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ARTICLE

Diversification and Performance in Credit Unions: A Non-Linear Approach

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ABSTRACT

This study verified the existence of a non-linear relationship between diversification and the performance of Brazilian credit unions by analyzing panel data from 455 credit unions from June 2012 to December 2019. Through three regression models, estimated by the Systemic Generalized Method of Moments, it was identified that diversification has a non-linear U-shaped relationship with performance. This result demonstrates the existence of a minimum point for diversification, from which increases in diversification of financial products would provide positive effects on performance. This study stands out for bringing a curvilinear model for diversification in credit unions. This finding facilitates the understanding of which level of diversification is beneficial for the performance of credit unions, in addition to favoring the formation of strategies and analysis of the implementation of new financial products in credit unions.

KEYWORDS

Inverted U; curvilinear relationship; Systemic GMM

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Diversificação e Desempenho em Cooperativas de Crédito: uma Abordagem Não Linear

RESUMO

Este estudo verificou a existência de uma relação não linear entre a diversificação e o desempenho das cooperativas de crédito brasileiras ao analisar dados em painel de 455 cooperativas de crédito no período de junho de 2012 a dezembro de 2019. Por meio de três modelos de regressão, estimados pelo Método dos Momentos Generalizado Sistêmico, identificou-se que a diversificação possui uma relação não linear com o desempenho, na forma de U. Esse resultado demonstra a existência de um ponto mínimo para a diversificação, a partir do qual aumentos na diversificação de produtos financeiros proporcionariam efeitos positivos no desempenho. Este estudo se destaca por trazer um modelo curvilíneo para a diversificação em cooperativas de crédito. Tal achado facilita o entendimento de qual nível de diversificação é benéfico para o desempenho das cooperativas, além de poder favorecer a formação de estratégias e análises de implementação de novos produtos financeiros nas cooperativas de crédito.

PALAVRAS-CHAVE

U invertido; relação curvilínea; GMM Sistêmico

1. INTRODUCTION

Product or business diversification occurs when the company expands to manufacture and sell products, or a line of products, that have no market interaction with the company's other products (Rumelt, 1982). Diversification can be classified into three types: (i) unique diversification, which is equivalent to a low degree of diversification; (ii) related diversification, which corresponds to a moderate level of diversification; and (iii) unrelated diversification, also called conglomerate, which refers to a high level of diversification, with companies that have business areas that have little or no relationship with each other (Palich et al., 2000; Ferreira & Braga, 2004; Hitt et al., 2008).

With regard to profit-oriented industrial companies, there is a vast body of literature that examines the impacts of diversification on their value and performance, but the consequences of increasing or decreasing diversification have not yet been clearly defined (Palich et al., 2000; Goddard et al., 2008). In the same sense, the literature that studies the effects of diversification on the performance of financial intermediaries has also not reached conclusive results (Laeven & Levine, 2007). Thus, these inconclusive results may suggest the existence of a non-linear relationship between diversification and performance; after all, different degrees of diversification can have different effects on banking institutions (Kim et al., 2020), whether on the financial stability of the institution or even on its performance (Rogers et al., 2008).

Different models have been tested to describe the relationship between diversification and performance. Some studies in the literature have been able to demonstrate that moderate levels of diversification produce higher levels of performance, compared to limited or extensive diversification. Such studies were able to provide support for a curvilinear model, indicating a possible relationship between diversification and performance in an inverted U shape. Such a finding suggests that diversification provides economies of scale and scope up to a specific limit

from which performance would decline when the marginal cost of diversification exceeds its marginal benefits, due to internal levels of inefficiency and agency problems (Palich et al., 2000; Ali et al., 2016).

The discussion about the diversification of products and services and its relationship with performance is also important in credit unions, the focus of this study. Such financial institutions, which have a strong social appeal, can use this strategy to better serve their members, taking advantage of their knowledge of their audience and their know-how to offer financial products that meet the needs of their members and, consequently, increase their sources of revenue, making them more stable and competitive.

By working with different products, credit unions may be able to capture synergies, achieve economies of scope and scale, reduce their costs and acquire new knowledge. In addition, product diversification can have implications for the risk of the cooperative, since, when faced with a decline in demand or an increase in competition for a particular product that threatens its revenues, the diversified institution has the possibility to focus its strategies and encourage sales of other products that are more favorable at the moment. This can help the institution reduce risk by limiting the negative impact of a single product (Mammen et al., 2021), stabilizing its revenues and, consequently, improving its performance.

When considering the lack of definition in the literature regarding the effects of diversification on performance, the possibility of linear and curvilinear models, as well as the relevance of this strategy for credit unions (Palich et al., 2000; Rogers et al., 2008; Goddard et al., 2008; Ali et al., 2016; Kim et al., 2020), this study aimed to verify the existence of a non-linear relationship between the diversification of financial products and the performance of Brazilian credit unions.

In this research, 455 Brazilian single credit unions, belonging to the Sicoob, Sicredi and Unicred systems, were studied during the period from June 2012 to December 2019. In order to identify the non-linear relationship between diversification and performance, we estimated dynamic regressions using the Systemic Generalized Method of Moments (Systemic GMM), which seeks to correct possible endogeneity problems.

This study contributes to the discussion on the existence of the relationship between diversification and performance, more specifically on the assessment of the nature and form of this relationship in credit unions. This is because credit unions are institutions with peculiar characteristics, non-profit oriented, with great capillarity, in which their customers are also their owners, and, in addition, contribute to financial inclusion in the country. Three different performance proxies were used to analyze the performance of credit unions, both for the financial dimension and for the social dimension.

The fact that credit union managers are informed about how much product or service diversification can be used to build a long-term competitive advantage, to understand whether higher levels of diversification provide higher performance, or to know if there is a maximum point for diversification from which this would not provide additional gains are relevant information in terms of financial sustainability. Furthermore, this understanding can be valuable for cooperative systems to formulate their product diversification strategies, in order to encourage their affiliated singular credit unions to follow a more focused or diversified path of financial products. In this sense, this study seeks to bring this discussion to the light of credit unions in a developing country, which is the case of Brazil.

The results indicate the existence of a minimum point for diversification, from which increases in diversification would provide positive effects on performance, confirming the existence of a

non-linear U-shaped relationship. This non-linear relation of the financial product diversification in credit unions was confirmed for both financial and social dimension performance proxies.

2. LITERATURE REVIEW

2.1. Analysis of performance in Credit Unions

The lack of consensus on the firm's objectives polarizes the discussion in the context of strategy on performance measurement. Therefore, even assuming a long-term shareholder wealth maximization assumption, defining the best indicator to measure performance is not a simple decision (Bandeira-de-Mello & Marcon, 2006).

In the context of credit unions, performance becomes more complex, due to the peculiar characteristics of these institutions, such as the fact that they do not seek to maximize profit. The literature emphasizes that, when analyzing the performance of credit unions, it is necessary to consider characteristics that are inherent to these institutions (Carvalho et al., 2015), because, when noting that the final mission of credit unions is not to maximize the profit, it is clear that there is no direct measure based on the market performance of credit unions and the corresponding benefits to the owner (Cuong et al., 2020).

In credit unions, the surplus is generated by operations with the members themselves and is called surplus or residue. Such leftovers can be reinvested in credit unions or returned to their members, depending on the volume of operations, transactions, and deposits made in the cooperative. Doctrinally, profit does not exist, as its concept is related only to the remuneration of capital, while leftovers are distributed according to the volume of transactions of the associates. However, despite their outstanding characteristics, credit unions must also be efficient and profitable, since the surplus is related to the efficient use of resources and ensures that these institutions continue to play their social role (Carvalho et al., 2015).

Therefore, it is necessary to use an approach to measure the performance of these institutions. One way of evaluating the performance of an organization is through the study of its financial dimension, for example, by analyzing its financial statements. Accounting is an important provider of information for the evaluation of organizational performance; it provides information necessary for financial indicators to be measured reliably (Gasparetto, 2004).

In addition to the financial dimension, other measures can be analyzed in the context of credit unions. In this sense, social information stands out, which can include: participation in assemblies, activities of associates, membership growth, participation, educational committees, proportion of active cooperative members and productivity growth in a given area, among others (Bialoskorski Neto et al., 2006).

2.2. Relationship between diversification and performance

The product diversification strategy, the focus of this study, refers to the process by which companies specializing in a single product become multi-product companies (Lowe & Teece, 2001). The central issue for the theory of multi-product organizations is the explanation of why firms diversify their product lines into related and unrelated ones, instead of reinvesting in traditional lines or transferring resources to owners (Teece, 1982).

Three models stand out in the literature when investigating the relationship between diversification strategy and performance: the linear model, the inverted U model, and the intermediate model (Palich et al., 2000).

According to the linear model, it is assumed that diversification and performance are linearly and positively related. This assumption is based on the theory of market power, internal market efficiency arguments, among others (Palich et al., 2000). The approach portrayed on issues of market power refers to the possibility of diversified companies enjoying various forms of anti-competitive behavior (Goddard et al., 2008). Regarding domestic market efficiency, the argument is that the diversified company has more flexibility in capital formation (Palich et al., 2000).

In the Inverted-U model, some theoretical reasons for the superiority of related diversification can be highlighted, such as exploiting a variety of common corporate resources, economies of scope, and learning curve efficiencies (Palich et al., 2000). From a resource use perspective, diversification represents a more profitable way of employing underutilized resources (Montgomery, 1994). Regarding economies of scope, it is understood as synergies enjoyed by an institution that produces a group of complementary products and services (Besanko et al., 2007).

However, although the benefits accrue with diversification, at some point, these efforts are also associated with relevant costs. Thus, it is argued that the marginal costs of diversification increase rapidly as diversification reaches high levels. It can be concluded that firms experience some optimal level of diversification, with performance decreases on either side of this maximization point. These arguments form the theoretical basis for the Inverted-U relationship between diversification and performance (Palich et al., 2000).

In the intermediate model, the assumption is that companies are unable to exploit portfolio synergies after a certain degree of diversification. Thus, there would be no additional benefit from related (or concentric) diversification, compared to unrelated (conglomerate) diversification (Rogers et al., 2008). In general, this model could be linked to the notion that diversification produces positive but decreasing returns beyond the optimal point (Palich et al., 2000).

Still regarding the functional forms, empirical studies have found other different functional forms, reflecting the relationship between the degree of diversification and performance. They can then be linear and positive, in a U-shaped form, in the form of an inverted U, or even in the form of an S and an inverted S. The variety of functional forms demonstrates heterogeneity across sectors and countries, highlighting the importance of considering each specific case (Solano et al., 2019).

In the findings of previous studies, there is the work of Palich et al. (2000) indicating that the relationship between diversification and performance occurs in the form of an inverted U-shape. In the same vein, the following works found evidence of an inverted U-shaped relationship between diversification and performance: Ali et al. (2016), when studying Pakistani companies; Kim et al. (2020), in commercial banks in OECD countries; and Solano et al. (2019), in Chilean exports. On the other hand, the work carried out by Rogers et al. (2008), in Brazilian industrial companies, found a curvilinear relationship between diversification and performance, but without a clear definition if it occurs in a U-shaped or inverted U-shaped form.

As stated above, this study assumes the following research hypothesis: “Credit unions have an optimal level of diversification that maximizes their performance, from which increases in diversification would lead to decreases in performance”.

3. METHODOLOGICAL PROCEDURES

3.1. Research classification, sample and data collection

The classification of this research is defined as descriptive, with a quantitative approach, using documentary procedures and with an ex-post facto characteristic.

Individual credit unions belonging to the three largest cooperative credit systems in Brazil: Sicoob, Sicredi and Unicred, at the end of December 2019, were considered as the objects of research. Data on credit unions were obtained from the website of the Central Bank of Brazil [BCB] (2020a, 2020b), in the Balance Sheets and the IF.data database (BCB, 2020b). In addition, information related to the semi-annual national Gross Domestic Product (GDP) collected at the Brazilian Institute of Geography and Statistics (IBGE, 2020) was used.

According to the list of credit unions under the supervision of the Central Bank of Brazil (BCB, 2020c), as of 12/31/2019, there were a total of 911 credit unions in operation in the country; of these, two (2) were confederations (Unicred and Cresol), and 34 were central credit unions, leaving a total of 875 individual credit unions.

Therefore, the initial population of credit unions in the study consisted of 875 individual credit unions. However, for the adequacy of the sample, the following exclusions were made: i) credit unions that did not belong to the analyzed systems; ii) credit unions classified as capital and loan, which are those that do not capture deposits; iii) credit unions that did not present information in any analyzed period; iv) credit unions that were incorporated during the analyzed period; v) credit unions with negative equity. In the end, there was a non-probabilistic sample, composed of 455 singular credit unions, representing 52% of the population.

The analyzed period was from June 2012 to December 2019, considering half-yearly data. The choice is justified because it is the period from which the BCB provides information on the number of debt associates, up to the data available before the Covid-19 pandemic. Finally, it is noteworthy that the data for analysis consisted of 16 semesters, containing 455 credit unions and forming a balanced panel of 7,280 observations, with the operationalization performed by the Stata® software.

3.2. Analytical model

The model used was the Systemic Generalized Method of Moments (Systemic GMM), developed by Blundell and Bond (1998), considered a more adequate methodology for several econometric problems, such as the endogeneity of variables and the use of dynamic panels. In addition, the estimation was performed in two stages and with the Windmeijer correction, in order to obtain more robust estimates.

A possible endogenous relationship between diversification and performance means that diversification can affect company performance, but that performance can also influence diversification (Park & Jang, 2012). To capture the persistence of performance, the dynamic model was used (Lee et al., 2014) with the use of the lagged dependent variable used as a regressor (dynamic), which is a basic problem of endogeny, arising from the dynamic panel (Baltagi, 2008). Another source of endogeny was diagnosed – the relationship between the variable Ratio between Equity and Total Assets (PA) and performance, with this endogeneity arising from the existence of causality, in both directions, between capital and return (Berger, 1995).

In view of this, Equation 1 was estimated by the Systemic GMM, in order to verify the curvilinear model of diversification:

$$Y_{it} = \lambda Y_{i,t-1} + \beta_1 DIV_{it} + \beta_2 \left(DIV\right)_{it}^{2} + CONTROL_{it} + u_{it} \quad (1)$$

Thus, Y is the performance-dependent variable [Return on Equity (ROE), Equity Growth (CPL) and the natural logarithm of the number of credit union members with debt (LnNCoop)]; i = 1,..., N represents the credit unions in the sample; t = 1,..., T symbolizes the analyzed semesters (2012-1 to 2019-2); λ is the persistence coefficient, estimated for the lagged dependent variable in each model; β is the slope, estimated for each independent variable; $u_{it} = \alpha_i + \varepsilon_{it}$ is the composite error term, where α_i is the unobserved individual effect and ε_{it} is the random error term. The model variables are described in Tables 1, 2 and 3.

In order to validate the GMM-Systemic model and obtain consistent results, the following tests were applied: (i) Phillips-Perron (PP) unit root test, with the null hypothesis that all panels contain a unit root, and the alternative hypothesis that at least one panel is stationary; (ii) Arellano Bond autocorrelation test, whose null hypothesis indicates that there is no autocorrelation of order n (1 or 2); (iii) Sargan / Hansen test, with the null hypothesis that instrumental variables and residuals are not correlated; and (iv) Hansen's difference test, whose null hypothesis assumes that the instrument subsets are exogenous (Blundell & Bond, 1998; Roodman, 2009). The level of significance considered for the analysis of the tests was 5%.

3.3. Description of the variables used

This study tested three variables as performance proxies (Table 1): Return on Equity (ROE), Adjusted Equity Growth (CPLA) and the Natural Logarithm of the Number of Associates (LnNCoop), to address the financial dimensions and social performance.

Table 1
Dependent variables

Acronyms	Definition of dependent variables	References
ROE_{it}	Return on Equity. Credit union profitability measure and proxy for financial performance. $ROE = \frac{Surplus}{Equity}$	DeYoung and Rice (2004); Goddard et al. (2004); Stiroh and Rumble (2006); Mercieca et al. (2007); Goddard et al. (2008); Bressan et al. (2011); Lee et al. (2014).
$CPLA_{it}$	Growth in Adjusted Shareholders' Equity (PLA). Equity evolution measure and proxy for the financial performance of the credit union $CPLA = \left(\frac{PLA\ of\ the\ current\ semester}{PLA\ of\ the\ previous\ semester}\right) - 1$	Bressan et al. (2011); Gollo and Silva (2015).
$LnNCoop_{it}$	Natural logarithm of the number of members with debts of at least R$ 200.00, according to IF.Data. Proxy used to measure the social function of the credit union through its body of members (active members).	Adapted from Bialoskorski Neto et al. (2006).

Source: Authors cited in the table.

From the national and international literature, the independent variables of main interest of the study were defined, involving the diversification variable (DIV) and its quadratic transformation $(DIV)^2$, which are proxies for the diversification of financial products of credit unions (Table 2).

Table 2
Independent variables of main interest

Acronyms	Definition	Expected sign	References
DIV_{it}	Diversification: one minus the Herfindahl-Hirschman Index (1-HHI). Measures the indirect effect of income diversification. $DIV = 1 - \left(\left(\frac{OCRED}{RO}\right)^2 + \left(\frac{AIL}{RO}\right)^2 + \left(\frac{TVMIFD}{RO}\right)^2 + \left(\frac{PSERV}{RO}\right)^2 + \left(\frac{OUTRAS}{RO}\right)^2 \right)$	Positive	Esho et al. (2005); Stiroh and Rumble (2006); Mercieca et al. (2007); Goddard et al. (2008); Elsas et al. (2010); Kang et al. (2011); Ali et al. (2016).
	Quadratic transformation of diversification. The quadratic variable of diversification is included to test the nonlinear relationship between diversification and performance, seeking to identify an optimal degree of diversification.	Negative	Rogers et al. (2008); Elsas et al. (2010); Kang et al. (2011); Ali et al. (2016).

Source: Authors cited in the table.

The diversification measure followed an approach based on the Herfindahl-Hirschman index (Esho et al., 2005; Stiroh & Rumble, 2006; Mercieca et al., 2007; Goddard et al., 2008; Elsas et al., 2010). This approach captures the effect of indirect diversification exposure, reflecting the degree to which the credit union is specialized or diversified between credit operations and non-credit operations (Goddard et al., 2008).

Thus, the measure of diversification in this study (DIV) was obtained by dividing operating income (RO) into five main categories: 1) Income from Credit Operations (OCRED); 2) Income from Interbank Liquidity Applications (AIL); 3) Income from Securities and Derivative Financial Instruments (TVMIFD); 4) Income from the Provision of Services (PSERV); and 5) Other Operating Income (OTHER). Diversification can take values between 0 (when the credit union obtains its income from a single source) and 0.80 (when the credit union generates a fully balanced income mix, considering five sources of income). Thus, the maximum diversification that can be obtained through this proxy is 0.8, due to the division of operating income into five parts, that is, into its five different sources.

Finally, the control variables that can impact the performance of individual Brazilian credit unions are described in Table 3 and were used together in all three models tested in the work.

Table 3
Independent control variables

Acronym	Definition	Expected sign	References
$Y_{i,t-1}$	Lagged dependent variable (ROE, CPL and LnNCoop). They are the dynamic variables of the model; seek to capture the persistence of performance and the number of members of credit unions with loans.	Positive	Goddard et al. (2004); Athanasoglou et al. (2008); Carvalho et al. (2010); Migliardo and Forgione (2015); Barros et al. (2020).
$LnAT_{it}$	Natural logarithm of total assets. Proxy to control the size of the credit union and its effect on performance.	Positive	Stiroh and Rumble (2006); Goddard et al. (2008); Lee et al. (2014); Ali et al. (2016).
$\Delta lnAT_{it}$	Variation in the natural logarithm of total assets. Proxy to control the effects of the growth of credit unions.	Positive	Stiroh and Rumble (2006); Mercieca et al. (2007); Goddard et al. (2008); Lee et al. (2014).
$(\Delta lnAT)^2_{it}$	Quadratic transformation of the variation of the asset's natural logarithm. Included to verify the non-linear relationship between asset growth and performance.	Negative	Stiroh and Rumble (2006); Mercieca et al. (2007); Goddard et al. (2008).
EA_{it}	Ratio between loans and total assets. Interpreted as a measure of loan specialization that can provide benefits from valuable information. $EA=\frac{\text{Loans}}{\text{Total assets}}$	Uncertain	Kimball (1997); Stiroh and Rumble (2006); Mercieca et al. (2007); Goddard et al. (2008); Lee et al. (2014).
PA_{it}	Ratio between equity and total assets. Proxy interpreted as a security measure for credit unions. $PA=\frac{\text{Equity}}{\text{Total Assets}}$	Uncertain	Berger (1995); Goddard et al. (2004); Stiroh and Rumble (2006); Mercieca et al. (2007); Goddard et al. (2008); Lee et al. (2014).
$\Delta lnPIB_{it}$	Variation in the natural logarithm of the semi-annual national GDP (Gross Domestic Product). It verifies the impact of economic growth on the performance of credit unions.	Positive	Goddard et al. (2008).
$Incorp_{it}$	Incorporation. Dummy variable that assumes a value equal to 1 when total and/or partial incorporation occurs, and 0 otherwise. Included to consider the effect of mergers (by the developer) on credit union performance.	Uncertain	Goddard et al. (2009); Mckillop and Wilson (2011); Pessanha et al. (2012).

Source: Authors cited in the table.

4. RESULTS

4.1. Descriptive statistics

The performance proxy "Return on Equity (ROE)" showed a greater dispersion, with a coefficient of variation of 87.16%. When verifying the median (0.0678) of this variable, it can be seen that more than half of the return data from credit unions were positive, demonstrating that

the credit unions in the sample had more leftovers than losses in the analyzed period. However, there were periods with losses (as seen in the minimum return of -0.5452) (Table 4).

Table 4
Descriptive Statistics of Quantitative Variables

	N	Minimum	Maximum	Median	Mean	Std-Dev	Coef. Of Variation
ROE	7280	-0.5452	0.6900	0.0678	0.0677	0.0590	0.8716
CPLA	7280	-0.5526	5.8072	0.0850	0.0951	0.1278	1.3436
LnNCoop	7280	0.0000	11.8173	7.5642	7.6435	1.3012	0.1702
(N Coop.)	7280	0.00	135,580	1,928	4,684.83	7,754.63	1.6553
DIV	7280	0.0544	0.7438	0.5517	0.5292	0.0948	0.1791
$(DIV)^2$	7280	0.0030	0.5533	0.3044	0.2890	0.0890	0.3078
LnAT	7280	14.2898	22.5104	18.5124	18.4956	1.3609	0.0736
ΔlnAT	7280	-0.3876	1.6115	0.0858	0.0934	0.0979	1.0480
$(\Delta lnAT)^2$	7280	0.0000	2.5971	0.0078	0.0183	0.0560	3.0602
EA	7280	0.0708	0.9429	0.5452	0.5389	0.1426	0.2645
PA	7280	0.0537	0.9805	0.1915	0.2413	0.1562	0.6475
ΔlnPIB	7280	-0.0114	0.0788	0.0326	0.0311	0.0281	0.9034

Source: Research data.

The second performance proxy, Growth in Adjusted Shareholders' Equity (CPLA) also presented a high coefficient of variation (134.36%), indicating a positive growth in Adjusted Shareholders' Equity in more than half of the data (median of 8.50%). In addition, there was a maximum growth, in the period, of 580.72%, and reductions of up to 55.26% in Adjusted Shareholders' Equity (Table 4). It should be noted that the credit union that showed the highest growth in the sample carried out two incorporations between 2012 and 2018, which partly explains this high growth of the PLA.

In the third performance proxy, Number of Credit unions with Debt (N Coop.), again there was a greater dispersion in the data, with 165.53% of variation in relation to the average. Furthermore, it is evident that more than half of the observations showed more than 1,928 active members, and from the analyzed credit unions, a maximum total of 135,580 active members was obtained (Table 4).

The Variable Revenue Diversification (DIV), which can range from 0 (lowest level of diversification) to 0.8 (highest level of diversification), had its average value of 0.5292, and its median of 0.5517, indicating that most of the observations demonstrate greater diversification, with the greatest diversification of the sample, 0.7438, and the smallest, 0.0544 (Table 4).

Reductions in the half-yearly GDP of the Brazilian economy can be noted, which, from 2012-1 to 2019-2, went through periods of expansion and contraction (Table 4). As for the Incorporation variable (Incorp), as it is a dummy variable, its descriptive statistics were not included in Table 4; however, it is noticeable that, in 1.96% of the observations, there was an occurrence of incorporation between the credit unions.

Additionally, Table 5 presents the correlation matrix of the independent variables that compose the estimated models.

Table 5
Correlation matrix

	DIV	DIV²	LnAT	ΔlnAT	ΔlnAT²	EA	PA	ΔlnPIB
DIV	1							
DIV²	0.9865***	1						
LnAT	0.3352***	0.3221***	1					
ΔlnAT	0.0203*	0.0155	0.0184	1				
ΔlnAT²	0.0101	0.0067	-0.0408***	0.6965	1			
EA	-0.5768***	-0.5842***	-0.1194***	0.0528***	0.0296**	1		
PA	-0.5192***	-0.4909***	-0.4603***	-0.1589***	-0.0451***	0.3515***	1	
ΔlnPIB	0.0062	0.0122	-0.063***	0.0245**	0.0205*	0.0995***	0.0387***	1

Significance levels: *** 1%; ** 5%; * 10%.
Source: Research data.

It is noted, in the correlation matrix, that two correlations were high (above 60%): (1) the correlation between DIV and DIV², and (2) the correlation between ΔlnAT and ΔlnAT². These high correlations are expected, given that the variables and their corresponding quadratic transformations were included. However, as the quadratic transformation of diversification is one of the main variables of interest, and the literature has highlighted the non-linear relationship between asset growth and performance, it was decided to keep these variables in the study. In addition, it is noteworthy that, as the Pearson correlation was performed, the Incorporation variable (Incorp), which is a dummy variable, was not included.

4.2. Econometric Analysis

Before estimating the Systemic GMM, the multicollinearity assumption, usually required in the Ordinary Least Squares method, was verified through the Variance Inflation Factor – VIF. The VIF showed that the analyzed models had a higher inflation factor of 9.21 (ROE), 9.21 (CPLA) and 9.92 (LnNCoop). However, it is noteworthy that this result is expected, as seen from the correlation matrix, since diversification and its quadratic form were considered, which are the main responsible for the increase in VIF. Thus, the choice of the quadratic model, which includes the diversification variable and its squared version, already indicates the existence of a greater correlation between these variables. Corroborating these justifications, all validation tests of the Systemic GMM model were met (Table 6).

In the Systemic GMM diagnostic analysis, the literature indicates the unit root test to verify the existence of a stationary process, which would be adequate. Thus, the Phillips–Perron (PP) test was applied, the results of which showed that the independent variables presented at least one stationary panel, with the exception of the variable LnAT (Logarithm of Total Assets). However, as LnAT is a control variable and the literature emphasizes that the stationary process is a sufficient condition, but not a necessary one (Blundell & Bond, 1998; Barros et al., 2020), it was considered that the results provided a condition for the estimation of models by Systemic GMM.

Table 6
Results of the estimations by the Systemic GMM

	Dependent Variable (Y)		
	ROE	**CPLA**	**LnNCoop**
$Y_{i,t-1}$	-0.1853***	-0.0745***	0.3998***
	(0.0511)	(0.0273)	(0.0501)
DIV	-1.5621***	-1.1941***	-4.7161***
	(0.3085)	(0.3074)	(1.3096)
DIV^2	1.7299***	1.4599***	5.8568***
	(0.3041)	(0.3283)	(1.2799)
LnAT	-0.0224***	-0.0151**	0.4800***
	(0.0031)	(0.0062)	(0.0448)
ΔlnAT	0.0115	-0.1808**	-0.0070
	(0.0173)	(0.0823)	(0.1044)
$(\Delta lnAT)^2$	-0.0589	2.0758***	0.7866*
	(0.0395)	(0.4521)	(0.4099)
EA	0.2433***	0.2561***	1.2259***
	(0.0241)	(0.0415)	(0.1823)
PA	-0.6623***	-0.4045***	0.4626
	(0.0732)	(0.1283)	(0.2993)
ΔlnPIB	-0.2929***	0.5483***	1.9532***
	(0.0342)	(0.0435)	(0.1853)
Incorp	-0.0096	-0.0132	0.0499
	(0.0062)	(0.0345)	(0.0830)
Intercept	0.8597***	0.5138***	-4.3074***
	(0.1171)	(0.1462)	(0.6926)
AR(1)	-6.3970***	-3.9432***	-4.2539***
AR(2)	1.8344*	0.8029	0.8498
Sargan test	4979.4622***	5288.5137***	2580.5291***
Hansen test	442.1111	453.2491	454.9849
Dif-Hansen (iv) test	0.49	0.99	0.00
N. of observations	6825	6825	6825
N. of groups	455	455	455
N. of instruments	423	483	528

Notes: The lags of the first differences and levels of the variables were used as instruments: $Y_{i,t-1}$, DIV, DIV^2 and PA. The other regressors are assumed to be exogenous. The Sargan test indicates that the instruments are correlated with the residuals, while the Hansen test indicates that the instruments are not correlated with the residuals, the latter being more robust. AR(1) was significant and negative, and AR(2) not significant at 5%. Dif-Hansen attests to the orthogonality conditions of the instrument subset. Standard errors are in parentheses; in tests, the value of the statistic is displayed, and the statistical significance is indicated by the symbols: *10%; **5%; ***1%.
Source: Research results.

The Arellano and Bond autocorrelation tests showed negative and significant first-order autocorrelation, while the second-order one was non-significant, given the assumption that second-order autocorrelation does not exist. The Sargan and Hansen tests seek to demonstrate the exogeneity (validity) of the instruments; however, the Hansen test is considered more robust. Thus, the null hypothesis of the Hansen test was not rejected in the three models, indicating that there is no correlation between the instruments and the residuals. Finally, the Hansen Difference test pointed to the validity of all subsets of instruments. The tests confirm the validity of the estimates through the Systemic GMM (Table 6), and it is now possible to proceed with the analysis and discussion of the results (Table 6).

By analyzing the main explanatory variable of the model, Diversification (DIV), and its quadratic transformation (DIV^2), it was possible to respond to the objective of the study and reject the research hypothesis that "Credit unions have an optimal level of diversification that maximizes its performance, from which increases in diversification would lead to decreases in performance".

The results of the three models showed a significant and negative relationship between diversification and performance, as measured by the proxies for Return on Equity (ROE), Adjusted Equity Growth (CPLA) and Natural Logarithm of the Number of Members with Loans (LnNCoop). In addition, the quadratic transformation of diversification (DIV^2) had a significant and positive relationship with performance, also in the three models. These results confirmed the existence of a non-linear U-shaped relationship between diversification and performance, providing subsidies to reject the research hypothesis, since an inverted U-shaped relationship was expected.

These findings contradict studies by Palich et al. (2000), Ali et al. (2016), Solano et al. (2019) and Kim et al. (2020), as well as the finding that diversification would provide a positive impact on performance up to a certain optimal point, from which increases in diversification would lead to reductions in performance. Thus, these increases in diversification could cause increases in costs and in a greater number of activities to manage that would offset the benefits of diversification, justifying the existence of a relationship between performance and diversification in the form of an inverted U. However, this relationship was not verified in this study.

In order to better examine the relationship between performance and diversification, Figure 1 explains the growth of performance variables (ROE, CPLA and LnNCoop) at different levels of diversification, keeping all other variables constant (considering their averages). In this way, the nonlinear U-shaped relationships in the estimated models are clear. In addition, the partial derivative of the dependent variables with respect to diversification was obtained to estimate the critical points of the graphs, which, in this case, are minimum points. The minimum diversification points were 0.4515 for the ROE performance variable; 0.4090 for the CPLA performance proxy; and 0.4026 for the logarithmic variable of number of credit union members with debts (LnNCoop).

It is revealed, therefore, that there is a minimum level of diversification, which is around 0.42, according to the Herfindahl-Hirschman index. Credit unions can achieve this result by obtaining approximately more than 30% of their revenue outside their dominant business, ie, outside their credit operations. This level of diversification, according to the literature, indicates a moderate diversification strategy, as diversification levels that generate more than 30% of their revenue outside their dominant business, whose businesses are somehow linked to each other, use a diversification strategy related at the corporate level (Hitt et al., 2008).

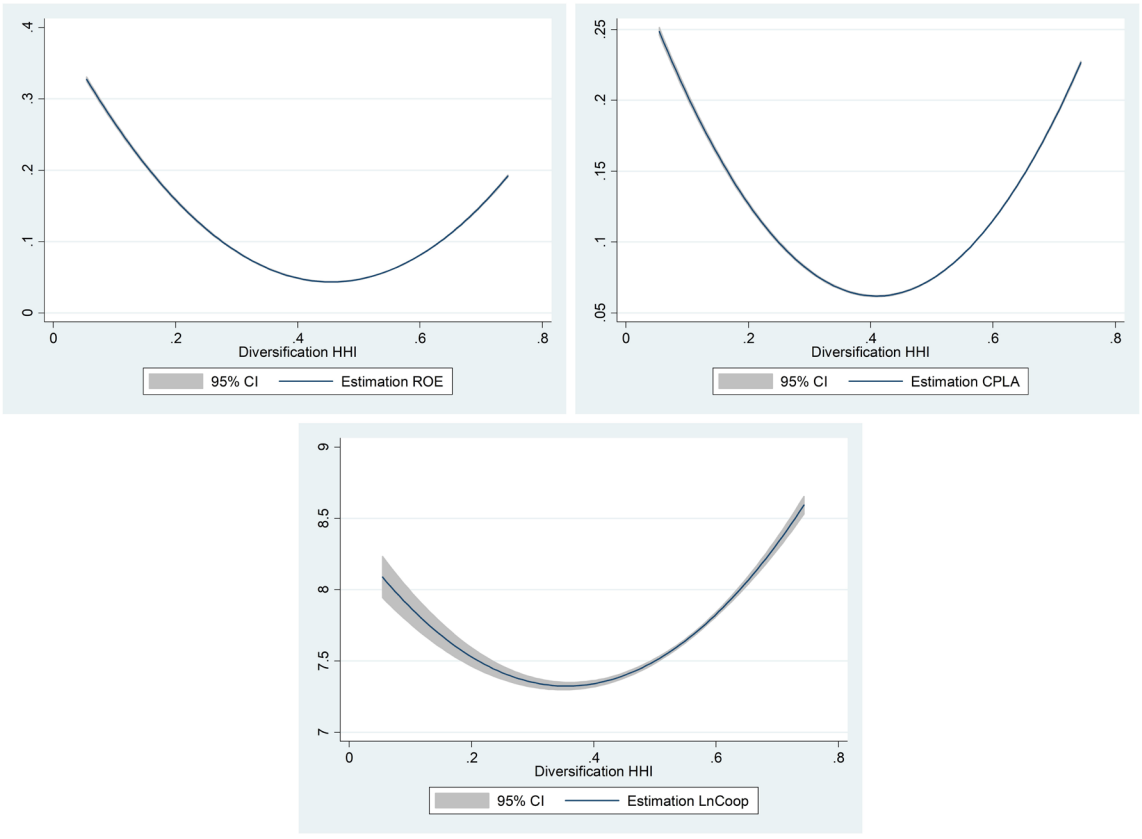

Figure 1. Models describing the relationship between the predicted performance and diversification (U-shaped models)
Fonte: Research results.

From this minimum point, diversification would have a positive impact on the performance of credit unions, whether considering the return variable, the growth of adjusted Equity or the number of members with loans. Thus, the findings of this study indicate that higher levels of diversification of financial products are beneficial for the performance of credit unions, indicating that greater diversification could provide synergies and economies of scope.

In this sense, economies of scope could be an incentive for the growth of these institutions, as the average costs of credit unions could reduce as the scope of financial products offered increases. Thus, if, by increasing their number of members, credit unions are able to guarantee the demand for a more diversified scope of services, they will naturally have an incentive to grow (Malikov et al., 2017).

As for the other variables in the model, it was found that the dependent variable lagged in one period (AR 1) was significant for the ROE, CPLA and LnNCoop models; however, with different signs. In the case of ROE and CPLA, they showed a negative persistence, suggesting that the current performance has a negative impact on future performance, which may be a demonstration of the better provision of services by the credit union in the next period. The number of members showed a positive persistence, indicating that the number of members with current loans positively impacts the number of future members, suggesting that current members attract new members to credit unions.

The proxy variable, for the size (LnAT) of the credit unions, also showed different signs, according to the dependent variable. When verifying the relationship between size and profitability (ROE) and equity growth (CPLA), the result was different from what was expected and indicated that larger credit unions tend to have a reduction in their performance, revealing that larger institutions have to bear extra costs, such as administration and coordination (Ali et al., 2016). However, the size of the credit union showed a positive relationship with the number of members with loans, suggesting that the fact that larger credit unions can bring more solidity to the members, attracting them to this type of institution.

On the other hand, asset growth (ΔlnAT) and its corresponding quadratic (ΔlnAT2) were jointly significant only for the Adjusted Equity Growth variable. The relationship presented was non-linear U-shape, suggesting that asset growth would have a positive effect on adjusted Equity growth only from a certain minimum level.

The loan specialization (EA) proxy was positive and significant in all models, as discussed by Kimball (1997) and Stiroh and Rumble (2006), suggesting benefits of specialization. On the other hand, the variable that represents the level of equity capital (PA) exposed a significant and negative relationship in the ROE and CPLA model, proposing that credit unions are operating with excessive caution and ignoring investment opportunities that are capable of generating positive returns (Goddard et al., 2008).

Finally, we discuss the result of the variable that measures the growth of the economy (ΔlnGDP), which was significant in all models, but showed divergent signs between them. First, in the profitability model (ROE), the relationship was negative, the opposite of what was expected and demonstrated by Goddard et al. (2008); suggesting that the growth of the economy has a negative impact on the profitability of credit unions and that these institutions would be better alternatives for periods of economic downturn. However, when verifying the impact of the variable on the growth of adjusted Equity and on the number of members with loans, there is a positive relationship, which corroborates the thought that the best performance of the country stimulates the best performance of credit unions (Goddard et al., 2008). It is also noteworthy that the incorporation variable was not significant in the three models.

5. CONCLUSIONS

This work verified the existence of a non-linear relationship between diversification and the performance of Brazilian credit unions, with the hypothesis that "credit unions have an optimal level of diversification that maximizes their performance, from which increases in diversification would lead to decreases in performance. It was confirmed that the relationship is non-linear; however, a significant U-shaped relationship between diversification and performance in the three proposed models was verified, rejecting the research hypothesis.

It is inferred that this divergent result from the expected may be a reflection of the differentiated characteristics of credit unions, considering that the related literature, which identified a relationship in the form of an inverted U-shape, had as research object industrial companies, exporters and banks—all these institutions are profit oriented. However, the reality of credit unions is different, since these are non-profit institutions that seek to better serve its members, having a stronger social function.

The U-shaped relationship indicates that credit unions have a minimum level of diversification, at which, from that point on, it starts to have a positive impact on their performance. Thus, a lower diversification may not be very interesting for these institutions. However, if the credit union is able to provide a greater variety of financial products, this could have a better impact on

its performance, with its members using its products more, being loyal and, perhaps, making the credit union its main financial institution, once that the credit union member would not need to look for other financial institutions. This is because the financial products he wants would already be provided in the credit union in a more attractive way, and the credit union could better take advantage of its economies of scope, internal resources and improve its performance.

Thus, this study contributes to the literature on diversification and performance in credit unions by examining the existence of a curvilinear relationship between these variables. The use of a new proxy for performance was suggested, which sought to capture the number of active credit union members and also bring performance to a more social perspective. These findings may be interesting for credit unions insofar as the understanding of the existence of a minimum point of diversification favors the formation of cooperative strategies and the analysis of the implementation of new products/services.

As limitations, the time period stands out, since the data available for the number of associates with loans were only available from 2012 onwards, and the social performance proxy. Finally, for future research, we suggest: verifying the functional form of the relationship between diversification and performance in credit unions from other countries, in order to ascertain whether this is a characteristic of these institutions; to verify the possibility of a S-shaped or cubic functional form; and testing other proxies and models that capture the social performance of credit unions.

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LV: Contextualization of the theme, definition of the objective, theoretical review, data collection, application of the method, results, analysis, conclusions and review of the text. **VB:** Contextualization of the theme, definition of the objective, support in the application of the method, analysis, conclusions and review of the text.

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CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest.