Work in progress

Regulatory Change and Capital Adjustment of Cooperative Financial Institutions [x]

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Keywords Credit unions, Banking, Capital ratios, Pro-cyclical, Prompt Corrective Action, Regulation

JEL G21, G18, G28

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[x] The authors thank Christine Brown, Santiago Carbo Valverde, Rebel Cole, Bob DeYoung, Kevin Davis, Scott Frame, Michael Goldstein, Jens Hagendorff, Mohammad Kabir Hassan, Michael King, Phil Molyneux, Rob Nijskens, Steven Ongena, Matthew Osborne and Barry Quinn for useful comments and suggestions on a previous draft of this paper. The usual disclaimer applies.

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Regulatory Change and Capital Adjustment of Cooperative Financial Institutions

1 Introduction

Since the seminal study of Modigliani and Miller (1958), capital structure has been a core topic in financial economics research. Firm-specific, industry, legal and institutional factors have been shown to influence the capital structure of non-financial firms in the US and elsewhere, and its adjustment over time.[1] As the recent financial crisis has demonstrated, adequate capitalization of financial institutions is crucial for the safety and soundness of the financial system.

Against this background, we examine the capital management of US credit unions during the period 1994-2010. Credit unions are non-profit, cooperative financial institutions governed by their membership on a one-member-one-vote basis, with eligibility for membership defined by the credit union's common bond. Our analysis of the capital management of credit unions contributes to the capital structure literature in five ways. First, we provide in-depth evidence on the capital adjustment of not-for-profit financial institutions. Second, our dynamic model for capital adjustment includes a control for survivorship bias.[2] We estimate a panel sample-selection model, comprising a probit regression for the probability of survival for each credit

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[1] See: Rajan and Zingales (1995); MacKay and Phillips (2005); Flannery and Rangan (2006); Lemmon, Roberts and Zender (2008); Cook and Tang (2010); Hovakimian and Li (2011); Oztekin and Flannery (2012).

[2] "A more thorough investigation of the survivorship issue would entail a model of firm exit and an appropriate identification strategy, i.e. instrument(s), to disentangle the exit decision from the capital structure decision ….. a potentially fruitful area for future research." Lemmon, Roberts and Zender (2008, p1581). From a population of around 12,000 credit unions that were live in 1994, just over 4,800 disappeared through liquidation, acquisition or conversion between 1994 and 2010.

union in each six-month period, and a fixed-effects regression for the change in the capital-to-assets ratio. The model describes the capital-adjustment process, and measures the speed of mean reversion. Third, we assess the impact of the new capital adequacy regulatory regime introduced in 2000, a major regulatory change, on the capital-adjustment process. Fourth, we explore the effects of changes in state-level macroeconomic conditions on capitalization,[3] and identify whether capital adjustment is pro- or counter-cyclical. Fifth, we examine the determinants of credit union survival and capitalization during the financial crisis of the late-2000s. We examine the usefulness of a number of financial health indicators, observed in 2007, as indicators of the likelihood of survival over the following three years.

At the end of 2010 credit unions accounted for approximately 10% of all consumer savings and deposits in the US, servicing over 90 million members drawn from a wide cross-section of society. Unlike other retail financial institutions, credit unions are not permitted to raise capital by issuing new equity. Over time, net worth accumulates through the retention of earnings that are not distributed to members, in the form of dividends on share accounts, or favourable rates paid on deposit accounts, or subsidized rates charged on loans. This implies capital shortages cannot be rectified quickly, and suggests that the capital adjustment of credit unions may differ from that of commercial banks and non-financial firms.

Before 2000 US credit unions were not subject to any formal capital (net worth) requirements. US Treasury (1997) recommended that the National Credit Union Association (NCUA), the regulator, introduce specific net worth requirements (in the form of defined minima for capital-to-assets ratios). Under a new prompt corrective action (PCA) regime introduced in

[3] According to Cook and Tang (2010), the impact of macroeconomic conditions on the dynamics of capital adjustment has been neglected in the empirical literature.

2000, a range of measures would be available for restoration of the net worth of credit unions identified as poorly capitalized (see Section 2, below).

Under these regulatory arrangements, US credit unions have, in general, withstood the financial crisis of the late-2000s better than many banks (Smith and Woodbury, 2010).[4] Nevertheless, 46 credit unions failed in 2008 and 2009 at a cost of $985 million to the National Credit Union Insurance Fund (NCUSIF); and a further 28 credit unions failed in 2010 at a cost of $221 million. The crisis in the US real estate market has impacted on the credit union industry, primarily through the investment policies of a number of the corporate credit unions, which used cash deposits received from retail credit unions to purchase risky asset-backed securities, and realized large losses in several cases.[5] In the light of these developments, an analysis of the experience and performance of the credit union industry during the financial crisis is highly relevant for the ongoing debate concerning the future regulation of financial institutions.

Key empirical findings are as follows. Following the introduction of a new capital adequacy regulatory framework in 2000, credit unions in general adopted a more active approach to capital management, resulting in any undercapitalization exposure following an adverse capitalization shock being addressed more rapidly. Increases in credit union lending naturally tend to reduce capitalization, which varies pro-cyclically. In the absence of any option to raise new capital in the form of equity, credit unions tend to manage their capital cautiously over the

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[4] Historically, losses imposed on insurance funds have been lower for credit unions than for banks (Kane and Hendershott, 1996; Wilcox, 2005a).

[5] In January 2009, the NCUSIF issued a $1 billion capital note to US Central Corporate Credit Union. In March 2009 the two largest corporate credit unions, US Central and Western Corporate, were placed in conservatorship, to be followed later in 2009 and 2010 by Constitution, Members United and South West Credit Unions. These five institutions account for 70% of all corporate credit union assets, and more than 98% of investment losses. A bailout of the corporate credit unions, in the form of a corporate stabilization plan, was signed into law in May 2009, with all NCUSIF-insured credit unions being required to contribute to a Temporary Corporate Credit Union Fund. These payments have contributed significantly towards a reduction of the capitalization of the credit union industry as a whole, from 2007 onwards.

business cycle. The probability of survival is increasing in size, but decreasing in age. A high capital-to-assets ratio or a high loans-to-assets ratio increases the probability of survival, but a high liquid assets-to-total assets ratio reduces the probability of survival. During the financial crisis of the late-2000s, large credit unions experienced a smaller reduction in their capitalization, on average, than small credit unions. Observed in December 2007, the z-score risk measure would have been a more reliable predictor of survival or non-survival over the following three years than several other financial-health indicators.

In summary, this study provides new insights into the factors that determine the capital held by not-for-profit financial institutions, the relationship between state-level macroeconomic conditions and credit union capitalization, and the impact of a major regulatory change on capital management and capital adjustment. The rest of the paper is organized as follows. Section 2 describes the current framework for capital-adequacy regulation of US credit unions. Section 3 reviews the literature on capital-adequacy regulation and capital management, for both banks and credit unions. Section 4 describes the empirical model, comprising a probit regression for the probabilities of survival or disappearance, and a fixed-effects regression for capital adjustment that incorporates a correction for survivorship bias. Section 5 describes the data, and reports descriptive statistics. Section 6 reports and interprets the empirical findings. Section 7 examines patterns of credit union survival or disappearance, and capital adjustment, during the financial crisis of the late-2000s. Finally, Section 8 summarizes and concludes.

2 Capital adequacy regulation of credit unions

Before 2000, the NCUA required that credit unions transfer a certain percentage of annual income into a reserve account.[6] The level of net worth was viewed by supervisors as an indicator of financial health, and was used in an algorithm to calculate a CAMEL (capital adequacy, asset quality, management, earnings and asset/liability management) score. The PCA framework, included in Section 301 of the Credit Union Membership Access Act (CUMAA) of 1998 and implemented in August 2000, defines five categories of capitalization, in terms of the ratio of net worth-to-assets, denoted KA: well capitalized, $KA \geq 7\%$; adequately capitalized, $6\% \leq KA \leq 6.99\%$; undercapitalized, $4\% \leq KA \leq 5.99\%$; significantly undercapitalized, $2\% \leq KA \leq 3.99\%$; and critically undercapitalized, $KA < 2\%$. Credit unions classified as well capitalized are free from supervisory intervention. Credit unions classified as adequately capitalized or below are required to take steps to restore net worth to adequate levels.[7] Most credit unions are low risk, due to restrictions on their activities embodied in cooperative principles and the common bond. Since credit unions cannot issue equity, however, they are exposed to automatic regulatory PCA intervention in the event of unexpected growth in assets. This was evidenced in the early 2000s, when many investors liquidated investments in risky securities and deposited the proceeds with credit unions. The pressure on capitalization drove some credit unions to refuse deposits, reduce services, convert to Savings and Loans or Community Banks, or merge with other credit unions.

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[6] Legislation relating to deposit insurance has been in force since the early 1970s. Insured credit unions are more highly capitalized, more liquid and take fewer risks than their non-insured counterparts (Karels and McClatchey, 1999). By contrast, increased access to deposit insurance provides perverse incentives for banks to undertake riskier investments, increasing the probability of bank failure (O'Hara and Shaw, 1990).

[7] The CUMAA specifies mandatory actions for credit unions that do not meet capital adequacy standards. These include: annual earnings retentions of at least 0.4% of total assets; the submission and adherence to a net worth restoration plan (NWRP); lending restrictions; and the prohibition of increases in assets until net worth is restored. The CUMAA allows the NCUA to use 14 supervisory actions to supplement the mandatory actions.

In 1994 the proportion of credit unions classified as adequately capitalized or below (post-2000 terminology), with capital-to-assets ratios below 7%, was as high as 8.3%. In anticipation of the new regulatory arrangements, this proportion dropped to 3.2% in 1999, and 1.4% in 2007. During the recent financial crisis, however, this proportion increased sharply, reaching 5.2% in 2009 and 4.9% in 2010. Capitalizaton is inversely related to size: in 2010 the average capital-to-assets ratio of credit unions in the largest assets size decile was 10.1%, while the corresponding figure for the smallest decile was 20.4%. In 2010, 23.3% of all credit unions reported capital-to-assets ratios in excess of 16%. Jackson (2007) suggests that in comparison with banks, US credit unions in general are overcapitalized. The NCUA has proposed: (i) that credit unions be afforded the ability to raise supplemental capital in the form of either voluntary patronage capital, mandatory membership capital or subordinated debt; and (ii) that the capital-to-assets ratio monitored by the regulator be risk-based, effectively reducing the level of required capital (NCUA, 2005, 2007, 2010). The US Senate (December, 2010) has asked the Comptroller General to evaluate the effectiveness of the NCUA's regulatory arrangements, for both insured credit unions and corporate credit unions.

Any capital raised by US credit unions through retained earnings is tax exempt, affording credit unions a competitive advantage over banks and other mutual financial services providers. Tax-exempt status has assisted the credit union industry in maintaining capitalization substantially higher than the minimum regulatory level (US Government Accountability Office, 2005).[8] Large capital buffers might be maintained as a means of signalling strength to depositors

[8] The tax-exempt status of US credit unions has been justified by its proponents as a policy tool to tackle financial exclusion. An August 2010 report (and several previous reports) on tax reform suggests it might be appropriate for credit unions to be subject to corporate taxation (US Government Accountability Office, 2005; The President's Economic Recovery Advisory Board, 2010).

or the regulator, or might reflect a shortage of suitable investment opportunities owing to regulatory constraints on permissible activities.

3 Literature review

Marcus (1981) examines the determinants of capital-to-assets ratios for US banks for the period 1965-77, using a partial-adjustment model. Target capital-to-assets ratios depend on both peer group pressure and regulatory pressure. Using a simultaneous-equations model, Shrieves and Dahl (1992) examine the relationship between leverage capital requirements and risk for the period 1983-87, and report a positive relationship between capital and risk. Banks operating below the regulatory minimum capital-to-assets ratio (at that time 7%) increased their capital more quickly than those operating above the minimum. Jacques and Nigro (1997) examine the impact of risk-based capital standards for US banks introduced in 1991, during their first year of enforcement, when capitalization was increased and exposure to risk was reduced.

Aggarwal and Jacques (2001) examine the impact of PCA on bank capitalization and portfolio risk. During the period 1990-93 capital-to-assets ratios increased and risks were reduced following the introduction of new capital standards and PCA. Undercapitalized banks adjusted faster than those that were adequately capitalized. Berger, DeYoung, Flannery, Lee and Oztekin (2008) model the capital adjustment of US publicly-traded bank holding companies (BHC) for the period 1992-2006. BHCs set target capital levels substantially above the regulatory minima, and poorly capitalized BHCs adjust rapidly towards their targets.[9]

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[9] Outside the US, Brewer, Kaufman and Wall (2008) find that the capitalization of the largest international banks during 1992-2005 was highest in home countries with effective corporate governance laws, and where PCA was practised. Gropp and Heider (2010) report that the market-to-book ratio, profitability and asset size were determinants of the capital structure of large US and European banks during the period 1991-2004. In dynamic capital-adjustment regressions, time-invariant bank-specific fixed effects have significant explanatory power for the

Recent attention has focused on the role of capital buffers in absorbing shocks arising from unanticipated changes in credit risk. Bank lending is pro-cyclical, but credit risk is counter-cyclical: defaults tend to increase during economic downturns. The lending practices of banks may contribute to upturns (relaxed credit standards and excessive lending) and downturns (tighter credit standards, and increased capitalization to mitigate insolvency risk). Capital regulation that requires banks to increase capitalization during downturns may accentuate this effect. Alternatively, banks could target lower capitalization during downturns in order to maintain lending relationships, at the cost of increasing default probabilities (Berger, DeYoung, Flannery, Lee and Oztekin, 2008).

A few studies examine the impact of capital regulation for credit unions.[10] Jackson (2007) examines the capitalization of US credit unions during the period 1990-2006. The average capitalization at the end of 2006 was 11.6%, four percentage points higher than the corresponding figure in 1990. Using bank capitalization as a benchmark, Jackson suggests that credit unions were overcapitalized by 30-40% (between $8.8 billion and $11.7 billion) in 2006. Smith and Woodbury (2010) compare the financial stability of US banks and credit unions during the period 1986-2009. Credit unions are less sensitive to the business cycle than banks. The balance sheets of both tend to deteriorate when unemployment rises, but the trajectory and magnitude of delinquencies and charge-offs at banks are more pronounced. This suggests capital requirements for credit unions could be lowered, to account for the lower risk.

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cross-sectional variation in capital structure. Regulatory constraints are of less importance than market variables in determining the capital structure of banks.

[10] Bogan (2012) examines the link between capital structure and operational self-sufficiency for microfinance institutions located in Africa, East Asia, Eastern Europe, Latin America, the Middle East and South Asia for the period 2003-2006.

Hillier, Hodgson, Stevenson-Clarke, and Lhaopadchan (2008) examine the responses of Australian credit unions during the period 1987-94 to the imposition of new capital adequacy regulations. There is evidence that accounting window-dressing techniques were used to adjust reported capital ratios. Brown and Davis (2009) examine the capital management of Australian credit unions during the period 1993-2006. Some credit unions managed their capitalization by setting a short-run target for return on assets, with the intention of gradually eliminating discrepancies between actual and desired capital ratios.

4 Empirical model specification

An important original feature of the empirical model used in this study is the inclusion of a control for survivorship bias in the capital-adjustment equation. Capital adjustment in each period is observed only for those credit unions that survive, but capitalization is expected to be a key determinant of the probability of survival, creating a non-zero expectation conditional on survival for the disturbance term of the capital-adjustment equation. Attrition features prominently in the recent corporate demography of US credit unions, with the total number of institutions having decreased by around one-third during the 1994-2010 observation period for this study. Accordingly, we estimate the capital-adjustment equation using the Heckman (1979) sample-selection model, including a probit regression for the probabilities of survival or disappearance for each credit union in each six-month time period.

The data used in the present study is of exceptionally high quality, providing virtually 100% coverage of the US credit union industry, excluding privately-insured credit unions, over a 17-year period. We are able to track attrition in the population to a very high level of accuracy, with a cause of disappearance being identified for 99.4% of all non-survivors, and the acquiring credit union being identified for 98.8% of credit unions that exited as a result of acquisition (which account for 89.9% of all exits). For credit unions that were involved in M&A transactions in any six-month period as acquirers, we are able to adjust the lagged variables used in the capital-adjustment equation by creating lagged values for a 'synthetic' credit union based on the aggregate net worth of the acquirer and the acquired credit union.

The availability of data both before and after the introduction of the current regulatory arrangements for PCA in 2000 enables us to identify the effect of this major regulatory change on the capital adjustment of US credit unions. The empirical model incorporates coefficients that reflect the speed and time-path of capital adjustment, before and after this regulatory event. Impulse response functions are employed to identify the adjustment paths of well capitalized credit unions, and credit unions classified as adequately capitalized or below.

For credit unions classified as well capitalized ($k_{i,t-1} \geq 0.07$), and for those classified as adequately capitalized or below ($k_{i,t-1} < 0.07$), the specification of the capital-adjustment equation allows for different patterns of dependence of $\Delta k_{i,t}$ on $k_{i,t-1}$ and $\Delta k_{i,t-m}$ (for m=1,2) for the periods up to and including 2000.1, and 2000.2 onwards. The specification also allows for different intercepts for credit unions that were well capitalized ($k_{i,t-1} \geq 0.07$) and adequately capitalized or below ($k_{i,t-1} < 0.07$), for each of three separate subperiods: 1995.2-2000.1 (before the introduction of PCA); 2000.2-2007.2 (from the introduction of PCA to the start of the financial crisis); and 2008.1-2010.2 (the financial crisis).

The specification of the empirical model is as follows.

Survivorship equation:

$$y^*_{i,t} = \gamma_1 s_{i,t-1} + \gamma_2 k_{i,t-1} + \gamma_3 q_{i,t-1} + \gamma_4 n_{i,t-1} + \gamma_5 x_{i,t-1} + \gamma_6 e_{i,t-1} + \gamma_7 a_{i,t-1} + \sum_s \tau_s D_{s,i,t} \qquad [1]$$

Capital-adjustment equation:

$$\Delta k_{i,t-1} = \text{intercept} + \sum_{j=1}^{4} I_{i,t}^{j}(\alpha_1^j k_{i,t-1} + \delta_{11}^j \Delta k_{i,t-1} + \delta_{12}^j \Delta k_{i,t-2}) + \omega\phi(\hat{y}_{i,t}^*)/\Phi(\hat{y}_{i,t}^*)$$

$$+\beta_{11}\Delta c_{i,t-1} + \beta_{12}\Delta c_{i,t-2} + \beta_{21}\Delta n_{i,t-1} + \beta_{22}\Delta n_{i,t-2} + \beta_{31}\Delta e_{i,t-1} + \beta_{41}\Delta g_{i,t-1} + \beta_{42}\Delta g_{i,t-2} + \eta_i + v_{i,t} \qquad [2]$$

Survivorship depends on assets size (s), capitalization (k), liquidity (q), non-performing loans ratio (n), loans-to-assets ratio (x), non-interest expenses-to-assets ratio (e) and age (a). The survivorship equation examines the cross-sectional relationship between these covariates and the probability of survival. Individual effects for each six-monthly time period allow for variation over time in the average rates of survival and disappearance. Capitalization depends on loans (c), non-performing loans ratio (n), non-interest expenses-to-assets ratio (e) and gross state product (g).[11] The capitalization equation examines the capital-adjustment process for each credit union over time. Credit union individual effects control for cross-sectional heterogeneity in the credit union population. Table 1 lists the variable definitions in full.

In dynamic panels with small T, fixed-effects estimation is biased, owing to the presence among the covariates of the lagged dependent variable. In such cases, a Generalized Method of Moments (GMM) dynamic panel estimator is usually recommended (Arellano and Bond, 1991; Arellano and Bover, 1995; Blundell and Bond, 1998). In panels with large T, the bias in the fixed-effects estimator diminishes as T increases, while the GMM estimator rapidly becomes unwieldy due to a proliferation of lagged values of the dependent variable and covariates that qualify for use as instruments. In the present case, the availability of more than 30 observations on each surviving credit union renders the bias in the fixed-effects estimator sufficiently small to be ignored.[12] Accordingly, we estimate the capital-adjustment equation using fixed effects. The

[11] Goddard, McKillop and Wilson (2002) and Wilcox (2005a,b; 2006) report evidence that larger credit unions are more efficient and more robust than their smaller counterparts. Goddard, McKillop and Wilson (2009) examine the determinants of credit union acquisition. Wheelock and Wilson (2011) suggest that future deregulation, permitting credit unions to expand their range of activities will lead to further growth and efficiency improvements.

use of lagged values of all covariates eliminates any endogeneity problem that might otherwise arise, owing to simultaneity between the contemporaneous values of the capital-to-assets ratio and other financial ratios.

Conditional on $k_{i,t-1}$ having been observed, $\Delta k_{i,t}$ is observed with probability $\Phi(y^*_{i,t})$ and unobserved with probability $1-\Phi(y^*_{i,t})$, where ϕ and Φ are the density function and distribution function of the standard normal distribution. $u_{i,t} \sim N(0,1)$; $v_{i,t} \sim N(0,\sigma^2_v)$; and η_i is an individual effect specific to credit union i. The issue of survivorship bias in the fixed-effects capital-adjustment equation arises because the dependent variable is observed only for credit unions that survived each six-month period. Unobservables that influence the capital-to-assets ratio might also influence the survival probability, rendering the disturbance term of the capital-adjustment equation non-random. In order to incorporate a sample selection correction into a fixed-effects regression, Vella (1998) recommends estimating a series of cross-sectional probit regressions for survival or non-survival in each time period, and constructing the inverse Mills ratio variable for inclusion in the fixed-effects regression from these probit regressions.[13] We estimate a single pooled probit regression for survival with a full set of time dummies, and covariates that are important in driving survival or disappearance in previous studies.[14]

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[12] Flannery and Hankins (2010) report Monte Carlo simulation evidence for the order of magnitude of the bias in the fixed-effects estimator of the coefficient on the lagged dependent variable, as follows: 0.144 for T=6, 0.070 for T=12 and 0.026 for T=30.

[13] In the present case, the ability of cross-sectional probit regressions to explain survival or non-survival is variable, and the estimated coefficients are unstable, owing to the relatively small proportion of disappearances (around 1.5% of the total population) in each six-monthly period (see Table IV).

[14] Previous research has examined the role of bank-specific, regulatory and regional economic conditions as determinants of bank failure (Wheelock and Wilson, 2000; Cole and White, 2012). The limited evidence on credit union failure suggests that young, small and poorly capitalized credit unions are most likely to fail (Wilcox, 2005a; Goddard, McKillop and Wilson, 2009).

Lagged values are used for the covariates of the capital-adjustment equation, to avoid possible endogeneity issues. The growth in loans $\Delta c_{i,t-m}$ controls for the effects of an increase in lending on the capital-to-assets ratio. In addition to a natural tendency for growth in lending to place downward pressure on the capital-to-assets ratio through an increase in the assets denominator, empirical evidence suggests that periods of rapid loan growth tend to be followed by increased defaults, and consequent depletion of capital (Berger and Udell, 2004).

The change in the ratio of non-performing loans to total loans $\Delta n_{i,t-m}$ is a proxy for credit risk. We expect an increase in the non-performing loans ratio to be associated with a subsequent decrease in the capital-to-assets ratio, as capital is depleted by the losses arising from the eventual write-off of non-performing loans. The change in the non-interest expenses to assets ratio $\Delta e_{i,t-1}$ reflects an anticipated tendency for a credit union with high operating costs to encounter difficulties in maintaining adequate capitalization. Excessive operating costs deplete net income, making it difficult to increase capital in line with growth in lending.

The growth in Gross State Product $\Delta g_{i,t-m}$ controls for the effects of variations in state-level macroeconomic conditions. A state-level geographic definition is employed, since most credit unions operate within defined geographic boundaries. The theoretical relationship between capital buffers and the business cycle is unclear. Forward-looking financial institutions might accumulate capital during an upturn, to protect against losses during a future downturn. Alternatively, myopic institutions might deplete capital during an upturn by exploiting transient lending and other investment opportunities to the full. During a downturn, the same institutions might be pressed to raise new capital in a climate of increasing loan defaults and write-offs (Ayuso, Perez and Saurina, 2004; Lindquist, 2004).[15]

For 4,432 of the 4,471 credit unions identified as having been either acquired or subject to a purchase and assumption order, an acquiring credit union is identified by the NCUA.[16] The acquisition of another credit union is likely to affect the capital adjustment of the acquirer. For example, if the acquired credit union is undercapitalized relative to the acquirer, then some reduction in the capitalization of the acquirer is to be expected when the balance sheets of acquirer and acquired are combined. To control for this effect, synthetic first-difference and lagged values of the variables $k_{i,t}$, $c_{i,t}$, $n_{i.t}$ and $e_{i,t}$ for the acquirer credit union are constructed for the periods immediately following the acquisition, using the combined data for the acquirer and the acquired credit unions immediately prior to the acquisition.[17]

5 Data and descriptive statistics

The balance sheet and income statement data used in the empirical analysis reported in this study are compiled from the '5300 Call Reports', published by the NCUA. Biannual data are available for the period June 1994 to December 2010 inclusive, providing a maximum of 34

[15] For a contrary view, see Stolz and Wedow (2011). Cook and Tang (2010) report that non-financial firms find it easier to adjust capitalization toward target levels when favourable macroeconomic conditions prevail.

[16] For the remaining 39 acquisitions, we were unable to identify the acquiring credit union. Most of these acquisitions were small. We consider the effects of this omission on the estimation results to be negligible.

[17] For the biannual observation immediately following an acquisition, $k_{i,t}$ is the capital-to-assets ratio for the acquirer, incorporating the capital and the assets of the acquired credit union. The constructed value of $\Delta k_{i,t}$ for the acquirer is $k_{i,t} - k^*_{i,t-1}$, where $k^*_{i,t-1}$ is the synthetic capital-assets ratio of the acquirer and the acquired before the acquisition, $[(NW^{acquirer}+NW^{acquired})/(ASSET^{acquirer}+ASSET^{acquired})]_{t-1}$. The constructed values of $k_{i,t-1}$, $\Delta k_{i,t-1}$ and $\Delta k_{i,t-2}$ for the acquirer are $k^*_{i,t-1}$, $k^*_{i,t-1} - k^*_{i,t-2}$ and $k^*_{i,t-2} - k^*_{i,t-3}$, respectively. For the next biannual observation, $\Delta k_{i,t}$ and $k_{i,t-1}$ are the actual values for the acquirer incorporating the acquired, and the constructed values of $\Delta k_{i,t-1}$ and $\Delta k_{i,t-2}$ are $k_{i,t-1} - k^*_{i,t-2}$ and $k^*_{i,t-2} - k^*_{i,t-3}$, respectively. For the following observation, $\Delta k_{i,t}$, $k_{i,t-1}$ and $\Delta k_{i,t-1}$ are the actual values, and the constructed value of $\Delta k_{i,t-2}$ is $k_{i,t-2} - k^*_{i,t-3}$. The other covariates are treated in the same manner.

time-series observations on each credit union. NCUA reports data for 12,051 credit unions in December 1994, and 7,334 credit unions in December 2010. State-level macroeconomic data are obtained from the US Bureau of Economic Analysis.

Table 2 reports the total number of US credit unions at the end of December in each year from 1994 to 2010, with averages of the variables employed in the capital-adjustment model. Over the period there was a pronounced decline in credit union numbers, balanced by a large increase (415%) in average asset size. The average capital-to-assets ratio increased by around 3% between 1994 and 2007, from 12.8% to 15.6%. Capitalization appears to be pro-cyclical: the average capital-to-assets ratio declined from 14.8% in 1999 to 13.3% in 2003; and from 15.6% in 2007 to 13.4% in 2010. Liquidity ratios increased significantly following the introduction of PCA. The non-performing loans ratio has declined gradually over time, but has seen an upturn during the current financial crisis. The rate of growth in loans is sensitive to the economic cycle. There were marked reductions in the rate of loan growth in 1998 (Asian crisis), 2001-2003 (post-'dotcom' bubble), and 2007-2010 (financial crisis).

Table 3 reports an analysis of entry and exits. The drop in credit union numbers from 12,057 in 1994 to 7,334 in 2010 forms part of a longer-term decline, from a peak in numbers at 23,866 in 1969. Between 1994 and 2010, 156 credit unions entered, and 4,873 exited. Most exits were as a consequence of acquisition (4,382 credit unions). The annual exit rate was smaller during the 1990s than it was in most years subsequently. This rate was stable throughout the 2000s (between 3% and 4% per year), and apparently insensitive to the economic cycle. There were fewer acquisitions in 2009 and 2010, however, than in any previous year since 1998.

6 Dynamic panel model for survival and capital adjustment

Table 4 reports the estimation results for the probit regression for the probability of survival. Coefficients significantly different from zero are obtained for all covariates. Larger credit unions are more likely to survive than smaller ones, and younger credit unions are more likely to survive than older ones. Other characteristics that increase the probability of survival are: a high capital-to-assets ratio; a low liquidity ratio; a low non-performing loans ratio; a high loans-to-assets ratio; and a low ratio of non-interest expenses to total assets. Table 5 reports the estimation results for the fixed-effects capital-adjustment equation, in which the dependent variable is the change in the capital-to-assets ratio over each six-month period.

6.1 Dynamics of capital adjustment

The first column of Table 5 reports a pooled estimation using the data for all credit unions. The coefficients on $I^j_{i,t}k_{i,t-1}$, $I^j_{i,t}\Delta k_{i,t-1}$ and $I^j_{i,t}\Delta k_{i,t-2}$ describe capital adjustment separately for credit unions in the following categories: well capitalized ($k_{i,t-1}\geq 0.07$) until 2000.1 (j=1); adequately capitalized or below ($k_{i,t-1}<0.07$) until 2000.1 (j=2); well capitalized from 2000.2 (j=3); and adequately capitalized or below from 2000.2 (j=4). By classifying credit unions by their capitalization, we identify the impact on capital adjustment of the introduction of the current regulatory arrangements for PCA. The interpretation of the coefficients reported in Table 5 may be simplified by transforming the estimated coefficients to recover the implied coefficients on $k_{i,t-1}$, $k_{i,t-2}$ and $k_{i,t-3}$ in the equivalent levels regression for $k_{i,t}$. With reference to equation [2], the coefficients on $I^j_{i,t}k_{i,t-m}$ for m=1,...,3 and j=1,...,4, denoted λ^j_m, are as follows: $\lambda^j_1 = \alpha^j_1 + \delta^j_{11} + 1$, $\lambda^j_2 = -\delta^j_{11} + \delta^j_{12}$ and $\lambda^j_3 = -\delta^j_{12}$. Table 6 reports λ^j_m, based on the estimation using the data for all credit unions (first column of Table 5), and the corresponding impulse response functions (IRF). The IRF identify the impact on $k_{i,t}$ at selected values of $t \geq 1$, of the injection into equation [2] of an unanticipated negative unit capitalization shock of $v_{i,t} = -1$ at t=0. Figure 1 illustrates the hypothetical adjustment paths following a capitalization shock of a credit union that is initially classified as well capitalized, before and after the introduction of PCA. Figure 2 refers to a credit union initially classified as adequately capitalized or below.

According to Table 6, the time-series behaviour of the capital-to-assets ratio is stationary, because $\sum_{m=1}^{3} \lambda_m^j < 1$ in all four cases (j=1,...,4). Given that the adjustment path is, accordingly, characterized by mean reversion, the set of estimated coefficients λ_m^j yields two descriptors of the adjustment path in the event of a negative capitalization shock. First, the rate of mean reversion itself, measured by the sum of the coefficients on the lagged capital-to-assets ratio variables in [2] $\sum_{m=1}^{3} \lambda_m^j$, reflects a credit union's total exposure to capitalization below its individual long-run mean, referred to below as *undercapitalization exposure*. The closer is $\sum_{m=1}^{3} \lambda_m^j$ to one, the greater is this exposure. In Figures 1 and 2, the rate of mean reversion is reflected in the total area between the IRF and the horizontal axis, which is also a measure of the total exposure (the summation over time of the amounts by which the credit union was undercapitalized in each period). Second, for any given rate of mean reversion, the relative magnitudes of the individual λ_m^j in $\sum_{m=1}^{3} \lambda_m^j$ convey information about the distribution over time of the undercapitalization exposure, and the *adjustment speed*. If, for example, λ_1^j is large and λ_2^j, λ_3^j are small or negative, most of the exposure occurs soon after the shock, and the reversion to the long-run mean capitalization is fast. By contrast, if λ_1^j is small and λ_2^j, λ_3^j are large, the exposure continues for longer after the shock has taken place, and the reversion to the long-run mean capitalization is slower. In Figures 1 and 2, the adjustment speed is reflected in the steepness of the recovery path, or the time that is required for the IRF to recover to any particular (small) distance from the horizontal axis.

For well capitalized credit unions ($k_{i,t-1} \geq 0.07$), the estimated rate of mean reversion is relatively slow, both before and after the introduction of PCA, with $\sum\lambda_m^1 = 0.8655$ and $\sum\lambda_m^3 = 0.8593$. For credit unions that were adequately capitalized or below, ($k_{i,t-1} < 0.07$), the rate of mean reversion is faster, with $\sum\lambda_m^2 = 0.7133$ and $\sum\lambda_m^4 = 0.7826$. If a credit union that is initially poorly capitalized experiences a negative capitalization shock, therefore, the total undercapitalization exposure is less than in the case of a similar shock to a credit union that is initially well capitalized. For credit unions that were initially well capitalized, the introduction of PCA made little or no difference to this descriptor of the capital-adjustment process. For credit unions that were initially adequately capitalized and below, there was some increase in the magnitude of the undercapitalization exposure following the introduction of PCA. These estimates are broadly comparable to those reported for US banks by Shrieves and Dahl (1992) and Aggarwal and Jacques (2001);[18] although the latter report substantially smaller 'rate of mean reversion' estimates, and therefore a smaller undercapitalization exposure, for banks that were initially undercapitalized. These patterns might reflect the narrower range of options for raising new capital quickly that is open to credit unions, in comparison with banks.

While the rate of mean reversion in the capital-to-assets ratio appears to have been little affected by the introduction of PCA, Table 6 indicates some significant differences in the short-

[18] The estimations reported by Shrieves and Dahl (1992, p452, Table III) imply a corresponding undercapitalization exposure measure of 0.942 for US banks with capitalization above the mid-1980s regulatory threshold (7% equity capital-to-assets ratio), and 0.729 for banks below this threshold. The corresponding estimates for the Tier 1 leverage ratio reported by Aggarwal and Jacques (2001, p1151, Table III) are: 0.857, 0.888, 0.895 for well capitalized banks in 1991, 1992 and 1993, respectively; 0.834, 0.771, 0.773 for adequately capitalized banks; and 0.637, 0.220, 0.565 for undercapitalized banks (same three years).

run dynamics of capital adjustment and the speed of mean reversion. For well capitalized credit unions, $\lambda_1^1 = 0.5698$ before the introduction of PCA, and $\lambda_1^3 = 0.8286$ after the introduction of PCA. Similarly, for credit unions classified as adequately capitalized or below, $\lambda_1^2 = 0.5437$ before and $\lambda_1^4 = 0.8258$ after the introduction of PCA. For both groups, there are approximately compensating reductions in the magnitudes of λ_2^j and λ_3^j from j=1 to j=3, and from j=2 to j=4.

The IRF depicted in Figures 1 and 2 illustrate these features of the capital-adjustment process. Comparing the adjustment paths for well capitalized credit unions (Figure 1) before and after the introduction of PCA, the total undercapitalization exposure, measured by the area between the horizontal axis and the IRF, is similar. The distribution of this exposure over time post-PCA, however, is weighted more heavily towards the lower values of t, and less heavily towards the higher values of t, than the corresponding pre-PCA exposure.

Comparing the adjustment paths for credit unions that were adequately capitalized or below (Figure 2), the total undercapitalization exposure is likewise smaller than for well capitalized credit unions. Again, the distribution of this exposure over time in the post-PCA estimation is weighted more heavily towards the lower values of t, and less heavily towards the higher values of t, than the corresponding exposure for the pre-PCA estimation. These patterns suggest a tendency for the adoption of more active capital-management policies by credit unions following the introduction of PCA, which resulted in the exposure of individual credit unions to capitalization below their individual long-run mean values being addressed more rapidly.

6.2 Other influences on capital adjustment

In the estimation reported in the first column of Table 5 using the data for all credit unions, the coefficient on $\phi(\hat{y}_{i,t}^{*})/\Phi(\hat{y}_{i,t}^{*})$, a positive and significant coefficient on the inverse

Mills ratio, generated from the probit regression (Table 4), indicates that common unobservables impact on both the capital-to-assets ratio and the survival probability. Accordingly, the inclusion of the inverse Mills ratio in the capital-adjustment equation mitigates the survivorship bias that would otherwise arise.

In the estimation using the data for all credit unions, negative coefficients on $\Delta c_{i,t-m}$ reflect a tendency for an increase in lending to place downward pressure on the capital-to-assets ratio, through an increase in the assets denominator. Negative coefficients on $\Delta n_{i,t-m}$ imply that an increase in the non-performing loans ratio is associated with a subsequent decrease in the capital-to-assets ratio, as capital is destroyed by the losses arising from the eventual write-offs. A negative coefficient on $\Delta e_{i,t-1}$ supports the hypothesis that a credit union that has difficulty in containing its operating costs may encounter difficulties in maintaining adequate capitalization.

The coefficient on $\Delta g_{i,t-1}$ is large and positive, and the coefficient on $\Delta g_{i,t-2}$ is small and negative. Unlike banks, credit unions do not have the option of raising new capital in the form of equity. Credit unions might therefore adopt a more cautious approach than banks to the management of their capital over the course of the economic cycle. This might explain the observed empirical tendency for capital-to-assets ratios to vary pro-cyclically. Our results concur with recent evidence that credit unions face relatively low exposure to business-cycle fluctuations, and are relatively robust to macroeconomic shocks (Smith and Woodbury, 2010). Finally, significant negative coefficients on intercept-shift dummy variables for the financial crisis (2008.1 to 2010.2), for both credit unions with $k_{i.t-1} \geq 0.07$ and those with $k_{i,t-1} < 0.07$ (not reported in Table 5) reflect a deterioration in the capitalization of the credit union industry as a whole that is also apparent in the descriptive statistics reported in Table 2.

6.3 Capital adjustment for credit unions by 1994 assets size band, and post-1994 entrants

The remaining columns of Table 5 report estimations for credit unions in each of five assets size bands defined using 1994 data, and for a (smaller) sixth group comprising subsequent entrants. Survival rates are highly dependent on assets size: only 30.1% of the credit unions in the smallest 1994 assets size band survived until 2010, while 85.8% of the credit unions in the largest 1994 assets size band survived.

For credit unions classified as well capitalized ($k_{i,t-1} \geq 0.07$), the coefficients on $I^{j}_{i,t} k_{i,t-1}$ and $I^{j}_{i,t} \Delta k_{i,t-m}$ suggest that the rate of mean reversion in capital adjustment is faster for credit unions in the smallest and largest assets size bands, and slower for credit unions of intermediate size. For credit unions that are adequately capitalized or below ($k_{i,t-1}<0.07$), there is more variation in these coefficients, presumably due to sampling error with relatively few observations in some cells. The rate of mean reversion for this group, both before and after the introduction of PCA, is fastest in the smallest assets size band.

In the estimations for credit unions in each of the five 1994 assets size bands, the coefficients on the inverse Mills ratio are positive and significant for all but the smallest size band. In general, the importance of the sample-selection effect increases with assets size. The coefficients on $\Delta c_{i,t-m}$ are negative and predominantly significant. The coefficients on $\Delta n_{i,t-m}$ are predominantly negative, and significant in the estimations for the larger assets size bands. All coefficients on $\Delta e_{i,t-1}$ are negative and significant. The coefficients on $\Delta g_{i,t-1}$ are positive and significant, indicating that the capitalization of credit unions in all assets size bands is pro-cyclical. The coefficients on $\Delta g_{i,t-2}$ are negative and significant for the larger size bands, and insignificant for the smaller size bands. Large variations in the magnitudes of several of the estimated coefficients for the post-1994 entrants should be interpreted with caution in view of the small number of observations for this estimation.

7. Credit union capitalization during the financial crisis

This section reports a cross-sectional analysis of the change in credit union capitalization during the late-2000s financial crisis. We report estimations of a Heckman sample-selection model for credit union survival or non-survival, and the change in the capital-to-assets ratio, over the three-year period from December 2007 to December 2010. The sample comprises all credit unions that filed call report data in December 2007, having also filed data in the eleven previous biannual censuses, from June 2002 to June 2007 inclusive. The sample is trimmed by removing observations in the top and bottom percentiles for three variables: the change in the capital-to-assets ratio, the rate of growth of assets, and the z-score (defined below). In total, 8,096 credit unions filed call report data in December 2007. The trimmed sample comprises 7,604 credit unions, 6,912 of which were live in 2010, with 692 having exited. For the surviving credit unions, the mean capital-to-assets ratio fell by 2.1%, from 15.3% in 2007 to 13.2% in 2010. As we have noted in Section 1, the bailout of several corporate credit unions that entered conservatorship in 2009 and 2010 was a significant contributory factor towards this trend.

The covariates in the survivorship equation in the Heckman model, all observed at December 2007, are: log asset size; loans-to-assets ratio; share of credit card lending in total loans; share of vehicle loans in total loans; and share of real estate loans in total loans. In addition, four widely-used indicators of financial health are included in alternative reported specifications of the survivorship equation: capital-to-assets ratio; z-score; liquid assets-to-assets ratio; and non-performing loans-to-loans ratio. z-score is the ratio of the sum of the capital-to-assets ratio and return on assets (ROA) to the standard deviation of ROA, where ROA is for 2007 (calculated using data from the June 2007 and December 2007 call reports), and the standard deviation of ROA is calculated from the six yearly ROA observations from 2002 to 2007, inclusive. The financial-health indicators are used to achieve identification. The covariates in the change in capitalization equation are: log asset size; loans-to-assets ratio; and the shares in total loans of credit card lending, vehicle loans, and real estate loans, respectively (as above).

Table 7 reports the estimation results. The estimated correlation between the stochastic components of the two equations, denoted ρ, is positive and significant in columns (1) and (5), and near-significant in column (2), indicating that the use of the sample-selection correction is justified in these cases. The specification of the change in capitalization equation is the same in all five models, and any differences between the estimated coefficients are negligible. The coefficients on log assets size indicate that a larger asset size was associated with a smaller reduction in capitalization, on average. The coefficients on the loans-to-assets ratio are negative but insignificant. An increase in the proportion of the loans portfolio allocated to either credit card lending, or vehicle loans, or real estate loans, would have produced a larger reduction in capitalization, other things being equal.

Columns (1) to (4) include in the survivorship equation each of the four financial-health indicators in turn, and column (5) includes all four financial-health indicators. The probability of survival was positively associated with asset size, and negatively associated with the loans-to-assets ratio. An increase in the proportion of the loans portfolio allocated to either vehicle loans, or real estate loans, would have reduced the probability of survival.

The coefficients on the capital-to-assets ratio, z-score and liquid assets-to-assets financial-health indicators in columns (1) to (3) are signed as anticipated, and significant. In column (4) the coefficient on the non-performing loans-to-total loans ratio is insignificant. The latter might be an ambiguous predictor of the probability of survival: a high value for this ratio might correlate with poor past lending practice, or it might reflect a more timely recognition of non-performing loans, and timely action to clean up the balance sheet, than on the part of other institutions with similar issues that were unrecognised at the onset of the crisis. In column (5), the z-score is the only financial-health indicator with a significant coefficient. We infer that in December 2007, the z-score would have been a more reliable predictor of survival or non-survival than any of the other financial-health indicators that are considered here.

8. Conclusion

Capital structure is a core topic in financial economics research. For financial institutions, adequate capitalization is critical for financial stability. Capital regulation naturally features prominently in the debate concerning the reconfiguration of regulatory arrangements for financial institutions generally, in the wake of the financial crisis of the late-2000s. Against this background, we examine the capital-adjustment process for US credit unions before and after the implementation of a landmark regulatory change in 2000, in the form of capital requirements and arrangements for PCA (prompt corrective action) regulatory intervention in the event that any credit union's capitalization falls below defined thresholds.

According to the probit survivorship regression in the sample-selection model, larger credit unions are more likely to survive than smaller ones, and younger credit unions are more likely to survive than older ones. Other characteristics that increase the probability of survival include a high capital-to-assets ratio, a low liquid assets-to-assets ratio, a low non-performing loans ratio, a high loans-to-total assets ratio, and a low ratio of non-interest expenses to total assets. According to the capital-adjustment equation, the capital-to-assets ratio is stationary over time, and credit union capitalization is mean-reverting. When a credit union that is initially poorly capitalized experiences a (hypothetical) negative shock to its capitalization, the total exposure to capitalization below the credit union's individual long-run average is less than in the case of a similar shock to the capitalization of a credit union that is initially well capitalized. Examination of the short-run dynamics of capital adjustment suggests that more active capital management policies were adopted by all credit unions following the introduction of PCA in 2000. The exposure to undercapitalization following an adverse shock was addressed more rapidly under the post-2000 regulatory arrangements.

As anticipated, the empirical results indicate that increases in credit union lending tend to reduce capitalization. Credit union capitalization is found to vary pro-cyclically. This suggests that credit unions manage their capital cautiously over the business cycle, in the absence of an option to raise new capital in the form of equity. By accumulating capital when it is easiest to do so during an economic upturn, there is more scope for capital to be depleted through write-offs during a subsequent downturn. This (along with constraints on asset and funding diversification) may explain why credit unions have weathered the financial crisis of the late-2000s better than many commercial banks. On average, large credit unions experienced a smaller reduction in capitalization than smaller institutions during the crisis. Observed in December 2007, the z-score would have been a more reliable indicator of the likelihood of survival during the crisis than several other financial-health indicators.

In general, it is apparent that many credit unions, and small credit unions in particular, hold capital in excess of the level required to absorb losses. Excessive capitalization may inhibit the growth of individual credit unions, particularly since capital is generated from retained earnings. Clearly, a balance must be struck between reforming regulation so as to free up the capital of credit unions that are financially secure, and addressing the challenges raised by the financial crisis for the wider US financial services industry.

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Table 1 Definition of variables

The table provides definitions of the variables used in the empirical analysis.

$s_{i,t}$ = natural logarithm of Total Assets [ASSET] for i = 1,...,N, t = 1995.2 to 2010.2;

$k_{i,t}$ = Capital-to-Assets ratio = Net Worth [NW]/Total Assets;

$q_{i,t}$ = Liquid Assets [LIQ]/ Total Assets;

$n_{i,t}$ = Non-performing Loans [NP] / Total Assets;

$x_{i,t}$ = Loans [LOAN]/ Total Assets;

$e_{i,t}$ = Non-interest Expense [NIE] / Total Assets;

$a_{i,t}$ = natural logarithm of Age;

$c_{i,t}$ = natural logarithm of Loans;

$g_{i,t}$ = natural logarithm of Gross State Product;

$cc_{i,t}$ = share of Credit Card Lending in Total Loans;

$ve_{i,t}$ = share of Vehicle Loans in Total Loans;

$re_{i,t}$ = share of Real Estate Loans in Total Loans;

$z_{i,t}$ = ratio of the sum of the Capital-to-Assets ratio and ROA (annual value, 2007) to the standard deviation of ROA (six annual values, 2002-2007);

$D_{s,i,t}$ (for s=1995.2,...,2010.2) are 0-1 dummy variables for each biannual observation;

$I^1_{i,t} = 1$ if credit union i has $k_{i,t-1} \geq 0.07$, for t=1995.2 to 2000.1 inclusive, 0 otherwise;

$I^2_{i,t} = 1$ if credit union i has $k_{i,t-1} < 0.07$, for t=1995.2 to 2000.1 inclusive, 0 otherwise;

$I^3_{i,t} = 1$ if credit union i has $k_{i,t-1} \geq 0.07$, for t=2000.2 to 2010.2 inclusive, 0 otherwise;

$I^4_{i,t} = 1$ if credit union i has $k_{i,t-1} < 0.07$, for t=2000.2 to 2010.2 inclusive, 0 otherwise;

Table 2 Descriptive statistics

The table reports the number of credit unions and the mean values of key variables by year.

	Number of credit unions	ASSET	NW/ASSET	LIQ/ASSET	NP/LOAN	LOAN/ASSET	NIE/ASSET	ΔLOAN	ΔGSP
Dec 94	12051	24.2	.127	.0384	.00432	.615	.0200	.0000	.0675
Dec 95	11746	26.3	.134	.0403	.00436	.643	.0208	.0679	.0473
Dec 96	11442	28.7	.140	.0377	.00430	.651	.0216	.0489	.0600
Dec 97	11245	31.3	.145	.0380	.00426	.651	.0223	.0358	.0616
Dec 98	10991	35.4	.145	.0397	.00429	.617	.0218	.0087	.0590
Dec 99	10627	38.8	.148	.0994	.00397	.625	.0179	.0454	.0532
Dec 00	10314	42.5	.145	.1095	.00387	.662	.0201	.0778	.0494
Dec 01	9982	50.3	.138	.1573	.00411	.600	.0192	.0034	.0246
Dec 02	9686	57.9	.135	.1560	.00419	.570	.0188	.0117	.0377
Dec 03	9367	65.6	.133	.1631	.00408	.553	.0187	.0172	.0543
Dec 04	9014	72.3	.136	.1410	.00385	.564	.0190	.0363	.0598
Dec 05	8691	78.6	.143	.1209	.00389	.595	.0198	.0487	.0573
Dec 06	8359	85.5	.151	.1200	.00310	.618	.0208	.0291	.0525
Dec 07	8096	93.6	.155	.1287	.00314	.613	.0213	.0094	.0482
Dec 08	7799	104.3	.151	.1251	.00364	.586	.0208	-.0041	.0133
Dec 09	7547	117.2	.138	.1410	.00388	.552	.0199	.0079	-.0082
Dec 10	7334	124.6	.134	.1471	.00402	.530	.0216	-.0200	.0423

Table 3 Entrants and exits, 1995-2010

The table reports the number of credit unions entering and exiting by year. Exits are classified as follows: acquisition; purchase and assumption; liquidation; conversion to bank; conversion to privately insured credit union; and unclassified. The table also reports the exit rate and the number of live credit unions at the end of each year.

	Entrants	Acquisition	Purchase & Assumption	Liquidation	Conversion to bank	Conversion to privately insured	Unclassified disappearance	Total exits	Exit rate	Number live at end of year
1994	-	-	-	-	-	-	-	-	-	12051
1995	13	290	5	22	1	0	0	318	.0264	11746
1996	20	293	11	17	1	1	1	324	.0276	11442
1997	19	192	4	17	0	3	0	216	.0189	11245
1998	8	215	5	28	3	11	0	262	.0233	10991
1999	13	335	11	24	3	4	0	377	.0343	10627
2000	13	292	13	18	3	0	0	326	.0307	10314
2001	10	296	8	25	6	2	5	342	.0332	9982
2002	7	265	7	23	1	4	3	303	.0304	9686
2003	15	315	5	10	2	2	0	334	.0345	9367
2004	3	332	6	11	3	0	4	356	.0380	9014
2005	8	302	1	25	2	0	1	331	.0367	8691
2006	10	313	2	23	1	0	3	342	.0394	8359
2007	4	248	2	10	3	0	4	267	.0319	8096
2008	4	275	1	19	1	1	4	301	.0372	7799
2009	4	229	1	23	1	2	0	256	.0328	7547
2010	5	190	7	19	0	0	2	218	.0289	7334

Table 4 Probit regression for survival or non-survival

The table reports estimates of coefficients in equation [1]. The dependent variable is a dummy variable, coded 0 for non-survival and 1 for survival between time t–1 and time t. z-statistics for significance of estimated coefficients are reported in parentheses. 0-1 dummy variables for each 6-month observation period are included in the probit regression; these coefficients are not reported.

The probit regression is estimated over 30 six-month periods (Jan/Jun 1995 to Jul/Dec 2010, inclusive). Non-survival comprises the categories Acquisition, Purchase & Assumption, Liquidation and Unclassified Disappearance, as reported in Table 3. The categories Conversion to Bank and Conversion to Privately Insured are treated as right-censored in the probit regression.

Variable definitions as follows: $s_{i,t}$ = natural logarithm of assets; $k_{i,t}$ = capital-to-assets ratio; $q_{i,t}$ = liquid assets-to-assets ratio; $n_{i,t}$ = non-performing loans-to-loans ratio; $x_{i,t}$ = loans-to-assets ratio; $e_{i,t}$ = non-interest expenses-to-assets ratio; $a_{i,t}$ = natural logarithm of age.

Covariates	Coefficients	Covariates	Coefficients
$s_{i,t-1}$	$.1696^{***}$	$x_{i,\,t-1}$	$.1093^{***}$
	(42.7)		(3.29)
$k_{i,t-1}$	1.1296^{***}	$e_{i,\,t-1}$	-6.3859^{***}
	(15.0)		(-28.2)
$q_{i,\,t-1}$	$-.5008^{***}$	$a_{i,\,t-1}$	$-.1029^{***}$
	(-11.1)		(-7.42)
$n_{i,\,t-1}$	$-.8936^{***}$	No. observations	311,576
	(-5.98)	No. disappearances	4,812

Note
*** denotes statistically different from zero, 1% level, two-tail test; ** 5% level; * 10% level.

Table 5 Fixed effects regressions for capital adjustment

The table reports estimates of coefficients in equation [2]. The dependent variable is $\Delta k_{i,t}$. z-statistics for significance of estimated coefficients are reported in parentheses. The specification allows for different intercepts (not reported) for credit unions that were well capitalized ($k_{i,t-1} \geq 0.07$), and for those that were adequately capitalized or below ($k_{i,t-1} < 0.07$), for each of three subperiods: 1995.2-2000.1, 2000.2-2007.2, and 2008.1-2010.2.

Variable definitions as follows: $k_{i,t}$ = capital-to-assets ratio; $c_{i,t}$ = natural logarithm of loans; $n_{i,t}$ = non-performing loans-to-total loans ratio; $q_{i,t}$ = liquid assets-to-total assets ratio; $e_{i,t}$ = non-interest expenses to assets ratio; $g_{i,t}$ = natural logarithm of Gross State Product; $I^1_{i,t} = 1$ if $k_{i,t-1} \geq 0.07$ for t=1995.2 to 2000.1; $I^2_{i,t} = 1$ if $k_{i,t-1} < 0.07$ for t=1995.2 to 2000.1; $I^3_{i,t} = 1$ if $k_{i,t-1} \geq 0.07$ for t=2000.2 to 2010.2; $I^4_{i,t} = 1$ if $k_{i,t-1} < 0.07$ for t=2000.2 to 2010.2; $y^*_{i,t}$ is the latent variable from the probit regression for disappearance/survival (see equation [1] and Table 4).

	All	Percentiles of June 1994 asset size distribution					Post-94
Covariates:		>p80	p60-p80	p40-p60	p20-p40	<p20	entrants
$I^1_{i,t} k_{i,t-1}$	-.1345***	-.1393***	-.1186***	-.1165***	-.1255***	-.1515***	-.4378***
	(-79.63)	(-50.39)	(-42.84)	(-37.40)	(-33.11)	(-27.06)	(-6.01)
$I^1_{i,t} \Delta k_{i,t-1}$	-.2957***	-.2294***	-.2658***	-.2868***	-.3058***	-.3056***	-.3016***
	(-86.04)	(-40.40)	(-41.42)	(-43.07)	(-38.24)	(-29.72)	(-4.33)
$I^1_{i,t} \Delta k_{i,t-2}$	.0567***	.0343***	.0370***	.0587***	.0874***	.0634***	.0924***
	(17.43)	(6.42)	(6.31)	(9.00)	(11.71)	(6.48)	(1.70)
$I^2_{i,t} k_{i,t-1}$	-.2867***	-.1758***	-.1933***	-.0999***	-.4367***	-.4948***	.1429
	(-17.84)	(-4.35)	(-6.36)	(-3.59)	(-13.33)	(-7.57)	(1.25)
$I^2_{i,t} \Delta k_{i,t-1}$	-.1696***	-.1147***	-.1364***	-.1992***	.0178	-.2361***	-.0862
	(-14.57)	(-4.21)	(-6.94)	(-8.67)	(0.64)	(-6.14)	(-1.14)
$I^2_{i,t} \Delta k_{i,t-2}$	-.0021	.0172	-.0043	-.0119	.1544***	.0127	-.0490*
	(-0.24)	(0.86)	(-0.27)	(-0.58)	(5.72)	(0.38)	(-1.71)
$I^3_{i,t} k_{i,t-1}$	-.1407***	-.1827***	-.1293***	-.1188***	-.1243***	-.1545***	-.5178***
	(-101.43)	(-72.20)	(-55.29)	(-46.45)	(-40.52)	(-33.81)	(-15.23)
$I^3_{i,t} \Delta k_{i,t-1}$	-.0307***	.0367***	-.0075	-.0295***	.0183**	-.0431***	-.1918***
	(-9.68)	(6.95)	(-1.30)	(-4.52)	(2.56)	(-4.40)	(-5.68)
$I^3_{i,t} \Delta k_{i,t-2}$	.1815***	.0337***	.2039***	.2347***	.2805***	.1688***	.0382
	(57.43)	(6.77)	(36.04)	(36.95)	(38.14)	(17.04)	(1.30)
$I^4_{i,t} k_{i,t-1}$	-.2174***	.0302	-.0367	-.2161***	-.0905	-.5204***	-.2685***
	(-11.02)	(0.99)	(-0.88)	(-6.13)	(-1.50)	(-5.72)	(-3.23)
$I^4_{i,t} \Delta k_{i,t-1}$	.0432***	.1224***	.2366***	.1667***	-.0545*	.0263	.0273
	(3.71)	(4.71)	(7.96)	(8.00)	(-1.74)	(0.76)	(0.38)
$I^4_{i,t} \Delta k_{i,t-2}$	.0345***	.0579**	.0476*	.0432**	.1684***	-.0498	.0665
	(2.72)	(2.48)	(1.81)	(2.13)	(5.13)	(-1.03)	(1.11)
$\phi(\hat{y}^*_{i,t}) / \Phi(\hat{y}^*_{i,t})$	.0394***	.3909***	.1645***	.0920***	.0760***	.0039	-.0301
	(18.13)	(29.49)	(23.74)	(13.67)	(11.26)	(0.76)	(-1.19)
$\Delta c_{i,t-1}$	-.0051***	-.0056***	-.0016***	-.0016**	-.0023***	-.0087***	.0017
	(-16.99)	(-8.87)	(-2.82)	(-2.29)	(-2.81)	(-10.54)	(0.79)
$\Delta c_{i,t-2}$	-.0010***	-.0031***	-.0030***	-.0034***	-.0019**	-.0011	-.0004
	(-3.62)	(-5.01)	(-4.85)	(-5.03)	(-2.41)	(-1.36)	(-0.35)
$\Delta n_{i,t-1}$	-.0140***	-.1107***	-.0227**	-.0094	-.0136	-.0051	-.1120***
	(-6.17)	(-5.18)	(-2.11)	(-1.01)	(-1.59)	(-1.10)	(-2.60)
$\Delta n_{i,t-2}$	-.0141***	-.1099***	-.0392***	-.0279***	.0039	-.0088*	-.1397***
	(-5.88)	(-4.95)	(-3.60)	(-2.73)	(0.43)	(-1.80)	(-3.07)
$\Delta e_{i,t-1}$	-.1605***	-.3096***	-.1737***	-.2000***	-.2218***	-.1239***	-.0733
	(-33.79)	(-20.73)	(-20.97)	(-18.85)	(-18.54)	(-9.69)	(-1.63)
$\Delta g_{i,t-1}$	.0478***	.0369***	.0415***	.0527***	.0514***	.0407***	.0357
	(18.65)	(12.85)	(12.70)	(12.20)	(7.91)	(2.79)	(0.61)
$\Delta g_{i,t-2}$	-.0069***	-.0255***	-.0134***	-.0073*	.0018	.0002	-.0917
	(-2.76)	(-9.08)	(-4.20)	(-1.71)	(0.28)	(0.01)	(-1.59)

No. observations	294,204	70,767	67,293	60,585	52,371	41,349	1,839
No. credit unions	11,865	2,421	2,422	2,388	2,320	2,170	144
F-statistic	1563.4***	565.7***	483.6***	431.6***	335.5***	181.0***	32.8***

Note
*** denotes statistically different from zero, 1% level, two-tail test; ** 5% level; * 10% level.

Table 6 Implied coefficients in the levels autoregression for the capital-to-assets ratio, and impulse response functions

The table reports estimates of coefficients on the lagged capital-to-assets ratio variables in the levels regression for the capital-to-assets ratio, calculated by means of transformation of corresponding coefficients reported in the first column of Table 5. With reference to equation [2], the coefficient transformations are: $\lambda_1^j = \alpha_1^j + \delta_{11}^j + 1$; $\lambda_2^j = -\delta_{11}^j + \delta_{12}^j$ and $\lambda_3^j = -\delta_{12}^j$, where λ_s^j denotes the coefficient on $I_{i,t}^j k_{i,t-s}$ in the levels regression.

The impulse response functions show the values of $(k_{i,t} - \bar{k}_i)$ for selected t generated by the levels autoregression following the introduction of a negative unit shock of $v_{i,0} = -1$. $k_{i,t}$ denotes credit union i's capital-to-assets ratio, and $\bar{k}_i$ denotes the long-run mean (equilibrium) value of $k_{i,t}$. $v_{i,t} = 0$, $k_{i,t} = \bar{k}_i$ for t<0; $v_{i,0} = -1$, $k_{i,0} = \bar{k}_i + v_{i,0}$; $v_{i,t}=0$, $k_{i,t} = \bar{k}_i + \lambda_1^j k_{i,t-1} + \lambda_2^j k_{i,t-2} + \lambda_3^j k_{i,t-3} + v_{i,t}$ for t>0.

Capitalization:	7% or more	Under 7%	7% or more	Under 7%
Period:	until 2000.1 (j=1)	until 2000.1 (j=2)	from 2000.2 (j=3)	from 2000.2 (j=4)
Implied coefficients in the levels autoregression for $k_{i,t}$				
$I_{i,t}^j k_{i,t-1}$	.5698	.5437	.8286	.8258
$I_{i,t}^j k_{i,t-2}$	.3524	.1675	.2122	-.0087
$I_{i,t}^j k_{i,t-3}$	-.0567	.0021	-.1815	-.0345
Sum = $\sum_{m=1}^{3} \lambda_m^j$	.8655	.7133	.8593	.7826
Impulse response functions				
t = 0	-1.00	-1.00	-1.00	-1.00
1	-0.57	-0.54	-0.83	-0.83
2	-0.68	-0.46	-0.90	-0.67
3	-0.53	-0.34	-0.74	-0.51
4	-0.51	-0.27	-0.65	-0.39
5	-0.44	-0.20	-0.53	-0.29
7	-0.35	-0.12	-0.37	-0.17
10	-0.25	-0.05	-0.20	-0.07
15	-0.14	-0.01	-0.07	-0.02
20	-0.08	0.00	-0.03	0.00
Sum = $\sum_{t \geq 1} (k_{i,t} - \bar{k}_i)$	-7.43	-3.49	-7.11	-4.60

Table 7. Estimations of Heckman sample selection model for change in capitalization, December 2007 to December 2010

The table reports a cross-sectional Heckman sample-selection model for survival or non-survival, and the change in the capital-to-assets ratio, over the period 2007.2 to 2010.2. The sample comprises 7,604 credit unions that were live in 2007.2, 6,912 of which survived until 2010.2. z-statistics for significance of estimated coefficients are reported in parentheses. ρ = correlation between the stochastic components of the survivorship and capital-adjustment equations. Intercepts are not reported.

Variable definitions as follows: $k_{i,t}$ = capital-to-assets ratio; $s_{i,t}$ = natural logarithm of assets; $x_{i,t}$ = loans-to-assets ratio; $cc_{i,t}$ = share of credit card lending in total loans; $ve_{i,t}$ = share of vehicle loans in total loans; $re_{i,t}$ = share of real estate loans in total loans; $z_{i,t}$ = ratio of the sum of the capital-to-assets ratio and ROA (annual value, 2007) to the standard deviation of ROA (six annual values, 2002-2007); $q_{i,t}$ = liquid assets-to-assets ratio; $n_{i,t}$ = non-performing loans-to-loans ratio.

	(1)	(2)	(3)	(4)	(5)
Change in capitalization equation: Dependent variable = $(k_{i,2010.2}–k_{i,2007.2})$					
$s_{i,2007.2}$	.0010***	.0010***	.0009***	.0009***	.0010***
	(5.00)	(4.87)	(4.64)	(4.58)	(5.00)
$x_{i,2007.2}$	-.0025	-.0024	-.0023	-.0023	-.0025
	(-1.57)	(-1.52)	(-1.46)	(-1.45)	(-1.56)
$cc_{i,2007.2}$	-.0153***	-.0153***	-.0152***	-.0152***	-.0153***
	(-5.68)	(-5.67)	(-5.65)	(-5.64)	(-5.69)
$ve_{i,2007.2}$	-.0169***	-.0168***	-.0167***	-.0167***	-.0169***
	(-6.30)	(-6.28)	(-6.24)	(-6.23)	(-6.30)
$re_{i,2007.2}$	-.0132***	-.0131***	-.0130***	-.0130***	-.0132***
	(-4.69)	(-4.66)	(-4.62)	(-4.61)	(-4.68)
Survivorship equation: Dependent variable = 1 if live in 2007.2 and 2010.2, 0 otherwise					
$s_{i,2007.2}$	.2549***	.2365***	.2268***	.2356***	.2352***
	(14.7)	(14.1)	(13.2)	(14.1)	(12.9)
$x_{i,2007.2}$	-.3026**	-.2074*	-.4648***	-.3921***	-.2502*
	(-2.44)	(-1.67)	(-3.64)	(-3.21)	(-1.90)
$cc_{i,2007.2}$	-.2608	-.1862	-.2338	-.2284	-.2006
	(-1.32)	(-0.94)	(-1.19)	(-1.16)	(-1.01)
$ve_{i,2007,2}$	-.5358***	-.6509***	-.5270***	-.5143***	-.6591***
	(-2.70)	(-3.25)	(-2.66)	(-2.59)	(-3.29)
$re_{i,2007.2}$	-.6515***	-.7803***	-.6634***	-.6484***	-.7828***
	(-2.99)	(-3.55)	(-3.04)	(-2.98)	(-3.55)
$k_{i,2007.2}$	1.3476***	-	-	-	.4526
	(3.82)				(1.22)
$z_{i,2007.2}$	-	.0024***	-	-	.0023***
		(7.52)			(6.57)
$q_{i,2007.2}$	-	-	-.4117**	-	-.3268*
			(-2.14)		(-1.68)
$n_{i,2007.2}$	-	-	-	-.2870	.0410
				(-0.28)	(0.04)
ath(ρ)	.1298**	.0986*	.0598	.0502	.1269**
	(2.21)	(1.88)	(1.11)	(0.93)	(2.26)

Note
*** denotes statistically different from zero, 1% level, two-tail test; ** 5% level; * 10% level.

Figure 1

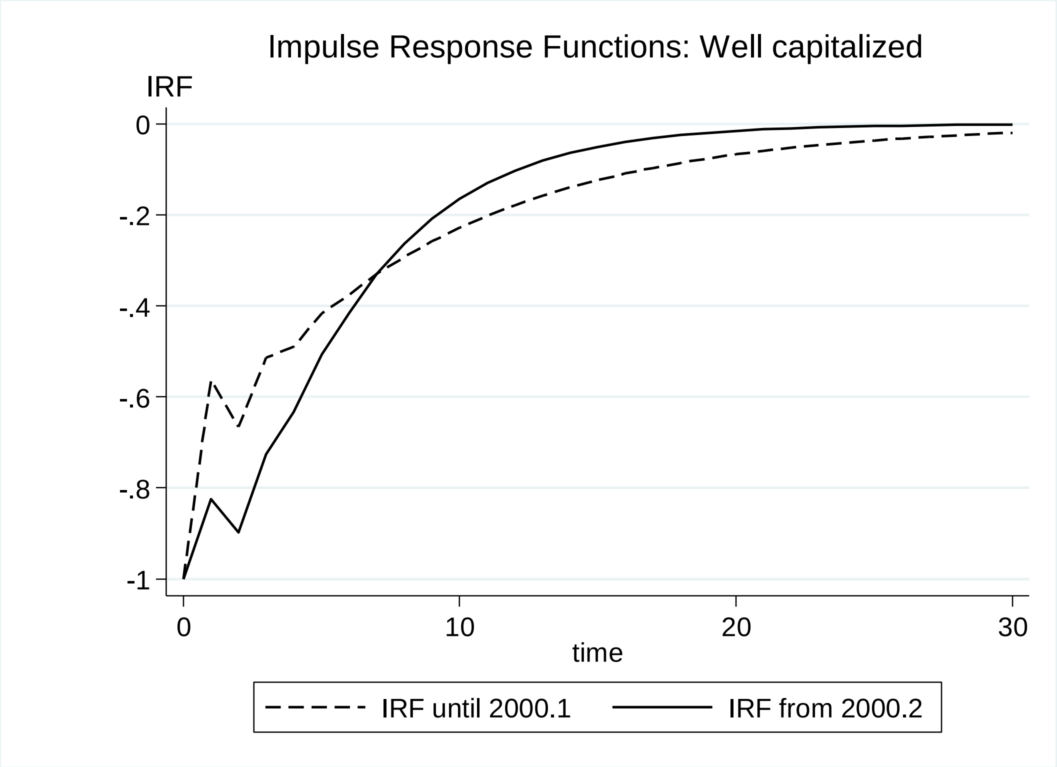

Figure 2