INTEREST RATES AND CAPITAL ACCUMULATION REGIMES IN BRAZIL

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ABSTRACT

This study seeks to identify the accumulation regime for the Brazilian economy in the post-stabilization period, based on variations of interest rate indicators. Using monetary extensions of post-Kaleckian growth and distribution models, three accumulation regimes are derived, depending on the reactions of the rates of capital accumulation, capacity utilization, and profit to variations in the interest rate. In order to identify the accumulation regimes, an empirical exercise is conducted through the estimation of Vector Error-Correction Models (VECM). The analysis of the impulse-response functions indicates the prevalence of contractive accumulation regimes.

Keywords: Accumulation Regime; Brazilian economy; Profit rate; Interest rate.
JEL: O4; O11; B5

1. Introduction

The view of the New Consensus Macroeconomics (NCM) regarding monetary policy invariably embraces the notion of money neutrality in the long run. This notion dictates that monetary policy and the interest rate only have temporary real effects on output and employment in the face of nominal rigidities, not interfering with their long-run equilibrium. This idea is challenged by heterodox traditions, such as the post-Keynesian and the neo-Kaleckian, which adhere to Keynes's (1933) research program of a monetary theory of production. According to this view, monetary policy and interest rate changes have both short and long-term real effects.

However, as pointed out by Hein (2014), even though monetary analysis has acquired a central role in Keynesian thought, the first post-Keynesian growth models systematically ignored the effects of monetary variables in their equilibrium solutions. It was only in the second half of the 1980s and throughout the 1990s that these models actually adhered to the program of a monetary theory of production, with the works of Taylor (1985), Dutt (1989), Lavoie (1993, 1995), and Hein (1999), among others. The introduction of monetary variables into these growth and distribution models consisted, initially, on the integration of the interest rate in the capital accumulation function.

Lavoie (1995) was one of the first to incorporate interest rate effects into an accumulation function based on Bhaduri and Marglin (1990). Building on Lavoie (1995), Hein (2007) showed that interest rate variations can also have positive effects on accumulation, be it through their distributive impact on profits (between rentiers and firms) or through their impact on functional income distribution. Likewise, Hein's

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(2007) model admits several equilibrium solutions for the rates of capacity utilization and profit with respect to exogenous variations in the interest rate.

This paper uses the theoretical framework of neo-Kaleckian models to investigate the current accumulation regime in the Brazilian economy in the post-stabilization period. During this time, the Brazilian economy went through different monetary policy frameworks – initially based on an exchange rate anchor and, later, on inflation targeting – which prioritized the stabilization of price levels, as prescribed by the NCM. Even though the inflation targeting regime (ITR) has undergone occasional flexibilizations since the first decade of the 2000s, this regime remains the guiding practice of the monetary policy carried out by the Brazilian Central Bank to this day.

The analysis of this monetary policy framework suggests that not only has it not been effective in its goal of stabilizing inflation, but that it has also not contributed positively to economic growth (Arestis et al., 2009; Nassif, 2015). When it comes to economic growth in particular, Bresser-Pereira *et al.* (2019) suggest that such policy framework has contributed to the stagnation of gross fixed capital formation in Brazil as it has exacerbated the liquidity preference of capital holders. Empirical evidence supports the idea that this stagnation has made income distribution in Brazil even more unequal, with a rise in interest income and lower levels of public investment (Bruno; Caffé; 2015). Furthermore, the monetary policy implemented during the post-stabilization period is often associated with the phenomenon of financialization and with its deleterious impacts on capital accumulation (Bruno et al., 2011).

Taking these trends into account, this paper aims to identify the accumulation regime in the Brazilian economy in the post-stabilization period, based on interest rate variations. Following Hein's (2007) monetary extension of a post-Kaleckian model, the possibility of three accumulation regimes is raised, based on reactions of the equilibrium variables to exogenous variations in the interest rate: a) contractive, in which the rate of capital accumulation, the rate of capacity utilization, and profit are negatively affected by an increase in interest rates; b) intermediate, in which the rate of capital accumulation is negatively affected by an increase in the interest rate, but the rates of capacity utilization and profit are positively affected by interest rates; c) puzzling, in which the rates of capital accumulation, capacity utilization and profit are positively affected by an increase in interest rate levels.

To define the accumulation regimes, three Vector Error Correction (VEC) models are estimated. In addition to a model based on the benchmark interest rate, two additional models with alternative interest rate indicators are also estimated. The impulse-response functions allow for the identification of the reactions of the equilibrium variables of the neo-Kaleckian model (the rates of capital accumulation, capacity utilization and profit) to interest rate shocks. Based on the trends described above, the hypothesis that interest rates have had a negative impact on the rate of capital accumulation in the Brazilian economy over the analyzed period is proposed, which raises the possibility of contractive or intermediary regimes.

This paper seeks to expand the yet limited empirical evidence regarding the impact of monetary policy variables on the rate of capital accumulation in Brazil from a neo-Kaleckian perspective. As far as is known, it contributes in a potentially unprecedented way to this strand of the literature by using multivariate time-series models that explicitly incorporate interest rate indicators. Even though there are neo-Kaleckian works that apply VAR models to the Brazilian economy (Avritzer et al., 2016; Gonçalves, 2018), they do not explicitly incorporate the effects of interest rate variations on the accumulation regime. Previous empirical works for the Brazilian economy that have sought to incorporate these effects have done so with single-equation models.

This work is organized as follows. Section 2 reviews the integration of interest rates into the framework of neo-Kaleckian models. This section is followed by a brief review of the empirical literature (section 3) and by a description of the data used in the empirical study (section 4). Section 5 presents the empirical study, beginning with a brief history of monetary policy in the post-stabilization period, followed by the estimation of Vector Error Correction models and their respective impulse-response functions, which will allow for the identification of the accumulation regimes for each period.

2. Neo-kaleckian growth and distribution models: a monetary extension

Even though Keynes' formulation of a monetary theory of production emphasized the influence of monetary variables over the equilibrium of the real economy, the impacts of these variables did not gain theoretical prominence in the equilibrium solutions of the first post-Keynesian models of growth and distribution. In the models presented by Kaldor (1956) and Robinson (1956), functional income distribution was determined by investment, which was a function of the expected profit rate. In a market equilibrium situation, this gives rise to the Cambridge equation, which establishes the link between the rates of profit and accumulation:

$$r = \frac{g}{s_\pi} \quad (1),$$

where g is the rate of capital accumulation, r is the profit rate and s_π is the propensity to save out of profits. Assuming endogenous changes in functional income distribution, these models predict an adjustment of savings to investment, with a full rate of capacity utilization in the long run. Thus, for a given rate of capacity utilization, a positive relationship between the rate of capital accumulation, the profit share, and the profit rate is established.

The neo-Kaleckian models of Rowthorn (1981), Dutt (1984) and Taylor (1983) endogenize the rate of capacity utilization in the capital accumulation function. The positive relationship between the rate of capital accumulation and the rate of profit is maintained, as in the Cambridge models. In neo-Kaleckian models, however, income distribution becomes a function of the mark-up of oligopolistic

firms. Following this view, the rate of capital accumulation is positively influenced by the rates of profit and capacity utilization:

$$g = g(r, u) \quad (2),$$

where u is the rate of capacity utilization, which has a double impact on the accumulation function as it also affects the profit rate separately (HEIN, 2014). From this perspective, an increase in the profit share negatively affects the rates of capacity utilization, profit and capital accumulation. Therefore, this model validates the Kaleckian Paradox of Costs[3] as an increase in the wage share causes lower equilibrium rates of capacity utilization, capital accumulation and profit.

The main critique of neo-Kaleckian models came from Bhaduri and Marglin's (1990) seminal work, which separately incorporates the profit share in the accumulation function (h):

$$g = g(h, u) \quad (3),$$

This formulation opposes the strong accelerator effect in the neo-Kaleckian models mentioned above, which postulate a double positive impact of the rates of profit and capacity utilization on the rate of capital accumulation. By incorporating positive, independent effects of the profit share and of the rate of capacity utilization on the accumulation function, the double impact of the rate of capacity utilization on the neo-Kaleckian accumulation function is eliminated (Hein, 2014).

With the accumulation function defined in (3), wage variations start presenting a contradictory impact on capital accumulation function, as it allows for a negative impact of the profit share on capital accumulation. Wage increases, therefore, have an ambiguous effect since their impact on the rate of capacity utilization may not offset the effects of a decrease in the profit share. Therefore, this model invalidates the Kaleckian Paradox of Costs, allowing for the occurrence of profit-led ($dg/dh>0$) and wage-led ($dg/dh<0$) regimes.

Lavoie (1995) made one of the first attempts to integrate an exogenous interest rate into a model based on Bhaduri and Marglin (1990). The model presented below follows Hein's (2007) extension of Lavoie's (1995) model. It is a closed-economy model, without economic activity of the state, and with constant technical conditions of production. The rate of capacity utilization is given by the relationship between actual and potential output, and functional income distribution is determined by the firms' mark-up pricing. Based on these premises, Hein (2007) defines the profit share (h) as a function of the mark-up (m), and the profit rate as a function of the profit share, the rate capacity utilization (u), and the capital-potential output ratio (v):

[3] As explained by Kalecki (1971), the cost paradox stipulates that an advantageous behavior for the firm from an individual point of view (decrease in expenses) does not lead to desirable results in an aggregate perspective. Therefore, the increased propensity to save of capitalists would not only lead to a decrease in national income, but also to a fall in the rate of profit.

$$h = \frac{\text{П}}{pY} = 1 - \frac{1}{1+m} \quad (4).$$

$$r = \frac{\text{П}}{pK} = \frac{\text{П}}{pY}\frac{Y}{Y^v}\frac{Y^v}{K} = hu\frac{1}{v} \quad (5).$$

The introduction of the interest rate into the model follows the post-Keynesian horizontalist monetary theory, which assumes an exogenous monetary interest rate (determined by the monetary authority), while the amounts of credit and money are endogenously determined by economic activity. When interest income is introduced into the model, profits are divided between business profits (П^n) and rentier's income (Z) – the latter being determined by the stock of long-term credit granted to firms (B) and by the exogenous interest rate (i)[4]:

$$\pi = \pi^n + Z = \pi^n + iB \quad (6).$$

With regard to the interest rate's distributive effects, Hein (2007) considers two possibilities. First, an interest-inelastic mark-up is considered. In this case, interest rate changes do not affect the distribution between profits and wages, affecting only the distribution of profits between corporate profits and rentier income. In the case of an interest-elastic mark-up, however, changes in the interest rate affect the distribution between profits and wages. Considering that there are no savings out of wages, Hein (2007) divides total savings between retained profits ($\pi - Z$) and rentier savings (S_z). From equations (5) and (6), the saving rate can be defined as follows:

$$\sigma = \frac{S}{pK} = \frac{\pi - Z + S_z}{pK} = h\frac{u}{v} - i\lambda(1 - s_z), \quad 0 < s_z \leq 1 \quad (7),$$

where s_z represents the propensity to save out of interest income. As shown above, an increase in the interest rate would lead to a lower savings rate, as income is transferred from firms to rentiers, who have a higher propensity to consume. The same is true for an increase in the debt-capital ratio (λ).

Based on Bhaduri and Marglin (1990) and on Kalecki's (1937) principle of increasing risk – which states that the firm's access to credit is positively related to the firm's internal resources -, Hein (2007) defines the rate of accumulation by incorporating negative impacts of the interest rate and of the debt-capital ratio, where β,τ and θ represent the elasticities of the rate of capacity utilization, profit share, and interest rate, respectively:

[4] The debt-capital ratio λ is initially constant and defined by: $\lambda = \frac{B}{pK}$

$$g = \frac{\Delta K}{K} = \frac{I}{K} = \alpha + \beta u + \tau h - \theta \lambda i, \;\; \alpha, \beta, \tau, \theta > 0, \;\; g > 0 \; for \; r - i > 0 \tag{8}$$

Starting from the goods market equilibrium condition ($g = \sigma$), the equilibrium rates of capacity utilization, capital accumulation and profit are derived as follows:

$$u^* = \frac{\lambda i(1 - s_z - \theta) + \alpha + \tau h}{\frac{h}{v} - \beta} \tag{9}$$

$$g^* = \frac{\lambda i\left[\beta(1 - s_z) - \theta\frac{h}{v}\right] + \frac{h}{v}(\alpha + \tau h)}{\frac{h}{v} - \beta} \tag{10}$$

$$r^* = \frac{\frac{h}{v}[\lambda i(1 - s_z - \theta) + \alpha + \tau h]}{\frac{h}{v} - \beta} \tag{11}$$

With a constant λ, the reactions of the equilibrium variables to changes in the interest rate can be derived:

$$\frac{\partial u}{\partial i} = \frac{\lambda(1 - s_z - \theta) + \frac{\partial h}{\partial i}\left(\tau - \frac{u}{v}\right)}{\frac{h}{v} - \beta} \tag{12}$$

$$\frac{\partial g}{\partial i} = \frac{\lambda\left[\beta(1 - s_z) - \theta\frac{h}{v}\right] + \frac{\partial h}{\partial i}\frac{1}{v}(\tau h - \beta u)}{\frac{h}{v} - \beta} \tag{13}$$

$$\frac{\partial r}{\partial i} = \frac{\frac{h}{v}\lambda(1 - s_z - \theta) + \frac{\partial h}{\partial i}\frac{1}{v}(\tau h - \beta u)}{\frac{h}{v} - \beta} \tag{14}$$

As shown in the equations above, the effects of changes in the interest rate on the equilibrium variables depend on the profit share *h*, the propensity to save out of rentier income s_z, as well as on the profit share (τ), the interest rate (θ) and the capacity utilization (β) elasticities. Depending on the reactions of the equilibrium variables, three accumulation regimes in the case of a rigid mark-up can be derived:

Table 1: Accumulation regimes with exogenous interest rate variations

	$\frac{\partial u^*}{\partial i}$	$\frac{\partial g^*}{\partial i}$	$\frac{\partial r^*}{\partial i}$
Normal case (contractive) $\frac{\beta v}{h}(1-s_z)-\theta<(1-s_z)-\theta<0$	-	-	-
Intermediate case $\frac{\beta v}{h}(1-s_z)-\theta<0<(1-s_z)-\theta$	+	-	+
Puzzling case $0<\frac{\beta v}{h}(1-s_z)-\theta<(1-s_z)-\theta$	+	+	+

Source: adapted from Hein (2014).

As can be seen, when there is a high propensity to save out of interest income and a high elasticity of interest to accumulation, the redistribution associated with higher interest rates causes a contractive effect on the equilibrium variables, characterizing the normal case. When there is a low propensity to save out of rentier income and weak effects of the firm's internal funds on investment, rising interest rates have a positive effect on the equilibrium rates of capacity utilization and profit. These effects, combined with a high elasticity of the rate of capacity utilization to accumulation, have a positive impact on the accumulation rate, characterizing the puzzling case. Finally, there is also the intermediate case, in which an increase in interest rate levels causes an increase in the equilibrium values of capacity utilization and profit rate, while also causing the rate of capital accumulation to fall. This case happens when there is a low propensity to save out of rentier income, weak effects of the firm's internal funds on investment, and a low elasticity of the rate of capacity utilization to accumulation (Hein, 2014).

3. Empirical literature review

This section highlights some econometric works that have attempted to incorporate interest rates into neo-Kaleckian models. Although some of the studies exclusively deal with monetary extensions of these models, such as Hein and Ochsen (2003), a considerable part of the literature also incorporates the effects of financialization. In these cases, the interest rate is integrated as another indicator of rentier income, alongside dividend income. This review showcases only a few pioneering studies that explicitly incorporate interest indicators as an extension of neo-Kaleckian models[5]. The first group of works is restricted to advanced economies. These studies are characterized by samples that encompass relatively

[5] It is not the intention of this section, therefore, to carry out a comprehensive review of the empirical literature on financialization, which goes beyond the scope of this work.

long periods of time (generally from the 1960s onwards) and place special emphasis on long-term interest rate indicators.

Hein and Ochsen (2003) conducted a pioneer study based on the work of Lavoie (1995), seeking to examine the effects of exogenous changes of long-term interest rates on the equilibrium rates of capacity utilization, capital accumulation and profit for France, Germany, the United Kingdom and the United States between the years 1961 and 1995. With the exception of Germany after the 1970s, the results do not indicate a large participation of interest rates in the growth deceleration of these economies.

Stockhammer (2004) presents a microeconomic-based model that establishes a link between capital accumulation and rentier income, using the interest and the dividend income of non-financial companies as proxies for the phenomenon of financialization. The period investigated runs from the 1960s to the 1990s and includes the United States, Germany, France and the United Kingdom. Similarly, Van Treeck (2008) proposes a model based on the analysis of shareholder value orientation for the same group of countries. Starting from a linear extension of Bhaduri and Marglin's (1990) accumulation function, the author includes the effects of interest and dividends payments in the accumulation functions as a proxy for shareholder value orientation. He derives different regimes from the effects of dividends and interest on the equilibrium values of the rates of capital accumulation, capacity utilization and profit.

Focusing specifically on the United States, Onaran *et al.* (2011) investigated how financialization has affected aggregate demand in the country. Unlike the previous works, Onaran *et al.* (2011) incorporate the effects of interest rates in an open-economy framework. The results suggest that changes in functional income distribution had a negative overall effect on aggregate demand in the United States. Finally, Hein and Schoder (2011) propose an extension of Hein and Ochsen's (2003) model that also incorporates dividend income, seeking to define potential interest rate regimes for Germany and the United States in the period between 1960 and 2007. The results reveal that interest rate increases have caused a contraction in the endogenous variables of the model, in addition to a redistribution of income in favor of profits.

Regarding the literature applied to Brazil, a small group of studies can be found that explicitly incorporate the effects of interest rates in the post-Kaleckian accumulation function. Similarly to the works applied to advanced economies, empirical studies for the Brazilian economy estimate single-equation models, based on monetary extensions of the capital accumulation function inspired by Bhaduri and Marglin (1990). Also in line with this literature, some studies, such as Bruno *et al.* (2011), also include the effects of financialization. In contrast to the works on advanced economies, however, the studies applied to Brazil are restricted to shorter time periods (generally from the 1990s onwards), with an increased frequency of observations. Furthermore, the emphasis on interest rate indicators is restricted to the short-term interest rate for all studies.

Aiming to test the influence of interest-led financialization on accumulation, Bruno *et al.* (2011) used the neo-Kaleckian accumulation function from Stockhammer (2007), with the ratio between the accumulation factor of the benchmark rate (Selic) and the capital stock working as a proxy of financial income. In the period from 1991 to 2003, estimated elasticities indicate a negative influence of the profit rate on investment, while the interest rate had a positive influence. From 2004 to 2008, capitalized interest income has negatively influenced the rate of capital accumulation, while the rate of profit started showing a positive effect on the accumulation rate, pointing to a finance-led growth regime.

Oreiro *et al.* (2013) developed an extension of a post-Keynesian model using a quadratic neo-Kaleckian accumulation function that incorporates the real exchange rate and the real interest rate. The authors estimated this equation for Brazil between 1995 and 2008. Using quarterly data, they sought to define the accumulation regime as wage-led or profit-led. The coefficients estimated by the Error Correction Model reveal a negative impact of the real interest rate on the rate of capital accumulation.

Feijó *et al.* (2016) investigated the factors related to the slowdown of growth in Brazil during the post-stabilization period. The authors begin with an extension of a model based on Bhaduri and Marglin (1990) that incorporates not only the short-term real interest rate but also other monetary and financial indicators, such as the degree of indebtedness of firms, the degree of external vulnerability and the public debt burden. Using quarterly data from 1995 to 2011, the authors highlight the short-term interest rate as the main explanatory variable for the observed low investment rates throughout the period, suggesting the prevalence of a finance-led accumulation regime. Also based on a neo-Kaleckian accumulation function, Feijó *et al.* (2019) tested the determinants of investment in Brazil following different theoretical strands of the debate on economic development in Brazil. The authors estimated the capital accumulation function with monthly data between 1999 and 2013. Following the post-Keynesian developmentalist strand, the short-term real interest rate is added to the accumulation function. Results show a negative impact of the interest rate on the rate of capital accumulation in every specification.

4. Data and Methodology

This section details the sources and data that will be used in the empirical study. All time series were used in quarterly frequency and were seasonally adjusted with the X-12-Arima method. The choice of frequency is mainly due to the availability of data of the capital stock series estimated by Martins and Rugitsky (2018), which goes from the first quarter of 1996 to the second quarter of 2017. This series was calculated by the authors using the Perpetual Inventories Method, which can be found in Martins (2017). The series was brought to a quarterly frequency through quarterly deviations from the annual average from the quarterly capital stock series calculated by Souza Júnior (2017).

For the interest rate indicators, quarterly averages obtained from monthly data have been used. The benchmark interest rate (Selic) is used for the entire sample period (from 1996 to 2017), covering a total

of 85 observations for the first model. As a complement, two other models were estimated, the first with an *ex-ante* real interest rate indicator (DI360) and the second with a long-term interest rate indicator (TJLP). The DI Swaps series, which serves as a proxy for the *ex-ante* interest rate, is only available from the fourth quarter of 1999 onwards, which reduces the sample to 71 observations for the second model (from the fourth quarter 1999 to the second quarter of 2017). Likewise, the TJLP indicator underwent significant changes in its estimation methodology, which coincided with the last quarter of 1999[6]. In order to avoid sample distortions, the decision was made to restrict the time frame of the TJLP in the third model to 71 observations as well.

The data and sources are detailed bellow:

Table 2: Data and Sources

Data	**Details**	**Sources**
Benchmark interest rate (Selic)	Quarterly average of the benchmark interest rate accumulated over the previous 12 months, deflated by the IGP-DI (general price index).	Central Bank of Brazil
Ex-ante interest rate (DI360)	Quarterly average of the fixed DI swap rate for 360 days, deflated by the IGP-DI of the following 12 months[7]	Central Bank of Brazil (BM&FBOVESPA)
Long-term interest rate (TJLP)	Quarterly average of the long-term interest rate (% p.a.), deflated by the IGP-DI of the following 12 months.	Central Bank of Brazil
Rate of capital accumulation (g)	Yearly growth rate of the capital stock.	Based on the capital stock series estimated by Martins and Rugitsky (2018)
Rate of capacity utilization (u)	Rate of industrial capacity utilization calculated by the Brazilian National Industry Confederation (CNI).	CNI
Rate of profit (r)	Quarterly average of the profit rate.	Martins and Rugitsky (2018)

Source: elaborated by the author.

[6] Up until 1998, the TJLP was defined based on long-term foreign debt bonds. As described by Costa and Deos (1999, p.22): the TJLP was defined based on the weighted average of the annualized average profitability of external debt bonds (with a minimum redemption period of 1 year), issued by the Republic of Brazil, and federal domestic public debt securities (when issued on the primary market, with a redemption period equal to or greater than 6 months)". Some calculation changes were introduced throughout 1999, motivated by the external instability of the period. In September 1999, the new methodology was established that was used throughout this sample, which started to depend on country risk and inflation expectations (PRATES, CINTRA and FREITAS, 2000).

[7] The IGP-DI for the following year works as a proxy for inflation expectations, since there is no data series that captures the expectations for this index. In order to avoid possible sample distortions, the models involving inflation expectations were reproduced using the series of IPCA expectations. The impulse-response functions point to the same trends observed in this study, indicating that there were no sample distortions and contributing to a greater robustness of the results.

5. Regimes of interest rates and capital accumulation: an empirical exercise for Brazil (1996-2017)

The aim of this section is to identify the Brazilian accumulation regime in the post-stabilization period, based on interest rate variations. Using Hein's (2007) monetary extension of the post-Kaleckian model presented in section 2, analysis is made on how the equilibrium variables (the rates of capital accumulation, capacity utilization and profit) respond to changes in the interest rate indicators. As previously shown, the theory predicts the occurrence of contractive, intermediary and puzzling regimes, depending on the directions of such reactions.

First, a brief description is given of the monetary policy frameworks in Brazil from 1996 to 2017[8], seeking to preliminarily define the accumulation regimes. This is followed by an estimation of VEC models in the following section. The analyses of the impulse-response functions show the reactions of the equilibrium variables to shocks in the interest rate indicators, allowing for the identification of the accumulation regimes. In addition to the model based on the benchmark interest rate (Selic rate), two complementary models with alternative interest rate indicators are also presented.

5.1.Monetary Policy in the Post-Stabilization Period

In line with the various stabilization programs implemented in Latin America in the 1990s, the Real Plan sought to combine liberalizing institutional reforms with a nominal anchor arrangement based on a semi-fixed exchange rate, in order to mitigate the chronic inflation scenario of the Brazilian economy. This policy framework required the maintenance of persistently high interest rates and created an increased dependence on foreign capital in the Brazilian economy, which became the target of recurrent speculative attacks in the second half of the 1990s. As pointed out by Arestis *et al.* (2009), the main consequences of such attacks were the decline in foreign exchange reserves and the rise in interest rates to promote capital inflow. In 1999, the stabilization policy of the Real Plan reached its limit after a severe exchange rate crisis, causing the country to opt for a floating exchange rate. The exchange rate depreciation resulting from this new regime created new inflationary pressures in the Brazilian economy, which led to an increase in short-term interest rates and to the implementation of an Inflation Targeting Regime (ITR) in the middle of that same year.

The ITR is part of a broader framework called "macroeconomic tripod", which associated inflation targeting with free-floating exchange rates and primary surpluses. The first years of the ITR were characterized by declining inflation targets with a faster speed of convergence of inflation to the targets. This initial period was marked by a relatively weak economic performance, with an average annual GDP growth of 2.84% between 1999 and 2006 (IBGE, 2020). Furthermore, Nassif (2015) points out that,

[8] As highlighted in the previous section, the period delimitation is due to the availability of data referring to the quarterly capital stock series estimated by Martins and Rugitsky (2018).

despite the deleterious effects in terms of economic activity, the ITR was also not efficient in ensuring the main goal of price stability. The author observes that, throughout this initial period, the target was only reached in the year 2000.

The replacement of Antônio Palocci by Guido Mantega at the Ministry of Finance in 2006 marks the beginning of the flexibilization of the macroeconomic tripod (Oreiro, 2015). Monetary policy trends in this period interrupted the pattern of decreasing inflation targets from the previous period, adhering to a fixed target of 4.5% p.a. from then on. The flexibilization of the tripod was marked by the acceleration of economic growth compared to the previous period. This was largely motivated by an increase in public investment and in the wage share, which went from 54% in 2005 to 58% in 2009 (Martins; Rugitsky, 2018). Finally, the overvalued exchange rate helped to hold back inflationary pressures during that time, allowing for a reduction of the Selic rate from 2006 onwards.

The global financial crisis, the effects of which on economic activity were felt from the third quarter of 2008, led to an even greater flexibilization of the macroeconomic tripod. Through counter-cyclical measures, the monetary policy pursued a significant reduction in the benchmark interest rate until mid-2010. This policy was complemented by fiscal and credit policies of an equally expansionist nature, with a substantial increase of the share of credit lines offered by public banks. The declining tendency of interest rates was only reversed at the end of 2009, following the upward trend of the inflation rate. As of 2010, the Central Bank also adopted a macroprudential policy framework, which worked as a complement to the ITR, adding an extra layer of complexity to the monetary policy transmission channels.

Dilma Rousseff's government gave continuity to the contractive measures started in the previous government by raising the basic interest rate to 12.5% per year. However, the deterioration of the international economic scenario throughout 2011, together with the prospect of inflationary deceleration, created a window of opportunity for pursuing nominal exchange rate depreciations (Nader, 2018). This moment marks an initial attempt of breaking up with the traditional Brazilian monetary policy framework, as the Central Bank began a new cycle of expansion, with interest rates reaching their lowest level (7.25% per year) in 2012 – the lowest level since the beginning of the post-stabilization, which was maintained until 2013. This cycle of falling interest rates marks the beginning of the “New Macroeconomic Matrix”, which was characterized not only by a depreciated exchange rate that is more favorable to industrial activity, but also by a fiscal policy that favored private investment.

However, such measures were not enough to increase the rate of capital accumulation, which began to decline. As a result, the cycle of interest rate reductions initiated in 2011 was interrupted in 2013, given the prospect acceleration in inflation. This reversal of the interest rate trajectory interrupted the brief recovery of investment levels at the beginning of 2013, starting a period of growth deceleration. The rise in interest rates was maintained despite the slowdown of accumulation, as it sought to (unsuccessfully)

mitigate the inflationary effects of the exchange rate depreciation. This new upward cycle was also accompanied by a gradual dismantling of the macroprudential measures, which had been gaining ground since 2010.

Dilma Rousseff's second term began with the formation of an orthodox economic team, which further deepened the contractionary monetary policy that had been taking place since the second half of 2013. As pointed out by Martins (2018), the monetary policy strategy was now based on the principle of coordination of expectations. Thus, the Central Bank proceeded by setting a deadline at the end of 2016 for inflation expectations to converge towards the target. This approach was not trivial as it removed the focus from current inflation and established the convergence of expectations as the main goal of the adjustment process (Martins, 2018). In order to meet these objectives, the National Monetary Council maintained the inflation target at 4.5% but reduced the tolerance interval to 1.5 p.p..

Based on the trends described above, the table below summarizes the different monetary policy frameworks implemented during the post-stabilization period, showing the directions and averages of the real Selic rate (deflated by the IGP-DI) as well as the recorded averages of the rates of capital accumulation (g), profit (r) and capacity utilization (u):

Table 1: Monetary Policy Frameworks (1996/T2-2017/T2)

Policy Framework	Real Selic trend	Real Selic (average)	g (average)	r (average)	u (average)
Exchange rate anchor (1996 to 1999)	Decrease	19.94	2.38	32.58	78.30
Rigid Macroeconomic Tripod (1999 to 2006)	Increase	6.53	1.39	35.87	80.82
Flexibilization of the macroeconomic tripod (2006 to 2013)	Decrease	5.06	3.37	37.77	82.51
Rigid Macroeconomic Tripod (2013 to 2017)	Increase	4.71	2.54	31.29	79.41

Source: elaborated by the author.

As can be seen, on average, the exchange rate anchor framework registered higher interest rates than those registered in the subsequent periods of strict adherence to the inflation targeting regime. The comparison between the periods also shows that, in general, periods of increase in the Selic rate seem to be associated with relatively lower averages of the rates of capital accumulation rate, profit, and capacity utilization.

A preliminary analysis allows us to raise some hypotheses about the accumulation regimes during this period. The exchange rate anchor period presents ambiguous trends due to the high volatility of interest rates. Overall, however, the fall in interest rates at the end of the decade seems to be accompanied by a simultaneous fall in the rate of capital accumulation, as well as by an initial growth (followed by a

relative stability) of the other two variables, raising the possibility of an intermediate regime. The volatile growth of real interest rates after the implementation of the macroeconomic tripod also raises ambiguous interpretations. Likewise, the recovery of economic activity seems to precede, in some quarters, the cycle of falling nominal interest rates that began in 2006, inaugurating the period of flexibilization of the macroeconomic tripod. From this moment on, however, the equilibrium variables move in a clearer direction as the cycle of falling interest rates is accompanied by an increase in the levels of capital accumulation. Likewise, the last period (with the return of the strict adherence to the macroeconomic tripod) suggests a contractive regime since the interest rate hike cycle is reflected by a contraction of the other indicators. Using the taxonomy proposed by Hein (2014), at least in the last two periods, the preliminary observation suggests a "normal case", in which interest rate increases cause contractions in the equilibrium variables.

5.2.Specific considerations about the Monetary Policy transmission channels

Before proceeding with the econometric analysis, this section points out some peculiarities of the transmission channels of monetary policy in Brazil, drawing some parallels with the post-Kaleckian model analyzed in section 2. As highlighted by Hein (2014), the impacts of changes in short-term interest rates on the equilibrium variables are given through two main distributive channels: through the distribution of profits between firms and rentiers and through the effect of the interest rate on functional income distribution[9]. Assuming an interest-inelastic mark-up (interest rates do not significantly affect functional income distribution), some considerations should be made about the effects of interest rates on consumption out of interest income, as well as on firms' investment decisions. With regard to the transmission of interest rates to private investments, Kalecki's (1937) principle of increasing risk states that firms finance their capital stock both through their accumulated retained earnings and through access to long-term finance. Therefore, long-term interest rates assume significant importance in the Kaleckian analysis of the transmission of monetary policy to investment. Furthermore, as highlighted by Hein (2014), long-term interest rates are expected to be determined by the short-term monetary policy rate.

Barboza (2015) raises the possibility of a "truncated" term structure of the interest rate in Brazil. According to the author, decades of persistent high inflation, combined with capital markets dominated by short-term government bonds with high remuneration, prevented the formation of a yield curve beyond the short term. Thus, the stimuli generated by short-term interest rates do not seem to be adequately transmitted to long-term rates (Barboza, 2015). Furthermore, Bruno and Caffe (2015) point to the fact that

[9] "First, we have the effect of an interest rate variation on the distribution of income between firms and rentiers, which will affect households' consumption and firms' investment. (…) Second, we have the potential effect of changes in the interest rate on the mark-up in firms' pricing and hence on the profit share, which will then affect the goods market equilibrium rates of capacity utilization, capital accumulation and profit" (Hein, 2014, p.349)

long-term interest rates in Brazil are highly volatile, which goes against the typical Kaleckian argument that considers long-term interest rates more stable[10].

On top of this is the issue of credit market segmentation in Brazil. As pointed out by Barboza (2015), the supply of long-term credit to private companies is mainly carried out by the Brazilian Development Bank (BNDES) in the form of earmarked credit. The TJLP (long-term interest rate) served as a reference for the BNDES' long-term financing between 1995 and 2017 and is systematically lower than the benchmark interest rate, showing a reduced sensitivity to monetary policy measures. This disparity contributes to a reduced effect of the Selic rate on aggregate demand, due to the large share of earmarked credit in Brazil (Barboza, 2015).

With regard to the effects of interest rates on consumption, some peculiarities must be taken into account. As Hein (2014) points out, an increase in interest rates can result in a decrease in aggregate savings, depending on the propensity to consume out of rentier's income. In the case of Brazil, this effect is expected to be relatively high, given the large share of risk-free, floating rate bonds in the composition of federal public debt. As Barboza (2015) points out, there seems to be a certain immunity of Financial Treasury Bills (LFTs) in relation to wealth effects. Therefore, at the same time as they increase the discount factors applied to LFTs' earnings, increases in the monetary policy rate also increase these returns in the exact same proportion, thus eliminating the impact on the price of the bond and on the holder's wealth (Barboza, 2015, p.144). Likewise, Bresser-Pereira *et al.* (2019) state that persistent financial indexation in Brazil could have contributed to creating a reverse wealth effect.

5.3.Interest-rate effects on the equilibrium variables: an exercise on the Brazilian accumulation regime based on VEC models

This section presents the results of the Vector Error Correction (VEC) models, which show the responses of the rates of capital accumulation, profit and capacity utilization to shocks on the interest rate indicators. Based on the Hein's (2014) classifications for the monetary extension of the post-Kaleckian model, an attempt to identify the accumulation regime of the Brazilian economy in the post-stabilization period is made. As discussed in section 2, depending on the signs of the variations detected for each equilibrium variable, three possibilities for the accumulation regime can be derived: contractive ($\partial g/\partial i<0$; $\partial r/\partial i<0$; $\partial u/\partial i<0$), intermediate ($\partial g/\partial i<0$; $\partial r/\partial i>0$; $\partial u/\partial i>0$) and puzzling ($\partial g/\partial i>0$; $\partial r/\partial i>0$;$\partial u/\partial i>0$).

As explained above, a model (model 1) with the real Selic rate for the period from the second quarter of 1996 to the second quarter of 2017 is estimated. Subsequently, two other models will be estimated for

[10] "Different from traditional beliefs, for which long-term investment would not be considerably affected by the same uncertainties that arise from short-term interest rates, the fact that the volatility of these rates has more persistent effects on the Brazilian economy cannot be ignored. Contrary to the typical Kaleckian argument, according to which long-term interest rates are supposedly more stable, the latter do not escape the exchange-interest dynamics, which involve dimensions of specific inconvertibility of the national monetary regime. Thus, high interest rates in the 'short long term', despite their significant relative decline, reflect this fundamental macroeconomic instability" (Bruno; Caffe, 2015, p. 49)

the period that goes from the fourth quarter of 1999 to the second quarter of 2017. Model 2 utilizes the *ex-ante* interest rate indicator (DI360) and model 3 uses the long-term interest rate indicator (TJLP). It should be noted that the following estimates are based on the assumption of an interest-inelastic mark-up, based on previous attempts to include functional income distribution as an endogenous variable[11].

The first step in the identification of a VEC model is to verify the degree of integration of the series. The results of the Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests indicate that the series of the rates of capital accumulation, profit and capacity utilization (*g, r*, and *u*) are non-stationary at level but are stationary at the first difference. With regard to the interest rate indicators, the Selic series is also integrated of order 1. The TJLP and DI360 series, on the other hand, are stationary at level in the majority of the tests. However, given that most series used in the three specifications have unit roots with a significance level of 1percent, it is still possible to model the series with a VEC model[12]:

Table 2: Unit root tests

Test			Selic (c)	DI360 (c)	TJLP (c)	g (c + t)	g* (c + t)	r (c + t)	r* (c + t)	u (c + t)	u* (c + t)
ADF	Statistics		-2.54461	-4.43745	-4.62063	-0.50067	0.063137	-1.53089	-1.28748	-1.62139	-2.04683
	Critical	1%	-3.51554	-3.52705	-3.52705	-4.07101	-4.09455	-4.07101	-4.09455	-4.07242	-4.09661
	Values	5%	-2.89862	-2.90357	-2.90357	-3.4642	-3.47531	-3.4642	-3.47531	-3.46487	-3.47628
		10%	-2.58661	-2.58923	-2.58923	-3.15859	-3.16505	-3.15859	-3.16505	-3.15897	-3.16561
PP	Statistics		-2.89564	-4.59802	-4.74915	-1.02638	-0.38013	-1.25758	-0.83668	-1.28669	-1.33657
	Critical	1%	-3.51026	-3.52705	-3.52705	-4.07101	-4.09455	-4.07101	-4.09455	-4.07101	-4.09455
	Values	5%	-2.89635	-2.90357	-2.90357	-3.4642	-3.47531	-3.4642	-3.47531	-3.4642	-3.47531
		10%	-2.5854	-2.58923	-2.58923	-3.15859	-3.16505	-3.15859	-3.16505	-3.15859	-3.16505
KPSS	Statistics		0.594227	0.229748	0.056907	0.154814	0.189206	0.305902	0.265588	0.255975	0.224398
	Critical	1%	0.739	0.739	0.739	0.216	0.216	0.216	0.216	0.216	0.216
	Values	5%	0.463	0.463	0.463	0.146	0.146	0.146	0.146	0.146	0.146
		10%	0.347	0.347	0.347	0.119	0.119	0.119	0.119	0.119	0.119

Source: author's elaboration. "t" and "c" represent, respectively, the adoption of a deterministic trend and a constant in the specification of the test equation (*values corresponding to the shortest sample, from 1999 /Q4 to 2017/Q2).

The next step is to determine the lag structure of the VEC models. Based on the autocorrelation (Lagrange multiplier) and heteroskedasticity (White test) residual tests and following the Akaike (AIC) and Schwartz (SIC) information criteria, three lags have been defined for models 1 and 3, and two lags for model 2:

[11] Complementary tests were carried out in which the functional income distribution was incorporated to the shocks of the interest indicators. However, for the three models, the results obtained of the variation in the profit share were not statistically significant, which justifies the assumption of an interest-inelastic mark-up in the short term.

[12] For more details, see Campbell and Perron (1991). As the authors point out, the inclusion of stationary cointegrated series I(0) does not affect the significance of the estimates.

Table 3: Information criteria and residual tests for Model 1 (Selic)

Lags	2		3		4	
	AIC	SC	AIC	SC	AIC	SC
	-26.831	-25.3807	-27.0728	-25.1391	-27.2187	-24.8015
Lagrange multiplier residual autocorrelation test						
Lags	Stat.	p-value	Stat.	p-value	Stat.	p-value
1	43.85672	0.0002	22.64665	0.1235	24.09729	0.0874
2	39.01445	0.0011	19.70196	0.2339	18.06611	0.32
3	38.2978	0.0014	22.06494	0.1411	10.39644	0.8451
4	37.11134	0.002	23.15096	0.1098	20.44532	0.2008
5	20.43394	0.2013	23.73771	0.0954	27.7321	0.034
6	14.13702	0.5885	18.17015	0.314	11.98965	0.7447
White heteroskedasticity test (p-value)						
Lags	2		3		4	
	0.0112		0.1658		0.6038	

Source: author's elaboration.

Table 4: Information criteria and residual tests for Model 2 (DI360)

Lags	2		3		4	
	AIC	SC	AIC	SC	AIC	SC
	-25.4569	-23.7174	-25.55611	-23.2814	-25.3302	-22.5202
Lagrange multiplier residual autocorrelation test						
Lags	Est. LM	p-valor	Est. LM	p-valor	Est. LM	p-valor
1	14.03955	0.5958	13.23994	0.6551	11.87188	0.7528
2	8.345184	0.9379	9.599185	0.8867	15.83826	0.4643
3	15.25761	0.5059	11.77801	0.7591	18.36171	0.3031
4	21.77684	0.1505	17.74227	0.3392	11.82056	0.7562
5	18.79686	0.2793	12.22024	0.7287	11.05897	0.8058
6	17.27133	0.3683	12.7623	0.6901	13.34917	0.6471
White heteroskedasticity test (p-value)						
Lags	2		3		4	
	0.2441		0.5871		0.6571	

Source: author's elaboration.

Table 5: Information criteria and residual tests for Model 3 (TJLP)

Lags	2		3		4	
	AIC	SC	AIC	SC	AIC	SC
	-25.5483	-23.9426	-25.5309	-23.3899	-25.246	-22.5699
Lagrange multiplier residual autocorrelation test						
Lags	Est. LM	p-valor	Est. LM	p-valor	Est. LM	p-valor
1	13.97918	0.6003	11.57618	0.7726	12.81047	0.6866
2	8.667319	0.9265	11.43327	0.782	15.48076	0.4897
3	15.23603	0.5074	9.217592	0.9042	14.68086	0.5481
4	21.63919	0.1552	18.15539	0.3149	14.17678	0.5855
5	18.32368	0.3053	12.7318	0.6923	11.32074	0.7893
6	15.86287	0.4626	11.74571	0.7613	13.12884	0.6633
White heteroskedasticity test (p-value)						
Lags	2		3		4	
	0.1168		0.5693		0.5162	

Source: author's elaboration.

Starting with model 1 (Selic), the estimation with two lags presents problems of autocorrelation and heteroskedasticity. These problems are solved from the third lag, which does not present problems in the residues at a significance level of 5 percent. The analysis of the information criteria is ambiguous, as the Schwartz criterion indicates three lags and the Akaike criterion tends to favor the specification with four lags. In order to avoid the loss of degrees of freedom, a VEC(3) is chosen for model 1.

Residual tests for model 2 (DI360) indicate a good fit, without autocorrelation and heteroskedasticity at a significance level of 1 percent. However, the analysis of the information criteria raises some ambiguity, as the Schwartz criterion indicates the option with two lags and the Akaike criterion favors the option with three lags. In this case, the option is made for the criterion with 3 lags, as the specification better adapts to the cointegration tests[13]. Finally, the analysis of model 3 does not indicate the presence of residual heteroskedasticity and autocorrelation in any of the specifications, with a significance level of 1 percent. Based on the information criteria, a VEC (2) is chosen for model 3.

Based on these specifications, a Johansen cointegration test[14] was performed in order to establish the existence and number of cointegrated equations:

[13] The specification with two lags points to the existence of cointegration in the Trace statistics, but does not reject the null hypothesis of non-cointegration in the Maximum-Eigenvalue statistics.
[14] For more details, see Johansen (1988) and Johansen and Juselius (1990).

Table 6: Johansen cointegration test

	Cointegrated equations	Trace statistics	Critical value - 5%	Prob.	Maximum-Eigenvalue statistics	Critical value - 5%	Prob.
Model 1	None	55.08948	47.85613	0.009	30.11908	27.58434	0.0231
	1	24.9704	29.79707	0.1625	10.6206	21.13162	0.685
	2	14.3498	15.49471	0.0738	7.905698	14.2646	0.3883
	3	6.444098	3.841466	0.0111	6.444098	3.841466	0.0111
Model 2	None	75.77686	47.85613	0	38.63881	27.58434	0.0013
	1	37.13805	29.79707	0.006	25.9297	21.13162	0.0098
	2	11.20835	15.49471	0.199	7.54904	14.2646	0.4264
	3	3.659306	3.841466	0.0558	3.659306	3.841466	0.0558
Model 3	None	61.19748	47.85613	0.0017	35.79761	27.58434	0.0035
	1	25.39987	29.79707	0.1476	17.54266	21.13162	0.1479
	2	7.857213	15.49471	0.4808	5.184776	14.2646	0.7183
	3	2.672437	3.841466	0.1021	2.672437	3.841466	0.1021

Source: elaborated by the author.

The results show that all models reject the null hypothesis of absence of cointegration at a significance level of 1%, both for the Trace and for the Maximum-Eigenvalue statistics. Furthermore, model 2 points to the existence of at least two cointegrating equations, according to the critical values.

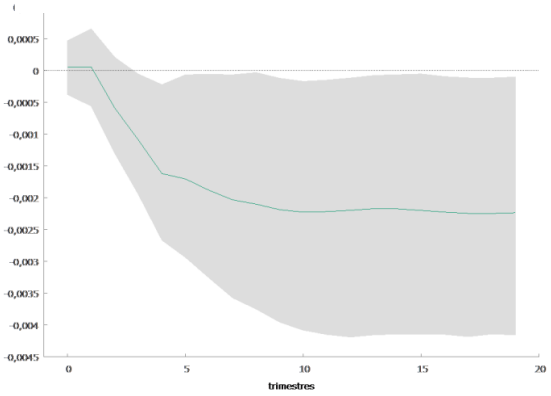
With the models specified, discussion can be made of the results of the impulse-response functions. In all specifications, the Cholesky decomposition was ordered based on the following exogeneity principle (from the most exogenous to the most endogenous): (1) interest rate indicator; (2) rate of capacity utilization; (3) profit rate; (4) rate of capital accumulation. The degree of exogeneity was based on the post-Keynesian horizontalist monetary theory, where the interest rate is the most exogenous variable. The rate of capacity utilization performs the role of an adjustment variable in the neo-Kaleckian model, being the first to react to interest rate shocks. Finally, the relationship between the profit rate and the capital accumulation rate makes the latter accumulate the endogenous effects of the other variables of the model. These relationships are generally validated by Granger-causality tests.

Graph 1 presents the impulse-response functions for the 3 estimated models. Starting with model 1, negative reactions can be observed of the three equilibrium variables in relation to a shock in the Selic rate. The impact of an interest rate shock on the rate of capacity utilization is negative over the entire period with a 95 percent confidence interval. The profit rate also shows a negative reaction to an interest rate shock. However, this does not occur within a significant confidence interval in the standards established for this study. Finally, the rate of capital accumulation has permanent negative effects from the fourth quarter onwards, within the 95 percent confidence interval. As the joint movement of the rates

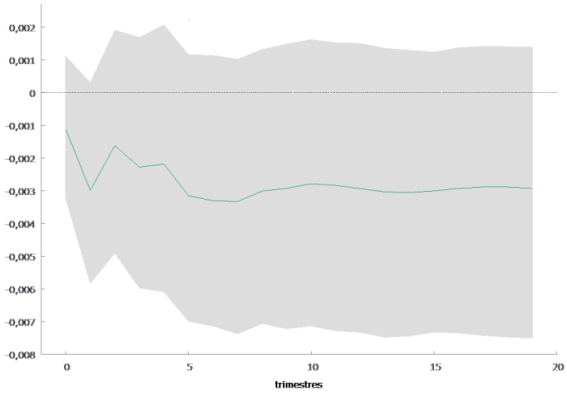
of capacity utilization and profit is consistent with the theory, the reactions suggest the prevalence of a contractive regime in the post-stabilization period.

Graph 1: Impulse-response functions

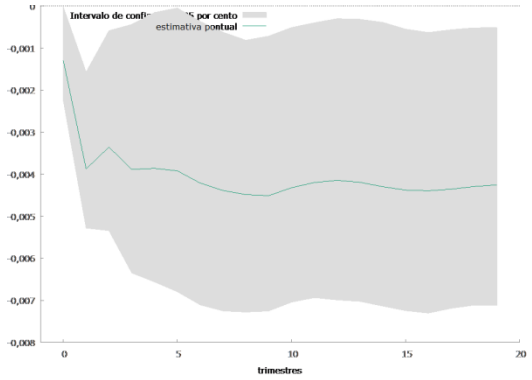
(a) Response of g to Selic



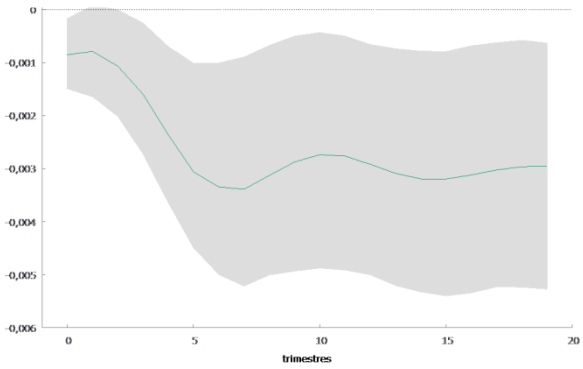
(b) Response of r to Selic



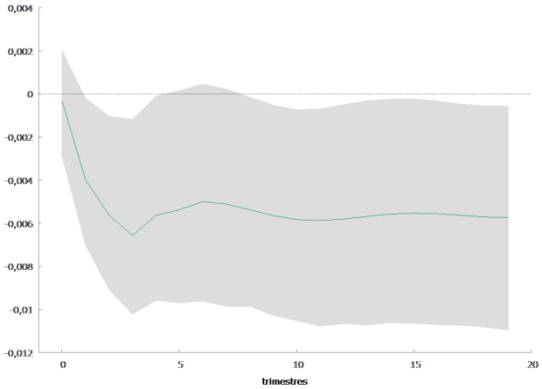
(c) Response of u to Selic



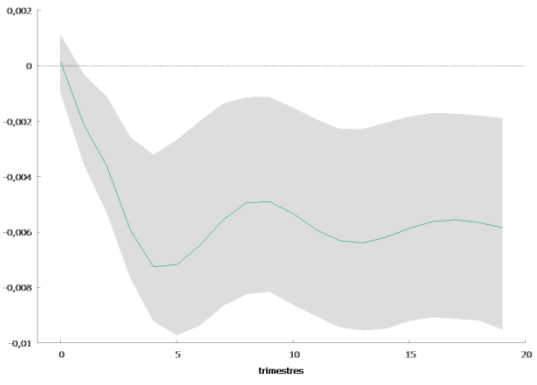
(d) Response of g to DI360



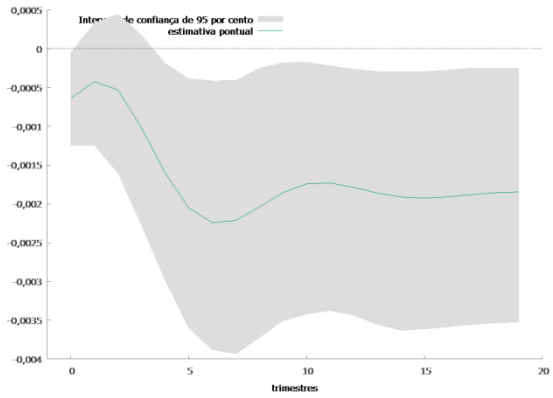
(e) Response of r to DI360



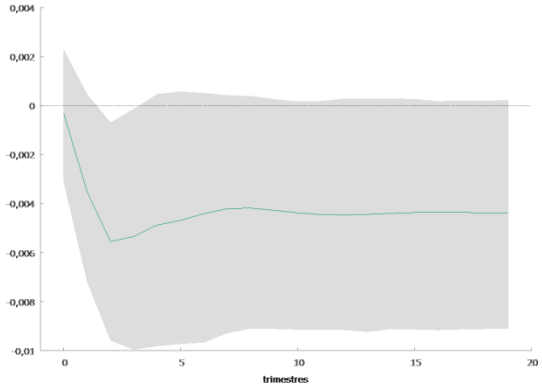
(f) Response of u to DI360



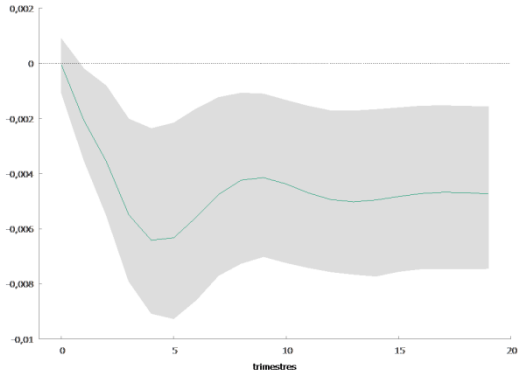
(g) Response of g to TJLP



(h) Response of r to TJLP



(i) Response of u to TJLP



95 percent confidence interval

Table 3: Granger-causality tests

Null Hypothesis	Model	F Statistics	p-value
D(Selic) does not Granger cause D(u)	1	3.92033	0.0118
D(u) does not Granger cause D(Selic)	1	4.68368	0.0047
D(u) does not Granger cause D(g)	1	11.5778	3.00E-06
D(u) does not Granger cause D(r)	1	2.76965	0.0475
D(U) does not Granger cause D(G)	2	7.22056	0.0003
D(DI360) does not Granger cause D(U)	2	2.27753	0.0887
D(U) does not Granger cause D(G)	3	10.5515	1.00E-04
D(TJLP) does not Granger cause D(G)	3	2.44902	0.0946

Source: Elaborated by the author.

These findings are reinforced by the Granger-causality tests (the significant results are shown for each model in table 3), which emphasize some monetary policy transmission channels. It can be observed

that a variation in the Selic rate Granger-causes the variation of the rate of capacity utilization at a significance level of 5 percent. The rate of capacity utilization precedes the other endogenous variables of the model, indicating a possible indirect effect of interest rate transmission to accumulation via changes in the rate of capacity utilization. The Granger-causality tests also seem to reinforce the endogenous role of the rate of capacity utilization, as predicted by neo-Kaleckian models, as this variable seems to mediate the other transmission effects.

Complementing the results obtained from the previous model, an analysis of models 2 and 3 is made, with the *ex-ante* interest rate indicator (DI360) and the TJLP, respectively. As in the previous model, shocks in the *ex-ante* interest rate cause negative reactions on the three equilibrium variables of the model. With the exception of very specific moments, all three variables registered negative reactions within the 95 percent confidence interval. Unlike the previous model, the Granger-causality tests reveal that the rate of capacity utilization Granger-causes changes in the rate of capital accumulation at the 5 percent level. However, the *ex-ante* interest rate also Granger-causes variations in the rates of capacity utilization and profit at the 10 percent level. These trends seem to validate the transmission mechanisms observed in the previous model.

In line with the previous models, the impulse-response functions reveal a negative response of the equilibrium variables to shocks in the TJLP. These reactions are significant within a 95 percent confidence interval for the rate of capital accumulation and for the rate of capacity utilization for much of the observed period. With the exception of a brief period where the reaction of the profit rate is significant, its permanent effects cannot be verified with a significance level of 5 percent. Also in line with the previous models, Granger-causality tests show that variations in the rate of capacity utilization Granger-cause variations in the capital accumulation rate with a significance level of 5 percent. Unlike the previous models, however, there is an indication that variations in the TJLP Granger-cause variations in the capital accumulation rate at a significance level of 10 percent, with no significant effects on capacity utilization. These trends corroborate the idea that the TJLP could have a greater direct influence on investment decisions, when compared to the previous interest rate indicators.

The results found here are consistent with the parameters estimated by Oreiro *et al.* (2013) and Feijó *et al.* (2016), who found a significant negative correlation between the short-term interest rate and the rate of capital accumulation. Likewise, the results are in line with those estimated by Feijó *et al.* (2019), which establish a negative impact of the *ex-ante* interest rate on capital accumulation. The results found here are also consistent with the parameters estimated by Bruno *et al.* (2011) for the period from 2004 to 2008, in which interest income had a negative impact on the rate of capital accumulation[15].

[15] For this period, Bruno et al. (2011) classify the accumulation regime as finance-led. It should be noted, however, that this terminology differs from the one used here, which follows the taxonomy proposed by Hein (2014). For Bruno et al. (2011), the finance-led regime would be closer to Hein's (2014) puzzling regime. Despite the differences in nomenclature, the results

Nevertheless, the results are not consistent with those from 1991 to 2003, in which interest income seems to have positively influenced the rate of accumulation. Some points can help explain this difference, beginning with the interest income indicator which, unlike the one used here, is based on the accumulated Selic rate. In addition, the sub-sample that precedes 1999 is marked by an unstable international environment that made interest rates susceptible to the consequences of the recurrent financial crises, causing increased volatility and a considerably higher level of the Selic rate.

6. Summary and Conclusions

This study has conducted an empirical exercise to identify the Brazilian accumulation regime in the post-stabilization period, based on Hein's (2007) monetary extension of a post-Kaleckian model. It is worth emphasizing that it is not the intention of this exercise to capture all the impacts and transmission channels that connect monetary policy with the studied variables. Starting from a model with no foreign sector and no economic activity of the state, recognition is made of the limitation of this exercise for analyzing the complexity of factors that dictate the dynamics of capital accumulation in the Brazilian economy as it excludes some important variables. This study is, above all, an exercise that seeks to reflect on the dynamics of capital accumulation in the Brazilian economy from the perspective of a restricted neo-Kaleckian model.

This study has sought to give an empirical contribution to the neo-Kaleckian literature by estimating a restricted VAR model. Thus, although there are some neo-Kaleckian empirical studies that apply VAR models to the Brazilian economy (Avritzer et al., 2016; Gonçalves, 2018), they do not explicitly incorporate the effects of interest on the accumulation regime. Likewise, empirical studies that integrate interest rates into the neo-Kaleckian framework do so with single equation models. Thus, an attempt has been made to expand the body of empirical evidence on the impact of interest rates on the accumulation regime with a new theoretical approach (by estimating the accumulation regime based on interest rate shocks), as well as with a specific technique (by estimating VEC model for the Brazilian economy).

An analysis of the Brazilian monetary policy frameworks during the post-stabilization period was made - from the exchange rate anchor to the macroeconomic tripod. It was found that the different frameworks were associated with specific variation and volatility patterns of the Selic rate. The comparative analysis of the equilibrium variables (capital accumulation rate, rate of capacity utilization and profit rate) raised the possibility of an intermediate accumulation regime for the two initial periods. Nonetheless, the years that followed the flexibilization of the macroeconomic tripod seem to suggest a contractive accumulation regime.

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found by Bruno et al. (2011) for the post-2004 period are consistent with those presented here, insofar as interest rates cause the rate of capital accumulation to fall.

The effects captured by the VEC models confirm these trends, indicating a contractive regime during the post-stabilization period, given that the equilibrium variables reacted negatively to shocks in the Selic rate. As a complement, two other models were estimated, incorporating indicators for the *ex-ante* interest rate as well as for the long-term interest rate (TJLP). The results of these models converge with the analysis of the benchmark rate, offering stronger evidence for a contractive accumulation regime.

In addition to the impulse-response functions, the Granger-causality tests point to some peculiarities of the monetary policy transmission channels. They show that the Selic rate Granger-causes variations in the rate of capacity utilization, which, in turn, Granger-causes variations in the other equilibrium variables, suggesting an indirect effect of the interest rate on accumulation through the rate of capacity utilization. This same trend is observed, with a lower level of significance, for the *ex-ante* interest rate. The TJLP, on the other hand, seems to Granger-cause the capital accumulation rate without intermediations. These findings are consistent with a truncated term structure of the interest rate in Brazil as they suggest an obstruction of the direct effects of the Selic rate and its term structure on the rate of capital accumulation. Likewise, the direct effects of the TJLP on capital accumulation is consistent with the segmentation of the credit market in Brazil because the TJLP was the base rate of the BNDES' earmarked credit up to the year 2017. As a result, the TJLP may have contributed to obstructing the direct effects of the Selic rate on capital accumulation.

Finally, the occurrence of contractive regimes emphasizes the inadequacy of the institutional framework of Brazilian monetary policy - especially with regard to the inflation targeting regime - for the promotion of a sustainable level of economic growth. As this analysis shows, the periods with the highest levels of capital accumulation coincided with periods of flexibilization of the macroeconomic tripod and the inflation targeting regime. Likewise, these periods registered the highest levels of the rates of capacity utilization and profit. Therefore, the flexibilization measures implemented during the 2000s – such as the adoption of non-declining targets, lower speed of convergence to the target, and the adoption of macroprudential measures – allowed for a cycle of reduction in interest rates that, as suggested by the results of this exercise, seems to have had a positive impact on output.

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