The Effect of Fund Transfer Pricing on Brazilian Bank Branch Performance

O Efeito de Preço de Transferência de Fundos no Desempenho de Agências Bancárias Brasileiras

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Abstract
Financial institutions have implemented fund transfer pricing in response to demands from regulatory bodies to better manage their risk and as part of their cash-pooling strategies. For banks, implementing a fund transfer price causes a redistribution of income between the various bank branches depending upon the determined transfer price and the volume of resources demanded or offered by each branch. In this context, this study's objective is to examine the effect of the potential implementation of fund transfer pricing on the performance of Brazilian bank branches. This study examines and runs a linear regression of 21 years of monthly banking statistics (2000-2020), lists the most relevant factors contributing to interbranch transfer volume, and demonstrates how an interbranch transfer volume analysis determines the fund transfer price effect in the performance of bank branches. Contrary to the expectations of prior studies, the total volume of interbranch transfers between Brazilian bank branches for the period examined is not zero, which means that, on average, bank branches generate resources that are allocated to other parts of the bank that are not bank branches. This study finds evidence that branches short of funds may be financing their income with resources from branches with excess funds and that implementing funds transfer pricing does not have a null effect in Brazilian bank branches. On average, the branches' incomes increase. While implementing a price for the transfer of funds leads to an increase in the bank branches' average income, it is not necessarily the case that a greater number of bank branches will register an increase in their income. This evidence is important because it demonstrates that a bank's strategy regarding the supply or demand of interbranch resources should inform decisions on whether or not to implement a fund transfer pricing policy.
Keywords: Fund transfer pricing; Interbranch transfer volume; Cash-pooling; Performance evaluation.

Resumo
As instituições financeiras implementaram preços de transferência de fundos em resposta às demandas dos órgãos reguladores para melhor gerenciar seus riscos ou como parte de uma estratégia de cash-pooling. Para os bancos, a implementação de um preço de transferência de fundos provoca uma redistribuição de resultados entre as diversas agências dependendo do preço de transferência determinado e do volume de recursos demandados ou oferecidos por cada agência. Portanto, o objetivo deste estudo é examinar o efeito de potencial implementação de preço de transferência de fundo no desempenho de agências bancárias brasileiras. Este estudo examina e usa regressão linear em 21 anos de estatísticas bancárias mensais (2000-

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2020), lista os fatores mais relevantes que contribuem para o volume de transferências entre agências, e demonstra como uma análise do volume de transferências entre agências serve para determinar o efeito do preço de transferência de fundos no desempenho das agências bancárias. Ao contrário do esperado por outros estudos, o volume total de transferências entre as agências dos bancos brasileiros no período analisado não é zero, o que significa que, em média, as agências bancárias geram recursos que serão alocados em outras partes do banco que não sejam agências bancárias. Este estudo encontra evidências de que agências deficitárias podem estar financiando suas receitas com recursos de agências com excesso de recursos, e a implementação de preços de transferência de fundos não tem efeito nulo nas agências bancárias brasileiras. Ou seja, na média, as receitas das agências aumentam. Embora a implementação de um preço para a transferência de fundos conduza a um aumento do rendimento médio das agências bancárias, não necessariamente um maior número de agências bancárias irá registar um aumento do seu rendimento. Essa evidência é importante porque demonstra como a estratégia de um banco em relação à oferta ou demanda de recursos entre agências é relevante para a consideração da implementação de uma política de preços de transferência de fundos.
Palavras-chave: Preço de transferência de fundos; Volume de transferência interdependência; *Cash-pooling*; Avaliação de desempenho.

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1. Introduction

Financial institutions constantly seek ways to improve their performance appraisal systems to survive in a competitive market. Performance appraisal systems are key factors in ensuring the successful implementation of an institution's strategies and techniques to achieve its objectives (Ahmad et al., 2020; Ferreira & Otley, 2009; Kim, 2018). Because financial institutions can have a diversified product portfolio, there is a fruitful environment for a more comprehensive approach to the performance evaluation of bank branches (Bidinoto et al., 2015; Friedrich et al., 2022). While management accounting studies discuss the need for comprehensive and multi-dimensional performance measurement systems in organisations (Ferreira & Otley, 2009; Hall, 2008; Kaplan & Norton, 1996), there is no consensus in the literature on the most appropriate technique for evaluating bank branch performance (Ahmad et al., 2020; Paradi & Zhu, 2013; Souza et al., 2008).

This study presents the potential effect of implementing a fund transfer pricing policy on the performance of Brazilian bank branches. This matter is relevant because the implementation of a transfer pricing policy is one of several regulatory requirements associated with the monitoring of liquidity in financial institutions (Grant, 2011; Winckler & Strietzel, 2017) and is also a cash-pooling strategy adopted by economic groups (Erbolat & Orsini, 2018; Mucelli et al., 2020). In this regard, where an organisation has already implemented a feature like transfer pricing for risk management or strategic reasons, management accountants can incorporate it into their multi-criteria approach to evaluating bank branch performance. Fund transfer prices adjust the income of bank branches according to each branch's contribution as a source or destination of resources (Dermine, 2013; Morch et al., 2008). In other words, implementing a fund transfer price results in a redistribution of the overall income among the different bank branches according to the determined transfer price for resources and the volume of those resources demanded or offered by each branch, i.e., interbranch transfers.

In this context, this study's objective is to examine the effect of the potential implementation of fund transfer pricing on the performance of Brazilian bank branches and, consequently, to examine the main factors that contribute to an increase or decrease in the volume of interbranch transfers. We analysed 21 years of monthly data from Brazilian bank branches (2000-2020) to examine the potential effect of implementing a fund transfer pricing policy for bank branches. This study lists the most relevant factors that contribute to the interbranch transfer volume and demonstrates how an analysis of the volume of interbranch transfers determines the effect of a fund transfer price on the branches' income.

However, accounting research has not addressed the impact of implementing a fund transfer price on financial institutions, especially commercial banks. Fund transfer pricing research contributes to the literature on financial services by investigating the relationship between operational variables, performance measures, and branch efficiency (Elliot, 2018; Krishnan et al., 1999; Paradi & Zhu, 2013). This study answers the call for transfer pricing research that goes beyond its role in compliance and tax management and emphasises its role as a strategic business tool (Kumar et al., 2021). Given that evidence indicates that financial services industry accountants are willing to use fund transfer pricing as a performance measure (Winckler & Strietzel, 2017), this study addresses this little-researched topic and discusses the potential consequences of implementing such a system for the evaluation of bank branch performance.

Following this introduction, section 2 of this study presents a literature review that addresses transfer pricing and management accounting, studies on the performance evaluation of Brazilian bank branches, and recent studies on fund transfer pricing and its particularities. Section 3 presents the analysis and discussion of the effect of implementing a fund transfer pricing policy on the performance of Brazilian bank branches and, specifically, its effect on the branches' income. Section 4 offers conclusions from this study's results and analysis.

2. Literature review

2.1. Transfer pricing and management accounting

Transfer pricing refers to the price set for transferring tangible goods, intangible goods, and services among entities belonging to an organisation, such as subsidiaries, divisions, or branches. The primary theoretical objective of transfer pricing is to fairly and accurately consider the value contributed by each associated entity to the value chain within an organisation (Arya & Mittendorf, 2010; Smolarski et al., 2019). Most research on transfer pricing focuses on multinational organisations and relates to regulation and compliance, profit shifting, and tax avoidance and evasion (e.g., Amidu et al., 2019; Korol et al., 2022; Ogidiaka et al., 2022; Sari et al., 2021). Korol et al. (2022) find that not all countries have uniform and standardised rules for preparing transfer pricing documentation. They highlight the lack of a unified methodology for valuing financial assets for tax purposes and preventing their use in illegal financial transactions. Ogidiaka et al. (2022) discuss how transfer pricing leads to the loss in revenue in Nigeria through profit-shifting techniques, while Sari et al. (2021) identify income shifting using transfer pricing in Asian developing countries and note that specific anti-avoidance rules can reduce such practices. Finally, Amidu et al. (2019) examine the impact of transfer pricing and earnings management on tax avoidance in Ghana and find that most firms employ transfer pricing strategies and manipulated earnings to avoid tax. Kumar et al. (2021) provide a contemporary and comprehensive review of transfer pricing research themes.

Tax authorities have established guidelines and regulations to prevent such abuses. The Transfer Pricing Guidelines for Multinational Enterprises and Tax Administrations (OECD,

2017)[1] constitute the most widely recognised framework for transfer pricing rules. The OECD guidelines recommend the use of various methods to determine transfer prices, including comparable uncontrolled price (CUP), the resale price method (RPM), the cost plus method (CPM), the transactional net margin method (TNMM), and the profit split method (PSM). These methods involve comparing intercompany transaction prices, costs, and profit margins with similar transactions between independent parties (Hickman & Moura, 2023; Wardhana, 2019, OECD, 2010).

Despite transfer pricing being a topic researched by management accountants, Kumar et al. (2021) identify in their bibliometric analysis that there is little emphasis on research into the role of transfer pricing as a strategic business tool. Management accountants can use transfer pricing for activities such as tax planning and compliance, risk management, cost allocation, supporting decision-making, and performance measurement. Management accountants play a vital role in analysing, monitoring, and managing the implications of transfer pricing within an organisation, providing financial insights, supporting decision-making processes, and collaborating with various stakeholders to ensure compliance, optimise performance, and mitigate risks. In this regard, this study focuses on how transfer pricing can contribute to assessing the performance of each entity within an organisation, specifically the branches within a commercial bank.

2.2. The performance evaluation of bank branches

With increased competition from new products and distribution channels, banks strive to succeed by improving their performance using financial performance measurement systems (Carlsson-Wall et al., 2016; Elliot, 2016; Krishnan et al., 1999). However, the literature does not agree upon the best technique for evaluating bank branch performance (Souza et al., 2008; Paradi & Zhu, 2013) and, given the diversified portfolio of products in commercial banks, there is a fruitful environment for using various criteria for evaluating the performance of bank branches (Bidinoto et al., 2015; Friedrich et al., 2022).

In this regard, an international survey identifies ratio analysis, regression analysis, and frontier efficiency methodologies as the most common approaches to measuring bank branch performance (Paradi & Zhu, 2013). Studies analysing the performance of Brazilian bank branches focus on either strategic issues and qualitative measurement (e.g., Machado Jr & Rotondaro, 2003; Melo & Domenico, 2012; Neves Júnior et al., 2007; Rocha, 1987) or the quantitative measurement of the performance of commercial banks and their branches (e.g., Freitas & Morais, 2008; Neves Júnior et al., 2007). The most frequently used methods to measure the performance of Brazilian commercial banks and their branches were data envelopment analysis (DEA) (Becker et al., 2003; Cavalcante & Macedo, 2011; Friedrich et al., 2022; Macedo & Cavalcante, 2009; Souza et al., 2008), analytic hierarchy process (AHP) (Bidinoto et al., 2015), and principal components analysis (PCA) (Crocco et al., 2002). Bidinoto et al. (2015) provide a brief commentary on the different methods used to measure the performance of bank branches, and Ahmad et al. (2020) offer a more comprehensive review.

However, few studies explore the factors related to the different strategies of commercial banks and the geographic locations of their bank branches (e.g., Crocco et al., 2002; Limodio & Strobbe, 2023; Sicsú & Crocco, 2003). Differences arising from factors related to different geographic locations should be accounted for when comparing the performance of bank branches. For example, there will be a distortion in the measurement of the performance of bank branches if a branch that is short of funds does not account for the cost of receiving funds (i.e., purchasing) and if a branch with an excess of funds does not account for the revenue

[1] Some publications adopt the OCDE acronym for the French name (i.e., *Organization de Coopération et de Développement Économiques*) while other publications adopt the OECD acronym for the English name (i.e., *Organization for Economic Co-operation and Development*).

from providing funds (i.e., selling). This distortion occurs because the branches that are short of funds will present a superior financial performance if they do not count the cost of using funds raised by the branches with excess funds (see Bicudo de Castro, 2014).

Consequently, if bank branches' performance appraisals depend upon their income, the manager of a branch that is short of funds is likely to receive a better performance appraisal than the manager of a branch holding excess funds. This appraisal is likely because companies tend to evaluate managers positively (negatively) when the result is positive (negative), regardless of whether the actions taken to achieve the results are adequate (Ittner et al., 2003). One branch may simply outperform another because it operates in a geographic location with higher-income clients or faces less competition. Due to the complexity of financial institution environments, we would expect the performance evaluation of bank branches to be comprehensive and multi-dimensional (Ahmad et al., 2020; Elliot, 2016; Kim, 2018). Consequently, the proposition of this study is to embed a transfer pricing on the transferral of funds between branches. This change would augment financial institutions' performance evaluation systems with an objective measure that accounts for the transferral of resources between branches.

2.3. Fund transfer pricing

The concept of funds transfer pricing is important for banks because it allows them to determine an internal price when allocating funds across different branches. The OECD recommends that each financial institution establishes a fund transfer pricing policy (OECD, 2010). Fund transfer pricing is a specific type of transfer pricing (see Arya & Mittendorf, 2010), and the OECD identifies it as a treasury transaction (OECD, 2010). In the case of a centralised organisation, internal trade is mandatory, and the treasury determines the fund transfer price unilaterally (Holmstrom & Tirole, 1991). In this situation of centralised decision-making, the transfer price would affect how the bank's profit or loss is divided among the bank branches. Still, it would not affect the overall amount of the bank's profit or loss (Arya & Mittendorf, 2010). It is worth noting that the price of transferring funds is a specific case of transfer pricing in which several particularities of traditional transfer pricing do not apply (e.g., Giacomelli & Aguiar, 2017; Perčević & Hladika, 2017). Furthermore, in the case of transfers between Brazilian domestic bank branches, the price for transferring funds is not subject to legal differences regarding principles adopted between Brazil and the OECD (e.g., Freire & Moreira, 2020; Monteiro et al., 2021). Also, economic groups can adopt a fund transfer pricing policy as part of a cash-pooling strategy, which would involve centralised treasury management to optimise the cash flow of the different units of an economic group (Erbolat & Orsini, 2018; Mucelli et al., 2020).

In those banks that adopt funds transfer pricing, the treasury is responsible for managing liquidity and for the internal pricing of funds for its different business units or branches (Alper et al., 2018; Baros et al., 2022; Chittenden, 2000; Kim, 2018). The treasury can be thought of as a financial institution within a financial institution, buying funds from branches that have an excess of funds and selling funds to branches that are short of funds (Grant, 2011; Subramanian & Kattumannil, 2022). By adopting a positive rate for the transfer pricing of funds, the implementation of a transfer price results in revenue for those branches holding an excess of funds (the fund providers) and costs for those branches with a shortage of funds (the fund recipients) (Kawano, 2005; Morch et al., 2008).

Bank branch performance is also subject to macroeconomic factors as well as factors specific to the geographic location of each branch (e.g., business environment, population income) (Crocco et al., 2002; Limodio & Strobbe, 2023; Peters et al., 2015; Sicsú & Crocco, 2003); in such circumstances, implementing a fund transfer price can be used to adjust the performance of bank branches to account for such factors. Commercial banks that do not adopt

transfer pricing fail to reward those branches (holding an excess of funds) that are funding other branches (with a shortage of funds). In this sense, implementing fund transfer pricing can severely affect bank branches' performance. However, a bank's strategy will determine how they implement a transfer pricing policy (and price). For example, if a bank's strategy is to reward branches that hold an excess of funds, the stipulated transfer price must be high, and if the strategy is to reward branches that are short of funds, the stipulated transfer price must be low (Bicudo de Castro et al., 2019).

Several international regulatory bodies recommend implementing a fund transfer pricing policy (see Dziwok, 2016; Grant, 2011; Ritchie, 2016; Winckler & Strietzel, 2017). Practitioners and academics linked to regulatory bodies (Grant, 2011; Rime et al., 2017), financial institutions (Kawano, 2005; Kocakulah & Egler, 2006), as well as organisations like SAP (Levey, 2008), PwC (Tumasyan, 2012) and Deloitte (Peters et al., 2015), also discuss fund transfer pricing. Furthermore, given the growing relevance of liquidity analysis in financial institutions, the finance literature also discusses the pricing of funds transfer (e.g., Chavez-Velazquez, 2020; Dermine, 2013, 2016; Dziwok, 2016; Dziwok & Wirth, 2020; Grant, 2011; Hoffmann & Loeffler, 2017; La Ganga & Trevisan, 2010; Serpel et al. 2023; Rime et al., 2017). Implementing a fund transfer pricing policy paves the way for management accounting to play a more significant role in the financial services sector under a performance evaluation approach (Quan, 2009). However, only a few studies of such implementations take a management accounting perspective (e.g., Bicudo de Castro, 2014; Bicudo de Castro et al., 2019; Lucien, 1979; Morch et al., 2008; Rice & Kocakulah, 2004).

Fund transfer pricing remains a relevant topic among practitioners, who believe fund transfer pricing policies can be used for strategic planning, profit centre management, and as an institutional tool for evaluating the performance of business units, the implementation of strategies, and the achievement of goals (Drury, 1998; Elliot, 2018; Quan, 2009; Winckler & Strietzel, 2017).

3. Analysis and discussion of the effect of fund transfer pricing on the performance of bank branches

This study analysed a sample of Brazilian banks because Brazilian financial institutions are required to follow the Central Bank's accounting rules, which include the provision of monthly financial reporting to the Central Bank, and the application of the Accounting Plan for Financial Institutions (*Plano Contábil das Instituições do Sistema Financeiro Nacional* – COSIF), which comprises a compulsory chart of accounts, pre-defined accounting methods, and standard reporting formats (World Bank, 2013). Consequently, different Brazilian banks' accounting data are readily available and comparable (see Appendix). Furthermore, due to international harmonisation, the Brazilian accounting standards, including the Central Bank's accounting rules, have converged with the IFRS (Bicudo de Castro & Mihret, 2020; Rodrigues et al., 2012).

By following the simulation used by Morch et al. (2008) and the analytical model used by Bicudo de Castro et al. (2019), and by stipulating a single fund for the transfer of funds, we could measure the effect of implementing a fund transfer price by imputing the fund transfer price rate to the interbranch transfer volume demanded or offered by each bank branch. For this analysis, we adopted a single fund for the transfer of funds; see Morch et al. (2008) or Kawano (2000) for a comparison of fund transfer pricing methods. Following Bicudo de Castro et al. (2019), we note that this analysis is not affected by the rate of return or interest cost. Rather, this analysis focuses on whether branches have excess funds or are short of funds (i.e., the interbranch transfer volume demanded or offered).

When adopting a single fund for the transfer of funds, we used the following equation to represent the effect of the fund transfer price on the income of a branch of a commercial bank:

$$V710' = V710 + Transfer * Price$$

The variable V710' represents the income of the bank branch adjusted by the price of the transfer of funds, in that it comes from V710 (i.e., the V710 account where income and expenses attributed to the bank branches are recorded) plus the transfer price multiplied by the volume of interbranch transfers. Adopting a single fund for the transfer of funds, the effect on the bank branch's income due to the implementation of a funds transfer price will be an amount to be credited or debited to the bank branch's income account. This amount is a function of the volume of interbranch resources transferred and the interest rate used as the price for these transferred funds. If the branch has excess funds, the interbranch value transferred is positive, and if the branch is short of funds, the interbranch value transferred is negative. Consequently, with the implementation of a transfer price with a positive rate, a branch holding excess funds will increase its income, while a branch that is short of funds will have a decrease in its income.

From a fund transfer volume perspective, the implementation of a transfer price will affect bank branch results as follows:

$$\Delta V710 = Transfer * Price,$$
where $\Delta V710 = (V710' - V710)$

A bank branch's income will increase with a positive rate and a positive volume of funds transferred. With a positive rate and a negative transfer volume, the branch's income will decrease. When using a negative rate on the transfer of funds, the incomes from positive and negative transfer volumes would be reversed (see Bicudo de Castro et al., 2019). However, given that a negative nominal interest rate is a very unlikely scenario in the Brazilian economy, this study only discusses the implementation of a funds transfer price using a positive rate.

The effect of adopting fund transfer pricing in Brazilian bank branches was tested using 21 years of monthly bank branch data (2000-2020). This analysis used monthly reports from January 2000 to December 2020, totalling 21 years of monthly observations (252 months). The information required for the analysis comprises demographic information pertinent to each branch and the balances recorded under the headings in the accounts listed in the Appendix. Table 1 lists the statistics relating to the data obtained, and Table 2 provides the correlation matrix between the variables.

Table 1
Statistics descriptive

Variable	Obs.	Minimum	Maximum	Average	Standard deviation
V110	4,920,739	$0	$31,454,586,020	$1,982,286	$71,178,634,710
V120	4,920,739	$0	$581,956,623,099	$44,408,416	$2,784,522,584,237
V130	4,920,739	$0	$317,348,300,596	$43,139,124	$2,193,628,634,689
V140	4,920,739	-$231,095,693,045	$40,020,380,858,827	$264,242,976	$34,624,560,141,978
V160	4,920,739	-$940,042,421	$426,739,630,154	$84,303,970	$1,870,421,275,473
V180	4,920,739	-$793,600	$1,064,646,435	$15,706	$2,318,800,536
V184	4,920,739	-$908,603,892	$0	-$15,944	$2,072,732,148
V190	4,920,739	$0	$4,295,557,826	$620,470	$22,237,251,280
V200	4,920,739	$0	$212,350,847,029	$19,695,896	$1,281,113,797,348
V401-419	4,920,739	$0	$7,247,054,642	$6,808,702	$40,465,046,464
V420	4,920,739	$0	$27,296,736,142	$20,817,487	$69,950,205,187
V430	4,920,739	$0	$592,533,054,782	$89,485,358	$3,780,612,661,663
V440	4,920,739	$0	$40,018,061,175,272	$251,339,012	$34,594,528,077,458
V460	4,920,739	$0	$276,751,632,354	$20,463,018	$1,179,641,471,236
V470	4,920,739	$0	$61,693,918,303	$3,849,975	$241,932,307,773
V480	4,920,739	-$159,827,955,989	$157,097,734,626	$771,855	$111,804,627,357
V490-500	4,920,739	$0	$298,501,679,476	$43,103,617	$1,952,123,433,223
V610	4,920,739	-$39,489,579,170	$136,099,039,218	$21,025,957	$1,019,284,705,864
V710	4,920,739	-$37,754,406,987	$21,391,548,249	$727,917	$116,136,614,235
Transfer	4,920,739	-$402,732,540,568	$308,099,757,491	$12,903,963	$1,879,737,147,262

Source: prepared by the authors.

We calculated the *Transfer* variable using the difference between the accounts V140 and V440, and this information was used to measure the interbranch transfer volume, which is the financial resources offered or demanded by each branch.[2] For this study, we assumed that the interbranch transfer, registered as interfinancial relations and interdependencies in the account V140 for assets and in the account V440 for liabilities, occurs between the bank's branches under treasury control. Note that interbank transactions (between different banks) are recorded in the account V120 for assets and in the account V430 for liabilities.

[2] Variables V140 and V440 are highly correlated. See the correlation matrix in Table 2, and exploratory analysis results with all accounts in Table 3.

Table 2
Correlation Matrix

Variable	V110	V120	V130	V140	V160	V180	V184	V190	V200	V401-419	V420	V430	V440	V460	V470	V480	V490-500	V610	V710
V110	1																		
V120	.629 **	1																	
V130	.621 **	.822 **	1																
V140	.043 **	.060 **	.042 **	1															
V160	.513 **	.601 **	.781 **	.039 **	1														
V180	.085 **	.077 **	.094 **	.004 **	.069 **	1													
V184	-.044 **	-.112 **	-.107 **	-.002 **	-.133 **	-.206 **	1												
V190	.421 **	.579 **	.669 **	.020 **	.701 **	.174 **	-.222 **	1											
V200	.479 **	.722 **	.753 **	.031 **	.787 **	.091 **	-.157 **	.665 **	1										
V401-419	.276 **	.370 **	.366 **	.098 **	.359 **	.070 **	-.048 **	.308 **	.345 **	1									
V420	.103 **	.133 **	.156 **	.001 **	.075 **	.029 **	-.012 **	.086 **	.039 **	.148 **	1								
V430	.620 **	.949 **	.885 **	.054 **	.691 **	.116 **	-.150 **	.653 **	.793 **	.406 **	.127 **	1							
V440	.053 **	.067 **	.063 **	.999 **	.063 **	.004 **	-.005 **	.039 **	.049 **	.102 **	.004 **	.063 **	1						
V460	.244 **	.295 **	.371 **	.048 **	.440 **	.031 **	-.043 **	.288 **	.369 **	.190 **	.047 **	.335 **	.029 **	1					
V470	.373 **	.548 **	.555 **	.079 **	.473 **	.074 **	-.043 **	.307 **	.393 **	.241 **	.026 **	.516 **	.081 **	.253 **	1				
V480	.164 **	.240 **	.249 **	.011 **	.257 **	.049 **	-.038 **	.233 **	.292 **	.155 **	.021 **	.273 **	.015 **	.123 **	.105 **	1			
V490-500	.651 **	.877 **	.854 **	.066 **	.784 **	.062 **	-.077 **	.628 **	.739 **	.370 **	.096 **	.869 **	.072 **	.410 **	.610 **	.227 **	1		
V610	.447 **	.668 **	.635 **	.046 **	.674 **	.055 **	-.136 **	.524 **	.833 **	.246 **	.015 **	.655 **	.054 **	.292 **	.445 **	.188 **	.711 **	1	
V710	-.329 **	-.566 **	-.341 **	-.053 **	-.185 **	-.046 **	.027 **	-.224 **	-.270 **	-.174 **	-.026 **	-.539 **	-.040 **	-.175 **	-.339 **	-.086 **	-.501 **	-.275 **	1

** Pearson's correlation coefficient with significant correlation at 0.01 (two-tailed).
Source: prepared by the authors.

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3.1. The interbranch transfer volume

The first step in understanding the effect of implementing funds transfer pricing on bank branch income is to understand what contributes to the interbranch transfer volume. For this purpose, a linear regression was calculated using the interbranch transfer volume as the dependent variable and the accounts and control variables as the independent variables. Control variables are derived from the demographic information relevant to each branch and the base date of observations. A thorough analysis of the correlations between the variables indicated a high variance inflation factor (VIF), suggesting multicollinearity between some independent variables. These results mean that some of the accounts used as independent variables are highly correlated, as shown in the Table 2 correlation matrix, with multicollinearity compromising the quality of a linear regression using such variables. The solution to this problem is to combine independent variables with high correlation coefficients in one or more factors, based on a result of exploratory factor analysis.

An exploratory principal components analysis (PCA) highlights five components (see Table 3). Table 3 presents the exploratory analysis, with all the accounts and values up to a minimum of 0.7 that were considered relevant as they represent at least 49% of the factor variance (Hulland, 1999). Table 4 presents the analysis with only the highly correlated accounts that comprise the *Factor* independent variable.

Table 3
Principal Component Analysis (PCA) with all accounts

Variable	1	2	3	4	5
V490-500	0.936	-0.014	-0.146	-0.016	-0.052
V430	0.935	-0.029	-0.073	-0.128	-0.032
V130	0.911	-0.037	-0.020	0.014	0.061
V120	0.903	-0.016	-0.174	-0.178	-0.067
V200	0.862	-0.060	0.153	0.242	-0.021
V160	0.839	-0.041	0.157	0.286	0.081
V610	0.779	-0.037	0.059	0.219	-0.137
V190	0.737	-0.063	0.308	0.091	0.046
V110	0.683	-0.012	-0.149	-0.136	0.021
V470	0.613	0.049	-0.221	-0.112	-0.178
V710	-0.481	-0.026	0.412	0.467	0.282
V401-419	0.454	0.103	0.045	-0.123	0.404
V460	0.449	0.001	0.022	0.258	0.107
V480	0.310	-0.030	0.187	0.237	0.216
V140	0.089	0.994	0.038	0.019	-0.017
V440	0.101	0.991	0.050	0.029	-0.011
V184	-0.162	0.036	-0.672	0.251	0.237
V180	0.129	-0.021	0.573	-0.490	-0.155
V420	0.127	-0.005	0.000	-0.413	0.782

Source: prepared by the authors.

Table 4
Principal Component Analysis (PCA) with correlated accounts

Variable	Factor
V430	0.932
V490-500	0.926
V130	0.917
V200	0.897
V120	0.893
V160	0.857
V610	0.811
V190	0.766

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Source: prepared by the authors.

The first factor in Table 3 highly correlates with eight accounts. These accounts relate to interbank investments (V120), interbank deposits (V430), securities and derivative financial instruments (V130), credit operations (V160), other securities and assets (V190), administrative cheques (V490), other obligations (V500), permanent assets (V200), and equity (V610). According to the Table 2 correlation matrix between the variables, these are the accounts with the highest correlation coefficients that contribute to a high VIF in linear regression. The second factor is mainly represented by the interbranch transfer volume in accounts V140 for assets and V440 for liabilities, constituting the *Transfer* variable. The third, fourth, and fifth factors do not have highly correlated accounts.

To avoid multicollinearity between the model's independent variables, we combined the eight accounts with a significant representation into a single factor as a new variable in the model, called *Factor*. Correlations between the eight accounts and the *Factor* variable are available in Table 4.

The linear regression, using the transfer volume as the dependent variable and the accounts and control variables as the independent variables, is:

$$Transfer_{ti} = \beta_0 + \beta_1 Factor_{ti} + \beta_2 V110_{ti} + \beta_3 V180_{ti} + \beta_4 V184_{ti} + \beta_5 V401\text{-}419_{ti} + \beta_6 V420_{ti} + \beta_7 V460_{ti} + \beta_8 V470_{ti} + \beta_9 V480_{ti} + \beta_{10} YEAR + \beta_{11} BANK + \varepsilon_{ti}$$

Table 5 shows the regression results:

Table 5
Regression

Variables	Coefficients	Standard Deviation	Standardised Coefficients	*t* -statistic	Sig.	VIF
Constant	-58,895,832	3,265,902	-	-18.0	0,000	-
Factor*	- 1,505,251,357	974,121	-0.801	- 1,545.2	0,000	2.78
V110	- 0.1935	0.0107	-0.007	-18.1	0,000	1.70
V180	20.6643	0.2591	0.025	79.8	0,000	1.06
V184	- 26.1280	0.2948	-0.029	-88.6	0,000	1.09
V401-419	1.4995	0.0160	0.032	93.5	0,000	1.23
V420	- 0.3741	0.0090	-0.014	-41.6	0,000	1.16
V460	0.8821	0.0005	0.554	1,624.3	0,000	1.20
V470	0.8807	0.0030	0.113	293.4	0,000	1.54
V480	0.4195	0.0055	0.025	76.6	0,000	1.10
V710	- 7.2901	0.0058	-0.450	- 1,265.7	0,000	1.31

Note. A total of 4,920,739 observations, with BANK (212 financial institutions) and YEAR (21 years) used as control variables, the R^2 is 0.52, the adjusted R^2 is 0.52, and the *F* stat is 22464.48 with a significance of 0,000.
* The variable is the factor composed of the variables V120, V430, V130, V160, V190, V490-500, V200, and V610, which are highly correlated.
Source: prepared by the authors.

Linear regression supports the argument that the volume of interbranch transfer can be a function of the variable *Factor* and other accounts. The dummy control variables, referring to year and bank, have coefficients statistically different from zero, indicating that, in addition to the accounts, the volume of interbranch transfer can also be influenced by the period and bank.

Examining the standardised coefficients and considering an increase in the demand for resources by the branch (i.e., a negative balance for the variable *Transfer*), it is evident that a high balance in the variable *Factor* contributes to a greater demand for interbranch resources. The other account that contributes to a demand for resources is the account V710 (income), which suggests that an increase in bank branch income accounts is associated with a greater

demand for interbranch resources by the bank branch. The volume of interbranch transfers increases following an increase mainly in the account V460 (obligations for loans and onlendings) and in the account V470 (derivative financial instruments), meaning that an increase in the funds raised recorded in these accounts by the branch coincides with the branch offering more resources inside the bank.

As with implementing fund transfer pricing, a bank branch's income is directly influenced by the volume of interbranch transfers. This analysis helps to identify the profile of branches that may or may not benefit from the implementation of a policy of fund transfer pricing. The evidence is aligned with previous research, which recommends a fund transfer pricing policy for managing liquidity in financial institutions (e.g., Chavez-Velazquez, 2020; 2016; Dziwok, 2016; Dziwok & Wirth, 2020; Grant, 2011; Hoffmann & Loeffler, 2017; La Ganga & Trevisan, 2010; Serpel et al. 2023; Rime et al., 2017). However, these studies have the financial institution as the level of analysis, focusing on the different financial products recorded in its balance sheets, and do not examine the volume of interbranch transfers (Paradi & Zhu, 2013).

Bank branches with high balances in the liability account that records borrowing and onlending obligations tend to provide resources to the bank as branches with excess funds. In the case of branches with a shortage of funds, there is a high correlation between the accounts recording interbank investments and deposits, operations with securities and derivative financial instruments, credit operations, administrative cheques, other securities and assets and obligations, permanent assets, and equity. These accounts are associated with branches that are short of funds, implying that these branches tend to demand funds within the bank to finance their activities. Another account identified as a contributor to a demand for interbranch resources is the bank branch's income. This insight supports the argument that branches short of funds may be financing their income with resources from branches with excess funds.

3.2. The effect on bank branch income

Considering that the effect of implementing a fund transfer price (i.e., $\Delta V710$) on bank branch incomes is directly related to the volume of interbranch transfers, the question remains: how much do the branches of a given commercial bank benefit, particularly in terms of their income? Considering a positive fund transfer rate, branches that are short of funds will have a reduction in the income (i.e., $Transfer < 0 \rightarrow \Delta V710 < 0$), while branches with an excess of funds will have an increase in the income (i.e., $Transfer > 0 \rightarrow \Delta V710 > 0$).

Our analysis also addressed the results of specific bank branches to understand the effect of implementing a fund transfer price. We selected the five Brazilian banks with the highest number of branches in December 2020 for this analysis. The banks and their branch numbers registered as of December 2020 are Banco do Brasil (4,368 branches), Banco Bradesco (3,390 branches), Itaú Unibanco (2,841 branches), Caixa Econômica Federal (3,372 branches), and Banco Santander (2,758 branches). Together, the branches of these five banks represented 90% of the more than 18,000 bank branches registered with the Central Bank of Brazil in December 2020. Furthermore, the five largest banks represented more than three-quarters of all observations collected for the period January 2000 to December 2020.

Based on the data obtained, it appeared that the average value of the volume of interbranch transfer, the variable *Transfer*, was positive and statistically different from zero, according to the test shown in Table 6. The same statement was also valid for the five largest banks in terms of the average value of interbranch transfers. A positive average interbranch transfer volume suggests that, on average, implementing a transfer price with a positive rate increases the income of bank branches. However, there is a possibility that some banks have a structure or strategy for transferring resources where more of their branches are short of funds.

In such a scenario, implementing a fund transfer pricing with a positive rate will increase the income a small number of branches with an excess of funds at the expense of many branches that are short of funds.

Table 6
***Transfer* variable for the five largest banks**

	All banks	Banco do Brasil	Caixa Econômica Federal	Banco Bradesco	Itaú Unibanco	Banco Santander
Transfer variable						
Observations	4,920,739	1,110,275	624,336	923,695	714,307	414,116
Average	12,903,963	10,536,199	31,008,125	9,720,066	14,454,820	15,770,696
Median	2,820,054	-112,756	-127,703	14,897,293	10,204,557	7,371,075
Skewness	12.1	64.1	37.8	-103.3	-86.0	-78.3
Std. Error of Skewness	0.001	0.002	0.003	0.003	0.003	0.004
Kurtosis	11,213	6,092	3,389	14,001	9,405	9,439
Std. Error of Kurtosis	0.002	0.005	0.006	0.005	0.006	0.008
Percentile						
10%	-22,735,159	-53,365,180	-73,669,724	1,138,749	8,854	-9,077,505
25%	-1,541,048	-14,630,284	-20,520,567	4,653,450	2,604,888	-255,911
50%	2,820,054	-112,756	-127,703	14,897,293	10,204,557	7,371,075
75%	17,401,137	8,745,523	190,388	39,858,127	28,045,688	27,041,725
90%	50,007,746	32,177,621	32,359,184	84,104,349	64,941,462	63,160,555
Test for *Transfer* > 0						
t -statistic	15,228	6.955	6,706	4,569	11,414	5,982
Degrees of freedom	4,920,738	1,110,274	624,335	923,694	714,306	414,115
Significance (two-tailed)	0.000	0.000	0.000	0.000	0.000	0.000
Average difference	12,903,963	10,536,199	31,008,125	9,720,066	14,454,820	15,770,696

Source: prepared by the authors.

The average interbranch transfer volume was statistically different from zero for all five banks analysed, suggesting that, on average, bank branches will have an increase in their income as a consequence of implementing a fund transfer price with a positive rate.

However, it was observed that both Banco do Brasil and Caixa Econômica Federal had negative median values for the volume of interbranch transfers. The positive values for the transfer volume skewness for Banco do Brasil and Caixa Econômica Federal also suggest a proportionately greater number of branches concentrated below the average, which, in turn, suggests a large number of branches that are short of funds in contrast to a small number of branches with an excess of funds. As a comparison, Banco Bradesco and Itaú Unibanco, and to a certain degree Banco Santander, predominantly have branches with excess funds.

We classified the volume of interbranch transfers between excess of funds (*Transfer* > 0) and short of funds (*Transfer* < 0) branches to quantify the potential impact of implementing a price for the interbranch transfer in the aforementioned banks month by month. Considering the equation $\Delta V710 = Transfer * Price$ and a positive rate, branches that are short of funds would register a decrease in their income (i.e., $Transfer < 0 \rightarrow \Delta V710 < 0$). In contrast, branches with excess funds would register an increase in their income (i.e., $Transfer > 0 \rightarrow \Delta V710 > 0$).

As shown in Table 7, Banco Bradesco and Itaú Unibanco consistently had a large proportion of their branches with excess funds, which implies that, with the eventual

implementation of a fund transfer price, the vast majority of branches would register an increase in their income, i.e., $N(\Delta V710_{ti} > 0)/N(\Delta V710_{ti})$, where N(.) is the number of observations for a given month *t* and bank *i*. Although Banco Santander recorded a higher proportion of branches with excess funds during the 19 months analysed, the proportion of branches that were short of funds was greater than the branches holding excess funds. This result means that, for Banco Santander, during the period from April 2009 to January 2011, if a transfer price with a positive rate were implemented, most branches would register a decrease in their income statement due to their deficit positions (see Figure 1).

Table 7
Impact on monthly income accounts

	Banco do Brasil	Caixa Econômica Federal	Banco Bradesco	Itaú Unibanco	Banco Santander
Monthly observations	252	252	252	252	252
$N(\Delta V710_{ti} < 0) / N(\Delta V710_{ti})$					
Maximum	74.3%	90.5%	16.3%	20.4%	59.1%
Minimum	28.8%	12.2%	1.1%	1.9%	3.2%
Average	49.9%	52.5%	5.2%	9.8%	27.1%
$N(\Delta V710_{ti} < 0)$					
Months N	96	128	0	0	19
Months %	38.1%	50.8%	0.0%	0.0%	7.5%
$N(\Delta V710_{ti} > 0) / N(\Delta V710_{ti})$					
Maximum	71.2%	87.8%	98.9%	98.1%	96.8%
Minimum	25.7%	9.5%	83.7%	79.6%	40.9%
Average	50.1%	47.5%	94.8%	90.2%	72.9%
$N(\Delta V710_{ti} > 0)$					
Months N	156	124	252	252	233
Months %	61.9%	49.2%	100.0%	100.0%	92.5%

Source: prepared by the authors.

Regarding Banco do Brasil and Caixa Econômica Federal, it can be seen in Figure 1 that the former had a greater volume of branches which were short of funds during almost a third of the analysed period (from January 2013 to December 2020), while the latter had a higher volume of branches which were short of funds for half of the analysed period (from December 2011 to December 2020).

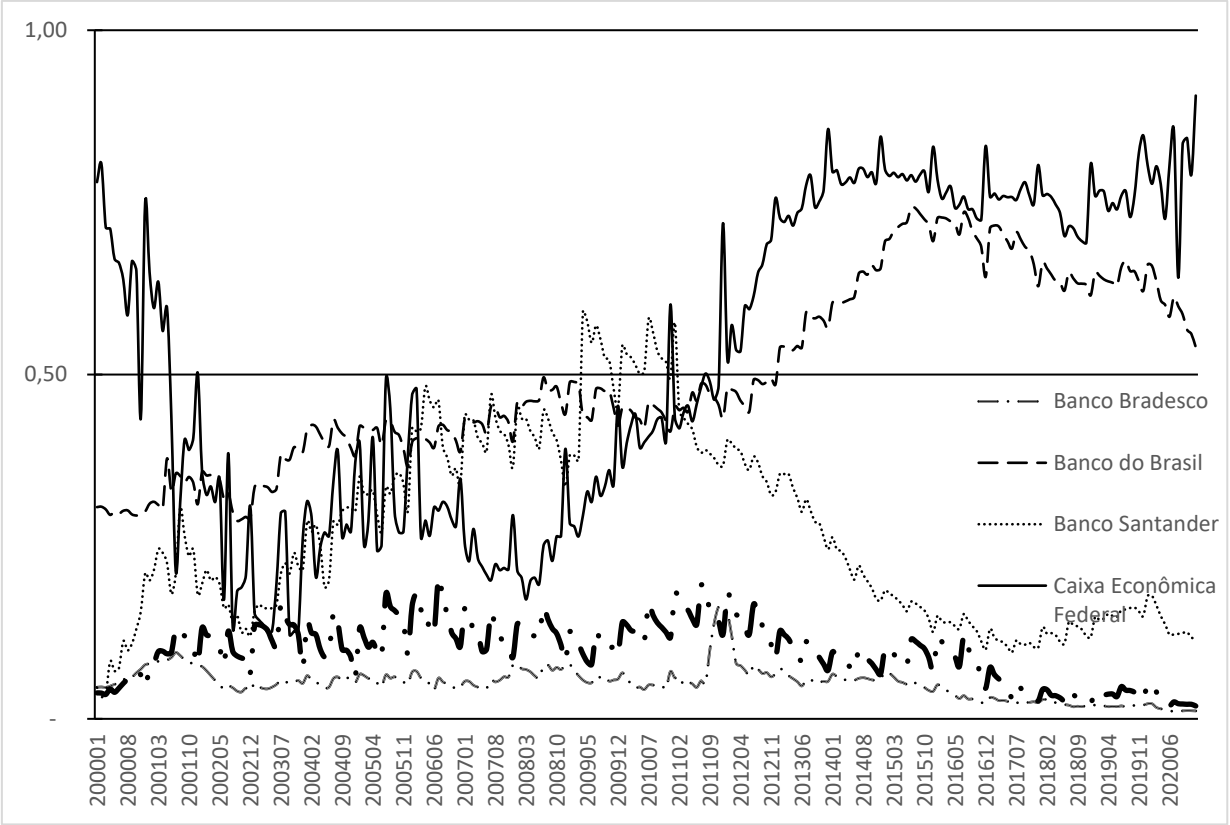

Figure 1. The proportion of branches recording a reduction in the income statement, N($\Delta V710_{ti} < 0$)/N($\Delta V710_{ti}$)

Given the different profiles of the volume of interbranch transfer of the five banks analysed and the immediate consequence in the income of the branches, we can infer that, although the average value of the volume of interbranch transfer of resources was positive for all five banks, the implementation of a fund transfer price would not necessarily increase the income of the vast majority of a bank's branches. Examples such as Banco do Brasil and especially Caixa Econômica Federal outline a profile where many branches are short of funds, implying that the implementation of fund transfer pricing with a positive rate would benefit a proportionately small number of branches with excess funds to the detriment of a greater proportion of branches which are short of funds.

Therefore, although implementing a price for the transfer of funds leads to an increase in the bank branches' average income, our analysis indicated that a greater number of bank branches would not necessarily register an increase in their income accounts. According to our analysis of what contributes to the value recorded in the volume of interbranch transfers, we note that banks adopt different strategies regarding the transfer of interbranch resources. It is also possible for banks to adopt different methods – following the Accounting Plan for Financial Institutions (*Plano Contábil das Instituições do Sistema Financeiro Nacional* – COSIF) – of accounting for interbranch activities to the Central Bank of Brazil. Furthermore, according to the analysis of the distribution of the interbranch transfer value of the five largest Brazilian banks, there are different strategies. At the end of the analysed period, Banco do Brasil and Caixa Econômica Federal predominantly had branches that were short of funds; they were lending more resources than borrowing from customers. In contrast, Banco Bradesco, Banco Itaú Unibanco, and Banco Santander predominantly had branches with excess funds; they were taking more resources than lending to customers. Therefore, even if the average value of bank branch income *increased*, it is not necessarily the case that a greater number of bank branches

would register an increase in their income. This evidence should be contrasted with findings from previous research on how implementing a fund transfer pricing policy can improve bank performance (Levey, 2008; Serpel et al., 2023) because attention must be paid to how such policies reflect on the bank's branches (Kocakulah and Egler, 2006; Ritchie, 2016). Our analysis of the effect of a fund transfer price on bank branches' income indicated that financial institutions, such as Banco do Brasil and Caixa Econômica Federal, will have more branches registering a reduction in their income than branches registering an increase in their income. This evidence demonstrates how a bank's strategy regarding the supply or demand of interbranch resources is relevant to their consideration of whether or not to implement a fund transfer pricing policy. This evidence is in line with previous research, which highlights the relevance of a bank's strategy to their implementation of a fund transfer pricing policy (Limodio & Strobbe, 2023; Peters et al., 2015).

We note that previous research examining fund transfer pricing as a management tool assumed that the commercial bank treasury allocates all interbranch funds raised among bank branches (Bicudo de Castro et al., 2019). However, contrary to the expectations of other studies, the total volume of interbranch transfers between the branches of Brazilian banks for the period examined was not zero. That is, the information recorded did not include all the parties involved in the interbranch transactions of commercial banks. On average, bank branches generate resources that will be allocated to other parts of the bank that are not recorded in the Central Bank of Brazil report used for our analysis; these resources go to parts of the bank that are not domestic bank branches. Our analysis of the data made available by the Central Bank of Brazil confirms that, on average, Brazilian bank branches have excess funds.

4. Conclusions

Fund transfer pricing has been gradually implemented in financial institutions, as required by regulatory bodies, or as part of their cash-pooling strategies. However, there is no record of the impact of implementing a fund transfer price on Brazilian financial institutions, especially commercial banks. In this regard, this study measured the effect of the performance of Brazilian bank branches on the potential implementation of a fund transfer price. Our analysis used 21 years of monthly bank branch data (2000-2020) from the Central Bank of Brazil. We identified the main accounts that contribute to an increase or decrease in the volume of interbranch transfers, and found that the volume of interbranch transfers directly influences a bank branch's income when fund transfer pricing is implemented. This information helps identify the profile of branches that may or may not benefit from implementing fund transfer pricing.

Our analysis of the data available from the Central Bank of Brazil confirmed that, on average, Brazilian bank branches have excess funds. Consequently, this study contributes to the discussion on using fund transfer pricing as a management tool because the evidence indicates that implementing fund transfer pricing does not have a null effect on Brazilian bank branches' performance; rather, the evidence indicates that, on average, the branches' income *increases*. Naturally, such an increase will be at the expense of other parts of the bank involved in these interbranch transactions. Further, our analysis of the effect of fund transfer pricing on bank branches' incomes provides evidence that financial institutions, such as Banco do Brasil and Caixa Econômica Federal, will have more branches registering a reduction in their income than branches registering an increase in their income. This evidence is very important because it demonstrates how a bank's strategy regarding the supply or demand of interbranch resources is relevant to the consideration of whether or not to implement a fund transfer pricing policy.

This study contributes to research on the potential consequences of using fund transfer pricing as a risk management or cash-pooling tool. While other works examining this topic use simulation or analytical models with only two branches, this is the first study using an extensive database of bank branches available from the Central Bank of Brazil. As the Brazilian accounting standards have converged with the IFRS, the results obtained in this analysis can be generalised to other settings, having considered the relevant economic variables. Future studies on the topic may develop a bolder analytical model to stipulate a potential optimal rate for the price of the transfer of funds or make an analysis using other methods of transfer rates (e.g., multiple funds, average rates, marginal rates, etc.).

Appendix – Accounts used for the analysis

The monthly report used for this analysis is called ESTBAN – *Estatística Bancária Mensal*, issued by the Central Bank of Brazil.[3] The *Saldos* ESTBAN file by municipality and branch is generated monthly with information from the *Estatística Bancária Mensal (Código documento 4500)*, covering the monthly balance of the main balance sheet items of commercial banks and multiple banks with commercial portfolios.

Document nº 13 – *Estatística Bancária Mensal / Global do* COSIF – *Plano Contábil das Instituições do Sistema Financeiro Nacional*[4] lists the information available at ESTBAN – *Estatística Bancária Mensal*. The accounts listed in the document required for analysis are listed below. The available report groups some accounts (i.e., V401-419 and V490-500), where *Assets = Liabilities + Equity + Income*.

Assets:

- V110 *Encaixe*.
- V120 *Aplicações interfinanceiras de liquidez*.
- V130 *Títulos e valores mobiliários e instrumentos financeiros derivativos*.
- V140 *Relações interfinanceiras e interdependências*.
- V160 *Operações de crédito*.
- V180 *Arrendamento mercantil*.
- V184 *Provisão para operações de arrendamento mercantil*.
- V190 *Outros valores e bens*.
- V200 *Permanente*.

Liabilities:

- V401 *Serviços públicos* + V402 *Atividades empresariais* + V403 *Especiais do Tesouro Nacional* + V404 *Saldos credores em contas de empréstimos e financiamentos* + V411 *Depósitos à vista de pessoas físicas* + V412 *Depósitos à vista de pessoas jurídicas* + V413 *Depósitos à vista de instituições financeiras* + V414 *Depósitos à vista de judiciais* + V415 *Depósitos à vista obrigatórios* + V416 *Depósitos à vista para investimentos* + V417 *Depósitos à vista vinculados* + V418 *Demais depósitos à vista* + V419 *Outros saldos credores em contas de empréstimos e financiamentos*.
- V420 *Depósitos de poupança*.
- V430 *Depósitos interfinanceiros*.
- V440 *Relações interfinanceiras e interdependências*.
- V460 *Obrigações por empréstimos e repasses*.
- V470 *Instrumentos financeiros derivativos*.
- V480 *Obrigações por recebimento*.
- V490 *Cheques administrativos* + V500 *Outras obrigações*.

Equity:

- V610 *Patrimônio líquido*.

Income:

- V710 *Contas de resultado*.

[3] Available at https://www.bcb.gov.br/estatisticas/estatisticabancariamunicipios
[4] Available at https://www3.bcb.gov.br/aplica/cosif

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