28 percent of the magnitude of the coefficient in column 1; and implies that a one standard deviation decrease in investment capital is associated with a 0.05 standard deviation drop in car sales in the county. That is, at least at the county level, the substitution effect appears insufficient to offset fully the contraction in NPCU credit supply brought about investment capital losses.

6. Conclusion

How did the collapse of ABS prices and the ensuing financial crisis of 2007-2009 affect the supply of credit to consumers? There are significant measurement and identification challenges to addressing this question, and this paper addresses some of these challenges using a new dataset that describes unique interbank relationships within the credit union industry. The industry accounts for a quarter of all car financing in the US and is a major provider of consumer credit. Moreover, the interbank relationships within the industry allows us to measure precisely the impact of ABS related losses incurred at the correspondent bank—the corporate credit union—onto the balance sheet of the consumer credit provider—the natural person credit union. The variation in these losses at the NPCU level is unlikely to be related to local credit demand.

We find large contagion effects. ABS related losses at corporate credit unions are associated with a large contraction in the supply of credit among downstream natural person credit unions. We also investigate the importance of capital in buffering lending using the cross sectional heterogeneity in the way credit production at NPCUs varied with respect to the balance sheet shocks. Finally, we also provide evidence that the contraction in credit supply may have affected the availability of mortgage and automobile credit, perhaps helping to account for some of the collapse in auto sales during the crisis, as well as the weakness in house prices (Rajan and Ramcharan (2013)). Taken together, these results suggest that capital regulation might be a useful tool in limiting the ability of the traditional financial system to transmit securities price volatility onto the real economy.

Tables and Figures

Table 1A. The Percent of Total Consumer Installment Credit

	By holder			By originator		
	2005	2009	2010	2005	2009	2010
Credit Unions	13.9	12.9	12.2	13.9	12.9	12.2
Commercial Banks	27.4	31.4	33.2	28.3	32.1	33.2
Finance Companies	30.9	30.3	29.2	38.8	35.0	32.7
Savings Institutions	4.6	2.7	2.4	5.0	3.2	2.9
Nonfinancial Business	3.0	2.9	2.8	3.0	2.9	2.8
Securitized	13.9	12.0	6.1	0.0	0.0	0.0

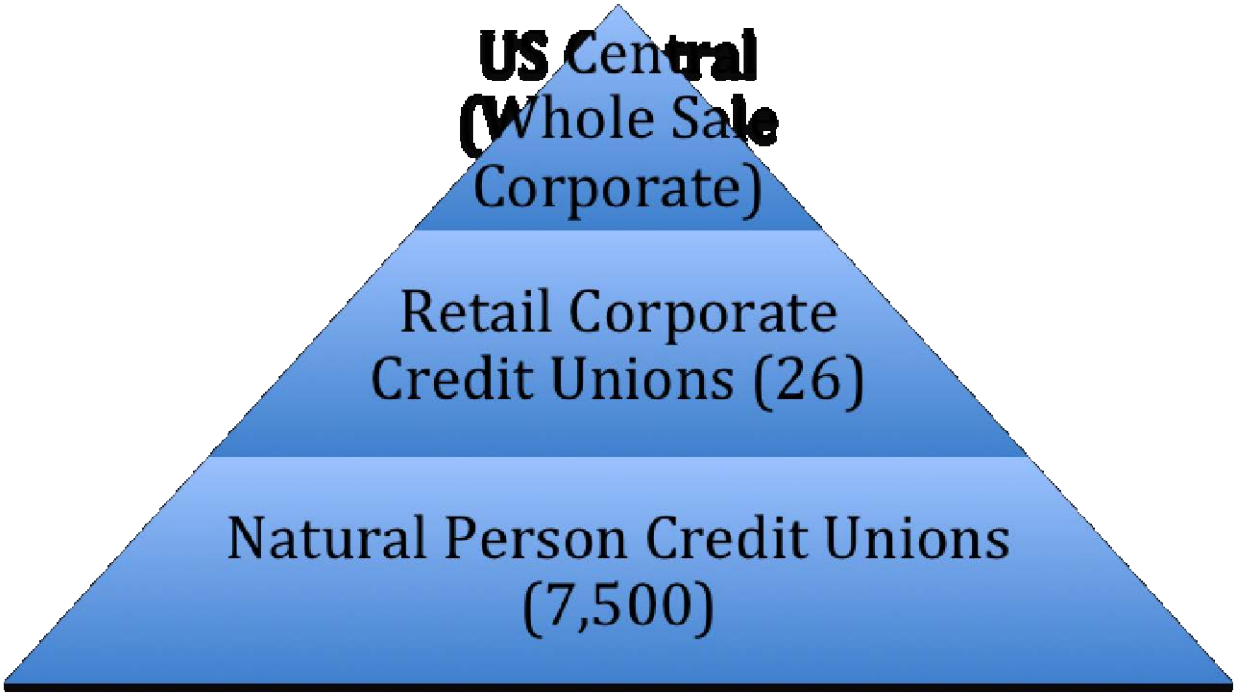
Table 1B. Auto Loan Market Share (Percent)

	2005	2009	2010
Credit Unions	20.8	23.6	24.1
Commercial Banks	24.1	32.6	37.0
Finance Companies	35.1	29.1	27.6
Savings Institutions	3.9	2.4	2.2
Securitized	16.2	12.2	9.1

Table 1C. Credit Unions Share of Housing Loans (Percent)

	2006	2009	2010
By Number of Loans	13.6	15.8	17.6
By Dollar Value of Loans	3.92	3.70	4.30

Figure 1A. The Credit Union Structure



Natural Person Credit Unions (NPCUs) provide loans and financial services to members defined by a common bond or field of affiliation. Common bonds are typically defined by occupation: teachers or police within a certain geographic area, or Ford Motor Employees. NPCUs are typically members of one retail corporate credit union (CCU), and contribute loss absorbing membership capital to its CCU affiliate. CCUs provide payments, settlement and liquidity management services for its member NPCUs. US Central aggregates these services vis-à-vis the rest of the financial system.

Figure 1B. An Example of a Credit Union Network

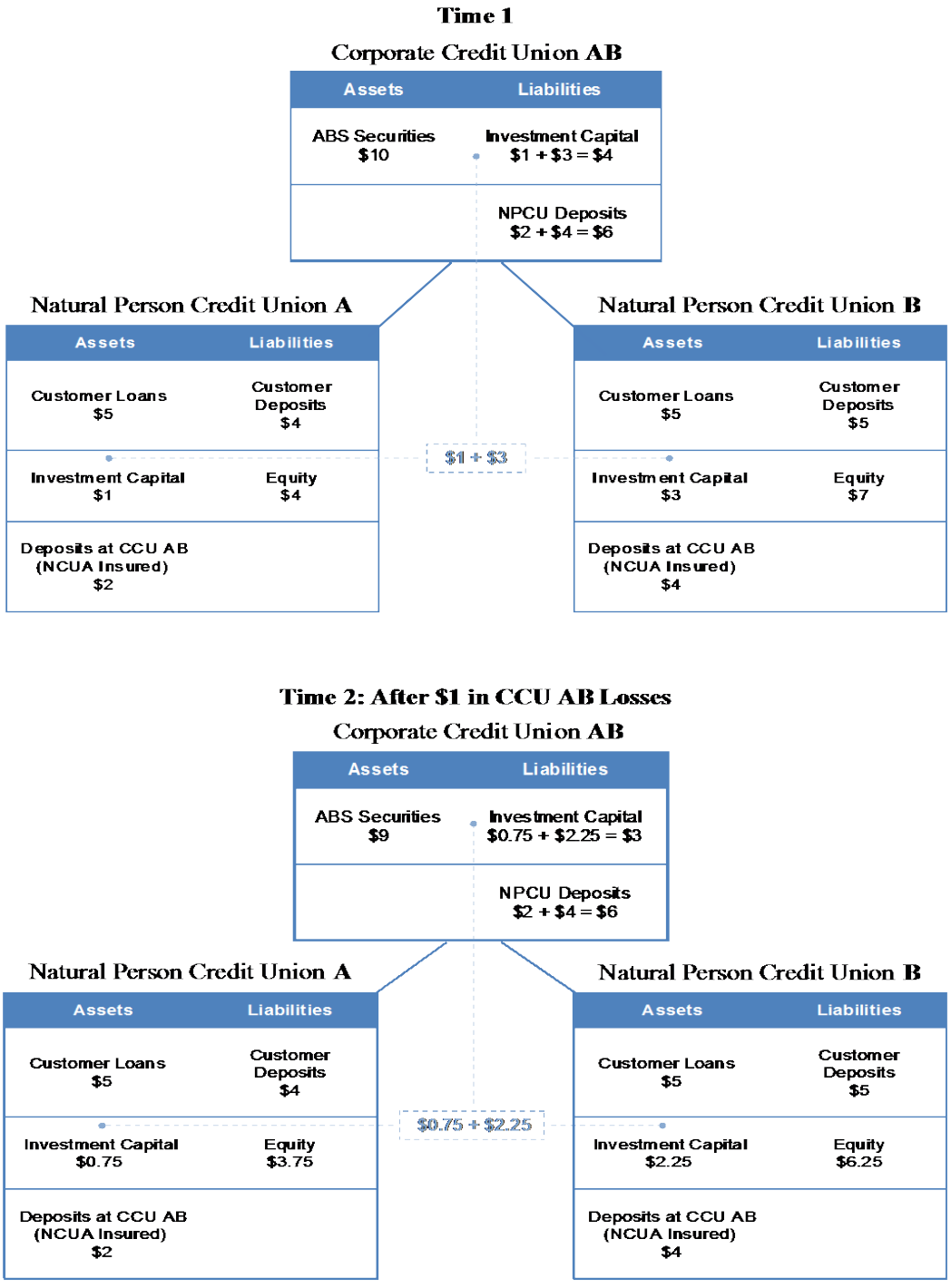


Figure 1B shows a hypothetical credit union network, based on two natural person credit unions (A and B) and one corporate credit union (AB). It also shows how a dollar in losses at CCU AB (in excess of retained earnings) is apportioned between NPCU A (25%) and NPCU B (75%) based on their initial allocation of investment capital.

Table 2. Total Assets in the Credit Union Industry, Expressed as Share of Assets in Banks

Year	Below 75th Percentile	Below 90th Percentile	Below 95th Percentile	Below 98th Percentile	Below 99th Percentile	All Banks
2005	1.2	0.66	0.51	0.39	0.34	0.22
2006	1.22	0.67	0.51	0.4	0.34	0.23
2007	1.26	0.69	0.53	0.41	0.36	0.24
2008	1.31	0.72	0.56	0.43	0.38	0.26
2009	1.38	0.77	0.59	0.47	0.41	0.28
2010	1.44	0.81	0.63	0.49	0.43	0.29

For each year, Table 2 computes the fraction of assets in credit unions relative to total assets in banks of different sizes. To construct the denominator in column 1 for example, we sum total assets in the banking system observed in the final quarter of each year, excluding those banks with assets in the top quartile of assets. Similarly, column 2 excludes those banks in the top decile of the assets.

Table 3. Field of Membership

Field of Membership	Number of Natural Person Credit Unions
Community credit union	1,187
Associational - faith based	207
Associational - fraternal	46
Associational - other than faith based or fraternal	94
Educational	170
Military	20
Federal, State, Local Government	260
Manufacturing - chemicals	31
Manufacturing - petroleum refining	10
Manufacturing - primary and fabricated metals	31
Manufacturing - machinery	25
Manufacturing - transportation equipment	9
Manufacturing - all other	153
Service - finance, insurance, real estate, trade	43
Service - health care	97
Service - transportation	54
Service - communications and utilities	94
Single common bond - other	12
Multiple common bond - primarily educational	344
Multiple common bond - primarily military	66
Multiple common bond - primarily federal, state, local government	415
Multiple common bond - primarily chemical	61
Multiple common bond - primarily petroleum refining	42
Multiple common bond - primarily primary and fabricated metals	50
Multiple common bond - primarily machinery	37
Multiple common bond - primarily transportation equipment	43
Multiple common bond - primarily other manufacturing	221
Multiple common bond - primarily finance, insurance, real estate, trade	73
Multiple common bond - primarily health care	174
Multiple common bond - primarily transportation	103
Multiple common bond - primarily communications and utilities	170
Multiple common bond - primarily faith based	74
Multiple common bond - other	203
State chartered natural person credit union	2,787
Total	7,406

Table 3 lists the number of natural person credit unions that operate in each field of membership. A field of membership defines the occupational or other category in which a NPCU might provide financial services.

Table 4A. NPCU Balance Sheet, Summary Statistics, 2006 Fourth Quarter

	Capital Asset Ratio (percent)	Loans ($millions)	Investment Corporate Capital as a percent of Equity	Investment Securities as a percent of Assets
Mean	17.78	65.43	5.70%	1.60%
Median	16.00	8.62	4.90%	0.00%
Standard Deviation	7.66	358.46	28.70%	103.00%

Table 4B. Average Share of Investment Securities—AAA and AA Asset Backed Securities--on the Balance Sheet of Corporate Credit Unions in 2006

CCU name*	Average Share of Investment Securities on the balance sheet in 2006
CenCorp	0.78
Constitution	**0.96**
Corporate America	0.96
Corporate One FCU	0.92
EasCorp	0.95
First Carolina	0.92
First Corporate	0.85
Georgia	0.94
Iowa Corporate	0.71
Kentucky Corporate FCU	0.82
Kansas Corporate	0.92
Louisiana Corporate	0.88
Members United	**0.89**
Mid-Atlantic Corporate	0.90
Midwest Corporate FCU	0.90
Missouri Corporate Credit Union	0.88
Southwest Corporate	**0.90**
Southeast Corporate Federal Credit Union	0.88
SunCorp	0.89
Treasure State	0.85
Tricorp FCU	0.84
VaCorp FCU	0.84
Volunteer Corporate	0.87
West VA	0.92
Western Corp	**0.88**

*Corporates that eventually failed during the crisis are in bold.

Table 5. Distribution of Natural Person Credit Unions Corporate Linkages, by State

State	Largest Share		Second Largest Share		Third Largest Share	
Alabama	Corporate America	0.97	Southeast Corporate FCU	0.25	Volunteer Corporate	0.16
Arizona	First Corporate	0.96	Western Corp	0.22	Southwest Corporate	0.12
Arkansas	Southwest Corporate	1.00	Kansas Corporate	0.05	Mid-Atlantic Corporate	0.04
California	Western Corp	1.00	Southwest Corporate	0.10	Corporate One FCU	0.06
Colorado	SunCorp	1.00	Corporate One FCU	0.07	Western Corp	0.04
Connecticut	Constitution	0.99	Members United	0.20	EasCorp	0.04
Delaware	Mid-Atlantic Corporate	1.00	Members United	0.04		0.00
Florida	Southeast Corporate FCU	1.00	Southwest Corporate	0.28	Western Corp	0.06
Georgia	Georgia	1.00	Southwest Corporate	0.20	Southeast Corporate FCU	0.09
Idaho	Western Corp	0.98	SunCorp	0.33	Southwest Corporate	0.22
Illinois	Members United	0.99	Corporate One FCU	0.09	Western Corp	0.02
Indiana	Members United	0.96	Corporate One FCU	0.48	Western Corp	0.04
Iowa	Members United	0.99	Iowa Corporate	0.99	Southwest Corporate	0.02
Kansas	Kansas Corporate	0.97	Southwest Corporate	0.06	Missouri Corporate Credit Union	0.01
Kentucky	Kentucky Corporate FCU	1.00	Corporate One FCU	0.18	Members United	0.06
Louisiana	Southwest Corporate	0.90	Louisiana Corporate	0.75	Corporate One FCU	0.01
Maine	Tricorp FCU	0.99	EasCorp	0.12	Members United	0.03
Maryland	Mid-Atlantic Corporate	0.91	Members United	0.14	Western Corp	0.14
Massachusetts	EasCorp	0.91	Members United	0.68	Tricorp FCU	0.15
Michigan	CenCorp	1.00	Corporate One FCU	0.14	Western Corp	0.04
Minnesota	Members United	1.00	Western Corp	0.02	Midwest Corporate FCU	0.02
Mississippi	Southeast Corporate FCU	0.98	Corporate America	0.30	Volunteer Corporate	0.14
Missouri	Missouri Corporate Credit Union	0.98	Members United	0.06	Southwest Corporate	0.04
Montana	Treasure State	0.98	Western Corp	0.07	Southwest Corporate	0.02
Nebraska	SunCorp	0.99	Kansas Corporate	0.30	Western Corp	0.10
Nevada	Western Corp	0.96	Southwest Corporate	0.12	First Corporate	0.12
New Hampshire	Tricorp FCU	0.95	EasCorp	0.86	Members United	0.19
New Jersey	Members United	0.89	Mid-Atlantic Corporate	0.32	Western Corp	0.04
New Mexico	Southwest Corporate	1.00	Constitution	0.03	First Corporate	0.03
New York	Members United	0.99	Mid-Atlantic Corporate	0.18	Southwest Corporate	0.04
North Carolina	First Carolina	1.00	Western Corp	0.09	Volunteer Corporate	0.06
North Dakota	Midwest Corporate FCU	0.94	Members United	0.08	Iowa Corporate	0.08
Ohio	Corporate One FCU	1.00	Members United	0.04	Mid-Atlantic Corporate	0.01
Oklahoma	Southwest Corporate	0.99	Kansas Corporate	0.14	Members United	0.03
Oregon	Southwest Corporate	0.99	Western Corp	0.54	Corporate One FCU	0.03
Pennsylvania	Mid-Atlantic Corporate	1.00	Members United	0.11	Corporate One FCU	0.03

Table 5 (continued). Distribution of Natural Person Credit Unions Corporate Linkages, by State

State	Largest Share		Second Largest Share		Third Largest Share	
Rhode Island	Members United	1.00	EasCorp	0.08	Tricorp FCU	0.04
South Carolina	First Carolina	1.00	Southwest Corporate	0.04	Georgia	0.04
South Dakota	Members United	1.00	Midwest Corporate FCU	0.14	Southwest Corporate	0.06
Tennessee	Volunteer Corporate	1.00	Southeast Corporate FCU	0.16	Western Corp	0.05
Texas	Southwest Corporate	1.00	Western Corp	0.04	Members United	0.02
Utah	SunCorp	1.00	Western Corp	0.15	Southwest Corporate	0.09
Vermont	Tricorp FCU	1.00	Members United	0.24	EasCorp	0.21
Virginia	Vacorp FCU	0.96	Mid-Atlantic Corporate	0.09	Members United	0.03
Washington	Southwest Corporate	0.82	Western Corp	0.77	Corporate One FCU	0.03
West Virginia	West VA	0.97	Corporate One FCU	0.09	Mid-Atlantic Corporate	0.03
Wisconsin	Members United	0.88	Western Corp	0.09	Corporate One FCU	0.07
Wyoming	SunCorp	1.00	Southwest Corporate	0.03		0.00

Table 5 reports the top three corporate connections (fraction) for the natural person credit unions in each state; the data are observed in 2008.

Table 6. Balance Sheet Characteristics of Natural Person Credit Unions, by Corporate Affiliation

	Total Assets ($millions)	Loan Growth	Cash Ratio	Leverage Ratio	Investment Securities Ratio	Deposits Ratio
Constitution	33,087	0.44	0.09	0.15	0.05	0.86
Corporate America	18,058	1.48	0.08	0.15	0.02	0.86
Corporate One	14,712	0.98	0.09	0.17	0.00	0.85
EasCorp	25,303	0.62	0.09	0.15	0.02	0.86
First Carolina	30,963	1.16	0.06	0.15	0.06	0.85
First Corporate	20,983	0.71	0.11	0.17	0.00	0.85
Georgia	54,123	1.54	0.09	0.13	0.01	0.88
Iowa Corporate	13,801	0.84	0.11	0.18	0.00	0.84
Kansas	9,463	0.57	0.10	0.15	0.00	0.85
Kentucky	12,874	0.14	0.08	0.16	0.00	0.85
Louisiana	12,008	0.84	0.11	0.17	0.00	0.85
Members United	11,664	1.02	0.09	0.17	0.00	0.85
Mid-Atlantic Corporate	13,541	0.73	0.09	0.16	0.00	0.85
Midwest Corporate	11,886	0.87	0.10	0.15	0.02	0.86
Missouri Corporate	14,005	0.74	0.07	0.14	0.00	0.87
Southeast Corporate	10,165	0.05	0.13	0.13	0.00	0.86
Southwest Corporate	32,782	1.15	0.10	0.15	0.02	0.85
SunCorp	26,096	1.01	0.08	0.15	0.00	0.86
Treasure Sate	18,660	0.62	0.08	0.15	0.00	0.87
Tricorp	14,280	1.17	0.10	0.14	0.00	0.87
VACorp	30,873	1.02	0.08	0.14	0.00	0.87
Volunteer Corporate	13,373	0.97	0.10	0.14	0.00	0.86
West VA	15,996	0.79	0.11	0.18	0.00	0.84
CenCorp	7,444	-0.03	0.10	0.17	0.00	0.86
WesCorp	61,816	1.57	0.06	0.13	0.03	0.87

Table 6 reports the median value from the set of natural person credit unions that are affiliated with each corporate credit union. The data are observed in 2006.

Figure 2. Investment capital and NPCU Deposits at CCUs

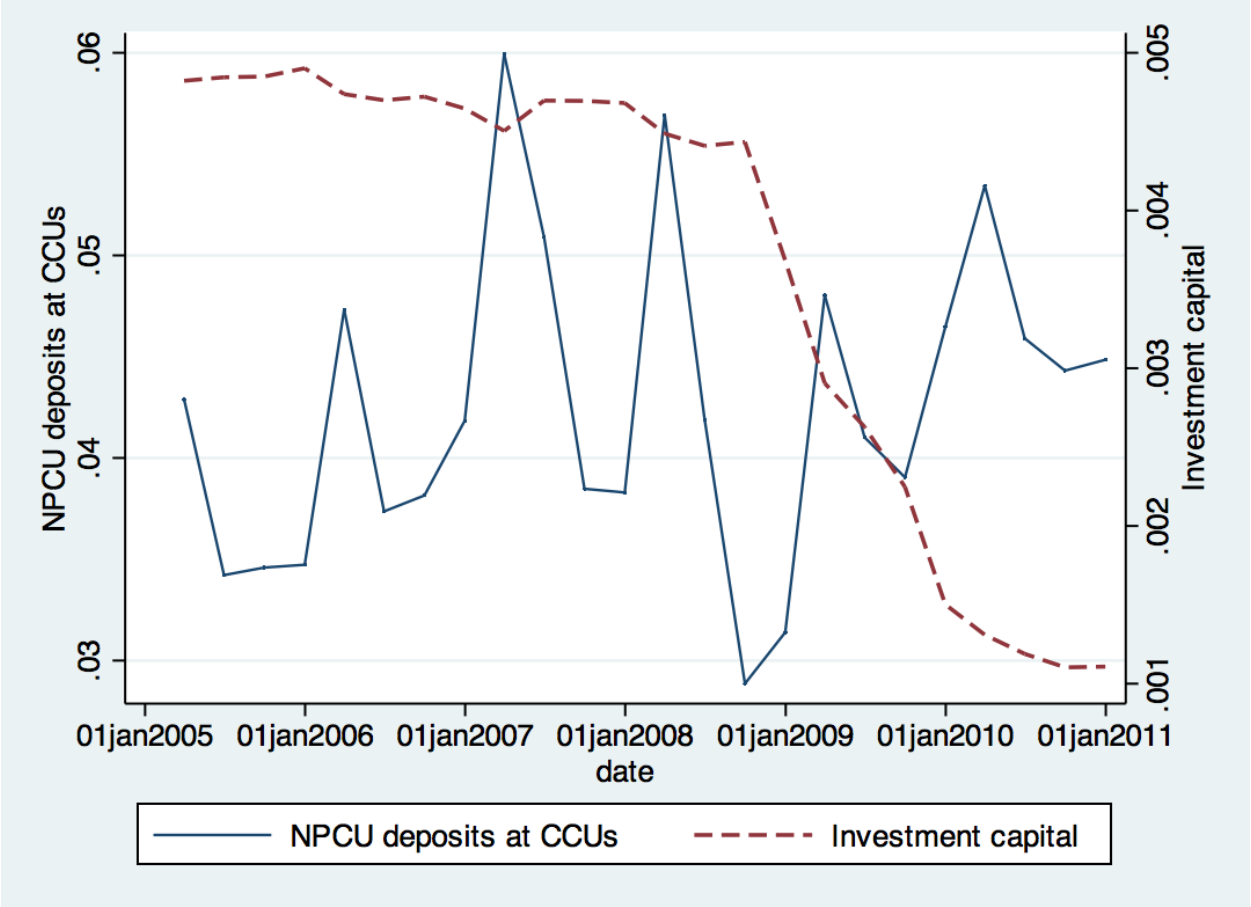
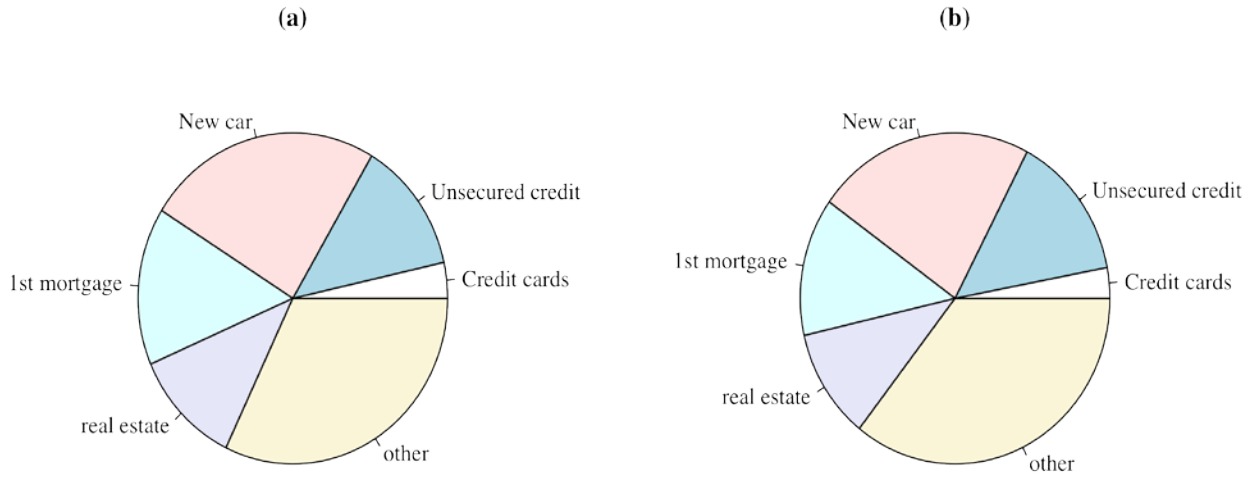


Figure 2 plots the total amount of NPCU deposits placed in CCUs (solid line, left axis) and the total value of investment capital contributed by NPCUs (dashed line, right axis). Both series are deflated by aggregate NPCU assets.

Figure 3. The Composition of Natural Person Credit Union Lending



Panel (a) includes only those NPCUs that were members of CCUs that eventually failed by the end of the sample. Panel (b) includes all other NPCUs.

Figure 4. Investment Capital and Total Lending in the Credit Union Industry, 2005-2010

Figure 4 plots the total amount of membership and paid in capital at corporate credit unions (dashed line) and total lending by natural persons credit unions (solid line).

Table 7. Dollar Change in Total Lending in the Credit Union Industry, 2006-2010 ($ billions)

Year	2006	2007	2008	2009	2010
$ billions	40	36	42	7	-10

Table 8. The Impact of Investment Capital Growth on Lending Growth

Dependent Variable: Lending Growth between 2007-2010

	(1) No control	(2) Demographics	(3) House prices	(4) Balance sheet controls	(5) CCU controls
Change in Investment Capital, 2007-2010	0.0213***	0.0208***	0.0250***	0.0193**	0.0195**
	(0.00758)	(0.00765)	(0.00737)	(0.00840)	(0.00848)
Population Density		0.0391	0.0395		
		(0.0448)	(0.0449)		
Urban Population		-0.803	1.384		
		(0.979)	(1.298)		
Log of Median Income		-4.935	-1.992		
		(3.147)	(4.062)		
Income Inequality		-1.419	-5.516		
		(16.58)	(18.13)		
Poverty Rate		0.0918	0.223		
		(0.164)	(0.193)		
Percent Black		-6.785	-10.47**		
		(4.293)	(4.922)		
Average House Prices Growth, 2005-2006			113.6		
			(68.01)		
Average House Prices Growth, 2007-2010			74.317		
			(61.2774)		
Household Leverage			-2.192		
			(1.551)		
Average Loan Growth, 2005-2006				-0.0156	-0.0133
				(0.227)	(0.225)
Average Deposit Growth, 2005-2006				1.089***	1.079***
				(0.260)	(0.256)
Investment Capital Growth, 2005-2006				4.146	4.292
				(6.424)	(6.444)
Cash-Assets Ratio, 2006				0.0892	0.0961
				(0.0558)	(0.0738)
Capital-Asset Ratio, 2006				-0.129**	-0.130**
				(0.0544)	(0.0548)
Log of Total Assets,2006				-0.400	-0.453
				(1.431)	(1.424)
Share of Private Label MBS, 2007					43.50
					(296.1)
Investments-Assets Ratio, 2007					-55.09
					(37.43)
CCU Capital-Asset Ratio, 2007					1,856***
					(601.1)
NPCU Deposits in CCU, 2005-2006					-0.0133
					(0.0733)
Observations	5,705	5,705	4,589	5,648	5,648
R-squared	0.166	0.169	0.180	0.176	0.176

The specifications in Table 8 regress the log change in lending growth on the log change in investment capital, computed between 2007 and 2010. All specifications include state and corporate fixed effects. ***, ** and * denote significance at the 1, 5 and 10 percent respectively. Standard errors are clustered at the state level.

Figure 5. Investment Capital Losses, By County

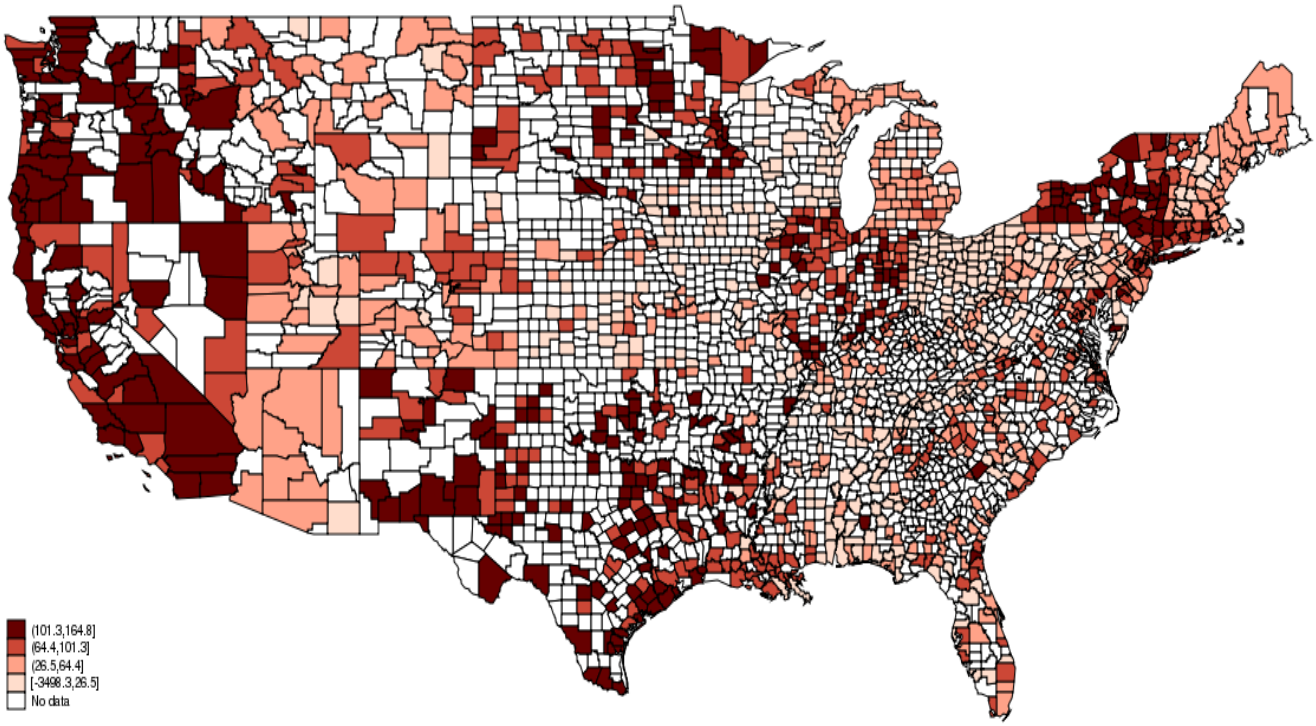


Figure 5 depicts the change in investment capital between 2007 Q1 and 2010 Q4, aggregated up to the county level. That is, for each of the 1,396 counties with active credit unions, Figure 5 first computes the total level of investment capital summed across all credit unions headquartered in the county, both in 2007 Q1 and again in 2010 Q4. Figure 5 then shows the percent difference in these two levels--this period encapsulates the CCU ABS related losses.

Table 9. The Impact of Investment Capital Growth on Lending Growth: The Role of Capital, Liquidity and Size

Dependent Variable: Lending Growth between 2007-2010

	(1)	(2)	(3)
	Capital	Cash	Size
Investment Capital, 2007-2010	0.0319***	0.0310***	0.0404***
	(0.00877)	(0.00942)	(0.0122)
Investment Capital, 2007-2010 * Capital-Asset Ratio, 2006	-0.000867**	-0.000886**	-0.00108**
	(0.000407)	(0.000411)	(0.000416)
Investment Capital, 2007-2010 * Cash-Asset Ratio, 2006		0.000105	0.000130
		(0.000430)	(0.000402)
Investment Capital, 2007-2010 * Bottom Quartile in Assets, 2006			-0.0118
			(0.00821)
Observations	5,689	5,689	5,684
R-squared	0.177	0.177	0.178

The specifications in Table 9 regress the log change in lending growth on the log change in investment capital between 2007 and 2010. Each specification includes the same set of controls as in Column 5 of Table 8 – the baseline specification, as well as the capital-asset ratio in 2006 quadratically. Column 2 includes the cash-asset ratio quadratically; column 3 includes the bottom quartile indicator variable separately. ***, ** and * denote significance at the 1, 5 and 10 percent respectively. Standard errors are clustered at the state level

Table 10. The Impact of Investment Capital Growth on Lending Growth: Instrumental Variable

	(1)	(2)	(3)	(4)	(5)	(6)
	First Stage	Reduced Form	IV	Reduced Form (Capital)	IV (Capital)	Assessments
Dependent Variable:	Growth in Investment Capital, 2007-2010	Loan Growth, 2007-2010	Loan Growth, 2007-2010	Growth in Investment Capital, 2007-2010	Loan Growth, 2007-2010	Loan Growth, 2007-2010
CCU Net Income, 2007-2010	0.00120***	0.000104***		0.00135***		
	(0.000335)	(3.17e-05)		(0.000503)		
Growth in Investment Capital, 2007-2010			0.0864*		0.180*	
			(0.0450)		(0.0940)	
CCU Net Income, 2007-2010 * Capital-Asset Ratio, 2006				-9.30e-05**		
				(3.75e-05)		
Growth in Investment Capital, 2007-2010 * Capital-Asset Ratio, 2006					-0.00838**	
					(0.00331)	
Log of Total Assessments, 2007-2010						-1.905***
						(0.414)
Observations	5,622	5,621	5,621	5,619	5,621	5,545
R-squared	0.723	0.177	0.153	0.178	0.127	0.176

All specifications include the same set of controls as in Column 5 of Table 8. Column 1 reports the first stage regression of the log change in investment capital between 2007 and 2010 on the 2000 share weighted corporate net income. Column 2 reports the reduced form regression of log change in lending between 2007 and 2010 on the 2000 share weighted corporate net income, and Column 3 instruments the change in investment capital with CCU net income. Columns 4 and 5 repeat the specification in Column 2 and 3 with an interaction term between the 2000 share weighted corporate net income and the 2006 average capital asset ratio. This ratio also enters quadratically. Column 6 regresses the log change in lending between 2007 and 2010 on the individual assessments from NCUA. ***, ** and * denote significance at the 1, 5 and 10 percent respectively. Standard errors are clustered by NPCU corporate affiliation. In Column 6, standard errors are clustered at the state level.

Table 11A. The Impact of Investment Capital Growth on the Probability that a Real Estate Loan Application is Rejected

Dependent Variable: 1 if mortgage application is rejected, 0 otherwise

	(1)	(2)	(3)
Growth in Investment Capital, Lagged 1 Quarter	-0.00559	-0.0495**	-0.0254
	(0.00601)	(0.0215)	-0.0166
Growth in Investment Capital, Lagged 1 Quarter *Capital-Asset Ratio, 2006		0.00377**	0.00264**
		(0.00165)	(0.00135)
Growth in Investment Capital, Lagged 1 Quarter * Debt-to-Income Ratio			-0.0122***
			(0.00425)
Growth in Investment Capital, Lagged 1 Quarter * Capital-Asset Ratio, 2006 * Debt-to-Income Ratio			0.000532*
			(0.000307)
Male	-0.00534***	-0.00536***	-0.00539***
	(0.00116)	(0.00116)	(0.00117)
Hispanic	0.0926***	0.0924***	0.0925***
	(0.00412)	(0.00413)	(0.00413)
Black	0.165***	0.165***	0.165***
	(0.00420)	(0.00424)	(0.00424)
Low Income Census Tract	0.0768***	0.0768***	0.0769***
	(0.00512)	(0.00513)	(0.00514)
Log of Loan Amount	0.0330***	0.0330***	0.0327***
	(0.00415)	(0.00418)	(0.00419)
Log of Income	-0.114***	-0.115***	-0.114***
	(0.00338)	(0.00338)	(0.00339)
Observations	2,811,414	2,795,686	2,795,686
R-squared	0.094	0.171	0.171

The dependent variable in Table 11A equals 1 if a mortgage loan application was rejected, and 0 if the loan was originated. The sample period extends from 2005Q1 to 2010Q4. Column 1 uses the full sample of available loan applications. Loan Amount/Income is the loan amount requested by the applicant divided by the applicant's income—these variables each enter log linearly as well. The variables Male, Hispanic and Black equal one if the applicant identifies with the respective category. Low Income Census Tract equals one if the property identified in the application is located in a low income census tract. All specifications include NPCU fixed effects, and year and quarter dummies for both when the application was filed, and when the NPCU made a decision on the application. Columns 2 include an interaction term between the lag log change in investment capital and the capital to asset ratio of NPCU averaged over 2006. Column 3 includes the same interaction term as in Column 2 as well as a triple interaction term between the lag log change in investment capital and the capital to asset ratio of NPCU averaged over 2006 and the applicant debt-to-income ratio, along with the linear subcomponents. ***, ** and * denote significance at the 1, 5 and 10 percent respectively. Standard errors are clustered by NPCU level.

Table 11B. The Impact of Investment Capital Growth on Automobile Sales

Dependent variable: Growth in the Number of New Financed Cars

	(1)	(2)	(3)
	NPCU Level	NPCU Level	County Level
Growth in Investment Capital, Lagged 1 Quarter	0.0742***	0.184***	-0.0205***
	(0.0173)	(0.0457)	(0.00552)
Growth in Investment Capital, Lagged 1 Quarter *Capital-Asset Ratio, 2006		-0.00657**	
		(0.00290)	
Observations	21,000	20,808	5,432
R-squared	0.171	0.171	0.376

The sample period extends from 2008Q1 to 2010Q4. Column 1 regresses the quarterly log change in the number of automobile financed by NPCU on the log change in investment capital lagged one quarter. Column 2 adds an interaction term between the lagged log change in investment capital and the capital to asset ratio of NPCU averaged over 2006 to the specification in column 1. In Columns 3, the dependent variable is the growth in the total number of new cars purchased in the county regardless of the source of credit, and NPCU investment capital is aggregated up to the county level. Year, quarter and county fixed effects are included in all specification, and standard errors are clustered at the county level. . ***, ** and * denote significance at the 1, 5 and 10 percent respectively.

Data Sources and Notes

1. Data on the credit union balance sheets, including investment capital and special assessments are obtained from the Federal Reserve Board's Credit Union Call Report Database, provided by the National Credit Union Association (NCUA). These data are public and can be obtained from NCUA.gov. Information on the affiliation between natural person credit unions and corporate credit unions are not public and are based on a 2009 census conducted by the NCUA. Information on county and zip code level house prices are obtained from Core Logic. County level median income is obtained from the Census' American Community Survey, while county level unemployment comes from the Department of Labor. The mean county level household debt to income ratio was graciously provided by Amir Sufi.

2. The data on loan applications and mortgage credit come from the Home Mortgage Disclosure Act (HMDA). Credit unions are required to report to HMDA if they have $40 million or more in assets; originate home loans in an MSA, and are federally insured (a contributor the NUCA share insurance fund). In constructing the binary rejection variable used in Table 14, we omit those loan applications that were approved but rejected by the applicant; withdrawn by the applicant without any action by the lender; or closed by the lender because the application remained incomplete.

3. The data matching credit supplier automobile purchases at the county level come from Polk.

References

Adrian, Tobias and Hyun Song Shin. "Liquidity and Leverage". *Journal of Financial Intermediation,* 19(3), July 2010, pp. 418-437.

Allen, F. and D. Gale, 2000. Financial Contagion, *Journal of Political Economy,* Vol. 108, No. 1, pp. 1-33.

Ashenfelter, Orley and Rouse. 1998. "Income, Schooling, and Ability: Evidence from a New Sample of Identical Twins", *Quarterly Journal of Economics, 113, 253-84.*

Bhattacharya, S. and A.V. Thakor, 1993. Contemporary Banking Theory, *Journal of Financial Intermediation*, Vol. 3, pp. 2-50.

Berger, A.N., and C.H.S. Bouwman, 2008. Financial Crises and Bank Liquidity Creation, available at SSRN: http://ssrn.com/abstract=1231562.

Berger, A.N., and G.F. Udell, 1994. Lines of Credit and Relationship Lending in Small Firm Finance, *Proceedings*, Federal Reserve Bank of Chicago, May Issue, pp. 583, 599.

Brunnermeier, M.K., 2009. Deciphering the Liquidity and Credit Crunch 2007-2008, *Journal of Economic Perspectives* 23, pp. 77-100.

Caballero, Ricardo and Simsek, Alp. 2012. "Fire Sales in a Model of Complexity". *Mimeo.*

Campbell, John, Stefano Gigolo and Para Pataki "Forced Sales and House Prices", with, *American Economic Review,* 101:2108-2131, August 2011

Chodow-Reich, Gabriel. "The Employment Effects of Credit Market Disruptions: Firm Level Evidence from the 2008-09 Financial Crisis" working paper.

Cornett, Marcia Million, Jaime John McNutt, Philip E. Strachan and Hassan Tehran Ian. "Liquidity Risk Management and Credit Supply in the Financial Crisis" *Journal of Financial Economics,* 2011, Vol. 101, pp. 297-312

Coeval, J.D., and A.V. Thakor, 2005. Financial Intermediation as a Beliefs-Bridge Between Optimists and Pessimists, *Journal of Financial Economics*, Vol. 75, pp. 535-569.

Diamond, D.W. and R.G. Rajan, 2000. A Theory of Bank Capital, *Journal of Finance*, Vol. 55, pp. 2431-2465.

Diamond, D.W., and R.G. Rajan, 2005. Liquidity Shortages and Banking Crises, *Journal of Finance*, Vol. 60 No. 2, pp. 615-647.

Geneakoplos, John "The Leverage Cycle." In D. Acemoglu, K. Rogoff and M. Woodford, eds., *NBER Macroeconomic Annual 2009,* vol. 24: 1-65, University of Chicago Press [plus erratum]

Gorton, G., 2009, "Slapped in the face by the invisible hand: Banking and the Panic of 2007," http://papers/ssrn.com/sol3/papers/cfm?abstract_id=1401882.

Gorton, G.B., and A. Winton, 2000. Liquidity Provision, Bank Capital, and the Macroeconomy, available at SSRN: http://ssrn.com/abstract=253849.

Hancock, D., A.J. Liang, and J.A. Wilcox, 1995. Bank Capital Shocks: Dynamic Effects on Securities, Loans, and Capital, *Journal of Banking and Finance*, Vol. 19, No. 3-4, pp. 661-677.

Hanson, S., A.K. Kashyap, and J.C. Stein, 2011. A Macroprudential Approach to Financial Regulation, *Journal of Economic Perspectives*, Vol. 25(1), pp. 3-28.

Hellmann, Thomas F., Kevin C. Murdock, and Joseph E. Stiglitz. 2000. "Liberalization, Moral Hazard in Banking, and Prudential Regulation: Are Capital Requirements Enough?" *American Economic Review*, 90(1): 147-165.

Hill, Enoch, Alessandra Fogli and Fabrizio Perri. 2012. "The Geography of the Great Recession". *NBER WP 18447.*

Holmström, B. and J. Tirole .1998. "Private and Public Supply of Liquidity," Journal of Political Economy 106 (February): 1-40.

Ivashina, Victoria, and David S. Scharfstein. "Bank Lending During the Financial Crisis of 2008." *Journal of Financial Economics* 97, no. 3 (September 2010): 319–338.

Khang, In Gu, Zhiguo He and Arvind Krishnamurthy. 2010. Balance Sheet Adjustments in the 2008 Crisis. *IMF Economic Review.* 58: 118-156.

Kashyap, A.K., R. Rajan, and J.C. Stein, 2002. Banks as Liquidity Providers: an Explanation for the Coexistence of Lending and Deposit Taking, *Journal of Finance*, Vol. 57, pp. 33-73.

Keys, Benjamin, Tanmoy Mukherjee, Amit Seru and Vikrant Vig. "Did Securitization Lead to Lax Screening? Evidence from Subprime Loans", *Quarterly Journal of Economics*, February 2010, 125(1), pp. 307-362.

Khwaja, A.I., and A. Mian, 2008. Tracing the Impact of Bank Liquidity Shocks: Evidence from an Emerging Market, *American Economic Review*, Vol. 98(4), pp. 1413-1442.

Mian, Atif and Amir Sufi. 2011. "What Explains High Unemployment? The Aggregate Demand Channel" *Chicago Booth Working Paper.*

_____."The effects of Fiscal Stimulus: Evidence from the 2009 'Cash for Clunkers' Program." *Quarterly Journal of Economics,* Vol 127, Issue 3, August 2012.

Mian, Atif, Kamalesh Rao and Amir Sufi. 2011. “Household Balance Sheets, Consumption, and the Economic Slump”, *Chicago Booth Working Paper.*

Paravisini, Daniel. Local Bank Financial Constraints and Firm Access to External Finance, *Journal of Finance* , 63:5, October 2008

Peek, J. and E.S. Rosengren, 1995. Bank Regulation and the Credit Crunch, *Journal of Banking and Finance*, Vol. 19(3-4), pp. 679-692.

Peek, J. and E.S. Rosengren, 1997. The International Transmission of Financial Shocks: The Case of Japan, *American Economic Review*, Vol. 87(4), pp. 495-505.

_____ "Collateral Damage: Effects of the Japanese Bank Crisis on Real Activity in the United States," American *Economic Review* 90(1):30-45 (March 2000).

Puri, Manju, Jorg Rocholl and Sascha Steffen “Global retail lending in the aftermath of the U.S. financial crisis: Distinguishing between supply and demand effects,” *Journal of Financial Economics*, 2011, 100(3), 556-578.

Rajan, Raghuram, 1994, "Why Bank Credit Policies Fluctuate: A Theory and Some Evidence", *Quarterly Journal of Economics*, vol 109, pp 399-442.

Rajan, Raghuram and Rodney Ramcharan, 2012. “The Anatomy of a Credit Crisis: The Boom and Bust in Farm Land Prices in the United States in the 1920s” *NBER Working Paper 18027.*

Ramcharan, Rodney and Christopher Crowe, 2013, “The Impact of House Prices on Consumer Credit: Evidence from an Internet Bank, *Journal of Money, Credit and Banking, 45 (6), pp 1085-1116.*

Repullo, R., 2004. Capital Requirements, Market Power, and Risk-Taking in Banking, *Journal of Financial Intermediation*, Vol. 13(2), pp. 156-182.

Shleifer, A. and R. Vishny, 2011. Fire Sales in Finance and Macroeconomics, *Journal of Economic Perspectives*, Vol. 25, No. 1, pp. 29-48.

____”Unstable Banking”. 2010. *Journal of Financial Economics*, 97, 306-318.

_____“Liquidation Values and Debt Capacity: A Market Equilibrium Approach.” Journal of Finance, 47(4): 1343–66.

Scheinkman, Jose and Wei Xiong. Overconfidence and speculative bubbles. Journal of Political Economy (2003) vol. 111 (6) pp. 1183-1219.

Stein, Jeremy. Prices and trading volume in the housing market: A model with down-payment effects. The Quarterly Journal of Economics (1995) vol. 110 (2) pp. 379-406

Von Thadden, Ernst-Ludwig, 2004. Bank Capital Adequacy Regulation Under the New Basel Accord, *Journal of Financial Intermediation*, Vol. 13(2), pp. 90-95.

Wilcox, James A. 2011. "Reforming Credit Unions Capital Requirements" http://www.haas.berkeley.edu/groups/finance/Credit%20Union%20Capital%20Reform%20Wilcox%2020110303.pdf