Political Economy of the Brazilian Central Bank and the Global Financial Cycle: an empirical evaluation based on the MS-VAR model (2000-2017)

Eliane Cristina de Araújo (State University of Maringá - Brazil)
Elisangela Luzia de Araújo (State University of Maringá - Brazil)
Mateus Ramalho Ribeiro da Fonseca (Federal University of Rio Grande do Sul – Brazil)
Pedro Perfeito da Silva (Central European University)

Abstract

The present paper investigates theoretically and empirically the effectiveness of monetary policy in Brazil, which since 1999 has adopted the Inflation Target Regime, in light of the behavior of the global financial cycle. The main idea of this research is to evaluate the implications of the discretionary conduct of the monetary policy in the environment of global financial instability, under the assumption that it interferes decisively in its efficiency and autonomy. In order to reach the objective of the study, it analyzes the general features of monetary policy based on the New Macroeconomic Consensus and contrasts with the post-Keynesian critique and, moreover, emphasizes the implications of the global financial cycle for the conduct of monetary policy. In the following it is estimated a model of Autoregressive Vectors with Markov chains (MS-VAR) for the Brazilian economy, in the period between January of 2000 and December of 2017, considering the variables traditionally used in the empirical literature, besides the inclusion of a variable representative of the influence of the global financial cycle. The main results were in line with expectations and showed that the greater financial instability has direct effects on domestic inflation, raising it, so that a review of central banks' performance would be fundamental in this context.

Keywords: Inflation Target Regime, Global Financial Cycle, Brazil.

JEL: C14, E12, E42.

1. Introduction

The crisis of the Bretton Woods System (SBW) in the early 1970s led to substantial changes in the International Monetary and Financial System (IMFS) with important implications for domestic macroeconomic policymaking, especially for

developing countries. At the external level, the new context influenced countries to pursue the liberalization of economic relations, taking advantage of capital inflows and the discipline of international trade on government policies (Mishkin, 2005; Kose et al., 2009). Internally, the focus would be on the inflation control, which, driven by clear rules, would boost the confidence of the private sector, the true protagonist of the growth process (Fischer, 1998).

In light of the changes mentioned, and in face of the collapse of the Developmental State in the early 1980s, Brazil adhered to economic globalization based on a strategy of subordinate insertion, mainly through the financial channel. Specifically, it meant an upward trend in the trade and financial liberalization, prioritizing price level stabilization in the macroeconomic management.

Even though this strategy was able to overcome hyperinflation with the 1994 Real Plan, on the other hand, the consequent growth strategy – combining foreign savings with semi-fixed exchange rate regime – engendered new forms of instability, culminating in the 1999 financial crisis. In response to this context, macroeconomic policy moved towards the so-called macroeconomic tripod based on the flexible exchange rate regime, the primary surplus target and the inflation targeting regime (ITR), to be fulfilled through a main instrument, the determination of the benchmark interest rate (Selic)[1].

During almost two decades of ITR, several studies such as Sicsú (2002), Mendonça (2004, 2005, 2007), Minella et al. (2003), Squeff (2009), Ferreira and Jayme Jr (2005), Dezordi et al. (2009), Mendonça, Dezordi and Curado (2009), Modenesi and Araújo (2011, 2013) and Fonseca, Oreiro and Araújo (2017) focused on the analysis of the Brazilian monetary policy by evaluating the effectiveness of increasing the Selic to achieve price level stability. However, despite their contribution to the subject, such studies did not investigate the influence of the global financial cycle.

Considering this literature gap, the paper intends to evaluate the relationship between the benchmark interest rate and the price level in Brazil based on the estimation of Markov-switching vector autoregressive model (MS-VAR) for the period from 2000 to 2017. The potentially original contribution of this article is to consider the influence of the global financial cycle as a conditioning factor of domestic monetary policy. It is assumed that the global financial cycle decisively interferes in the conduction of

[1] Such economic policy strategy is based on the New Macroeconomic Consensus. For more information, see Arestis and Sawyer (2008).

domestic monetary policy and that the effects of financial instability are aggravated by the rigidity of ITR.

This study is structured as follows. After this introduction, the second section presents a summary of the recent international experience of ITR-based monetary policy and central bank independence, followed by the Post-Keynesian critique of this institutional framework. The third section focuses on the econometric estimation and the discussion of its results. Finally, the final considerations of the paper are presented; among other results, it is affirmed that greater financial instability has direct effects on the rise of domestic inflation, therefore a review of central bank practice is essential in this context.

2. Inflation Targeting Regime and Central Bank independence: a synthesis of international experience

According to the New Classical School, it is not effective to conduct discretionary monetary policy because economic agents are able to anticipate policy makers' decisions. On the other hand, monetary policy rules can be used to fight inflation without the short-term recessive costs presented by monetarism. Therefore, based on the credibility-reputation-delegation triad, several models emerged to design the optimal conduct for central banks, highlighting the role of independence and inflation targeting[2].

The central bank independence consists of delegating the conduction of monetary policy to an independent organization, focused on the inflation control, thereby maintaining the credibility of monetary policy and the reputation of the monetary authority. The ITR can be defined as a strategy for the monetary policy, based on the announcement of an inflation target for an established period. In other words, this regime seeks to anchor agents' expectations about future inflation through the transparency of monetary policy.

In addition, there is an institutional commitment of the monetary authority to price stability, to which the other objectives are subordinated. According to the New Classical School, this commitment will be stronger in case of central bank independence. The use of available information of many variables is the basis for

[2] For more information about the New Classical School, see Lucas (1972), Lucas and Sargent (1981) and Lucas (1983).

adjusting the monetary policy instrument, the short-term interest rate, which is raised whenever inflation is closer to the target or the current GDP is closer potential GDP.

In practice, 27 countries currently adopt the ITR: Armenia, Australia, Brazil, Canada, Chile, Colombia, Czech Republic, Ghana, Guatemala, Hungary, Iceland, Indonesia, Israel, Mexico, New Zealand, Norway, Peru, Philippines, Poland, Romania, Serbia, South Africa, South Korea, Sweden, Thailand, Turkey, United Kingdom. Hammond (2012) presents a summary of the ITR structure these countries and their institutional features, highlighting aspects like objective, central bank independence, convergence horizon and inflation measures (see table 1).

Table 1 – Key Features of Inflation Targeting Regime

Country and date of ITR adoption	Legal mandate	Target horizon	Central bank operational independence	Target type and measure	Target determined by
Armenia, Jan. 1996	Price stability	Medium-term	Yes	Target + Range; Target Core	Government and CB
Australia, Jun. 1993	Monetary stability, full employment, economic prosperity and well-being	Medium-term	Yes	Range; Target Core	Government and CB
Brazil, Jun. 1999	Price stability	Annual target	Yes	Target + Range; Target Core	Government and CB
Canada, Feb. 1991	Economic and Financial Welfare	Renewed for five years until the end of 2021	Yes	Target + Range; Target Core	Government and CB
Chile, Set. 1999	Monetary stability and normal functioning of domestic and foreign payments	Around two years	Yes	Target + Range; Target Core	CB
Colombia, Oct. 1999	Maintainance of currency purchasing power	Medium-term	Yes	Range; Target Core	CB
Czech Republic, Dec. 1997	Price stability and support for economic policy to sustainable economic growth	Medium-term, 12–18 months	Yes	Target + Range; Target Core	CB
Gana, Informally 2002, Formally May 2007	Price stability, economic growth and effective operation of the banking and credit systems	Medium-term	Yes	Target + Range; Target Core	Government and CB
Guatemala, 2005	Price stability	End of year	Yes	Target + Range; Target Core	CB
Hungary, Jun. 2001	Price stability	Medium-term	Yes	Target + Range	CB
Iceland, Mar. 2001	Price stability and support for the government's main economic policy	Medium-term	Yes	Target + Range	Government and CB
Indonesia, July 2005	The stability of the rupee value	Medium-term	Yes	Target + Range; Target Core	Government and CB
Israel, Informally	Price stability and support for the government's	Two years	Sim	Range; Target Core	Government and CB

1992, Formally 1997	economic policy				
Mexico, 2001	Maintain the purchasing power of Mexican currency	Medium-term	Yes	Target + Range; Target Core	CB
New Zealand, Dec. 1989	Price stability	Medium-term	Yes	Range; Target Core	Government and CB
Norway, Mar. 2001	Low and stable inflation, output and employment	Medium-term	Yes	Punctual; HCPI	Government
Peru, Jan. 2002	Reserves on monetary stability	Any time	Yes	Target + Range; Target Core	CB
Philippines, Jan. 2002	Price stability, balanced and sustainable growth	Medium-term	Yes	Target + Range; Target Core	Government and CB
Poland, 1998	Price stability and support for government economic policies	Medium-term	Yes	Target + Range; Target Core	CB
Romenia, Aug. 2005	Price stability and support for general economic policy.	Medium-term	Yes	Target + Range; Target Core	Government and CB
Serbia, Informally Set. 2006, Formally Jan. 2009	Price stability, financial stability and support to the economic policy	Medium-term	Yes	Target + Range; Target Core	Government and CB
South Africa Feb. 2000	Protection of currency value and sustainable economic growth	Continuously	Yes	Range; Target Core	Government
South Korea, 1998	Price stability	Three years	Yes	Target + Range; Target Core	CB (with Government)
Sweden, Announced Jan. 1993, Applied 1995	Price stability, economic growth and employment	Two years	Yes	Range; Target Core	CB
Thailand, May 2000	Promote the monetary stability and formulate monetary policies	Eight quarters	Yes	Target + Range; Target Core	Government and CB
Turkey, Jan. 2006	Price stability	Three years	Yes	Target + Range; Target Core	Government and CB
United Kingdom, Oct. 1992	Price stability, economic growth and employment	Any time	Yes	Target + Range	Government

Source: Hammond (2012) and national central banks; reformulated by the authors.

Initially, table 1 shows considerable diversity in central bank legal mandates, including other monetary policy objectives besides inflation control such as economic growth, welfare, low unemployment and financial stability. Regarding central bank independence, in terms of autonomy for setting the monetary policy objective, Hammond (2012) points out that, as the objective of monetary policy of price stability is generally established by law, the independence of objective, as suggested by Rogoff

(1985), becomes a second-order issue in the definition of inflation targeting regimes[3]. However, it is noteworthy that the central banks of countries that adopt ITR have operational independence, that is, freedom to choose the necessary instruments to reach the previously established inflation target. In theoretical terms, as Walsh (1995) suggests, the central bank independence can be understood in terms of the independence of its economic policy instruments.

Concerning the convergence horizon, most countries adopt a medium-term convergence period from two to three years. These medium-term horizons give greater flexibility to the inflation targeting regime by anchoring inflation expectations while allowing short-term divergence from the stipulated target. Additionally, an important aspect of choosing the time horizon for inflation convergence refers to the extension of monetary policy transmission mechanisms, that is, if the process by which monetary policy decisions are transmitted to real output and inflation is slow, the central bank is not able to shape inflation in the short run.

Another relevant feature of ITR is the definition of a punctual or a range target. In this regard, the first alternative constitutes a stricter regime, which faces additional difficulty achieve the target. Table 1 shows that countries generally choose both, i.e., a punctual target with lower and upper inflation tolerance bounds.

The definition of the measurement of price level is also an important since it can be a full index or a core inflation one. All 27 ITR countries rely on the consumer price index as a measure of inflation, especially for its monthly frequency. However, despite using the full index, many central banks also analyze core inflation measures as an indicator of the inflationary pressures of the economy. For instance, Hammond (2012) argues that Australia, Canada, Czech Republic, Ghana, Hungary, Norway, Poland, Sweden and Turkey also publish core inflation forecasts. These core inflation estimations are characterized by the exclusion of the most sensitive components of price index in face of various types of shocks. The use of the core inflation aims to reduce the volatility of the price index and thus to avoid excessive use of the monetary policy in the event of supply shocks.

Finally, in fifteen ITR countries, the inflation target is set jointly between the government and the central bank. In nine countries, the central bank sets the target

[3] Rogoff (1985) proposes the constitution of a central bank that has independence of both objectives and instruments. In other words, the central bank would be free to define the ultimate goals of monetary policy and what instruments will be used to achieve them.

alone, and among them, only Sweden is considered a developed economy. Lastly, in only three countries (South Africa, Norway and the United Kingdom) the inflation target is set by the government.

Specifically about the Brazilian case, which will be empirically evaluated in this article, table 1 shows that the country is one of the few to pursue only price stability, leaving monetary policy underutilized to broader economic objectives, as is done by many other countries even under the ITR institutional framework.

Regarding the inflation convergence horizon, Brazil is also one of the few countries that presents an annual target as the inflation convergence horizon to the established target. Therefore, when the economy is exposed to shocks, the central bank is forced to respond quickly to shocks in order to meet the inflation target within the set horizon. This arrangement may affect negatively other economic variables such as employment and GDP as well as add difficulties for the accommodation of supply shocks.

3. Central Bank Theory and Practice: Post Keynesian Critique

The recent performance of central banks around the world, as mentioned, is largely based on the New Classical theoretical framework developed since the 1970s mainly by Robert Lucas. The core proposition of this approach is that the discretionary conduct of monetary policy results in the inflationary bias, which can be overcome by the adoption of independent central bank. As exposed previously, this theoretical framework relies on Rogoff's (1985) and Walsh's (1995) credibility-reputation-delegation models to identify optimal conduct for central banks.

Based on this theoretical framework, from the 1990s onwards, the theory and practice of central banks around the world began to reflect the idea that inflation should be the main objective pursued by macroeconomic policy – to which all others goals are subordinated – and that monetary stability is the fundamental condition for long-term growth. The range of policies, methods and tools that central banks could use to achieve their objective was also narrowed. In fact, it came to be represented solely by an inflation target pursued through benchmark interest rates control by an independent central bank. Relevant issues such as financial stability have been set aside and excluded from the scope of central bank policies.

Nevertheless, this conduct of central banks has also been widely criticized. Post-Keynesian approach, for example rejects the neutrality of money, opposing the key ITR foundations. Following Keynes, these authors argue that central bank policy rather than focusing on price stability itself should reflect the concern about income and wealth distribution, supporting the the currency as a social relationship by keeping financial stability (Arestis; Sawyer, 2006; Down, 2016).

Arestis and Sawyer (2006) highlight some of the problems of Keynesian theory to the ITR framework under the guidance of independent central banks. Briefly they emphasize that:

I. the adoption of a nominal anchor, such as an inflation target, leaves little room of maneuver to stabilize output;

II. the separation of the real and monetary factors implies that the rise in interest rates would only change demand in the short term, not changing supply in the long term, which is completely different from Keynes' view that the money supply has short and long term effects on real and nominal economic variables;

III. the consideration of only demand-led inflation may be a mistake for at least two reasons: the effectiveness of monetary policy over the control of aggregate demand and, second, costs may be a major pressure source on price;

IV. the assumption that there is a single interest rate equilibrium, which equals savings and investment and is consistent with full employment. This is inconsistent with the Keynesian view that there is a corresponding level of effective demand and, therefore, different levels of employment at each interest rate level.

Down (2016) criticizes the policies of central banks that, in her view, act contrary to the current world with negative consequences on the real economy, either in aggregate or in terms of income distribution. The first factor that the author mentions is that changes in interest rates imply changes in the availability and price of credit between different agents (rentiers and investors in productive activity), leading to relevant distributive impacts. Secondly, she argues that the current dominant model of central banks allows them to control only the price of money, not other financial assets in a world where deregulation and financial innovation expanded continuously. In this regard, the reductionist view of the role of central banks in recent decades does not address the complexity and uncertainty surrounding globalized finance: financial crises may lead to the collapse of prices/liquidity of these financial assets, compromising the

ability of the entire system to supply credit, disarticulating the foundations of macroeconomic stability.

Hartwell (2019) also criticizes the ITR and the central bank independence. First, the author discusses the relationship between the ITR-based central bank and the broader institutional system that supports monetary policy. In this sense, the author shows several implications of such conduct, including the fact that the weight of the financial sector tends to grow in countries with an independent central bank, suggesting that central bankers face more pressure not from politicians or voters, but from the banks themselves. Second, the author addresses the position of independent central banks in the context of globalized finance. In this regard, the author shows the correlation between the interest rates of the main central banks of the world, indicating that there is a coordination or convergence of monetary policy of these "independent" central banks.

Bibow (2004) also discusses the ITR and the central bank independence making a harsh critique of temporal inconsistency – theoretical justification for independence. According to the author, it leads to a biased and dangerously unilateral view of central bank independence and monetary policy in which the maximization of independence is always the best thing to do, albeit at the expense of product stabilization. He analyzes the lack of reliable studies showing the economic performance of independent central banks, assessing that the scant literature is flawed due to the confusion between cause and effect.

The author also highlights that the argument based on temporal inconsistency distorts the discretion versus rule debate, moving away from Keynes and even Friedman's propositions, which never conceived an independent central banker in his theory, believing that concentration of vast powers in the hands of a banker free of any effective political control would be a risk. Thus, the short-sighted view of monetary policy translates into unjustified single focus on price stability, rather than addressing the important functions of a central bank, such as effective policy coordination and democratic accountability.

Summing up, the post-Keynesian debate asserts the centrality of overcoming the current way of conducting monetary policy by central banks, that is, focusing on "a goal, an instrument" given by the ITR and the independent central banks to an institutional framework more realistic, particularly aware of the context of globalized finance and its potentially unstable effects, notably in developing countries.

4. The global financial cycle and its impacts on monetary policy

With the outbreak of the 2007 Global Financial Crisis (GFC), the expansionary and unconventional monetary policy by the United States strengthened the discussion about the global financial cycle and its developments in countries that do not have a convertible currency and therefore suffer the effects of the cycle. It is also noteworthy that recent literature on the global financial cycle goes back to Minsky's (1986, 1991) concern with how the interaction between productive units, linked by payment commitments in a specific institutional environment, leads to the evolution of balances sheets between hedge, speculative and Ponzi profiles.

Relying on these insights, the recent research from the Bank for International Settlements (BIS) proposes the concept of global financial cycle to address the challenges posed by the financial crisis and its developments. In this regard, BIS (2014) and Borio (2012) define the financial cycle as mutually reinforced interactions between perceptions of value and risk, attitudes towards risk and financial constraints. There are four features of the financial cycle: i) a longer duration than the business cycle; ii) the coincidence of its peaks with banking crises; iii) synchronization between economies due to capital mobility and the role of the US dollar; and iv) the response to the macroeconomic environment and the economic policy regime, so that financial liberalization and the New Macroeconomic Consensus increased the breadth and duration of the cycle.

In empirical terms, the measurement of the financial cycle (domestic or global) can be made from several variables, but the smallest set is composed by the real credit growth, the ratio of credit to nominal product and the real estate price growth. The first two are a proxy for the degree of leverage, while the latter measures the available guarantees. Thus, the upward phase of the cycle is characterized by expansion in these dimensions. Empirical studies – such as Nier, Sedik and Mondino (2014), Pasricha et al. (2015) and Rey (2013) – rely on the global financial market volatility indicator (VIX), calculated by the CBOE[4] (Chicago Board Options Exchange Market). In this regard, lower levels of VIX characterize moments of rise in the global financial cycle.

[4] According to Nier, Sedik and Mondino (2014), the empirical literature about the global financial cycle uses VIX as a measure of risk aversion and uncertainty in the global financial market, as the index shows

The approach based on global financial cycle provides relevant arguments for understanding the eruption of GFC and its consequences. The first is the result of the contribution of Borio (2014) and Borio, James and Shin (2014) regarding the source of imbalances in the international financial and monetary system. According to the authors, the main source of financial instability would be the excessive elasticity of this system, materialized in the fact that the very incubation of a period of cyclical rising leads to interactions between institutional regimes and agents' behavior, which mutually reinforce each other by deepening the expansive trajectory as well as expanding vulnerabilities in the financial and real sectors.

According to Borio (2014), the building of financial booms, which precedes processes such as the recent GFC, goes through several elements. They are: (i) the pro-cyclical and volatile nature of agents' perceptions of value and risk, so that a lower perception of risk validates asset valuation, further encouraging risk taking; ii) inappropriate incentives for agents, reinforcing short-term focus and coordination and lead agent issues; iii) the mechanisms of mutual reinforcement, such as the interaction between the fall in perceived risk and the incentive to take more risk, given that there is a concomitant increase in access to external sources of financing and liquidity of assets; and iv) the absence of institutional constraints to expansion, such as the current economic policy regime that combines liberalized financial systems (in the external and internal dimension) and monetary policies focused solely on short-term inflation.

Another important element refers to the relationship between domestic financial cycles, leading to the global financial cycle. BIS (2014) and Borio (2012) focus on two points: i) the immediate reaction of the advanced countries (mainly the US) to GFC, as well as the limits of these responses taken; and ii) the impact of such measures on domestic financial cycles around the world and the possibility of further problems. In this sense, these studies discuss the centrality of US decisions in shaping the global cycle and conditioning cycles around the world. However, these studies have a more pragmatic focus, giving priority to the most appropriate policy mix for countries in different stages of the domestic financial cycle – topic of interest of the next section. Going further, Rey (2013) emphasizes the existence of a global cycle that hierarchizes and connects the domestic ones, as well as that US monetary policy performs a leading

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the expectation of stock market volatility over the next thirty days. In times of rising global financial cycle, there is a low level of volatility; in times of decline, a higher level of volatility is observed.

role in the determination of global cycles, influencing the volume and direction of gross capital flows.

From Rey's (2013) conclusions, it is possible to infer two important reflections. The first is that US monetary conditions are transmitted through global capital flows, conditioning a global financial cycle that is obviously not aligned with country-specific macroeconomic conditions. Because of this, it is possible to state that there is a dilemma (and not a trilemma) in the open macroeconomics, being not possible to combine full capital mobility and monetary policy autonomy. The second concerns the link between Rey's (2013) conclusions and Cohen's (2013) theory about power in the international financial and monetary system.

In this regard, the author's treatment of the global financial cycle highlights the two dimensions of dollar power in the currency hierarchy: i) autonomy, since it can reduce or postpone the costs of adjustment through interest rate decisions, which affect the exchange rate and thus the competitiveness of exports and the amount of foreign debt (denominated in domestic currency); and ii) influence, because US monetary policy dictates the pace of the global financial cycle and capital flows, limiting the degrees of freedom of economic policy in emerging and developing countries, which, in the absence of defensive policies that mitigate the pressure externally, cannot prevent the rise of the domestic financial cycle. This occurs because, on the one hand, maintaining a higher interest rate aimed at slowing down domestic credit supply expansion leads to currency appreciation and excessive capital inflows (restoring credit growth through external sources), while, on the other hand, the reduction of interest rates, in order to avoid such problems, favors the expansion of domestic credit and corroborates the loss of monetary policy autonomy.

Such studies on the global financial cycle pose a topic for discussion regarding the limits of the ITR, especially in the case of developing economies with no convertible currency such as Brazil. Thus, in times of cyclical boom, the capital inflows to emerging and developing countries favors exchange rate overvaluation, facilitating the achievement of the inflation target. However, in periods of reversal, private actors try to defend their profit margins by favoring a rise in price levels.

Therefore, the literature on the global financial cycle sheds light on two weaknesses of the ITR. Firstly, the evolution of the price level may also respond to factors outside the economy in question. In addition, the focus on controlling inflation as the main objective of economic policy hides other problems such as currency

overvaluation, current account imbalances and excessive short-term capital inflows, which deepen financial fragility even in a context of low inflation.

5. The macroeconomic impacts of Inflation Targeting Regime: an empirical assessment based on the MS-VAR model

This section presents the empirical analysis of the article by estimating Markov-Switching Vector Autoregressive model (MS-VAR), which incorporates regime changes in the time-series estimation. In other words, this model allows to discuss the nonlinear interaction between macroeconomic variables. Being the potentially original contribution of this paper, we reinforce the nonlinear characters of this empirical strategy by including the global financial cycle in the evaluation of Brazilian monetary policy.

According to Krolzig (1996; 1997; 1998), MS-VAR models rely from two important instruments: VAR models, proposed by Sims (1990), that are widely used to analyze macroeconomic relations; and models that use Markov chains to analyze regime changes in macroeconomic variables[5]. Krolzig (1997) created a simple notation to identify the models according to their respective parameters (see table 2).

Table 2 – Types of MS-VAR models

Parameters	MSM(m)-VAR(p)	MSMH(m)-VAR(p)	MSI(m)-VAR(p)	MSIH(m)-VAR(p)	MSIAH(m)-VAR(p)
μ	variant	variant	-	-	-
v	-	-	variant	variant	variant
$\sum$	invariant	variant	invariant	variant	variant
A_i	invariant	invariant	invariant	invariant	variant

Source: Krolzig (1997). Own elaboration.
Notation: MSM: Markov chain where the average varies; MSMH: Markovian chain where the mean and variance vary; MSI: Markov chain where the intercept varies; MSIH: Markovian chain where the intercept and variance vary; MSIAH: Markovian chain in which the intercept, autoregressive vestments, and variance vary; m: number of regimes; p: number of lag of VAR; μ: average (M), v: intercept (I), Σ: variance (H), A_i: autoregressive parameters (A).

In this article, we estimate a MS-VAR in which all parameters will be dependent on the regimes, that is, a MSIAH(m)-VAR(p) model. Such decision was made in order

[5] Several authors have worked with this model pointing to the existence of nonlinearity in macroeconomic models. For more details see: Hamilton (1989); Krolzig (1997); Ehrmann, Ellison and Valla, (2003).

to keep the flexibility of the estimation, needed to obtain convergence in the Expectation-Maximization (EM) algorithm[6].

It is important to note also that several variables present structural breaks, especially in 2001, 2002, 2007 and 2008, what adds difficulties for linear estimation. Regarding the variables, as previously exposed, the external dimension is incorporated by the consideration of the global financial cycle. Hence, we estimate a model composed of six variables with monotonic transformation in natural logarithm (see table 3).

Table 3 - Data Specification

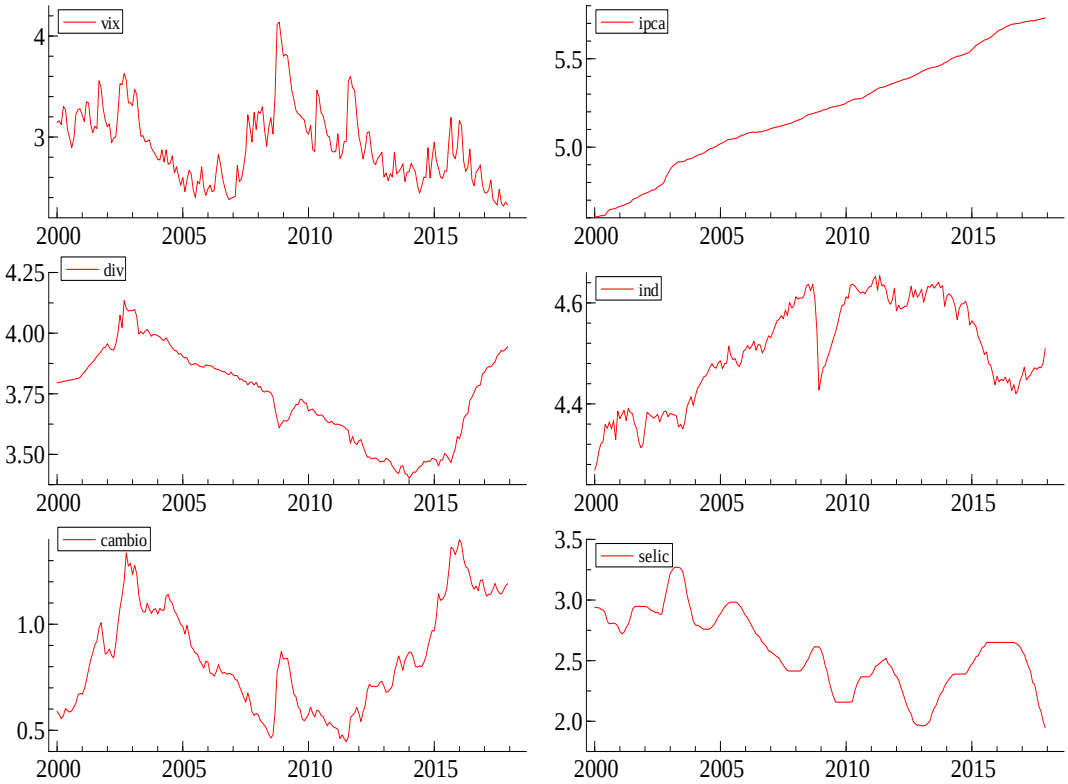
Serie	Name	Description
Global Financial Cycle	VIX	Volatility Index, calculated by BCOE - monthly average
Activity Level	IND	Industrial production - general industry - quantum - seasonally adjusted index (2002 average = 100)
Exchange rate	CAMBIO	Free Exchange Rate - Monthly average.
Public Sector Net Debt	DIV	Percentage of public sector net debt as a proportion of monthly GDP.
Interest rate	SELIC	Annualized benchmark interest rate.
Price Level	IPCA	National Broad Consumer Price Index (IPCA) 9January 1995 =100).

Source: Institute of Applied Economic Research (IPEA); Central Bank of Brazil (CBB).

As previously stated, our sample covers data from January 2000, the date of formal implementation of the ITR, to December 2017. According to Woodridge (2002), an estimation has a sufficient degree of confidence when it meets two conditions: (i) more than 60 observations; (ii) fewer parameters than total observations. In our estimation, both conditions are met since 164 parameters were estimated from 214 observations. The selection of endogenous variables was based on Fonseca, Silva and Araújo (2017). The behavior of each variable can be observed in Figure 1:

Figure 1 – Behavior of the variables over time

[6] For more information, see McLachlan and Krishnan (2007).



Source: the authors based on OxMetrics 7.2.

The adoption of industrial production as a proxy for level of activity demands further explanation. As industrial production represents less than 20 percent of Gross Domestic Product (GDP), its use has limitations that cannot be ignored. The best scenario would be the use a broader indicator of economic activity that would also include, for example, the service sector. However, in the absence of a monthly economic activity index, the adoption of industrial production index becomes inevitable, being usual in other studies like Araújo and Modenesi (2010a, 2010b), Modenesi and Araújo (2013), Fonseca, Peres and Araújo (2016) and Fonseca, Silva and Araújo (2017).

An important step before making the actual estimations is to perform model selections tests. First, the table 4 presents the lag selection tests:

Table 4 - Lag Selection Test.

Lags (p)	LogL	LR	FPE	AIC	SC	HQ
0	477.779	NA	4.80E-10	-4.429853	-4.335168	-4.391588
1	3067.68	5009.58	1.85E-20	-28.41017	-27.74738	-28.14232
2	3227.48	300.0952	5.79E-21	-29.57262	**-28.34173***	**-29.07518***
3	3265.36	**68.99185***	**5.70e-21***	**-29.59022***	-27.79122	-28.86319

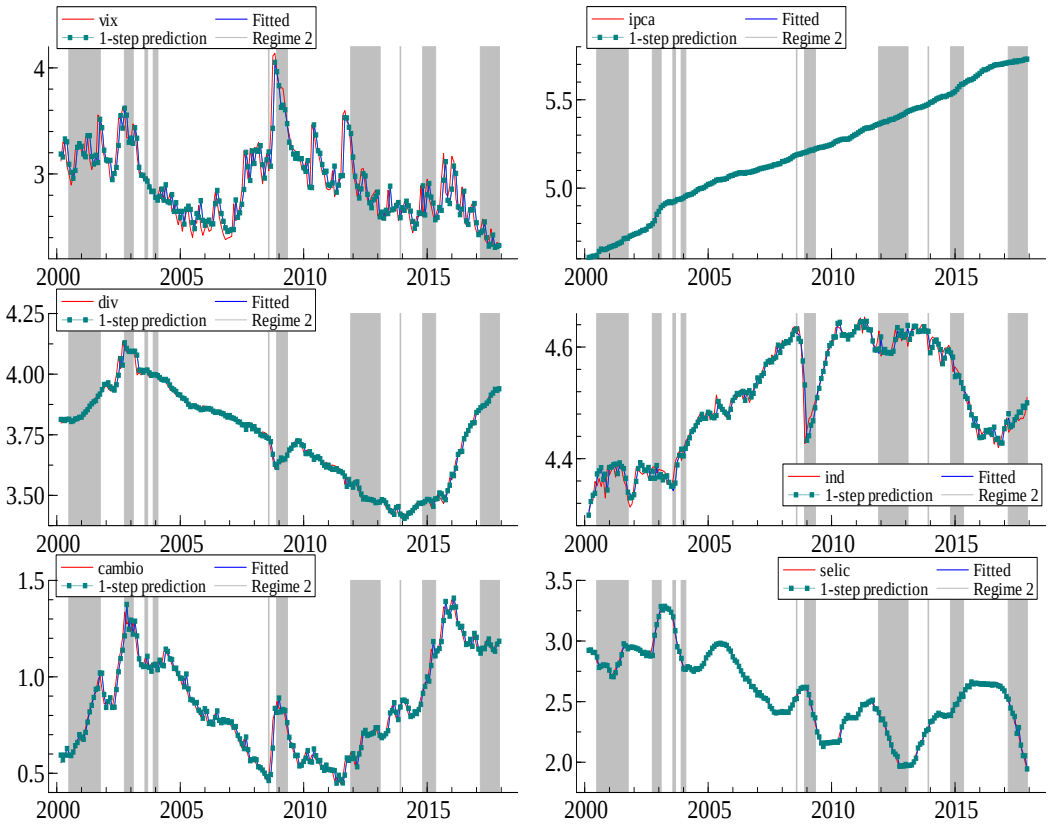
Source: the authors based on OxMetrics 7.2.

Based on this information, MS(2)-VAR(3) was estimated, in which the number of possible regimes was 2 (two) and the optimum lag was 3 (three). The explanation for the two-regime estimation is based on the dynamics of the price level, which presents a upward regime, characterized by higher inflation rates, and a downward regime, characterized by lower rates. Moreover, the number of parameters to be estimated in a three-regime MS-VAR model grows considerably, exceeding the degrees of freedom.

The MS-VAR estimation is justified by the linearity test. According to the LR test, the relationship between endogenous variables are not linear at a significance of 1 percent.

The behavior of residuals is also pivotal to the proper estimation of MS-VAR. In this regard, at a significance of 1%, the Portmanteau and ARCH tests indicated, respectively, the absence of residual autocorrelation and heteroscedasticity. The convergence of the EM algorithm occurred after two interactions, with a change probability of 0.0001. Figure 2 shows the adjustment of the model in each estimated regime.

Figure 2 – Adjustment of the model to the regimes



Source: the authors based on OxMetrics 7.2.

The MS(2)-VAR(2) model estimated for the period from January 2000 to December 2017, showed the following regime transition matrix:

$$\hat{T} = \begin{bmatrix} 0{,}95681 & 0{,}10800 \\ 0{,}043188 & 0{,}89200 \end{bmatrix} \qquad (1)$$

It can be seen from the matrix $\hat{T}$ that the estimated regimes in the model are persistent, that is, since monetary policy remains in one of the regimes, the probability of staying in this same regime is high. This is because, according to the matrix $\hat{T}$, being in the first regime, the probability of switching to the second regime is 4.3%, while the probability of staying in the same regime is 95.7%. The same occurs in the second regime, once in it, the probability of change is 10.8%, and of permanence is 89.2%.

Figure 2 shows that, according to the estimated probabilities, the two regimes can be classified temporally, resulting in Table 5:

Table 5 - Classification of estimated regimes

Regime 1	Regime 2
04/2000 - 04/2000 (0.528)	05/2000 - 10/2001 (0.970)
11/2001 - 09/2002 (0.992)	10/2002 - 02/2003 (0.999)
03/2003 - 04/2003 (0.998)	05/2003 - 02/2004 (0.884)
03/2004 - 10/2008 (0.989)	11/2008 - 03/2009 (0.972)
04/2009 - 06/2012 (0.990)	07/2012 - 02/2013 (0.900)
03/2008 - 02/2017 (0.975)	03/2017 - 12/2017 (0.993)
Total: 157 months It represents 73.71% of the estimated period with an average duration of 26.17 months.	Total: 56 months It represents 26.29% of the estimated period with an average duration of 9.33 months.

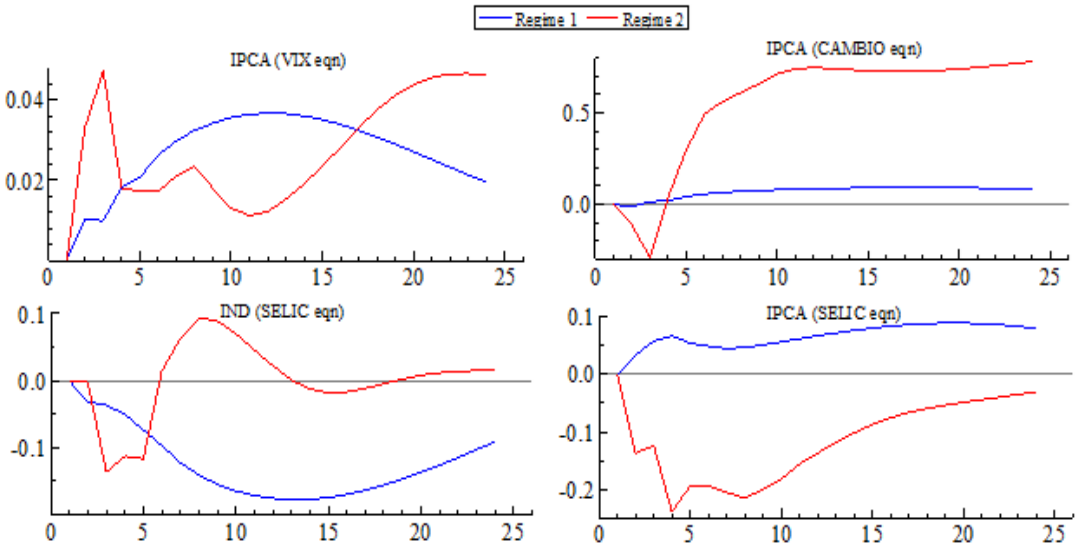
Source: Own elaboration through OxMetrics 7.2.
Note: Probability in parentheses.

The regime 1 (one) is more persistent and predominant, totaling 157 months of the analyzed period and having an average duration of 26.17 months. Regime 2 (two) has a lower persistence, totaling 56 months of the period analyzed and having an average duration of 9.33 months.

Thus, to further analyze the results of the MS-VAR model, the impulse-response functions are important in time series analysis since they summarize the information of the estimated autoregressive parameters, variances and covariances, making the interpretation of changes in the parameters easier to observe.

The impulse-response functions of the MS-VAR model are exposed according to the estimated regimes: the blue lines represent the estimation that depends on the first regime; while the red lines represent the second regime (see figure 4).

Figure 4 - Impulse-Response Functions



Source: the authors based on OxMetrics 7.2.

The analysis of impulse response functions can be organized around two strands. The first focuses on the direct impact of monetary policy on Brazilian macroeconomic performance, which shows that contractionary monetary policy depends on the price level regime.

Therefore, in a regime characterized by low inflation rates, an increase in interest rates is associated with an initial inflationary effect due to the price puzzle phenomenon. On the other hand, in a regime characterized by higher inflation, contractionary monetary policy behaves as expected, helping to curb inflation. The response of the level of economic activity follows a different pattern. Thus, under both regimes, a contractionary policy has a recessive effect.

The second strand of analysis covers the external dimension of price level evolution, including the exchange rate and the global financial cycle. Considering the direct relationship between price level and exchange rate in the two regimes, an exchange rate overvaluation seems to contribute to inflation control. In this regard, it is possible that the ITR effectiveness rely on an indirect channel, exchange rate overvaluation, which engenders negative consequences such as the deepening of deindustrialization and regressive specialization of the Brazilian economy.

Regarding the global financial cycle, a shock in the VIX variable, i.e., an increase in global financial instability seems to be associated with an increase in the price level in both regimes. This result can be interpreted based on Post-Keynesian

economics, according to which private agents seek to defend their profit margins in periods characterized by deteriorating expectations.

The results obtained should be analyzed in the light of two dimensions: (i) the position of the Brazilian economy in the International Monetary and Financial System; (ii) the Brazilian macroeconomic performance over the last two decades. In the first dimension, the price level response to an advance in global financial instability can be faced as an indicator of Brazil's peripheral position in the international currency hierarchy as the global financial cycle is fundamentally influenced by developed countries' monetary policy.

Furthermore, in line with the previous discussion, it is noted that the performance of the ITR in the fight against inflation is a function of the current state of the global financial cycle. This conclusion becomes relevant as the adoption of the ITR around the world was in the midst of a period of cyclical expansion, characterized by increased global economic integration and reduced risk aversion by investors. In other words, the effectiveness of the ITR tends to be put at risk in periods of greater instability, which have been recurrent after the GFC.

Turning to the consequences for macroeconomic performance, the results indicate that the Brazilian economy tends to face inflationary pressures amid the reversal of the global financial cycle. According to the ITR assumptions, this implies the adoption of a contractionary monetary policy amid the international economic slowdown. This trend is aggravated by the ITR arrangements in Brazil as well as by the price puzzle phenomenon.

The recent evolution of the Brazilian economy reinforces the results obtained as periods of growth slowdown coincide with higher inflation, especially at the beginning of the economic downturn. Given that currency overvaluation seems to be the most effective channel to contain inflation, there is also a strong exposure of short-term macroeconomic performance to external fluctuations, as well as negative effects on export competitiveness.

Finally, the empirical limitations of this exercise are straightforward since the behavior of impulse response functions does not imply a causal relationship. On the other hand, the combination of results that converge with previous literature with additional aspects related to the impact of the global financial cycle is indicative of the need to deepen the discussion about the recent performance of central banks, in particular, the performance of the ITR in Brazil.

6. Final Remarks

This article discussed the relationship between the benchmark interest rate and the general price level in Brazil during the Inflation Targeting Regime. From a theoretical point of view, the post-Keynesian critique to the New Macroeconomic Consensus and, consequently, to the Inflation Targets Regime and the central bank independence was presented. Also, the interaction between this research problem and the financial dimension has been incorporated, considering the recent literature on the impact of the global financial cycle on emerging and developing economies.

In the empirical section, a Markov-Switching Vector Autoregressive model (MS-VAR) was estimated from a monthly sample from January 2000 to December 2017. In addition, a proxy variable of the global financial cycle was included in the estimation of the model, which is the main contribution of the present work.

This empirical exercise generated results in line with the Post-Keynesian critique of the ITR and central bank independence. Firstly, it was observed that the impact of the rise in the benchmark interest rate on inflation is a function of the price level regime. On the one hand, in a regime characterized by low inflation rates, a contractionary monetary policy had an initial inflationary effect due to the price puzzle phenomenon. On the other hand, under a regime characterized by higher inflation, an increase in interest rates contributed to the control of inflation. As expected, the price level also responded to other constraints such as the exchange rate and, in particular, the global financial cycle.

In this sense, a shock towards currency devaluation has been shown to have a negative impact on price level. On its turn, an advance in global financial instability has been linked to a rise in the price level, indicating that the actors may be trying to protect their profit margins by raising prices.

The recent evolution of the Brazilian economy seems to reinforce these results as periods of economic slowdown coincide with higher inflation, especially at the beginning of the downturn. This trend is aggravated by the features of the Brazilian ITR as well as by the price puzzle phenomenon. Finally, it is important to highlight that such results do not intended to exhaust the discussion on the topic, but rather to establish aspects to be further explored in future research.

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