From Wall Street to Main Street:

The Impact of the Financial Crisis on Consumer Credit Supply

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ABSTRACT

How did the collapse of the asset-backed securities (ABS) market during the 2007 to 2009 financial crisis affect the supply of credit to the broader economy? Using new data on the U.S. credit union industry, we find that ABS-related losses are associated with a large contraction in the supply of credit to consumers, especially among those credit unions that began the crisis with weaker capitalization. We also find that this credit supply shock restricted the availability of mortgage and automobile credit. These results show how movements in the prices of financial assets can affect the real economy.

This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1111/jofi.12209.

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The proximate cause of the 2007 to 2009 financial crisis centered around the collapse of the housing bubble in the U.S. Mortgages and other loans were securitized into asset backed securities (ABS), which were held on banks' balance sheets and widely distributed throughout the financial system. Falling housing prices and rising mortgage defaults then led to sharp declines in the price of mortgage-backed securities (MBS) and other types of ABS, raising concerns about the liquidity and solvency of the banking sector (Brunnermeier (2009), Keys et al. (2010), Shleifer and Vishny (2011)).

Less well understood, however, is how the financial crisis—initially centered in the ABS market—might have led to the Great Recession. High levels of household leverage during the boom in conjunction with falling housing prices during the bust may have depressed consumer demand, leading to the relatively slow recovery in output growth, employment, and consumption (Mian and Sufi (2011)). But the ABS-related balance sheet losses incurred by the financial sector may have also led to a fundamental post-crisis disruption in credit intermediation, contributing to the recession

and slow economic recovery. The goal of this paper is to study how the financial crisis and the collapse of the ABS market might have affected the supply of credit to consumers. We then use microeconomic data from the housing and automobile markets to measure the real consequences of this credit shock.[1]

The traditional challenges to inference in any such analysis focus on measurement and identification issues.[2] In the case of the latter, economic theory suggests that illiquidity in one corner of the banking sector together with large realized balance sheet losses could induce a contraction in the aggregate supply of credit and economic activity (Allen and Gale (2000), Diamond and Rajan (2005, 2011), Shleifer and Vishny (2010)). However, the decline in housing 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.

Measuring the impact of the crisis on the balance sheet of individual financial institutions can be equally difficult. Financial institutions are typically connected through contractual relationships, as well as exposures to similar assets, markets, and counterparties (Khang, He, and Krishnamurty (2010)). These connections can expose an institution to the ABS market directly through balance sheet holdings of these securities, as well as indirectly through the counterparties with which 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 data set that describes unique institutional features of the credit union industry in the U.S. This industry competes with banks and features prominently in consumer credit, serving about 90 million people in the U.S.[3] Credit unions account for about 25% of auto financing and around 11% of all consumer installment credit in the U.S. At the end of 2010, total assets in the credit union system were about 1.4 times

larger than the combined assets of those banks that traditionally specialize in consumer lending. That is, community banks and neighborhood banks with less than $10 billion in assets.[4]

Before the financial crisis, the credit union system was self-contained and structured into three tiers (See Figure 1 below). 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 credit unions' balance sheets 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 shed light on how the transmission of shocks within a financial network might affect local lending.

At the bottom of the three-tiered system are natural person credit unions (NPCUs). These institutions are organized around individuals with a common bond or field of membership, and operate following the model of traditional local banking[5] – that is, NPCUs specialize in making loans to and taking deposits from geographically proximate consumers and small businesses that share the common bond. Most NPCUs have virtually no direct exposure to financial products such as ABS. To realize scale economies in the provision of financial services, NPCUs pool membership and paid-in capital—which we also refer to as investment capital—to create larger retail corporate credit unions (CCUs), the next step up in the tier. Investment capital is perpetual and is intended to cover losses at CCUs in excess of earnings and reserves.[6] 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 CCU operate as correspondent banks for their member NPCUs and do not provide credit to the general population. The basic model within the CCU system is to invest deposits from member NPCUs in financial securities to manage liquidity within the industry. At the peak of the boom in 2006, investment securities accounted for about 90% of the balance sheet of the typical

CCU. The collapse of the ABS market in 2007 to 2009 led to the failure of the four largest CCUs as well as the single wholesale CCU; these institutions had large exposures to the riskier private label MBS.[7]

The resulting CCU ABS losses were in turn charged against investment capital held on the asset side of the balance sheet at member NPCUs. These charges were in proportion to each NPCU's relative investment capital contribution to the CCU. Our identification strategy builds on the fact that these relative capital 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 considerably reduce the potential for biased estimates due to latent credit demand.

Our results can be easily summarized. A one standard deviation decline in investment capital from 2007 to 2010 is associated with a 2.3 percentage point, or 0.1 standard deviation, decline in loan growth over the same period. This estimate suggests that the $7 billion in CCU losses passed onto NPCUs through 2010 may have engendered upwards of a $50 billion contraction in credit supply. These results are robust to a number of spatially disaggregated controls, like housing 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. The point estimate is also little changed when controlling for NPCU and CCU measures of risk-taking before the crisis.

To better understand the mechanisms underlying the contraction in credit, we exploit the cross-sectional differences in the way NPCUs responded to these balance sheet shocks. Theories of banking that emphasize bank capital's role as a buffer against adverse shocks would predict that those NPCUs that entered the crisis with more capital relative to assets may have been better able

to insulate lending from the balance sheet losses associated with CCUs (Bhattacharya and Thakor (1993), Diamond and Rajan (2000), Peek and Rosengren (1995), Shleifer and Vishny (2010)). We find that indeed the pre-existing capital-asset ratio of a NPCU significantly dampened the impact of investment capital write-downs onto lending.

To address further concerns about biased estimates arising from latent credit demand, we construct an instrument based on CCU losses from 2007 to 2010. The institutional structure of the system suggests that CCU investment decisions, and the resulting losses during the crisis, are likely conditionally orthogonal to latent credit demand facing a given NPCU. We weight these losses by each NPCU's relative investment share in its CCU in 2000. These shares are observed well before the boom and bust, and reflect the variation in pre-existing contractual exposures that are plausibly unrelated to the level or change in credit demand around the financial crisis. This source of variation in NPCU investment capital losses thus provides an important robustness check for the baseline OLS results. The IV estimate is larger though not statistically different than that obtained in the OLS analysis, and suggest that ABS losses may have significantly reduced the supply of consumer credit.

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

Taken together, the results suggest that the collapse in the price of financial securities backed by housing may have led to a sizeable contraction in credit availability in the real economy, impacting markets well beyond the housing sector and perhaps contributing to the Great Recession and the slow economic recovery. The remainder of this paper proceeds as follows: Section I describes the data and institutional details; Section II presents the main results; Section III studies the impact of the shock on the housing and automobile markets; and Section IV concludes.

I. Institutional Background and Data

A. Institutional Background

Measurement and identification problems render it difficult to estimate the impact of the collapse of the ABS market on broader credit supply. Financial institutions are typically connected not only through contractual relationships, but also through exposures to similar assets, markets, and counterparties. Further, there is no readily available way to measure the full exposure of a financial intermediary to the ABS market (Khang, He, and Krishnamurty (2010)), and even if it were possible to measure an institution's direct and indirect exposure to the ABS market, financial institutions and their clients might be subject to the same aggregate shocks—the general economic uncertainty during the crisis, or the decline in credit demand during the subsequent recession. These common shocks make it difficult to interpret any statistical relationship between the collapse of ABS prices and credit growth.[8]

The credit union system is an important supplier of consumer credit (Table I), and the institutional structure of this system, depicted in Figure 1, helps address these thorny measurement and identification issues. NPCUs generally have no direct exposure to financial products such as ABS, and instead operate following 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. For example, firemen in a given county, employees of a specific corporation, or residents that live within a particular radius of a town might form a NPCU to use relationship-based financial services (see the Internet Appendix).[9] Only in a handful of cases, primarily among the larger credit unions like Navy Federal, does lending extend beyond the hyper-local. These institutional features suggest that local economic conditions and the field of membership are likely to be key determinants of potential credit demand for a given NPCU—information that we observe in our data set.

– Table I here –

– Figure 1 here –

To realize scale economies in the provision of payments, settlements, custodial services, and liquidity management, NPCUs pool membership and paid-in capital—That is, investment capital—to create larger retail CCUs, which are the next step up in the tier. Figure 2 provides an example of a credit union network. Membership and paid-in capital are intended to cover losses in excess of earnings at CCUs and are recorded as investments on the asset side of a NPCU's balance sheet. Also

on the asset side of the NPCU balance sheet are the deposit accounts that NPCUs maintain at CCUs in order to manage liquidity. While the business model of NPCUs centers on traditional relationship banking, CCUs operate in the traditional correspondent bank mold: they do not make loans to the general population, but instead provide financial services to their NPCU members. A single wholesale credit union—the now defunct U.S. Central—further aggregates these financial services among the retail CCUs vis-à-vis the rest of the financial system.

– Figure 2 here –

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, some CCUs were active in the AA- and AAA-rated private label ABS market. In the fall of 2008 there were approximately $63 billion of MBS in the CCU system.[10] Once the collapse in the ABS market began, expected losses were on the order of $30 billion, while there were only $2.4 billion in retained earnings in the CCU system to cover these losses. The four largest CCUs eventually failed along with U.S. Central.

The above institutional setup allowed the shocks emanating from the collapse in the 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 plausibly unrelated to local credit demand. As Figure 2 indicates, losses at a given CCU are primarily transmitted onto the balance sheet of its member NPCUs in proportion to each NPCU's initial investment capital stake.[11]

These initial stakes reflect contractual arrangements that precede the crisis by decades in many cases, and are relatively sticky. Federal regulations require membership capital to have a

minimum duration of three years, in the form of either term certificates that have a minimum duration of three years or adjustable balances with a minimum withdrawal notice of three years (www.ncua.gov). Paid-in capital accounts typically have a 20-year minimum duration, and in terms of satisfying losses in excess of retained earnings at CCUs, are senior to membership capital. This stickiness would have made it difficult for NPCUs to rapidly adjust their investment capital position in a CCU either during the boom or in anticipation of the collapse. Instead, NPCUs readily adjust their "regular" deposits in CCUs, and these deposits fell during the first few months of the crisis until they were guaranteed by the government.

In addition to writing down investment capital, the regulator, the National Credit Union Association (NCUA), also levies special assessments on NPCUs to cover a CCU's ABS-related losses. These assessments are proportional to a NPCU's insured deposits relative to total system deposits, and offer another source of conditionally exogenous variation in the assignment of CCU losses onto the balance of NPCUs. In what follows, we use both sources of variation, that is, the depletion of investment capital and special assessments, to measure a NPCU's total balance sheet exposure to CCU ABS losses. We obtain similar results if we instead use these different loss assignment rules separately.[12] In sum, the variation in losses to contributed investment capital on the balance sheets of NPCUs and the variation in assessments provide a powerful and rare opportunity to study how the collapse of the ABS market might have affected credit supply to the broader economy during the Great Recession.

That said, the fact that a NPCU's decision to become a member of a particular CCU is not random but largely driven by historic and geographic factors suggests that common geographic trends could be a source of bias. For example, NPCUs in booming areas could have increased deposits at their associated CCU, inducing the latter to expand its balance sheet through holdings of ABS. The subsequent collapse in the ABS market could have in turn coincided 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 be explained by latent geographic economic trends and the actions of NPCUs.

It is also possible that the additional profits that a CCU might have earned before the crisis from its portfolio of ABS could affect the lending behavior of affiliated NPCUs. For example, those NPCUs affiliated with a CCU earning high returns from trading in private label ABS may themselves lend more aggressively during the boom. Large losses at the CCU during the bust could then chasten the affiliated NPCU's 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 incentives distinct from the impact of investment capital-related balance sheet losses.

– Figure 3 here –

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

Why did CCUs Fail? While we condition on a large number of observables and construct several different tests to address identification concerns, the institutional details surrounding the

failure of the largest CCUs can also help guide interpretation of the statistical evidence. Investigations into the CCU failures suggest that the actions of individual NPCUs may have played little role in shaping CCUs' investment decisions. Instead, these investigations identify corporate governance and management failures at the failed CCUs,[13] idiosyncratic shocks such as the change in management in 2004 at WesCorp—the largest retail CCU—that led to excessive optimism and an aggressive growth strategy built around ABS[14,15], as well as regulatory deficiencies that allowed CCU portfolios to become overly concentrated in ABS as contributing factors.[16]

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

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

B. Data

We collect quarterly data from the NCUA *Call Report* database for the universe of NPCUs and CCUs, over the 2005Q1 to 2010Q4 period, which encompasses the boom in housing prices, as well as much of the financial crisis. The call reports do not provide information on the membership relationship between NPCUs and CCUs; we obtain these confidential data separately from the NCUA based on its census of these relationships performed in late 2009.[17]

In 2005Q1, there were about 7,500 NPCUs and 26 CCUs in the database. Table II Panel A summarizes some basic balance sheet statistics for NPCUs at the peak of the boom in 2006Q4. The average NPCU had an equity-to-asset ratio of around 18%, and held a portfolio of loans valued at around $65 million. For the average NPCU, investment capital—that is, membership and paid-in capital to the CCU held on the asset side of the balance sheet—expressed as a share of the NPCU's own capital—the liabilities side of the balance sheet—was 6%; this share is equivalent to about 1% 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%, with a median of zero.

– Table II here –

In contrast, consistent with CCUs not engaging in direct lending to consumers, but transacting mainly in financial assets to manage liquidity for their NPCU members, column 1 of Table II Panel B shows that investment assets dominated the balance sheet of CCUs. In particular, column

1 shows that investment securities, primarily a mix of agency (Fannie Mae and Freddie Mac) and the riskier private label ABS, accounted for about 88% of the average CCU's balance sheet, ranging from a low of 71% to a high of 96%, in 2006. Column 2 shows, however, that there was substantial heterogeneity in exposure to private label ABS across CCUs: while about half the CCUs had no direct exposure to private label ABS, about 56% of WesCorp's investment portfolio consisted of private label ABS; WesCorp was the largest retail CCU failure. Most of the other failed CCUs also had sizeable private label ABS exposures, with the correlation between these private label exposures in 2006 and subsequent CCU losses during 2007 to 2010 around 0.83.

Geography is an important factor in explaining the pattern of contractual linkages between NPCUs and CCUs (see the Internet Appendix). 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, but most NPCUs within a state tend to be members of the state or regional CCU. For example, 99% of the NPCUs in Iowa are members of the Iowa CCU, while 97% of the NPCUs in Kansas have joined the Kansas CCU.

For the member NPCUs of each CCU, Table III Panel A reports the median of several balance sheet variables observed at the peak of the boom in 2006. The pattern of varying economic activity across states, together with the historic geographic specialization of CCUs suggests that there might be some heterogeneity across the pool of NPCUs that each CCU serves. This is evident primarily for asset size and lending growth. WesCorp served NPCUs mainly in California, where the scale of lending is l6arger than in more rural states like Iowa. As a result, the median NPCU of WesCorp is about 4.5 times larger than the median NPCU that belongs to the Iowa CCU, and median lending growth of the former is nearly twice that of the latter.

– Table III here –

However, the basic business model of NPCUs is relatively similar across CCUs. For example, there is 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 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.

II. Main Results: Investment Capital and Credit Growth

The arguments outlined earlier suggest that in a cross-section of NPCUs observed over the crisis, investment capital losses should be associated with a decline in credit growth. Both the aggregate time-series results in Figure 4 and the pattern of lending in Table III Panel B provide initial evidence consistent with this prediction. Our empirical strategy in this section is to begin by testing this cross-sectional prediction, correcting for obvious demographic and economic fundamentals that might directly bear on the local demand for credit. Second, building on well-known theoretical arguments, we examine how the lending response to these investment capital losses varies with NPCU characteristics such as capital and liquidity observed just before the crisis. However, although NPCUs lend locally, and relatively disaggregated geospatial controls can help correct for local credit demand, there are inherent limitations to establishing causality in these analyses. Therefore, in Section II.C, we use the variation in ABS-related losses incurred at the CCU level to provide evidence that investment capital losses might be associated with a contraction in consumer credit supply.

– Figure 4 here –

A. Investment Capital and Credit Growth: The Basic Regressions

To focus the analysis on the crisis period, we use data from the onset of the crisis in 2007 through the end of 2010. For both 2007 and 2010, we compute the average level of loans made by a NPCU and the average level of its investment capital; we then log difference the time-averaged data across the two periods to construct the change in lending and investment capital over the crisis period. The cross-sectional specification regresses the log change in loans on the log change in investment capital. The cross-sectional regressions always include the log level of loans in 2007 to absorb any persistent factors affecting loans during this period, as well as field of membership and state fixed effects. Standard errors are clustered at the state level; clustering at the CCU level produces similar results, and are available upon request. Table IV contains summary statistics of the main variables.

– Table IV here –

Column 1 of Table V reports the investment capital coefficient estimated using only the 2007 log level of loans and the aforementioned fixed effects as controls.[18] We find a large and significant positive association between the change in lending over the crisis and the change in investment capital. A one standard deviation decrease in investment capital over this period is associated with a

2.3 percentage point drop or 0.1 standard deviation decrease in lending between 2007 and 2010 (*p*-value=0.00).

To gauge the dollar value implications of this estimate, for each NPCU we multiply its percent change in investment capital by 0.0213—the nonstandardized coefficient derived from column 1. This product yields the implied percent change in lending at that NPCU given its change in investment capital over the crisis. Multiplying this implied change in lending at the NPCU by its average level of loans in 2007 yields each NPCU's predicted dollar value change in lending over the period associated with the observed shock to investment capital. Taking the sum across all NPCUs suggests that the $1.2 billion decline in investment capital observed in the subsample used in column 1 is associated with a $9 billion decline in lending.[19] That is, every dollar decline in investment capital implies a $7.5 decline in lending.

Given that investment capital write-downs and assessments during this period are around $7 billion, this multiplier suggests that these costs imply a $52.5 billion contraction in lending—about 66% of the "missing" $80 billion in credit implied by the pattern of new lending in Table III Panel B.[20] Available upon request are cross-sectional results based upon the peak-to-trough change (2007Q1 to 2010Q4); this approach captures about $2.4 billion of the investment capital losses, and implies a multiplier closer to 11. Taken together, the evidence suggests that the losses likely had a sizeable impact on lending. Of course, other lenders could have compensated for some of this contraction, muting the aggregate effects of this credit supply contraction. We discuss the potential for substitution in Section IV.

– Table V here –

Omitted variables that are correlated with investment capital losses between 2007 and 2010 and shape the local demand for credit are the main threat to causal inference. In column 2 we therefore control for a number of county-level characteristics that might affect the demand for consumer credit using county-level data from the *American Community Survey* over the period 2006 to 2009. These controls include the log of the median income in the county, the percent of urban population in the county, population density, the Gini coefficient to capture income inequality within the county, the poverty rate, and the percent of the population that is African American. After controlling for state and field of membership fixed effects, these county-level socioeconomic variables have little independent explanatory power for NPCU credit growth. More importantly, the point estimate on the investment capital variable in column 2 is little changed.

That said, there is an enormously powerful geographic element to the post-crisis recession (Hill, Fogli, and Perri (2013)). Those regions that suffered the steepest declines in housing prices and had the most leveraged households before the crisis appeared to suffer the biggest subsequent slumps in economic activity (Mian, Rao, and Sufi (2013)). At the same time, the depletion of investment capital also varied geographically (Figure 5). WesCorp, based in California, was the largest CCU and the collateral backing its investment portfolio of private label residential MBS was heavily skewed towards California (Countrywide was a major originator of these loans). WesCorp's NPCU members, also based mostly in California, suffered some of the largest declines in investment capital after WesCorp's failure. At the same time, California was one of the epicenters of the boom and bust, and thus it remains possible that these results are driven by some latent demand variable, perhaps related to the housing boom and bust.

– Figure 5 here –

Available upon request are specifications in which we drop WesCorp members from the sample and control for pre- and post-crisis changes in local credit demand in a number of ways in a panel context. We find that the correlation between the run-up in housing prices at the county level (2005 to 2006) and the subsequent change in investment capital between 2007 and 2010, computed at the county level, is statistically insignificant, suggesting that the results are unlikely to be driven by the housing boom and bust.[21]

We also regress the change in investment capital on housing price growth at the zip code level during the boom (2005 to 2007) and find no significant relationship. Likewise, available upon request are results from a regression of the average change in investment capital during the bust (2009 to 2010) on lending growth during the boom (2006 to 2007).[22] The point estimate is 0.47 (*p*-value=0.94), suggesting that the cross-sectional variation in lending behavior among NPCUs during the boom is not significantly related to their investment capital losses during the bust. In addition, while Florida was another epicenter of the housing boom and bust, NPCUs in Florida do not appear to have suffered systematically steeper declines in investment capital (Figure 5). In contrast, some upper Midwestern counties—areas not usually associated with the housing boom—experienced sharp investment capital declines.

The above evidence gives us some confidence that the real estate-fueled lending boom at the NPCU level may not have led to the subsequent CCU ABS-related losses. Nonetheless, column 3 of Table V directly controls for the average change in housing price change within the county both during the boom and over the crisis using the *CoreLogic House Price Index* (HPI). Further, because household leverage during the boom may have shaped the local adjustment to the housing shock, column 3 also controls for county-level data on household leverage observed in 2006, from Mian, Rao, and Sufi (2013). These data are available for a subsample of counties. We find that the investment capital coefficient remains little changed.

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

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

Nevertheless, column 4 of Table V controls for a number of NPCU variables observed just before the crisis. These variables include loan growth, deposit growth, investment capital growth, and the growth in deposits at CCUs, all averaged over the period 2005 to 2006. Column 4 also controls for log size (measured in terms of assets), leverage ratio, and the cash-to-assets ratio, all observed in 2006. Including these balance sheet variables does little to change the point estimate on the change in investment capital over the crisis.[23]

Adding to these NPCU-level controls, column 5 of Table V directly controls for risk-taking by CCUs during the boom by including the share of private label MBS in the CCU's MBS portfolio in 2007, the share of investments in total assets, and the capital-to-asset ratio of the CCU, all observed in 2007. The investment capital point estimate remains significant at conventional levels and little changed.

Taken together, the evidence in Table V suggests that investment capital losses during the crisis might have induced a sizeable contraction in consumer credit. Notwithstanding, there are limits to the ability of this approach to control for latent credit demand, and thus in the next subsection we examine cross-sectional heterogeneity in the lending response to these investment capital losses to better assess the plausibility of our main results. In what follows, we use the specification in column 5, which controls for key NPCU and CCU observables, as the baseline specification.

B. Investment Capital and Credit Growth: Cross-Sectional Heterogeneity

If investment capital losses shifted NPCU credit supply, then theories that build on capital's role as a buffer against adverse shocks would predict that those NPCUs that entered the crisis with more capital relative to assets may have been better able to insulate lending from these balance sheet losses (Bhattacharya and Thakor (1993), Diamond and Rajan (2000), Peek and Rosengren (1995), Shleifer and Vishny (2010)).[24] 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. The prospect of further losses at CCUs as well as the growing uncertainty surrounding the overall solvency of the CCU system could have also induced 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 (2013)).

The above arguments suggest that if indeed our 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 NPCUs responded to these balance

sheet shocks. To explore such cross-sectional differences, we compute the regulatory capital-to-asset ratio in 2006— at the height of the boom and before any ABS losses were anticipated—and interact the capital-asset ratio with the change in investment capital observed over the crisis. The capital-asset ratio also directly enters quadratically to absorb independent non-linear effects it might have on lending; we also control for the standard set of NPCU and CCU variables from column 5 of Table V.

— Table VI here —

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

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

interact the change in investment capital with a indicator variable for whether the NPCU is in the bottom quartile of assets, measured in 2006. The role of capital as a buffer in shaping the transmission of investment capital losses to lending remains unchanged. Taken together, the results suggest that alternative latent demand explanations for the positive correlation between investment capital and loan growth are unlikely. We next turn to variation in ABS-related losses at the CCU level to allow for a causal interpretation.

C. Investment Capital and Credit Growth: Identification

Using the variation at the source of the shock, in this case CCU losses between 2007 and 2010, as an instrument for changes in investment capital can yield estimates of investment capital that are unlikely to be biased by latent credit demand (Peek and Rosengren (2000)). This approach is motivated by the fact that the change in investment capital between 2007 and 2010 reflects both the initial amount invested as well as the overall losses incurred by the associated CCUs during the crisis. Further, the CCU losses incurred during the crisis are likely orthogonal to latent credit demand at the NPCU level, especially when conditioning on direct measures of CCU risk-taking, like the size of the CCU's private label MBS portfolio (Table II Panel B).

That said, the CCU losses are assigned to a NPCU based on the latter's relative investment capital contribution, and the variation in relative contributions could itself reflect local cumulative effects of the housing boom in the years immediately preceding. For example, those NPCUs in areas with a booming housing market could have acquired investment capital at a faster rate than NPCUs in areas less affected by the housing boom. This former group of NPCUs would then have greater exposure to the CCU losses during the bust, and at the same time face a greater contraction in loan

demand relative to those NPCUs less affected by the housing boom. That is, although we include the growth in investment capital between 2005 and 2006 and measures of local fundamentals in the NPCU's county, the NPCU's initial investment capital contribution in a CCU could still be related to latent credit demand.

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

The first-stage regression, reported in column 1 of Table VII, regresses the change in investment capital at a NPCU, computed between 2007 and 2010, on the NPCU's associated CCU net income computed again between 2007 and 2010 and weighted by the 2000 NPCU relative investment share. The regression also includes the baseline controls from column 5 of Table V. Consistent with the nature of the contractual arrangements that govern the allocation of CCU losses, there is a large positive relationship between CCU net income and changes in the affiliated downstream NPCU investment capital. From column 1, a one standard deviation decrease in the share-weighted CCU net income is associated with a 4.4 percentage point or 0.05 standard deviation decline in the change in investment capital (p-value=0.00). The reduced-form regression in column 2 provides direct evidence linking the variation in CCU net income to lending growth at the downstream NPCUs. This evidence suggests that a one standard deviation decrease in weighted CCU net income is associated with a 0.02 standard deviation, or 1.25 percentage point, decline in loan growth over the period.

— Table VI here —

We have already seen that the capital-asset ratio in 2006 dampened the impact of actual investment capital write-downs on lending. This cross-sectional heterogeneity in the capital-asset ratio of NPCUs in 2006 can further help in interpreting the association between CCU profitability and lending growth at downstream NPCUs. The reduced-form specification in column 3 thus interacts weighted CCU net income with the NPCU capital-asset ratio in 2006. The interaction term is large and statistically significant. A one standard deviation decrease in weighted CCU net income is associated with a 0.95 percentage point drop in lending for a NPCU at the 25th percentile capital-asset ratio. But for a NPCU at the median ratio, a similar change in CCU net income is associated with only a 0.43 percentage point drop in lending.

Building on this evidence, column 4 of Table VII presents the coefficient obtained from instrumenting the change in investment capital with weighted CCU net income. The IV point estimate is considerably larger than the corresponding OLS coefficient in column 5 of Table V, but is less precisely estimated, and not statistically different from its OLS counterpart. Available upon request are statistically similar, though larger, estimates when using CCU net income weighted by 2007 contractual shares; the investment capital point estimate when using unweighted CCU net income as an instrument is smaller than in column 4 and less precisely estimated (*p*-value=0.11).

The evidence in column 5 continues to suggest that cross-sectional heterogeneity in the NPCU capital-asset ratio may have dampened the impact of investment capital losses on lending. For a NPCU whose capital-asset ratio is at the 25th percentile, the impact of a one standard deviation decrease in investment capital on lending is about 90% larger than that for a NPCU at the 75th percentile capital-asset ratio. The results thus suggest that CCU ABS-related losses might have had a sizeable impact on NPCU credit supply.[25]

III. The Impact of the Shock

So far we report evidence that the contraction in NPCU credit supply due to CCU ABS related losses might have been at least on the order of $50 billion. A natural question that follows is how this contraction in credit supply affected the supply of credit at the extensive margin. To address this question, we now provide evidence on the impact of NPCU investment capital write-downs on the extension of new housing and automobile credit using data on mortgage loan applications from the *Home Mortgage Disclosure Act* (HMDA) and a data set on county-level automobile purchases, respectively. Moreover, while it is impossible to completely exclude latent credit demand explanations, these explanations now face a stiffer test—they have to explain not just the correlation between investment capital and total loan growth, but also the correlations between investment capital and mortgage loan growth and between investment capital and auto loan growth we obtain when conditioning on detailed individual-level socioeconomic characteristics.

A. Mortgage Applications and the Extensive Margin

This subsection uses data from HMDA on mortgage applications to investigate the impact of investment capital changes on mortgage credit at the extensive margin. HMDA reporting requirements apply to select financial institutions. This leaves a sample of around three million home mortgage applications received by about 4,000 NPCUs from 2005 to 2010 (see the 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 both when the application and when the NPCU made a decision on the application, and NPCU fixed effects. This rich set of applicant-level controls makes it difficult to attribute any correlation between investment capital changes and the probability of rejection to omitted local economic factors or compositional changes in the applicant pool. In any event, the CCU ABS-related losses and resulting changes in investment capital at the NPCU level were "silent" events, not widely known to the general public, and hence are not likely to influence the composition of loan applications at a given NPCU.[26]

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

— Table VIII here —

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. Column 2 continues

this theme, interacting the investment capital variable with the capital-asset ratio in 2006. The cross-sectional heterogeneity in capital-asset ratios appears to be important. Both the change in investment capital and the interaction term are individually and jointly significant. After a one standard deviation decrease in investment capital, the probability of rejection increases by about 0.3% for a NPCU at the 25th percentile of the capital-asset ratio. But for a NPCU at the median ratio, the probability of rejection increases by only 0.13%.

However, rather than limiting credit availability uniformly for all types of borrowers in response to investment capital shocks, the most leveraged institutions in column 2 may have also become more conservative in their lending practices, disproportionately denying credit to the riskier borrowers (Rajan (1994), Rajan and Ramcharan (2012)). Column 3 of Table VIII investigates this hypothesis. The specification uses a triple interaction term that interacts the change in investment capital, the capital-asset ratio in 2006, and a proxy for the applicant's riskiness, namely, the applicant's leverage, defined as the ratio of the requested loan amount to the applicant's income. This variable is included linearly, as well as interacted separately with the change investment capital.

The coefficients in column 3 imply that facing an investment capital write-down, rejection rates rise most sharply for those borrowers seeking the most leveraged loans. And this type of screening appears strongest at NPCUs with smaller capital-asset ratios. For example, at a NPCU at the 25th percentile capital-asset ratio, a one standard deviation decline in investment capital is associated with a 0.7 percentage point increase in the probability of rejection among applicants at the 25th percentile loan-income ratio. But for applicants at the median loan-income ratio, the impact of a one standard deviation decline in investment capital on the rejection probability is about 20% larger.[27]

B. Automobiles and the Extensive Margin

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

Column 1 of Table IX regresses the growth in the number of cars financed by a NPCU on the growth in investment capital the previous period. All regressions use year and quarter fixed effects, which help absorb aggregate shocks such as the *Cash for Clunkers* program, and NPCU-level fixed effects, which help absorb local time-invariant shocks (Mian and Sufi (2012)). In column 1, we find a large positive association between the change in investment capital and the number of cars financed by a credit union. A one standard deviation decrease in investment capital is associated with a 2.1 percentage point or 0.04 standard deviation drop in the number of cars financed. Results are similar when using the change in the approximate value of the cars financed as the dependent variable (these are available upon request).

— Table IX here —

Column 2 interacts the change in investment capital with the capital-asset ratio in 2006. For a given change in investment capital, there is again significant evidence that more leveraged institutions contracted credit at the extensive margin to a greater extent. A one standard deviation decrease in investment capital is associated with a three percentage point drop in car sales growth the next quarter for a NPCU at the 25th percentile capital-asset ratio, while the impact is approximately 17% smaller for a NPCU at the median ratio.

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

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

Column 3 regresses the change in the total number of cars sold—irrespective of lender—on the change in investment capital at the county level. The estimated coefficient on investment capital is significant and 28% of the magnitude of the coefficient in column 1, which implies that a one standard deviation decrease in investment capital is associated with a 0.05 standard deviation drop in car sales in the county. Thus, at least at the county level, the substitution effect appears

insufficient to fully offset the contraction in NPCU credit supply brought about by investment capital losses.

IV. Conclusion

How did the collapse of ABS prices and the ensuing 2007 to 2009 financial crisis affect the supply of credit to consumers? There are significant measurement and identification challenges to addressing this question. In this paper, we address some of these challenges using a new data set that describes unique interbank relationships within the credit union industry. The industry accounts for a quarter of all automobile financing in the U.S. 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 CCUs are associated with a large contraction in the supply of credit among downstream NPCUs. We also investigate the importance of capital in buffering lending using the cross sectional heterogeneity in the way credit production at NPCUs varies with respect to the balance sheet shocks. Finally, we provide evidence that the contraction in credit supply may have affected the availability of mortgage and automobile credit, perhaps helping to account for some of the collapse in auto sales during the crisis, as well as the weakness in housing prices (Rajan and Ramcharan (2012)). Taken together, the results suggest that Wall Street and Main Street might be deeply connected and that capital regulation might be a useful tool in limiting the ability of the traditional financial system to transmit securities price volatility to the real economy.

Appendix: Data Sources

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 NPCUs and CCUs is not public and is based on a 2009 census conducted by the NCUA. Information on county and zip-code level housing prices is obtained from *CoreLogic*. County-level median income is obtained from the *U.S. Census Bureau*'s *American Community Survey*, while county-level unemployment comes from the *U.S. Department of Labor*. The mean county-level household debt to income ratio was graciously provided by Amir Sufi.

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 Metropolitan Statistical Area (MSA), and are federally insured (a contributor to the NCUA share insurance fund). In constructing the binary rejection variable used in Table VIII Panel A, we omit those loan applications that were approved but rejected by the applicant, that were withdrawn by the applicant without any action by the lender, or that were closed by the lender because the application remained incomplete.

Data matching credit supplier to automobile purchases at the county level come from *R.L. Polk*.

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FOOTNOTES

[1] Chodorow-Reich (2014) also use detailed micro data to study how distress in the banking system might have affected employment, measured at the firm level. At the more aggregate level, Ivashina and Scharfstein (2010) examine the impact of the crisis on credit supply in the syndicated loan market, Cornett et al. (2011) look more broadly at credit in the banking system, while Puri, Rocholl, and Steffen (2011) focus on international spillovers from the U.S. crisis.

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

[3] Credit unions require a special exemption to originate business loans in excess of 12.5% of total assets.

[4] The importance of credit unions relative to banks tends to decline when including the assets of the larger banks, with portfolios that include a greater share of commercial and investment lending.

[5] 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.

[6] The paid-in and membership capital contributed by NPCUs to absorb losses at CCUs are distinct from the capital that NPCUs use to meet their own capital requirements.

[7] As prices fell and the ABS market became illiquid, there was only $2.4 billion in retained earnings available to cover about $30 billion in unrealized losses in the ABS market.

[8] For instance, a bank might curtail lending because of contagion effects emanating from the interbank market: one bank's distress from exposure to the ABS market might affect the

balance sheet of another bank as in Allen and Gale (2000), forcing the latter bank to also restrict lending. But because these banks operate in the same markets or are members of the same network, they are also subject to common shocks—general economic uncertainty during the crisis and depressed credit demand among clients—that might also lead to an observationally identical decline in credit growth. This in turn makes it difficult to identify whether any observed decline in credit growth reflects a contraction in credit supply due to ABS-related balance sheet shocks or instead some unobserved common shock.

[9] The Internet Appendix to this paper is available in the online version of this article on the Journal of Finance website.

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

[11] From Figure 2: If NPCU A (B) contributes \$1(\$3) to the \$4 of investment capital at CCU AB, then a \$1 loss at CCU AB translates into a \$0.25 (\$0.75) depletion of investment capital held on the balance sheet of NPCU A(B).

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

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

off-balance sheet asset backed commercial paper conduit only weeks before the ABCP market unraveled.

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

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

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

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

[18] Tables V, VI, and VII report standardized coefficients.

[19] Note that the investment capital levels in the cross-section are computed as 2007 and 2010 averages—not the peak-to-trough change. Also, the call report data set that we have access to captures about $3.9 billion of the official $7 billion depletion in investment capital during the sample period from 2005 to 2010. Of this, about 250 credit unions either failed or merged

between 2007Q1 and 2010 Q4, helping to account for the fact that we observe $1.2 billion in the cross-section out of the $3.9 billion available in the panel.

[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. The multiplier suggests that the industry as whole might target a 13% capital asset ratio. The multiplier for banks might be of a similar magnitude, as banks have also traditionally shown a deep reticence to raise capital (Hanson, Kashyap and Stein (2011)), and as Adrian and Shin (2010) report, banks also actively adjust their balance sheets in response to changes in net worth.

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

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

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

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

[25] Because the IV estimate weights the credit supply mechanisms by the relative power of the instrument in explaining the variation in both actual and expected investment capital write-

downs, the somewhat larger IV point estimate might reflect the fact that CCU losses could also shift NPCU credit supply due to the uncertainty surrounding future investment capital write-downs and assessments (Angrist, Graddy, and Imbens (2000)). During the sample period, estimates of these future assessments fluctuated significantly, from a high of around $20 billion in mid-2009 to around $12 billion by end of 2010. The more powerful is weighted CCU income in explaining expected investment capital write-downs, the more representative the IV estimate will be of both actual and expected investment capital write-downs in shifting the NPCU credit supply curve.

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

[27] The results in Table VIII Panel A also suggest that those credit unions associated with distressed CCUs did not systematically "gamble for resurrection" by originating a greater number of riskier loans ex-post (as in Hellman, Murdock, and Stiglitz (2000)). It remains possible that borrowers thought credit unions associated with distressed CCUs might "gamble for resurrection" ex-ante, thereby increasing the number of mortgage applications by subprime borrowers at those credit unions and biasing our estimates. This, however, seems highly implausible given credit unions' field of membership requirement precludes mortgage applications from nonmembers, and news about the failure of the five largest CCUs did not spread widely (footnote 26).

Figure 1. The credit union industry 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, for example, 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. U.S. Central aggregates these services vis-à-vis the rest of the financial system.

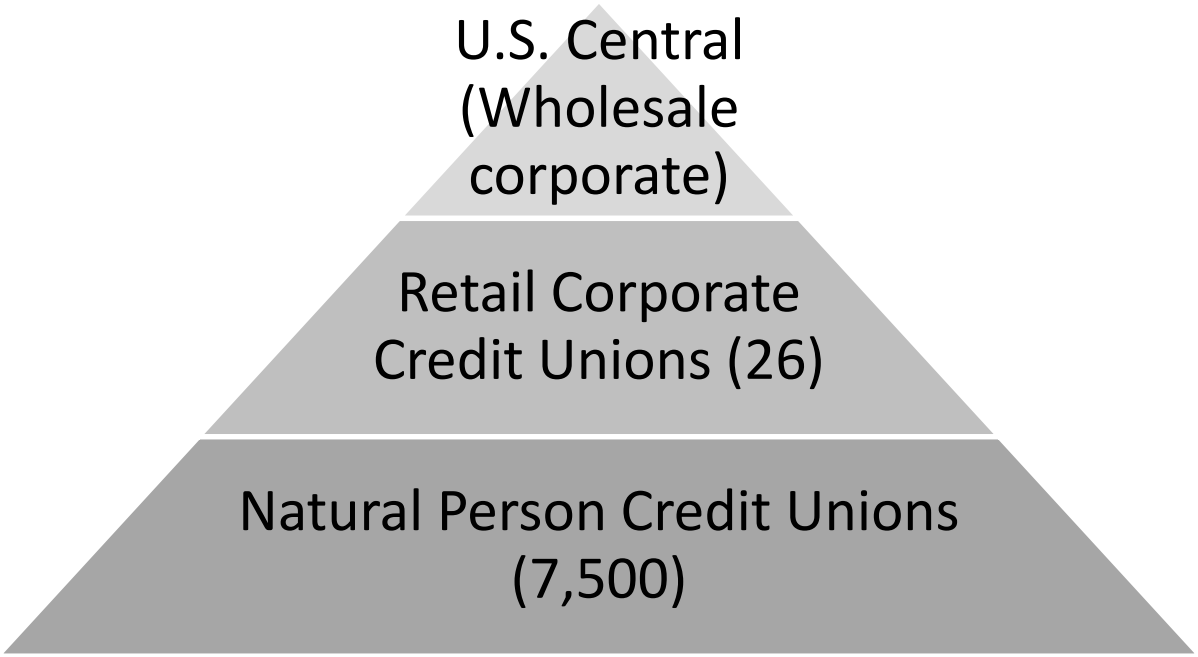

Figure 2. An example of a credit union network. This figure shows a hypothetical credit union network, based on two NPCUs (A and B) and one CCU (AB). It also shows how a dollar in losses at CCU AB (in excess of retained earnings) is apportioned between NPCU A (25%) and NPCU B (75%) based on their initial allocation of investment capital.

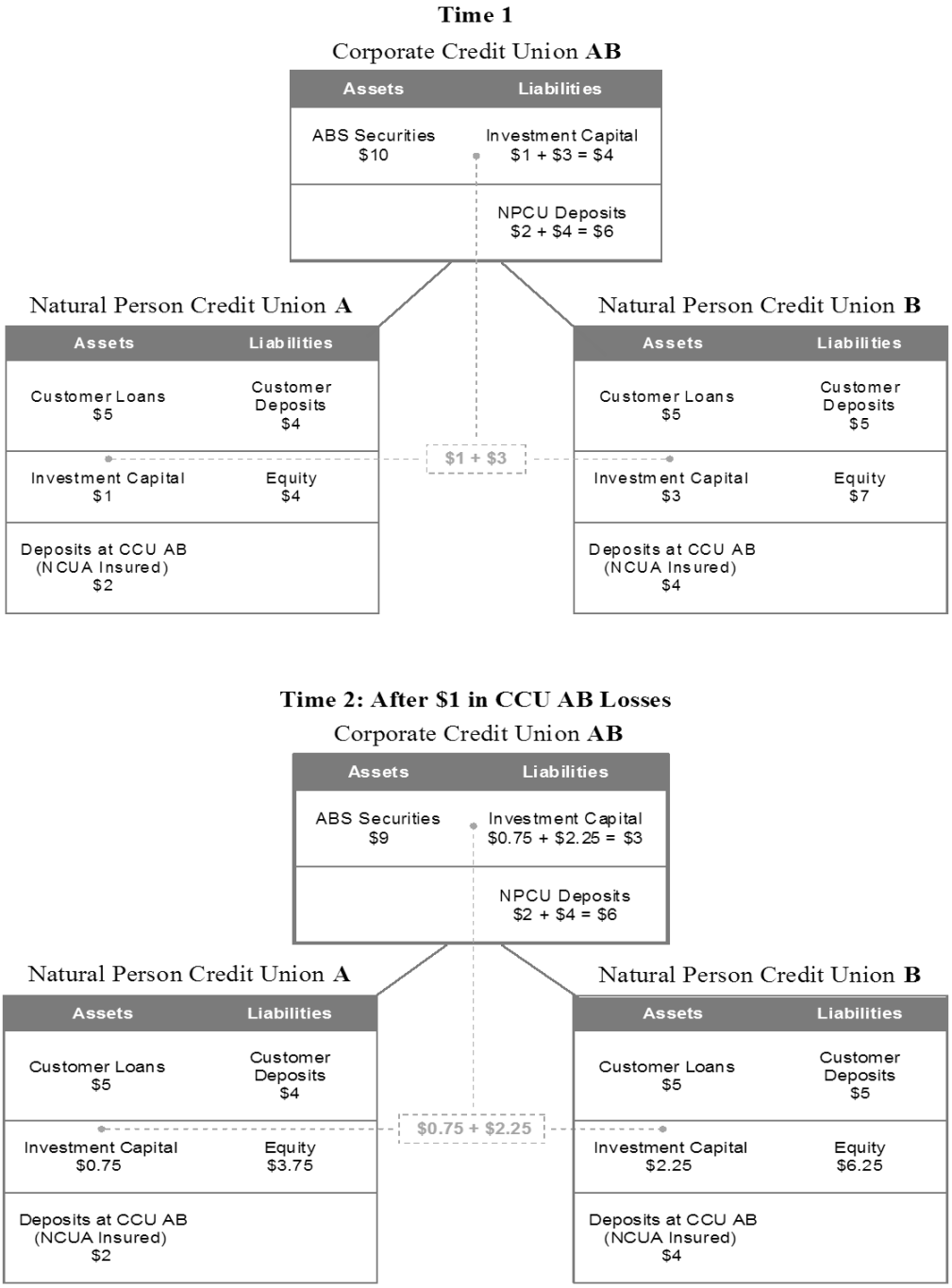

Figure 3. The composition of NPCU lending. This figure plots the lending profiles of NPCUs that were connected to CCUs that failed (Panel A), and NPCUs that were connected to CCUs that did not fail (Panel B).

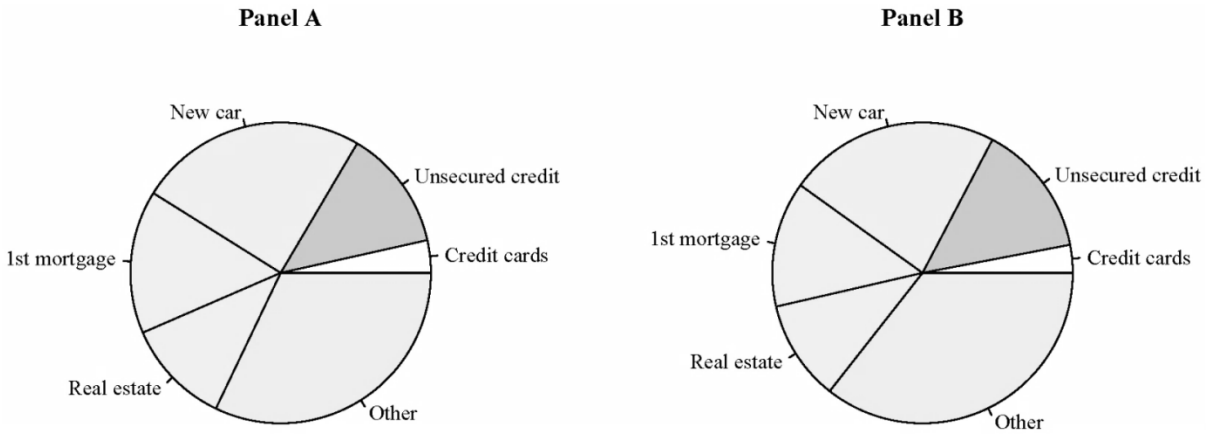

Figure 4. Investment capital and total lending in the credit union industry, 2005-2010. This figure plots the total amount of membership and paid-in capital at CCUs (dashed line) and total lending by NPCUs (solid line).

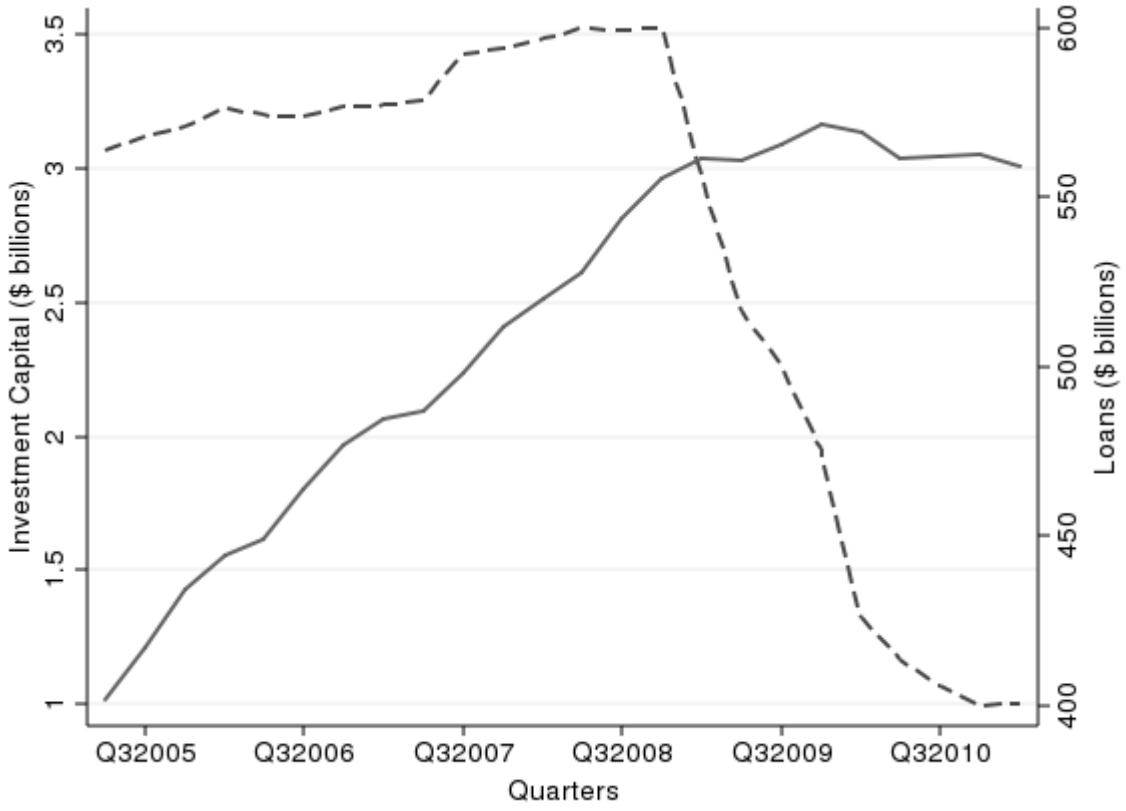

Figure 5. Investment capital losses by county. This figure depicts the change in investment capital between 2007Q1 and 2010Q4, aggregated up to the county level. That is, for each of the 1,396 counties with active credit unions, the figure first computes the total level of investment capital summed across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

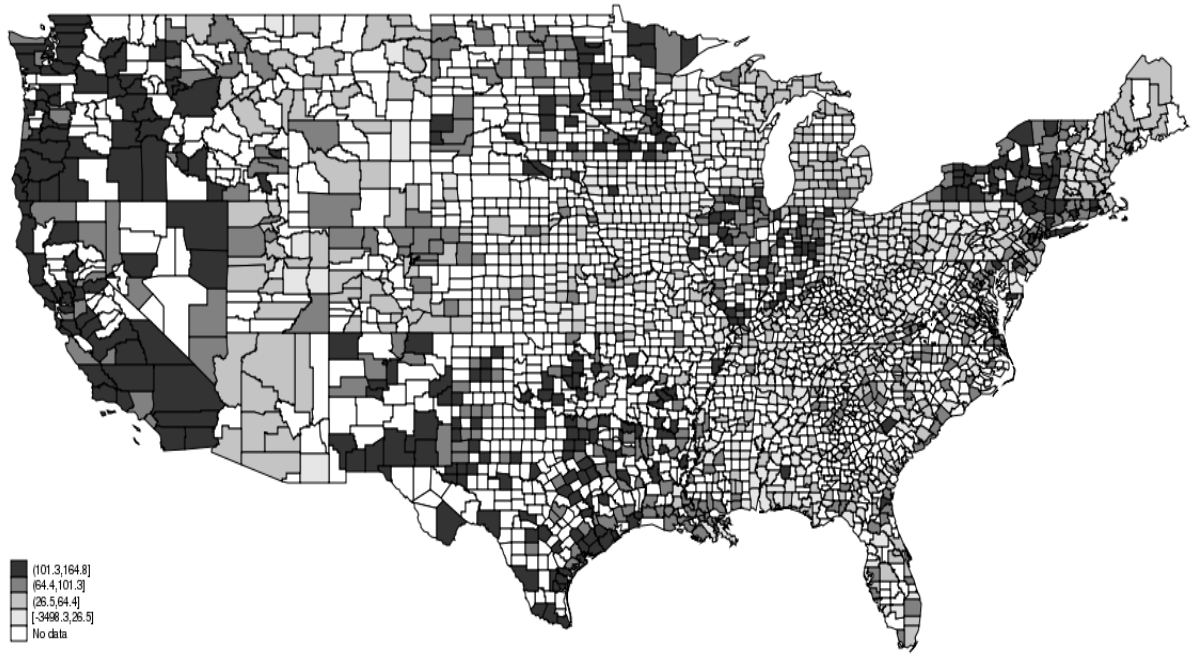

Table I

Market Share of the Credit Union Industry in the Supply of Consumer Credit

This table lists the market share of various sources of consumer credit.

Panel A. 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

Panel B. Auto Loan Market Share (%)

	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

Panel C. Credit Unions Share of Housing Loans (%)

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

Table II

NPCU Balance Sheet and CCU Investments

Panel A provides a summary of NPCUs' balance sheet. These variables include the capital-asset ratio, the level of loans, NPCU investment capital at the CCU relative to equity, and NPCU investment securities relative to assets. Panel B records the fraction of investment securities relative to CCU assets, as well as the concentration of private label ABS in CCU investment portfolios, averaged over 2006. * indicates CCUs that eventually failed during the crisis.

Panel A. NPCU Balance Sheet Summary Statistics, 2006Q4

	Capital-asset ratio	Loans ($millions)	CCU investment capital, as % of equity	Investment securities, as % 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

Panel B. CCUs' Investment Securities—AAA and AA ABS in 2006

	Investment securities, as % of assets	Private label asset backed securities, as % of investment portfolio
Central Corporate	76.25	1.57
Constitution Corporate*	95.82	27.62
Corporate America	95.49	5.86
Corporate One	90.76	6.65
Eastern Corporate	92.56	0.59
First Carolina Corp.	90.09	0.00
First Corporate	78.47	0.00
Georgia Central	92.67	0.00
Iowa Corp Central	71.29	0.00
Kansas Corporate	78.92	0.00
Kentucky Corporate	90.29	0.00
Louisiana Corporate	86.11	1.63
Members United Corp.*	86.39	3.71
Mid-Atlantic Corporate	87.25	0.26

Midwest Corporate	84.23	0.00
Missouri Corporate	84.56	0.00
Southeast Corporate	87.52	9.18
Southwest Corporate*	85.82	19.47
Suncorp Corporate	86.70	4.45
Treasure State Corporate	82.13	0.00
Tricorp	77.28	0.00
VACorp	77.73	0.00
Volunteer Corporate	86.54	1.52
West VA Corporate	90.56	0.00
Western Corporate*	86.89	56.39

Table III

NPCU Balance Sheet by CCU Affiliation and NCPU Lending Growth

Panel A reports balance sheet variables of the median NPCU by CCU affiliation in 2006. Panel B records the year-to-year change in the dollar amount in total NPCU loan between 2006 and 2010. * indicates CCUs that eventually failed during the crisis.

Panel A. 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
Central Corporate	33,087	0.44	0.09	0.15	0.05	0.86
Constitution Corporate*	18,058	1.48	0.08	0.15	0.02	0.86
Corporate America	14,712	0.98	0.09	0.17	0.00	0.85
Corporate One	25,303	0.62	0.09	0.15	0.02	0.86
Eastern Corporate	30,963	1.16	0.06	0.15	0.06	0.85
First Carolina Corp.	20,983	0.71	0.11	0.17	0.00	0.85
First Corporate	54,123	1.54	0.09	0.13	0.01	0.88
Georgia Central	13,801	0.84	0.11	0.18	0.00	0.84
Iowa Corp Central	9,463	0.57	0.10	0.15	0.00	0.85
Kansas Corporate	12,874	0.14	0.08	0.16	0.00	0.85
Kentucky Corporate	12,008	0.84	0.11	0.17	0.00	0.85
Louisiana Corporate	11,664	1.02	0.09	0.17	0.00	0.85
Members United Corp.*	13,541	0.73	0.09	0.16	0.00	0.85
Mid-Atlantic Corporate	11,886	0.87	0.10	0.15	0.02	0.86
Midwest Corporate	14,005	0.74	0.07	0.14	0.00	0.87

Missouri Corporate	10,165	0.05	0.13	0.13	0.00	0.86
Southeast Corporate	32,782	1.15	0.10	0.15	0.02	0.85
Southwest Corporate*	26,096	1.01	0.08	0.15	0.00	0.86
Suncorp Corporate	18,660	0.62	0.08	0.15	0.00	0.87
Treasure State Corporate	14,280	1.17	0.10	0.14	0.00	0.87
Tricorp	30,873	1.02	0.08	0.14	0.00	0.87
VACorp	13,373	0.97	0.10	0.14	0.00	0.86
Volunteer Corporate	15,996	0.79	0.11	0.18	0.00	0.84
West VA Corporate	7,444	-0.03	0.10	0.17	0.00	0.86
Western Corporate*	61,816	1.57	0.06	0.13	0.03	0.87

Panel B. 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 IV

Summary Statistics

This table contains summary statistics for the main explanatory variables used in the analysis.

	Mean	Standard deviation
NPCU Variables		
Lending Growth, 2007-2010 (%)	0.75	24.95
Investment capital Growth, 2007-2010 (%)	-106.07	109.99
Average Loan Growth, 2005-2006 (%)	1.42	2.99
Average Deposit Growth, 2005-2006 (%)	-0.58	2.40
Investment Capital Growth, 2005-2006 (%)	0.004	0.07
Cash-Assets Ratio, 2006	11.92	9.98
Capital-Asset Ratio, 2006	17.29	6.86
Log Total Assets,2006	9.60	1.71
NPCU Deposits in CCU, 2005-2006 (% of assets)	7.05	7.59
CCU Variables		
Private label MBS, 2007 (% of assets)	0.14	0.18
Investment-Assets Ratio, 2007	0.89	0.03
Capital-Asset Ratio, 2007	0.03	0.006
County Variables		
Population Density	1554.19	5510.90
Fraction Urban Population	0.79	0.41
Log of Median Income	10.78	0.21
Income Inequality (Gini Coefficient)	0.45	0.04
Poverty Rate (%)	14.36	4.72
Fraction Black	0.14	0.15
Average House Prices Growth, 2005-2006 (%)	0.01	0.01
Average House Prices Growth, 2007-2010 (%)	-0.01	0.01
Household Leverage	1.56	0.42

Table V

The Impact of Investment Capital Growth on Lending Growth

The dependent variable in this table is the log change in lending growth, computed between 2007 and 2010. All specifications include state and field of membership fixed effects. ***, **, and * denote significance at the 1%, 5%, and 10% level respectively. Standard errors are clustered at the state level. All variables are standardized to have zero mean and a standard deviation of one.

	(1)	(2)	(3)	(4)	(5)
	No controls	Demographics	House prices	Balance sheet controls	CCU controls
Growth in Investment Capital, 2007-2010	0.0910***	0.0891***	0.107***	0.0826**	0.0835**
	(0.0325)	(0.0328)	(0.0315)	(0.0360)	(0.0363)
Population Density		0.000988	-0.00889		
		(0.0113)	(0.0161)		
Urban Population		-0.0122	0.0209		
		(0.0148)	(0.0196)		
Log of Median Income		-0.0437	-0.0177		
		(0.0279)	(0.0360)		
Income Inequality		-0.00196	-0.00764		
		(0.0230)	(0.0251)		
Poverty Rate		0.0171	0.0416		
		(0.0305)	(0.0359)		
Percent Black		-0.0381	-0.0588**		

	(0.0241)	(0.0276)		
Average House Prices Growth, 2005-2006		0.0541		
		(0.0324)		
Average House Prices Growth, 2007-2010		0.0332		
		(0.0274)		
Household Leverage		-0.0470		
		(0.0333)		
Average Loan Growth, 2005-2006			-0.00268	-0.00228
			(0.0390)	(0.0387)
Average Deposit Growth, 2005-2006			0.167***	0.165***
			(0.0399)	(0.0392)
Investment Capital Growth, 2005-2006			0.0131	0.0136
			(0.0203)	(0.0204)
Cash-Assets Ratio, 2006			0.0372	0.0400
			(0.0233)	(0.0308)
Capital-Asset Ratio, 2006			-0.0369**	-0.0372**
			(0.0155)	(0.0156)
Log of Total Assets,2006			-0.0292	-0.0331
			(0.105)	(0.104)
Share of Private Label MBS, 2007				0.00505
				(0.0344)
Investments-Assets Ratio, 2007				-0.0279
				(0.0190)
CCU Capital-Asset Ratio, 2007				0.0350***
				(0.0113)

NPCU Deposits in CCU, 2005-2006					-0.00399
					(0.0220)
Observations	5,705	5,705	4,589	5,648	5,648
R^2	0.166	0.169	0.180	0.176	0.176

Table VI

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

The dependent variable in this table is the log change in lending growth, computed between 2007 and 2010. Each specification includes the same set of controls as in column 5 of Table V–the baseline specification–as well as the capital-asset ratio in 2006 quadratically. ***, **, and * denote significance at the 1%, 5%, and 10% level respectively. Standard errors are clustered at the state level. All variables are standardized to have zero mean and a standard deviation of one.

	(1) Capital	(2) Cash	(3) Size
Growth in Investment Capital, 2007-2010	0.137***	0.133***	0.170***
	(0.0375)	(0.0403)	(0.0506)
Growth in Investment Capital, 2007-2010 * Capital-Asset Ratio, 2006	-0.111**	-0.112*	-0.117**
	(0.0550)	(0.0560)	(0.0549)
Capital-Asset Ratio, 2006	-0.0724**	-0.0740**	-0.0909**
	(0.0340)	(0.0344)	(0.0355)
Capital-Asset Ratio, 2006, Squared	0.0511	0.0513	0.0494
	(0.0548)	(0.0552)	(0.0543)
Growth in Investment Capital, 2007-2010 * Cash-Asset Ratio, 2006		0.00779	0.00140
		(0.0320)	(0.0313)
Cash-Asset Ratio, 2006		0.0459	0.0410
		(0.0431)	(0.0429)
Cash-Asset Ratio, 2006, Squared		-0.00533	-0.00625
		(0.0434)	(0.0438)
Growth in Investment Capital, 2007-2010 * Bottom Quartile in Assets, 2006			-0.0347
			(0.0247)
Bottom Quartile in Assets, 2006			-0.0107
			(0.0258)
Observations	5,689	5,689	5,689
R^2	0.177	0.177	0.178

Table VII

The Impact of Investment Capital Growth on Lending Growth: Instrumental Variables

All specifications include the same set of controls as in column 5 of Table V. Column 1 reports the first-stage regression of the log change in investment capital between 2007 and 2010 on the 2000 share-weighted corporate net income. Column 2 reports the reduced-form regression of log change in lending between 2007 and 2010 on the 2000 share-weighted corporate net-income. Columns 3 repeats the specification in column 2 with an interaction term between the 2000 share-weighted corporate net-income and the 2006 average capital-asset ratio. This ratio also enters quadratically. Column 4 instruments the growth in investment capital, 2007-2010 with the 2000 share-weighted corporate net-income. Column 5 includes an interaction term between the growth in investment capital, 2007-2010 and the 2006 average capital-asset ratio. This ratio also enters quadratically. ***, **, and * denote significance at the 1%, 5%, and 10% level respectively. Standard errors are clustered by NPCU corporate affiliation. All variables are standardized to have zero mean and a standard deviation of one.

	(1) First Stage	(2) Reduced Form	(3) Reduced Form (Capital)	(4) IV	(5) IV (Capital)
Dependent Variable:	Growth in Investment Capital, 2007-2010	Loan Growth, 2007-2010	Growth in Investment Capital, 2007-2010	Loan Growth, 2007-2010	Loan Growth, 2007-2010
CCU Net Income, 2007-2010	0.0488***	0.0186***	0.241***		
	(0.0136)	(0.00567)	(0.0897)		
Growth in Investment Capital, 2007-2010				0.380*	0.792*
				(0.198)	(0.414)
CCU Net Income, 2007-2010 * Capital-Asset Ratio, 2006			-0.187**		
			(0.0755)		
Growth in Investment Capital, 2007-2010 * Capital-Asset Ratio, 2006					-0.721**
					(0.285)
Observations	5,622	5,621	5,619	5,621	5,621
R^2	0.723	0.177	0.178	0.153	0.127

Table VIII

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

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

	(1)	(2)	(3)
Growth in Investment Capital, Lagged 1 Quarter	-0.00559	-0.0495**	-0.0254
	(0.00601)	(0.0215)	(0.0166)
Growth in Investment Capital, Lagged 1 Quarter *Capital-Asset Ratio, 2006		0.00377**	0.00264**
		(0.00165)	(0.00135)
Growth in Investment Capital, Lagged 1 Quarter * Debt-to-Income Ratio			-0.0122***
			(0.00425)
Growth in Investment Capital, Lagged 1 Quarter * Capital-Asset Ratio, 2006 * Debt-to-Income Ratio			0.000532*
			(0.000307)
Male	-0.00534***	-0.00536***	-0.00539***

	(0.00116)	(0.00116)	(0.00117)
Hispanic	0.0926***	0.0924***	0.0925***
	(0.00412)	(0.00413)	(0.00413)
Black	0.165***	0.165***	0.165***
	(0.00420)	(0.00424)	(0.00424)
Low Income Census Tract	0.0768***	0.0768***	0.0769***
	(0.00512)	(0.00513)	(0.00514)
Log of Loan Amount	0.0330***	0.0330***	0.0327***
	(0.00415)	(0.00418)	(0.00419)
Log of Income	-0.114***	-0.115***	-0.114***
	(0.00338)	(0.00338)	(0.00339)
Observations	2,811,414	2,795,686	2,795,686
R^2	0.094	0.171	0.171

Table IX

The Impact of Investment Capital Growth on Automobile Sales

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

	(1)	(2)	(3)
	NPCU Level	NPCU Level	County Level
Growth in Investment Capital, Lagged 1 Quarter	0.0742***	0.184***	0.0205***
	(0.0173)	(0.0457)	(0.0055)
Growth in Investment Capital, Lagged 1 Quarter *Capital-Asset Ratio, 2006		-0.0066**	
		(0.0029)	
Observations	21,000	20,808	5,432
R^2	0.171	0.171	0.376