Basel III capital buffers and Canadian credit unions lending: Impact of the credit cycle and the business cycle*

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Abstract

We take advantage of the long-standing regulation of the risk-based capital and the leverage ratio in Canada to provide empirical evidence on the relation between the credit unions' capital buffers and loans to members. Based on a unique sample of the 100 Canadian largest credit unions from 1996 to 2014, we find that both the risk-based capital buffer and the leverage buffer are positively related to changes in loans and loan growth. However, changes in these two types of buffers are negatively related to changes in the loans to assets ratios. This finding suggests that to adjust their capital buffers, Canadian credit unions curtail their loans and underscores the importance of the Basel III conservation and the countercyclical buffer requirements in fostering credit. Further, we show that the risk-based capital buffer is positively related to the credit cycle. However, a mechanical application of the rule based on the credit-to-gross domestic product (GDP) gap to activate the countercyclical buffer, would have misguided Canadian credit unions.

Keywords: Capital regulation, Credit union capital, Loans to members, Business cycle fluctuations, Countercyclical capital buffer, Conservation capital buffer, Basel III.

Introduction

The impact of capital regulation on credit allocation of lending institutions is one of the most important[2] drivers of the linkages between the financial and the real sectors (e.g., Karmakar and Mok, 2015). Following the global financial crisis, major capital injection programs[3] have been initiated to support bank lending, and to a lesser extent, credit union lending in the U.S. Notwithstanding a lack of consensus in the empirical literature on the effects of capital requirements on bank lending, in theory, capital can affect lending through two channels: the lending channel and the capital channel. Both channels suggest that capital-constrained banks are more likely to shrink assets (loans) during downturns. With the introduction of Basel III more stringent capital rules, concerns about the impact of capital on lending have resurfaced (see Kim and Sohn, 2017 among others). Even though this debate is of paramount importance for financial stability, the implications of the Basel III standards adoption for non-bank depository institutions, namely credit unions, are largely misunderstood. Credit unions' experience contributes to the debate on the effects of capital on lending in two ways. First, credit unions' loans to members largely dominate their portfolios, which suggests that constraints on capital will affect adversely their intermediation activities. Second, they are more capital-constrained compared to banks as they cannot issue shares in the equity capital market because of their status of private entity.

As non-profit institutions, credit unions (CU) operate on the principle of one-member-one-vote and thrive by self-help and solidarity ideals[4] (Brizland and Pigeon, 2013). Smaller[5] than banks, CUs exhibit specific characteristics and offer services that make them highly complementary to banks. For example, CUs are supposed to be more efficient than banks in the assessment of the borrowers' creditworthiness, because the members know each other fairly well, due to the "common bond"[6] and can impose sanctions on delinquent payers (see Banerjee et al., 1994). Furthermore, unlike banks, credit unions fund a large share of their lending activities with stable "guaranteed" deposits. Vital to the national economy, they provide alternative non-profit-oriented financing to small and medium enterprises (SMEs), households and other economic agents that otherwise would have difficulty accessing traditional bank financing (CIBP, 2014).

Recently, some jurisdictions such as L'Autorité des marchés financiers (AMF), the Financial Market Authority in the province of Quebec in Canada adopt Basel III stricter capital rules for

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[2] Hancock and Wilcox (1993, 1994), Kashyap and Stein (1995, 2000), Kishan and Opiela (2000), Gambacorta and Mistrulli (2004), Berger and Udell (2004) are some of the earlier papers.

[3] Troubled Asset Relief Program (TARP) for example.

[4] According to the Canadian Credit Union Association (CCUA, 2016), at the end of 2015, Assiniboine Credit Union had provided over $149.2 million in loans to support affordable housing and child care facilities as well as women's resource centers, indigenous organizations and settlement organizations. In the same vein, Vancity Credit Union is also involved in social infrastructure lending. In 2014, the credit union reported that approximately one quarter of its business loan portfolio of $4.6 billion was invested in "impact" areas, including in business or sectors that support affordable housing and financial inclusion.

[5] Compared to banks, credit unions hold less assets. For example, Royal Bank of Canada (RBC), the largest Canadian bank, accounted for 940 billion $CAD in assets in 2014, almost 4.5 times the size of the entire Desjardins Group, the largest federation of unions in Canada, and roughly 25 times the size of the Caisse Centrale Desjardins.

[6] The common bond (usually, community bond, occupational bond, associational bond) is the factor, which unites all the members of a credit union. Members know and trust each other, the savings of members are available to fellow members as loans. Credit judgements are made on character and personal records on top of commercial risk factors, see for instance, Emmons and Schmid (1999), Ely (2014), McKillop and Wilson (2011, 2015).

credit union prudential regulation. Based on the recommendations of Basel III (BCBS (2011)), the AMF's new guidelines for credit unions were issued in January 2013 and are annually revised (AMF (2016)). Outside Quebec, the Saskatchewan province is also considering the application of the Basel III requirements. In North America, Canada has the highest proportion of members of credit unions —currently some 10 million, about one-third of Canada's total population. Roughly, half of the credit unions that operate in Canada are located in the province of Quebec and federated under the Desjardins group, the first credit union movement in North America. Collectively, credit unions employ more than 27,000 people and manage $186 billion in assets. They also hold 7 per cent of the mortgage lending market outside Québec, 11 per cent of the small business market and 11 per cent of lending to the agricultural sector (CCUA, 2016). Deposit insurance enjoyed by credit union members and the importance of credit unions in the Canadian system justify their regulation. Evidence also shows that members' (depositors and borrowers) capacity to control and discipline credit unions executives is limited. In fact, due to the one-member-one vote situation, the incentive and ability of members to generate a concentration of voting power is limited and attendance of members at votes are low (Hillier et al., 2008). This reduced member supervisory power increases the information asymmetry that can trigger credit union runs in tumultuous times. Therefore, designed to protect depositors and deposit insurers against excessive risk taking from executives, the regulation of credit unions seeks to ensure the solvency of credit unions.[7] Furthermore, strong capital requirements contribute to the stability of credit unions, especially during gloomy episodes.

The application of Basel III to credit unions implies that credit unions must meet a new set of requirements: (a) a leverage ratio (including off-balance sheet activities) as a supplementary measure to Basel II risk-based capital requirement; (b) a countercyclical and a conservation capital buffer to promote the build-up of capital buffers in periods of expansion to be used during periods of stress; and (c) the short-term and long-term liquidity standards (liquidity coverage ratio (LCR) and net stable funding ratio (NSFR)). Credit unions while managing tail risk must maintain adequate amounts of capital to support their risk and growth. Prior to the Basel III adoption, two capital requirements were in effect. The risk-based capital ratio (total capital / total risk-weighted assets) is being implemented worldwide, and the non-risk-based capital ratio or leverage (total capital / total assets) was newly introduced under Basel III but has already been in effect in Canada for quite a while. Different limits have been applied by provinces. Prior to Basel III, the 8% limits on the risk-based capital ratio is adopted by all provinces except Alberta (10.5%). Regarding leverage limits, all provinces have adopted a 5% leverage limit except Ontario (4%). Under Basel III requirements, limits are 3% for the leverage ratio and respectively 7%, 8.5% and 10.5% for the CET1, the Tier 1 and the total capital ratios. According to Demirguc-Kunt and Detragiache (2005), Reinhart and Rogoff (2009), and Gourinchas and Obstfeld (2012)) among others, financial crises tend to follow excessive credit growth episodes. To prevent banks and the whole economy from the procyclicality of negative externalities, the Basel committee (BCBS, 2010a) introduced the countercyclical and conservation capital buffers requirements to urge financial institutions to build capital as soon as excessive growth materializes. The countercyclical capital buffer and the conservation buffer each amounts to 2.5% (of the risk-weighted assets or RWA). The conservation and countercyclical capital buffers are introduced by regulators to credit unions in response to the

[7] According to the Australian Financial Institutions Commission (AFIC) among others similar organizations, capital regulation aims to protect the interests of depositors and promote integrity and financial efficiency.

2007-2008 banking crisis in which credit unions, known to perform better than banks through the business cycle (Smith and Woodbury, 2010), were definitely not the culprit. The countercyclical buffer must be activated following the build-up of financial vulnerabilities whereas the conservation buffer is required permanently, but it can be lowered during stress times. Following Drehmann, Borio, and Tsatsaronis (2011) and Drehmann and Tsatsaronis (2014), the BCBS (2010b) chooses the credit-to-GDP gap as the anchor for the countercyclical capital buffer activation. The credit-to-GDP gap is defined as the difference between the credit-to-GDP ratio (i.e., the ratio of a country's national debt to its gross domestic product (GDP)) and its long-run trend.

The countercyclical and conservation capital buffers will impose a burden on credit unions (CUs) during credit expansion. CUs will be required to come up quickly with an additional capital buffer. Despite the desirability of such capital buffer, a sudden required increase could challenge credit unions due to their not-for-profit and private business status. Hillier et al. (2008) show that under the pressure to satisfy the newly introduced risk-based capital ratio minimum of 8% in 1992, Australian credit unions resorted to regulatory arbitrage. Instead of raising new capital or reducing risk, credit unions reshuffled their assets components to make them seem artificially less risky. This behavior is a clear evidence of the difficulties credit unions face in having to raise rapidly their capital level. To meet capital requirements, financial institutions rely mainly on common equity issuance or earnings retention (disclosed reserves). Unfortunately, credit unions are handicapped in either of these means. First, credit unions are private entities and cannot issue common equity on financial markets (Wilcox (2011), Andrews (2014), Hoel (2007), Jackson (2007)). They instead issue membership capital shares, which are not eligible as capital instruments (under IFRS standards) because they lack permanency. Members can withdraw their shares in the event of resignation. Some credit unions issue investment shares, but this is limited by the one-member-one-vote principle. Hence, the only and least costly alternative for credit unions to meet the buffer requirements under Basel III is by retaining their limited earnings (Andrews, 2014). However, retention of earnings conflicts with the non-profit status of credit unions. It limits their ability to charge higher spreads to their customers-members-owners and so to generate sufficient profit to be retained to build up capital. Further, members have a preference for distributed profit (as dividends) over earning retention for the purpose of capital adequacy. Furthermore, credit unions have lost the tax advantage that allowed them to retain more profit as capital (Moore, 2014) and are currently experiencing competition with banks even in rural areas where they were major players. Due to this reliance on profit, sudden capital requirements may not be desirable for credit unions.[8]

Since credit unions have limited means to raise capital but hold portfolios composed essentially of loans to their members, our study of the impact capital buffer requirements on loans to members contributes to the current debate on credit union regulation. In fact, the Canadian Credit Union Association (CCUA) underscores in its 2016 federal pre-budget submission, the importance to soften the capital burden on credit unions lending through (a) a federal loan guarantee program

[8] Brown and Davis (2009) found that Australian credit unions set performance levels on short-term assets to progressively bridge the gap in capital (the difference between the target capital ratio and the actual one). In addition, Goddard et al. (2016) find evidence of a gradual capital adjustment by credit unions in anticipation of the United States Prompt Corrective Action (PCA) in 2000. Like US credit unions, Canadian credit unions set their desired levels of capital ratio well above the regulatory target and divulge them in their annual reports. They adopt a conservation capital building strategy essentially based on their disclosed reserves. For example, to meet capital standards, credit unions of Manitoba and Newfoundland & Labrador maintain a minimum of 3% of their assets in the form of retained earnings. In British Columbia, credit unions are required to hold at least 35% of retained earnings as capital. In Quebec, the Desjardins Group, to strengthen its capital position, regularly retains one-third (1/3) of its revenues for capital accumulation.

(which could lower loan risk weights) and (b) a new tax measure that recognizes how credit unions build capital. As the new Basel III buffers requirements will be applied on risk-based capital buffers, the Canadian credit unions experience is useful given that a large part of U.S. credit unions, until recently, were not subject to risk-based capital requirements.[9]

Against this background, after building a unique dataset of 100 biggest Canadian credit unions, which account for more than 95 per cent of total credit union system assets in Canada for the period of 1996 to 2014, we are the first to seek answers to the following two research questions: 1) How does the risk-adjusted capitalization of a credit union affect its lending? and 2) As the countercyclical buffer will be activated based on the credit-to-gross domestic product GDP gap (CGDPG), how Canadian credit unions would have adjusted to this requirement?

We find that the capital buffer size has a positive relation with the credit unions' loans to assets changes and loan growth. However, changes in the capital buffers (both risk-based and non-risk based) are negatively associated with changes in loans to assets or loan growth. Therefore, since capital buffers drive CU lending, to adjust to the minimum capital buffer requirements, credit unions are more likely to shrink assets and curtail new loans. These findings underscore the importance of the Basel III capital buffer regulation to force credit unions to hold sufficient buffers through the business and credit cycles. Furthermore, we find that CU capital buffers are bigger than 5% of risk-weighted assets (RWA), the maximum buffer mandated by Basel III. If we assume that the countercyclical capital buffer were activated starting in 1996, our buffer simulation suggests that credit unions would have amply complied with this requirement. However, we find that under this setup, credit unions would have to raise capital at the wrong time (before 2000 and right at the beginning of the crisis in 2009). This reinforces critiques about the mechanical application of the credit-to-GDP gap and confirms the importance of the national regulatory clairvoyant judgement and discernment in the implementation of capital buffers requirements.

To the best of our knowledge, no study like ours clearly addresses the effects of the risk-based capital buffer requirements on credit union lending. Our paper draws on both the literature on the effects of bank capital on lending and the studies on the behavior of capital buffers. Goddard et al., (2016) find that US credit union capital buffers are positively related to the business cycle (countercyclical). Contrary to Goddard et al. (2016), Stolz and Wedow (2011) find that Germany's savings and cooperative banks' capital buffers are procyclical during the 1993-2004 period.[10] Hessou and Lai (2017) also document a positive relation between the capital buffer and the business cycle for Canadian credit unions. These findings suggest that credit unions manage to build their capital buffers during booms to avoid undesirable and socially costly adjustment during busts (by reducing assets or loans), and there is no need to require them to hold additional countercyclical capital buffers. Earlier studies on the relation between bank capital and lending focus on the role of the Basel I capital rule on the 1990-1991 credit crunch.[11] Following the introduction of Basel III buffers, Drehmann and Gambacorta (2012) study the effects of the implementation of the countercyclical buffers on bank lending. Based on 772 banks from the EU countries and the United

[9] https://www.nafcu.org/capitalreform/.
[10] The main difference between the two studies is that they are conducted in two different countries using different ratios and different times. There is also a difference in the capital ratios used in both studies; Stolz and Wedow (2011) use the risk-based capital buffer whereas Goddard et al., 2016 use the capital-to-assets ratio.
[11] Hancock and Wilcox (1993, 1994), Berger and Udell (2004), and Bernanke and Lown (1991).

States from 1998 to 2009, they find that adhering to the credit-to-GDP gap (CGDP) rule could reduce credit growth during excessive booming periods but could lessen asset shrinking during busts. Jokivuolle and al. (2015) show that a drop in output has an intensified impact on bank loan losses if the private sector is excessively indebted. Goddard et al. (2016) show that the loans-to-assets ratios are negatively related to the credit union leverage ratios, suggesting that increases in the US credit unions loans lower their capital buffers.

The remaining sections are organized as follows. Section 1 presents a literature review on the relation between capital and lending. We describe the data and the empirical model in sections 2 and 3. Section 4 discusses regression results, section 6 follows with robustness checks, and section 7 concludes.

1. Literature review on the role of capital on financial institutions lending

The point of departure for all modern studies on the effects of capital structure is the Modigliani-Miller (M&M, 1958) proposition.[12] As credit unions are required to comply with the minimum capital requirements (e.g., Wilcox (2011)), their capital structure becomes an important determinant of their asset growth. Capital can affect CU lending via two channels: the lending and the capital channels. Both channels imply that capital-constrained CUs are more likely to shrink assets (loans in particular) drastically during dire downturns. Furthermore, given their non-profit and cooperative status, credit unions face formidable challenges in meeting capital regulations (Moore, 2014; Hillier et al., 2008). Therefore, CUs are even more susceptible to adjust their capital ratios by shrinking assets or reduce new loans.

The US "credit crunch" of the 1990s has generated numerous analyses on the effects of capital regulation on bank lending. Most of these studies document a positive effect of capital on lending (Bernanke and Lown, 1991; Furlong, 1992; Hancock and Wilcox, 1994). Bernanke and Lown (1991) study determinants of the slowdown in lending (demand factor, funding problem, overzealous regulatory tightening, and capitalization) and find that capital was the main driving force behind loan slowdown. Specifically, 1-percentage-point increase in bank capital results into approximately 2–3 percentage point increases annually in loan growth for the period 1990-1991. Furlong (1992) also documents a positive relation between lending growth and the ratio of bank capital to target capital. He shows that 1-percentage-point rise in bank capital surplus increases loans by 4.9-percentage point for the period 1985-1991. Hancock and Wilcox (1994) test whether banks substitute less risky securities to loans following the introduction of the risk-based capital ratio in the beginning of 1990s. They find that a shortfall in each US$1 of bank capital leads to a reduction of approximately US$4.50 in bank credit in the US in 1991. Outside the US, some authors have studied the nonlinear effect of capital on bank lending. For instance, Gambacorta and Mistrulli (2004) confirms the positive effect of excess capital on Italian banks' lending. They also find that the impact of monetary policy and output shocks on Italian banks lending depend on bank capitalization.

In the aftermath of the subprime crisis, as the Basel Committee on Banking Supervision (BCBS)

[12] In a frictionless world with full information and complete markets, capital structure is irrelevant for the firm value. Taxes, financial distress and transaction costs, information asymmetry and especially regulations drive all deviations from the M&M theory.

boosts capital requirements, issues on the effects of capital on lending has re-emerged. Based on the US BHC data from 1992Q2 to 2009Q3, Berrospide and Edge (2010) document an increase of approximately 0.7–1.2 percentage points per annum in loan growth following a 1- percentage-point increase in bank capital ratio. Similarly, Carlson et al. (2011) find that a 1-percentage-point increase in the capital ratio causes loan growth to increase approximately 0.05–0.2 percentage points annually for US commercial banks for the period 2001 to 2009. However, this effect is not significant prior to the crisis in 2008.[13] Kim and Sohn (2017) find that 1% point increase in the risk-based capital for US small banks, which share the small size attribute with CUs, is associated with 0.4-0.5 % point increase in loan growth.

2. Data

We painstakingly collected financial data on the 100 major credit unions in Canada based on the list of the 100 largest credit unions published quarterly by Credit Union Central Canada. According to System Results published in March 2016 by the Canadian Credit Union Association, as of fourth quarter 2015, the top 100 credit unions account for 88.6 per cent of total credit union system assets in Canada (excluding Quebec). If one includes Quebec, this figure jumps to over 95 per cent. Specifically, we downloaded balance sheets, income statements and capital requirements data from annual reports published by credit cooperatives on their websites, with 690 annual reports analyzed. This corresponds to an average of 7 years of data per credit union. Some credit unions post few annual reports on their websites. The collected data was then cleared to detect any inconsistencies that may affect the quality of the analysis. The most represented provinces are: Quebec (with a federation of 344 local credit unions), British Columbia (27 credit unions), Ontario (25 credit unions), Manitoba (20 credit unions) and Alberta (11 credit unions). Data on macroeconomic variables comes from Statistics Canada and the Quebec Statistics Institute. Our unique sample consists of an unbalanced panel of 100 major credit unions (by total assets) in Canada from 1996 to 2014. Data on credit-to-GDP gap are extracted from the BIS (Bank for International Settlements) database of total credit to the private non-financial sector, capturing total borrowings from all domestic and foreign sources.

3. The empirical model

The aim of this paper is twofold. First, we study how the capital buffer holdings affect credit union's loans to members. Second, we examine how the credit union risk-weighted capital buffer behaves relative to the credit-to-GDP gap.

A. Credit union capital buffer and lending

To address our first research question, i.e., to study the impact of capitalization on credit union lending, we adapt the Karmakar and Mok (2015) approach. Our model is given by the following equation:

[13] Gambacorta and Marques-Ibanez (2011), Cornett et al. (2011), Francis and Osborne (2012), and Gambacorta and Shin (2016) present similar results.

$$\Delta LOAN_{it} = \beta_0 + \beta_1 BUFF + \sum_{j=2}^{K} \beta_j X_{ijt-1} + \varepsilon_{it}. \qquad (1)$$

The dependent variable $\Delta LOAN$ is the changes in the loan to assets ratio (*LOTA*) or the share of mortgage loans in total loans (*MORT_LOAN*) or the share of commercial loans to total loans (*COM_LOAN*). $BUFF$ is either the bank risk-based capital buffer at year *t-1* ($BUFF_{it-1}$) or the change in bank capital buffers at date *t* ($\Delta BUFF_{it-1}$). Credit union specific characteristics and other macroeconomic variables are included in vector X_{ijt-1} and ε_{it} is the error term. Arming with the null hypothesis that CU capital buffer does not affect the change in CU loan growth, we can state our hypothesis in terms of the coefficient β_1 as follows: H3a: $\beta_1 = 0$. Significant positive value of β_1 implies that the capital buffer is an important determinant of the credit union ability to grant loans to their members. To estimate equation (1), we employ the robust fixed effect panel methodology. As the explanatory variables (see sub-section D) are predetermined, there is no endogeneity concern. We reckon that the effect of regulation is better assessed when there is a control and treated sample to serve as "natural experiment". For such a framework, the D-in-D methodology is widely used. Unfortunately, we do not have a control sample as all credit unions, without exception, have been subject to the same capital regulation throughout the period under study. Given the short length of our data, we cannot compare the behaviors of the credit union lending pre and post implementation.

B. Risk-based capital buffers and the credit cycle

Insert Graph 2 here

Following the introduction of Basel III standards, credit unions will be required to comply with the countercyclical capital buffers requirement based on the credit-to-GDP (*CGDP*) gap or (*CGDPG*). To seek answers to our second research question and assuming that the CGDP gap was activated starting in 1996, we examine how Canadian credit union would have adjusted to the countercyclical buffers,. To achieve that, we compute the CGDPG using the Basel III recommended smooth parameter λ = 400000 (see Graph 2). We follow the analysis by Drehmann and Gambacorta (2012) and assume that the additional buffers are required when the CGDPG exceeds 2% and the value of the required additional buffer increase linearly with the CGDPG up to 10%, above which it becomes constant and equal to 2.5% as advocated by Basel III.

$$\begin{cases} BUFF = 0\% & if\ CGDP\ Gap < 2\%, \\ BUFF = 0.25 * CGDP\ Gap & if\ 2\% \leq CGDP\ Gap \leq 10\%, \\ BUFF = 2.5\% & if\ CGDP\ Gap > 10\%. \end{cases}$$

In the absence of official capital buffer regulations, empirical evidence shows that both credit unions and banks hold significant buffers above the required minimum capital levels. First, the incentive to hold buffers stems from the fact that credit unions cannot adjust fully to their desired buffer targets. Otherwise, they would not need to hold capital buffers. Second, a violation of the regulatory minimum capital requirements triggers costly supervisory actions, leading to potential closure of the credit union (e.g., Marcus, 1984; Milne and Whalley, 2001; Milne, 2004, Stolz and Wedow, 2011, among others). More importantly, given the high cost of holding sufficient capital to manage tail risk, capital buffers allow credit unions to secure future growth opportunities such as lending to their borrowing members with positive net present value projects. As credit unions are regulated based on capital ratios, they are deemed to secure sufficient capital to support their lending.

Similar to the approach used in numerous studies on capital structure (Hessou and Lai, 2017; Stolz and Wedow, 2011; Ozkan and Ozkan, 2004; and Stolz and Wedow, 2011), our partial adjustment model assumes that each year the credit union increases its capital to reduce the shortfall between the target and realized capital. Under Basel III tightened capital requirements, to adjust towards target capital ratios, credit unions can increase their capital position (the numerator of the ratio) or decrease their risky asset holdings or their total assets. To study the relation between the buffer and the credit cycle, we employ the following partial adjustment model.

$$\Delta BUFF_{it} = \alpha(BUFF_{it}^{*} - BUFF_{it-1}), \quad (2)$$

where $BUFF_{it}$ is either the risk-based capital or the leverage buffer of the credit union *i* at time *t*, and ε_{it} is the error term assumed to be distributed according to a normal distribution of mean 0 and a constant standard deviation. Equation (2) assumes that at time *t*, a typical credit union *i* closes a proportion α of the gap between its actual buffer $BUFF_{it-1}$ and its desired or targeted buffer $BUFF_{it}^{*}$ in the current period. α is also interpreted as the speed of adjustment. The targeted buffer $BUFF_{it}^{*}$, being unobservable, is assumed to depend on the business and credit cycles interacting with credit risk and credit union-specific variables. Hence, the unobservable target buffer is expressed as follows:

$$BUFF_{it}^{*} = \theta_0 + \theta_1 CCYCL_t + \theta_2 BCYCL_t + \sum_{j=3}^{K} \theta_j X_{ijt-1} + \varepsilon_{it}, \quad (3)$$

where X_{ijt-1} is the *j*th control variables observed for the credit union *i* at time *t*, $CCYCL_{it}$ and $BCYCL_{it}$ are respectively the credit cycle and the business cycle. Assuming that X_{ijt-1} is properly determined, if the tradeoff theory of capital structure choice holds, then we should have $(\theta_0, \theta_1, \ldots., \theta_K) \neq 0$. We replace expression (3) in equation (2) and obtain:

$$\Delta BUFF_{it} = \alpha\left(\theta_0 + \theta_1 CCYCL_t + \theta_2 BCYCL_t + \sum_{j=3}^{K} \theta_j X_{ijt-1} - BUFF_{it-1} + \varepsilon_{it}\right) \quad (4)$$

$$= \alpha\theta_0 - \alpha BUFF_{it-1} + \alpha\theta_1 CCYCL_t + \alpha\theta_2 BCYCL_t + \sum_{j=3}^{K} \alpha\theta_j X_{ijt-1} + \alpha\varepsilon_{it}.$$

By adding $BUFF_{i-t}$ to both sides of Eq. (3), we get the following expression:

$$BUFF_{it} = \alpha\theta_0 + (1-\alpha) BUFF_{it-1} + \alpha\theta_1 CCYCL_t + \alpha\theta_2 BCYCL_t + \sum_{j=3}^{K} \alpha\theta_j X_{ijt-1} + \alpha\varepsilon_{it}.$$

And letting $\beta_0 = \alpha\theta_0$; $\beta_1 = (1-\alpha)$; $\beta_2 = \alpha\theta_1$; $\beta_3 = \alpha\theta_2$; $\beta_j = \alpha\theta_j$, and $\mu_{it} = \alpha\varepsilon_{it}$ gives:

$$BUFF_{it} = \beta_0 + \beta_1 BUFF_{it-1} + \beta_2 CCYCL_t + \beta_3 BCYCL_t + \sum_{j=4}^{K} \beta_j X_{ijt-1} + \varepsilon_{it}. \quad (5)$$

Assuming the null hypothesis that credit cycle fluctuations do not have an impact on the change in credit unions' capital buffers, we can state our hypotheses in terms of the coefficient β_2 as follows: H1a: $\beta_2 = 0$. Significant values of β_2 imply that the credit cycle affects the build-up of Canadian capital buffers. A positive sign for this coefficient means that the capital buffer moves countercyclically relative to the credit cycle.

C. Estimation methodology

To test the impact of capital buffers on loans by way of equation (Eq. 1), we follow Bernanke and Lown (1991), Hancock and Wilcox (1994) and Berrospide and Edge (2010) and use a robust fixed panel effect regression methods. Concerning the capital buffer equation (Eq. 5), we employ the commonly used Syst-GMM of Blundell and Bond (1998) that we complement with the 3-SLS methodology. Since we include the lag of the capital buffer as an explanatory variable and it is likely correlated with the unobservable fixed effect, to estimate Eq. 5, we use the dynamic GMM methodology. This rules out the standard ordinary least squares (OLS) approach and even the fixed effects approach which is shown to produce biased and inconsistent coefficient estimates (see Nickell, 1981). Initially attributed to Hansen (1982), the GMM estimation has been extended to a dynamic panel structure by Arellano and Bond (1991) and successively updated by Arellano and Bover (1995) and Blundell and Bond (1998). The Blundell and Bond (1998) version has the advantage of being robust to the distribution of errors. Since it uses more moment conditions and yields more efficient parameter estimates, it is considered more efficient than 2SLS (Hall, 2005) and 3SLS. It provides consistent and more efficient estimators than the 2SLS used by Shrieves and Dahl (1992), Rime (2001) and others to study bank capital and risk. Given the possible quasi unit root characteristic of our data, it also gets around the weak instrument problem that the Arellano and Bond (1991) estimator would encounter.[14] The Blundell and Bond (1998) system GMM leads to unbiased partial adjustments estimates and controls not only for endogeneity in bank-specific variables but also for the dynamic nature of the capital buffer variable. The system-GMM has been widely used in the literature (see Ayuso et al, 2004; Flannery and Rangan, 2006; Flannery and Hankins, 2013 and DeYoung and Jang, 2016; Bancel and Salé (2017) among many others). The methodology also fits with the structure of our data, which consist of large N (100 credit unions) and small T (21 years), a structure suitable for the dynamic GMM.[15]

D. Description of variables

a. Capital buffers and loan growth

Capital buffers (BUFF_R): The risk-based capital[16] buffer *(BUFF_R)* is the capital ratio, a credit union hold in excess of the regulatory minimum capital ratio. The regulatory minimum for the risk-based capital ratio (i.e., Total capital / Total risk-weighted assets) is 8%.

Loans to members (LOAN): The most important component in credit unions portfolios, loans to members contribute largely to credit unions risk weighted assets (RWA). As credit unions are required to hold capital proportional to their RWA, changes in the capital buffer can affect credit unions ability to grant loans. As suggested by Drehmann and Gambacorta (2012), mandatory

[14] The correlation between capital buffers and their lag is 0.89 and 0.76 respectively for the leverage buffer (BUFF)

[15] We thank the referees for directing us to this motivation.

[16] Total regulatory capital is computed as the sum of Tier 1 capital or core capital and Tier 2 capital or additional capital instruments. Main components of Tier 1 capital are the retained earnings and the capital injections by the credit union public owners and members. Tier 2 capital is made of subordinated debt and mostly issued by large credit unions to boost their capital buffer.

increases of the capital buffer could reduce credit growth during booms and attenuate credit contraction once it is released in busts. We capture the credit union lending behavior by loan growth (*LOANG*) computed as the annual difference of the logarithm of total loans and the loans to assets ratio (*LOTA*). We also deepen the analysis by considering different types of loans: commercial loans as a percentage of total loans (*COM_LOAN)* and mortgage loans as a proportion of total loans *(MORT_LOAN)*.

b. Credit unions control variables

Since we use two models (Eqs 1 and 5), we present the control variables, CU specific and macro variables for both equations.[17] The variable definitions are given in Table 5.

(Insert Table 5 here)

Credit union risk (LOSS, Z-score): We use two proxies of credit union risk. The loan loss provision (*LOSS*) captures the credit union anticipated credit risk whereas (*Z-score*) proxies credit union default risk. Z-score is an accounting-based measure of the probability of bankruptcy (see e.g., Esho et al. (2005)). Following Imbierowiz and Rauch (2014) among others, we compute the Z-score, originally proposed by Roy (1952), as follows: Z-score = (CAPR + μ_{ROA})/σ_{ROA}, where CAPR is the capital-to-assets ratio, μ_{ROA} is the average ROA and σ_{ROA} is the ROA volatility. Since we have a limited data length, we compute for each credit union the average and the standard deviation of the ROA (σ_{ROA}). Using the Z-score metric, Hesse et al. (2007) show that credit unions are more stable than commercial banks as they have lower return volatility offsetting their lower capital and profitability.

Credit unions are more likely to see their loan growth curtailed following declines in their loan portfolio quality. For the capital buffer equation (Eq. 5), given that the computation of *Z-score* involves capital ratios, as in Shrieves and Dahl (1992) and Rime (2001), we use the *LOSS* variable. The bigger the anticipated risk (*LOSS*), the higher the buffer to prevent capital to fall below the minimum requirement.

Liquidity (LIQUID): A higher ratio of liquid assets (such as cash plus Treasury-bill (T-bill) to total assets) may reduce the credit union incentive to target higher capital buffers. In the same token, a better liquidity position provides a buffer for potential portfolio losses. Therefore, credit unions with more liquidity might be able to grant more loans. Credit unions can sell their liquid positions to cover their capital needs (Stolz and Wedow, 2011).

The credit union size (SIZE): Size (log of total assets) may influence the credit union ability to grant loans. Large credit unions can attract larger loanable funds to sustain their desired loan growth. Alternatively, smaller credit unions are mostly retail-oriented; this means that size can have both positive and negative effects on credit union lending. Since large and diversified credit unions have a strong risk management culture, they hold lower capital buffer. We also use *SIZE* to account for the diversification and economy of scale enjoyed by large credit unions (e.g., Aggarwal and Jacques, 1998; Ayuso et al. 2004; Flannery and Rangan, 2006 and 2008; Guidara and al., 2013).

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[17] We thank the referees for suggesting us the additional control variables.

Return on assets (ROA): We measure credit union profitability by the ratio of net income after taxes and extraordinary items to total average assets. As credit unions rely mainly on their internal funds to finance their equity, it is expected that most of their retained earnings will be used to grant new loans. In addition, dividends paid to members store up in saving accounts and eventually in loans or acquisitions. Therefore, we expect a positive relation between credit union lending and profitability. Since credit unions adjust capital buffers by retaining earnings, there may be a positive effect of the return on assets (ROA) on capital buffers. However, a negative impact may also be plausible. Credit unions may choose to pay dividends when they are well capitalized. CUs hold smaller capital buffers while earning high returns on assets (ROA) may also be possible thanks to the ability of the credit unions to generate consistently high profits to boost capital buffers, once needed, by way of retained earnings. Hence, we expect an ambiguous sign for the credit union return on assets (ROA).

Mergers (dyMERG): We also include a dummy variable to capture mergers. The reason for including this variable are merger waves in the Canadian credit union system. The dummy variable takes a value of 1 for the acquirer in the year of the merger and zero otherwise. The expected sign of the variable is positive for credit union lending resulting from the credit union getting bigger with more members. As large and more diversified credit unions would need less capital buffer, we expect a negative sign between credit union mergers and capital buffer holdings.

The credit and business cycles (CYCL): We use the Credit-to-GDP Gap ($CGDPG$) and the real gross domestic product growth by province ($GDPG$), as proxies for the credit cycle ($CCYCL$) and the business cycle ($BCYCL$) respectively. We measure the credit cycle as the deviation between the (private sector) credit-to-GDP ratio and its long-term trend. The trend is computed as a one-side Hodrick–Prescott filter (HP filter) with a high value for the smoothing parameter $\boldsymbol{\lambda = 400000}$.[18] This choice is based on research showing that the credit-to-GDP gap is a very good indicator of the systemic risk build up (see Drehmann et al., 2011). As the Credit-to-GDP Gap data is not available at a provincial level, we use the Canada-wide data provided by the BIS (Bank of International Settlements).[19]

Age of credit unions (AGE): In general, the longer the credit union existence, the more it gains experience in risk management and the bigger it accumulates capital buffer. It can therefore offer services with lower interest rates than those of the competitors. The variable (AGE), measured by the natural logarithm of the credit union age, is positively related to the members' benefits.

Regulatory change (REG): We control for regulatory changes in the banking system. The RWA regulations have been amended in 1998 and 2008 to account respectively for market risk and operational risk (for details, see for instance, Guidara et al., 2013). This would have implicitly

[18] We thank the referee for suggesting the diagnosis. We obtain the credit cycle (*Credit-to-GDP Gap*) by applying the HP-filter to the credit-to-GDP ratio publicly available on the BIS website. The filtered variable weakness is due to the high smoothing parameter of 400,000 suggested by the BIS for the computation of the Credit-to-GDP. See Graph 2 (panel A) for the dynamic of the credit-to-GDP (with different parameters) and the Graph 2 (Panel B) for a comparison between the dynamic of the Canadian GDP growth and the Credit-to-GDP gap. As it can be observed from Graph 2 (Panel A) the volatility of the cycle extracted from the HP transformation increases with the smoothing parameter (100 (line), 1600 (dot line), 400000 (long-dash line)). For comparison, the original credit-to-GDP ratio averages 251.8786 with a median value 256.7 meaning that it is somewhat more stable than the filtered serie (mean: 2.29 and med: 8.59). Alternatively, we could winsorize the extreme values; however, as this information do not vary within credit unions but only over years, this exercise will seriously limit the size of the sample.

[19] http://www.bis.org/statistics/c_gaps.htm. Given the relatively short period of data available to us (1996-2014), the term business or credit cycle should be interpreted with caution.

affected credit unions capital buffer targets and consequently their loan portfolio allocations. Hence, we include a dummy variable which takes the value of one for the period before 2008 and zero after. We do not explicitly account for the period before the first change of the RWA computation (1996-1998) because the first amendment related to the inclusion of the market risk was announced in 1996 and enforced in 1998 and presumably banks have started to adjust to this rule since 1996.

Market concentration (HHI): As shown by Beck, Demirguc-Kunt and Maksimovic (2004) and others, the competition in the loan market is important for the analysis of loan availability. As credit unions operate mostly at a provincial level, aggregate measures of the banking sector concentration will likely have a limited power in capturing the loan competition faced by credit unions. Besides the popular measure of concentration, the Herfindahl-Hirschman index (*HHI*) employed by many authors (e.g., Lei and Song (2013)), we use an index computed at the provincial level. The banking concentration index is extracted from World Bank Global Financial Development Database (GFDD). The province-specific HHI is computed as follows:

$$HHI_k = 1 - \sum_{j=1}^{J_k} \left(\frac{L_{kj}}{L_k}\right)^2 ,$$

where we assume that there is J_k credit unions in the province *k*. L_{jk} is the total loan of credit union *j* in province *k*. L_k is the total loan issued by all credit unions in the province featured in the 100 largest credit unions.

Confidence of the market (COM_SPREAD): Access to the interbank market might be subject to liquidity shocks, which could play an important role in the CU funding decisions, hence on their lending capabilities. To control for the CU "interbank liquidity shock effect", following Cornett, McNutt, Strahan and Tehranian (2011), we use a proxy for the TED spread[20] indicator that measures the liquidity strains on the banking sector. The proxy named *COM_SPREAD* is computed as the difference between the 3-month commercial paper rate and the 3-month Treasury bill (T-bill) rate. We believe that credit unions that borrow from banks or on the repo market may be subject indirectly to the liquidity shock from these markets. Therefore, during periods of tight liquidity, credit unions are better off by limiting their lending if there are liquidity-constrained. This is possible mainly for large credit unions which rely on banks to meet their liquidity needs.

Government monetary policy (TERM_SPREAD): Government monetary policies could influence lending activities because a relatively low government-set interest rate fosters credit supply. Since the money supply intertwines with the government interest rates, the 10-year government bond rate and the long term (LT) bond rate minus the short term (ST) bond rate, (or *LT-ST spread*), are generally used to gauge the effect of a country's monetary policy on bank lending. We know that bank lending/borrowing is sensitive to the 10-year bond yield and the ST-LT spread structure affects a bank's profit margin (see e.g., Bernanke, Gertler and Gilchrist, 1999).[21] For the same reason, the ST-LT spread structure is likely a determinant of the CU loan portfolio allocation. Hence, by way of the 10-year Canadian spread, we capture the impact of Canada's monetary policy

[20] The TED spread is the difference between the interest rates on interbank loans and on short-term U.S. government debt. TED is an acronym formed from T-Bill and ED, the ticker symbol for the Eurodollar futures contract.
[21] We thank the referee for pointing out this issue.

on CU lending. We use the term spreads computed by the Bank of Canada, according to a methodology developed by Bolder et al. (2004).

E. Credit union asset and liability structure

a. Credit union asset structure

We present descriptive statistics on assets and liabilities components in Tables A.4 and A.5. We provide these for the whole sample period (1996-2014) and for three sub-periods: The pre-crisis period (1996 to 2006), the crisis period (2007-2009) and the post-crisis period (2010-2014).

(Insert Tables 1 and 2 here)

The average credit union has 9.192 billion $CAD in total assets. The largest total assets among credit unions is 44 billion $CAD, attained in 2014 by Caisse Centrale Desjardins. This can be compared to those operated in the Canadian financial services industry, where the largest bank in Canada (Royal Bank) is 4.5 times larger than the whole Desjardins group, the largest credit union in asset size. The smallest credit union by asset size is Pierceland Credit Union located in the province of Saskatchewan with 35.441 million $CAD in assets in 2012.

(Insert Tables 1 and 2 here)

(Insert Graph 1 here)

The distribution of assets year by year can be found in Table 4 (Panel A). We also compute the distribution of assets by year for a homogenous set of credit unions with available annual reports for the 1996-2014 period (see Table 4, panel B). Credit unions total assets have continuously risen except during the 2009 crisis during which the average level of total assets fell below its 2008 level (see Graph 1).

From Tables 1 and 2, we see that credit unions hold on average 4% of their funds in cash-like assets. This proportion is 3% today, down from a 5% in the pre-crisis period. We also note that 79% of credit unions' total assets consist of loans to members (commercial and agricultural (30%), residential mortgages (54%) and personal loans (16%)). This loan-dominated business model was increasingly magnified over time in our sample, with a 75% loans-to-assets ratio before the crisis (1996-2006), 78% during the crisis (2007-2009) and 81% in the post crisis period. This highlights the credit unions' traditional vocation of providing credit to the economy.

Investment is the second important component of credit union assets. Credit unions invest some of their funds in secured/collaterized assets or derivative products for hedging purposes. In terms of assets held, they invest in government secured assets and credit union central shares. On average, 12% of credit union assets are made of investments in such assets. Asset holdings for investment purposes have decreased over time, from 14% in the pre-crisis period to 11% in the post-crisis period up to 2014.

b. Credit union liabilities and members' equity structure

On average, 86% of the credit unions' funds come from deposits (personal and commercial members) and this ratio is quite stable throughout our period of study. Asset growth and in particular members' loan growth that cannot be sustained by members deposits, is funded by way of securitization, loan syndication, corporate borrowings or issuance of investment or savings accounts shares. Credit union borrowings average 3% of total funds. Members' equity also provides an additional source of financing and is comprised of retained earnings and members' shares. On average, members' equity contributes to 6% of total funds.

Credit unions on average use 80% of their funding to grant loans to their members. The share of commercial and mortgage loans in the total loans portfolio averages to 24.57% and 53.7% respectively. Thereby, these loans are the major components in the credit union loan portfolios.

F. Credit cycle, capital buffer and descriptive statistics of variables used in the regression analysis

(Insert Tables 3, 6 and 7 here)

(Insert Graphs 2 and 3 here)

To build countercyclical buffers, credit unions are required to hold between 0% and 2.5% of their RWA. We compare the credit unions' actual capital buffers to those that would have been required if the Basel III buffers were activated since 1996. Applying the methodology proposed by Drehmann and Gambacorta (2012), we find that the countercyclical buffer would have been activated up to its maximal value of 2.5% from 1996 to 1999. It would have been deactivated from 2000 to 2008, activated again in 2009, and remain activated until now (see Graph 3, Panel A, long-dash line). Credit union capital buffers increase by an amount well above the minimum requirement (5% of the RWA under Basel III (2.5% for the conservation buffer and 2.5% for the countercyclical buffer)) throughout the whole period (see Table 3). There is evidence that the median value of the credit union buffer goes below the minimum regulatory buffer in 2012, meaning that some less capitalized credit unions would have held insufficient capital buffers (see Graph 3, dot line) if the buffers were activated. Despite the fact that many credit unions would have met the capital buffer requirements, there is concern about the buffers' activation. Based on the Drehmann and Gambacorta (2012) approach, the buffers would have been deactivated during the period of booms (2007-2008) and activated in 2009 at the beginning of the crisis, defeating the purpose of the countercyclical buffer. Repullo et al. (2011) show that a mechanical application of the buffer based on credit-to-GDP gap would tend to reduce bank capital requirements when the GDP growth is high and to increase these when the GDP growth is low. Therefore, it may end up exacerbating the inherent pro-cyclicality of risk-sensitive bank capital regulation. We obtain the same result from our credit-to-GDP gap experiments on Canadian credit unions.

Table 6 summarizes the descriptive statistics of the variables used in the study. The correlation matrix in Table 7 shows that most variables are significantly correlated with each other. For example, large credit unions (*SIZE*) hold lower capital buffer[22] (*BUFF*_R) and less liquid assets

[22] Recall that the capital buffer is the additional capital banks hold above the minimum required. *BUFF_R* is the additional capital credit unions hold above the minimum capital-to-risk weighted assets ratio.

(*LIQUID*). They also allow lower provision for losses (*LOSS*) but take much more risk (*RISK*). The correlation between the capital buffer and the credit cycle is positive and significant whereas the correlation of the capital buffer with the business cycle is negative and significant. We also find that the business cycle is negatively correlated with the credit cycle. There is also evidence that the capital buffer is negatively related to the loan growth, meaning that increases in loan growth lower credit union risk-based capital buffers.

4. Regression analysis

Insert Table 8 here

Recall that our first research question is to study the effects of capital buffers on credit union loan portfolios. We measure the risk-based capital buffer by the level of capital buffer (*BUFF_R*) and by the change in capital buffer (*ΔBUFF_R*). Results from this analysis is summarized in Table 8. We uncover a positive relation (0.191) between credit union capitalization (*BUFF_R*) at a point in time and its ability to extend loan in the next period. In opposite, changes in capital buffer and loan are negatively (-0.278) related. This result suggests that one standard deviation of the capital buffer (0.031) is associated with a decline in loans to assets of 0.008, or more than twice the standard deviation of the loans to assets ratio (0.0035). This finding supports the idea that capital buffer constrained credit unions are likely to cut granting credit to the economy. We interpret further these results as follows:

The positive relation between credit union capital buffers (*BUFF_R*) and changes in loans to assets ratios underscores the importance of capitalization for CU intermediation activities. Credit unions with plentiful capital in one period are able to extend loans to their members in the next period. This finding suggests that credit unions experiencing negative capital shocks during crises are more likely to reduce lending. Therefore, regulators should insure that credit unions maintain a buffer bigger than the minimum requirements, something that echoes the Basel III capital buffer requirements.

The negative relation between changes in capital buffers (*ΔBUFF_R*) and changes in loans to assets ratios (*ΔLOTA*) means that credit unions adjust their loan portfolios to meet capital requirements. This finding implies that credit unions are likely to shift their loan portfolios toward safer assets (i.e., lending contraction) if they are exposed to negative capital shocks during hard times. This result is consistent with the one found by Goddard et al. (2016) for non-risk based leverage ratios.

Other factors that are positively associated to changes in loans-to-assets include the return on assets (*ROA*) and liquidity with coefficients of 0.248 and 0.991 respectively. This positive relation suggests that profitable years are followed by subsequent loan granting and that credit unions with more liquidity in a year are more likely to extend loans in the following year.

However, we find that higher level of concentration (*HHI*) or higher level of risk (*Z-score*) are negatively related to banks loan extension with coefficients of -0.001 and -0.172 respectively. We find no clear effect of capital buffers on commercial or mortgage loans. Higher liquidity position is also associated to higher portions of commercial and mortgage loans. Further, we find that large credit unions are more exposed to mortgage loans and that the business cycle affects negatively credit unions commercial loans.

As the countercyclical buffer would be triggered by tracking the credit cycle, to address our second research question, we study next how the buffer evolved through the credit cycle. We show in Graph 3 (Panel A) that credit unions not only hold substantial buffers above the minimum required buffer but also increase these over time (Graph 3 (Panel B)). We include as instruments capital buffer lags of order higher than 2 and the first or higher moments of the explanatory variables as instruments for the GMM (level and difference equations).

(Insert Table 9 here)

Tables 9 presents the results of estimating Eq. (5), the Hansen test and the tests of serial correlation in the residuals.[23] The effect of the credit cycle is positive (0.0001) but not significant suggesting that credit unions would have to adjust their buffer should the regulator adopts the credit-to-GDP gap as the trigger for the countercyclical buffer requirement. However, as CUs already hold sufficient capital buffers, additional requirements might rather affect their buffer target but will unlikely induce them to shrink assets.

Our results contribute to the regulatory effort to sustain financial intermediation during economic stress times. If constrained in hard periods, credit unions cannot simply reduce their assets to adjust to the risk-weighted buffers. Instead, they have to reduce their asset risk or cut new loans. This underscores the importance of preventing impairments to their capital buffers. In addition, our result is similar to the one in (Karmakar and Mok (2015)). We find that a higher capital buffer at a date *t-1* is positively related to loan growth at date *t*. These results suggest that the activation of the buffers during booms will reduce the excessive loan growth whereas its deactivation during busts, will provide credit unions with sufficient additional capital to augment loans to their members.

5. Robustness checks

(Insert Table 10 and 11 here)

We also test whether our results on the impact of risk- based capital buffer on lending is driven by the severe shock in GDP experienced in 2009 following the subprime crisis. We perform the analysis ignoring the year 2009 and obtain similar results to those reported previously (see column 3, Table 10) for the risk-based capital buffer.[24]

We check whether the results are driven by major credit unions such as Caisse Centrale Desjardins and Vancity credit union. We exclude the 10th decile of the size distribution (the largest credit union) and find that our two results holds (see column 2, Table 10) and are not driven by the observations in the tail of the size distribution.

The risk-based capital ratio has been criticized because its denominator, the RWA (risk-weighted assets) can be gambled (as documented by Hillier et al. 1998 for Australian credit unions). Hence, we complement our capital buffer measure with a non-risk-weighted capital buffer (*BUFF_A*). The

[23] We use all exogenous variables (i.e., *LOSS, LIQUID, SIZE, RISK, GDPG, CGDPG, dyMERGER, ROA, AGE*) as instruments. The Hansen J test p-value of the GMM estimation is 0.592 suggesting that instruments are valid and robust. We also include the *TERM spread* as an instrument for the lag of the buffer. As our serial correlation test (AR (1) test in Table 9) rejects the presence of the 2nd order autocorrelation, we use lags of the *BUFF_R* variable (lag 2 to 4) as GMM-type instruments. We have 23 instruments, which is below 76, the number of groups, ruling out overidentification issues.

[24] However, the negative relation disappears for the case of non-risk-based capital buffers.

non-risk adjusted capital buffer is computed as the credit union capital-to-asset ratio minus the minimum requirement of 5%. The positive effect of capitalization still holds (see column (2), Table 11). However, since the non-risk-adjusted buffer is not regulated under Basel III, the negative relation with changes in the *BUFF_R* documented earlier weakens.

As our liquidity measure only accounts for cash and cash-like instruments, we use another metric of liquidity (*LIQ2*) computed as (Cash + Investments)/Total assets. Our main result holds suggesting that the impact of the capital buffer is not driven by a crude measure of CU liquidity.

6. Policy implications

Under Basel III, the two mandatory capital buffers (conservation and countercyclical risk-based capital buffers) require credit unions to maintain sufficient Tier 1 capital buffers[25] to stay well-capitalized. Some D-SFI (Domestic Systemically Financial Institutions) such as the Caisses Populaires Desjardins will be required to have a 1% common equity additional capital buffer. These capital buffer requirements are desirable for several reasons. First, they serve as a backstop against sudden macroeconomic or idiosyncratic[26] portfolio unexpected losses inflicted to credit unions. Second, as credit unions cannot rapidly build up their capital compared to banks, the buffer requirements will force less capitalized credit unions to build up capital that can be used in periods of distress. Third, as the disciplinary role of credit union members is weakened[27] in most credit unions, capital buffers could serve as a backstop against adverse results from management moral hazard behavior.[28] Fourth and more importantly, as capitalization is an important determinant of loan growth in credit unions, additional buffers will foster lending during busts and constrain excessive asset expansion during booms. As indicated earlier, unlike banks, credit unions are more constrained in raising additional capital.[29] For example, under the pressure to attain 8% capital ratio in 1992 imposed by the Australian Financial Institutions Code (AFIC), credit unions in Australia did accounting window dressing instead of improving their capital positions. To avoid such arbitrage, capital buffers regulations should not be "one size fits all" and exert undue regulatory burden to credit unions. In this respect, regulators might account for credit union specificities when applying Basel III rules to credit unions.[30] We recommend that the transition period be sufficiently long to allow credit unions to progressively build up their capital buffers. Our results somewhat support the suggestion made by Canadian Credit Union Association (CCUA) in their 2016 pre-

[25] 2.5% of RWA for the conservative buffer and 2.5% or RWA for the countercyclical buffer.

[26] Such as operational losses or major credit losses due to correlated defaults because of their "common bond".

[27] In fact, due to the one-member-one vote situation, the incentive and ability of members to generate a high concentration of voting power is limited and attendance of members at votes are low (Hillier et al., 2008). This reduction of the member supervisory power increases the information asymmetry that can trigger credit union runs in the event of doubt about its financial condition. In addition, credit unions as private entities are immune to free-market discipline.

[28] This includes expense preference or excessive risk taking. For example, Ely (2014) shows that the switch by many credit unions to community and multiple-bond fields of membership have increased credit unions' risk.

[29] The only alternatives for them is to retain profit or issue members or investment shares. Credit unions are non-profit oriented institutions, and so cannot charge higher margins compared to commercial banks. This limits their ability to rely solely on profits to build up their capital buffers. Credit unions are also constrained in their capacity to raise investment shares. In addition, investment shares are not eligible as common shares or Tier 1 capital because they are redeemable on the member demand. Concerning member shares, the issue price ranges from $5 to $100 per share and members cannot purchase more than $1,000 worth of membership shares in addition to the minimum number of membership shares required by a credit union's by-laws.

[30] The implementation of these buffers may be adjusted to reflect credit unions' size, cooperative structure, and constituencies' characteristics in order to preserve their social service as non-profit entities. For example, regulators could limit dividend payment by low capitalized credit unions until they meet the minimum capital buffer requirement, which is 2.5% of risk-weighted assets.

budget submission to the Department of Finance of Canada. Firstly, they propose the implementation of federal loan guarantee to support credit union lending. This will lower the risk weight applied to these loans and thereby reduces the required capital. Secondly, as credit union changes in capital buffer are negatively associated to their lending, the tax rebated suggested by the CCUA will allow credit union to build additional capital through retained earnings.[31] Concerning the activation of the countercyclical buffer, our simulation suggests that regulators should not rely solely on the credit-to- GDP gap as a sole trigger, as it would have been misleading in the Canadian case. As credit unions operate locally, we believe that a provincial-level credit-to-GDP ratio will be more suitable for their regulation than a national measure of credit-to-GDP.

7. Conclusion

Based on a unique sample of the 100 largest credit unions in Canada from 1996 to 2014, this paper examines the effects of the Basel III buffer requirements on credit unions lending. We find that capital buffers are positively related to credit unions' loans to assets ratios and loan growth. However, changes in the risk-based capital buffer are negatively associated with changes in loans and changes in loan growth. These results suggest that capital buffers are an important input for credit union lending and that these are more likely to curtail new loans to adjust to the required capital ratios during recessions, something that underscores the importance of the capital buffer regulations. Additionally, we find that credit unions hold capital buffers bigger than 5% of risk-weighted assets (RWA) which is the maximum buffer advocated under Basel III. Assuming that the countercyclical capital buffer were activated starting in 1996, our buffer simulation suggests that credit unions on average would have fulfilled the requirement. We find that if the countercyclical buffer were activated since 1996, it would have required credit unions to raise capital at the wrong time (before 2000 and at the beginning of the crisis in 2009). This echoes critics about the mechanical application of the credit-to-GDP gap and confirms the importance of both local and national regulatory judgment and discernment in the implementation of buffers requirements.

[31] In addition to these measures, regulators could exceptionally allow credit unions to use some hybrid capital such as high quality debentures or investment shares as Tier 1 capital under some restriction (longer maturity) to guarantee their loss absorbing capacity.

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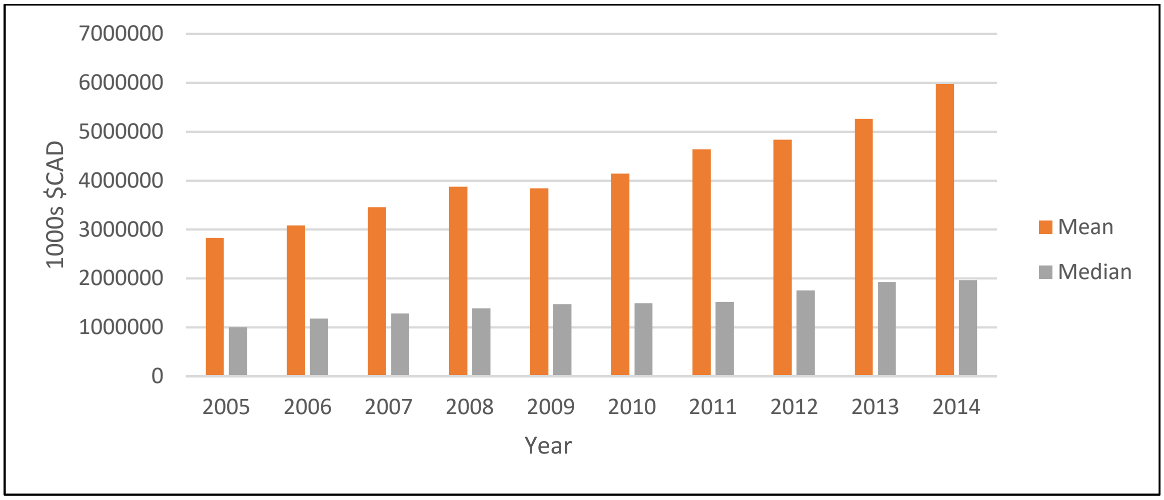
Graph 1: Asset distribution by year for credit unions with available annual reports from 2005 to 2014

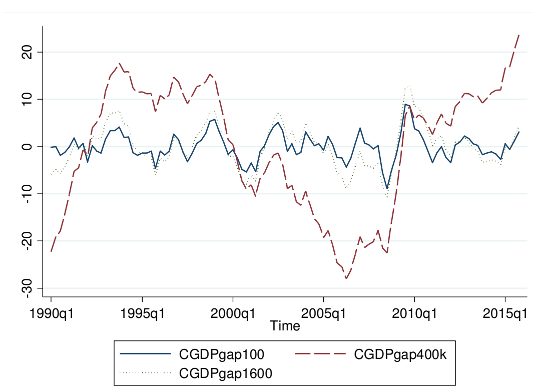
This graph plots the average and median value of credit union total assets by years. For the sake of homogeneity, we only use a set of 18 of the 100 largest credit unions which have continuous reported annual data for the 1996-2014 period.



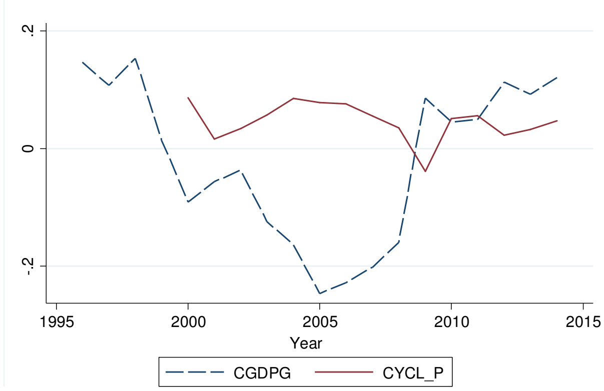
Graph 2: Canadian credit-to-GDP (CGDP) gap and GDP growth (CYCL_C)

The graph plots the Canadian credit-to-GDP gap computed for different parameters (λ = 100, 1600 and 400 000) (Panel A) and the plots of the CGDPG (with λ = 400 000) and the Canadian GDP growth. The credit-to-GDP gap is defined as the difference between the credit-to-GDP ratio (i.e., the ratio of a country's national debt to its gross domestic product (GDP)) and its long-run trend.

Panel A: CGDPG with (λ = 100, 1600 and 400 000)



Panel B: Joint plot of the CGDPG with (λ = 400 000) and the GDPG

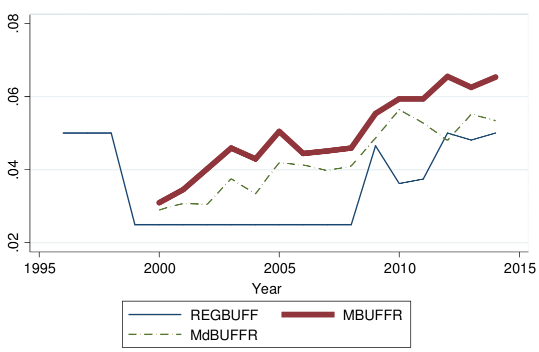


Graph 3: Credit union risk-based capital buffer and the credit cycle

This graph plots in panel A, the different capital buffers (regulatory minimum, average capital buffer and the median capital buffer) and in panel B the dynamic of the credit-to-GDP ratio and the risk-based median capital buffer. The credit-to-GDP ratio is the ratio of a country's national debt to its gross domestic product (GDP).

Both the median and the average capital buffers (MdBUFFR, MBUFFR) are above the minimum buffer (REGBUFF) except in 2011 when the median buffer falls below the minimum buffer suggesting that there are credit unions that operate below the minimum buffer requirement at this date. Panel B shows evidence that the Canadian credit has increased steadily since the beginning of the sample. Interestingly, credit unions have increase their buffer in the same period.

Panel A: Actual buffers and minimum buffer under Basel III



Panel B: Credit to GDP ratio and credit union buffer

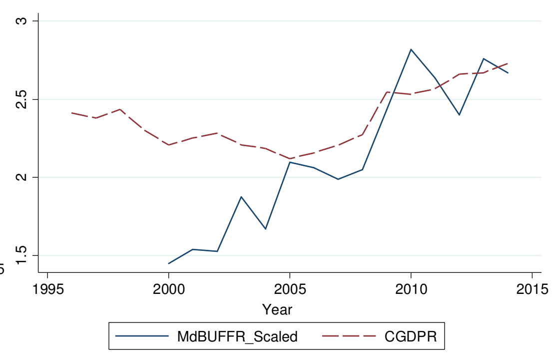


Table 1: Average assets and liabilities, major components in 1000s of $CAD

This table presents the average of major asset and liability components in 1000s of $CAD. We provide descriptive statistics for the whole sample period (1996-2014) and three sub-periods: the pre-crisis period (1996 to 2006), the crisis period (2007-2009) and the post-crisis period (2010-2014). We account for heterogeneity in size by computing weighted statistics. Weights are computed for a given credit union as the ratio of its average total assets and the sum of all credit union average assets. Weights must sum to 1. On the assets side we compute statistics for cash, loans to members and investments. On the liabilities and members' equity side, we look at the member deposits, borrowings and members' equity. Data covers the 100 largest credit unions in Canada according to the ranking of the Credit Union Central Canada (CUCA) during the 1996-2014 period.

Assets and liabilities (in 1000s $CAD)		1996-2014	1996-2007	2008-2009	2010-2014
Assets (major components) in 1000s $CAD					
	Cash	280,399.5	359,614	418,212.9	158,318.3
	Loans to members	6,649,570.9	5,780,384.3	6,272,912.9	7,458,044.8
	Investments	1,428,026.9	1,477,173.5	1,145,947.0	1,524,266.5
Total assets		9,192,280.4	8,263,917.8	8,852,468.9	10,000,000
Liabilities and member's equity (major components) in 1000s $CAD					
	Member deposits	7,422,235.5	6,715,729.2	6,869,167.6	8,194,868.8
	Borrowings	216,344	187,789.6	275,742.1	203,853.4
Total liabilities		8,221,307	7,880,625	7,423,582	8,843,668
	Members' equity	515,619.9	377,240	465,368.2	640,249.9

Table 2: Assets and liabilities, major components in proportions

This table presents major components of assets and liabilities in relative proportions. We provide descriptive statistics for the whole sample period (1996-2014) and three sub-periods: the pre-crisis period (1996 to 2006), the crisis period (2007-2009) and the post-crisis period (2010-2014). We account for heterogeneity in size by computing weighted statistics. Weights are computed for a given credit union as the ratio of its average total assets and the sum of all credit union average assets. On the assets side we compute statistics for cash, loans to members and investments. On the liabilities and members' equity side, we look at the member deposits, borrowings and members' equity. Data covers the 100 largest credit unions in Canada according to the ranking of the Credit Union Central Canada[32] (CUCA) during the 1996-2014 period.

Shares of assets and liabilities components	1996-2014	1996-2006	2007-2009	2010-2014
Asset structure (major components)				
Cash	0.04	0.05	0.05	0.03
Loans to members	0.79	0.75	0.78	0.81
Investments	0.12	0.14	0.10	0.11
Property and equipment	0.01	0.01	0.01	0.01
Others assets	0.04	0.05	0.06	0.04
Total liabilities and member's equity structure (major components)				
Member deposits	0.86	0.85	0.87	0.87
Borrowings	0.03	0.03	0.03	0.02
Members' equity	0.06	0.05	0.07	0.06
Others liabilities	0.05	0.07	0.03	0.05

Table 3: Average and median of regulatory capital, capital ratios and risk-weighted assets (in 1000s of $CAD)

This table presents the average and median of total regulatory capital, capital ratios and risk-weighted assets in 1000s of $CAD. Median values are in parenthesis. We provide descriptive statistics for the whole sample period (1996-2014) and three sub-periods: the pre-crisis period (1996 to 2006), the crisis period (2007-2009) and the post-crisis period (2010-2014). We account for heterogeneity in size by computing weighted statistics. Weights are computed for a given credit union as the ratio of its average total assets and the sum of all credit union average assets. Weights must sum to 1. Data covers the 100 largest credit unions in Canada according to the ranking of the Credit Union Central Canada (CUCA) during the 1996-2014 period.

Mean (Median)	1996-2014	1996-2006	2007-2009	2010-2014
Leverage ratio	0.0672	0.0611	0.0676	0.0698
	(0.0654)	(0.06)	(0.0647)	(0.0683)
Risk-based capital ratio	0.1328	0.1250	0.1274	0.1399
	(0.1324)	(0.1189)	(0.1302)	(0.136)
in 1000s $CAD				
Total regulatory capital	670,451.3	540,297.9	655,824.1	745,564.7
	(531,850)	(548,432)	(592,633)	(439,947)
Risk-weighted assets	4,963,129	4,253,719	5,032,201	4,307,359
	(4,499,025)	(4,225,353)	(5,837,589)	(5,311,559)

[32] Now the Canadian Credit Union Association (CCUA)

Table 4: Total assets, distribution by year (1000s $CAD)

This table presents the descriptive statistics (by year) of the total assets held by credit unions. Data covers the 100 largest credit unions in Canada according to the ranking of the Credit Union Central Canada (CUCA) during the 1996-2014 period.

Panel A: Asset distribution by year for the whole credit union system (2005-2014)

Year	N. obs	Mean	Median	Std. dev	Min	Max	Skew (kurt.)
2014	93	2,112,724	620,258	5,300,005	41,042	44,300,000	6.07 (45.73)
2013	99	1,810,147	568,682	4,298,811	37,083	34,800,000	5.21 (38.53)
2012	95	1,709,835	533,044	3,893,035	35,441	29,300,000	4.95 (31.00)
2011	85	1,757,447	527,686	4,031,550	69,077	30,000,000	5.01 (31.81)
2010	76	1,713,599	514,932	3,817,718	51,118	26,900,000	4.73 (28.33)
2009	61	1,846,629	535,624	3,767,254	44,550	22,600,000	3.84 (18.75)
2008	44	2,223,224	733,864	4,464,992	43,992	25,300,000	3.87 (18.17)
2007	33	2,426,342	927,035	4,340,368	157,468	20,400,000	2.98 (11.53)
2006	26	2,265,204	815,763	4,188,155	141,691	17,600,000	2.66 (9.12)
2005	18	2,828,980	1,002,046	4,440,743	255,238	15,800,000	2.00 (5.67)

Panel B: Asset distribution by year for credit unions which continuously provide annuals report from 2005 to 2014

Year	N. obs	Mean	Median	Std. dev	Min	Max	Skew (kurt.)
2014	18	5,970,327	1,961,590	10,800,000	447,638	44,300,000	2.793 (10.22)
2013	18	5,260,232	1,925,562	8,748,023	391,389	34,800,000	2.46 (8.39)
2012	18	4,835,383	1,752,696	7,660,676	369,683	29,300,000	4.95 (31.00)
2011	18	4,639,409	1,516,758	7,675,352	362,301	30,000,000	5.01 (31.81)
2010	18	4,139,512	1,494,454	6,866,562	355,221	26,900,000	2.35 (7.81)
2009	18	3,839,135	1,471,968	6,067,704	312,348	25,300,000	2.35 (7.63)
2008	18	3,872,400	1,383,817	6,566,588	340,291	22,600,000	2.12 (6.43)
2007	18	3,452,425	1,284,265	5,599,230	291,441	20,400,000	2.98 (11.53)
2006	18	3,080,926	1,180,277	4,843,571	278,433	17,600,000	2.66 (9.115)
2005	18	2,828,980	1,002,046	4,440,743	255,238	15,800,000	2.00 (5.67)

Table 5: Definition of the variables

This table presents the dependent variables, the business cycle indicators and the credit union-specific control variables.

	Dependent variables
BUFF_R (risk-based)	Basel capital to risk-weighted assets ratio minus 8%
BUFF_A (non risk-based)	Basel capital to risk-weighted assets ratio minus 8%
LOTA	Loans to assets (Loans to members/Total assets)
LOANG	Loans to members growth (Difference of the logarithm of total loans to members)
COM_LOAN	Share of commercial loans in total loans
MORT_LOAN	Share of mortgage loans in total loans
	Credit and business cycle variables
CYCL (CGDPG)	Credit-to-GDP Gap Canada obtained by applying the HP filter with a parameter of 400 000
GDP growth	GDP growth by province
	Credit unions specific (control) variables
LIQUID	Cash over total assets
RISK	Risk-weighted assets scaled by total assets
SIZE	Natural log of total assets
ROA	Annual net profit before taxes over total assets
dyMERGER	1 for the acquirer in the year of the merger and 0 otherwise
LOSS	Loan loss provision over total loans
BANK_R	Bank lending rate
AGE	Age of the credit union
Z-score	Computed as (CAPR + μ_{ROA})/σ_{ROA}
HHI	Province-specific concentration index
TERM_SPREAD	10-year Government bond yield – 3-month T-bill yield
COM_SPREAD	3-month Commercial paper rate – 3-month T-bill yield
MORTG_SPREAD	5-year Mortgage rate– 3-month T-bill rate
REG	Takes one before 2008 and zero after to capture regulatory changes

Table 6: Descriptive statistics for the variables used in the study

This table presents the descriptive statistics for the variables used in the study. These statistics are computed based on the 100 largest credit unions in Canada according to the ranking of the Credit Union Central Canada (CUCA) during the 1996-2014 period. Dependent variables are: *BUFF_R* (Basel risk-based capital ratio minus 8%), *LOTA* (loans to assets) and *RWA* (risk-weighted assets scaled by the average whole sample risk-weighted assets) and *LOANG* (the annual difference of the logarithm of the total loans). Credit and business cycle variables are: *CGDPG* (the credit-to-GDP gap) for the credit cycle and the *GDPG* (GDP growth by province). Credit unions specific (control) variables are: *LIQUID* (cash over total assets), *RISK* (risk-weighted assets scaled by the total assets), *SIZE* (natural log of total assets), *dyMERGER* (1 for the acquirer in the year of the merger and 0 otherwise), *LOSS* (loan loss provision over total loans), *AGE* (age of the credit union), *Z-score* ((CAPR + μ_{ROA})/σ_{ROA}), *HHI* (Province-specific concentration index), *TERM_SPREAD* (10-year Government bond yield – 3-month T-bill yield), *COM_SPREAD* (3-month Commercial paper rate – 3-month T-bill yield), *MORTG_SPREAD* (5-year Mortgage rate– 3-month T-bill rate), *REG* (takes one before 2008 and zero after to capture regulatory changes).

VARIABLES	**N**	**Mean**	**p50**	**Sd.**	**p25**	**p75**	**Skewness**	**Kurtosis**	**Min**	**Max**
BUFF_R	485	0.058	0.050	0.048	0.031	0.070	0.058	0.048	0.002	0.632
BUFF_A	449	0.020	0.017	0.021	0.008	0.028	2.628	18.625	-0.050	0.200
LOANG	589	0.094	0.077	0.105	0.047	0.116	3.885	29.44	-0.127	1.184
LOTA	689	0.823	0.839	0.0705	0.801	0.870	-1.988	7.747	0.471	0.919
COM_LOAN	495	0.245	0.254	0.106	0.176	0.309	0.560	7.163	0.0001	0.99
MORT_LOAN	466	0.537	0.557	0.149	0.436	0.648	-0.864	3.998	0.0003	0.896
ROA	689	0.005	0.004	0.005	0.003	0.006	4.832	34.640	-0.016	0.0530
LOSS	687	0.001	0.001	0.002	0.000	0.002	6.521	59.17	-0.002	0.0261
RISK	402	0.525	0.530	0.107	0.441	0.606	0.127	3.196	0.257	0.919
LIQUID	689	0.049	0.033	0.050	0.016	0.070	2.594	13.39	0.000	0.398
SIZE	689	13.580	13.31	1.258	12.640	14.38	0.688	3.169	10.48	17.61
AGE	689	59.00	63.00	19.19	54.00	69.00	-0.842	5.069	0.000	114
BANK_R	630	3.893	3.25	1.46	3.25	3.25	2.141	6.036	3.25	8
CGDPG	696	2.291	8.589	11.79	1.415	11.26	-1.170	2.829	-24.63	23.66
GDPG	666	0.041	0.045	0.047	0.0320	0.0560	-0.327	11.91	-0.206	0.296
Z-score	681	-0.139	-0.139	2.674	2.674	2.674	2.674	2.674	-57.51	20.84
HHI	696	0.704	0.819	0.248	0.671	0.842	-1.894	5.717	0	1
TERM_SPREAD	692	1.274	1.103	1.274	0.693	1.851	0.139	2.222	-0.348	2.856
COM_SPREAD	692	0.266	0.197	0.169	0.187	0.266	2.460	8.765	0.0718	0.842
MORTG_SPREAD	692	-3.197	-3.080	0.666	-3.4	-2.905	0.203	3.277	-4.401	-1.729

Table 7: Correlation matrix

This table presents the Pearson correlation statistics on the dependent variables, business cycle variables and some credit union-specific (control) variables. Our results are built on non-balanced panel data of the 100 largest credit unions in Canada according to the ranking of the Credit Union Central Canada (CUCA) during the 1996-2014 period. Dependent variables are: *BUFF_R* (Basel risk-based capital ratio minus 8%), *LOTA* (Loans to assets). Business cycle variables are: *GDPG* (GDP growth by province). Credit cycle is measured by the credit-to-GDP gap (*CGDPG*). Credit unions specific (control) variables are: *LIQUID* (cash over total assets), *RISK* (risk-weighted assets scaled by the total assets), *SIZE* (natural log of total assets), *LOSS* (loan loss provision over total loans), *AGE* (age of the credit union) and *ROA* (the return on credit union assets).

	BUFF_R	*LOANG*	*CAP*	*RWA*	*RISK*	*LOSS*	*LIQUID*	*SIZE*	*GDPG*	*CGDPG*	*ROA*	*AGE*
BUFF_R	*1*											
LOANG	***-0.12***	*1*										
CAP	*-0.01*	*0.11*	*1.00*									
RWA	*-0.07*	***0.15***	***0.99***	*1.00*								
RISK	***-0.36***	*0.08*	***-0.13***	*-0.08*	*1.00*							
LOSS	*0.02*	*-0.03*	*-0.06*	*-0.03*	*-0.01*	*1.00*						
LIQUID	***0.34***	*-0.11*	***-0.13***	***-0.14***	***-0.23***	*0.07*	*1.00*					
SIZE	***-0.25***	*0.08*	***0.75***	***0.80***	*0.04*	***-0.11***	***-0.23***	*1.00*				
GDPG	*-0.03*	*-0.03*	*-0.04*	*-0.04*	*0.06*	*-0.01*	*-0.01*	*0.02*	*1.00*			
CGDPG	***0.15***	*-0.09*	*-0.11*	***-0.16***	*0.00*	*-0.02*	*0.00*	***-0.10***	***-0.25***	*1*		
ROA	*0.07*	*0.10*	*-0.03*	*-0.03*	*-0.05*	*-0.02*	*-0.03*	*-0.04*	*0.09*	***-0.11***	*1.00*	
AGE	*0.09*	*-0.06*	***0.21***	***0.16***	***-0.25***	*-0.08*	*-0.05*	*0.09*	*-0.07*	*0.03*	*-0.07*	*1.00*

Note: We use **bold** for correlation values significant at the 1% level.

Table 8: Fixed effects estimation of the risk-based capital buffer (BUFF_R) on credit union loan portfolio

This table presents the estimation of the effect of capital buffer on credit union lending

$$\Delta LOAN_{it} = \mu + \beta_1 BUFF_{it-1} + \sum_{j=2}^{K} \beta_j X_{ijt-1} + \varepsilon_{it} \qquad (1)$$

Where $\Delta LOAN = LOAN_{it} - LOAN_{it-1}$ and $LOAN$ is the loans to assets ratio (*LOTA*), the share of mortgage loans in total loans (*MORT_LOAN*) or the share of commercial loans in total loans (*COM_LOAN)*. *BUFF* is either the risk-based capital buffer in level (*BUFF_R)* or change in capital buffer (*ΔBUFF_R)*. Our analysis is conducted on non-balanced panel data of the 100 largest credit unions in Canada according to the ranking of the Credit Union Central Canada (CUCA) during the 1996-2014 period. ***Credit unions specific (control) variables*** include: *LIQUID* (cash over total assets), *SIZE* (natural log of total assets), *ROA* (return on credit union assets), *BANK_R* (bank business prime rate), *LOSS* (non performing assets over total assets), *Z-score* ((risk-based capital ratio minus average (ROA))/standard deviation (ROA)), *AGE* (age of the credit union), *dyMERGER* (1 for the acquirer in the year of the merger and 0 otherwise). ***Macro variables*** include: *HHI* (credit union province specific concentration index), *COM_SPREAD* (market confidence computed as the difference between 3-month Commercial paper rate and 3-month T-bill rate), *TERM_SPREAD* (government policy measured by the difference between 10-year government bond yield and 3 month T-bill yield), *MORTG_SPREAD* (computed as the difference between 5-year mortgage loan rate and 3-month T-bill rate). ***Business and credit cycle variables*** are: *GDPG* (GDP growth by province) and *CGDPG* (the credit-to-GDP Gap). Regulatory variable is *REG* which captures regulatory changes. It takes one before 2008 and zero after. Robust standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1.

We uncover a positive relation (0.191) between the credit union capitalization (BUFF_R) in one period and its ability to extend loans in the next period. In opposite, changes in capital buffers and loans are negatively (-0.278) related suggesting that capital buffer constrained credit unions are likely to reduce credit to the economy.

Table 8 (cont.)

	Effect of BUFF_R on CU loans			Effect of ΔBUFF_R on CU loans		
VARIABLES	ΔLOTA	ΔMORT_LOAN	ΔCOM_LOAN	ΔLOTA	ΔMORT_LOAN	ΔCOM_LOAN
BUFF_R	**0.191*****	-0.329	**0.310***			
	(0.0333)	(0.214)	(0.169)			
ΔBUFF_R				**-0.278*****	0.285	-0.0959
				(0.0810)	(0.251)	(0.345)
LIQUID	**0.248****	0.197*	0.00894	**0.241****	0.0943	-0.0144
	(0.0951)	(0.114)	(0.115)	(0.0922)	(0.105)	(0.112)
SIZE	-0.0392	**-0.0934*****	0.0137	-0.0629	**-0.0866*****	0.0202
	(0.0587)	(0.0227)	(0.0259)	(0.0567)	(0.0231)	(0.0239)
ROA	**0.991****	0.155	-0.00281	**0.823*****	0.354	0.0737
	(0.420)	(0.955)	(1.236)	(0.232)	(0.981)	(1.249)
BANK_R	0.00202	-0.0209	0.0147	-0.00235	-0.00844	0.0271*
	(0.00848)	(0.0178)	(0.0167)	(0.00860)	(0.0162)	(0.0148)
LOSS	-1.303	**11.88*****	**-3.876***	-1.242	**11.00*****	**-4.340***
	(1.962)	(3.837)	(2.270)	(2.217)	(3.493)	(2.361)
Z-score	**-0.00104*****	0.000221	3.37e-05	**-0.00103*****	7.73e-05	0.000167
	(0.000224)	(0.00173)	(0.000359)	(0.000240)	(0.00174)	(0.000396)
AGE	0.00538	0.00410	0.00754	0.00648	0.00297	0.0113
	(0.00541)	(0.00717)	(0.00768)	(0.00516)	(0.00753)	(0.00769)
dyMERGER	-0.00207	-0.00147	**0.0183****	0.00288	-0.00165	**0.0189****
	(0.00777)	(0.00971)	(0.00868)	(0.00625)	(0.00973)	(0.00861)
HHI	**-0.172****	-0.136	-0.117	**-0.184****	-0.113	-0.0986
	(0.0767)	(0.169)	(0.112)	(0.0881)	(0.169)	(0.115)
COM_SPREAD	-0.0660	0.0989	-0.161	-0.0382	-0.00476	-0.265*
	(0.0656)	(0.168)	(0.148)	(0.0652)	(0.167)	(0.142)
TERM_SPREAD	-0.00837	-0.0162	0.0117	-0.00796	-0.0115	0.0181
	(0.00879)	(0.0155)	(0.0165)	(0.00861)	(0.0135)	(0.0155)
CYCL_P	-0.144	-0.247*	-0.0251	-0.169	-0.182	0.0215
	(0.104)	(0.139)	(0.0763)	(0.103)	(0.127)	(0.0684)
CGDPG	-0.000940	-0.000650	**-0.00397****	-0.000865	-0.000323	**-0.00426****
	(0.000984)	(0.00232)	(0.00177)	(0.00100)	(0.00231)	(0.00180)
REG	-0.0452	-0.0163	-0.0687	-0.0355	-0.0369	-0.0853
	(0.0319)	(0.0859)	(0.0699)	(0.0322)	(0.0794)	(0.0604)
Constant	0.368	1.261**	-0.602	0.656	1.166*	-0.955*
	(0.674)	(0.606)	(0.565)	(0.676)	(0.589)	(0.499)
Obs.	383	275	288	358	264	277
R-squared	0.170	0.110	0.079	0.207	0.131	0.081
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Nb of CU-id	89	70	73	87	69	72

Table 9: Blundell-Bond GMM (one step) estimation of the relation between the risk-based capital buffer (*BUFF_R*) and the credit cycle

$$BUFF_{it} = \beta_0 + \beta_1 BUFF_{it-1} + \beta_2 CCYCL_t + \beta_3 BCYCL_t + \sum_{j=4}^{K} \beta_j X_{ijt-1} + \varepsilon_{it} \quad (5)$$

This table presents the Blundell-Bond GMM one step estimates of the Basel risk-based capital buffer (*BUFF_R*). The two-step estimation does not converge. Our results are built on non-balanced panel data of the 100 largest credit unions in Canada according to the ranking of the Credit Union Central Canada (CUCA) during the 1996-2014 period. The dependent variable is the risk-adjusted capital buffer (*BUFF_R*) computed as the Basel risk-based capital ratio minus 8%. Business cycle variables are: *GDPG* (GDP growth by province). Credit cycle is measured by the credit-to-GDP gap (*CGDPG*). *GDPG*dyLOW* is introduced to control for low capital buffer credit unions as in Hessou and Lai (2017). Credit unions specific (control) variables are: *LIQUID* (cash over total assets), *RISK* (risk-weighted assets scaled by the total assets), *SIZE* (natural log of total assets), *dyMERGER* (1 for the acquirer in the year of the merger and 0 otherwise), *LOSS* (loan loss provision over total loans), *AGE* (age of the credit union) and *ROA* (return on credit union assets). Blundell-Bond AR (1) and AR (2) tests are provided at the end of the table. Instruments include the lags of the buffer. We also include as instruments the rest of explanatory variables.

VARIABLES	GMM	2SLS
BUFF_R	0.0858	0.300***
	(0.0912)	(0.115)
LOSS	0.286	-0.701
	(1.069)	(0.842)
LIQUID	0.171**	0.00678
	(0.0853)	(0.0230)
SIZE	-0.00299	-0.0392***
	(0.00222)	(0.00907)
RISK	-0.0604	-0.133***
	(0.0568)	(0.0186)
BANK_R	-0.0112	-0.00284
	(0.0103)	(0.00293)
GDPG	0.147***	0.0376*
	(0.0489)	(0.0212)
*GDPG*dyLOW*	-0.158**	-0.0899***
	(0.0682)	(0.0253)
CGDPG	0.000616	0.000109
	(0.000489)	(0.000255)
AGE	0.000104	0.00359***
	(0.000125)	(0.00108)
dyMERGER	-0.00163	0.00276
	(0.00293)	(0.00284)
ROA	0.327	0.440
	(0.347)	(0.458)
REG	0.0894	0.00307
	(0.0669)	(0.00913)
Constant	0.139**	0.447***
	(0.0642)	(0.0909)
Observations	315	245
Number of CU-id	76	67
AR(1) test	0.045	
AR(2) test	0.078	
Hansen J	0.592	

Table 10: Robustness checks (Part 1):

In this table, we offer a first analysis of our robustness check: In (1) we use an alternative dependent variable (LOANG), in (2), we provide the analysis without the largest credit unions and in (3), and we provide the analysis with the peak 2009 of the global financial crisis excluded. In Table 10, we estimate the following equation.

$$\Delta LOAN_{it} = \beta_0 + \beta_1 BUFF_{it-1} + \sum_{j=2}^{K} \beta_j X_{ijt-1} + \varepsilon_{it} \qquad (1)$$

where $\Delta LOAN$ is either the loan growth (column 1) or the change in loans to assets ratio. $BUFF$ is either the risk-based capital buffer in level (*BUFF_R)* or change in capital buffer (*ΔBUFF_R)*. Our analysis is conducted on non-balanced panel data of the 100 largest credit unions in Canada according to the ranking of the Credit Union Central Canada (CUCA) during the 1996-2014 period. ***Credit unions specific (control) variables*** include: *LIQUID* (cash over total assets), *SIZE* (natural log of total assets), *ROA* (return on credit union assets), *BANK_R* (bank business prime rate), *LOSS* (non performing assets over total assets), *Z-score* ((risk-based capital ratio minus average (ROA))/standard deviation (ROA)), *AGE* (age of the credit union), *dyMERGER* (1 for the acquirer in the year of the merger and 0 otherwise). ***Macro variables*** include: *HHI* (credit union province specific concentration index), *COM_SPREAD* (market confidence computed as the difference between 3-month Commercial paper rate and 3-month T-bill rate), *TERM_SPREAD* (government policy measured by the difference between 10-year government bond yield and 3-month T-bill rate), *MORTG_SPREAD* (computed as the difference between 5-year mortgage loan rate and 3-months T-bill rate). ***Business and credit cycle variables*** are: *GDPG* (GDP growth by province) and *CGDPG* (the credit-to-GDP Gap). Regulatory variable is *REG* which captures regulatory change. It takes one before 2008 and zero after. Robust standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1.

Our main message hold under these different robustness check scenarios. Only the positive effect of capitalization weakens under the alternative measure of loan growth.

Table 10 (cont.)

VARIABLES	(1) LOANG as Dep. Variable		(2) Results without largest CU		(3) Results without the year 2009	
BUFF_R	0.0958		**0.186*****		**0.175*****	
	(0.400)		(0.0355)		(0.0357)	
ΔBUFF_R		**-1.281*****		**-0.262*****		**-0.244*****
		(0.414)		(0.0766)		(0.0819)
LIQUID	0.752**	0.759*	0.267**	0.273**	0.281***	0.285***
	(0.356)	(0.387)	(0.103)	(0.104)	(0.0765)	(0.0775)
SIZE	-0.796***	-0.799***	0.0429	0.0206	0.0117	-0.0113
	(0.250)	(0.281)	(0.0308)	(0.0282)	(0.0260)	(0.0213)
ROA	-1.611	0.489	0.926***	0.798***	1.073***	0.911***
	(2.050)	(1.549)	(0.351)	(0.273)	(0.379)	(0.246)
BANK_R	-0.0159	-0.0400	0.00796	0.00400	0.0195**	0.0160*
	(0.0299)	(0.0302)	(0.00858)	(0.00874)	(0.00866)	(0.00908)
LOSS	3.843	6.270	-1.160	-1.079	-3.322**	-3.376**
	(6.620)	(5.457)	(1.421)	(1.528)	(1.309)	(1.399)
Z-score	-0.0016*	-0.0017*	-0.0012***	-0.001***	-0.000961***	-0.000933***
	(0.0007)	(0.0008)	(0.00018)	(0.0002)	(0.0002)	(0.0002)
AGE	0.053***	0.0492**	0.000532	0.00102	0.00380	0.00441
	(0.0189)	(0.0229)	(0.00524)	(0.00529)	(0.00471)	(0.00453)
dyMERGER	0.0408	0.0241	-0.00216	0.00385	-0.00403	-0.000258
	(0.0435)	(0.0455)	(0.00976)	(0.00829)	(0.00888)	(0.00777)
HHI	-0.434	-0.390	-0.169*	-0.166*	0.0142	0.00728
	(0.343)	(0.297)	(0.0870)	(0.0932)	(0.0682)	(0.0636)
COM_SPREAD	0.109	0.315	-0.1000	-0.0726	-0.157**	-0.133**
	(0.242)	(0.256)	(0.0662)	(0.0665)	(0.0624)	(0.0648)
TERM_SPREAD	-0.0342	-0.0298	-0.00718	-0.00811	0.00583	0.00638
	(0.0462)	(0.0416)	(0.00909)	(0.00897)	(0.0109)	(0.0107)
CYCL_P	-0.253	-0.289	-0.0543	-0.0829	0.0650	0.0363
	(0.417)	(0.439)	(0.0531)	(0.0528)	(0.0476)	(0.0485)
CGDPG	0.00216	0.00397	-0.00111	-0.00105	-7.82e-05	0.000175
	(0.00329)	(0.00327)	(0.000982)	(0.00102)	(0.00113)	(0.00116)
REG	-0.0488	0.0365	-0.0647**	-0.0573**	-0.0350	-0.0264
	(0.105)	(0.106)	(0.0289)	(0.0285)	(0.0308)	(0.0312)
Constant	8.139***	8.424***	-0.462	-0.174	-0.475	-0.178
	(3.048)	(3.098)	(0.339)	(0.334)	(0.311)	(0.303)
Obs.	330	305	342	317	352	328
R-squared	0.286	0.287	0.201	0.219	0.203	0.219
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Nb. of CU-id	84	80	84	82	89	86

Table 11: Robustness checks (Part 2):

In this table, we offer a first analysis of our robustness checks. In (1) we use an alternative liquidity variable (LIQ2). In (2), we use an alternative measure of capital buffer (the non risk-adjusted capital buffer, BUFF_A)

$$\Delta LOAN_{it} = \beta_0 + \beta_1 BUFF_{it-1} + \sum_{j=2}^{K} \beta_j X_{ijt-1} + \varepsilon_{it} \qquad (1)$$

Where $\Delta LOAN$ is either the loan growth (column 1) or the change in loan to asset ratio. $BUFF$ is either the risk-based capital buffer or the non risk capital buffer (both in level and difference). Our analysis is conducted on non-balanced panel data of the 100 largest credit unions in Canada according to the ranking of the Credit Union Central Canada (CUCA) during the 1996-2014 period. Other control variables included in the regression are not reported for conciseness. Robust standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1.

<u>Table main message</u>: Our main result holds with an alternative measure of credit liquidity (in (1)) and capital buffer measure (in (5)). The positive effect of capitalization holds even with the non risk-adjusted capital buffer ((5)). The negative relation between changes in the non risk-adjusted buffer and loans is however insignificant.

VARIABLES	(1) Alternative liquidity measure *LIQ2*=(CASH+Investments)/Assets		(2) Alternative capital buffer measure (*BUFF_A*)	
BUFF_R	**0.107*** **			
	(0.0372)			
ΔBUFF_R		**-0.215*** **		
		(0.0752)		
BUFF_A			**0.748*** **	
			(0.205)	
ΔBUFF_A				-0.827
				(0.510)
LIQ2	**0.546*** **	**0.528*** **	**0.528*** **	**0.588*** **
	(0.0907)	(0.0934)	(0.0821)	(0.0927)
Other control variables	Yes	Yes	Yes	Yes
Constant	0.0601	0.277	-0.420	-0.134
	(0.617)	(0.621)	(0.420)	(0.420)
Obs.	379	356	355	343
R-squared	0.319	0.344	0.346	0.358
Fixed effects	Yes	Yes	Yes	Yes
Nb of idcoop	89	87	80	79