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

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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. This industry is important for consumer finance, and we find that ABS related losses at correspondent credit unions are associated with a large contraction in the supply of consumer credit and a hoarding of cash among downstream credit unions. We also find that this contraction in credit supply was concentrated among downstream credit unions that began the crisis with lower capital asset ratios, and that it may have amplified the initial decline in house prices. These results suggest that capital regulation might shape the ability of financial institutions to transmit securities price volatility onto the real economy.

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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), Gorton (2009), Shleifer and Vishny (2011)).

Less well understood however, is the mechanism through which the decline in ABS prices might have affected the supply of credit to consumers and small businesses in the broader economy. 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 slow economic recovery and weak house price growth.

The goal of this paper then is to study how the financial crisis of 2007-2009 affected the supply of credit to consumers.[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), 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 observationally similar reduction in bank lending and economic activity.

[2] 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, Khawaja and Mian (2008), Paravisini (2008), and Peek and Rosengren (1997).

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.[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 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]

Despite the industry's importance in consumer lending, 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 bank 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

[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.

NPCUs have virtually no direct exposure to financial products such as ABS, and to realize scale 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. 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. The depletion of investment capital on the balance sheet of NPCUs are associated with a significant contraction in lending over the subsequent four quarters. The economic magnitudes are also substantial. A one standard deviation decrease in the growth of investment capital in a given quarter is associated with a 0.23 percentage point decline in lending growth over the subsequent four quarters; the average quarterly growth rate of loans is 0.19 percent during the sample period. The analysis also suggests that the $7 billion in CCUs losses passed onto NPCUs through 2010 may have engendered an $80 billion contraction in credit supply. These results are robust to a number of spatially disaggregated controls, like house

[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.

price dynamics and pre crisis consumer leverage, which absorb any systematic variation in latent credit demand that might correlate with investment capital balance sheet losses at NPCUs.

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 Rosengreen (1995), Shleifer and Vishny (2010)). But influential theories also observe that the impact of these balance sheet shocks on credit production might also hinge on balance sheet liquidity (Holmstrom and Tirole (1998) and Caballero and Simsek (2012).[9] Controlling for balance sheet liquidity as well as asset size, we find that nearly all of the contraction in credit occurred at those NPCUs that entered the crisis with relatively less capital.

Moreover, using data on mortgage credit applications, which allows us to hold constant key applicant level demographic and economic observables, we show that those NPCUs with relatively less capital were far more likely to restrict credit availability at the extensive margin in response to investment capital losses. This contraction in credit availability was also disproportionately aimed at that those applicants seeking the most leveraged mortgages. Building on these results at the extensive margin, and consistent with recent evidence suggesting that credit availability might affect asset prices, we also find that the contraction in credit supply may have significantly reduced house price growth in those areas where NPCUs were dominant financial services providers (Mian and Sufi (2008), Rajan and Ramcharan (2012)).

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. This in turn may have also amplified the initial decline in house prices, as financial intermediaries with balance sheets exposed to these securities, either directly or indirectly as in the case of NPCUs, may have contracted the supply of mortgage credit. This paper proceeds as follows. Section 2 describes the data and institutional details; Section 3 presents the main results;

[9] Liquidity has also been shown to insulate lending from shocks to the liabilities side of the balance sheet (Kashyap and Stein (2000)).

Sections 4 focuses on the mechanism while Section 5 studies the impact of the shock on the housing market; we conclude in Section 6.

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, and the resulting financial crisis, on broader credit availability. Banks and other 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 a particular market such as the ABS market (Khang et. al (2010)). Even if it were possible to measure a bank's direct and indirect exposure to the ABS market, these connections suggest that 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.[10]

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 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

[10] For instance, a bank might curtail lending because of contagion effects emanating from the inter bank 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 a member 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.

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 have traditionally pooled 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.[11] 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. 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, borrowing and lending against these securities; in the fall of 2008, there were approximately $63 billion of mortgage-backed securities in the CCU system.[12] Once the collapse in the ABS market set in, 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.

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

[11] Many states require membership capital to have a minimum duration of 3 years. 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 junior to membership capital.

[12] 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.

primarily transmitted onto the balance sheet of its member NPCUs in proportion to each NPCU's initial investment capital stake.[13] These initial stakes reflect contractual arrangements that precede the crisis by decades in many cases. But in addition to the depletion of investment capital, the regulator, the National Credit Union Association (NCUA), also levies special assessments on NPCUs to cover these CCU ABS related losses. These assessments are proportional to a NPCU's insured deposits relative to total system deposits. In what follows, we use both the depletion of investment capital and special assessments to measure more accurately a NPCU's total balance sheet exposure to CCU ABS losses. To be clear: all results in this paper are unchanged if we use only the depletion of investment capital (available upon request).[14]

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. That is, these arguments would suggest that estimates of the impact of the log change in investment capital plus assessments at NPCU i in period $t-1$, ΔC_{it-1}, on the log change in lending, ΔL_{it}, are unlikely to be biased by unobserved shocks to local credit demand, e_{it}:

$$\Delta L_{it} = \beta_0 + \beta_1 \Delta C_{it-1} + e_{it} \text{ , where } \operatorname{cov}\left(e_{it}, \Delta C_{it-1}\right) = 0 \quad (1)$$

The assumption that $\operatorname{cov}\left(e_{it}, \Delta C_{it-1}\right) = 0$ does not imply that credit demand and economic conditions did not worsen for some NPCUs, but rather that local shocks to credit demand did not systematically vary with the depletion of investment capital and assessments resulting from the collapse of the ABS market and the ensuing losses at the CCU. We now describe the data.

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

[13] 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).
[14] 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).

and CCUs, and we obtained these data separately from the NCUA based on its census of these relationships performed in late 2009.[15]

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 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, 98 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

[15] 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.

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 corporate 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 7 times larger than the median NPCU that belongs to Iowa corporate. Median lending growth in the former is also nearly thrice 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.

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 member CCU, inducing the latter to expand its balance sheet through holdings of ABS. 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.

Preliminary material loss reviews into the CCU failures suggest however that the specific actions of a given NPCU may have played little role in shaping a CCU investment decision. Instead, a change in management in 2004 at WesCorp—the largest retail CCU—brought about by the retirement of that company's long tenured CEO may have been a principal factor in shifting WesCorp's investment strategy towards ABS. In turn, this shift by the largest retail CCU may have then led other CCUs to follow suit. In addition, the regulator (NUCA) has successfully

argued in court that the risks associated with the ABS products sold to the industry were misrepresented by the various investment banks that sold these assets. 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.nuca.gov). These arguments render it unlikely then that house price developments at the zip code level, or the actions of a specific NPCU may have systematically affected the investment behavior of a given CCU.

That said, it is also possible that the additional profits that a CCU might have earned during the boom 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. That said, if we focus on the extreme case of 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 2).

3. Main Results

Figure 3 plots total loans and the evolution of total membership and paid-in capital—investment capital—present in the corporate credit union system and recorded as assets on the balance sheet of natural person credit unions (NPCUs). Investment capital rose slowly from 2005. But from a peak of around $3.5 billion in 2008, investment capital fell precipitously, as ABS losses began to be recognized as “other than temporary impairments” and charged against the balance sheet of NPCUs. By the end of 2010, investment capital in the system was just under

$1 billion, and NPCUs had also paid another $1.4 billion in special assessments to cover these ABS losses. Figure 3 also shows that lending rose steadily in the first half of the sample, but abruptly plateaued in the same quarter as accounting rules forced ABS losses within the CCU system to be recognized as "other than temporary".

This timing hints at a potentially large connection between shocks to NPCU balance sheets emanating from ABS losses and the supply of credit: new lending per year fell from an average of around $40 billion before the crisis to about -$1.5 billion a year after 2008 (Table 7). But this "missing" $80 billion in loans over 2009-2010 may also reflect depressed credit demand, as the US economy entered into a recession at around the same time. It is only then by drilling down to the local credit union level and using appropriate controls can we isolate more convincing variation in order to identify credit supply effects.

Using total lending growth as the dependent variable, column 1 of Table 8 estimates equation (1) using a single lag of the log change of the sum of investment capital plus special assessments. In this most parsimonious specification, the only controls are bank fixed effects, which absorb time invariant bank characteristics, and year and quarter fixed effects which control for aggregate shocks that affect all NPCUs equally. The sample period extends from the 2nd quarter of 2005 through the final quarter of 2010. The coefficient on the log change in investment capital is significant at the one percent level, and it indicates that a one standard deviation decrease in investment capital growth is associated with a 0.06 percentage points drop in lending growth the next quarter—about a 20 percent decline relative to the average growth in lending over the sample period.[16]

Unobserved shocks to credit demand that correlate with the depletion of investment capital remain the principal challenge to inference. Thus, before interpreting the economic magnitude of the estimate in column 1, or exploring the mechanisms that might underlie this result, we first focus on the robustness of this relationship. As we noted earlier, the distribution of corporate membership among NPCUS is not random, but is clustered geographically, as many NPCUS within the same state are also connected to the same CCU. This raises the possibility that NPCUs within the same state might be subject to similar credit demand shocks. And because these NPCUs are also likely to be members of the same CCU, they may also be subject to a

[16] As noted earlier, we use both the depletion of investment capital and special assessments to measure more accurately a NPCU total balance sheet exposure to CCU ABS losses. All specifications in this paper have also been run using only the change in investment capital. These results are equally robust and available upon request.

similar pattern of investment capital related balance sheet losses. [17] We thus include state specific time trends, which allow aggregate time varying shocks to lending growth to vary by state. From column 2 the results are unchanged.

Aggregate time varying shocks to lending growth might also vary by CCU membership. For example, lending growth during the boom was more vigorous among NPCUs affiliated with some of the larger CCUs that eventually failed (Table 6). Column 3 of Table 8 thus includes corporate specific time trends, which allow NPCUs that are members of the same CCU to have the same time varying shocks to lending growth. From column 3, the point estimates are little changed.

As a further check, column 4 altogether drops Wescorp members from the sample. Recall Wescorp, which eventually failed, was the largest retail CCU, and it drew most of its membership from NPCUs in California—one of the epicenters of the boom and bust in housing related credit demand. Wescorp was also heavily invested in ABS derived from Countrywide mortgages—a subprime lender that also specialized in California. The results are again little changed (column 4), suggesting that they are unlikley to be driven latent factors associated with local housing conditions—a concern we return to in the next section.

Variation in the field of membership provides another potential source of unobserved shocks to credit demand that might correlate with the depletion of investment capital, leading to biased estimates. During the crisis, those NPCUs that drew their members from the military or the health sector may have suffered a smaller decline in the demand for credit relative to those with members drawn from the manufacturing sector or state and local governments. Biased estimates can then arise to the extent that these differences in the local demand for credit are systematically correlated with CCU membership and the depletion of investment capital. In column 5 we use the full sample of NPCUs and include field of membership specific time trends to absorb any time variation in credit demand that are common to NPCUs that operate within the same field of membership. The estimate on the change in investment capital remains unchanged.

Although these results appear robust to a plausible range of shocks, linear time trend interactions may only imperfectly control for shocks that are common to those credit unions that

[17] The housing boom and bust and other potential changes in the local demand for credit was also geographically segmented. NPCUs in California for example may have experienced a greater demand for credit during the boom and a greater collapse in asset prices and decline in the pool of credit worthy borrowers relative to some other states like North Dakota, where an oil and gas boom has kept asset prices and credit demand high.

operate in the same state, field of membership or are members of the same CCU . After all, credit demand and overall economic conditions differed dramatically before and after the collapse of the ABS market. To better model this discontinuity, column 6 uses a binary "crisis variable", which equals 1 from 2007 second quarter through 2010 fourth quarter, and 0 otherwise. We construct three sets of interaction terms, interacting the crisis variable with the state, field of membership and CCU connection indicators. The resulting interaction terms using this binary variable allow the impact of the crisis on lending to vary across NPCUs depending on whether they operated in the same state, field of membership or have the same CCU membership. The coefficient estimate on investment capital growth appears unaffected by this alternative parameterization of common shocks.

Column 7 uses state and corporate fixed effects interacted with year and quarter dummies. This approach allows all NPCUs operating in either the same state or those affiliated with the same CCU to have common lending shocks within each period; those shocks can then vary non-parametrically across periods. For example, in the final quarter of 2008, house prices declined more steeply in California than in Kansas. And these time varying differences in the intensity of the housing boom and bust across states and CCU memberships could be a source of bias. However, from column 7, while the investment capital coefficient declines somewhat, it remains significant at the one percent level.

Of course, the relationship between house price fluctuations and household leverage on latent credit demand remains an important issue, and the next section focuses on these issues in more detail. But before doing so, column 8 of Table 8 adds several standard time varying balance sheet ratios controls. These include cash assets, total deposits and NPCU equity, all scaled by total assets and lagged one quarter; the log of total assets, lagged one quarter; along with the one quarter lagged growth in allowances for expected loan losses—the latter is a proxy for a NPCU's expected local lending conditions, and is good indicator of local credit conditions, as perceived by the NPCU itself. Including these variables does little to alter the point estimate on investment capital changes, and in what follows we omit these time varying controls, using bank and time fixed effects along with the state, corporate and field of membership specific linear time trends as the core controls in the preferred baseline specification.

House Prices and Consumer Leverage

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 depletion of investment capital also varied geographically (Figure 4). Wescorp, based in California, was the largest CCU, and as already mentioned, the collateral backing its investment portfolio of private label residential mortgage backed securities was heavily skewed towards California. Wescorp's NPCU members, also mostly based in California, also 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 some latent demand variable.

We have already dropped Wescorp members from the sample (column 4 of Table 8), and considered a number of different specifications that absorb geographic and CCU trends in various ways to address this concern. 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 4). In contrast, some upper Midwestern counties—areas not usually associated with the housing boom—experienced sharp investment capital declines. 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.[18] Nevertheless, given the marked geographic variation in the crisis, we now consider further robustness checks.

To this end, column 1 of Table 9 controls for the one quarter lag change in the Core Logic House Price Index (HPI) house price index computed at the county level. The results are little changed. Because of geography and other factors, some counties experienced a sharper rise in house prices during the boom (2005-2006) than others, rendering them more susceptible to the bust. The use of NPCU fixed effects already linearly absorbs those time invariant factors that

[18] 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.

might shape a county's exposure to the housing boom, but these effects may be non linear. To address this concern, Column 2 focuses on the sub-sample of NPCUs located in those counties that experienced average house price growth in 2005-2006 that was above the median. Column 3 restricts the sample to those NPCUs in counties with below median house price growth during the boom. Across both subsamples, the impact of investment capital on lending remains significant at the one percent level.

Given the very local nature of NPCU lending, county level controls might be too spatially aggregated to effectively capture local demand shocks. We have zip code level house prices for a smaller subsample of NPCUs, and column 4 uses the one quarter growth in the HPI index; again the results are unchanged. Finally, because household leverage during the boom (2006) helped shape the local adjustment to the housing shock, we use county level data on household leverage from Mian, Rao and Sufi (2011). Column 5 considers NPCUs in counties where the mean debt to income ratio for households in 2006 is above the median—the counties with the most leveraged households on average. Column 6 restricts the sample to NPCUs operating in counties where households on average were least leveraged during the boom—below the median debt to income ratios. Interestingly, the investment capital point estimate appears a little larger for NPCUs in the least leveraged counties, but in both cases, the estimate is large and significant.

Further Robustness Checks

The preceding evidence suggests that changes in investment capital and assessments emanating from indirect loses in the ABS market may have significantly affected local credit growth. These results also appear robust to a number of plausible controls. However, it would seem unlikely that the full impact of these balance sheet losses on lending growth emerge fully in a single quarter. Table 10 thus uses a distributed lag model over four quarters in order to better understand the evolution of the impact of these balance sheet losses.

The point estimates from column 1 of Table 10 suggest that the impact of investment capital losses on lending growth peaks around the 3rd quarter after the initial shock, and drops by more than half from this peak one quarter later. After a one standard deviation decrease in investment capital in a given quarter, these estimates imply a 0.23 percentage point decline in

lending growth over the subsequent four quarters; recall that the average quarterly growth in lending is 0.19 percent during the sample period.

We have already controlled for a number of different balance sheet variables (column 8 of Table 8), but a residual concern is whether these estimates conflate the impact of investment capital depletion and assessments due to CCU ABS related losses with losses from any ABS held directly on the balance sheet of an NPCU. To assess this possibility, column 2 of Table 10 restricts the sample to those NPCUs at the bottom 75th percentile of assets in the current quarter—the subsample in which the median direct exposure to ABS is zero—while column 3 uses the top quartile of NPCUs; the median direct exposure to ABS in this sub-sample is 6 percent of total assets. The results are similar across the two sub-samples. Finally, over the five year sample period, the number of NPCUs declined by about 8 percent through mergers and acquisitions, as well as failures. To gauge the potential impact of this attrition on these estimates, column 4 uses a balanced panel, excluding those NPCUs that eventually attrited out of the sample. The estimated impact of the decline in membership capital is little changed.

These panel estimates appear robust to a number of different perturbations, and we now focus on the cross-sectional variation in investment capital depletion and lending. Cross-sectional estimates are robust to concerns about serial correlation that might feature in the panel estimation. Moreover, since the cross section encompasses the pre- and post-crisis periods, cross-sectional estimates are likely to yield economic magnitudes that better reflect the full impact of the collapse in investment capital on lending over the entire crisis period.[19] To this end, we collapse the dataset into two periods—2007 Q1 and 2010 Q4—the last quarter before the crisis (pre crisis), and the final quarter of the sample period (post crisis). We then difference the time collapsed data, purging any time invariant NPCU characteristics that might affect the level of loans pre and post crisis, and regress the percent change in loans on the percent change in investment capital. We include membership and state fixed effects in this cross section regression and cluster standard errors at the county level.

The results from this specification are reported in column 5 of Table 10. The point estimate is statistically significant and suggests that a one standard deviation decrease in investment capital over the crisis is associated with a 0.12 standard deviation decline in the

[19] For example, in the panel, there is evidence—available upon request—that the impact of investment capital changes on lending growth may have been larger in 2009, when investment capital losses were a surprise and there was still considerable uncertainty about the policy response at the onset of the crisis.

percent change in lending. To gauge the dollar value implications of this estimate, for each NPCU we multiply its percent change in investment capital by 7.18—the estimate in column 5. 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 stock of loans in the first quarter of 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 $2.2 billion decline in investment capital observed in the subsample used in column 5 is associated with a $25.2 billion decline lending. That is, every dollar decline in investment capital implies an $11.3 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 $79 billion dollar contraction in lending—nearly all of the "missing" $80 billion in credit implied by the pattern of new lending in Table 7. [20]

The contraction in credit also appears to extend across the various lending subcomponents. Using the baseline panel specification from column 1 of Table 10, Table 11A indicates that as with total lending, the impact of investment capital losses on these loan subcomponents generally peak in the third quarter after the shock. However, the cumulative impacts appear largest for new and used car lending followed by housing related loans. These types of loans featured prominently in various securitization products, and the general collapse of the ABS market could have prompted NPCUs to curtail lending to those assets that underlie these securities—automobiles, and housing. Table 11B uses the growth in the number of new loans by each category as the dependent variable in order to gauge the impact of these shocks on the extension of new credit. The impact on the extensive margin again appears large and significant for automobile and housing related purchases.

[20] 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% 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.

4. Mechanism

The positive association between investment capital changes and lending appears stable across a large number of different specifications, but understanding the underlying mechanism behind this positive association would better permit a causal interpretation. In particular, 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 the balance sheet losses associated with CCUs (Bhattacharya and Thakor (1993), Diamond and Rajan (2000), Peek and Rosengreen (1995), Shleifer and Vishny (2010)).[21]

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 estimate the baseline specification—state, corporate specific and field of membership time trends, as well as NPCU fixed effects, separately for those banks in each of the four quartiles of the capital asset distribution in 2006. The results are striking. From column 1 of Table 12A, the four lags of the investment capital variable are jointly significant at the one percent level. The point estimates imply that a one percentage point increase in balance sheet loses emanating from membership capital is associated with a 0.014 percentage point drop in lending growth over four quarters among those NPCUs in the bottom quartile of the capital asset ratio distribution. This is about 30 percent larger relative to the estimate for the whole sample reported in column 1 of Table 9.

[21] There is some evidence that bank capital might be an empirically important buffer against balance sheet shocks. But as Berger and Bouwman (2008) observes, much of this evidence relies on variation induced by the adoption Basel I regulations, and the unusual combination of several major changes in bank capital regulation and a recession make it difficult to draw general conclusions about the relationship between bank capital and credit production (Berger and Udell 1994; Hancock, Laing, and Wilcox 1995; Peek and Rosengren 1995)).

In column 2 of Table 12A, the four lags of the membership capital variable are jointly significant at the 5 percent level, and the implied impact of a one percentage point decline is 0.01 percentage drop in lending growth. At the third quartile—column 3—the point estimates suggest a similar 0.01 drop in lending. However, for those NPCUs at the fourth quartile, the investment capital lags are neither individually nor jointly significant (p-value=0.58), suggesting that these NPCUs were able to insulate lending from balance sheet losses.

Before making too much of this result, we should note however that 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 1 of Table 12B addresses this concern. It creates a categorical variable that absorbs the NPCU capital asset ratio into quartiles, interacting this categorical variable with the change in investment capital. Column 1 also includes a similar categorical variable based on asset size, interacting this variable as well with the change in investment capital. This specification thus allows the impact of changes in investment capital to depend on the capital asset ratio, as well as on asset size.

Nesting these hypotheses leads to greater imprecision, but the evidence continues to suggest that capital asset ratios may have buffered lending. In contrast, the size interaction terms are not significantly different from zero. Column 2 of Table 12B repeats this exercise for liquidity, examining whether the results on capital are in fact driven by liquidity. We create categorical variables that decomposes the ratio of cash to assets in 2006 into quartiles, interacting these variables with the change in investment capital. The evidence continues to suggest that those banks with higher capital to asset ratios may have been best able to buffer lending.

Tables 12A and 12B suggests that those NPCUs that most expanded their balance sheet during the boom disproportionately curtailed credit production in response to investment capital shocks during the bust. The erosion of capital as well as the uncertainty surrounding the solvency of CCUs might then induce these NPCUs to hoard liquidity.

Table 13 investigates this hypothesis, using the growth in cash assets on the balance sheet as the dependent variable. Here we exclude cash held at corporates, and construct the dependent variable as the growth in cash on hand, plus cash deposited at other financial institutions (excluding CCUs), plus investments with original maturities of three months or less—cash

equivalents. The results are striking. For the bottom three quartiles, the lagged changes in investment capital are jointly significant at the one percent level or better. And the point estimates suggest that after a one percentage point decline in investment capital, cash on the balance sheet increases by 0.14 percentage points among those in the bottom quartile (column 1). The impact is around 0.13 and 0.10 percentage points for those banks in the second and third quartiles. In contrast, the investment capital lags are jointly insignificant among these NPCUs in the top quartile.

While alternative latent credit demand explanations remain possible, the evidence on the role of capital in shaping the transmission of the balance sheet onto lending and the growth in cash render these alternative explanations somewhat unlikely. Nevertheless, in the next section we focus on detailed microeconomic data from the mortgage market to understand better these results.

5. The Impact of the Shock

Loan Applications and the Extensive Margin

The evidence suggest that the contraction in NPCU credit supply due to CCU ABS related losses may have been on the order of $80 billion, and we now study the impact of this contraction on mortgage credit availability. Mortgage credit is an important element of NPCU lending, accounting for about a quarter of originated loans. There is also growing evidence that changes in credit availability might affect asset prices during periods of booms and busts (Mian and Sufi (2008), Rajan and Ramcharan (2012)).[22] It is possible then that the collapse in the price of securities backed by housing could have amplified further the initial decline in house prices, as financial intermediaries with balance sheets exposed to these securities, either directly or indirectly as in the case of NPCUs, reduced the supply of credit at the extensive margin (Shleifer and Vishny (2010)).

To investigate the impact of investment capital changes on mortgage credit at the extensive margin, we use data from the Home Mortgage Disclosure Act dataset (HMDA) on

[22] Because house purchases typically require credit, the demand for housing can depend on credit availability (Stein (1995)). Greater credit availability in an area also makes it easier to resell homes, rendering the local housing market more liquid, and embedding a liquidity premium, especially in those areas where short term, speculative investors are most active (Shleifer and Vishny (1992)).

mortgage applications. 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. These 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.

The dependent variable in Table 14 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. The one quarter lag investment capital variable is negative—additional lags are superfluous and these specifications are available upon request—suggesting that a decline in investment capital might be associated with a higher probability of rejection. But this relationship is not significant at conventional levels. 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 (Table 12), and column 2 of Table 14 restricts the sample to those NPCUs in the bottom quartile of capital. In this subsample, there is a robust negative association between investment capital changes and the rejection probability. A one standard deviation drop in investment capital is associated with a 0.5 percentage point increase in the probability of rejection—a 3 percent increase relative to the unconditional mean. Column 3-5 replicate this specification for the other capital asset quartiles.

Consistent with the hypothesized role of capital as a buffer against the transmission of balance sheet shocks onto lending, the point estimate in these subsamples of better capitalized institutions are small and insignificant.

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 6 investigates this hypothesis, interacting the change in investment capital with 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.

The interaction term is negative and significant at the one percent level, and suggests that in response to a decrease in investment capital, those institutions in the bottom quartile of capital were far more likely to deny credit to borrowers seeking more leveraged loans; perhaps, the borrowers most optimistic about future house price growth. A one percentage point decrease in investment capital is associated with a 0.2 percentage point increase in the rejection rate for a borrower at the 10^{th} percentile loan to income ratio. But for a borrower at the 90^{th} percentile of this ratio, a similar decrease in investment capital implies a 3.4 percentage point rise in the denial rate—an almost 15 fold increase.

House Prices

This evidence raises the possibility that the contraction in mortgage credit supply at the extensive margin could adversely affect house prices. Also, these price effects could be substantial, given that NPCUs may have selectively restricted credit to the most optimistic potential buyers—those buyers most willing to select the most leveraged loans. Of course, if potential borrowers could easily substitute towards other sources of credit, such as banks, then any price impact might be limited. Tables 1A-1C appears inconsistent with this substitution hypothesis, as NPCUs in the aggregate actually increased market share relative to other financial institutions after 2007.

Moreover, at the zipcode level, the substitution hypothesis would predict an increase in non credit union mortgage credit in those zip codes with NPCUs that experienced large declines

in investment capital, as households in those zip codes seek alternative sources of credit. The coefficient from regressing the percent change in non NPCU mortgage credit between 2010 Q4 and 2007 Q1 within a zipcode on the percent change in investment capital over the same period in the zipcode is small (-0.878) and statistically insignificant (p-value=0.55), providing little support for the idea that other financial intermediaries may have been alternative source of credit in areas where NPCUs reduced lending.[23] This makes it likely that the possible contraction in NPCU credit availability may have amplified the initial decline in house prices, especially in those areas where NPCUs were most active.

To investigate this possible amplification effect, we turn to the Core Logic (HPI) zip code level house price index. The relationship based lending model of NPCUs suggest that the bulk of their credit extension is likely to flow to members living nearby, and we focus on the finest level of spatial disaggregation, aggregating loans and other variables at the NPCU level up to the zip code in order to match the HPI zip code level data. As before, we perform this aggregation for two periods:—2007 Q1 and 2010 Q4—the last quarter before the crisis (pre crisis), and the final quarter of the sample period (post crisis). Computing the difference across the two time periods allows us to then study the relationship between the change in house price and credit over the crisis in the zip code (*i)* level cross-section*:*

$$(2) \qquad \Delta HPI_i = \alpha_0 + \alpha_1 \Delta L_i + v_i$$

Column 1 of Table 15 reports the OLS estimate of the impact of total credit growth on house price growth. The measure of credit in column 1 includes mortgage credit as well as the types of credit that can help individuals smooth consumption during the crisis, such as unsecured and credit card lending. The latter types of credit can in turn limit the incidence of foreclosures and the knock on impacts on house prices (Campbell et. al (2011)). Controls include state fixed effects, which absorb state level factors such as regulations that might affect house price growth identically for zip codes in the same state. To control for local economic conditions, we also use the percent change in median income in the county over the period, the level of unemployment in the county at the end of the period in 2010, the log level of the HPI index in 2007 Q1, and the

[23] The result appears consistent with the evidence in Cornett et. al (2010), which indicate that the banking system may itself have curtailed credit supply.

share of credit union mortgage credit in the zip code relative to other types of lenders taken from the Home Mortgage Disclosure Act (HMDA) database. Credit growth is significant at the one percent level and a one standard deviation decrease in credit growth implies a 0.02 standard deviation change in the HPI index. Column 2 uses solely mortgage credit, and here the implied impact is similar to column 1.

Theories that link credit availability with asset prices observe that OLS estimates, which conflate both demand and supply side factors, could over- or underestimate the impact of a contraction in credit supply on prices. For example, credit supply by credit unions could be irrelevant for asset prices and OLS estimates could reflect the (positive or negative) correlation between house prices and loan demand. But we have already seen that the speculative, most optimistic borrowers—those seeking the most leveraged loans—were disproportionately denied credit, and OLS might significantly underestimate the true impact of credit contraction on prices.

Specifically, Geneakoplos (2009) suggests that buyers tend to be the optimists in the population, restrained in their enthusiasm for buying only by the funds they can access; greater credit availability allows them to pay even more for the asset. Hence, faced with a balance sheet shock and the need to contract credit supply, a bank may deny credit first not to the conservative low risk borrower, but as the results in Table 13 intimate, to the speculative or optimistic marginal borrower—the very borrower that would have been willing to pay more for the house. This type of screening could in turn lead to a sizable collapse in house price growth.

Scheinkman and Xiong (2003) develops a related argument, noting that credit availability and lower transactions costs can allow the speculative borrower to bid up asset prices beyond fundamentals in the hope of a future sale to someone with a more optimistic valuation. A contraction in the supply of credit that disproportionally targets the optimistic borrower willing to leverage up, could then have an impact on house price growth far larger than what OLS estimates might suggest.

Therefore, to derive plausibly causal estimates of the impact of the contraction of credit supply on house price growth, we use the change in investment capital as an instrument for credit growth. We have already seen that the depletion of investment capital is associated with a contraction in credit growth at the NPCU level, and the first stage results—reported in column 3 of Table 15—reaffirm this result at the zip code level. A one standard deviation decrease in investment capital is associated with a 0.16 standard deviation decline in lending. Moreover, the

depletion of investment capital on the balance sheet of NPCUs occurred in response to trading decisions at the CCU level, and is likely to be unrelated to house price developments at the zip code level.

Furthermore, while the CCU losses were driven by initial concerns about national house prices and the resulting collapse in the ABS market, this collapse was unlikely to be driven by house price changes in any particular zip code. And the previous evidence also revealed that the impact of investment capital growth on lending growth remained relatively constant even after controlling for zip code level house price growth, as well as a variety of common local trends. This is consistent with the idea that although the ABS related losses at CCUs stemmed from declining house prices, the apportioning of those losses among NPCUs was unrelated to local economic conditions or local house price growth.

The IV estimate reported in column 4 are large, though estimated with less precision than its OLS counterpart (p-value=0.06). This estimate suggests that a one standard deviation decrease in credit growth is associated with a 0.17 standard deviation decline in house price growth. Credit unions were not however uniformly important for mortgage lending across zip codes. And using data from HMDA, column 5 focuses on those zip codes where the share of credit unions in housing loan volumes were in the top quartile—above 6 percent. In this subsample, the impact of credit union credit on house price changes is nearly twice as large compared to the full sample. To put these results in context, moving from a zip code in the 75th percentile of loan growth to the 25th percentile implies a 5.1 percentage point or 0.38 standard deviation decline in the HPI index. These estimates are somewhat smaller when restricting the sample to solely mortgage credit (column 6). Taken together, these results suggests that the contraction in credit supply among NPCUs stemming from CCU losses might have significantly amplified the drop in house prices during the crisis.

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. Financial institutions are exposed to ABS both on their balance sheet as well as through a number of indirect channels, making the measurement of

exposures difficult. And while economic theory generally predicts that bank balance sheet losses can adversely affect credit supply, these losses typically occur during times of reduced credit demand. This paper addresses some of these challenges using a new dataset that describes unique interbank relationships within the credit union industry. This 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 and a hoarding of cash among downstream natural 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. Controlling for pre-existing liquidity as well as size, we show that the credit crunch was concentrated among those NPCUs that had relatively low capital asset ratios. Finally, we also provide evidence that the contraction in credit supply may have further amplified the decline in house price growth during the crisis. Taken together, these results suggest that capital regulation might be a useful tool in limiting the ability of banks 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

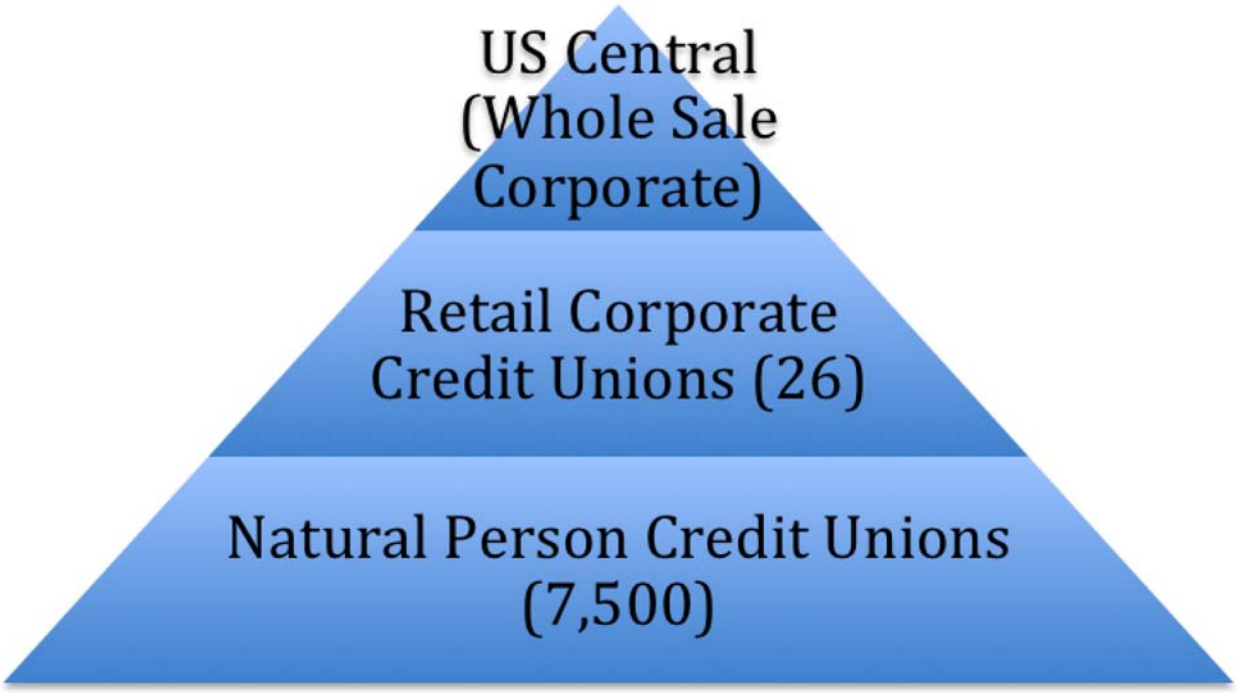
Table 1B. Auto Loan Market Share (Percent)

	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)

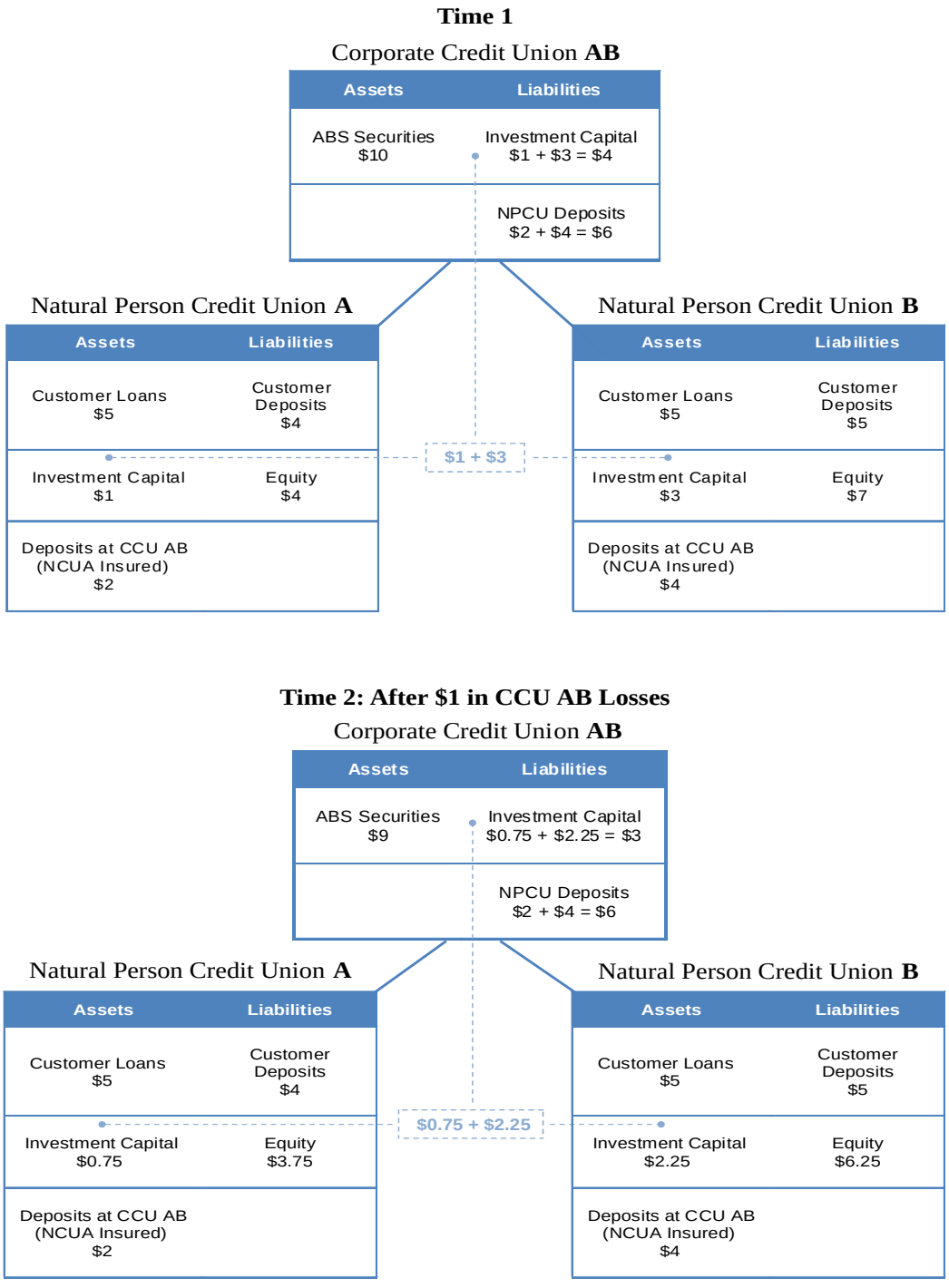
	2006	2009	2010
By Number of Loans	13.6	15.8	17.6
By Dollar Value of Loans	3.92	3.70	4.30

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



This figure 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, this table 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

This table 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

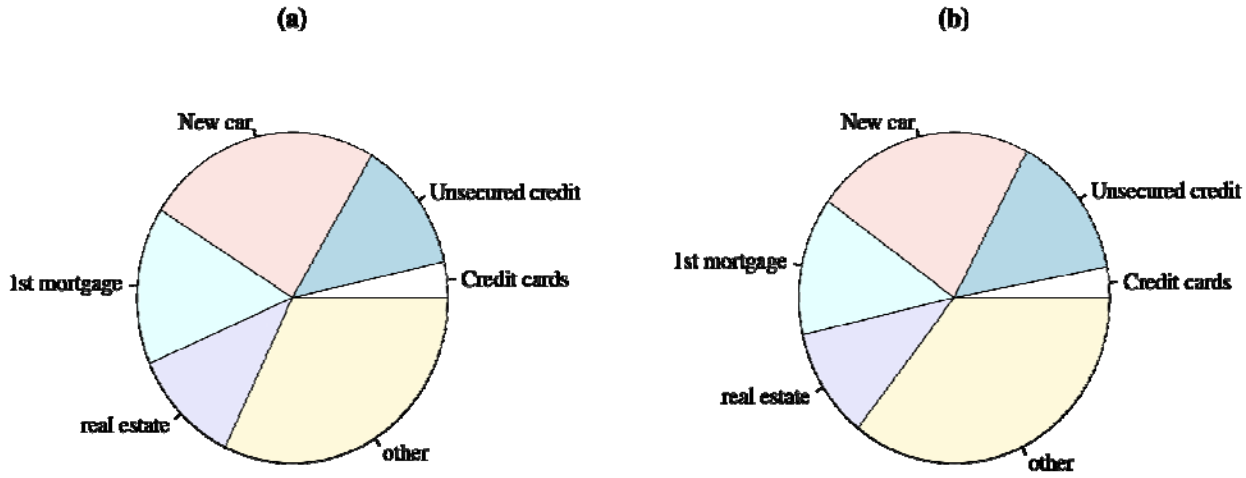
This table reports the top three corporate connections (fraction) for the natural person credit unions in each state; the data are observed in 2008.

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
Western Corp	61,816	1.57	0.06	0.13	0.03	0.87

This table 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. 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 3. Investment Capital and Total Lending in the Credit Union Industry, 2005-2010

This graph 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

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	No Controls	State Specific Time Trend	Corporate Specific Time Trend	Drop Wescorp	Field of Membership Specific Time Trend	Crisis Trend	State and corporate fixed effects interacted with year and quarter dummies	Time Varying Controls
Growth in Investment Capital, Lagged One Quarter	0.235***	0.277***	0.264***	0.212***	0.263***	0.304***	0.1663***	0.222***
	(0.0585)	(0.0592)	(0.0592)	(0.0644)	(0.0592)	(0.06)	(0.0636)	(0.0624)
Cash /Assets								0.00512*
								(0.00265)
Leverage Ratio								-0.00389
								(0.00881)
Deposits/Assets								-0.00396
								(0.00675)
Log Assets								0.035
								(0.105)
Growth in loan losses allowances								0.0985**
								(0.0418)
Observations	152,099	152,099	152,099	135,364	152,081	140,788	152,099	134,819
R-squared	0.205	0.210	0.211	0.205	0.211	0.215	0.220	0.217

Table 8 regresses the log change in lending growth on the log change in investment capital, lagged one quarter. The sample period covers Q1 2005 to Q4 2010. All columns include NPCU fixed effects and year and quarter dummies. Column 2 includes a state specific time trend; column 3 includes both a state specific time trend and a corporate specific time trend. Column 4 includes the previous controls, but drops NPCUs connected to Wescorp Corporate. Column 5 includes the previous controls, and adds field of membership specific time trends. Column 6 parameterizes common state, corporate and field of membership trends using a "crisis" dummy that equals 1 for the post 2007 second quarter period and 0 otherwise: this variable is interacted with the state, corporate and field of membership variables. Column 7 interacts the state and corporate fixed effects with year and quarter dummies. Column 8 includes the ratios of cash, deposits and capital to assets, lagged one quarter, as well as the log value of assets, and the growth in allowances made for possible losses on loans and leases, excluding reserves. Estimated coefficients and their standard errors (in parentheses)are multiplied by 100 in the table for readability.***, ** and * denote significance at the 1, 5 and 10 percent respectively. Standard errors are clustered at the NPCU level.

Figure 4. Investment Capital Losses, By County

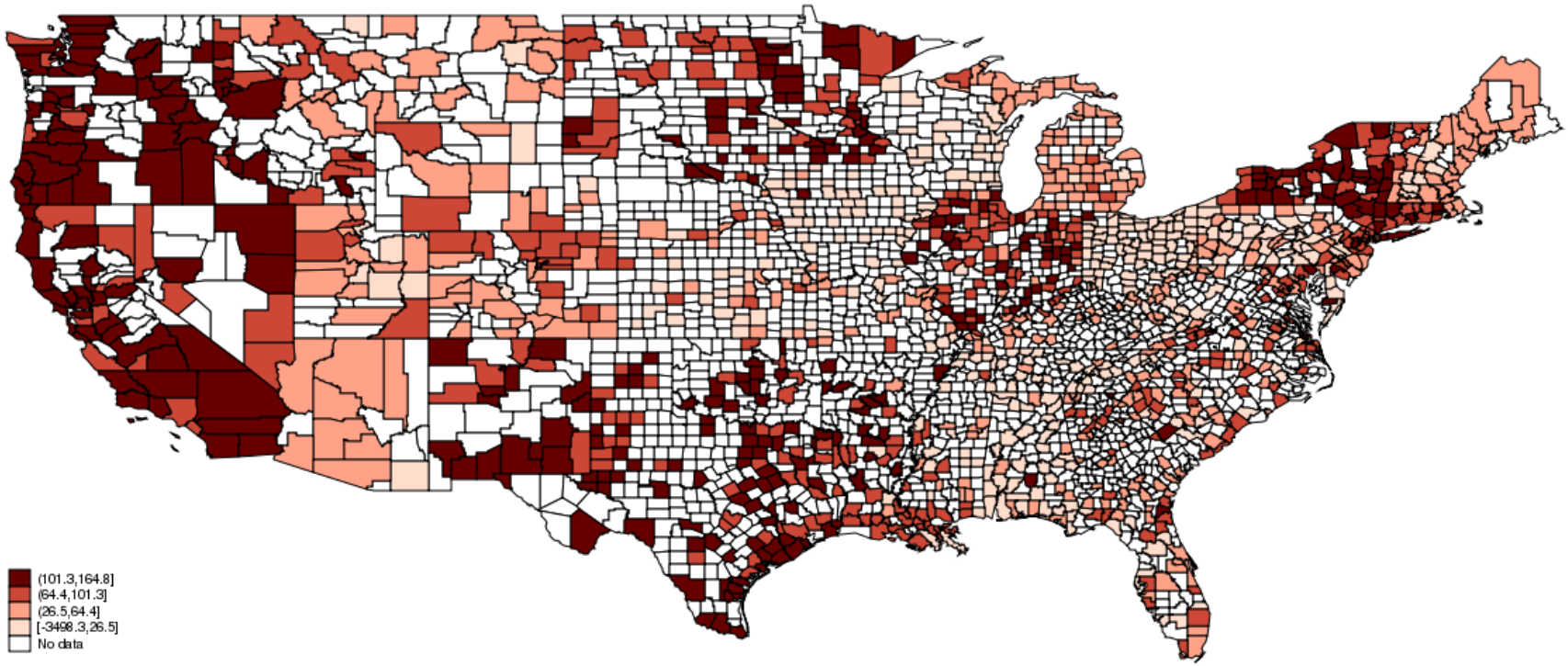


Figure 4 depicts the change in investment capital between 2007 Q1 and 2010 Q4, aggregated up to the county level. That is, for each of the 1,396 counties with active credit unions, Figure 4 first computes the total level of investment capital summed across all credit unions headquartered in the county, both in 2007 Q1 and again in 2010 Q4. Figure 4 then shows the percent difference in these two levels--this period encapsulates the CCU ABS related losses.

Table 9. House Prices and Consumer Leverage

Dependent Variable: Lending Growth

	(1)	(2)	(3)	(4)	(5)	(6)
	county house price growth	county house price boom above median	county house price boom below median	zip house price change	county household leverage above median	county household leverage below median
Growth in Investment Capital, Lagged One Quarter	0.298***	0.204***	0.339***	0.310***	0.192**	0.343***
	(0.0650)	(0.0785)	(0.0902)	(0.0882)	(0.0829)	(0.0844)
Growth in County House Price Index, Lagged One Quarter	0.00379					
	(0.00579)					
Growth in Zip code House Price Index, Lagged One Quarter				0.0100		
				(0.00833)		
Observations	121,608	87,138	64,943	65,164	76,893	75,188
R-squared	0.216	0.209	0.218	0.234	0.209	0.219

Table 9 regresses the log change in lending growth on the log change in investment capital, lagged one quarter. The sample period covers Q1 2005 to Q4 2010. All columns include NPCU fixed effects and year and quarter dummies, as well as a state specific time trend; a corporate specific time trend, and field of membership time trend. Column 1 controls for county level house price growth, lagged one quarter. Columns 2 and 3 split the sample into NPCUs located in counties that had above median house price growth in 2005-2006 (column 2), and those NPCUs in counties with average house price growth in 2005-2006 that was below the sample median. Column 4 includes zip code house price growth, lagged one quarter. Column 5 uses the sample of NPCUs located in counties with average 2006 household debt to income ratios that are above the median. Column 6 uses the sample of NPCUs located in counties with average 2006 household debt to income ratios that are below the median. Estimated coefficients and their standard errors (in parentheses) are multiplied by 100 in the table for readability.***, ** and * denote significance at the 1, 5 and 10 percent respectively. Standard errors are clustered at the NPCU level

Table 10. The Impact of the Change in Investment Capital on Lending Growth, Further Robustness Checks.

Dependent Variable: Lending Growth

	(1) baseline	(2) bottom 75th in assets	(3) top 25th in assets	(4) balanced panel	(5) cross-section (2010Q4-2007Q1)
Growth in Investment Capital, Lagged 1 Quarter	0.276***	0.308***	0.181**	0.326***	
	(0.0633)	(0.0813)	(0.0886)	(0.067)	
Growth in Investment Capital, Lagged 2 Quarters	0.264***	0.237**	0.241**	0.32***	
	(0.0806)	(0.107)	(0.0943)	(0.0857)	
Growth in Investment Capital, Lagged 3 Quarters	0.361***	0.264**	0.457***	0.473***	
	(0.0813)	(0.109)	(0.0928)	(0.0852)	
Growth in Investment Capital, Lagged 4 Quarters	0.137	0.102	0.0439	0.191*	
	(0.0891)	(0.118)	(0.105)	(0.0972)	
Difference in Investment Capital, 2010Q4-2007Q1					7.148***
					(2.950)
Observations	128,838	96,770	32,064	109,652	
R-squared	0.226	0.209	0.317	0.232	

Table 10 regresses the log change in lending growth on the log change in investment capital, lagged over four quarters. The sample period covers Q1 2005 to Q4 2010. All columns include NPCU fixed effects; and year and quarter dummies; and state, corporate and field of membership specific time trends. Column 2 excludes the top quartile of NPCUs defined in terms of size, while column 3 includes only NPCUs in the bottom 75th percentile. Column 4 excludes any NPCUs that attrited out of the sample. Estimated coefficients and their standard errors (in parentheses) are multiplied by 100 in the table for readability.***, ** and * denote significance at the 1, 5 and 10 percent respectively. Standard errors are clustered at the NPCU level. Column 5 regresses the percent difference in loan levels between 2010 Q4 and 2007 Q1 on the percent difference in investment capital over the same period; state and field of membership fixed effects are included, and standard errors clustered at the county level.

Table 11A. The Impact of the Change in Investment Capital on Different Lending Segments.

Dependent Variable: Lending Growth.

	(1) Credit card	(2) Unsecured loans	(3) New car loans	(4) Used Cars loans	(5) First Mortgage loans	(6) Real estate investment loans
Growth in Investment Capital, Lagged 1 Quarter	-0.272***	0.16	0.572***	0.422***	0.197	-0.0565
	(0.102)	(0.164)	(0.13)	(0.129)	(0.179)	(0.177)
Growth in Investment Capital, Lagged 2 Quarters	0.127	0.0644	0.252	0.34**	0.204	-0.253
	(0.123)	(0.2)	(0.156)	(0.156)	(0.208)	(0.213)
Growth in Investment Capital, Lagged 3 Quarters	0.28**	0.376*	0.457***	0.132	0.689***	0.547***
	(0.114)	(0.202)	(0.158)	(0.159)	(0.218)	(0.206)
Growth in Investment Capital, Lagged 4 Quarters	0.348**	-0.166	-0.23	-0.085	0.152	0.00546
	(0.142)	(0.244)	(0.173)	(0.186)	(0.226)	(0.249)
Observations	71,169	126,756	125,396	126,309	78,230	90,238
R-squared	0.436	0.121	0.172	0.122	0.186	0.159

The dependent variables are the growth in volume of credit in each lending segment. The sample period covers Q1 2005 to Q4 2010. All columns include NPCU fixed effects; and year and quarter dummies; and state, corporate and field of membership specific time trends. Estimated coefficients and their standard errors (in parentheses) are multiplied by 100 in the table for readability. ***, ** and * denote significance at the 1, 5 and 10 percent respectively. Standard errors are clustered at the NPCU level.

Table 11B. The Impact of the Change in Investment Capital on Different Lending Segments.

Dependent Variable: Growth in Number of Loans

	(1)	(2)	(3)	(4)	(5)	(6)
	Credit cards	Unsecured credit	New cars	Used cars	Real estate	1st mortgage
Growth in Investment Capital, Lagged 1 Quarter	0.348*	0.249	0.318**	0.299**	-0.0359	0.079
	(0.207)	(0.203)	(0.135)	(0.131)	(0.16)	(0.157)
Growth in Investment Capital, Lagged 2 Quarters	-0.0675	0.163	0.0944	0.417***	-0.162	0.259
	(0.229)	(0.229)	(0.156)	(0.147)	(0.178)	(0.183)
Growth in Investment Capital, Lagged 3 Quarters	-0.321	0.26	0.526***	-0.0103	0.476***	0.508**
	(0.228)	(0.222)	(0.156)	(0.151)	(0.178)	(0.203)
Growth in Investment Capital, Lagged 4 Quarters	0.0603	0.0432	-0.316	0.254	0.213	0.245
	(0.26)	(0.261)	(0.193)	(0.178)	(0.211)	(0.205)
Observations	68,693	121,351	119,993	120,827	86,977	75,540
R-squared	0.091	0.065	0.133	0.096	0.125	0.166

The dependent variables are the growth in the number loans in lending segment. The sample period covers Q1 2005 to Q4 2010. All columns include NPCU fixed effects; and year and quarter dummies; and state, corporate and field of membership specific time trends. Estimated coefficients and their standard errors (in parentheses) are multiplied by 100 in the table for readability. ***, ** and * denote significance at the 1, 5 and 10 percent respectively. Standard errors are clustered at the NPCU level.

Table 12A. The Impact of the Change in Investment Capital on Lending Growth, by Capital Asset Ratios.

Dependent Variable: Lending Growth

	(1)	(2)	(3)	(4)
	Capital Asset Ratio Quartile in 2006			
	1st quartile	2nd quartile	3rd quartile	4th quartile
Growth in Investment Capital, Lagged 1 Quarter	0.332***	0.382***	0.191	0.201
	(0.116)	(0.103)	(0.128)	(0.159)
Growth in Investment Capital, Lagged 2 Quarters	0.254*	0.331***	0.246	0.167
	(0.148)	(0.127)	(0.151)	(0.209)
Growth in Investment Capital, Lagged 3 Quarters	0.641***	0.446***	0.199	0.0287
	(0.135)	(0.139)	(0.162)	(0.209)
Growth in Investment Capital, Lagged 4 Quarters	0.135	-0.0579	0.491***	-0.157
	(0.155)	(0.134)	(0.181)	(0.226)
Observations	31,650	33,078	33,088	31,022
R-squared	0.260	0.257	0.222	0.193
F test: x=0	5.80	2.72	3.57	0.71
Prob > F	0.000	0.028	0.007	0.582

Table 12A regresses the log change in lending growth (volume of credit) on the log change in investment capital lagged over four quarters. The sample period covers Q1 2005 to Q4 2010. Estimated coefficients and their standard errors (in parentheses) are multiplied by 100 in the table for readability. All columns include NPCU fixed effects; and year and quarter dummies; and state, corporate and field of membership specific time trends. Column 1 includes only those NPCUs whose capital to asset ratio was in the bottom quartile in 2006. Columns 2-4 include those NPCUs whose capital to asset ratio was in the 2, 3rd, and 4th quartiles respectively. ***, ** and * denote significance at the 1, 5 and 10 percent respectively. The F-test reports the joint significance of the growth in investment capital across the four quarters. Standard errors are clustered at the NPCU level.

Table 12B. The Impact of the Change in Investment Capital on Lending Growth, by Capital Asset Ratios, Robustness Checks.

Dependent Variable: Lending Growth

	(1) Size	(2) Cash
Growth in Investment Capital, Lagged One Quarter	0.694***	0.36**
	(0.254)	(0.165)
X quartile dummy for capital asset ratio in 2006	-0.0729	-0.0286
	(0.0556)	(0.0527)
X quartile dummy for log total assets in 2006	-0.0942*	
	(0.0563)	
X quartile dummy for cash in 2006		-0.00659
		(0.0535)
Growth in Investment Capital, Lagged Two Quarters	-0.0248	0.417**
	(0.354)	(0.207)
X quartile dummy for capital asset ratio in 2006	-0.0334	-0.0883
	(0.0752)	(0.0694)
X quartile dummy for log total assets in 2006	0.141*	
	(0.0759)	
X quartile dummy for cash in 2006		0.0245
		(0.0699)
Growth in Investment Capital, Lagged Three Quarters	-0.15	0.989***
	(0.355)	(0.214)
X quartile dummy for capital asset ratio in 2006	-0.157**	-0.303***
	(0.0743)	(0.0689)
X quartile dummy for log total assets in 2006	0.342***	
	(0.079)	
X quartile dummy for cash in 2006		0.0433
		(0.0705)
Growth in Investment Capital, Lagged Four Quarters	0.119	0.744***
	(0.391)	(0.251)
X quartile dummy for capital asset ratio in 2006	-0.0779	-0.0706
	(0.0854)	(0.0812)
X quartile dummy for log total assets in 2006	0.0767	
	(0.0876)	
X quartile dummy for cash in 2006		-0.18**
		(0.0802)
Observations	128,801	128,801
R-squared	0.226	0.226

Table 12B regresses the log change in lending growth (volume of credit) on the log change in investment capital lagged over four quarters. The sample period covers Q1 2005 to Q4 2010. Estimated coefficients and their standard errors (in parentheses)are multiplied by 100 in the table for readability. All columns include NPCU fixed effects; and year and quarter dummies; and state, corporate and field of membership specific time trends. In all regressions, the equity capital growth rate is also interacted with a categorical variable that equals 1,2,3 and 4 if a NPCU's capital to asset ratio is in the first, second, third or fourth quartile in 2006. Column 2 also includes interactions based on a categorical variable for size (log total assets in 2006). Column 3 includes interactions based on a categorical variable for cash as a share of assets in 2006. Standard errors are clustered at the NPCU level.

Table 13. The Impact of the Change in Investment Capital on the Growth in Cash Assets, by Capital to Asset Ratios.

Dependent Variable: Cash Asset Growth

	(1)	(2)	(3)	(4)
	Capital Asset Ratio Quartile in 2006			
	1st quartile	2nd quartile	3rd quartile	4th quartile
Growth in Investment Capital, Lagged 1 Quarter	3.03**	3.6***	2.46*	4.08***
	(1.34)	(1.31)	(1.3)	(1.5)
Growth in Investment Capital, Lagged 2 Quarters	-0.972	0.703	-3.18**	-0.108
	(1.47)	(1.46)	(1.41)	(1.78)
Growth in Investment Capital, Lagged 3 Quarters	-9.86***	-6.03***	-5.5***	-4.58**
	(1.55)	(1.49)	(1.49)	(1.84)
Growth in Investment Capital, Lagged 4 Quarters	-6.42***	-0.61	-2.45	-0.272
	(1.76)	(1.72)	(1.74)	(1.84)
Observations	31,558	33,006	33,011	30,975
R-squared	0.149	0.131	0.102	0.069
F test: x=0	14.74	4.05	4.81	1.24
Prob > F	0.000	0.003	0.001	0.293

Table 13 regresses the log change in cash assets on the log change in investment capital, lagged over four quarters. Estimated coefficients and their standard errors (in parentheses) are multiplied by 100 in the table for readability. All columns include NPCU fixed effects; and year and quarter dummies; and state, corporate and field of membership specific time trends. Column 1 includes only those NPCUs whose capital to asset ratio was in the bottom quartile in 2006. Columns 2-4 include those NPCUs whose capital to asset ratio was in the 2, 3rd, and 4th quartiles respectively. ***, ** and * denote significance at the 1, 5 and 10 percent respectively. The F-test reports the joint significance of the growth in equity capital across the four quarters. Standard errors are clustered at the NPCU level.

Table 14. The Impact of Investment Capital Growth on the Probability that a Loan Application is Rejected

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

	(1)	(2)	(3)	(4)	(5)	(6)
		Capital Asset Ratio Quartile in 2006				
	full sample	1st quartile	2nd quartile	3rd quartile	4th quartile	1st quartile
Growth in Investment Capital, Lagged 1 Quarter	-0.559	-2.063*	0.574	-0.799	-0.145	-0.284
	(0.601)	(1.082)	(1.188)	(0.535)	(0.421)	(0.986)
Growth in Investment Capital, Lagged 1 Quarter*(Loan Amount/Income)						-0.920***
						(0.344)
Loan Amount/Income						0.0333
						(0.0445)
Male	-0.534***	-0.930***	-0.478*	-0.418*	-0.319**	-0.935***
	(0.116)	(0.277)	(0.249)	(0.228)	(0.143)	(0.279)
Hispanic	9.256***	9.041***	9.081***	9.908***	8.245***	9.051***
	(0.412)	(0.771)	(0.981)	(0.656)	(0.516)	(0.770)
Black	16.45***	17.58***	15.11***	16.00***	16.17***	17.58***
	(0.420)	(0.590)	(0.731)	(0.655)	(0.735)	(0.591)
Low Income Census Tract	7.679***	7.629***	8.825***	7.274***	7.099***	7.643***
	(0.512)	(1.268)	(1.365)	(0.792)	(0.739)	(1.273)
Loan Amount (Log)	3.305***	2.272***	4.061***	3.646***	3.578***	2.187***
	(0.415)	(0.793)	(0.808)	(0.498)	(0.365)	(0.814)
Income (Log)	-11.44***	-11.66***	-12.21***	-11.02***	-11.22***	-11.52***
	(0.338)	(0.886)	(0.735)	(0.469)	(0.405)	(0.921)
Observations	2,811,414	668,320	658,402	718,870	745,039	668,320
R-squared	0.171	0.149	0.210	0.150	0.171	0.149

The dependent variable in Table 14 equals 1 if a mortgage loan application was rejected, and 0 if the loan was originated. Estimated coefficients and their standard errors (in parentheses) are multiplied by 100 in the table for readability. 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 and 6 restrict the sample to NPCUs whose capital to asset ratio was in the bottom quartile in 2006. Columns 3-5 restrict the sample to NPCUs with capital to asset ratio was in the 2,3 and 4th quartiles in 2006 respectively.

Table 15. The Impact of Credit Growth on House Price Growth

	OLS			*IV*		
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variables:	Change in House Prices	Change in House Prices	Change in Credit (First Stage)	Change in House Prices		
	Full Sample				Top Quartile Zip Codes	
Change in Credit	0.00962**			0.0736*	0.139**	
	(0.00375)			(0.0387)	(0.0601)	
Change in Mortgage Credit		0.00469***				0.0412***
		(0.00177)				(0.0156)
Change in Investment Capital			9.63***			
			(2.97)			
Observations	2,069	1,736	1,961	1,959	487	451
R-squared	0.851	0.858	0.104	0.838	0.778	0.834

All variables are computed as the percent change between Q1 2007 and Q4 2010. The dependent variable in columns 1-2 and 4-6 is the percent change in the house price index in zip codes between Q1 2007 and Q4 2010. Column 3 uses the percent in total credit at the zip code level over Q1 2007 and Q4 2010. All specifications include the percent change in median family income at the county level, the level of county unemployment, the log level of the house price index in Q1 2007, the share of credit union mortgage credit relative to other lenders in the zip code and state fixed effects. ***, ** and * denote significance at the 1, 5 and 10 percent respectively, and standard errors (in parentheses) are clustered at the county level. The instrument in columns 4-6 is the change in investment capital.

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 are 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.

References

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

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.*

Cambell, John, Stefano Giglio and Parag Pathak "Forced Sales and House Prices", with, *American Economic Review,* 101:2108-2131, August 2011

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

Coval, 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] [CFP 1304]

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.

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.

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.*

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.

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, “The Impact of House Prices on Consumer Credit: Evidence from an Internet Bank, forthcoming, *Journal of Money, Credit and Banking.*

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

Van den Heuvel, Skander J., 2009. “The Bank Capital Channel of Monetary Policy,” working paper, Federal Reserve Board.

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