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MARIA ISABEL DA SILVA SANTOS

UMA INVESTIGAÇÃO SOBRE OS DETERMINANTES DA  
TAXA DE JUROS DE EQUILÍBRIO DE LONGO PRAZO NO  
BRASIL

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Londrina  
2025

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Dissertação apresentada ao Programa de Pós-Graduação em Economia (PPE), Mestrado, da Universidade Estadual de Londrina, como exigência para a obtenção do título de Mestre em Economia.

Orientador: Prof. Dr. Angelo Rondina Neto

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SANTOS, Maria Isabel da Silva. **Uma Investigação sobre os Determinantes da Taxa de Juros de Equilíbrio de Longo Prazo no Brasil**. 2025. (70 f.). Dissertação (Mestrado em Economia). Centro de Estudos Sociais Aplicados, Universidade Estadual de Londrina, Londrina, 2025.

## RESUMO

Esta dissertação investiga os determinantes da taxa de juros de equilíbrio de longo prazo no Brasil, considerando seus níveis persistentemente elevados em comparação aos padrões globais. A pesquisa é estruturada em dois ensaios independentes, porém interconectados, que convergem para uma investigação sobre a dinâmica das taxas de juros e seus componentes. O primeiro ensaio realiza uma análise bibliométrica, mapeando o debate na literatura e identificando determinantes-chave, como risco-país, dominância fiscal e incerteza jurisdicional. O segundo ensaio examina empiricamente a interação entre fatores econômicos globais, integração financeira e política monetária doméstica. Utilizando um modelo de correção de erro vetorial, o estudo capta os impactos de curto e longo prazo de choques externos e vulnerabilidades estruturais sobre o comportamento da taxa de juros. Em conjunto, os ensaios contribuem para o debate sobre política monetária e desenvolvimento econômico em economias emergentes, abordando, em particular, os desafios estruturais e de política que essas economias enfrentam para alinhar a dinâmica das taxas de juros ao crescimento econômico sustentável.

**Palavras-chave:** Taxa de juros; Integração financeira; Brasil; Política Monetária; Equilíbrio de longo prazo.

SANTOS, Maria Isabel da Silva. **An investigation into the determinants of the long-term equilibrium interest rate in Brazil.** 2025. (70 f.). Dissertation (Masters in Economics). Center of Applied Social Studies, State University of Londrina, Londrina, 2025.

### ABSTRACT

This dissertation investigates the determinants of the long-term equilibrium interest rate in Brazil, considering its persistently elevated levels compared to global standards. The research is structured into two independent but interconnected essays, converging on an investigation into the dynamics of interest rates and their components. The first essay conducts a bibliometric analysis, mapping the debate according to the literature and identifying key determinants such as country risk, fiscal dominance, and jurisdictional uncertainty. The second essay empirically examines the interaction among global economic factors, financial integration, and domestic monetary policy. Using a vector error correction model, the study captures the short-term and long-term impacts of external shocks and structural vulnerabilities on interest rate behavior. Together, the essays contribute to the discussion on monetary policy and economic development in emerging economies, particularly addressing the structural and policy-related challenges that developing economies face in aligning interest rate dynamics with sustainable economic growth.

**Keywords:** Interest rate; Financial integration; Brazil; Monetary policy; Long-term equilibrium.

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## LIST OF ABBREVIATIONS

BCB	Banco Central do Brasil
BP	Balança de Pagamentos
DSGE	Dynamic Stochastic General Equilibrium
EMBI	Emerging Markets Bond Index Plus
EUA	Estados Unidos da América
FDI	Foreign Direct Investment
FED	Federal Reserve Bank
GDP	Gross Domestic Product
GMM	Gaussian Mixture Models
FMI	Fundo Monetário Internacional
ITR	Inflation Targeting Regime
IPCA	Índice Nacional de Preços ao Consumidor Amplo
ITR	Inflation Targeting Regime
IS	Investments and Saving
LFT	Letra Financeira do Tesouro
LM	Liquid Money
ML	Maximum Likelihood Estimation
NAIRU	Non-Accelerating Inflation Rate of Unemployment
OLS	Ordinary Least Squares
PIB	Produto Interno Bruto
RMI	Regime de Metas de Inflação
SELIC	Sistema Especial de Liquidação e de Custódia
UIP	Uncovered Interest Rate Parity
US	United States
USD	Dólar Americano
VAR	Vector Autoregressive Model
VEC	Vector Error Correction Model
VIX	CBOE Volatility Index
WDI	World Development Indicators
WOS	Web of Science

## SUMMARY

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## 1 INTRODUCTION

The central objective of the dissertation was to investigate the determinants of long-term interest rates. The research aims to analyze how the monetary policy of emerging economies, particularly Brazil, is influenced by internal and external factors. Specifically, each chapter seeks to make its own contribution: the first chapter addresses the mapping of Brazilian and global literature on interest rate components, while the second estimates the impact of part of these determinants, such as financial integration and global interest rate, on short-term and long-term rates.

The discussion about interest rate levels in Brazil resurfaced in the economic debate following the adoption of the Inflation Targeting Regime (ITR) in 1999. Considering the process of industrialization, growth, and economic development, the country implemented measures, such as the exchange rate anchor regime and the use of the interest rate as a nominal anchor, replacing the previously practiced crawling peg exchange rate, as noted by Cardoso (2021), that, together with the external context (Mercosur and global crises), increased inflation due to the depreciation of the Real currency. The real interest rate in Brazil has decreased over time, especially after the “Brazilian Real Plan” and the ITR, but it still remains above the average of emerging countries with similar systems (Segura-Ubiergo, 2012).

The target for the SELIC is the main policy instrument managed by the Brazilian monetary authority to promote the convergence of the country’s inflation to the defined target (Carvalho, 2023). Emerging economies tend to have higher interest rates due to factors such as a greater need for foreign resources and higher default risks (Segura-Ubiergo, 2012; Schulz, 2019). Financial globalization, or liberalization, is supported in mainstream theory based on market efficiency, as this dynamic is seen as beneficial for the growth of emerging peripheral economies through the influx of foreign investment. Thus, the orthodox perspective advocates for free markets and the hypotheses of efficient markets and rational expectations. The dissertation is organized into two main chapters. Understanding the natural interest rate and its global implications is particularly important for policy coordination. Furthermore, it is essential to examine the debate surrounding this concept over time to provide critical knowledge into the factors influencing interest rate components, which is the focus of this study.

The first essay presents a bibliometric analysis of the determinants of long-term interest rates in Brazil, with a focus on the persistence of high interest rates between 1999 and 2023. The bibliometric analysis mapped the main factors discussed in the literature, including country risk, jurisdictional uncertainty, and semi-fiscal dominance. This bibliometric approach provided a comprehensive view of the debate, highlighting key theoretical and empirical contributions to the topic and identifying gaps and questions, such as whether the concentration of research on specific terms reflects a convention among studies or represents the main factors, as well as mapping secondary hypotheses, like the possibility of “rent-seeking” behavior. This approach enabled an analysis of the literature without incurring biases. The decision to study the framework surrounding interest rates and their potential components facilitates the development of a research agenda. This approach enables a comprehensive analysis, identifying gaps and opportunities to contribute meaningfully to the existing literature.

The second essay delves into the analysis of interest rate determinants, examining the interaction between global economic factors, financial integration, and monetary hierarchy,

positioning Brazil as an open economy situated in a peripheral role within the international monetary system. Using a vector error correction model, the study captures both short-term and long-term relationships between internal and external variables, emphasizing the influence of global interest rates and international capital flows. Additionally, an interest rate determination rule inspired by the Taylor Rule is proposed, tailored to emerging economies and addressing challenges such as exchange rate volatility and financial vulnerability. This chapter explores the impact of external shocks and structural factors on Brazilian monetary policy, contextualizing Brazil's experience within the Latin American and emerging economies framework to assess the constraints and opportunities posed by financial integration.

The decision to investigate Brazil is justified in its distinctive position as an open economy on the periphery of the international monetary system, characterized by historically high interest rates. Additionally, the heterogeneity of the domestic debate surrounding the components of interest rates, as well as Brazil's structural vulnerabilities and their influence on domestic policy decisions. While each essay in this dissertation is designed to stand independently, they are interconnected through their shared focus on the dynamics of interest rates, particularly in Brazil, where rates have historically remained above global averages. The investigation builds a narrative, exploring both the internal and external factors that shape interest rate behavior. By addressing key aspects such as financial integration, structural vulnerabilities, and external shocks, the essays collectively advance the understanding of the persistent challenges Brazil faces in managing interest rates, while situating these findings within the broader context of emerging economies.

This study is organized into three sections, in addition to this introduction. The second chapter corresponds to the first essay of this dissertation, while the third chapter presents the estimation of the interest rate determinants, as proposed in the second article. Finally, the last section is dedicated to concluding remarks.

## 2 A BIBLIOMETRIC INVESTIGATION INTO THE DETERMINANTS OF THE LONG-TERM EQUILIBRIUM INTEREST RATE IN BRAZIL BETWEEN 1999 AND 2023

### Resumo:

Este estudo investiga a persistência das elevadas taxas de juros relativas no Brasil no período de 1999 a 2024, com enfoque nas relações dessas taxas sobre a inflação e a efetividade das políticas monetárias de controle de preços. A análise se aprofunda na aplicação da meta para a taxa de juros como principal instrumento da política monetária, fundamentando-se na teoria da taxa natural de juros de Wicksell (1898), e ressalta a sua complexidade devido à sua natureza não diretamente observável. Com o objetivo de elucidar as causas das altas taxas de juros no país, de acordo com a literatura, a pesquisa se vale da análise bibliométrica. Identificou-se que fatores como o risco país, a incerteza jurisdicional e a semidominância fiscal são elementos significativos para explicar os níveis estruturais das taxas de juros. Os resultados apontam para a necessidade de uma estratégia coordenada, envolvendo políticas macroeconômicas e reformas estruturais, para a redução sustentada dos níveis das taxas de juros no Brasil.

**Palavras-chave:** Determinantes da taxa de juros, Taxa de juros natural, Política Monetária.

### Abstract:

This study investigates the persistence of relatively high interest rates in Brazil from 1999 to 2024, focusing on the relations of these rates on inflation and the effectiveness of monetary price control policies. The analysis delves into the use of the interest rate target as the primary tool of monetary policy, based on Wicksell's natural rate of interest theory, and highlights its complexity due to its non-directly observable nature. Aiming to elucidate the causes of high interest rates in the country, according to the literature, the research explores bibliometric analysis. It was identified that factors such as the country risk, the jurisdictional uncertainty, and the semi-fiscal dominance are significant elements to explain the levels of interest rates. The results point to the need for a coordinated strategy, involving macroeconomic policies and structural reforms, to sustainably reduce interest rates in Brazil.

**Keywords:** Interest rate determinants, Natural interest rate, Monetary Policy.

**Código JEL:** E43; E49; E52.

## 2.1 INTRODUCTION

This research investigates the determinants of Brazil's high interest rates since the implementation of the Inflation Targeting Regime in 1999, based on existing studies, exploring the economic and institutional factors influencing them. It provides a synthesis of the literature on interest rates in Brazil, pioneering the combination of an analysis of interest rate determinants with a bibliometric approach, allowing for a comprehensive, horizontal examination of the topic. Through this method, it was possible not only to identify the key factors influencing interest rates according to the literature but also to map the evolution of the debate.

The natural interest rate is an equilibrium interest rate, neutral concerning price levels, exerting no upward or downward pressure on inflation. Originally conceptualized by Wicksell (1898) and later adapted within the New Keynesian framework by Woodford (2003), it is regarded as a short-term real interest rate that fosters price stability in a model free from nominal distortions. Laubach and Williams (2003) interpret this rate as the one that, in the short run, aligns with the potential output level and ensures stable inflation in the medium term, in accordance with Taylor's rule (1993).

The debate on interest rates in Brazil resurfaced in the economic discourse following the adoption of the Inflation Targeting Regime in 1999. Considering the country's industrialization,

economic growth, and development process, various measures were implemented that<sup>1</sup>, combined with external factors<sup>2</sup>, exerted upward pressure on inflation due to the depreciation of the Real. Although Brazil's real interest rate has declined significantly over time, particularly after the implementation of the Real Plan and the Inflation Targeting Regime, it remains above the average observed in emerging economies that have adopted inflation targeting frameworks<sup>3</sup>.

The interest rate is the primary policy instrument managed by the Brazilian monetary authority to promote the convergence of inflation toward the established target. It serves as a mechanism for adjusting demand and economic activity levels and, consequently, for regulating price pressures, shaping the stance of monetary policy (whether contractionary or expansionary) in response to demand conditions (Carvalho, 2023). The literature presents various hypotheses to explain Brazil's persistently high interest rates, ranging from fiscal dominance to credit market imperfections (Favero & Giavazzi, 2002; Arida, Bacha & Lara-Resende, 2005; Netto, 2005; Barbosa, 2006; Pires, 2007; Goldfajn & Bicalho, 2011; Schwartzman, 2011; Segura-Ubiergo, 2012; Bresser-Pereira & Nakano, 2020).

Structured into five sections, this study begins with an introduction to interest rates and their stability, followed by a theoretical discussion on interest rate dynamics. The third section details the bibliometric methodology adopted, outlining the analysis and selection of sources. The results are presented in the fourth section, where the main factors behind Brazil's high interest rates are examined, along with an assessment of the domestic theoretical debate. Finally, the conclusion underscores the study's relevance as both a synthesis of economic theory and an argument for further investigation into Brazil's natural or neutral interest rate, as well as the need for structural reforms to enhance the country's economic environment and credibility.

## 2.2 MACROECONOMIC FRAMEWORK: NOMINAL INTEREST RATE AND NATURAL INTEREST RATE

It is essential to distinguish between three main concepts of interest rates, as presented in Figure 1: (i) the long-term equilibrium interest rate, (ii) the neutral or natural interest rate, and (iii) the ex-ante real interest rate. The first is anchored in macroeconomic fundamentals such as potential output and society's propensity to save. The second is sensitive to short- and medium-term shocks affecting aggregate supply and demand and tends to gravitate toward the equilibrium rate over time. Finally, the third is influenced by inflation expectations and the monetary policy implemented by the central authority, reflecting the real cost of money in future terms and adjusting dynamically in response to economic shocks and policy objectives (Ferreira, 2013).

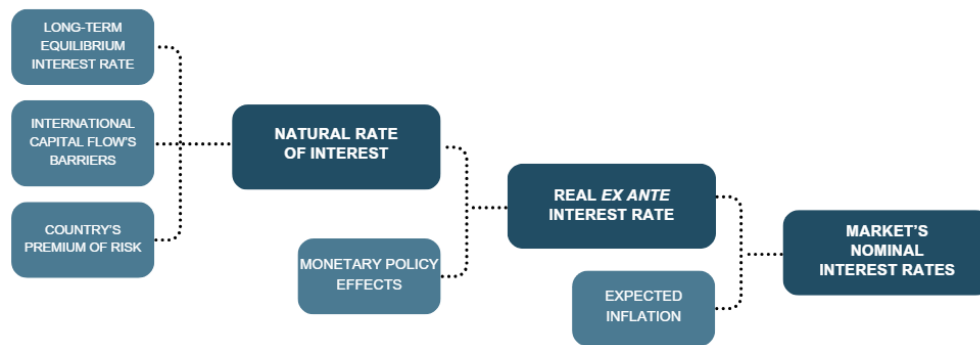
**Figure 1.1** - Relationship Between the Neutral Interest Rate and Other Economic Variables

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<sup>1</sup> Capital outflows, lack of fiscal progress, strong resistance from the Brazilian business community to unprecedentedly high interest rates, and increasing demand to adjust an exchange rate deemed excessively overvalued (exchange rate anchor regime, with the interest rate replacing the previously practiced crawling peg as the nominal anchor). See Cardoso (2021).

<sup>2</sup> The unilateral trade liberalization within Mercosur, along with the Mexican crisis (1994), the Asian crisis (1997), and the Russian crisis (1998), led to an increase in public sector debt and higher interest rates, ultimately prompting an IMF intervention that recommended the adoption of a new exchange rate regime.

<sup>3</sup> Approximately 2 percentage points, according to the analysis by Segura-Ubiergo (2012).



**Source:** Author's elaboration based on Ferreira (2013).

The Central Bank of Brazil (BCB) adopts the same definition as Ferreira (2013) for the ex-ante real interest rate, as indicated in the June 2023 inflation report (BCB, 2023). This definition is also employed by economic agents in their decision-making processes. In this context, it is important to clarify the terminology that will be used interchangeably throughout this text: natural interest rate, neutral interest rate, real equilibrium interest rate, and long-term equilibrium interest rate. Despite their conceptual distinctions, these rates are often interrelated in the framework of monetary policy and economic analysis.

The natural interest rate, originally conceptualized by Wicksell (1898) and later discussed by scholars such as Hayek (1939), is defined as the rate at which capital supply and demand would be balanced in a non-monetary economy, reflecting the marginal product of capital under conditions of full employment and flexible prices. In contrast, the neutral interest rate, as framed within New Keynesian models, represents the policy rate that balances the economy in the short run, eliminating inflationary or deflationary pressures. While the natural rate is shaped by long-term structural factors, the neutral rate adjusts in response to economic conditions and temporary shocks (Obstfeld, 2023). Additionally, the natural interest rate is also defined as the real equilibrium interest rate that would emerge in an ideal economic environment, free from nominal frictions. It is characterized as a short-term rate, subject to fluctuations over time, and aligned with price stability (Amato, 2005).

### ***2.2.1 NATURAL INTEREST RATE: MACROECONOMIC THEORETICAL FRAMEWORK***

The mainstream theoretical approach, which often underpins explanations within this paradigm - particularly in the Brazilian context - is largely based on the concept of the natural interest rate, as originally outlined by Knut Wicksell in 1898. According to Wicksell (1936)<sup>4</sup>, this rate is defined as the one that (i) balances savings and investment, (ii) corresponds to the marginal productivity of capital, or (iii) aligns with price stability. This central concept provides a theoretical framework for analyzing interest rates both in Brazil and in broader economic contexts.

These definitions share fundamental characteristics, such as consistency with the concept of economic equilibrium and an intrinsic association with the long term. Notably, price stability is linked to the relationship between the interest rate set by the Central Bank and the neutral interest rate, highlighting the crucial role of monetary policy in maintaining price equilibrium.

The natural interest rate, defined in various ways, is often regarded as a slow-moving variable, reflecting structural changes in the economy. According to Amato (2005), these changes are driven by technological progress, which influences capital productivity, as well as population growth and households' intertemporal preferences. In addition to these factors, other elements -

<sup>4</sup> It is worth noting that Wicksell's definition of "natural" had a significant influence on subsequent economic theories, particularly on the ideas of Friedman (1968) and Phelps (1968). These authors introduced the concept of the natural rate of unemployment, drawing a parallel to the natural interest rate.

such as fiscal policy, financial market structure, and risk considerations - are also cited as determinants of the natural rate. The natural interest rate is generally seen as the long-term real equilibrium interest rate, toward which the economy would converge as other economic variables - primarily the price level and output - adjust to equilibrium. However, its magnitude may vary across periods and across countries.

Keynes (1936) made significant contributions to the understanding of the neutral interest rate in the economy. According to him, the short-term neutral interest rate, often referred to as the “equilibrium interest rate”, is the rate that equates savings and investment, leading the economy to a state of equilibrium. When the real interest rate (adjusted for inflation) matches the neutral interest rate, aggregate demand equals potential output, and the economy is in equilibrium. The neutral interest rate is essential for understanding the functioning of financial markets and monetary policy, as it influences credit costs and investment decisions, serving as a benchmark for central bank actions.

However, Keynes challenged the neoclassical conception of Wicksell’s natural interest rate, which assumed an automatic equilibrium leading to full employment in capitalist economies. He argued that, in a monetary production economy, there is no automatic mechanism ensuring equilibrium between supply and effective demand. Keynes emphasized the complex role of money - not only as a medium of exchange and unit of account, but also as a store of value. Additionally, he highlighted the importance of expectations regarding interest rate fluctuations, which influence both monetary policy and interest rates. He also noted that the speculative demand for money plays a crucial role in understanding the relationship between short- and long-term interest rates (Mellini, 2019).

New keynesian or new wicksellian general equilibrium models<sup>5</sup> conceptualize the natural interest rate as the equilibrium rate that ensures price stability and a zero output gap in a dynamic model with flexible prices and wages. Scholars such as Woodford and Walsh (2005), Barsky, Justiniano, and Melosi (2014), and Goldsby, Laureys, and Reinold (2015) follow this theoretical approach in their estimates of the natural interest rate. Within this framework, the interest rate is defined as the equilibrium rate of return in an economy with flexible prices, characterized by the following properties:(a) it is determined on a period-by-period basis, (b) it is expressed in real terms, and (c) it is subject to both short- and long-term fluctuations (Ribeiro & Teles, 2011).

Complementarily, according to Messonnier and Renne (2007), another approach considers the interest rate as being consistent with short-term equilibrium, operating at its potential level, once the effects of aggregate supply and demand shocks dissipate. However, it follows a long-term central tendency in an economy free from cyclical fluctuations, reflecting the long-term growth trajectory. Authors who adopt this perspective include Clarida, Galí, and Gertler (2000), Laubach and Williams (2003), IMF (2014), Hamilton et al. (2015), Laubach and Williams (2016), Chen and Karp (2017), and Holston, Laubach, and Williams (2017).

Galí (2015), in his derivation of the new keynesian model, estimates the equilibrium interest rate from this same perspective and identifies equation (1), where  $\tilde{y}_t$  represents the output gap and  $v_t$  denotes a monetary policy shock. A positive variation indicates a contractionary shock, leading to a higher nominal interest rate, given inflation and output dynamics (with the reverse also holding true). Furthermore,  $\rho$  represents the “natural” component, associated with households’ intertemporal preferences. Thus, the specification of the interest rate rule,  $i_t$ , is consistent with the rule proposed by Taylor (1993).

$$i_t = \rho + \varphi_\pi \pi_t + \varphi_y \tilde{y}_t + v_t \quad (1)$$

Taylor (1993) defines that the interest rate can be set by the Central Bank following

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<sup>5</sup> According to Woodford (1997).

equation (2), where  $i$  is the nominal interest rate determined by the Central Bank,  $r^*$  represents the equilibrium (or natural) interest rate,  $\pi_t$  is the observed inflation rate,  $\pi^*$  is the inflation target,  $y_t$  denotes the output level at time  $t$ , and  $\bar{y}$  corresponds to the full employment output level. The real equilibrium interest rate  $r^*$  serves as a baseline for the nominal interest rate, upon which adjustments are made based on observed economic conditions. The term  $\pi_t + \alpha(\pi_t - \pi^*)$  represents the monetary policy response to inflation, while  $\beta(y_t - \bar{y})$  captures the response to the deviation of real output from its potential level. Thus, the real equilibrium interest rate  $r^*$ , acts as a reference point for the nominal interest rate, guiding monetary policy adjustments in response to prevailing economic conditions.

$$i_t = r^* + \pi_t + \alpha(\pi_t - \pi^*) + \beta(y_t - \bar{y}) \quad (2)$$

Chernavsky (2008), in turn, assumes a hypothetical economy characterized by complete nominal adjustments and rational expectations. As in more orthodox new classical models, the real interest rate is equivalent to the real equilibrium interest rate, which is defined period by period, keeping the economy in a state of constant equilibrium. In this context, the Central Bank's role becomes irrelevant, as it would neither have the ability nor the need to influence real interest rates. Although this perspective is extreme, it provides an interesting counterpoint to more flexible approaches regarding the natural interest rate.

In the perspectives analyzed, the natural interest rate plays a crucial role in the theoretical determination of real interest rates. It may serve as a long-term convergence benchmark, a rate around which real interest rates fluctuate in the short run, or a constant equivalent of the real rate. This implies that countries and periods with particularly high natural rates tend to experience elevated real interest rates, with Brazil potentially exemplifying this scenario.

Conversely, alternative perspectives on the neutral interest rate exist within macroeconomics, such as the post-keynesian approach. From this standpoint, Wicksell's (1898) hypothesis of the natural interest rate attempts to reconcile the reality of endogenous money with the quantity theory of money, yet it overlooks crucial aspects of uncertainty and human behavior in financial markets. This is because the premise suggests that if the natural interest rate aligns with the central bank's policy rate, it could lead to a stable growth equilibrium in the economy. However, this view assumes that all market participants are perfectly rational and possess complete information, enabling them to accurately assess risk and determine the appropriate interest rates for different investment projects. In reality, interest rates are shaped by subjective expectations and psychological factors. Furthermore, this approach fails to adequately explain market dynamics under financial instability, where expectations can shift rapidly and unpredictably (Pilkington, 2014).

According to Arestis and Sawyer (2007), the natural interest rate has limitations as a stabilizing mechanism for the economy. This is because this perspective tends to overlook distributive effects and financial stability, highlighting the need for a more integrated approach that combines monetary and fiscal policies to achieve broader and more equitable economic objectives. Complementarily, Sicsú (2009) argues that inflation is generally a supply-side issue, whereas interest rate adjustments primarily affect demand. He further contends that raising interest rates addresses only the symptoms of inflation, rather than its underlying causes. In line with the Post-Keynesian view, he proposes non-monetary alternatives for inflation control, such as institutional and technological changes.

Mellini (2019) argues that the interest rate is a variable determined by the Central Bank rather than a "natural" rate that emerges from market forces. This challenges the idea that a natural interest rate equilibrates savings and investment, given the active role of monetary policy and the central bank's ability to influence interest rates. In real-world economic conditions, interest rates are shaped by a range of institutional and political factors rather than solely by market forces. The

economic landscape is dominated by fundamental uncertainty, where liquidity preferences and Keynes' "animal spirits" play a central role - far from the assumption of efficient markets and rational agents with perfect information. According to Minsky (1976)<sup>6</sup>, uncertainty and speculation are inherent in financial markets, with interest rates being influenced not only by central monetary policies but also by risk perceptions and speculative investment decisions. This argument contradicts the notion of a natural equilibrium between savings and investment (Pilkington, 2014).

According to Lima (1999), Keynes advocates for the prudent use of monetary policy. He argues that individuals have an established perception of what constitutes a normal interest rate and expect the real rate to fluctuate around this expectation. Thus, monetary policy plays a role in shaping these perceptions and anticipating interest rate movements. Keynes (1996) emphasizes the rarity and short-lived nature of full employment. Monetary policy is therefore a crucial tool for bringing capitalist economies closer to this state. Moreover, nominal wage rigidity prevents deflation and increases the real debt burden in monetary terms. Automatic wage adjustments in response to cost shocks can, in turn, lead to persistent inflation (Mellini, 2019).

Nader (2018), drawing from Keynes (1982), revisits the concept of "euthanasia of the rentier" to critique the negative impact of financial speculation on the economy. Rentiers profit from high interest rates due to money scarcity, gains that could be neutralized by lowering interest rates. Such a measure would stimulate productive investments, reduce unemployment, and diminish the economic power of rentiers.

While Keynes and post-keynesians emphasize the importance of financial markets in providing credit to the productive sector, they also acknowledge the possibility of financial dominance. This occurs when financial markets surpass the productive sector and become the center of speculative activities (Mollo, 2015).

From a post-keynesian perspective, the stability and effectiveness of the interest rate are more complex than suggested by traditional models, as they consider the dynamic and interactive nature of the economy. This view contrasts with the notion of a stable and predictable natural interest rate, as this rate is neither fixed nor immune to external influences, such as monetary and fiscal policies or shifts in the global economic landscape (Aschermann, 2011).

Indeed, despite post-keynesian criticism, the concept of the natural interest rate plays a significant role in shaping central bank policies and serves as the foundation for many mainstream explanations regarding the persistence of high real interest rates in Brazil. These rates are often considered exceptionally high when compared to those observed in other countries. This perspective not only justifies the elevated levels of interest rates but also explains their long-term persistence, as changes in the natural rate tend to occur gradually and are closely linked to the country's structural economic reforms. Galí (2017) highlights a non-conventional monetary policy adopted by many central banks, based on forward guidance - that is, the strategy of influencing current macroeconomic outcomes by managing expectations regarding the future trajectory of the monetary policy rate, particularly when the zero lower bound is no longer binding.

Rondina Neto and Oliveira (2022) observed that the natural interest rate played a significant role in determining the benchmark<sup>7</sup> interest rate, as its behavior remained stable throughout the period analyzed under the Inflation Targeting Regime (ITR). Additionally, the authors emphasize the importance of inflation surprises as the main explanatory variable in the Central Bank of Brazil's (BCB) interest rate decisions. The results, derived from a quantile regression model and a vector autoregressive (VAR) model, indicate a maturation of the BCB's monetary policy process over the course of the ITR, with a reduction in the volatility of the estimated parameters in the reaction function, as market expectations became more anchored<sup>8</sup>.

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<sup>6</sup> See Pilkington (2014).

<sup>7</sup> By the monetary authority.

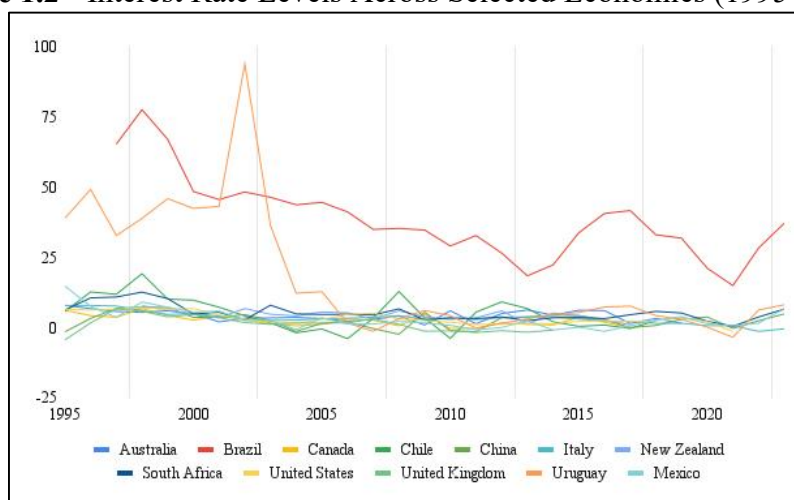
<sup>8</sup> Intrinsic to the Inflation Targeting Regime and to the fulfillment of the responsibilities defined as objectives under

The international understanding of the natural interest rate is essential for contextualizing the discussion in Brazil. Globally, there has been a downward trend in natural interest rates, reflecting structural changes in advanced economies, such as population aging and slower economic growth. This scenario impacts monetary policy and inflation expectations. For Brazil, as an emerging economy, understanding these global trends is crucial for aligning its monetary policies and economic strategies with the international environment, aiming at stability and sustainable growth. Figure 2 illustrates the interest rate levels across economies, allowing for a comparative perspective on Brazil's relative position.

Carvalho (2023) identifies a gradual decline in the natural interest rate, from approximately 3% in the 1970s to around 0.5% in 2022 in eurozone countries. This analysis is based on an adaptation of the model by Holston et al. (2017), incorporating the impact of the pandemic and inflation expectations. This downward trend is crucial for understanding the constraints faced by central banks in monetary policy implementation due to persistently low interest rates. Moreover, the study underscores the importance of central bank communication regarding long-term interest rate expectations, which is essential for anchoring inflation expectations and enhancing the effectiveness of monetary policy.

The high level of interest rates in Brazil is not viewed as a permanent condition. Creating the necessary conditions to lower interest rate levels is a complex yet achievable challenge, as demonstrated by successful cases in other emerging economies. Notable examples include Turkey, which reduced its real interest rate from 25% to single digits, Poland, which lowered its rate from 9% to 3%, as well as significant reductions observed in Chile and Peru (Goldfajn & Bicalho, 2011).

**Figure 1.2** - Interest Rate Levels Across Selected Economies (1995 - 2023).



**Source:** Author's elaboration based on WDI data (2024).

Emerging economies tend to have higher interest rates due to factors such as greater reliance on foreign capital and higher default risks. Between 2015 and 2018, South Africa, Brazil, India, Indonesia, and Russia recorded the highest neutral interest rates among emerging markets. In contrast, Eastern European nations consistently exhibited lower levels of neutral interest rates over the years (Schulz, 2019).

Vilella (2021) identified that the level of the natural interest rate can pose new challenges for central banks in some small open economies, such as Colombia and Peru, where the natural rate turns negative in certain periods. This phenomenon, known as the liquidity trap, prevents the central bank from stimulating the economy through nominal interest rate cuts once the rate reaches its lower bound, necessitating the use of non-conventional instruments. The author estimated the

natural interest rate between 2004 and 2020 for Chile, Colombia, Mexico, and Peru, finding respective rates of 1.4%, 0.2%, 4.3%, and -0.07%. An analysis of the monetary policy of the central banks in these countries during the same period revealed an expansionary bias in Chile and Mexico, while Colombia and Peru exhibited a contractionary stance.

In summary, understanding the natural interest rate and its global implications is essential, particularly for policy coordination. Moreover, it is important to examine the historical debate on this subject to develop a critical perspective that accounts for the factors influencing interest rate components, which this study aimed to address. The declining trend in natural interest rates in advanced economies has posed challenges for central banks worldwide, requiring policy adaptation and effective communication. However, it is important to recognize that emerging economies face specific challenges, such as a greater reliance on foreign capital and higher default risks. Furthermore, the identification of liquidity trap scenarios in countries like Colombia and Peru underscores the complexity of monetary policy management in environments where natural interest rates become negative. While Brazil has historically maintained high interest rates, the experience of other emerging economies demonstrates that significant reductions are achievable.

### 2.3 METHODOLOGY

Unlike bibliographic analysis, which focuses on content analysis of publications, bibliometric analysis aims to quantify terms within the bibliographic material (Paixão, 2017). Bibliometrics develops tools to quantify and examine scientific production through statistical methods, with the goal of evaluating not only the scope, evolution, and impact of science but also understanding the processes of its creation, dissemination, and application within society (Saes, 2000). A fundamental concept in bibliometrics is the identification of connections between pieces of information, enabling the creation of bibliometric indicators based on frequencies and co-occurrences in bibliographic metadata. Frequency refers to the number of times a specific piece of information appears, while co-occurrence measures how often two elements appear together. Several authors have described the possibility of constructing lists and information matrices, including Porter and Detampel (1995), Zhua and Porter (2002), and Porter and Cunningham (2005), as cited in Yanai (2012).

To analyze the characteristics of scientific production related to the determinants of interest rates in Brazil, a descriptive study was conducted using bibliometric techniques. This study focused on scientific articles published in peer-reviewed journals, applying the “economics” filter. The Web of Science - Main Collection (Clarivate Analytics) was selected as the database due to its compatibility with the software employed, as it allows for metadata export in the required formats, ensures standardized citation references, and provides the most efficient field-specific filtering (Aria & Cuccurullo, 2017).

This study aims to analyze the interest rate landscape in Brazil, considering the occurrence of significant events both in the domestic economy and in the global context. To achieve this, an analysis was designed to explore the network of factors influencing interest rates, aiming for a comprehensive and globally contextualized investigation. The research framework consists of four distinct search queries: (i) the natural interest rate in the global context, (ii) the natural interest rate in Brazil, (iii) interest rates in the global economy, and (iv) interest rates in Brazil.

This framework was designed to capture the dynamics of interest rates in Brazil within the context of global economic fluctuations, ensuring a balanced and unbiased perspective. The keywords used for the search were combined following the structure exemplified in query (iv): ((ALL=(“taxa de juros” OR “interest rate”)) AND ALL=(“brazil” OR “brasil” OR “brazilian” OR “brasileira”)). This term selection strategy was chosen to accurately reflect research on interest rates in Brazil and was replicated across all four queries, adjusting for their specific objectives.

The search query (i) yielded a total of 347 documents, (ii) resulted in 16, (iii) generated 15,830 relevant documents, and finally, (iv) returned 339. These records were subsequently

analyzed using RStudio, employing the “bibliometrix” package (Aria & Cuccurullo, 2017), complemented by the “biblioshiny” interface. Additionally, data visualizations were incorporated using VOSviewer to map thematic networks, providing visual insights into the main research areas and collaborations in the field of interest rate determinants in Brazil.

The selection criteria for content analysis were not strictly defined by citation count or specific publication years, given the exploratory nature of this study. Instead, the scope was limited by subject area filters to ensure relevance. The application of bibliometric methods to investigate the determinants of interest rates in Brazil represents a significant contribution to the existing literature. This approach provides new insights into research trends, identifies relevant studies, and highlights underdeveloped areas of knowledge, offering a previously unmapped perspective on the analysis of Brazilian interest rates.

#### **2.4. BIBLIOMETRIC INVESTIGATION OF SCIENTIFIC PRODUCTION ON THE DETERMINANTS OF INTEREST RATES IN BRAZIL**

This section examines the scientific production related to the determinants of interest rates in Brazil. Figure 3 presents four different datasets depicting annual research output, specifically the number of scientific articles published each year from at least 1995 to 2023. Despite variations in volume and volatility across the different datasets, a discernible periodicity emerges, aligning both internally and with global economic events, such as financial crises or significant political and economic shifts.

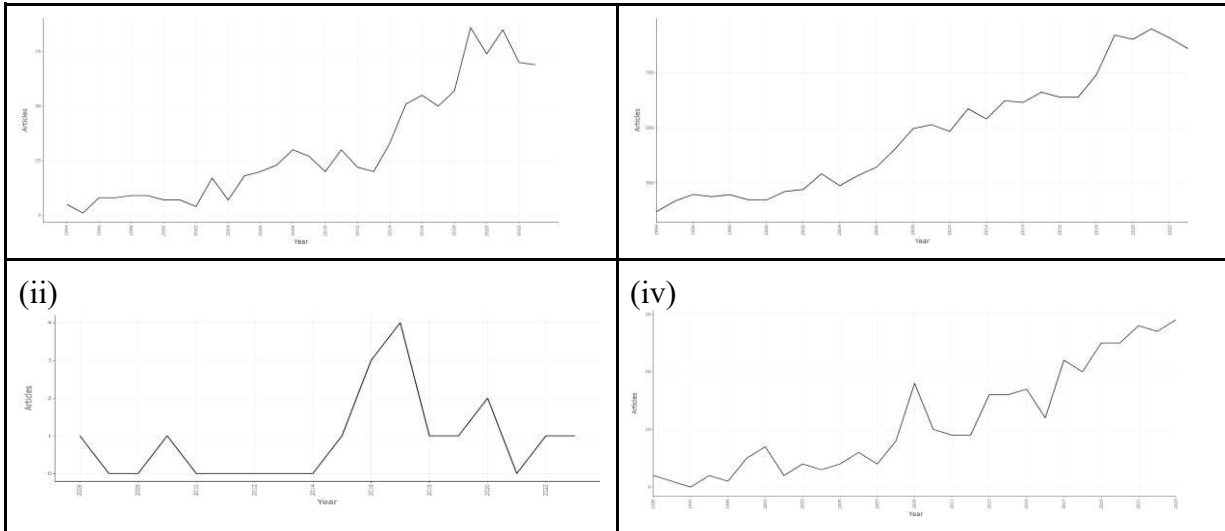
In the global context, graph (i) indicates a steady upward trajectory in research on the natural interest rate, signaling growing interest in the topic as complex macroeconomic challenges continue to emerge on the international stage. In contrast, graph (ii) reveals significant volatility in scientific production related to the natural interest rate in Brazil, possibly reflecting a direct response to domestic economic events and shifts in national monetary policies.

Graph (iii), which details research on interest rates worldwide, exhibits a smoother and more consistent growth trend, reflecting the larger sample size. This may suggest that, at an international level, real interest rates maintain persistent relevance in economic studies, without experiencing sharp fluctuations in response to specific events. Meanwhile, graph (iv) illustrates research on interest rates in Brazil, which, although following a similar trend to graph (iii), displays peaks and declines that suggest a higher sensitivity to the specificities of the Brazilian economic environment.

The synchronization of research peaks across the graphs likely reflects, at certain moments, a coordinated academic response to economic crises or substantial changes in monetary policy. The simultaneous peaks in 2008 across all graphs can be attributed to the global financial crisis and its repercussions in Brazil. Conversely, distinct fluctuations, such as the exclusive volatility observed in the Brazilian context in graphs (ii) and (iv), highlight the peculiarities of national economic debates. These fluctuations may be driven by events such as fiscal policy changes, shifts in inflation indices, or other country-specific economic shocks, particularly those observed since 2014.

**Figure 1.3 - Annual Scientific Production on the Analyzed Topic**

(i)	(iii)
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Source: Prepared by the author using WoS data in Bibliometrix.

These observations highlight not only the importance of understanding interest rates across multiple dimensions - both natural and real, and within national and global contexts - but also underscore the need to analyze research trends as a reflection of prevailing economic concerns. This is particularly evident in the economic crisis triggered by the pandemic, which can be observed across all graphs starting in 2019.

Considering a possible relationship between scientific production and economic events, particularly in monetary policy and interest rates, this connection can be inferred from the synchronization between these factors and the volume of publications<sup>9</sup>. The observed fluctuations in scientific output may reflect the dynamics of the economy, as the parallel between variations in the Selic rate and trends in research production suggests a dynamic relationship. In this context, changes in monetary policy may act as a catalyst for academic investigations.

Research on the natural interest rate and global interest rates has increased, while studies on the real interest rate have declined after an initial peak in 2000. The spike in research on Brazilian interest rates in 2001 may reflect an academic response to policy interventions and the stabilization efforts following high initial rates. After this period, a downward trend in research on Brazilian interest rates is observed, while overall interest rate studies continue to grow. The peak in Brazilian research in 2006 may be linked to the political environment, as presidential elections took place that year, alongside a slight upward shift in the real interest rate trajectory in 2005. Global research on interest rates and the natural interest rate peaked in 2008, coinciding with the onset of the global financial crisis and the subsequent monetary policy responses aimed at lowering interest rates. This period also saw an increase in academic interest, likely driven by the need to understand the low-interest-rate environment and its macroeconomic implications.

Between 2015 and 2016, the real interest rate exhibited an upward trend, correlating with an increase in academic research on interest rates in Brazil. This surge in research may have been driven by the country's recession, which was marked by a political crisis, as well as a moderate rise in global interest in the topic. From 2017 to 2023, a peak in research on Brazil's natural interest rate is observed in 2017, likely reflecting the impact of domestic political and economic turmoil. This is followed by a period of relative stability in research output, with another peak occurring in 2022, suggesting an academic response to political and economic developments in the post-pandemic period.

To assess whether research output on the natural interest rate is uniform across Brazil and globally, the global production on the natural interest rate was analyzed. The United States led

<sup>9</sup> As can be observed by referring back to Figure 2.

research on this topic until 2018, after which China emerged as the most prominent contributor from 2019 onward. Regarding the natural interest rate in Brazil, as expected, Brazil itself has been the main producer of research on the topic throughout the entire period, with a notable increase in 2016. Other countries contributing to research on Brazil's natural interest rate include the United States, Germany, France, and the United Kingdom, likely driven by interest in investigating the Inflation Targeting Regime (ITR). On the subject of global interest rates, research is led by the United States, with Brazil ranking 16th in terms of contribution. Finally, in research specifically focused on interest rates in Brazil, the most significant output comes from Brazilian institutions, followed by contributions from the United States, the United Kingdom, Turkey, and Germany - again, likely motivated by studies on the ITR in emerging economies.

There has been a consistent increase in research output on interest rates worldwide, with the United States maintaining a particularly high volume of publications. Brazil appears to follow the global trend in terms of growth in interest rate research, though with a lower publication volume compared to the leading countries. Regarding the natural interest rate, academic interest in Brazil has been increasing, particularly since 2015. Overall, while Brazil produces significantly fewer publications than some advanced economies, academic research on both interest rates and the natural interest rate has been growing steadily, suggesting that it is increasingly aligned with global research trends.

The methodology for analyzing the correlation between key terms is based on the co-occurrence network of terms, as this reflects both the content of the research (Callon *et al.*, 1991) and the relationships between concepts. According to Krsul (1998), this technique associates keywords, constructing multiple networks of relationships between terms. Additionally, it allows for measuring the strength and significance of the interaction between terms within research studies. The size of the words and their corresponding circles on the map is proportional to their frequency of occurrence, while the connections between words are determined by the number of times those terms were correlated or associated. It is also important to emphasize that the number of citations serves as an indicator of impact and the dissemination of ideas within academic research.

In global research on the natural interest rate, the term “monetary policy” holds a central position. A cluster was identified linking key terms such as “monetary policy”, “business cycles”, and “NAIRU”, emphasizing discussions on the natural interest rate and how monetary policies influence economic cycles and employment without accelerating inflation. The presence of the term “Eurozone” likely reflects the challenges faced in low-interest-rate environments, such as the liquidity trap. Another cluster highlights terms such as “DSGE model”, “Phillips Curve”, “unemployment”, “inflation”, and “natural rate”, illustrating the use of dynamic models to understand the impact of monetary policy on inflation and employment. This grouping can be classified under keynesian macroeconomic theory.

Additionally, a set of studies focuses on the relationship between short-term interest rates and the natural interest rate, where the debate remains theoretical. A peripheral cluster includes “China”, “optimal monetary policy”, and “inflation targeting”, reflecting research on interest rates and monetary policy strategies in emerging economies and their approaches to achieving inflation targets.

The data on the natural interest rate in Brazil revealed a well-defined central cluster, indicating that core research discussions focus on the determinants established in the literature. This cluster includes terms such as “financial stability”, “interest rate”, “emerging markets”, “macroprudential policies”, “Taylor rule”, “term structure”, and “Brazil”. Additionally, “monetary policy” serves as a key intersection point connecting these elements. Another consolidated cluster pertains to monetary policy analysis variables, centering debates around “exchange rate”, “inflation”, “credibility”, and “inflation targeting”. A strongly correlated research area also emerged, focusing on emerging markets, highlighting the structural interconnections between

these studies. Beyond these core clusters, there are less prominent research groups, including one focused on forecasting techniques and econometric aspects.

The co-occurrence of key terms related to global interest rates revealed two main clusters. The most centralized cluster focuses on financial stability analysis, incorporating terms such as “monetary policy”, “interest rate”, “exchange rate”, “financial crises”, “unemployment”, “banks”, “small open economy”, “emerging market”, “volatility”, “business cycles”, “money”, “liquidity”, and “China”. This cluster likely reflects the integration of concepts such as debt management, risk assessment, and the term structure of interest rates, emphasizing how these elements shape economic stability and market pricing. The second cluster maps research on the natural interest rate within the broader macroeconomic interest rate framework and could even be classified as a distinct field of study. It features keywords such as “fiscal policy”, “monetary policy”, “inflation targeting”, “Taylor rule”, “financial stability”, “liquidity trap”, “Eurozone”, and “pass-through”, which are frequently associated with this research domain. Additionally, credit risk was addressed peripherally, further expanding the scope of discussions in this field.

Additionally, research on interest rates in Brazil appears to be more concentrated, meaning fewer terms<sup>10</sup> are cited with higher frequency, forming well-established relationships but with fewer connections between terms. This results in a denser and less complex network. Once again, “monetary policy” emerges as the most central term, forming a cluster focused on economic stabilization policies. This cluster aligns with macroeconomic theoretical frameworks related to emerging economies that have adopted the ITR, such as Brazil. It includes terms like “interest rate”, “emerging markets”, “Brazil”, “Taylor rule”, “macroprudential policies”, “financial stabilization”, “exchange rate”, and “credibility”. Another distinct cluster also relates to economic stability but from the perspective of inflation control and exchange rate stability, featuring terms like “inflation” and “exchange rate”. Finally, a third cluster is centered on estimation techniques, incorporating terms such as “cointegration”, “causality”, “forecasting”, and “yield curve”.

Figure 4 presents a word cloud highlighting frequently associated terms in the study of monetary policy and interest rates. The terms were extracted based on their recurrence in the analyzed literature. The most prominent words, such as “monetary policy”, “interest rates”, “natural interest rate”, “inflation”, “secular stagnation”, and “Brazil”, indicate that the analyzed body of research primarily focuses on monetary policy approaches within both the Brazilian and international contexts.

The first analyses focus on the natural interest rate globally (i) and in Brazil (ii). key terms such as “natural interest rate” and “monetary policy” stand out, along with topics related to “interest rate” and its estimation. Based on the quantitative analysis of terms, the identified studies, the economic context, and the recurring keywords, it is possible to understand that research is oriented toward low growth and near-zero interest rates as potential drivers of studies on monetary policy strategies in periods of slow economic expansion and contained inflation, which aligns with empirical theory in the international context.

The second analysis complements the previous scenario, while contextualizing the particularities of the Brazilian economy. Terms such as “secular stagnation”, “population growth”, “natural interest rate”, “fiscal sustainability”, “commodities”, and “credit” indicate an interest in the structural forces underlying prolonged economic stagnation and how they interact with fiscal health. The theoretical approach, including macroeconomic foundations and schools of thought, is also present, possibly reflecting an effort to trace the origins of stagnation.

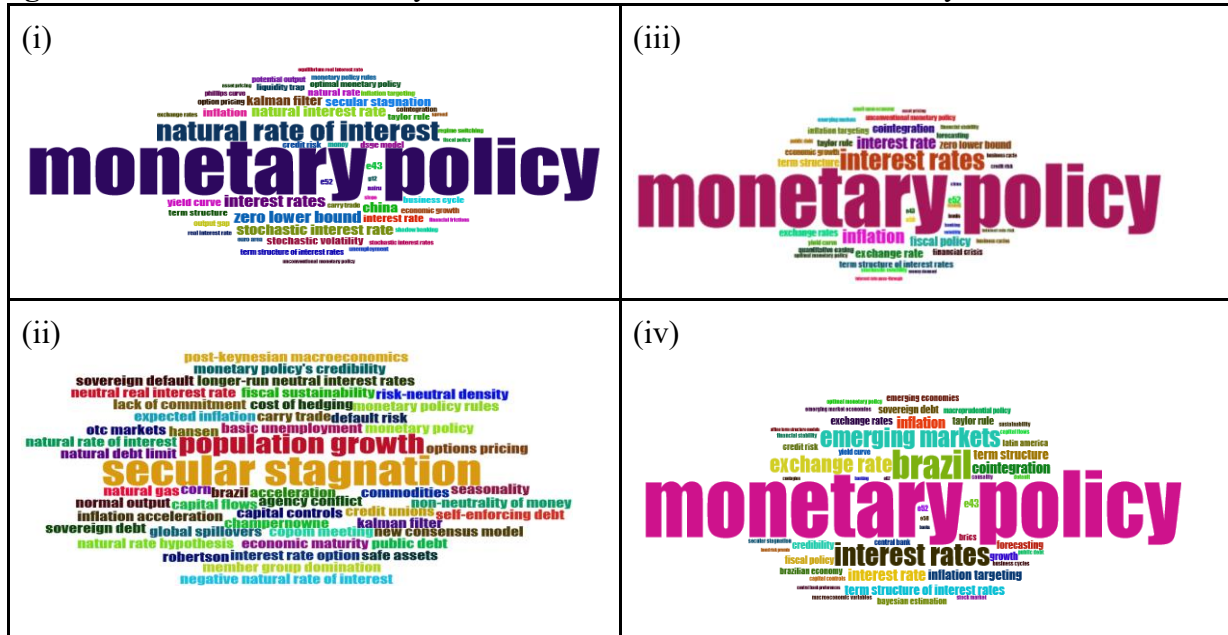
Regarding research on interest rates in the global context (iii) and in Brazil (iv), the former prominently features terms such as “monetary policy”, “interest rate”, “inflation”, “fiscal policy”, and “exchange rate”, all of which are closely aligned with macroeconomic theory. For the Brazilian case, a similar pattern emerges, with recurring terms like “monetary policy”, “interest

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<sup>10</sup> A parallel can be drawn with the determinants of interest rates, as these terms are consistently correlated with them, whether causally or not.

rate”, and “exchange rate”. However, certain specificities not only guide research but also motivate academic inquiry, such as “emerging markets”, “Brazil”, and “inflation targeting”. Additionally, terms that intersect with the determinants of interest rates are also present, including “credit risk”, “credibility”, “macroprudential policies”, and “fiscal policies”.

**Figure 1.4 - Word Clouds of Key Terms from WoS Identified in the Analysis**



Source: Author’s elaboration based on WoS data in Bibliometrix.

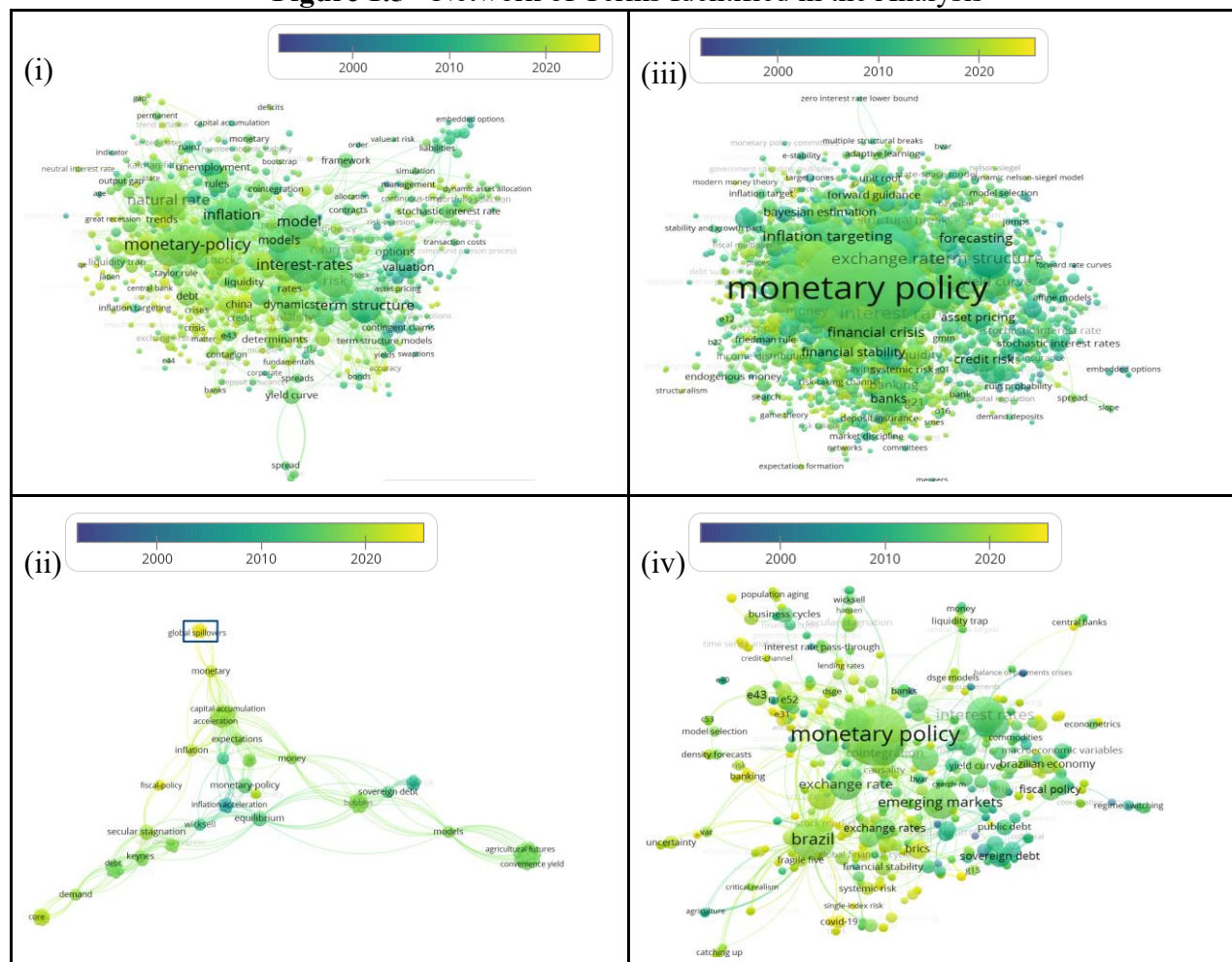
To investigate research trends over time, Figure 5 presents a network of terms spanning 1999 to 2024. This visualization serves as a contextual foundation for the subsequent analysis, which aims to explore the positioning of terms related to interest rates and the natural interest rate. This approach is employed because it not only illustrates the relationships between terms but also reveals how these connections have evolved or shifted over time.

Graph (i) in Figure 5 presents the thematic network of terms and concepts investigated over time. The most prominent topic is “monetary policy”, which has remained a constant research focus, along with “interest rate”. However, a shift over the years is observed, with a growing emphasis on the “natural interest rate”. This reflects an increasing interest in this equilibrium rate, despite the term’s significance in research. Notably, the debate is relatively recent, as it gains greater prominence around 2020. To further examine Brazil’s position in research on the natural interest rate - Graph (ii) - it is evident that this topic is one of the most recent and less established in the literature. The map indicates that the natural interest rate in Brazil has gained notable relevance only after 2020, despite some earlier publications. Other investigated topics include “inflation”, “fiscal policy”, “monetary policy”, and “secular stagnation”.

According to Graph (iii) in Figure 5, the term “monetary policy” is the most frequently used and remains highly contemporary, alongside “interest rate” and “exchange rate”. While some terms have become outdated, others have gained relevance in recent years, such as “financial crises”. This graph allows for a thematic mapping of research related to (a) interest rates and (b) the natural interest rate, highlighting their importance and academic production in this field. Similarly, Graph (iv) presents an analysis focused on Brazilian research - or international studies examining the Brazilian economy. The parallel rise of terms such as “natural interest rate” and even “Kalman filter” suggests that these topics have gained increasing prominence, offering potential for further exploration and scholarly contributions. The discussion on interest rates was particularly active around 2010; however, there remains a broad research agenda concerning the

determinants of interest rates. Although this subject has been previously explored, studies that specifically focus on the Brazilian economy and its unique characteristics remain a highly relevant and evolving field of investigation.

**Figure 1.5 - Network of Terms Identified in the Analysis**



Source: Author's elaboration based on WoS data in VOSviewer.

The analyses conducted underscore the relevance of these interest rates to the Brazilian economic environment and their broader implications. The observed fluctuations in interest rates, particularly in response to financial and political crises, underscore the reactivity of Brazil's financial system to both domestic and external shocks, reinforcing the complexity of identifying their determinants. Furthermore, the geographical and temporal investigation of research on this topic offers a thorough examination of the context in which the Brazilian debate unfolds. Beyond that, it underscores the importance of a synthesized approach, aligning with existing studies on the subject in a comprehensive and cross-sectional manner<sup>11</sup>.

Based on the bibliometric analysis, the following section examines the main determinants of long-term interest rates in Brazil, as explored in the economic literature. The findings indicate that academic production has not only mirrored global and national economic cycles but has also responded to specific events in the Brazilian economy, such as financial crises and changes in monetary and fiscal policies. One notable example is the ongoing discussion on fiscal dominance or semi-fiscal dominance, which remains a central theme in the literature. The study of the Brazilian case was essential, as it enabled a qualitative analysis that captures the specificities of

<sup>11</sup> In order to encompass the relevant perspectives according to the most influential literature.

the domestic economic debate.

#### **2.4.1 BIBLIOGRAPHIC INVESTIGATION INTO THE DETERMINANTS OF INTEREST RATES IN BRAZIL**

The monetary policy implemented during and after the Real Plan was characterized by maintaining a high real interest rate, partly to control the volume of international reserves in a context of current account deficits. This monetary policy strategy, with an average real Selic rate exceeding 25% per year between 1995 and 1998, played a important role in price stabilization but also had adverse consequences. Following the adoption of the ITR, the BCB pursued a conservative approach to Selic rate formation, marked by significant interest rate smoothing and a high equilibrium interest rate level (Modenesi, 2011).

Several theories have been proposed to explain why Brazil's benchmark interest rate has historically been among the highest in the world. Among these explanations is the reduced effectiveness of monetary policy, which argues that the high share of administered prices in the IPCA and the lack of coordination between fiscal and monetary policies contributed to keeping the Selic rate at elevated levels. Additionally, low savings rates have also been identified as a structural factor influencing this trend.

The high real interest rate discouraged investment and hindered Brazil's economic growth, as the cost of capital became excessively burdensome for businesses and investors. Moreover, it led to significant interest expenses on public debt, further contributing to debt accumulation. This scenario also reflected monetary dominance, where monetary policy negatively impacts public finances. As a result, the Brazilian economy experienced an intermittent growth pattern, while public debt expanded substantially (Modenesi, 2006).

The jurisdictional uncertainty hypothesis argues that the lack of long-term financing within the Brazilian jurisdiction is a key factor explaining the high Selic rate. This is attributed to the risk of an unfavorable judicial interpretation, perceived as anti-saver and anti-creditor in the event of a court ruling (Gonçalves, Holland, & Spacov, 2007)<sup>12</sup>. Another explanation, known as the Bresser-Nakano hypothesis (Modenesi, 2006), suggests that domestic interest rates determine country risk, as higher interest rates become a critical factor in default risk assessment. A third perspective, the convention effect hypothesis, posits that the Selic rate remains high in Brazil due to an established convention among economic agents, reinforcing expectations of persistently high interest rates.

The fragility of public finances is another argument, suggesting that fiscal imbalances and the growth of public debt play a role in sustaining the Selic rate. Several authors have explored this hypothesis, including Garcia and Didier (2000), Giambiagi (2002), Figueredo and Ferreira (2002), Garcia and Didier (2003), Favero and Giavazzi (2002), Modenesi (2003), Arida, Bacha, and Lara-Resende (2005), Barbosa, Camêlo, and João (2016), and Bresser-Pereira and Nakano (2020). These different perspectives reveal the complexity of the issue and emphasize the need for multiple approaches to reduce interest rates in Brazil, with the BCB being only one of the key players in this challenge.

Muinhos and Nakane (2006) investigated the relationship between high interest rates and debt levels. They found that, in the case of Brazil, interest rates appear to be a determining factor (in the Granger-causality sense, indicating temporal precedence) for debt levels, rather than being influenced by them. Additionally, Muinhos and Nakane hypothesized that inflation uncertainty could explain the persistently high real interest rates in Brazil, based on the observed gap between ex-ante and ex-post real interest rates in the country.

Goldfajn and Bicalho (2011) conducted a differentiated analysis of real interest rates in Brazil, examining both the short- and long-term dynamics. Their study, covering the period 1999

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<sup>12</sup> Based on Arida, Bacha, and Lara-Resende (2005).

to 2008, identified that factors such as credit-to-GDP ratio, debt levels, and risk premium (as measured by the EMBI) are key elements in understanding the ex-ante real interest rate, which they associate with the long-term real rate. For the short term, their estimates are based on an IS curve, incorporating variables such as the output gap, global output, fiscal expenditures, directed credit, and the real exchange rate. They also highlight the significant uncertainty surrounding estimates of the real equilibrium rate in the Brazilian economy.

According to Favero and Giavazzi (2002), high interest rates in Brazil are influenced by both monetary policy and term premia<sup>13</sup>. They argue that term premia and term risk premia are the main factors driving high interest rates at longer maturities, rather than expectations of future monetary policy. Jaeger (2012) and Schulz (2019) synthesize key determinants of high interest rates, identifying the following hypotheses: (i) fiscal weakness, (ii) low levels of domestic savings, (iii) institutional deficiencies, (iv) a history of high inflation and inflation volatility, and (v) credit market segmentation. The institutional deficiency factor can be linked, as previously discussed, to what Arida, Bacha, and Lara-Resende (2005) referred to as jurisdictional uncertainty.

Gonçalves, Holland, and Spacov (2007), in contrast, challenge the arguments of jurisdictional uncertainty and currency inconvertibility. They tested the hypotheses proposed by Arida, Bacha, and Lara-Resende (2005) and found unfavorable results for these claims. However, their analysis revealed statistically significant evidence of a correlation between interest rates, inflation, and the country's debt-to-GDP ratio.

According to Costa (2017), long-term real interest rates in Brazil are primarily influenced by U.S. 10-year real interest rates and risk premia. Other factors, such as debt levels and credit market indicators, were found to have no significant impact. The trend in long-term real interest rates had been declining until the 2013 "taper tantrum"<sup>14</sup>. The study estimates that, in the absence of external influences and risk premia, Brazil's long-term neutral real interest rate ranges between 4.4% and 4.6%. Moreover, monetary policy was found to have no significant role in shaping long-term real interest rates, suggesting that these rates are primarily determined by fundamental economic factors.

To corroborate this, Barbosa *et al.* (2016) concluded that the natural interest rate is influenced by both external and internal factors, such as: (i) international interest rates, (ii) exchange rate risk premium, (iii) country risk premium, and (iv) LFT premium. It is not dependent on Brazil's domestic savings rate or public deficit. The sustainability of public debt affects the natural interest rate through the country risk premium. Additionally, a more lenient stance by the Central Bank during this period contributed to above-target inflation in the years following 2011.

Paulani (2013) discusses the convention effect or rentism perspective, along with authors such as Lara Resende (2017), Bresser-Pereira, De Paula, and Bruno (2019), Feijó, Araújo, and Bresser-Pereira (2022), building on the concept proposed by Bresser-Pereira and Nakano (2002). According to this view, interest rates tend to be overvalued, as they attract foreign capital through interest rate hikes, enabling the accumulation of external savings following an international arrangement. According to Nader (2018), this phenomenon occurred during President Dilma Rousseff's first administration.

Borges and Pessôa (2021) identified several factors influencing the natural interest rate, including the cyclical position of global economic activity, terms of trade, and domestic fiscal and parafiscal policies. One of the key findings of the study is the significant variation in the neutral

<sup>13</sup> According to Favero and Giavazzi (2002), term premia represent the differences between observed interest rates for different maturities (i.e., short-term versus long-term interest rates) and the theoretical interest rates that would be determined solely by expectations of future interest rates.

<sup>14</sup> Based on Eichengreen and Gupta (2013) and Aizenman *et al.* (2014), Costa (2017) sheds light on the "taper tantrum", which refers to the U.S. Federal Reserve's (Fed) indication that it would reduce its asset purchase program. From November 2011 to May 2013, U.S. real interest rates had a negative contribution to the domestic long-term real interest rate, influenced by the second and third rounds of U.S. Quantitative Easing (QE), which ended with the taper tantrum episode, following the Fed's signal.

interest rate over time, as well as the changing nature of its determinants. For instance, between 1999 and 2004, domestic interest rates were high due to elevated country risk. However, from 2005 to 2015, the real neutral interest rate was primarily influenced by a persistent excess of demand over supply.

The June 2023 Inflation Report by the BCB analyzes the trajectory of neutral interest rates, highlighting a predominantly downward trend in the pre-pandemic period. This decline is attributed to factors such as demographic changes and the slowdown in productivity growth. The Covid-19 pandemic introduced an additional layer of complexity, raising uncertainties regarding the persistence and direction of natural interest rates.

The December 2023 Inflation Report by the BCB highlights the resilience of global economic activity and the continuation of the disinflation process, despite ongoing geopolitical challenges. Inflation remains elevated, particularly in services prices, and central banks in advanced economies emphasize the need to maintain high interest rates to achieve their inflation targets. In Brazil, economic activity slowed in the third quarter of 2023, yet growth projections were slightly revised upward. The 12-month accumulated inflation rate experienced a marginal increase, and future inflation expectations remain above target. Monetary policy remained contractionary, with expectations of a gradual reduction in the Selic rate, reflecting the need for prudence and moderation in economic management to control inflation and ensure sustainable growth.

Finally, based on the analysis presented thus far, we revisit the synthesis proposed by Rondina Neto (2018) regarding the determinants of Brazil’s interest rate levels, as outlined in the literature. This highlights the significance of various theoretical perspectives in explaining the structurally high levels of Brazilian interest rates.

**Table 1.1 - Determinants of Brazil’s Interest Rate Level Considering the Components of the Fisher Equation and Their Degree of Persistence.**

Fisher Equation components

		Real Interest Rate	Inflation Expectation
Degree of persistence	<b>Conjunctural</b>	Domestic and external macroeconomic fundamentals - Global interest rate level Monetary policy (ITR) design - Convention-effect	Domestic and external Macroeconomic fundamental
	<b>Structural</b>	Size and structure of the Welfare- State - Investment crowding-out - Corruption - Rent-seeker bias - Discourage of savings Size and composition of the public Debt - Pre-fixed public debt on the SELIC rate (LFTs’ Contagious- effect) - Pre-fixed public debt on foreign currency (US dollar) The developmental stage of the economy Credit market imperfections - Credit segmentation - Jurisdictional uncertainty - The absence of long-maturity credit market in Brazilian currency - Low levels of savings - Income inequality level	Lack of institutionalized instrumental independence by the BCB  Bad historical retrospect of defaults and hyperinflation  Persistence of indexation on administered prices

Source: Author’s elaboration based on Rondina Neto (2018).

Figure 6 presents the determinants of the nominal interest rate level from the perspective of the Fisher equation, where the components of this rate are categorized temporally, distinguishing between short-term (cyclical) and long-term (structural) impacts. Additionally, they are decomposed into real interest rates and inflation expectations. From the perspective of real interest rate determinants, key factors include the characteristics of the welfare state, “inherent”

structural specificities of the Brazilian economy<sup>15</sup>, the profile and composition of public debt, the stage of economic development, and, closely related to it, credit market imperfections, which exert influence over a longer time horizon. The international interest rate is another commonly cited factor in the literature, while the design of monetary policy under the inflation-targeting regime has a more immediate impact. From the inflation expectations perspective, macroeconomic factors play a significant role, along with income inequality, the independence of the Central Bank of Brazil, and default risk, influenced by the country's historical monetary and inflationary instabilities. Lastly, the indexation of administered prices is also a relevant determinant.

## 2.5 FINAL REMARKS

This study investigated the determinants of high interest rates in Brazil based on existing research, exploring the economic and institutional factors that influence them. The analysis, grounded in both bibliometric studies and a subsequent literature review, highlights the pursuit of inflation control as a central monetary policy objective. Among the key components of interest rates, the findings point to the persistently high level of public debt, the role of fiscal and monetary policies, domestic savings levels, and fiscal stability. Additionally, institutional factors, such as jurisdictional uncertainty and economic conventions among agents, are also identified as significant influences in maintaining elevated interest rates.

By examining the citation frequency of determinants, along with the analysis of recurring terms and co-citation networks in the bibliometric study, it was possible to assess the relevance attributed to each determinant. The consistency between the quantitative and qualitative analyses reinforces the understanding of the significance of different factors, particularly the impact of cyclical variables on research production.

Overall, the investigation clarified that there is no single reason for Brazil's high interest rates, but rather a set of interrelated factors, ranging from risk perception among economic agents to structural, domestic, and external policy issues. The diversity of determinants and the complexity of their interactions suggest that any strategy to sustainably reduce interest rates must address not only macroeconomic, monetary, and fiscal issues but also structural reforms that enhance the domestic economic environment and credibility, as financial considerations were a recurring theme throughout the research.

This study represents a synthesizing contribution to the analysis of interest rates in Brazil, serving as a pioneering effort in combining a bibliometric analysis with an investigation into the determinants of interest rates. Through this approach, it is not only possible to identify the main factors influencing interest rates in the Brazilian context, but also to trace the evolution of the debate over time. Finally, it underscores the ongoing yet timely need for coordinated policies that balance fiscal stability and economic growth, aiming to bring interest rates closer to an efficient natural level in Brazil.

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<sup>15</sup> Hypothesis of "rent-seeking" behavior among economic agents.

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### 3 FINANCIAL INTEGRATION AS DETERMINANT OF INTEREST RATES IN BRAZIL

#### **Abstract:**

This study investigates the determinants of Brazil's interest rate by analyzing the interplay between global economic factors and the impact of financial integration dynamics. Emphasizing the Brazilian economy position as a small open economy, the research extends beyond traditional internal determinants (such as public debt and domestic savings) by incorporating external influences, mainly global interest rates and international capital flows. The analysis employs a vector error correction model, capturing both short- and long-term relationships, with a focus on Brazil within the broader context of emerging economies. Additionally, an interest rate determination rule inspired by Taylor's Rule (1993) was proposed, adapting it to the specific challenges faced by developing economies, particularly in the presence of exchange rate volatility and financial vulnerability. The study covers the period from 1999 to 2023, contextualizing Brazil's monetary policy within a regional framework and highlighting the constraints and opportunities posed by financial integration. The findings contribute to a deeper understanding of the interaction between external shocks and structural factors in shaping domestic monetary policy.

**Keywords:** Interest Rate; Financial Integration; Brazil; VEC Model, Inflation Target Regime.

**JEL Classification:** E12; E52.

#### 3.1 INTRODUCTION

The primary aim of this study is to examine how Brazil's interest rate responds to international relation<sup>16</sup>, grounded in the view that Brazil functions as a small, open economy, as discussed in parts of the literature (Galí, 2015; Barbosa, Camelo, and João, 2015). While most interest rate models overlook this perspective, external variables do influence domestic monetary policy, especially interest rates. Traditional literature has focused on internal factors, such as public debt and low savings rates; however, authors as those cited above explore the links between global and Brazilian economic factors and their effect on domestic rates.

Financial integration, which enhanced in the late 1980s and gained momentum throughout the 1990s, initially unfolded in advanced economies before extending to emerging markets. The objective was to promote financial integration, privatization, reduction of market barriers, and the avoidance of capital controls. The adoption of an international financing model centered on the issuance of fixed-income securities and equities led to a significant increase in foreign portfolio investments within the Brazilian financial market. In advanced economies, this movement emerged as a natural consequence of competitive market dynamics, while in emerging economies, it was driven by the Washington Consensus.

The discussion about interest rate levels in Brazil resurfaced in the economic debate following the adoption of the ITR in 1999. Considering the process of industrialization, growth, and economic development, the country implemented measures, such as the exchange rate anchor regime and the use of the interest rate as a nominal anchor, replacing the previously practiced

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<sup>16</sup> Here considered as financial integration.

crawling peg exchange rate, as noted by Cardoso (2021), that, together with the external context (Mercosur and global crises), increased inflation due to the depreciation of the Real currency. The real interest rate in Brazil has decreased over time, especially after the “Brazilian Real Plan” and the ITR, but it still remains above the average of emerging countries with similar systems (Segura-Ubiergo, 2012).

The target for the SELIC is the main policy instrument managed by the Brazilian monetary authority to promote the convergence of the country’s inflation to the defined target (Carvalho, 2023). Emerging economies tend to have higher interest rates due to factors such as a greater need for foreign resources and higher default risks (Segura-Ubiergo, 2012; Schulz, 2019). Financial globalization, or liberalization, is supported in mainstream theory based on market efficiency, as this dynamic is seen as beneficial for the growth of emerging peripheral economies through the influx of foreign investment. Thus, the orthodox perspective advocates for free markets and the hypotheses of efficient markets and rational expectations.

However, after reviewing the literature, no studies were found that specifically relate financial integration and currency exposure to interest rates, as well as proposing one equation of estimation considering other factors, as proposed in the present paper. Therefore, without establishing or defining only one political-economic view (*i.e.*, school of thought), we observed that there is an extensive literature on the determinants of interest rates (Pilkington, 2014; Holston *et al.*, 2017; Borges; Pessôa, 2021), and also there is a scarcity of studies that examine the structural factors, particularly the relationship between Brazil and financial integration (Barbosa *et al.*, 2016; Costa, 2017; Bresser-Pereira; Nakano, 2020). The main difference between what the mentioned papers and ours is that we are interested to understand how financial integration affects the Brazilian basic interest rate (SELIC), which is an intersection among the aforementioned literatures.

The method proposed is the impulse-response obtained by the use of Vector Error Correction (VEC) model. For the proposed analysis, the application of a Vector Autoregression (VAR) model would be appropriate; however, this requires the variables to be stationary and there is no evidence of a cointegration relationship among them. Nevertheless, considering the specific variables in this research, it was identified that a vector error correction model would be more suitable. This is due to the cointegration characteristics present among the variables analyzed, allowing the VEC specification to capture both the short-term and long-term relationships between these variables.

Analyzing this relationship in Brazil as an emerging economies, this study proposes a VEC estimation to examine the behavior of interest rate over time from 1999 to 2023 across a developing countries context. This approach not only allows for a comparison of domestic results but, more importantly, enables analysis against a set of similar countries in relevant aspects, similar to that done by Clarida, Galí, and Gertler (1997) for other economies.<sup>17</sup>

Our paper is structured into five sections. The introduction outlines the research hypothesis, objectives, justification, and methodology. The second section presents a literature review on financial integration, monetary hierarchy, and interest rates, discussing theoretical perspectives and empirical findings that frame the study. The third section details the methodology, including the econometric model specification, the selection of variables, and the justification for applying

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<sup>17</sup> Canova (2005) proposed a panel with multiple VECs methodology.

the VEC model. The fourth section presents the empirical results, analyzing the short- and long-term relationships between domestic interest rates and their determinants, particularly the influence of financial integration and external economic factors. Finally, the concluding section synthesizes the findings and discusses their impact on the domestic economy. It also proposes a comparative analysis of inflation-targeting economies and examines the broader implications of financial integration for emerging markets as a potential avenue for advancing this study.

### **3.2 RELATIONSHIP AMONG FINANCIAL INTEGRATION, MONETARY HIERARCHY AND INTEREST RATE**

Financial integration was enhanced in the second half of the 1980s, initially in advanced economies and later in emerging markets, gaining significant momentum throughout the 1990s. The primary objective of this movement was to improve capital mobility as part of a broader process of financial globalization. The nature of this movement differed based on the characteristics of each country. In advanced economies, it emerged as a natural consequence of competitive market dynamics. In contrast, in emerging economies, it was driven by the Washington Consensus.

The theoretical foundation of this approach, rooted in mainstream economics, posits that increased integration among economies can stimulate growth<sup>18</sup>, particularly in emerging markets. This is because capital from wealthier nations can be directed toward economies with lower domestic savings but substantial growth potential (Freitas; Prates, 2001; Giannetti; Ongena, 2009). Similarly, Rodrik (2011) highlights the potential for globalization to help these economies overcome inefficiencies, which are partly due to structural constraints. Consequently, these economies are encouraged to open up to international trade and finance to attract foreign capital.

In accordance with the literature, particularly De Sola Perea and Nieuwenhuyze (2014), the mainstream perspective on financial integration highlights the improved capital allocation that occurs when capital can move freely among economies. This allows capital to flow from wealthier countries to poorer ones, potentially leading to higher returns on capital (Mankiw *et al.*, 1992). Financial integration also has the potential to mitigate the impact of shocks on national income, making consumption and investment less volatile in response to such shocks (Jappelli and Pagano, 2008). Additionally, Levine (2001) argues that financial integration facilitates the smooth transmission of monetary policy, while increased competition enhances the efficiency and development of the domestic financial sector and markets. Obsfeld (1998) further suggests that this dynamic allows domestic policies to be disciplined by external markets, which could promote greater stability.

On the other hand, Kregel (2008) highlights Keynes's contribution, noting his critique of the neoclassical tradition's failure to account for rational expectations and market efficiency, particularly in the context of financial liberalization in emerging economies. Keynes argued that these theories overlook the realities of how markets function and how agents behave, as decisions are often made under conditions of uncertainty, without prior information, and during adverse economic events.

Moreover, there is no standardized measure for the level of financial integration across

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<sup>18</sup> At least, there is a link between those variables. See Goldsmith (1969).

various economies. However, as Lane and Milesi-Ferretti (2008) suggest, a country with a large financial sector, high output *per capita*, and significant trade openness is considered to have a high degree of financial integration. Opening the economy to capital flows by avoiding control measures or integrating domestic and international markets is one way to achieve it (De Conti *et al.*, 2014).

The discussion around financial integration is broad, with no consensus in the literature. One perspective suggests that this dynamic leads to higher growth in economic activity and investment from the demand side, along with lower volatility. On the other hand, there is a more critical or negative view, which argues that financial integration can undermine prosperity and economic stability, making emerging economies more vulnerable to financial and balance of payments crises (De Sola Perea and Nieuwenhuyze, 2014).

Based on the literature, while the interconnectedness of economies presents numerous opportunities, particularly for emerging economies, the challenges it introduces are equally significant. These challenges must be carefully considered in the formulation of monetary policy, as they influence the outcomes and effectiveness of such policies. It is relevance for policymakers to anticipate these dynamics to ensure that the results align with their objectives. The following subsection will explore the relationship between monetary policy and financial integration.

### **3.2.1 MONETARY POLICY UNDER CAPITAL MOBILITY**

Increasing financial integration has direct implications for the conduct of monetary policy in Latin American economies, particularly within a context of high capital mobility and exchange rate volatility. As the region becomes more interconnected with global financial markets, central banks' ability to implement autonomous monetary policies is often constrained by external pressures on interest and exchange rates. This interdependence challenges the effectiveness of traditional monetary policies, requiring policymakers to consider exchange rate interventions, macroprudential measures, and, in some cases, capital controls to manage the effects of capital inflows and outflows. Understanding the dynamics between financial integration and monetary policy is relevant for maintaining economic stability amid external shocks and shifts in global liquidity conditions.

Considering monetary policy in the context of capital inflows to Latin America, Calvo, Leiderman, and Reinhart (1993) analyzed the external factors contributing to real exchange rate appreciation and the policy responses to these inflows. The capital inflows in the early 1990s were driven by external factors, particularly falling U.S. interest rates, which improved the solvency of Latin American debtors and encouraged capital to flow into the region. These inflows led to the accumulation of foreign reserves and appreciation of real exchange rates in many countries. However, these inflows were not necessarily sustainable, besides that, implied issues to policymakers, such as (i) real exchange rate appreciation that could harm export sectors, (ii) improper intermediation of capital leading to resource misallocation, and (iii) the possibility of sudden capital outflows, which could trigger financial crises. The historical context of the debt crisis in the 1980s underscores these risks.

Balancing inflation levels and exchange rate volatility through monetary policy, particularly when considering sterilized and non-sterilized interventions, presents issues and requires credibility to achieve positive results. Sterilized intervention involves the central bank selling bonds in exchange for foreign currency to reduce the monetary base and, thus, control

inflationary impact. However, this creates a fiscal burden, as it perpetuates capital inflows by maintaining the attractiveness of domestic yields. On the other hand, non-sterilized intervention increases the monetary base, which can accelerate inflation and put pressure on currency appreciation (Calvo, Leiderman, and Reinhart, 1993).

One of the most compelling arguments for financial integration is the increased mobility of capital. However, this dynamic imposes limitations on the effectiveness of monetary policy, such as the potential impact on domestic interest rates due to external inflationary pressures, increasing the economy's vulnerability to external shocks. The IS-LM-BP model by Mundell-Fleming (1960) *apud* Blanchard (2007), explores the effects of fiscal and monetary policies in open economies. As an extension of the IS-LM model, it includes the foreign exchange market, examining how the balance between goods and financial assets reacts in different exchange rate regimes, with an emphasis on capital mobility. Initially, it is understood that both the interest rate and the exchange rate are determinants of aggregate demand; the former directly impacts investment and, consequently, the latter. Some hypotheses of the model are the equal amount capital mobility, on the other words, domestic interest rate cannot diverge from global levels, and exchange rate is determined from interest differential.

Nevertheless, as seen at Blanchard (2007), monetary policy has been found to have different effects depending on the exchange rate regime adopted by the economy. In flexible exchange rate regimes, monetary policy has more power to adjust output and the exchange rate, as an increase in the domestic interest rate leads to currency appreciation, reducing net exports and, consequently, demand for domestic goods. Fiscal policy, in turn, is less effective under flexible exchange rates, as any fiscal expansion that raises demand also raises interest rates and appreciates the exchange rate, which reduces part of the expansionary impulse due to the decrease in net exports. However, in fixed exchange rate regimes, the central bank has less monetary autonomy, as the domestic interest rate must follow the external one to maintain the fixed exchange rate. Thus, fiscal policy is more effective, as the increase in demand does not affect domestic interest rates, and the central bank automatically accommodates the monetary effect of fiscal expansion to maintain the fixed exchange rate, where fiscal policy has a broader direct impact on output.

According Obstfeld and Rogoff (1995), reducing inflation and domestic economic instability should be addressed through reforms of domestic monetary policy institutions, without relying on exchange rate stabilization. While there are situations in which an internationally coordinated monetary response can be appropriate, such as global crises, coordination should not necessarily imply exchange rate stabilization, as market expectations can change dramatically, undermining the credibility of policymakers. This argument is true particularly in the context of fixed exchange rate regimes. While it is possible to maintain a fixed exchange rate, it becomes challenging in practice, as global capital markets tend to magnify any weaknesses in a country's commitment to this regime. More flexible systems, such as wider exchange rate bands, merely delay the inherent challenges faced under fixed exchange rates.

The reintroduction of capital controls has been proposed by both proponents of fixed exchange rates and those seeking to reduce the volatility of floating rates. However, these restrictions may result in significant economic costs with limited benefits, particularly due to the ease of evasion in an increasingly interconnected global economy (Obstfeld and Rogoff, 1995). Jones and Seguin (1995) argued that discouraging transactions is not the solution for control the flow, as increasing transaction costs does not directly reduce asset price volatility. Instead that

regulation should focus on promoting a secure framework to manage exchange rate risks effectively, rather than attempting to limit market activity through higher costs.

Blanchard (2006) argues that while the IS-LM-BP model was effective in demonstrating how monetary and fiscal policies can impact the balance of goods and capital in economies with open financial markets, it overlooks sectoral distortions, wage rigidity, and financial constraints that affect labor and tradable in advanced economies. For instance, that current account balance deficits in rich countries differ from past experiences in emerging markets, as they reflect private saving and investment rather than fiscal imbalances. Furthermore, that government interventions may be unnecessary if deficits result from rational private decisions, yet policy could still play a role in addressing structural issues like wage inflexibility or capital constraints that limit sectoral adjustments.

Mundell (1963) assessed that it was impossible for a country to simultaneously achieve exchange rate stability, monetary policy autonomy, and free capital mobility, known as the “trilemma” which a country can only achieve two of the three policy objectives. This is because, under a fixed exchange rate regime with high capital mobility, monetary policy loses its effectiveness, as any attempt to alter the money supply is offset by capital flows that adjust the balance of payments. However, under a flexible exchange rate regime, monetary autonomy is regained as the exchange rate can fluctuate to balance capital flows, allowing the central bank to focus on domestic goals, such as inflation and employment, but at the cost of exchange rate volatility. For Latin America, the trilemma represented a particularly issue: the need to choose between exchange rate stabilization policies, inflation control, and attracting foreign capital, as the balance among these forces is influenced by external shocks and internal pressures.

However, new perspectives have emerged from trilemma theory, Rey (2015) argued that in a financially integrated world, capital mobility restricts national monetary policy autonomy, regardless of exchange rate regimes. The role of the global financial cycle, which is primarily driven by monetary policy in core economies, especially the U.S. Federal Reserve, and manifests through synchronized fluctuations in capital flows, asset prices, and credit creation. This global cycle is sensitive to risk indicators like the VIX<sup>19</sup>, with low volatility promoting inflows and high leverage, while spikes lead to outflows and deleveraging. To smoothing that impact, countries must manage capital flows directly or indirectly, using macroprudential policies, and retain monetary policy effectiveness.

Moreover, other point of view, over the financial integration intensified, emerging markets faced greater financial instability and sudden capital outflows, often leading to severe debt crises and tight monetary policy. In response, many countries adopted managed exchange rate flexibility, controlled financial integration and limited monetary autonomy. This evolved into a “quadrilemma”, adding financial stability as a necessary element. The global financial crises highlighted that no country is immune, but those with mature institutions and robust fiscal capacities can better navigate these challenges through coordinated policies and less reliance on precautionary reserves (Aizeman, 2019).

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<sup>19</sup> The VIX, or Chicago Board Options Exchange Market Volatility Index, measures the implied volatility of options on the S&P 500 index.

### 3.2.2 MONETARY POLICY UNDER INFLATION TARGETING REGIMES

Monetary policy within an inflation-targeting regime prioritize price stability as its main objective, adjusting the operational target to raise (or decrease) interest rate to control inflation according to a predetermined target. The regime aims to anchor the expectations of economic agents, providing predictability and credibility to the central bank, while allowing timely responses to economic shocks. Nevertheless, there are four regime types adopted by countries, as (i) exchange rate targets, (ii) monetary aggregate targets, (ii) explicit inflation target, and (iv) implicit inflation targets (Snowdon and Vane, 2005).

Furthermore, the inflation-targeting regime is characterized for fundamentals features, such as (a) a public announcement of a medium-term inflation targets; (b) a commitment to price stability as the primary objective of monetary policy (developed countries maintain around 2% and 3% per year); (c) an inclusive strategy of information over the parameters used for policy decisions; (d) greater transparency in the implementation of monetary policy in a way that facilitates better communication with the public; (e) accountability for the central bank with respect to fulfilling its inflation objectives; and (f) the inflation targets imply a previous forecast for the target (Svensson, 1997a, 1997b; and Mishkin, 2002).

The implementation of an inflation-targeting regime depends on essential conditions. Firstly, the central bank must have the autonomy to employ any necessary tools to achieve its monetary policy goals, according Berger et al. (2001) and Piga (2000). Additionally, the absence of fiscal dominance is critical for effective adoption. Fiscal dominance, an idea introduced by Sargent and Wallace (1984), occurs when an unsound fiscal policy overrides monetary policy, making it unlikely for countries with substantial fiscal deficits to credibly sustain an inflation-targeting framework. In such cases, raising interest rates may counterintuitively boost aggregate demand and inflation instead of containing them.<sup>20</sup> Moreover, the adoption of a floating exchange rate regime is necessary to maintain the free flow of capital, a condition dictated by the “trilemma” of open economy policies and analyzed in the previous subsection.<sup>21</sup>

The conduct of monetary policy in the United States has varied significantly over time. Before 1979, the approach was largely accommodative, aiming to support economic growth with less on controlling inflation. However, post-1979, monetary policy became more proactive, with a strong emphasis on inflation control (Clarida *et al.*, 2000). This shift in approach is analyzed through the reaction function for the Federal Reserve, presented in equation (2.1):

$$r_t^* = r^* + \beta[E(\dot{P}_{t,k}|\Omega_t) - \dot{P}^* + \gamma E[(y_{t,q}|\Omega_t)] \quad (2.1)$$

In this context,  $r_t^*$  represents the target for the nominal Federal Funds rate;  $\dot{P}_{t,k}$  is the inflation rate between periods  $t$  and  $t + k$ ;  $\dot{P}_{t,k}$  is the inflation target;  $y_{t,q}$  measures the average deviation between current output and potential output, known as the output gap, over periods  $t$  to  $t + q$ ;  $E$  is the expectation operator; and  $\Omega_t$  is the set of information available to the monetary authority responsible for setting the policies at the moment the interest rate is determined. The

<sup>20</sup>This issue is particularly relevant for many developing nations and countries undergoing economic transition, as Mishkin (2000) points out, especially former socialist economies in Eastern Europe.

<sup>21</sup>That context is in consistent with New Keynesian approach.

desired nominal interest rate  $r_t^*$  for the Federal Funds is the rate when  $\dot{P}_{t,k}$  and  $y$  are at their target levels, thus representing the neutral interest rate. This reaction function, presented in equation (2.1), differs from the traditional Taylor Rule<sup>22</sup> expressed in equation (2.2), as it assumes rational expectations, known as forward-looking.

Taylor (1993) defines that the interest rate can be determined by the Central Bank following equation (2.2), where  $i_t$  is the nominal interest rate set by the Central Bank,  $r^*$  is the equilibrium (or natural) interest rate,  $\pi_t$  is the observed inflation rate,  $\pi^*$  is the inflation target,  $y_t$  is the output level at time  $t$ , and  $\bar{y}$  is the full employment output level of production factors. The equilibrium real interest rate  $r^*$  serves as a baseline for the nominal interest rate, upon which adjustments are made based on observed economic conditions. The term  $\pi_t + \alpha(\pi_t - \pi^*)$  represents the monetary policy response to inflation, while  $\beta(y_t - \bar{y})$  represents the response to the deviation of actual output from its potential. The equilibrium real interest rate,  $r^*$ , thus serves as a basis for the nominal interest rate, with adjustments made according to observed economic conditions.

$$i_t = r^* + \pi_t + \alpha(\pi_t - \pi^*) + \beta(y_t - \bar{y}) \quad (2.2)$$

In small open economies, the exchange rate can play a significant role in the decision-making process of the monetary authority. This leads to two important modifications in the Taylor Rule. First, the long-term equilibrium real interest rate, or natural rate, depends on the international real interest rate and fluctuates over time. Thus, the assumption that this rate is constant should not be applied, as is often the case in empirical studies of the Taylor Rule in a large, relatively closed economy where external events do not impact its interest rate. Second, in a small open economy, the exchange rate becomes a crucial factor in the central bank's interest rate-setting decisions. Consequently, the Taylor Rule incorporates an additional term in a small open economy, usually involving some transformation of the exchange rate. This term should average to zero in the long run so that, in equilibrium, the interest rate aligns with the natural rate plus inflation, as in a closed economy. Some empirical studies overlook this property, leading to specification errors. Therefore, the Taylor Rule for a small open economy can be specified according Barbosa, Camêlo and João (2016), for instance, by the following set of equations:

$$\hat{i}_t = \bar{r}^* + \pi_t + \phi\tilde{\pi}_t + \theta\tilde{y}_t + \gamma_1\tilde{q}_t + \gamma_2\Delta\tilde{q}_t \quad (2.3)$$

Where  $r_t$  represents the natural interest rate, with the subscript indicating its variation over time, and  $q_t$  denotes the real exchange rate. The tilde signifies the difference between the current value and the long-term equilibrium value, while  $\Delta$  represents the first difference of the designated variable.

$$i_t = \lambda\hat{i}_t + (1 - \lambda)\varphi(L)i_{t-1} + \varepsilon_t, \quad \varphi(1) = 1 \quad (2.4)$$

The equation (2.4) specifies the inertia in the adjustment process from the desired interest rate to the observed interest rate, where  $\varphi(L)$  is a polynomial in the lag operator  $L$  ( $Lx_t = x_{t-1}$ ). As stated by Barbosa, Camêlo and João (2016) in a small open economy with unrestricted capital mobility and perfect substitutability of assets, the domestic real interest rate equals the international interest rate. When these assumptions are not met, sovereign risk  $\gamma_t$  and exchange rate risk  $\tau_t$  terms must be incorporated, assuming no arbitrage opportunities exist. Therefore, the

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<sup>22</sup>Taylor's rule would be considered a special case of the Federal Reserve's reaction function equation.

natural interest rate in a small open economy is given by:

$$\bar{r}_t = r_t^* + \gamma_t + \tau_t \quad (2.5)$$

The specification of the Taylor Rule is forward-looking, based on Judd & Rudebusch (1998) and Soares & Barbosa (2006):

$$\Delta i_t = \alpha_1(\bar{r}_t + \pi_t - i_{t-1}) + \alpha_2(\pi_t^e - \bar{\pi}) + \alpha_3 y_{t-1} + \alpha_4 y_t + \alpha_5 \Delta q_t + \alpha_6 \Delta q_t + \alpha_7 \Delta i_{t-1} + \varepsilon_t \quad (2.6)$$

However, the determination of the short-term interest rate by the Central Bank alone is not enough for monetary policy to achieve its ultimate goal. There are mechanisms for transmitting interest rate adjustments to inflation, which are five main channels: market rates, asset prices, expectations, credit, and the exchange rate. Through these channels, changes in the short-term interest rate impact components of aggregate demand and, in turn, indirectly influence the inflation rate.

It is essential to recognize that the transmission of monetary policy effects is not immediate but occurs with a time lag. In light of this, monetary authorities should carefully monitor macroeconomic indicators that could impact policy decisions. In addition to tracking the actual and potential levels of prices and output - the primary target variables in their reaction function - authorities should also observe the natural interest rate and its trends over time, as this variable is implicitly accounted for within the reaction function, as seen (Rondina Neto, 2018).

### 3.2.3 THE ROLE OF FINANCIAL INTEGRATION IN ECONOMIC DEVELOPMENT

Even though financial integration has its advantages, there are also significant disadvantages, as highlighted in the literature. As stated by Caballero *et al.* (2008), peripheral economies are often subject to market imperfections, which can result in capital not being allocated optimally, leading to capital flowing back to richer countries. While capital flows can promote growth and investment, the destination of these resources is more relevant. If the capital is directed primarily toward the domestic market, it may not enhance export potential, and therefore, may not have a lasting positive impact on the balance of payments.

Schularick and Steger (2006) analyzed the relationship between financial integration and economic growth using a dataset to test whether international financial integration enhances economic performance through a GMM system for 24 countries over 1880 to 1914 of European countries, North American, Australasian, South American, Asian and Middle Eastern economies. The results indicated that European capital was important for growth in peripheral economies in the past, aligning with the theory. The paper highlights key features of the period that were essential for the standard neoclassical model to function effectively: (i) similar protection of property rights across countries; (ii) a moderately stable financial environment; (iii) a high degree of capital mobility; and (iv) substantial capital transfers from affluent core regions to less developed peripheral regions.

According to Tang (2016), financial markets can be seen as the metabolic system of an economy, where capital flows to all parts, while commodities move in the opposite direction, with capital clustering in the most profitable businesses. For example, in the case of China and the United States, there is an issue with capital flowing from capital-poor to capital-abundant regions. This occurs because the financial sector in the capital-poor country is less developed compared to

the other. Additionally, this understanding allows policymakers to predict and prepare for financial shocks originating from interconnected markets (Caballero *et al.*, 2008).

Furthermore, the risk of sudden changes in capital movements due to abrupt shifts in risk perception regarding economic fundamentals can lead to the need for adjustments in external deficits rather than fostering economic growth. Exposure to financial crises is a well-known concern. The expansion of the financial sector can result in the creation of complex financial products, which increases the risk of contagion. Besides, the potential for moral hazard and conflicts in managing institutional problems, along with the impact of external shocks, further complicates the situation.

Although Goldsmith (1969) and King and Levine (1993) highlighted a positive relationship between the initial level of financial development and factor productivity in some economies, Eichengreen (2001) and Kose *et al.* (2006) point out that the literature has not conclusively proven these benefits. Instead, they suggest that financial openness can potentially have a detrimental impact.

Moreover, De Sola Perea and Nieuwenhuyze (2014) emphasize the potential challenges that large and volatile capital flows pose to monetary policy, including inflationary pressures and real exchange rate appreciation, along with their broader economic consequences. Consequently, these authors question whether financial integration would not be a panacea. Schularick and Steger (2006) reinforce the conclusion that economies should first eliminate distortions, ensure property rights, and then fully open themselves to the world to reap the benefits of globalization.

Fischer (1998) and Summers (2000) argued for the potential stabilization effects among industrialized economies. Building on the relationship involving industrial aspects, Mendoza, Quadrini, and Ríos-Rull (2009) examined the imbalances that can arise in the global financial system due to the integration of countries at different levels of financial market development. Two key factors were identified by them: first, the cycle in which economically advanced nations gradually accumulate foreign liabilities in a sustained manner; second, the situation of economies with negative net foreign asset positions, which continue to hold positive net stakes in non-diversifiable equity and foreign direct investment (FDI).

In addition, Leal (2023) specifically investigates emerging economies in the periphery and notes that, according to conventional views held by some authors, capital inflows from central economies reduce domestic interest rates, thereby alleviating capital scarcity. However, this relationship has also increased exposure to speculative shocks, exchange rate volatility, and macroeconomic instability. Consequently, the integration of peripheral economies into globalization, accompanied by capital inflows, primarily triggered speculative crises in Latin American countries during the 1990s, ultimately leading to capital flight from other emerging markets due to the contagion effect.

This argument has been contested, with the primary reason being that financial integration alone does not necessarily improve welfare if other distortions are present (Bhagwati, 1998; Stiglitz, 2002). In the case of Latin America in the 1990s, the issue was not financial integration itself, but rather an inappropriately rigid exchange rate regime. The relationship between financial integration and economic outcomes should not rely on isolated policies, as risks and benefits are inevitable. Instead, structural and macroeconomic policies should be tailored to the specific circumstances of each country to optimize the risk-benefit tradeoffs when entering the global market (Kose, Prasad, Rogoff, and Wei, 2010).

Additionally, emerging peripheral economies face a productive asymmetry, particularly regarding financial integration and their subordinate position in the global economy, which is largely influenced by their production profiles. For instance, Latin America's export agenda relies heavily on commodities that lack variety, complexity, and technological sophistication, making these economies dependent on external capital flows. In contrast, Asia's export profile is dominated by the manufacturing of high-value-added products with a broad range of offerings, leading to stronger balance of payments and a reduced need for external resources (Leal, 2023; Paula *et al.*, 2024).

The relationship between financial internationalization and currency hierarchy is influenced by several factors, including the size of the issuing country, the structure of its domestic financial market, political influence, currency stability, and government policies. While internationalization can offer benefits such as lower transaction costs, reduced exchange rate risk, decrease seigniorage, the expansion of the banking sector, and increased global prestige and political influence, it also comes with challenges. These include reduced monetary policy autonomy, heightened currency volatility, and a significant responsibility for maintaining global economic stability (De Conti, 2011; Maziad *et al.*, 2011). The level of financial integration varies significantly across different economies. Typically, a high degree of financial integration is linked to a large financial (banking) sector relative to GDP, high output *per capita*, and substantial trade openness (Lane and Milesi-Ferretti, 2008).

Hierarchy in the international monetary system is defined by the dynamics surrounding the global use of currencies, with the distribution of currencies within the hierarchy determining their role in global market exchanges. However, the degree of trade and financial openness is not the most effective measure for assessing the impact of domestic financial integration on a currency's international use (Conti, 2011). Unlike the post-Keynesian view, the mainstream perspective suggests a direct relationship between a currency's position in the hierarchy and the internationalization method adopted. Accordingly, the more a currency is used on the international stage, the higher its position in the hierarchy (Orsi, 2019).

Conceptualized as short-term speculative investment currencies, many peripheral currencies undergo internationalization primarily through short-term investments. Investors often seek profits via speculative operations denominated in these currencies, such as carry trade operations, where returns are tied to interest rate differentials. Countries issuing these currencies are more dependent on international liquidity cycles and are more vulnerable to speculative shocks (Orsi, 2019). Consequently, when capital flows are unrestricted, periods of increased risk are particularly challenging for peripheral economies. This is partly due to the renunciation of the local currency, which lacks the liquidity<sup>23</sup> of central currencies (Conti *et al.*, 2014).

Peripheral currencies are unable to serve as financing currencies, with the U.S. dollar acting as the primary monetary unit for denominating contracts in international financial markets. To acquire financing currency, investors sell assets tied to peripheral currencies. This behavior reinforces the high demand for the dollar and its dominant position at the top of the currency hierarchy, while also exerting depreciation pressures on peripheral currencies, thereby maintaining their subordinate position in the hierarchy. Consequently, the external liabilities of investors are

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<sup>23</sup> The capability of an asset to be changed without losing capital, incurring transaction costs, and at any time (Plihon, 2001).

crucial for understanding the role of currencies on the international stage (Kaltenbrunner, 2015).

The interest rate is a return on illiquidity of an asset, according to Keynes (1936). The uncovered interest rate parity (UIP) theory posits that a country's interest rate is determined by the global base rate, a risk spread (such as country risk), and the expected exchange rate variation. However, this theory is limited because it does not consider monetary hierarchy and the international liquidity of currencies, which means that the interest rate differential also includes a premium for the currency's illiquidity (Carneiro, 2008; Conti *et al.*, 2014). Therefore, the interest rate can be disaggregated into the global base rate, country risk, expected exchange rate variation, and a premium for the currency's illiquidity.

The global base interest rate<sup>24</sup> is independent of other international rates; instead, other interest rates are influenced by it. This rate can be viewed as one determined in a closed economy, shaped by agents' liquidity preference, particularly their preference for the currency's liquidity. The interest rate on public debt issued by the reserve currency country, considered a zero-risk asset, can be interpreted as a premium for domestic illiquidity. Furthermore, in an open international economy, the interest rate also reflects a premium for the illiquidity of the asset's currency denomination. This premium is driven by global liquidity preference, specifically the liquidity of the currency. As a result, assets that lack the liquidity of the key currency typically command higher interest rates compared to those associated with the key currency<sup>25</sup>.

Country risk<sup>26</sup> interest rates are divided into political risk and market risk. Political risk involves changes in regulatory conditions and sovereign default risk, while market risk includes exchange rate and interest rate fluctuations. Unlike illiquidity premiums, which are driven by liquidity preferences and are exogenous, country risk premiums have both exogenous and endogenous factors. The exogenous factors include the impact of a currency's peripheral status on market risk, influenced by exchange rate and interest rate volatility. As well, global economic conditions and changes in risk aversion can elevate both political and market risks across various countries.

The relationship between market liquidity and risk premiums in interest rates is not always negative, as some authors suggest. Arida, Bacha, and Lara-Resende (2004) argue that reforms in the legal framework of peripheral economies could reduce country risk and lower interest rates. While financial integration and reduced control might reduce political risk, increased market liquidity can encourage speculation, which is predominantly pro-cyclical in peripheral countries. This can amplify price fluctuations and market consensus, potentially reducing market risk during optimistic phases but exacerbating it during downturns. Consequently, country risk tends to become more cyclical, with lower political risk but higher market risk, especially related to exchange rates. Expected exchange rate fluctuations are driven by both external and internal factors, with market liquidity playing a key internal role. Increased market liquidity tends to heighten exchange rate volatility, undermining the reliability of future expectations and contributing to interest rate volatility.

Only some components of interest rates in peripheral countries, like risk premiums and

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<sup>24</sup> Essentially, the interest rate is determined by the country issuing the key currency in the international monetary system.

<sup>25</sup> Outlook similar to Brazil's, which stimulates discussion about monetary currency issues.

<sup>26</sup> Risk premiums are partly determined by the conditions of the national economy, with market liquidity being particularly important.

expected exchange rate variations, are linked to the national economy. The rest are influenced by the international monetary system and global liquidity preferences, beyond the reach of national policies. While peripheral countries share common traits, each has unique characteristics shaped by their specific economic institutions and policies. It is essential to distinguish between factors determined by the national economy and those influenced by the global economy to avoid ineffective or counterproductive measures. Importantly, the relationship between increased market liquidity and reduced risk premiums is not always straightforward, as greater liquidity can sometimes increase country risk and interest rates rather than reduce them (Conti *et al.*, 2014).

Monetary hierarchy typically results in higher interest rates for peripheral countries compared to central ones. This differential stems from structural factors, like the liquidity premium, and cyclical factors, such as risk premiums and expected exchange rate variations. The illiquid nature of peripheral currencies also leads to significant volatility in exchange and interest rates, complicating national economic policy. The institutional weaknesses and significant risk revaluation that accompanied the onset of the crisis halted the trend of increasing financial integration. Internationally, this led to a process of financial disintermediation, reversing capital flows and creating severe financing challenges for some Eurozone countries. Despite efforts to address their macroeconomic and financial imbalances, these countries continue to carry substantial net external debt, and significant fragmentation of bank interest rates persists across national borders. (De Sola Perea and Nieuwenhuyze, 2014).

Faced with the context surrounding financial integration, investigating its impact is relevant due to its usability, especially for macroeconomic policy or the instruments that accompany it. Claeys, Moreno, and Suriñach (2009) analyzed the relationship among fiscal policy, interest rates, and economic integration. They focused on the practice of governments financing public debt through bond issuance, which competes with private sector bonds for financing. As a result, this additional demand exerts upward pressure on interest rates, hindering private investment. Since financial markets are forward-looking, higher long-term rates may occur immediately, driven by the anticipation of future deficits.

Contrary to what mainstream macroeconomic theory suggests, international financial integration has led to an increase in the relative volatility of consumption compared to income in emerging markets (Leal, 2023; De Sola Perea and Nieuwenhuyze, 2014). Yamada (2023) developed a small open economy model with a lending constraint based on the interest coverage ratio. The results indicate that financial integration enhances consumption smoothing and mitigates income shocks. However, the global real interest rate significantly influences external debt limits. An increase in the real interest rate tightens the borrowing constraint, thereby reducing consumption.

Tang (2023) investigated the level of interest rate and financial market integration within China, finding a positive outlook for this trend. The study showed that as interest rates declined, commodity and capital flows increased, which stimulated financial development and reduced financial costs. Factors such as maturity, creditor type, and currency denomination were found to influence interest rates. To measure financial integration, a model is used that divides the assessment into (i) volume indicators and (ii) price indicators. The first measures international capital flows and the stock of cross-border financial assets, while the second examines the differences among risk-adjusted yields across various markets (De Sola Perea and Nieuwenhuyze, 2014).

### **3.2.4 BRAZILIAN RELATION AMONG FINANCIAL INTEGRATION, MONETARY HIERARCHY AND INTEREST RATES**

After the adoption of the inflation targeting regime, the interest rate became the primary policy instrument used by the Brazilian monetary authority to guide inflation toward the defined target. It is employed to balance demand with the level of economic activity and, consequently, to manage price pressures. This dynamic determines the stance of monetary policy - whether contractionary or expansionary (Carvalho, 2023). Numerous hypotheses have been proposed to explain the persistently high levels of interest rates, ranging from fiscal dominance to domestic savings (Favero; Giavazzi, 2002; Arida, Bacha; Lara-Resende, 2005; Netto, 2005; Barbosa, 2006; Pires, 2007; Goldfajn; Bicalho, 2011; Schwartsman, 2011; Segura-Ubiergo, 2012; Bresser-Pereira; Nakano, 2020). However, many of the causes are linked to financial characteristics and the credit market, such as country risk (Favero; Giavazzi, 2002; Goldfajn; Bicalho, 2011; Barbosa *et al.*, 2016).

The high level of interest rates has been a topic of discussion in Brazil, particularly regarding the design of national monetary policy<sup>27</sup>. This situation is partly justified in the literature as a standard occurrence in emerging economies, due to the greater need for foreign capital and the higher risk of default (Goldfajn; Bicalho, 2011; Barbosa *et al.*, 2016; Schulz, 2019). From 2015 to 2018, South Africa, Brazil, Indonesia, India, and Russia presented neutral interest rates higher than other countries. In contrast, the Eastern European nations showed lower levels over time (Schulz, 2019). Furthermore, Costa (2017) identifies the long-term interest rate as being influenced by the 10-year real interest rate in the USA and the risk premium. In that study, monetary policy was found to have no significant impact, with economic structural factors instead determining the real long-term interest rate.

Arida, Bacha and Lara-Resende (2005), shed light on the argument of jurisdictional uncertainty and inconvertibility of currency, which was subsequently analyzed with negative results by Gonçalves, Holland and Spacov (2007). Their findings indicated a correlation between Brazil's interest rate, inflation, and debt-to-GDP ratio. These results align with those of other authors (Garcia; Didier, 2000; Giambiagi, 2002; Figueredo; Ferreira, 2002; Garcia; Didier, 2003; Muinhos and Nakane, 2006; Goldfajn and Bicalho, 2011; Barbosa; Camêlo; João, 2016; Bresser-Pereira; Nakano, 2020).

Nevertheless, this is not the sole argument, as external economic activities<sup>28</sup>. Beyond that, there would be a permissive policy profile that attracts foreign capital by increasing interest rates, this, through international arrangements, facilitates foreign savings, which could compromise the economy as a whole. This concern is highlighted by several authors (Mondenesi, 2006; Paulani, 2013; Bresser-Pereira; Nakano, 2020), who attribute the elevated interest rates to a convention effect, or rent-seeking behavior. The central argument from this perspective is that other variables, particularly structural ones, exert minimal influence on interest rates. This was identified during Dilma Rousseff's first term, according Nader (2018). Arida, Bacha and Lara-Resende (2005) further contribute to the discussion with the concept of currency inconvertibility. This investigation is complemented by the financial integration theory in emerging economies, exploring how this integration can impact interest rates in Brazil.

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<sup>27</sup> See Favero e Giavazzi (2002).

<sup>28</sup> See Costa (2017).

The relationship between the Brazilian economy and the rest of the global economies occurs through financial globalization, which primarily allows for capital mobility between economies (Carneiro, 1999). According to De Sola Perea and Niaiwenyze (2014), this relationship is defined by national policies that permit cross-border capital movements. Financial integration<sup>29</sup> does not necessarily imply that the adopting country will experience unrestricted inflows and outflows of capital, nor does it determine the extent to which this will occur, as other variables, such as risk perception, influence behavior in the financial markets.

According Johnson (2015), in his review of the factors affecting Brazil's interest rate, the nominal interest rate can be divided into the real interest rate and inflation expectations. Some determinants influence the real interest rate, which reflects the current state of the economy and its historical context. Other determinants shape agents' expectations for the future, impacting interest rate levels. Barboza (2015) also recognizes this division in his analysis of the impediments to monetary policy transmission in Brazil and their effects on interest rates.

Moreover, determinants can be categorized based on their influence on "conjectural" versus "structural" or "natural" factors. Conjectural factors, which lack persistence and are tied to the current economic situation, can impact short-term interest rates. In contrast, structural factors, which are more persistent, influence long-term interest rates<sup>30</sup>. This distinction between conjectural and structural effects on interest rates is explored by Goldfajn and Bicalho (2011) and Gotlieb (2013).

In conclusion, the literature points to several factors contributing to the high level of Brazilian interest rates, which are complementary rather than contradictory. These factors can be integrated within the standard macroeconomic theory, differentiating between those that impact the real economy and those that influence the monetary side of interest rate determination, similar to the distinctions made in IS-LM models.

**Table 2.1** – Determinants of Brazilian interest rate level considering the Fisher equation components and their degree of persistence

Fisher Equation components		
	Real Interest Rate	Inflation Expectation
Degree of persistence	<b>Conjectural</b> Domestic and external macroeconomic fundamentals - Global interest rate level Monetary policy (ITR) design - Convention-effect	Domestic and external Macroeconomic fundamental
	<b>Structural</b> Size and structure of the Welfare- State - Investment crowding-out - Corruption - Rent-seeker bias - Discourage of savings Size and composition of the public Debt - Pre-fixed public debt on the SELIC rate (LFTs' Contagious- effect) - Pre-fixed public debt on foreign currency (US dollar) The developmental stage of the economy Credit market imperfections - Credit segmentation - Jurisdictional uncertainty - The absence of long-maturity credit market in Brazilian currency - Low levels of savings - Income inequality level	Lack of institutionalized instrumental independence by the BCB  Bad historical retrospect of defaults and hyperinflation  Persistence of indexation on administered prices

Source: Author's own elaboration based Rondina Neto (2018).

<sup>29</sup> See Baele *et al.* (2004).

<sup>30</sup> As the natural interest rate.

In the context of fiscal factors, fiscal dominance is a significant determinant of interest rate levels, particularly when considering the magnitude and structure of the Brazilian state and its public debt. This dominance has a substantial impact on the real economy and can contribute to elevated interest rates. On the monetary side, inefficiencies within monetary policy lead to heightened inflation expectations among economic agents, necessitating higher interest rates to offset these expectations. Furthermore, imperfections in the credit market represent another set of factors influencing the monetary aspects of interest rate determination. Additionally, alternative explanations are linked to the design and implementation of monetary policies or broader political economy issues. These determinants of the elevated interest rate levels in Brazil are summarized in Table 1.

Among the reforms adopted alongside the ITR in the 1990s was the macroeconomic tripod, many of which were motivated by the Washington Consensus and the wave of mainstream ideas spreading from central to emerging peripheral economies, particularly in Latin America. The objective was to promote financial integration, privatization, reduction of market barriers, and the avoidance of capital controls. The adoption of an international financing model centered on the issuance of fixed-income securities and equities led to a significant increase in foreign portfolio investments within the Brazilian financial market. Concurrently, domestic agents increasingly embraced new forms of external financing.

The integration process was not thorough, as certain segments were excluded, with the stock market emerging as the most accessible sector for foreign investors (Freitas e Prates, 2001).

Brazil's integration into the global financial system occurred under unfavorable macroeconomic conditions and fiscal challenges. In line with the strategy of opening up the economy, the measures implemented as part of the Real Plan, such as restrictive monetary policy, created an attractive environment for foreign investors by offering high financial returns through elevated interest rates. The exchange rate anchor was employed as a strategy to stabilize prices, contributing to the control of the inflationary process that Brazil was facing. However, this led to currency appreciation, resulting in successive current account deficits. The interest rate hikes were used to balance the payments and maintain the inflow of foreign investments (Prates, 2002).

Leal (2023) summarized some relevant facts over time, the government's actions facilitated a significant liberalization of Brazil's capital account by removing bureaucratic hurdles and allowing residents to transfer larger sums abroad. Prior to the 1970s, Brazil tightly controlled capital flows, but in 1996, these restrictions were eased to accommodate the interests of international financial investors. This financial liberalization accelerated throughout the decade, with remaining barriers gradually dismantled, enabling foreign investors to gain unrestricted access to Brazil's financial markets. The bulk of portfolio investments flowed into the secondary stock market, while the issuance of fixed-income securities by financial institutions abroad supported the banking credit market. However, this opening of the financial sector also resulted in an increase in external liabilities, thereby increasing Brazil's external vulnerability.

Overall, Brazil's high degree of financial integration and its subordinate position in the international financial system undermined the potential for greater autonomy in monetary, fiscal, and exchange rate policies, even under a floating exchange rate regime. As a result, has highlighted the fragility of the domestic macrostructure, hampering economic growth and reducing policy space. The use of high-interest rates to attract foreign capital also led to currency appreciation. The resulting current account deficits made the Brazilian economy more vulnerable to external shocks.

Consequently, Brazil faced challenges as it entered the global financial system with a deregulated capital account and the adoption of a liberalizing agenda.

### 3.3 DETERMINANTS OF INTEREST RATES IN BRAZIL: METHOD AND MODEL SPECIFICATIONS

This section discusses the structure and specification of the VEC used to analyze the determinants of interest rates in Brazil and comparable economies. Below, the method, variables, and their justification are presented, along with the proposed model, aiming to understand the effect of each variable on the domestic interest rate.

#### 3.3.1 VECTOR ERROR CORRECTION MODEL

According to Mills (2008, 2015) the VEC is an extension of the VAR that incorporates cointegration among time series variables. When variables in a time series are cointegrated, it indicates that they have a stable long-term relationship, even though they may deviate from this relationship in the short term. The VEC model allows for modeling both short-term dynamics and adjustments toward the long-term equilibrium.

The VAR is the most used in the literature for analyzed similar investigations, as seen Borensztein, Zettelmeyer and Philippon (2001), Kim (2001), Canova (2005), Mackiwiak (2007), Dedola *et al.* (2017), Georgiadis (2016), Iacoviello and Navarro (2019), and Rondina Neto and Oliveira (2022). Conversely, Clarida, Galí, and Gertler (1997), along with Barbosa, Camêlo, and João (2016), proposed analyses based on GMM estimation to understand the monetary policy reaction functions of central banks. Fonseca, Peres, and Araujo (2016) developed a methodology similar to the present study, estimating a VEC model for countries that have adopted an ITR.

This model is derived from the concept that when the long-run matrix  $\Pi$  is singular, but not null ( $\Pi \neq 0$ ), the variables are cointegrated. In such cases,  $\Pi$  can be decomposed into two matrices  $\alpha$  and  $\beta$ , which  $\Pi = \alpha\beta'$ . The matrix  $\alpha'$  contains the  $r$  linearly independent rows of  $\Pi$  allowing  $\Pi$  to be expressed as a linear combination of these rows, with  $\beta$  as the coefficient matrix. These rows, known as cointegrating vectors, reduce the number of unit roots in  $\Pi$  to  $n-r$ , rather than the  $n$  unit roots present if  $\Pi = 0$ .

The rows of  $\alpha'$  are known as cointegrating vectors because, when post-multiplied by  $\Delta y_t$  they produce linear combinations of  $y_t$  that are stationary. Since  $y_t$  is assumed to be integrated of order I(1), its first difference  $\Delta y_t$  is stationary I(0). For the equation to balance,  $\alpha_1 y_t, \dots, \alpha_r y_t$ , must also be stationary I(0). Thus, the  $r$  linear combinations of  $\Delta y_t$  formed by the rows of  $\alpha'$  are stationary, making them the cointegrating vectors.

$$\Delta y_t = c + \Phi(\beta)\Delta y_{t-1} + \beta\alpha'y_{t-1} + u_t \quad (1)$$

If  $y_t$  is cointegrated with a cointegration rank of  $r$ , it can be expressed as a VEC. In this model, the changes in  $y_t$  are influenced by the past deviations from the long-run equilibrium, represented by the term  $e_t = \alpha'y_t$  which consists of the  $r$  stationary error corrections. This formulation is known as Granger's Representation Theorem, which generalizes the concept of error correction from a univariate to a multivariate framework.

$$\Delta y_t = c + \Phi(\beta)\Delta y_{t-1} + \beta e_{t-1} + u_t \quad (2)$$

There are some important points to note regarding the parameter matrices  $\alpha$  and  $\beta$  in the VEC. These matrices are not uniquely identified because different combinations can yield the same long-run matrix  $\Pi$ . If the cointegration rank  $r=0$ , the model simplifies to a VAR in first differences. If  $r=n$ ,  $\Pi$  is full rank, and  $y_t$  is stationary, making a VAR in levels suitable. The stationary error corrections  $e_t$  can influence the growth in  $y_t$  along with any constant or trend in the model, which affects estimation and inference.

To Arrive at equation (2), the first step involves applying a restriction that simplifies the model to a VAR( $p-1$ ) in the first differences of  $\Delta y_t$  which is estimated using OLS. This produces residuals,  $u_t$ , from which the sample covariance matrix is calculated. The subsequent step concentrates on estimating the multivariate regression to identify the cointegration relationships.

$$\Delta y_{t-1} = d + \sum_{i=1}^{p-1} \Xi_i \Delta y_{t-i} + v_t \quad (3)$$

Calculating the covariance matrices from OLS residuals  $\hat{v}$ , we reach equations (4) and (5).

$$\mathbf{S}_{11} = T^{-1} \sum_{i=1}^T \Xi_i \hat{v}_t \hat{v}'_t \quad (4)$$

$$\mathbf{S}_{10} = T^{-1} \sum_{i=1}^T \Xi_i \hat{u}_t \hat{v}'_t = \mathbf{S}'_{01} \quad (5)$$

In this process, two regressions are performed to isolate the effects of  $\Delta y_{t-i}, \dots, \Delta y_{t-p+1}$  from  $\Delta y_t$  and  $\Delta y_{t-1}$ , allowing the focus to be on the relationship between  $\Delta y_t$  and  $\Delta y_{t-1}$  which is parameterized by  $\beta a'$ . The matrix  $a$  is then estimated by identifying the  $r$  linear combinations of  $\Delta y_{t-1}$  that have the largest squared partial correlations with  $\Delta y_t$ . This is referred to as reduced rank regression.

This procedure maximizes the likelihood of the model by solving a system of equations expressed as in equation (6).

$$(\lambda_i \mathbf{S}_{11} - \mathbf{S}_{10} \mathbf{S}_{00}^{-1} \mathbf{S}_{01}) v_i = 0 \text{ for } i = 1, \dots, n. \quad (6)$$

Where  $\lambda_1 > \lambda_2 > \dots > \lambda_n$  are the eigenvalues, and  $V = (v_1, v_2, \dots, v_n)$  contains the corresponding eigenvectors, subject to the normalization  $V' \mathbf{S}_{11} V = I_n$ .

The maximum likelihood (ML) estimate of  $a$  is determined by the eigenvectors associated with the  $r$  largest eigenvalues, as posed by equation (7).

$$a = (v_1, v_2, \dots, v_r) \quad (7)$$

Subsequently, the ML estimate of  $\beta$  is calculated as evidenced in equation (8).

$$\beta = \mathbf{S}_{01} a \quad (8)$$

This estimate of  $\beta$  is equivalent to the one obtained by substituting  $a$  into the model and using OLS, which also yields ML estimates for the other parameters. In practice, the cointegrating rank  $r$  is typically unknown and needs to be determined. The set of equations used in ML estimation provides a method to identify the value of  $r = n$  and the matrix  $\Pi$  is unrestricted, the maximized log likelihood can be calculated, and for  $r < n$ , only the first  $r$  eigenvalues will be positive.

The likelihood ratio test for determining the number of cointegrating vectors  $r$  involves testing the hypothesis that there are  $r$  cointegrating vectors against the alternative that there are  $\eta$  vectors. This test is performed using trace statistics, which is calculated as in equation (9).

$$\eta_r = -T \sum_{i=r+1}^n \log(1 - \lambda_i) \quad (9)$$

Where  $\lambda_i$  are the eigenvalues, and  $T$ , is the sample size. The testing process proceeds sequentially, starting from  $r = 0$  up to  $r = n-1$ . The cointegrating rank  $r$  is chosen based on the last significant statistic  $\eta_{r-1}$  which rejects the hypothesis of  $n - r + 1$  unit roots in the matrix  $\Pi$ . An alternative test is the maximal-eigenvalue or  $\lambda$ -max statistic, which focuses on the significance of the largest eigenvalue and is given by equation (10).

$$\zeta_r = -T \log(1 - \lambda_{r+1}), \quad r = 0, 1, \dots, n - 1 \quad (10)$$

Both the trace statistic  $\eta_r$  and the  $\lambda$ -max statistic  $\zeta_r$  follow non-standard limiting distributions that generalize the Dickey-Fuller unit root distributions. These distributions depend on the number of variables  $n$  and the restrictions imposed on the constant and trend components in the VEC. If the model includes a linear trend, both the estimation and testing procedures must account for the trend and any restrictions on the constant and trend terms.

Through this model, the development of the Brazilian economy can be understood under the assumption that there are no changes in currency dynamics. Furthermore, impulse-response and variance decomposition analyses were applied to enhance the understanding of the effects of some important variables on the interest rate, according to literature, identifying which of them have the most significant impact in justifying the level of that rate.

### **3.3.2 MODEL SPECIFICATION**

The VEC was used to examine the relationship between variables considered determinants for their impact on the interest rate in Brazil and each selected country, thus building a comparative framework. The choice of this model for the study is due to the presence of cointegrated variables in the dataset, despite their non-stationary nature. Considering the period from 1999 to 2023, the dependent variable in the model is the real interest rate, reflecting the behavior of the domestic interest rate.

The period selected for this analysis begins after the implementation of the ITR in Brazil, as this policy shift marked a structural change in the conduct of monetary policy and institutional behavior. Brazil adopted the ITR in 1999, and prior to this transition, both institutional frameworks

and macroeconomic dynamics differed significantly, leading to data inconsistencies. The analysis extends until 2023, covering a 25-year period. The selection of this time frame was guided by statistical tests that compared different sample lengths. The final selection of the time frame was determined based on the significance of the results and the constraints imposed by the available number of observations. Additionally, despite the limitations associated with the time span required for the VEC, the chosen period was the most appropriate according to the literature.

The variables employed in the model include the global interest rate, exchange rate, inflation, GDP growth, and domestic interest rate, as seen in Table 2.2, with their ordering following the exogenous-to-endogenous structure typically applied in a model. The selection of variables in both models was guided by the literature reviewed in the second section, as well as Barbosa; Camêlo; João (2016) and other authors previously cited. All variables were annualized, and the domestic interest rate was specified as the dependent variable, as the objective of this analysis is to examine the impact of these factors on the domestic interest rates level.

**Table 2.2-** Description of Model Variables.

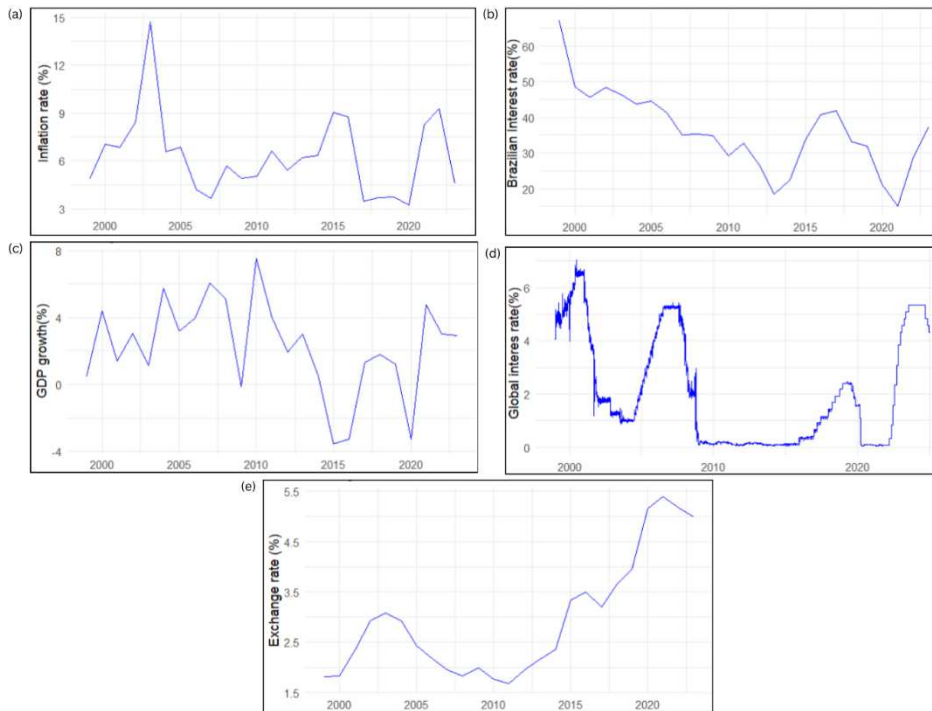
Variable	Period	Database
Global interest rate	1999 to 2023	Federal Reserve Economic Data
Exchange Rate	1999 to 2023	World Development Indicators
Inflation	1999 to 2023	World Development Indicators
GDP growth	1999 to 2023	World Development Indicators
Real interest rate	1999 to 2023	World Development Indicators

Source: Author's own elaboration.

The data utilized were obtained from the World Development Indicators (WDI) and the Federal Reserve Bank of St. Louis (FRED). The software used was R Studio. All variables were analyzed in their standard form rather than in logarithmic transformation, as they exhibited statistical adequacy in their original scale. To assess the absence of unit roots and ensure the appropriate econometric specification, stationarity tests were conducted using the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979, 1981) and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test (Kwiatkowski *et al.*, 1992). Both tests serve complementary purposes: the ADF test evaluates the null hypothesis of a unit root (non-stationarity), while the KPSS test assumes stationarity under the null hypothesis.

The figure 3.1 illustrates the behavior of the series over time, providing a visual representation of their dynamics. The graph highlights the lack of stationarity in each variable, facilitating a better understanding of their individual trends.

**Figure 2.1** - (a) Inflation rate time series behavior. (b) Domestic interest rate time series behavior. (c) GDP growth time series behavior. (d) Global interest rate time series behavior. (e) Exchange rate time series behavior.



Source: Author's own elaboration

The results, as well as the behavior of the series seen in Figure 3.1, indicated that the variables required first-difference transformation to achieve stationarity, ensuring robust statistical inference, aligned with the necessity of stationarity in time series models to prevent spurious regressions<sup>31</sup>. Consequently, the variables were differenced before proceeding with the econometric modeling.

### 3.4 VEC MODEL: RESULTS AND ANALYSIS

The Johansen cointegration test was conducted to examine the long-term equilibrium relationship among the variables included in the model. The application of this test is justified by the presence of non-stationary variables in levels that become stationary after first-differencing, allowing for the possibility of a cointegrating relationship<sup>32</sup>. Table 2.3 presents the results of the cointegration test for the variables to Brazil, providing statistical evidence on the existence and number of cointegrating vectors within the system.

**Table 2.3** - Johansen Cointegration Test.

Cointegrating Relationships	Test Statistic	Critical Value (5%)	P-Value
$r \leq 4$	2.565971	9.24	> 0.05
$r \leq 3$	16.745281	19.96	> 0.05
$r \leq 2$	33.339479	34.91	> 0.05
$r \leq 1$	73.053332	53.12	< 0.05
$r = 0$	129.035725	76.07	< 0.05

Source: Author's own elaboration

<sup>31</sup> Woodridge (2010) and Greene (2012).

<sup>32</sup> Johansen (1988) and Johansen and Juselius (1990).

According to the trace statistic, the null hypothesis was rejected at the 5% significance level, confirming the existence of two stable long-term relationships among the selected variables. This result supports the application of a VEC, which is suitable for capturing both short-term dynamics and long-term equilibrium relationships inherent in the system. After establishing cointegration, the optimal lag length was determined using multiple selection criteria: AIC (Akaike Information Criterion), HQ (Hannan-Quinn Criterion), SC (Schwarz Criterion), and FPE (Final Prediction Error). All criteria consistently suggested a lag length of 3, further validating the robustness and reliability of the selected lag structure for the model, a recommendation followed in the present paper.

Table 2.4 presents the estimated parameters of the VEC for long-term relationships. The results enhance the significance of the global interest rate in long-term equilibrium. The relationship between global and domestic interest rates was negative. An increase in global interest rates led to a decline in domestic interest rates, reflecting a dampening effect of external financial conditions on the domestic monetary policy. This inverse relationship aligns with the argument that higher global interest rates may reduce capital inflows to emerging economies, impact the domestic interest rate to maintain macroeconomic stability. In the second equation, the negative coefficient associated with the domestic interest rate indicated that an appreciation of the exchange rate<sup>33</sup> (a lower exchange rate value) led to a decline in domestic interest rates over the long run. Finally, the third equation allows for an analysis of the impact of inflation on domestic interest rates. The negative coefficient indicated that higher domestic interest rates contribute to reducing inflation over time, reinforcing the effectiveness of monetary policy in controlling price levels.

**Table 2.4** - Estimated Parameters of the VEC Model for Long-Term Relationships.

<b>Cointegration Eq</b>	<b>CointEq1</b>	<b>CointEq2</b>	<b>CointEq3</b>
Global interest rate	1.000000	0.000000	0.000000
Exchange rate	-0.000000	1.000000	0.000000
Inflation	0.000000	0.000000	1.000000
GDP	0.100925	0.690992	-0.063974
Domestic Interest Rate	-0.741391	-0.429574	-0.204614
Constant	-0.032157	-0.092502	-0.082366

Source: Author's own elaboration

In the long run, the negative relationship between domestic and global interest rates highlighted the impact of financial integration under the monetary hierarchy theory. The inverse relationship between global and domestic interest rates suggests a nuanced dynamic where external financial tightening can alleviate domestic rate pressures through capital flow adjustments, either by stimulating the domestic economy or by utilizing internal reserves. When global interest rates rise, domestic rates tend to fall. In the literature, this behavior is justified in emerging economies, such as Brazil, as they adjust their monetary policy strategically to maintain economic stability, often leveraging exchange rate dynamics, capital flow management or domestic policy tools to neutralize external financial shocks. The long-term cointegration between exchange rates and GDP reinforced the connection between economic activity and exchange rate valuation. An appreciation of the exchange rate was associated with higher value-added economic activity. Additionally, the

<sup>33</sup> It is important to note that the exchange rate follows the Brazilian standard, represented by the R\$/US\$ ratio.

negative relationship between inflation and interest rates aligns with the literature on ITR, where higher domestic interest rates contributed to reducing inflation over time.

The short-term dynamics of the estimated model, as presented in Table 2.5, illustrate the impact of various factors on the domestic interest rate. The global interest rate influenced the domestic rate in the same direction, meaning that when global interest rates rose, domestic interest rates followed a similar trend. In the initial period, that effect was strong, but it gradually diminished over time, the influence of global rates was immediate but dissipates in subsequent periods. Similarly, the exchange rate exhibited a positive relationship with the domestic interest rate. An increase in the exchange rate led to a rise in domestic interest rates, likely as a response to counteract inflationary pressures resulting from currency depreciation. However, in the second period, the impact became more rigid, indicating a more persistent influence on domestic monetary conditions.

**Table 2.5** - Estimated Parameters of the VEC Model for Short-Term Relationships.

<b>Coefficients</b>	<b>Global interest</b>	<b>Exchange rate</b>	<b>Inflation</b>	<b>GDP</b>	<b>Domestic Interest rate</b>
Ect1	-0.557873	0.665712	-0.836861	-0.329599	-0.249378
Ect2	-0.282672	-0.464915	1.233090	-0.265498	2.207349
Ect3	1.044896	-0.931830	-3.597091	1.260204	-3.016475
Global interest rates (1)	0.174515	-0.026259	-0.506626	0.100499	0.153250
Exchange rate (1)	0.675070	-1.018752	1.301405	0.224679	0.957094
Inflation (1)	-0.113840	-0.100171	-2.165571	0.321717	-0.733342
GDP growth (1)	0.280200	-0.179715	1.027179	-0.453098	0.758592
Dom. Interest rate (1)	0.308225	-0.131554	0.128065	0.244379	-0.532818
Global interest rates (2)	-0.84976	-0.169244	-0.599289	0.185563	0.079063
Exchange rate (2)	-0.889460	-0.191797	1.700048	-0.853690	1.660840
Inflation (2)	0.403638	-0.546284	-3.284217	0.910786	-1.999128
GDP growth (2)	-0.908266	0.343012	1.193261	-1.181952	1.460691
Dom. Interest rate (2)	0.324415	-0.008747	0.422131	-0.150705	-0.877989

Source: Author's own elaboration

On the other hand, the inflation rate demonstrated that the monetary authority reacted to rising inflation by increasing interest rates, particularly in the second period. In the first period, inflation did not appear to have an immediate effect on interest rates, perhaps that monetary policy responded to inflation persistence rather than reacting preemptively. GDP growth had a consistent positive effect on domestic interest rates in both periods, indicating a countercyclical monetary policy aimed at mitigating inflationary pressures from economic expansion. This behavior was particularly relevant given the literature's discussion on the inefficiency of using interest rates to regulate inflation. In this case, the expected effect did not materialize, as inflation was not driven by excess demand, but rather by cost-related factors probably.

After conducting the impulse response analysis, the model was evaluated, and the results are presented in Table 2.6. The diagnostic tests confirmed that the model met the necessary requirements. There was no evidence of serial correlation or heteroscedasticity in the residuals, and the normality assumption was not violated. Therefore, the model is statistically robust.

**Table 2.6** - VEC Model diagnostics.

<b>Test</b>	<b>Statistic</b>	<b>Degrees of Freedom</b>	<b>P value</b>
Serial Correlation (BG Test)	105.0000	125	0.9026
Normality (Jarque-Bera)	12.2120	10	0.2711
Skewness	6.3599	5	0.2728
Kurtosis	5.8524	5	0.3208
Heteroskedasticity (ARCH Test)	270.0000	675	1

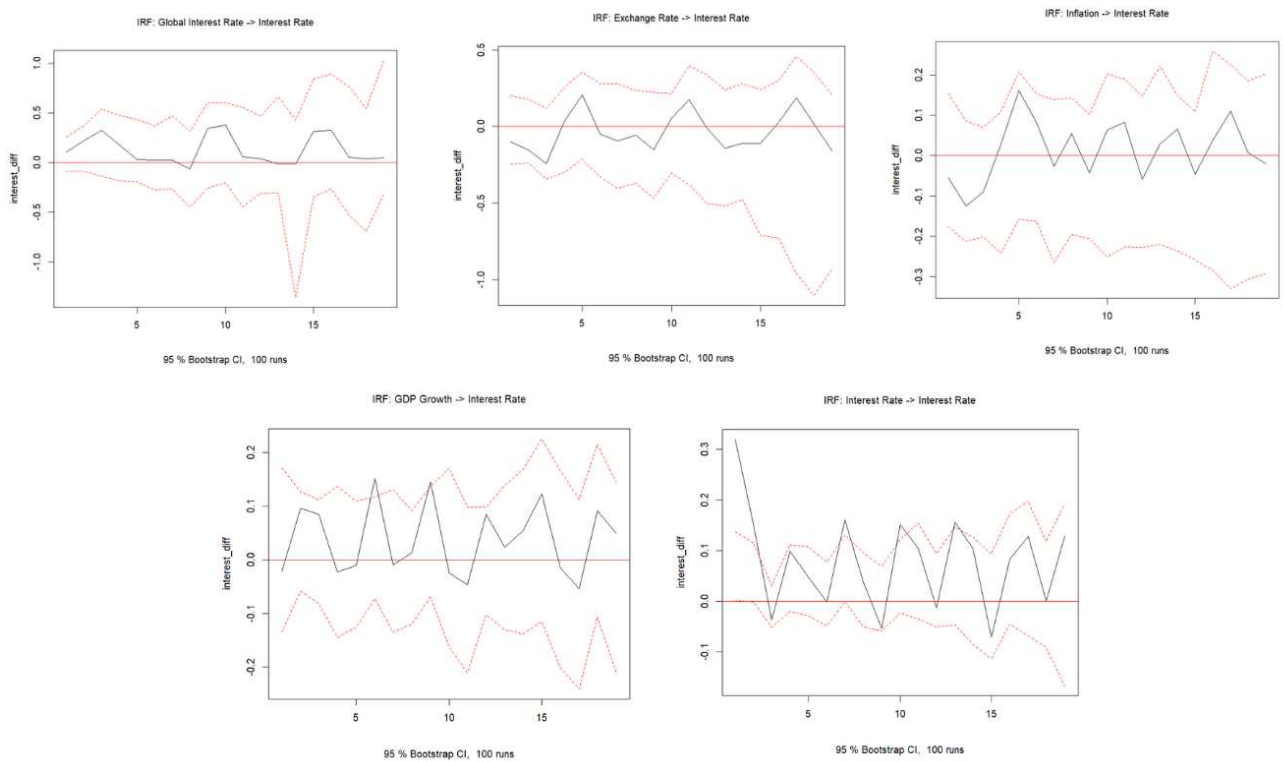
Source: Author's own elaboration

The structural dynamics of the transmission mechanism in a VAR are captured through impulse response functions (IRFs) and the variance decomposition of forecast errors. In this study, the trace IRF was used, which tracks the effect of a single instantaneous shock in a specific variable and analyzes how it impacts the current and future values of the domestic interest rate. Unlike the accumulated IRF, which assesses the effects of cumulative shocks over time, the trace IRF focuses on the direct and isolated impacts of a single shock over time, similar to the approach used by Biage, Correa, and Neder (2008).

The IRFs allowed the study of how a shock in key variables, such as the global interest rate, exchange rate, inflation, and GDP growth, affects the domestic interest rate over time. They make it possible to identify the behavior of the domestic interest rate in response to specific shocks and analyze the intensity and persistence of these impacts. Meanwhile, the variance decomposition of forecast errors complements this analysis by evaluating the relative importance of each variable in driving movements in the domestic interest rate, indicating how much of the variation in the interest rate can be explained by shocks in other variables within the model.

It is worth noting that a shock in a variable, such as the exchange rate or inflation, not only directly affects the domestic interest rate but can also generate indirect effects over time through the interrelationships among the model's endogenous variables. This transmission occurs via the model's dynamic structure, allowing for a better understanding of how shocks propagate and influence monetary policy.

Therefore, the IRF results presented below demonstrate how shocks in macroeconomic variables impact the domestic interest rate over time and determine the interest rate dynamics in the estimated VEC model. The analysis of the impulse-response function using the Cholesky decomposition over an 18-month horizon allowed an investigation of how shocks to each independent variable affect the SELIC interest rate. In Figure 3.2, it is possible to the domestic interest rate's response to shocks in each of the analyzed variables.

**Figure 2.2:** Impulse Response Functions.

Source: Author's own elaboration

Based on Figure 3.2, it was observed that a shock to the global interest rate had an immediate positive impact on the domestic interest rate. While this impact diminished over time, it remained positive, indicating that domestic monetary policy closely aligns with external conditions. In the case of the exchange rate, a shock resulted in a significant initial increase in the domestic interest rate. Although this positive effect progressively declined, it suggests efforts to contain inflationary pressures arising from potential currency depreciation. The positive relationship between these variables reflects actions aimed at achieving economic stability.

In the short term, the impact of inflation on the domestic interest rate was initially less pronounced but quickly became positive. This likely reflects a monetary policy response to rising inflation, consistent with inflation-targeting theories. Meanwhile, shocks to GDP growth caused an immediate positive impact on the domestic interest rate, indicating the implementation of countercyclical policies to prevent economic overheating and curb inflationary pressures driven by increased demand. Finally, an initial shock to the domestic interest rate itself led to a significant immediate increase, followed by fluctuations over time.

**Table 2.7** - Variance decomposition of interest rate

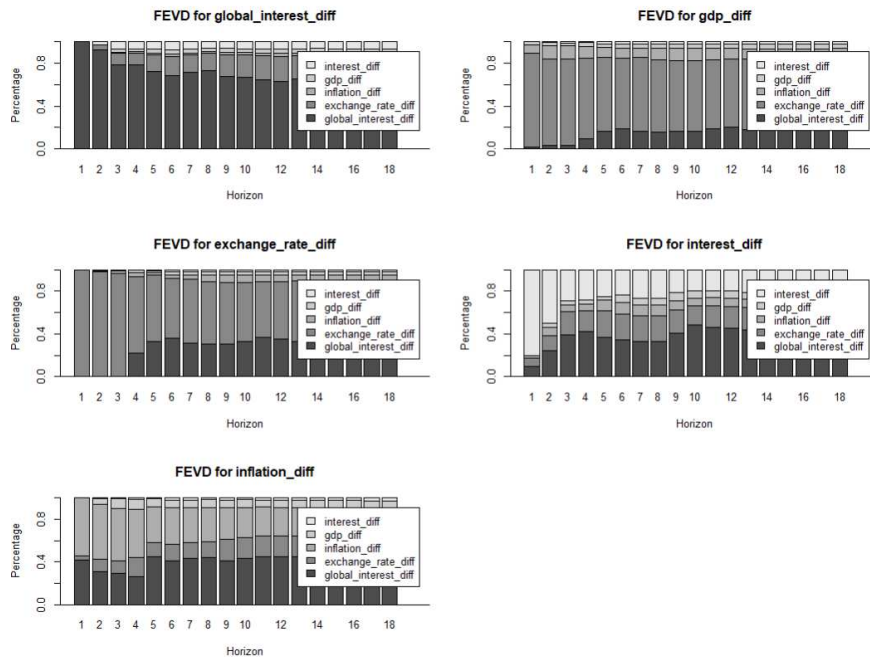
<b>Period</b>	<b>Global interest</b>	<b>Exchange rate</b>	<b>Inflation</b>	<b>GDP</b>	<b>Domestic Interest rate</b>
1	0.09331651	0.07797493	0.02356948	0.003623952	0.8015151
2	0.24746973	0.13703179	0.07481470	0.039284970	0.5013988
3	0.39017863	0.21656143	0.06193372	0.039429242	0.2918970
4	0.42198447	0.19832667	0.05784988	0.036768910	0.2850701
5	0.36788457	0.25081649	0.09741623	0.032149585	0.2517331
6	0.34819355	0.24103800	0.10318970	0.070083740	0.2374950
7	0.32864652	0.24119814	0.09822832	0.066138140	0.2657889
8	0.32887952	0.24152681	0.10112157	0.065211145	0.2632610
9	0.40879381	0.21934375	0.08221291	0.077941876	0.2117077
10	0.48273759	0.18335588	0.07164244	0.064620489	0.1976436
11	0.46014109	0.20427042	0.07447836	0.063223704	0.1978864
12	0.45606972	0.20194034	0.07696603	0.069375050	0.1956489
13	0.43687293	0.21177573	0.07447087	0.066942393	0.2099381
14	0.42504174	0.21689040	0.07631576	0.067824018	0.2139281
15	0.45963621	0.20318790	0.06977254	0.072495637	0.1949077
16	0.49847211	0.18645654	0.06497283	0.066514896	0.1835836
17	0.47627498	0.20204518	0.07029268	0.065286063	0.1861011
18	0.47388119	0.20080750	0.06983593	0.070678121	0.1847973

Source: Author's own elaboration

The variance decomposition shows the proportion of variations in the domestic interest rate that can be attributed to shocks in endogenous variables over time. In the initial periods, shocks in the global interest rate explained a relatively small share of the variance in the domestic interest rate (approximately 9.33% in the first period). Over time, this influence increased, reaching around 49.84% in the sixteenth period and stabilizing at approximately 47.39% in the eighteenth period. Shocks in the exchange rate accounted for about 7.80% of the variance in the first period, gradually increasing to approximately 24.15% in the eighth period and stabilizing at around 20.08% in the eighteenth period.

Inflationary shocks initially contributed marginally (about 2.36% in the first period) to the variance in the domestic interest rate, increasing to approximately 10.32% in the sixth period and stabilizing at around 6.98% in the eighteenth period. The contribution of GDP growth to the variance in the domestic interest rate started low, at 0.36% in the first period, and gradually increased to about 7.25% in the fifteenth period. Shocks in the domestic interest rate itself explained the majority of its variance in the early periods, with around 80.15% in the first period. Over time, this proportion significantly declined to approximately 18.47% in the eighteenth period, as the contributions of other variables, particularly the global interest rate and the exchange rate, became more pronounced, as seen in Figure 2.3.

**Figure 2.3:** Error variance decomposition for VECM variables.



Source: Author's own elaboration

The behavior of the variables reinforced the significance of external factors, particularly the global interest rate, in determining the dynamics of the domestic interest rate in an open economy like Brazil. Exchange rate fluctuations also exerted significant influence, reflecting a possible monetary policy response to external and inflationary pressures. Although inflation and GDP growth had moderate initial impacts, their influence gradually increased over time.

### 3.5 CONCLUDING REMARKS

This study evaluated the determinants of domestic interest rates in Brazil investigating the factors of the influence of financial integration and their impacts on the rates. Using a VEC model for the period from 1999 to 2023, the research provided empirical evidence on the short- and long-term relationships between domestic interest rates and other variables, including global interest rates, exchange rates, inflation, and GDP growth, according to the literature and relevant components.

The findings underscored the role of external factors, particularly global interest rates, in shaping the dynamics of Brazil's domestic interest rates, as noted in the literature. The inverse relationship between global and domestic interest rates, especially over the long term, highlighted the degree of financial integration and Brazil's exposure as a developing economy to external financial conditions. This result aligns with the monetary hierarchy theory, which emphasizes the susceptibility of emerging economies to shifts in global monetary policy.

A key contribution of this study is the empirical confirmation of the functioning of Brazil's ITR, demonstrating how the central bank strategically adjusts domestic interest rates not only in response to inflation and economic activity but also by incorporating global interest rates as an additional element in the Taylor rule framework. By integrating global interest rates into the domestic interest rate setting, the central bank effectively aims to mitigate inflationary pressures, particularly when external financial tightening could exacerbate domestic vulnerabilities.

The need for the economy to manage external shocks while maintaining price stability was analyzed, since theoretical explanations are broad and cyclical factors exert significant pressure. The results exposed the dual challenges faced by emerging economies, demonstrating both their vulnerability to external conditions and a potential for strengthening domestic behavior to change the expectations regarding the Brazilian economy, for instance.

Inflation and GDP growth also influenced domestic interest rates, though their impact was less pronounced compared to global interest rates and exchange rates. These results indicated that domestic interest rates responded to rising inflation, particularly over longer horizons, aligning with Brazil's inflation-targeting framework. Moreover, the positive relationship between GDP growth and domestic interest rates can suggest a countercyclical monetary policy aimed at mitigating inflationary pressures during periods of economic expansion. Thus, the results underscore the importance of strengthening structural factors to enhance their role in interest rate determination. However, this study does not propose reducing the relationship with developed economies but rather emphasizes the need for internal development through economic growth, reinforcing the significance of domestic components in shaping interest rate dynamics.

In conclusion, the results of this study underscore the challenges faced by emerging economies such as Brazil in navigating a highly integrated global financial system. The analysis demonstrated the importance of balancing external dependencies while advancing domestic objectives of price stability and economic growth. Future research should further examine the interplay between external and domestic factors by comparing economies that have adopted inflation targeting regimes, extending the analysis to a broader set of developing countries.

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#### 4 CONCLUDING REMARKS

This dissertation analyzed the determinants of long-term interest rates in Brazil, focusing on how internal and external factors influence monetary policy in an emerging economy. Through a bibliometric analysis and empirical estimation using a VEC model, the research provided understanding into the short- and long-term dynamics of domestic interest rates, emphasizing the roles of financial integration and global monetary conditions.

The first essay mapped the literature on interest rate components in Brazil, identifying key determinants such as country risk, jurisdictional uncertainty, and semi-fiscal dominance. This analysis highlighted persistent factors contributing to Brazil's historically high interest rates and uncovered potential biases within existing studies. The second essay advanced this discussion by empirically demonstrating the significant influence of global interest rates on domestic rates, revealing the strategic role of global interest rates in Brazil's monetary policy framework. The findings indicated that Brazil's central bank incorporates global interest rates as an additional parameter in the domestic interest rate rule, effectively augmenting the Taylor Rule to enhance inflation control within the ITR.

A key contribution of this research is the empirical validation that global interest rates act not only as external shocks but as integral elements of Brazil's monetary policy rule. This incorporation enables the central bank to adjust domestic rates strategically, mitigating inflationary pressures through a forward-looking approach that aligns with the monetary hierarchy theory. The results suggest that including global interest rates as a component of the domestic monetary policy rule can improve macroeconomic stability, particularly during periods of global financial tightening. Future research could expand this framework to other emerging economies, contributing to the broader discussion on the integration of external monetary conditions into domestic policy rules.

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