

# How do credit unions adjust their capital ratios? Evidence from Brazil

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## Abstract

**Purpose** – The purpose of this paper is to analyze the speed at which credit unions adjust their capital ratios.

**Design/methodology/approach** – The systemic Generalized Method of Moments (GMM-Sys) was applied to 704 Brazilian individual credit unions from 2014 to 2022, with a total of 5,864 observations.

**Findings** – The results indicate that the median Basel Ratio was higher than the Leverage Ratio, without breaching the regulatory minimum. Credit unions show differences in the speed of adjustment, with faster adjustment for the Basel Ratio compared to the Leverage Ratio. Size influences the speed of adjustment, with larger credit unions being more flexible in adjusting their Leverage Ratio more quickly, while smaller credit unions adjust more slowly to the Basel Ratio. During economic crises, the speed of adjustment of the Basel Ratio was higher, probably due to more thorough analysis by supervisors and stakeholder expectations.

**Originality/value** – The originality of this study lies in the analysis of the speed of adjustment of capital ratios in credit unions, focusing on the differences between the Basel and Leverage Ratios. This study fills a significant gap in the literature, offering insights into how these institutions adjust their capital ratios in the context of Basel III. The research also explores the impact of credit union size and economic crises on these adjustments, contributing to a deeper understanding of the financial behavior of these institutions and its implications for regulators and supervisors.

**Keywords** Capital structure, Capital ratios, Basel III, Credit unions

**Paper type** Doctoral Dissertation

## 1. Introduction

Financial institutions generally have higher leverage than non-financial ones and are subject to capital regulation. In 2008, numerous weaknesses of financial institutions were revealed by the Subprime Crisis, which led to significant pressure to reformulate the regulatory framework of the financial system. In this context, Basel III was created to improve upon the recommendations of Basel I and II (Fortuna, 2015; Jovanovic *et al.*, 2017; Abbas *et al.*, 2020), and these accords represent a milestone in banking regulation strategies implemented worldwide. Basel III reinforces the quantity and quality of capital (Pinheiro *et al.*, 2015; Cohen and Scatigna, 2016) to enhance financial institutions' ability to absorb unexpected losses and ensure stability (Hessou and Lai, 2018).

There is a fast-growing stream of literature investigating the dynamics of bank capital towards a new equilibrium, focusing on the speed at which financial institutions adapt their capital ratios under the influence of the Basel Accords (Berger *et al.*, 2008; Gropp and Heider,

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2010; Memmel and Raupach, 2010; De Jonghe and Öztekin, 2015; Cohen and Scatigna, 2016; Bakkar *et al.*, 2019; Wojewodzki *et al.*, 2020; Oliveira and Raposo, 2021; Abbas and Ali, 2024). It remains unclear whether the speed of adjustment differs between the Leverage Ratio (total equity to total assets), and the Basel Ratio (Tier I and Tier II capital to risk-weighted assets), for credit unions.

In light of these arguments, it is important to analyze the speed of adjustment, especially in order to further investigate the relative importance of factors specific to financial institutions and regulatory factors common to all financial institutions (Gropp and Heider, 2010). From this perspective, the following question needs to be answered: How quickly do credit unions adjust their Leverage and Basel Ratios, considering that they cannot set the desired ratio by ignoring the restrictions imposed by Basel III? Therefore, this study aims to analyze the speed at which credit unions adjust their capital ratios. To this end, a partial adjustment model was estimated following the empirical capital structure literature (corporate and banking), as proposed in Bakkar *et al.* (2019) and Abbas *et al.* (2020), but adapted to Brazilian credit unions.

Credit unions are becoming increasingly important in Brazil's National Financial System. According to the Banco Central do Brasil (BCB, 2022), the number of municipalities served by credit unions grew by 174, reaching a total of 3,080 (55.3% of all municipalities) and serving 15.6 million members in 2022. The percentage of the population associated with credit unions increased across all Brazilian regions, reaching 6.2% nationwide (BCB, 2022).

Unlike other financial institutions, credit unions operate on a non-profit basis and adhere to the principle of "one man, one vote," with the primary objective of providing financial services to their members (Zancan *et al.*, 2023). Moreover, as private entities, they are not permitted to raise capital by issuing new shares in the capital market (Hessou and Lai, 2018), implying that capital shortages cannot be corrected quickly, and suggesting a possible divergence in capital adjustment when compared to other financial institutions.

This study offers potential theoretical, practical and social contributions. With regard to theoretical aspects, although recently Wojewodzki *et al.* (2020), Abbas *et al.* (2020) and Oliveira and Raposo (2021) have analyzed the speed of adjustments in different contexts, these analyses do not include all Brazilian credit unions and no national studies with this focus were identified. Although credit unions represent a promising sector, further exploration of the speed of adjustment is needed to generate new insights about capital held by credit unions, the influence of size and periods of economic crises, aligning with discussions found in the international literature. From a practical perspective, understanding the adjustment dynamics of capital ratios can enable regulators to design more effective supervisory and intervention policies aimed at the stability of financial institutions (Pinheiro *et al.*, 2015; Hessou and Lai, 2018) and more cohesive capital adjustment policies (Wojewodzki *et al.*, 2020), as introduced in Basel III. Credit unions can use capital information to optimize capital management and improve their resilience in the face of economic and regulatory shocks. In terms of social aspects, understanding the speed of adjustment of capital ratios not only informs regulators and policymakers about the stability of the financial system but also has a direct impact on the communities served, reinforcing the important role that credit unions play for their members and the community (Gollo and Silva, 2015). Credit unions are recognized as agents of financial inclusion, especially in areas where traditional banks are absent, providing financial services to underserved populations (BCB, 2022; Zancan *et al.*, 2023). By adjusting their capital ratios effectively, credit unions ensure their ability to support economic and social development in these areas, a role further reinforced by their commitment to social responsibility and cooperative principles, which strengthen both economic and social resilience in the communities they serve (Carrera-Silva *et al.*, 2024).

This article is organized as follows. Section 2 presents a review of the existing literature, followed by a discussion of the model and the econometric methodology in Section 3. Section 4 reports the results, while Section 5 provides the related discussion. Finally, Section 6 discusses the article's conclusions.

## 2. Literature review

### 2.1 Empirical literature on the speed of adjustment of the capital structure

The partial adjustment model proposed by [Flannery and Rangan \(2006\)](#) revealed findings on the speed at which North American companies adjust their capital structure. The results indicated the presence of a target capital level and showed that companies close about one-third of the gap between their current and target capital ratios within a one-year period.

[Berger et al. \(2008\)](#) observed that North American banks hold significantly more capital than is required by regulators. The study, which covers publicly traded bank holding companies between 1992 and 2006, investigates the reasons for this excess capital. Analysis of partial adjustment models reveals that these banks actively manage their capital ratios, setting targets well above regulatory minimums and making rapid adjustments to achieve them.

[De Jonghe and Öztekin \(2015\)](#) analyzed the behavior of the banking capital of 20,073 banks in 64 countries between 1994 and 2010, using the partial adjustment model. The study revealed that the speed of adjustment of capital structure varies by country. Savings banks and cooperative banks adjust their capital structure more slowly than commercial banks because of the lack of access to external capital. In countries with stricter capital requirements, greater supervision, developed capital markets and high inflation, banks adjust their capital structures more quickly, a trend also observed during crises.

[Bakkar et al. \(2019\)](#) analyzed how banks adapt their capital ratios to achieve desired levels by using the partial adjustment model for 554 banks in the United States, Japan and the Eurozone from 2001 to 2012. Significant differences in the speed and mode of adjustment were identified. Banks adjust leverage ratios faster than regulatory ratios. Larger banks tend to adjust more slowly, especially in relation to leverage, while riskier banks adjust more quickly to regulatory ratios. Banks close to minimum regulatory requirements face restrictions that result in slower adjustments to leverage ratios.

[Wojewodzki et al. \(2020\)](#) investigated the impact of credit ratings on the capital structure of 391 banks in 76 countries from 1998 to 2013. The results show an inverse relationship between credit ratings and capital ratio adjustment speed, with higher ratings linked to slower adjustments and lower ratings leading to faster adjustments.

[Abbas et al. \(2020\)](#) analyzed the speed of adjustment of the leverage and regulatory ratios of 899 large commercial banks in the United States between 2002 and 2018. The results indicate that large banks adjust their regulatory ratios faster than their leverage ratios. Well-capitalized banks with high liquidity adjust faster than undercapitalized banks with low liquidity. The speed of adjustment is higher before crises than during or after them.

[Oliveira and Raposo \(2021\)](#) examined whether the determinants of European banks' capital structure depend on the type of the institution, private or public, by studying 586 banks from 21 European countries between 2000 and 2016. They also estimated the speed of adjustment, finding that private banks adjusted their capital more quickly than public banks. This difference is attributed to public banks being more affected by market volatility.

[Abbas and Ali \(2024\)](#) analyzed the speed of capital ratio adjustments in Japanese banks from 2005 to 2020. They found that leverage adjusts faster than other capital ratios, and that well-capitalized and high-liquidity banks adjust faster than undercapitalized and low-liquidity ones.

### 2.2 Development of hypotheses

Empirical studies show significant variation in the speed of bank capital adjustment, with results remaining mixed and inconclusive ([Mommel and Raupach, 2010](#); [De Jonghe and Öztekin, 2015](#); [Abbas and Ali, 2024](#)). [Bakkar et al. \(2019\)](#) note that it remains uncertain whether the adjustment speed should be higher for the Leverage Ratio (LR) compared to the Basel Ratio (BR).

In this perspective, evidence suggests that financial institutions are quicker to adjust to the capital leverage ratio than to the regulatory capital ratio (Bakkar *et al.*, 2019; Abbas and Ali, 2024). In contrast, in the study by Berger *et al.* (2008), banks make rapid adjustments towards the regulatory ratio and hold significantly more equity than required by their regulators. The study by Abbas *et al.* (2020) also found a faster adjustment to the regulatory ratio. The leverage ratio, in the context of credit unions, may incentivize managers to expand beyond the optimal size, as growth enhances their control over resources (Jensen, 1986).

On the other hand, the Basel III regulatory capital ratio currently in force makes credit unions seek to meet the established limit. It is understood that maintaining the minimum capital requirements can guarantee their resilience. Thus, as with financial institutions, credit unions are expected to adjust more quickly to the ratio established by the regulators. The first hypothesis (H1) can be stated as:

*H1.* The speed of adjustment of the Basel Ratio is higher than the Leverage Ratio in credit unions.

The study by Bakkar *et al.* (2019) and Abbas *et al.* (2020) finds that the speed of adjustments is influenced by the size of the financial institution. Larger banks tend to adjust their leverage ratios more slowly, especially when they are close to the minimum regulatory requirements. In contrast, smaller banks show faster adjustments in terms of the Basel Ratio. In the case of credit unions, the trend is different, with larger credit unions expected to adjust their leverage ratios more quickly. The reason for this is probably that credit unions, which often operate in local communities, need to be more agile in managing their capital to respond to economic changes and community needs, according to Carrera-Silva *et al.* (2024). In relation to the Basel Ratio, smaller credit unions may face different challenges compared with banks, which may result in slower adjustments. Credit unions may have access to less diversified sources of capital than banks, limiting their ability to quickly adapt to regulatory requirements. They may also be subject to more flexible regulatory supervision than banks, especially due to the costs and complexity of Basel III, which may lead to less pressure to adjust the Basel Ratio at the same speed. In addition, credit unions may prioritize stability and continuity of services to their members over optimizing capital ratios, which may result in a more cautious and deliberate approach to regulatory adjustments. The credit union size was tested. Thus, the second hypothesis (H2) can be stated as:

*H2.* Larger credit unions make faster adjustments to the Leverage Ratio, while smaller credit unions make slower adjustments to the Basel Ratio.

During economic crises, the effects of these periods can be evidenced by negative variations in the Gross Domestic Product (GDP) rate, as proposed in Filip and Raffounier (2014) and Iatridis and Dimitras (2013), such variations were identified for the years 2015 (−3.545), 2016 (−3.275) and 2020 (−3.276) in Brazil (Figure 1).

Abbas *et al.* (2020) identified that during the crisis periods (2007 and 2009), the time to reach the capital balance ratios and the speed of adjustment were significantly different from the previous periods (2002 and 2006) and post-crisis (2010 and 2018). The management of banks' capital structure changes during crises, and adjustments are made more quickly in these periods, probably due to more rigorous analysis by supervisors and other stakeholders (De Jonghe and Öztekin, 2015). Faster bank capital adjustment in the crisis period was also identified in Cohen and Scatigna (2016). Furthermore, Cao and Chou (2022) highlight that banks with higher regulatory capital ratios before the COVID-19 crisis showed greater lending resilience during the shock, emphasizing the importance of capital strength in crisis periods. It is believed that credit unions have also felt the impacts (Al-Zyoud and Ordóñez-Ponce, 2022), so crisis periods are identified as suitable times to assess the extent to which systems are resilient and how regulatory changes in these periods can contribute to the conditions for facing challenges such as this, especially to maintain the flow of credit to the economy. Thus, the third hypothesis (H3) can be stated as:



**Figure 1.** GDP growth rate (annual %). **Source(s):** Authors' own elaboration based on the [World Bank's national accounts \(2024\)](#)

H3. During economic crises, the speed of adjustment of the Basel Ratio in credit unions is greater than in periods without economic crises.

### 3. Method

#### 3.1 Research model

This study utilizes a partial adjustment model based on [Bakkar et al. \(2019\)](#). As shown in [Equation \(1\)](#), the current capital ratio of a credit union,  $k_{i,t}$ , whether measured by the Leverage Ratio (LR) or Basel Ratio (BR), is modeled as a weighted average – determined by the adjustment speed parameter  $\lambda$   $[0,1]$  – of its target capital ratio  $k^*_{i,t}$ , and the capital ratio from the previous period  $k_{i,t-1}$ , plus a random shock  $\varepsilon_{i,t}$ :

$$k_{i,t} = \lambda k^*_{i,t} + (1 - \lambda) k_{i,t-1} + \varepsilon_{i,t} \quad (1)$$

Where  $i, t$  indicates credit union  $i$  in year  $t$ . Each year, the credit union reduces the difference between its actual and target capital ratios by a proportion  $\lambda$  (lambda). Therefore, a lower value of  $\lambda$  indicates greater rigidity in the bank's capital structure, resulting in a longer time for the credit union to return to its target capital ratio following a shock.  $\lambda$  represents the speed of adjustment, while its complement  $(1 - \lambda)$  reflects the inertia of the capital. In the case of credit unions, the target capital ratio is not explicitly analyzed or defined. Rather, it consists of two elements: a linear combination of the observed characteristics of the bank and country from the previous period (lagged, at time  $t - 1$ ), represented by  $X_{i,t-1}$  ([Equation 2](#)), and fixed effects for both the bank and the time period ([Bakkar et al., 2019](#)).

$$k^*_{i,t} = \beta X_{i,t-1} + v_t + u_i \quad (2)$$

The study by [Gropp and Heider \(2010\)](#) was used to determine the banking characteristics of credit unions, showing that the determinants of non-financial institutions are transferred to banks, a finding later confirmed by [Hoque and Pour \(2018\)](#). Adjustments were made to consider the following determinants for credit unions: size, tangibility, profitability, and risk. This study applied the same sets of indicators for each capital ratio, leverage, and Basel ratio based on their approach. Substituting [Equation \(2\)](#) into [\(1\)](#), produces the specification in [Equation \(3\)](#):

$$k_{i,t} = \lambda (\beta X_{i,t-1} + v_t + u_i) + (1 - \lambda) k_{i,t-1} + \varepsilon_{i,t} \quad (3)$$

It is essential to emphasize that the presence of a lagged dependent variable and a short panel can result in biased estimates of the speed of adjustment if Ordinary Least Squares (OLS) or a standard fixed-effects model are employed (Bakkar *et al.*, 2019). Equation (3) was estimated using unbalanced panel data with the Systemic Generalized Method of Moments (two-step GMM-Sys), a technique also used in prior research (Bakkar *et al.*, 2019; Abbas *et al.*, 2020).

### 3.2 Data and variables

Financial balance statements of all individual credit unions were used, available on the BCB's website (2024). Annual data on the capital ratios regulated by Basel III are also available on the BCB (2024) Website. Only the Basel Ratio was considered to be regulatory capital, as it has values for all the years analyzed. Data were collected from 2011 to 2022, because the construction of the risk variable (RISK) required data from three previous years. However, the analyses were carried out from 2014 onwards, since the BCB (2024) reports ceased to apply Basel II and began to operate under the Basel III definition until 2022, which represents the last year with data available during the collection period for this research. Credit unions with data for only three years, credit unions with negative or unreported shareholders' equity, and credit unions with leverage ratios equal to or greater than one were removed due to measurement errors. In addition, credit unions classified as loan capital were removed, as they do not have current account and deposit transactions, among other characteristics that differentiate them from full and classic credit unions, which are the object of analysis. Thus, 704 individual credit unions were considered, totaling 5,864 observations, analyzed using Stata 14.0 software. The study variables are presented in Tables 1 and 2.

### 3.3 Analytical procedures

The econometric model was estimated using unbalanced panel data, employing the Systemic Generalized Method of Moments (two-step GMM-Sys) for analysis. This method is appropriate for models with a lagged dependent variable and short panel data, as it helps avoid biased estimates. The following tests were used for analysis: (1) correlation; (2) chi-square ( $\chi^2$ ); (3) overidentification by Hansen (1982), and (4) Arellano and Bond (1991). The Hansen test confirmed the validity of the instruments by showing no overidentification, while the Arellano and Bond tests indicated no significant serial correlation in the first-differenced errors, supporting the appropriateness of the instruments used.

The partial adjustment model (Equation 3) was analyzed for both the LR and BR, with special attention given to economic crisis years to assess differences in the speed of capital adjustment during these periods. Studies have identified differences in the speed of adjustment of capital ratios, especially when impacted by periods of crisis (De Jonghe and Öztekin, 2015; Cohen and Scatigna, 2016; Abbas *et al.*, 2020; Al-Zyoud and Ordóñez-Ponce, 2022). The same was analyzed in credit unions, considering the years 2015, 2016, and 2020 as periods of economic crisis and other years, as periods without crisis.

**Table 1.** Description of dependent variables

Variable	Description	Equation	Authors in the context of banks
Leverage Ratio (LR)	Ratio of total equity to total assets	$\frac{\text{Total Equity}}{\text{Total Assets}}$	Banks: De Jonghe and Öztekin (2015), Bakkar <i>et al.</i> (2019), Abbas <i>et al.</i> (2020), Wojewodzki <i>et al.</i> (2020) and Abbas and Ali (2024)
Basel Ratio (BR)	Ratio of reference property (Tier I plus Tier II) to risk-weighted asset	$\frac{\text{Reference Property (Tier I plus Tier II)}}{\text{Risk - Weighted Asset}}$	Banks: Berger <i>et al.</i> (2008), Bakkar <i>et al.</i> (2019), Abbas <i>et al.</i> (2020), and Abbas and Masood (2020)

**Source(s):** Authors' own elaboration

**Table 2.** Description of independent variables

Variable	Description	Equation	Authors in the context of banks or companies
Size (SIZE)	Natural logarithm of total assets	$\ln(\text{Total Assets})$	Banks: <a href="#">Berger et al. (2008)</a> , <a href="#">De Jonghe and Öztekin (2015)</a> , <a href="#">Hoque and Pour (2018)</a> , <a href="#">Bakkar et al. (2019)</a> , <a href="#">Wojewodzki et al. (2020)</a> , <a href="#">Abbas et al. (2020)</a> and <a href="#">Abbas and Ali (2024)</a> Companies: <a href="#">Lemmon et al. (2008)</a> and <a href="#">Frank and Goyal (2009)</a>
Tangibility (TANG)	Ratio of tangible assets to total assets	$\frac{\text{Tangible Assets}}{\text{Total Assets}}$	Banks: <a href="#">Gropp and Heider (2010)</a> , <a href="#">De Jonghe and Öztekin (2015)</a> , <a href="#">Hoque and Pour (2018)</a> , and <a href="#">Silva et al. (2019)</a> Companies: <a href="#">Rajan and Zingales (1995)</a> and <a href="#">Lemmon et al. (2008)</a>
Profitability (PROF)	Ratio between Earnings Before Interest and Taxes (EBIT) and total assets	$\frac{\text{EBIT}}{\text{Total Assets}}$	Banks: <a href="#">Hoque and Pour (2018)</a> , <a href="#">Bakkar et al. (2019)</a> , and <a href="#">Abbas et al. (2020)</a> Companies: <a href="#">Booth et al. (2001)</a>
Risk (RISK)	Ratio of standard deviation of EBIT to total assets	$\frac{\text{Standard Deviation of EBIT}}{\text{Total Assets}}$	Banks: <a href="#">Oliveira and Raposo (2021)</a> Companies: <a href="#">Booth et al. (2001)</a> and <a href="#">Lemmon et al. (2008)</a>

**Note(s):** SIZE, measured as the natural logarithm of total assets, is the only variable that is not an index and is updated to December 2022 by the General Market Price Index

**Source(s):** Authors' own elaboration

## 4. Results

### 4.1 Data and descriptive statistics

[Table 3](#) presents the descriptive statistics for the sample of 704 credit unions from 2014 to 2022. The initial analysis of the histograms identified extreme values in the variables, leading to the application of the winsorization technique. This method replaces extreme values with those at the defined cut-off points ([Frank and Goyal, 2009](#)). To mitigate the negative impact of incorrect data, all variables were winsorized at 1% ([De Jonghe and Öztekin, 2015](#); [Bakkar et al., 2019](#); [Abbas and Masood, 2020](#)).

The maximum LR was 73.37%, with an average of 22.19% and a minimum of 8.24%. The maximum BR value was 91.11%, with an average of 30.76% and a minimum of 12.49%. Regarding average size, the natural logarithm of total assets was 5.32, which represents around R\$183,000.00. The average tangibility was 4.28%, which confirms the view that credit unions have low fixed asset ratios. The profitability average was 2.81% of assets, which may qualify

**Table 3.** Descriptive statistics of the sample (2014–2022)

Variable	Mean	Median	Std. Dev	Minimum	Maximum
LR	0.221	0.181	0.130	0.082	0.733
BR	0.307	0.251	0.169	0.124	0.911
SIZE	5.322	5.328	0.651	3.563	6.730
TANG	0.042	0.038	0.026	0.001	0.152
PROF	0.028	0.027	0.022	-0.055	0.091
RISK	0.010	0.007	0.011	0.000	0.078
Observations	5,864	5,864	5,864	5,864	5,864

**Note(s):** See [Tables 1 and 2](#) for the list of variables. Standard deviation (Std. Dev.)

**Source(s):** Authors' own elaboration

these credit unions as unprofitable. It is important to consider, however, that these credit unions do not aim to make a profit, unlike other financial institutions, because their purpose is to provide financial services to their members. In addition, the average risk was 1.06%, demonstrating that it is a relatively safe sector.

Table 4 presents the correlation coefficients, which fall within the acceptable range. The low correlation indicates that multicollinearity is not a concern, while the variables' signs confirm their significance and economic relevance.

Figure 2 shows that based on the median capital ratios, the LR is usually lower than the BR. No Brazilian credit union fell below the regulatory minimum between 2014 and 2022. In 2020, a temporary reduction in ratios for credit unions using a simplified methodology increased lending capacity amid the COVID-19 pandemic, impacting the BR.

#### 4.2 Adjustment speeds of capital ratios

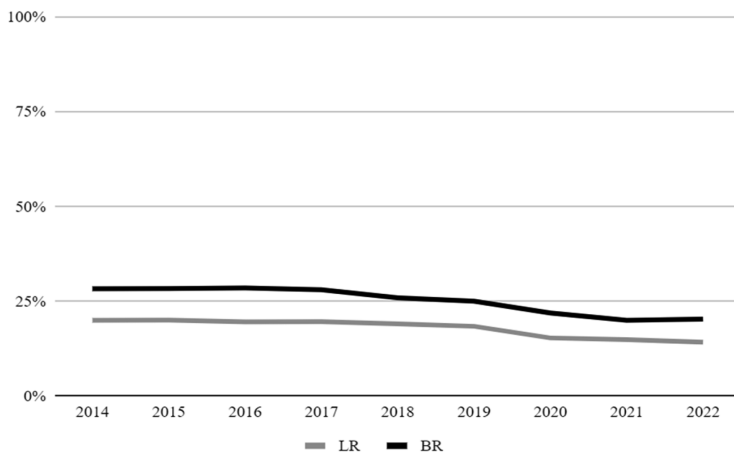
The unbalanced panel data were analyzed using two-step GMM-Sys for each capital ratio. Table 5 presents the results, including coefficients and robust standard errors in parentheses. Before introducing the models, the statistical tests were calculated. In the chi-square test ( $\chi^2$ ), the null hypothesis is rejected, indicating that there is an association between the variables in the model. The Hansen (1982) overidentification test shows that the null hypothesis was

**Table 4.** Correlation coefficients for credit unions (2014–2022)

	LR	BR	SIZE	TANG	PROF	RISK
LR	1.000					
BR	0.936	1.000				
SIZE	-0.432	-0.430	1.000			
TANG	0.327	0.270	-0.174	1.000		
PROF	0.364	0.376	0.143	0.029	1.000	
RISK	0.255	0.219	-0.399	0.176	-0.212	1.000

**Note(s):** See Tables 1 and 2 for the list of variables

**Source(s):** Authors' own elaboration



**Figure 2.** Median Leverage Ratio (LR) and Basel Ratio (BR) (2014–2022). **Source(s):** Authors' own elaboration

**Table 5.** Partial capital adjustment model for credit unions

	LR	BR
Dependent <i>lagged</i>	0.781*** (0.030)	0.767*** (0.028)
SIZE	-0.047*** (0.006)	-0.085*** (0.018)
TANG	-0.005 (0.067)	-0.759*** (0.111)
PROF	0.761*** (0.165)	1.061*** (0.375)
RISK	-0.241 (0.529)	-1.825* (1.087)
Constant	0.274*** (0.039)	0.536*** (0.115)
Observations	5,160	5,160
Credit unions	704	704
$\chi^2$	1368.410	962.060
$\chi^2$ ( <i>p</i> -value)	0.000	0.000
Hansen	130.220	107.930
Hansen ( <i>p</i> -value)	0.000	0.000
AR (1)	-4.870	-8.200
AR (1) ( <i>p</i> -value)	0.000	0.000
AR (2)	-0.170	-0.650
AR (2) ( <i>p</i> -value)	0.868	0.513

**Note(s):** See Tables 1 and 2 for the list of variables. \*\*\**p*-value <1% and \**p*-value <10%

**Source(s):** Authors' own elaboration

rejected in all the analyses, indicating that the instrument may be endogenous. However, the models are robust since the AR (1) and AR (2) tests by Arellano and Bond (1991) reject the hypothesis of no serial correlation in the first-order residuals in all analyses and does not reject it in the second-order residuals, validating the serial correlation of order 1 in the model and justifying the use of two-step GMM-Sys.

The main focus and variable of interest are the capital ratios, which consist of the coefficients of the lagged-dependent variables. The speed of adjustment for the LR was 21.9% or 0.219 [1-(0.781)], with 0.781 being the positive coefficient of the LR reported in the second column, significant at the 1% level. For BR, the speed of adjustment was relatively higher at 23.3% or 0.233 [1-(0.767)], as shown in the third column, with 0.767 being the positive BR coefficient, significant at the 1% level. The higher BR adjustment speed suggests a stronger focus on regulatory capital. These findings support H1, which states that the speed of adjustment of the BR is higher than the LR in credit unions, consistent with the theoretical limit of 100% (Berger *et al.*, 2008).

Brazilian credit unions require 2 years and 6 months to adjust the regulatory capital ratios (BR) and 2 years and 8 months for the LR, which corresponds to the half-life. The time required to reach equilibrium (half-life) is a concept commonly used in partial adjustment models and is calculated as the log of (0.5) divided by a log of (1 - speed of adjustment), as proposed by De Jonghe and Öztekin (2015), Bakkar *et al.* (2019), and Abbas *et al.* (2020).

#### 4.3 Effects of size on the adjustment speeds of capital ratios

Next, the study examined how size affects the speed of adjustment of credit unions' capital ratios (Table 6), comparing the smallest (1st quartile) and the largest (4th quartile) credit unions. The chi-square test ( $\chi^2$ ) indicates that there is an association between the variables in the model. The Hansen test (1982) indicates that the instrument may be endogenous in the 4th quartile. Similar to the previous models, the results are robust for ARs (1) and AR (2).

The speed of adjustment of the LR was 18.3% for smaller credit unions, with a positive coefficient of 0.817, significant at the 1% level. For larger credit unions, the speed of adjustment was 42.3%, with a positive coefficient of 0.577, significant at the 1% level. The half-life for smaller credit unions corresponds to 3 years and 4 months and 1 year and 3 months

**Table 6.** Effect of size on the speed of adjustment of credit unions

	LR (1st quartile)	LR (4th quartile)	BR (1st quartile)	BR (4th quartile)
Dependent <i>lagged</i>	0.817*** (0.036)	0.577*** (0.032)	0.819*** (0.033)	0.707*** (0.045)
SIZE	-0.113*** (0.025)	-0.027** (0.012)	-0.136*** (0.040)	-0.068*** (0.017)
TANG	0.038 (0.148)	0.359*** (0.111)	-0.628*** (0.227)	-0.586*** (0.150)
PROF	0.493* (0.254)	2.466*** (0.201)	0.555 (0.403)	2.192*** (0.458)
RISK	-0.352 (0.663)	-1.428** (0.679)	-0.939 (0.945)	-2.265 (1.579)
Constant	0.551*** (0.121)	0.156** (0.077)	0.707*** (0.192)	0.444*** (0.116)
Observations	1,180	1,368	1,180	1,368
Credit unions	263	243	263	243
$\chi^2$	472.300	343.580	500.830	235.450
$\chi^2$ (p-value)	0.000	0.000	0.000	0.000
Hansen	35.260	66.880	37.430	77.050
Hansen(p-value)	0.274	0.000	0.198	0.000
AR (1)	-3.030	-3.890	-4.240	-4.030
AR (1) (p-value)	0.002	0.000	0.000	0.000
AR (2)	-0.020	-1.330	-0.220	-1.350
AR (2) (p-value)	0.987	0.183	0.824	0.179

**Note(s):** See Tables 1 and 2 for the list of variables. \*\*\*p-value <1%; \*\*p-value <5%; \*p-value <10%

**Source(s):** Authors' own elaboration

for larger credit unions. The BR adjustment speed for smaller credit unions was 18.1%, lower than the adjustment speed for larger credit unions, which was 29.3%, both with positive coefficients of 0.819 and 0.707 and significant at the 1% level. The half-life for smaller credit unions is 3 years and 5 months. For larger credit unions, it was 2 years.

Larger credit unions adjust the LR faster (42.3%), while smaller ones adjust the BR more slowly (18.1%). These findings support H2, which suggests that larger credit unions make faster adjustments to the LR, while smaller credit unions make slower adjustments to the BR.

#### 4.4 Effects of periods of economic crisis and their absence on the adjustment speeds of capital ratios

The speed of adjustment of capital ratios was found to differ during periods of crisis (De Jonghe and Öztekin, 2015; Cohen and Scatigna, 2016; Abbas *et al.*, 2020; Al-Zyoud and Ordóñez-Ponce, 2022), with a decline in GDP serving as a strong indicator of economic crisis (Filip and Raffounier, 2014; Iatridis and Dimitras, 2013). An analysis was conducted to determine if these differences apply to credit unions, with the results presented in Tables 7 and 8, covering periods of economic crisis and absence of crisis, respectively. The chi-square test ( $\chi^2$ ) indicates an association between the variables in the model. The Hansen test (1982) suggests that the instrument may be endogenous to BR. Similar to the previous models, the results are robust for ARs (1) and AR (2).

On the one hand, when analyzing the regression models that include the economic crisis variables (Table 7), the crises in 2015, 2016, and 2020 showed negative coefficients (-0.004, -0.004 and -0.017) for the LR, significant at the 10%, 5%, and 1% levels. The same association occurred for BR, in 2015, with a negative coefficient of -0.018 significant at the 1% level.

On the other hand, for the regression models for periods without economic crisis (Table 8), the LR has positive coefficients for the years 2017 (0.003), 2018 (0.008), 2019 (0.016), and 2021 (0.012), significant at the 10% level for 2017 and at the 1% level for 2018, 2019, and 2021. This association may indicate that during periods of economic stability, the LR increased. In the case of the BR, positive and significant coefficients were identified for the years 2017 and 2019, with coefficients 0.010 and 0.014, both significant at the 1% level.

**Table 7.** Effects of periods of economic crisis on the speed of adjustment

	LR	BR
Dependent <i>lagged</i>	0.843*** (0.027)	0.729*** (0.045)
SIZE	-0.036*** (0.008)	-0.119*** (0.032)
TANG	0.053 (0.056)	-0.763*** (0.106)
PROF	0.520*** (0.152)	1.284*** (0.445)
RISK	-1.203** (0.608)	-2.761** (1.369)
2015 crisis	-0.004* (0.002)	-0.018*** (0.006)
2016 crisis	-0.004** (0.001)	-0.002 (0.004)
2020 crisis	-0.017*** (0.001)	-0.005 (0.003)
Constant	0.223*** (0.048)	0.741*** (0.196)
Observations	5,160	5,160
Credit unions	704	704
$\chi^2$	1275.100	659.120
$\chi^2$ (p-value)	0.000	0.000
Hansen	34.110	75.610
Hansen (p-value)	0.197	0.000
AR (1)	-4.680	-7.560
AR (1) (p-value)	0.000	0.000
AR (2)	-0.290	-0.780
AR (2) (p-value)	0.771	0.433

**Note(s):** See Tables 1 and 2 for the list of variables. \*\*\*p-value <1%; \*\*p-value <5%; \*p-value <10%

**Source(s):** Authors' own elaboration

**Table 8.** Effects of periods without an economic crisis on the speed of adjustment

	LR	BR
Dependent <i>lagged</i>	0.767*** (0.031)	0.817*** (0.027)
SIZE	-0.063*** (0.006)	-0.076*** (0.017)
TANG	-0.295 (0.507)	-0.819** (0.456)
PROF	1.112*** (0.254)	0.926** (0.439)
RISK	-0.418 (0.953)	-2.739* (1.465)
No crisis in 2017	0.003* (0.002)	0.010*** (0.003)
No crisis in 2018	0.008*** (0.002)	-0.004 (0.003)
No crisis in 2019	0.016*** (0.002)	0.014*** (0.003)
No crisis in 2021	0.012*** (0.001)	-0.000 (0.002)
No crisis in 2022	0.004 (0.012)	0.002 (0.011)
Constant	0.363*** (0.040)	0.486*** (0.108)
Observations	5,160	5,160
Credit unions	704	704
$\chi^2$	903.930	681.510
$\chi^2$ (p-value)	0.000	0.000
Hansen	33.010	49.640
Hansen (p-value)	0.162	0.003
AR (1)	-4.280	-7.600
AR (1) (p-value)	0.000	0.000
AR (2)	0.160	-0.920
AR (2) (p-value)	0.873	0.359

**Note(s):** See Tables 1 and 2 for the list of variables. \*\*\*p-value <1%; \*\*p-value <5%; \*p-value <10%

**Source(s):** Authors' own elaboration

When the speed of adjustment was analyzed, it was found to be higher in the regression model that considers periods of economic crisis, with a BR of 27.1% and a positive coefficient of 0.729, significant at the 1% level. The half-life in this period corresponds to 2 years and 2 months. Non-crisis periods showed a higher speed of adjustment of 23.3% for the LR, with a positive coefficient of 0.767, significant at the 1% level. The time required to reach equilibrium is 2 years and 6 months, which corresponds to the half-life. The results are compatible with the third hypothesis (H3), that during economic crises, the speed of adjustment of the BR in credit unions is greater than in periods without economic crises.

## 5. Discussion

### 5.1 Theoretical implications

The analysis of the speed of adjustment revealed significant insights into the behavior of credit unions in Brazil, particularly regarding capital ratios. The results suggest that the speed of adjustment of regulatory capital ratios (BR) is generally higher than for leverage ratios (LR). As the BR aligns with Basel III regulations, these regulations require credit unions to reach values higher than 12%, which is the minimum limit. This often results in a more conservative stance, with credit unions maintaining values above the minimum regulatory limit. Consistent with [Gropp and Heider \(2010\)](#), no credit union was below the minimum regulatory limit from the 2014 to 2022 period. However, in 2020, due to the COVID-19 pandemic, credit unions using a simplified methodology to extend credit experienced a temporary reduction in the BR.

The examination of the adjustment speeds of the capital ratios in Brazilian credit unions shows that the BR (23.3%) is relatively higher than that of the LR (21.9%), indicating a greater focus on regulatory capital adjustments. This evidence corroborates the findings for banks, such as [Abbas et al. \(2020\)](#), who identified a higher speed of adjustment of the regulatory ratio (22.6%) compared to the leverage ratio (18.5%) in large commercial banks in the United States. Differences in adjustment speeds were also identified in [Bakkar et al. \(2019\)](#) and [Berger et al. \(2008\)](#) for banks. As for half-life, the results show that credit unions are more flexible and quicker to adjust their regulatory capital ratios (2 years and 6 months). It is possible that the speed of adjustment is faster for the BR because credit unions face capital-based regulation. The findings are similar to those in [Abbas et al. \(2020\)](#), where the time required to adjust the regulatory ratio was faster than the leverage ratio: 2.7 years and 3.4 years, respectively.

The assessment of the adjustment speeds of capital ratios in Brazilian credit unions, according to size, shows that the LR adjusts faster in larger credit unions (42.3%), while the BR adjusts more slowly in smaller ones (18.1%). Larger credit unions show greater flexibility in adjusting their capital ratios quickly, while smaller ones make adjustments more slowly, contrasting with the results observed in banks ([Bakkar et al., 2019](#); [Abbas et al., 2020](#)). In practice, when credit unions suddenly need to change their capital ratios, such as during economic crises, it is important for regulators and supervisors to clearly understand that the size of an institution can influence the speed of adjustment.

The evaluation of periods of economic crisis suggests that, under such conditions, there is a decrease in the LR (years 2015, 2016 and 2020), which may be a response to uncertainty and the need to preserve capital. This association may also be explained by the prudential measures adopted by credit unions during periods of economic instability to preserve solvency and ensure financial stability. Similarly, in 2015, the BR showed an increase in risk or a reduction in the ability to absorb losses, as crises tend to increase financial and credit risks, negatively impacting the financial strength of credit unions. In such periods, credit unions may face pressure to increase capital reserves and reduce risky assets. In contrast, during non-crisis periods, credit unions expanded operations and optimized resources, driven by greater confidence in market opportunities. Higher leverage levels during these times may reflect a focus on growth and profitability, aimed at maintaining market position and diversifying products, as credit unions are not profit-driven ([Zancan et al., 2023](#)). During periods of economic stability, the BR increased (years 2017 and 2019), which corroborates [Al-Zyoud and Ordóñez-Ponce \(2022\)](#),

suggesting greater financial strength of credit unions, possibly as a result of more conservative risk management practices or a more prudent allocation of capital to protect against adverse shocks in the future. [De Jonghe and Öztekin \(2015\)](#) and [Cohen and Scatigna \(2016\)](#) found that capital structure adjustment occurred more quickly during crises. This indicates that Brazilian credit unions adjust rapidly during crises due to supervisory scrutiny and stakeholder expectations. These periods provide an opportunity to assess their resilience and the impact of regulatory changes under economic crises. Additionally, the results have implications for regulators, as they highlight the importance of prudential policies that enhance credit unions' stability during economic crisis. Policymakers can use these insights to refine regulatory frameworks, ensuring that capital requirements and supervisory measures are effectively tailored to support financial resilience while maintaining the flow of credit to the economy.

### 5.2 Managerial implications

Regulators should consider the size and periods of economic crisis when formulating capital policies for Brazilian credit unions. Managers of larger credit unions adjust their LR more quickly, reflecting greater resource flexibility. Effective capital management is also necessary, as the BR adjusts more quickly than the LR during periods of economic crisis. Credit union managers should prioritize maintaining adequate BR levels to comply with Basel III, and regulators may need to implement cohesive capital adjustment policies ([Wojewodzki et al., 2020](#)), similar to the measures taken during the COVID-19 pandemic, to ensure capital adequacy and financial resilience. These insights emphasize the importance of policies that strengthen the stability of credit unions, as well as the need for clear communication between regulators and credit union managers regarding capital management strategies, to preserve financial stability and ensure the continued flow of credit to the economy.

### 5.3 Limitations and future research agenda

This study provides valuable insights into the capital adjustment behavior of Brazilian credit unions; however, there are several limitations that future research could address. The analysis is restricted to credit unions in Brazil, and the findings may not be directly applicable to credit unions in other countries with different regulatory frameworks, economic conditions, or institutional characteristics. Future research could expand the sample to include credit unions from various countries, as did the global bank sample studied by [Wojewodzki et al. \(2020\)](#). Moreover, previous studies indicate that institutional factors such as regulatory strictness and supervisory effectiveness significantly influence the speed of capital adjustment, which may limit the generalizability of models across different countries ([De Jonghe and Öztekin, 2015](#); [Cohen and Scatigna, 2016](#); [Abbas et al., 2020](#)).

Furthermore, future research could explore other aspects of credit union management, such as liquidity, risk-adjusted performance, and the impact of digital transformation. Additionally, studies could examine whether credit unions in countries with stricter capital requirements and more effective supervision adjust their capital levels more rapidly, as observed by [De Jonghe and Öztekin \(2015\)](#).

Finally, an alternative avenue for future research could involve examining the speed of capital adjustment by credit unions during different crises, as observed in the studies by [Cohen and Scatigna \(2016\)](#), [Abbas et al. \(2020\)](#) and [Cao and Chou \(2022\)](#). These potential areas for further investigation could contribute to a more comprehensive understanding of the dynamics of global credit union capital management.

## 6. Conclusion

The topic of capital structure has been extensively researched for over sixty years, and it continues to be a subject of great interest ([Henrique et al., 2021](#); [Thakur et al., 2024](#)). In recent years, Basel III's stricter capital requirements have further intensified the focus on understanding

how financial institutions adjust their capital ratios. This evolving regulatory landscape has prompted renewed attention to the ways in which financial institutions manage their capital in response to more demanding standards. Therefore, this article analyzes the speed at which credit unions adjust their capital ratios, considering the period from 2014 to 2022.

The results show that the median BR was higher than the LR, with Brazilian credit unions adopting a more conservative approach by maintaining values above the Basel III minimum. The model reveals that credit unions adjust their capital ratios more quickly for the BR than the LR, supporting the first hypothesis (H1). This corroborates findings in the banking literature (Abbas *et al.*, 2020; De Jonghe and Öztekin, 2015). The half-life indicates that credit unions are more flexible in adjusting regulatory capital ratios compared with leverage ratios.

The size analysis shows that larger credit unions adjust their LR more quickly, while smaller ones adjust their BR more slowly, consistent with the second hypothesis (H2). This differs from bank findings (Bakkar *et al.*, 2019; Abbas *et al.*, 2020), as larger credit unions are more flexible in capital adjustments.

Also, the analysis revealed that during economic crises, the speed of adjustment of the BR is faster than in non-crisis periods, supporting the third hypothesis (H3). The faster adjustment of the BR during crises is likely due to more rigorous supervision, consistent with studies on banks (De Jonghe and Öztekin, 2015; Cohen and Scatigna, 2016). Cao and Chou (2022) also find that banks with stronger regulatory capital positions before crises show greater resilience and faster adjustment during such periods.

The findings enhance the understanding of how Brazilian credit unions adjust their capital structure, with key implications for regulatory policies. Regulators should consider that institution size affects adjustment speed and that credit unions adjust capital more quickly during crises. Also, flexible measures may be needed during crises to support capital adequacy and financial resilience, such as the measures adopted during the COVID-19 pandemic. Prudential policies and clear communication between regulators and credit unions are essential for stability and ensuring continued credit flow to the economy.

The research is restricted to the analysis of quantitative data exclusive to Brazilian credit unions, and may restrict the generalization of the results to other geographical and institutional contexts due to varying regulatory frameworks and market conditions. Future research could investigate the speed at which credit unions globally adjust their capital by expanding the sample analyzed, taking into account institutional differences. Additionally, it would be relevant to examine whether credit unions in countries with stricter capital requirements, more effective supervision, and more developed capital markets adjust their capital levels more quickly.

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