The Effect of Expectations on the Brazilian Benchmark Interest Rate

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Abstract

This article investigates how expectations influence the determination of the Brazilian benchmark interest rate. It rescues Keynes' views on the relationship between expectations and monetary policy to form the article's theoretical framework. Then, as empirical methodology, we use Autoregressive Distributed Lag Models and Bounds Testing Approach to Cointegration, to study, in the short and long-run, the connection between expectations and central bank interest rate. For the period from 2001Q3 to 2017Q4, results show that in the long-run business and consumer confidence, as well as expectations related to market interest rates, GDP, inflation and exchange rate play an important role on monetary policy actions. In the short-run, business and consumer confidence lose importance, while the other mentioned expectations are still statistically significant. Therefore, the way agents perceive future expectations of important variables, in the short and long-run, is important for monetary policy decisions in Brazil.

Key Words: Expectations, Monetary Policy, Interest Rates, Brazilian Economy

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Introduction

Monetary authorities exogenously set and control their benchmark interest rates. However, even though central banks have a key influence on market interest rates, they cannot be fully controlled. Market rates are set by a mark-up added to the central bank benchmark interest rate and this spread between the two rates indicates the degree of liquidity preference of agents and its determinant, namely expectations.

To directly affect the yield curve, central banks must regard agents' expectations in their monetary policy actions. It does not matter if a central bank follows a typical Taylor Rule in an inflation targeting system, or if it desires to foster economic growth, emplyment and income distribution, as it would be the case in a Post Keynesian monetary policy proposal. If expectations are neglected or disregarded, market rates may decouple from the level pursued by monetary authorities.

For instance, take monetary policy in Brazil from 2010 to 2016. Conservative monetary policy was the case from 2010 up to 2011. However, from mid-2011 on, the Brazilian Central Bank (BCB) surprisingly started decreasing its base rate, called Selic, until it reached its lowest value at that time, 7.25% per year. But due to several doubts regarding President Rousseff's economic policy actions, including the 2012 and 2013 annual inflation rates close to the target's upper bound of 6.5% per year, pressures over BCB emerged. From mid-2013 onwards, Selic started an upward cycle, but at a slower pace when compared to future market rates. Thus, agents doubted BCB's rate policy and, therefore, asked higher spreads in their market rates. In other words, agents expected much worse future difficulties than those seen by monetary authorities.

In October 2014, BCB tried to influence expectations positively, announcing a tighter inflation control. But again agents had a different scenario in mind, as Brazil was heading towards a stagflation: in 2015, the official consumer price index reached 10.7%, GDP decreased 3.55%, with an annual 14.25% Selic rate; 2016 was not different: Selic at 14%, GDP dropped again, 3.33%, and inflation reached 6.29%. So, from 2014 to 2016 Brazil faced a mixture of decreasing GDP, rising unemployment and deteriorating inflation. Despite that, monetary authorities continued to increase Selic. Hence, our assumption is that BCB was trying hard to improve agents' expectations, as 2012-2014 problematic monetary policy made agents less confident about future.

This paper analyzes the impact of expectations on the Brazilian benchmark Selic interest rate, from 2001Q3 to 2017Q4. To accomplish its goal, this article rescues Keynes' views on the theoretical relation between expectations and monetary policy, as he extensively wrote about this relationship and it helps understating what happened in Brazil. Furthermore, we undertake an empirical exam by means of an Autoregressive Distributed Lag Models (ARDL) to study, both in the short and long-run, the relationship between expectations and Selic determination, in the period mentioned above. We also make a special statistical exam regarding the period related to President Rousseff's troubled monetary policy when she was in office, from 2011 to 2016. Considering that Brazil adopts an inflation targeting system since 1999, in our empirical analysis we build a version of a Taylor Rule accounting for expectations in a Post Keynesian manner.

This paper contributes by proceeding to an empirical exam to test the statistical relevance of the connection between expectations and central bank rate policy in Brazil from 2001Q3 to 2017Q4, based on Keynes' ideas. Our main empirical results show that, in the long-run, business and consumer expectations, as well as expectations related to market rates, GDP, inflation and exchange rate play an important role on monetary policy actions. In the short-run, business and consumer confidence lose statistical significance, although other expectation variables, such as interest rate spreads, expected GDP growth, future inflation and exchange rate are still statistically significant. It means that the way agents perceive future expectations of important variables, in the short and long-run, is important for monetary policy decisions in Brazil, like Keynes and Post Keynesians strongly suggest.

The paper has four more sections, besides this introduction and final remarks. Section 2 describes Keynes and Post Keynesian's ideas on the relationship between expectations and monetary policy, presenting how sound expectations are key to a successful monetary policy. Section 3 narrates the history of monetary policy in Brazil over 2001-2017, whereas section 4 presents the empirical econometric exercise and the analysis of the results.

2. The relationship between expectations and interest rates

In the empirical Post Keynesian literature, the relationship between expectations and interest rate is an important line of research. For instance, Moore (1988) and Pollin (1991, 1996, 2008) found a bidirectional causality between Fed funds rate and long-term rates, despite Pollin's works showing a stronger causality running from long to short-term rates. Atesoglu (2003-04) reached a unidirectional causality from Fed funds rate to prime rates, the interest rate banks charge on their best customers. Atesoglu's (2005) results also pointed to a unidirectional causality from Fed funds rate to AAA assets and 30-year American Treasury bonds. Moreover, Payne (2006-07) and Cook (2008) found statistical significance going from the Fed funds rate to mortgage rates.

This paper dialogues with the literature above by analyzing how expectations and Selic interacted in Brazil, over 2001-2017. In theoretical terms, by means of the three reasons Keynes (1973) listed to explain money demand, we can better understand how expectations and interest rate can be related. Firstly, the transactions motive refers to the possession of liquidity for day-by-day transactions. Keynes split this reason into two, income-motive for households and business-motive for firms (Keynes, 1973). Money income is the determinant of money demand for transactions.

The second reason for holding money is precautionary money demand, which aims at either facing off any unpredictable adverse situation or taking advantage of profitable unforeseen opportunities (Keynes, 1973). However, as Carvalho (2009) argued, precautionary demand remained in a kind of blurred place in Keynes' writings, as he set only money income as its determinant, whereas implicitly arguing that expectations (of unpredictable adverse events and unforeseen profitable possibilities) also explained this liquidity demand. In the same sense, Chick (1983) and Tily (2006) debated and explained precautionary demand via money income and expectations.

Being able to demand money for precaution implies that agents have income and save part of it. The way money is saved depends on how agents form expectations and their degree of liquidity preference. If they believe in future losses, holding cash is preferred over investing. If there are optimistic prospects, agents invest money, giving up liquidity. This brings us to the third reason for demanding money: speculative motive.

The speculative motive is "the object of securing profit from knowing better than the market what the future will bring forth" (Keynes, 1973, p. 170). When agents speculatively demand money, they bet on having capital gains given by expected diminishing interest rates from present to future. Interest rate changes are not known, only expected; therefore, expectations define speculative demand. For speculative motive is relevant to monetary policy in such a way that "it is by playing on the speculative-motive that monetary management (or, in the absence of management, chance changes in the quantity of money) is brought to bear on the economic system" (Keynes, 1973, p. 196). In this sense, Keynes (1973) extensively stated the relevance of expectations for monetary policy by arguing that a central bank without credibility would fail in its policy, as agents would bear low expectations regarding its actions[3].

Regarding the three motives for money demand presented previously, there are two set of decisions that agents take. Firstly, given some money income, they decide which part settles transactions: this is the active balance, which is the use of money as means of exchange. Secondly, assuming that not all income has been spent, the other part of income becomes inactive balances at agents' hands, that is, money as a storage of wealth. So, the second decision is how agents keep this inactive storage of wealth:

> "does he want to hold it in the form of immediate liquid command (i.e. money or its equivalent)? Or is he prepared to part with immediate command for a specified or indefinite period, leaving it to the future market conditions to determinate on what terms he can, if necessary, convert deferred command over specific goods into immediate command over goods in general?" (Keynes, 1973, p. 166).

[3] It is worth mentioning the forth reason Keynes (1937) gave to explain money demand, the finance motive. Entrepreneurs request liquidity for this reason when they plan an investment and need funding for that. Self-financing partially addresses this need, but the remaining part needs to be financed by the financial system. The finance motive is part of the overall money demand, so it plays a role on determining market interest rate, as firms' demand for financing faces the liquidity pool offered by financial markets.

The answer to those questions depends on agents' degree of liquidity preference, defined by their expectations, which consider not only the awaited future interest rate but also forthcoming economic conditions. After having consumed part of their income, agents then set an asset portfolio based on their liquidity preference. On the one hand, positive outlooks make speculative money demand absorb a substantial part of one's savings. On the other hand, negative outlooks encourage agents to hold cash or assets rapidly and uncostly convertible to money, like bills.

We can see more clearly how expectation and its counterpart, liquidity preference, affect money supply and demand. Keynes (1973, p. 199) defined total money demand as

$$M = M_1 + M_2 = L_1(Y) + L_2(r) \qquad (1)$$

where M_1 is money demanded for transactions and precaution, and it is a function L_1 of income Y. M_2 is speculative money demanded and it is a function L_2 of interest rate, r. M_1 shows the role precautionary motive plays, it deals with uncertainties although expectation is not one of its determinants.

To include uncertainty, and so expectations, in M_1, based on Chick (1983, p. 204), Tily (2006, p. 191) defined the inactive balances held as liquidity as:

$$L(r) = L_s(M, \varepsilon_s|\mathrm{Y}) + L_p(\varepsilon_p|\mathrm{Y}) \qquad (2)$$

where $L(r)$ is total inactive money demand, which is a sum of speculative demand L_s and precautionary demand, L_p. Given Y, the latter is defined by expectations ε_p, while the former depends on available money supply, M, expectations ε_s, and the actual rate of interest.

Money supply is a key determinant of interest rate, r. As Keynes (1971, 1973) argued, interest rates are set at financial markets, where money supply and demand occur. These two functions depend on different stances of agents' liquidity preference. Those who prospect a favorable money supply in the future buy debts in the financial market, whereas those bearing pessimistic outlooks demand money. Money supply can be seen as a kind of liquidity preference synthesis: the greater the supply of money, the smaller precautionary money demand is.

For the purpose of this paper, it is useful to slightly adapt Tily's relation (2) to highlight the role of expectations on speculative money demand. Following Chick (1983, p. 204) "speculator *i* expects capital gains on bonds and, hence, purchases bonds in [time] *t* holding no speculative balances in money", let us assume that the speculative money demand is a temporary money request that lasts between withdrawing money from precautionary balances and supplying it at financial markets.

The amount of financial assets held by agents is exactly the amount of money they speculatively required not to hold as cash in their portfolio, but to offer at financial markets. Hence, the total storage of wealth can be broken into: i) M_s^S, the amount of money agents supply to financial markets in exchange for buying financial assets (speculative demand) and ii) M_p^D, the amount of money agents hold as cash balances (precautionary demand). This is equivalent to:

(3)

$$L(r) = M_s^S + M_p^D$$

Although the total amount of inactive balances does not change with neither more M_s^S nor M_p^D, money supply in financial markets changes whenever M_s^S and M_p^D shift. For instance, in an extreme liquidity trap case, the economy would only have M_p^D-type inactive balances, and private money supply M_s^S would be zero. In such case, the central bank could be even providing reserves to the system, but it could cause no change on market interest rate if investors just retain liquidity as M_p^D.

Assume that p is the proportion of speculative money demand so that $(1-p)$ is the cash balance. Also, set r_m, the market interest rate, as relevant for money demand for speculative and precautionary purposes. As so, speculative money demand can be seen as the counterpart of precautionary demand through relation (3.1). If precautionary demand increases, speculative motive reduces, and so does money supply in financial markets, changing market interest rates,

$$L(r_m) = pM_s^S + (1-p)M_p^D \quad (3.1)$$

To model how expectation affects interest rates, we make use of the slight[illegible]ent version of relation (2), considering expectations, ε, related to market interest rate r_m, which appears in both precautionary (r_{mp}) and speculative (r_{ms}) demands. Hence, equation (4) represents how expectations about market rates change the proportion between speculative and precautionary money demand[4]. Agents' expectations about market rates depend partly on what they prospect to [illegible] to the future base rate and partly on what they outlook for the economy as a whole. From these expectations result their willingness towards some combination of M_s^S and M_p^D,

$$L(r_m) = \{[(p)(L_s(M, r_{ms}, |\mathrm{Y})] + [(1-p)L_p(r_{mp}|\mathrm{Y})]\} \quad (4)$$

Equations (5) to (7) show how a market interest rate is determined. The expected base rate variation is the difference between the actual known base rate (r_{cbt}) and its unknown future value (r_{cbt+1}^{ε}), as equation (5) displays. Equation (6) depicts how market rates are set. Agents define a spread φ over the base rate; thereby, the difference between market and base rates is their liquidity preference. Finally, equation (7) is equation (5) inserted in (6), and it highlights the role expectations play on market interest rate setting. It shows that expectations concern the variation between current

(5)

(6)

(7)

[4] To our model, it is not necessary to emphasize the special role of banks as money creators in mo[illegible]economies, still it is not adequate to depict their behavior through relations (3), (3.1) and (4), as their $L(r_m)$ is not [illegible]e balance, only M_p^D can be called so. So, the following relation for banks' precautionary and speculative demand of [illegible] can be written: $M_s^S = \frac{1}{M_p^D}$. As mentioned before, M_s^S must be understood as money supply for those seeking liquidi[illegible]ancial markets. Arguments for M_s^S and M_p^D remain the same and this relation means that, when banks have greater liquidity preference, they reduce their speculative actions, curtailing money supply and pushing interest rates up.

and expected base rates and the overall economic state, $((1+\varphi)\Delta r^{\varepsilon})$, and they also regard the awaited level of the future base rate (r^{ε}_{cbt+1})[5].

$$\Delta r^{\varepsilon} = r_{cbt} - r^{\varepsilon}_{cbt+1}$$

$$r_m = r_{cbt} + \varphi r_{cbt}$$

so that,

$$r_m = (1+\varphi)\Delta r^{\varepsilon} + r^{\varepsilon}_{cbt+1}$$

We can now work on the relationship between equations (7) and (4), that is, between market interest rate and inactive money demand. Keynes (1973) stated that there is a given level of conventional interest rate that each agent regards as secure interest rate. Consider this conventional interest rate a sort of precautionary interest rate, r_{mp}, that makes agents hold cash, instead of lending. Thus, taking the level of interest rates as the regarded variable, we would have the following set of decisions, if:

$$f(r_m) = \begin{cases} r_{mp} < r_{ms}, & (1-p)Lp < (p)Ls \\ r_{mp} \geq r_{ms}, & (1-p)Lp > (p)Ls \end{cases} \qquad (8)$$

With fixed income contracts, if the level of $r_{ms} > r_{mp}$, market interest rates pay agents' liquidity preference and the speculative side of equation (4) is stronger than precautionary demand, augmenting money supply and pushing interest rates down. If $r_{mp} \geq r_{ms}$, the opposite happens by making $(p)L_s(M, r_{ms}, |\mathrm{Y}) \leq (1-p)L_p\left(r_{mp}|\mathrm{Y}\right)$.

Finally, it is possible to show the interaction between expectations basing r_m and central bank interest rate determination. Assume a base rate setting following a Taylor Rule in an inflation targeting regime, as Brazil adopts. Although it is not a Post Keynesian monetary policy framework, it is a widely used monetary regime, not only in Brazil but also in other countries throughout the world. Nevertheless, using it makes our model more realistic for undertaking empirical analysis.

Based on Arestis et al. (2009), equation (9) reports a standard Taylor Rule for open economies. The nominal base rate is defined by the market rate plus expected inflation $(r_m + \pi^{\varepsilon*}_t)$ (it has the inflation target $(\pi^{\varepsilon*}_t)$ as reference of expected inflation) plus deviations of inflation from its target, $(\pi_t - \pi^*_t)$, minus unemployment gap, $(U_t - U_n)$. In open economies exchange rates may affect inflation, and the base rate might respond to their movement, as Δe_t indicates. Lastly, $\propto$, β and γ are

(9)

[5] We present only a simple model that displays how an agent sets an interest rate on some as s model can be expanded to all agents with their desired interest rates. Let yc be the yield curve, i an agent and j a type of asset. We derive the financial system yield curve (yc) as $yc = \sum_{ij}(1+\varphi)\Delta r_{ij}{}^{\varepsilon} + r^{\varepsilon}_{cbt+1ij}$. Moreover, we are assuming the central bank base rate as the only benchmark rate of the financial system. Although it is not the only benchmark rate, it is the most relevant one. Even interest rates on fiscal policy bonds, which form a yardstick for long-term private debt negotiations, set a spread over the base rate.

parameters, reflecting the base rate sensitivity to inflation, unemployment gap and exchange rate fluctuations. So:

$$r_{bct} = (r_m + \pi_t^{\varepsilon}) + \propto (\pi_t - \pi_t^{*}) - \beta(U_t - U_n) + \gamma\Delta e_t$$

Substituting r_m in equation (9) generates the interaction between expectations and central bank base rate setting. This expanded Taylor Rule now accounts for market interest rate determination, so that expectations become key to r_{bct} determination. The central bank's exogenous interest rate is now linked to the endogenously set market rate:

$$r_{bct} = ((1 + \varphi)\Delta r^{\varepsilon} + r_{cbt+1}^{\varepsilon} + \pi_t^{\varepsilon}) + \propto (\pi_t - \pi_t^{*}) - \beta(U_t - U_n) + \gamma\Delta \quad (10)$$

Central banks act on the speculative money demand side, as Keynes (1973) stated, by trying to drive $(1 + \varphi)\Delta r^{\varepsilon} + r_{cbt+1}^{\varepsilon}$ over time. However, they may not guess or led expectations rightly, or even decide not to take them into consideration. If they fail to drive expectations, or disregard them, agents can decouple from the base rate. As a result, monetary policy would not be able to accomplish its objectives, because liquidity preference φ matters in how agents price market rates in reaction to central bank actions.

In this sense, it is worth recalling that expectations related to variables other than the base rate are also taken into consideration for setting r_m, such as expected inflation, GDP growth, exchange rate, etc. For instance, higher spreads over the base rate when inflation is under control indicate that agents distrust future economic conditions, and so prefer liquidity. This is quite common in moments of crisis, in which agents strongly demand liquidity, raising market interest rates when the opposite is necessary. Thus, not only are expectations regarding gains, risks and opportunity costs of financial assets important to interest rate determination, but also those concerning the overall state of an economy.

3. A brief history of monetary policy in Brazil from 2001 to 2017

Brazil adopts an inflation targeting regime since July 1999. Besides Brazil's January 1999 forex crisis, the period 1999-2002 was marked by other crises: the 2000 dot.com crisis, 9/11 terrorist attacks, 2001 Argentinian crisis, 2002 Brazilian Presidential elections crisis. To face these challenges policymakers undertook a strict monetary policy from 1999 to 2010. BCB (2018) shows how tough monetary policy actions were back then. The average nominal base rate was 15.88% p.a., from July 1999 to December 2010, declining from an annual 21%, in July 1999, to 10.75% in December 2010. The Consumer Price Index (IPCA) reached a 6.79% annual average in the period, climbing from 8.90% in 1999, to 12.53% in 2002, and then reducing to 5.90% in 2010. As a consequence, the real Selic rate was also set high in the first years of the Brazilian inflation targeting system.

Those strict monetary policy actions had a twofold effect on expectations. Firstly, from 2003 to 2005, monetary authorities worked to create positive expectations. Six-month ahead IPCA expectations decreased from 8.10% p.a. in 2003, to 6.16% in 2004, and to 5.20% in 2005 (IPEADATA, 2018), whereas economic growth increased from 1.14% in 2003, to 5.76% in 2004, and 3.2%, in 2005 (BCB, 2018). Nevertheless, investment variation recovered from -3.87% in 2003, to 8.56% in 2004, and 1.96% in 2005 (BCB, 2018).

In turn, the period from 2006 to 2010 was marked by economic growth with macroeconomic stability. Several factors, rather than only monetary policy actions, explain Brazil's performance at that time: i) world economic growth, with considerable increase in commodities prices helping the country's exports; ii) reduction in economic inequality, with improvement in income share coming from income transfer programs and real appreciation of the minimum wage; iii) a primary balance surplus of more than 3% of GDP, from 2002 to 2008. Still, monetary policy did its job. Inflation expectations reached 5.30% in 2005, decreased to 3.62% in 2007, and rose to 5.07% in 2010 (IPEADATA, 2018). Annual GDP growth reached an average of 4.5%, reaching 6.07%, in 2007, 5.05% in 2008, and peaking 7.5% in 2010 (BCB, 2018). Investment (as % of GDP) grew 9.50%, in quarterly average, from 2006 to 2010 (IPEADATA, 2018).

Even when the Great Financial Crisis hit the Brazilian economy, in the end of 2008 and throughout 2009, monetary policy was fairly conservative. In 2008, when the G-7 economies were already suffering from the consequences of the crisis, with an average GDP decrease of 0.28% (OCDE, 2018), Selic was at 13.75% p.a. (BCB, 2018). When Brazil was affected by the financial crisis, GDP decreased 0.12%, unemployment rate increased to 8.1%, however Selic achieved 8.75% in December 2009, while IPCA reached 4.31%, still a high real Selic rate. In turn, 2010 was marked by increasing inflation, GDP growth and Selic, 5.90%, 7.50% and 10.75%, respectively, while unemployment rate recovered to 6.70% (BCB, 2018). Thus, monetary policy actions were strict, but with no surprises, as they looked closely at inflation, GDP and unemployment rate, despite keeping high real interest rates.

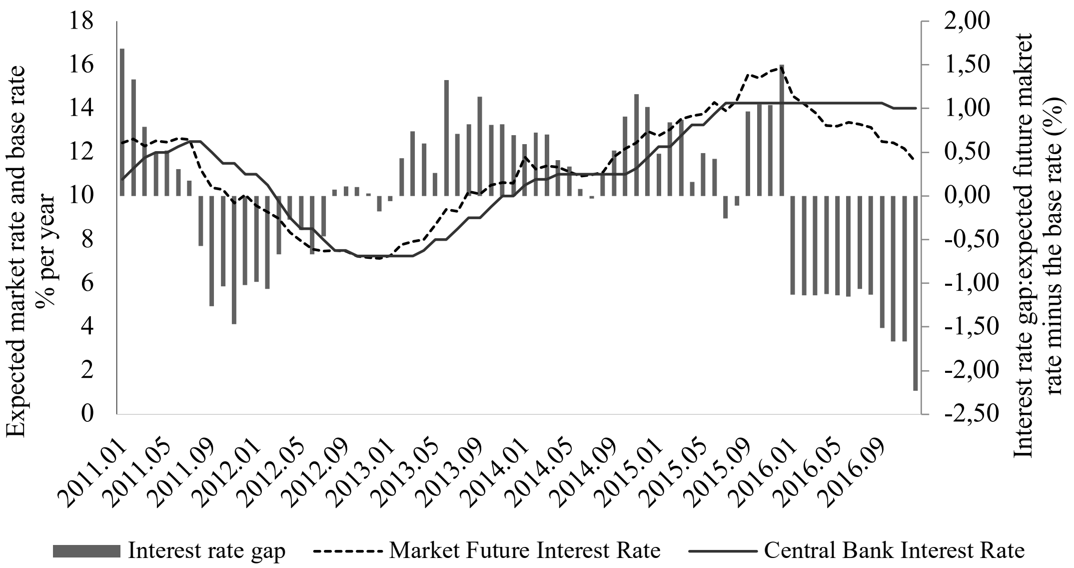
From 2011-2016 there was a considerable change in the conduct of monetary policy in Brazil, which can be split into three periods: i) 2011-2012, a moment of trust; ii) 2013-2014, a decoupling moment; iii) 2015-2017, a moment of rebuilding confidence. Figure 1 shows these moments by displaying three series: i) Selic interest rate; ii) future (one-year ahead) market interest rate; iii) the gap between these two rates.

At a first glance, 2011 and 2012 were marked by smooth monetary policy decisions, quite similar to the period 2001-2010. As Figure 1 shows, in the very beginning of 2011, the interest rate gap was positive and, as expected by agents, BCB increased Selic and consequently the interest rate gap narrowed. In August 2011, BCB started an unexpected decreasing cycle of Selic, yet it was credible and followed by agents. As a result, both future market rate and interest rate gap adhered to

BCB's intentions, leading to the lowest base rate Brazil had until then, 7.25% p.a.[6]. This moment of trust lasted throughout 2012, when the first sign of a positive interest rate gap appeared, and the future market rate got closer to the base rate.

The decoupling moment started in the end of 2012 and lasted until the end of 2014. In 2011 and 2012, IPCA remained at the target's upper bound. Nonetheless, agents were confident that the BCB was aware of that. Yet, in 2013, IPCA went up again, to 5.9%, reaching 6.4% in 2014. As a consequence, future interest rates increased, as agents were unconfident and demanded higher premiums. Moreover, Brazil's fiscal policy deteriorated even faster, going from a 2.18% of the GDP surplus in 2012 to a 1.86% deficit in 2015 (BCB, 2018). Also, some actions taken to balance public budget were so controversial that later on they were seen as illegal by the Brazilian Parliament, culminating in President Rousseff's impeachment in August 2016.[7]

Figure 1 - Brazil: Central Bank Selic Interest Rate, Market Future Interest Rate and Interest Rate Gap (January 2011 to December 2016)



Source: BCB (2018)

All of these factors made agents prefer liquidity and, therefore, demand greater spreads. This can be seen by the decoupling of the future market rate from the base rate. BCB started raising its Selic rate moderately, believing that agents would be easily persuaded and stop requiring higher spreads. This was not what happened. Apart from a short period in 2014, agents started expecting and demanding higher interest rates, as they saw the unconventional economic policy measures taking

[6] In 2017 and 2018, the Brazilian depression allowed for an even lower Selic, 6.50%. But before that, 2012 was marked by the lowest Selic ever.

[7] Furthermore, there were several unconventional monetary, fiscal and forex economic policies measures put into practice by President Rousseff's Cabinet, as Arestis and Terra (2015) describe. Some are worth mentioning: i) control over oil and other administered prices to offset inflation; ii) intervention in the energy sector market, by forcing a decrease in energy utility prices; iii) macroprudential measures on external capital flows were implemented, however in a swinging manner, without letting it clear which measure would prevail in the future.

place. But as 2014 was an electoral year, in which President Rousseff was trying her second term in office, BCB ran late in its attempt to create positive expectations. This bid happened only after the elections, but then agents were already too skeptical. In monetary policy terms, BCB had to pay the price for the loss of credibility: a Selic at a higher level with the economy slumping.

The third moment, 2015-2016, is the period when BCB fought to recover credibility. After the elections, in October 2014, BCB adjusted its policy by narrowing the interest rate gap to recover expectations. Throughout 2015 until January 2016, the future market rate increased, with the gap stabilizing only in mid-2016, when it was clear that President Rousseff would step down. However, to anchor expectations, BCB kept Selic at 14.25% from July 2015 to October 2016. Meanwhile, GDP contracted 3.55% in 2015 and 3.31% in 2016, whereas unemployment rate raised from 8.5% to 12.00% (BCB, 2018). Nevertheless, as administered prices were readjusted after being controlled, IPCA reached 10.67% in 2015 and declined to 6.29% in 2016 (BCB, 2018). During 2017, with expectations anchored, BCB began a rather fast downward of Selic, from 13.75% in January to 7.50% in December.

In summary, the Brazilian economy melted down. Figure 1 showed a considerable narrowing of the interest rate gap, and only from mid-2016 onwards, BCB became confident that it could start a Selic decreasing. This was the price BCB had to pay to drop future market rates, which were reflecting a greater liquidity preference of agents. BCB kept its base rate as stable as possible during the crisis, as an effect of a previous swinging monetary policy. So, what was the role expectations in BCB rate policy between 2001 and 2017?

4. Expectations and Interest Rate: An Empirical Exercise

We are now ready to apply an econometric methodology related to equation (10), which is a Taylor Rule extended with expectations. To investigate how expectations affect Selic determination from 2001Q3 to 2017Q4, we use the following variables: i) IPCA: CPI inflation, 12 month-accumulated; ii) GDP: log of GDP index, seasonally adjusted. Both series come from IBGE, the Brazilian Institute of Geography and Statistics. iii) SELIC: Selic interest rate; iv) SWAP: Swap pre-DI 360 days interest rate; v) IPCAEXP: IPCA expectations, 12 month-accumulated; vi) EXCHEXP: Exchange rate expectations (USD/BRL - end of period); vii) GDPEXP: GDP expectations. These series are provided by BCB. viii) BCI: Business Confidence Index and ix) CCI: Consumer Confidence Index, both from OECD.

Selic is the Brazilian benchmark overnight interest rate defined by BCB as part of its monetary policy action to guide short-term interest rates. IPCA is the Brazilian consumer price index used by BCB in its inflation targeting system. Swap pre-DI 360 days, in which “pre” works as a fixed interest rate and “DI” is the overnight average rate of interbank loans (one year ahead). IPCA expectations are the 12-month-ahead accumulated inflation expected by surveyed agents. Exchange rate expectations (USD/BRL) are monthly average nominal exchange rate expectations related to the end of each year. GDP expectations are quarterly expected values for the GDP of the following quarter.

As for business and consumer confidence variables, the aim is to analyze how supply and demand foresee the Brazilian economy in the near future. According to OECD (2018a, b), the Business Confidence Index (BCI) relies on firms' evaluation of current production, stocks, orders as well as their actual position and what they expect for the near future. The Consumer Confidence Index (CCI), bases itself on the plans of households for big purchases and their current and immediate future expectations. They are both amplitude adjusted with long-term average equal to 100.

Four different models are estimated:

i) Model 1: Dependent Variable: SELIC; Independent variables: IPCA, GDP, SWAP, IPCAEXP, EXCHEXP, GDPEXP.

ii) Model 2: Dependent Variable: SELIC; Independent variables: IPCA, GDP, SWAP, IPCAEXP, EXCHEXP, GDPEXP, DEBTEXP (Dummy for President Dilma in office).

iii) Model 3: Dependent Variable: SELIC; Independent variables: IPCA, GDP, SWAP, IPCAEXP, EXCHEXP, GDPEXP, BCI, CCI.

iv) Model 4: Dependent Variable: SELIC; Independent variables: IPCA, GDP, SWAP, IPCAEXP, EXCHEXP, GDPEXP, DEBTEXP, BCI, CCI (Dummy for President Dilma in office)

Autoregressive Distributed Lag Models (ARDL) Bounds Testing Approach to Cointegration, as in Pesaran & Shin (1999) and Pesaran et ali (2001), is the econometric methodology to be applied in this study. A typical ARDL (p, q_1, ..., q_j) in its error-correction form (ARDL-ECM) can be specified as follows:

$$\Delta y_t = \alpha_0 + \alpha_1 T + \delta_1 y_{t-1} + \delta_2 x_{t-1} + \sum_{i=1}^{p} \phi_{1i} \Delta y_{t-i} + \sum_{i=1}^{q} \phi_{2i} \Delta x_{t-i} + \quad (11)$$

where α_0 and α_1 are intercept and trend, x_t is a k-dimensional matrix of I(1) variables, δ_1 and δ_2 long-run coefficients, ϕ_{1i} and ϕ_{2i} are short-run coefficients, and u_t are iid disturbances.

Considering the variables mentioned previously, the basic ARDL specification can be depicted as follows:

$$\begin{aligned}\Delta(SELIC)_t = {} & \mu + \beta_1(SELIC)_{t-1} + \beta_2(IPCA)_{t-1} + \beta_3(GDP)_{t-1} + \beta_4(SWAP)_{t-1} + \beta_5(IPCAEXP)_{t-1} \\ & + \beta_6(EXCHEXP)_{t-1} + \beta_7(GDPEXP)_{t-1} + \beta_8(BCI)_{t-1} + \beta_9(CCI)_{t-1} + \sum_{i=0}^{r} \beta_{10}\Delta(SELIC)_{t-i} \\ & + \sum_{i=0}^{s} \beta_{11}\Delta(IPCA)_{t-i} + \sum_{i=0}^{m} \beta_{12}\Delta(GDP)_{t-i} + \sum_{i=0}^{w} \beta_{13}\Delta(SWAP)_{t-i} + \sum_{i=1}^{p} \beta_{14}\Delta(IPCAEXP)_{t-i} \\ & + \sum_{i=0}^{q} \beta_{15}\Delta(EXCHEXP)_{t-i} + \sum_{i=1}^{k} \beta_{15}\Delta(GDPEXP)_{t-i} + \sum_{i=0}^{n} \beta_{16}\Delta(BCI)_{t-i} + \sum_{i=0}^{n} \beta_{17}\Delta(CCI)_{t-i} + u_t\end{aligned} \quad (12)$$

The first step in the ARDL models is to examine if the set of variables cointegrate, i.e., whether they have a long-run relationship or not, checked via a Wald test to exam the joint significance of the model's long-term parameters. Under the null hypothesis of no cointegration (H_0: $\delta_1 = \delta_2 = 0$) Pesaran et ali (2001) provide bounds on critical values for the F statistics, under the following hypothesis: i) lower bound: all estimated variables are stationary (no cointegration); ii) upper bound: all variables are I(1) (there is cointegration); iii) F-statistic between the bounds: inconclusive test.

Before estimating the four ARDL specified models, it is important to run unit root tests to ensure that no variable in the empirical model is I(2), as the methodology is not suitable for these cases. The methodology is suitable for orders of integration found in our variables, as it is more appropriate when there is a mix of stationary I(0) and non-stationary I(1), and when there is some doubt regarding whether a variable is stationary or not, due to trend influence, for instance.

Table 1 presents the estimated Augmented Dickey-Fuller (ADF) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) unit root tests, both with a constant and a constant and trend. Although no variable was I(2), there was a mix of I(0) and I(1), or some doubt of whether certain variable is really trend stationary or not. This makes ARDL approach appropriate for our analysis.

We run the four ARDL models by allowing to each estimation a maximum of 4 lags. Then, the best model is selected via Akaike Bayesian Criteria (AIC). Table 2 reports the estimated models, along with the lags of each selected model.

Table 1 – Unit Root Tests

	ADF		KPSS	
	Constant	**Constant and Trend**	**Constant**	**Constant and Trend**
Selic	-1.42	-2.15	0.68*	0.21*
IPCA	-2.44	-2.42	0.22	0.14
GDP Index (log)	-1.83	-0.57	0.95*	0.20*
SWAP pre-DI	-1.90	-3.09	0.70*	0.21*
Inflation expectations	-3.33*	-3.33*	0.15	0.14*
GDP expectations	-2.94*	-3.57*	0.45	0.19*
Exchange rate expectations	-1.78	-1.82	0.23	0.22*
BCI	-3.25*	-3.59*	0.34	0.18*
CCI	-2.97*	-3.10	0.19	0.18*

Notes: * means rejection of the null at 5%.
ADF: H_0 - unit root; KPSS: H_0 - stationarity

Focusing on models 1 and 2, which are our basic models with no consumer nor business confidence variables, we notice that lags are selected for all variables. Autocorrelation LM test results show that both models have no signs of serial correlation in any of the estimated regressions. Parameter stability tests (CUSUM and CUSUMQ) report that all parameters are stable in these models. For models 3 and 4, with consumer and business confidence, both appear only in levels (with no lags) in the regressions. Their inclusion leads to IPCA and GDP appearing with no lags either. However, some instability is detected in model 3, around 2016, in the CUSUMQ test.

Table 2 – ARDL Estimations and Bounds Testing Approach

Model	Lags Selected Model	F-Statistics	Long Run Cointegration?	Autocorrelation LM Test [Prob]	Stability Tests	
					CUSUM	CUSUMQ
1	(2, 1, 3, 2, 4, 2, 4)	3.79	Yes	0.853 [0.434]	Stable	Stable
2	(2, 1, 4, 1, 4, 2, 4)	10.23	Yes	0.956 [0.394]	Stable	Stable
3	(2, 0, 0, 1, 4, 2, 4, 0, 0)	9.55	Yes	0.626 [0.540]	Stable	Instable
4	(2, 0, 0, 1, 4, 2, 3, 0, 0)	15.69	Yes	1.071 [0.353]	Stable	Stable

Notes: i) All models estimated with a constant; ii) Bounds Testing Approach – Critical Values for Models 1 and 2: I(0) Bound: 1.99 (10%); 2.27 (5%); I(1) Bound: 2.94 (10%); 3.28 (5%); iii) Bounds Testing Approach – Critical Values for Models 3 and 4: I(0) Bound: 1.85 (10%); 2.11 (5%); I(1) Bound: 2.85 (10%); 3.15 (5%); iv) H_0 (no long-run relationship)

Results of the bounds testing approach are reported in Table 2. Considering Pesaran's et ali (2001) critical values, the H_0 of "no cointegration vectors" can be rejected at 5% for all models, once each estimated F-statistics is greater than the critical values. This cointegration result has an interesting economic interpretation on its own. It implies that there is an important long-run relationship amongst expectations variables and Selic, i.e., expectations play some role in the definition of a long-run path for Selic, like argued by this paper's theoretical model.

ARDL is also able to maintain important information on both short and long-run properties of a model, where a short-run disequilibrium can be seen as a long-run adjustment process. Thus, after confirming a long-run relationship, we analyze short and long-run characteristics of all models. Table 3 reports the long-run equilibrium coefficients, based on the Bounds Testing Approach of each estimation.

Focusing on models 1 and 2, those without consumer or business confidence, estimations show that, when expectations are included in a Taylor-Rule-type equation, inflation and GDP, the two most typical variables in this sort of base rate determination, lose their statistical significance. Also, inflation comes even with a wrong sign. It is a strong indication that expectations are really important in monetary policy actions.

Furthermore, Swap pre-DI, the expected future market rate shows considerable statistical significance in all models. This is a very interesting result because it seems that what really matters in the Brazilian monetary policy is how agents perceive the future interest rate path, and so how they include expectations in their spread. Another important result is the statistical significance of GDP expectations in models 1 and 2. Also, the dummy variable, related to period of President Rousseff in power, is statistically significant only at 10%.

In models 3 and 4, that include business and consumer confidence, the pattern is quite similar to models 1 and 2. Again, IPCA and GDP lose importance, and Swap pre-DI is statistically significant, when expectations are included. But GDP expectations lose statistical significance in model 3. The other two variables of interest, business and consumer confidence, show statistical significance, but with opposite signs. While a higher consumer confidence lead to increasing interest rates, a higher business confidence result in decreasing interest rates

Another important result, the dummy variable, related to President Rousseff in power, is statistically significant at 5%, and with a positive sign. It means that her attempt to lower interest rate did not take effect as market rates were higher, owing to her misleading economic policy, which tried to structurally lower Selic, but the plan was very unsuccessful on building positive expectations to follow the Administration's intentions.

Table 3 – ARDL Bounds Testing Approach - Long and Short-Run Dynamics

Variables	Model 1	Model 2	Model 3	Model 4
	Coeffic. [Prob.]	Coeffic. [Prob.]	Coeffic. [Prob.]	Coeffic. [Prob.]
IPCA	-0.258 [0.132]	-0.238 [0.041]	-0.202 [0.112]	-0.169 [0.106]
GDP	0.020 [0.359]	-0.015 [0.519]	0.040 [0.032]	-0.015 [0.479]
SWAP	0.885 [0.000]	0.950 [0.000]	1.148 [0.000]	1.126 [0.000]
IPCAEXP	0.199 [0.552]	0.033 [0.886]	-0.237 [0.399]	-0.221 [0.332]
EXCHEXP	2.364 [0.171]	1.073 [0.132]	1.478 [0.006]	0.181 [0.630]
GDPEXP	0.685 [0.012]	0.462 [0.022]	0.275 [0.006]	0.042 [0.580]
BCI	-	-	-0.340 [0.076]	-0.415 [0.008]
CCI	-	-	0.507 [0.010]	0.363 [0.035]
Dummy		0.691 [0.089]		0.874 [0.020]
ECM(-1) [Prob.]	-0.418 [0.00]	-0.629 [0.00]	-0.544 [0.00]	-0.707 [0.00]
Significant Variables (Short Run)	SELIC(-1); IPCA(0); GDP(-1*,-2*); SWAP(0,-1); IPCAEXP (-2,-3*); EXCHEXP (-1); GDPEXP (0,-2,-3)	SELIC(-1); IPCA(0); GDP(-1,-2,-3); SWAP(0); IPCAEXP (-2*,-3); EXCHEXP (-1); GDPEXP (-2,-3)	SELIC(-1); SWAP(0); IPCAEXP (0,-1*,3); EXCHEXP (-1); GDPEXP (0,-2,-3)	SELIC(-1); SWAP(0); IPCAEXP (-3); EXCHEXP (-1)*; GDPEXP (0*,-2)

Note: * significant only at 10% probability

The next exams regard short-run adjustments. This is analyzed via an ECM representation of all estimated ARDL models. As long as there is long-run equilibrium, any short-run disequilibrium is a process of adjustment to the long-run. But the speed of adjustment can be faster or slower, depending on the model's characteristics.

Table 3 also reports the ECM results for all estimated ARDL models, together with the statistically significant variables for short-run dynamics. As expected, the Error Correction Mechanism (ECM_{t-1}) is negative in all estimations, ranging from 41% to 70%. It means that on average 57% of a short-run shock is dissipated in the first quarter, meaning that the long-run equilibrium relationship among the variables returns to the steady state rapidly. In the worst scenario, a short-run shock is dissipated in less than 3 quarters.

Table 3 also depicts which variables matter in the determination of short-run dynamics: one way or another all variables are important. Exceptions are related to business and consumer confidence, which are not found in any of the regressions performed. This is interesting as they appear significant in the long-run, but not in the short-run, suggesting that the BCB defines its Selic seeking short and long-run positive expectations, however dealing, in the short-run, with agents' expectations about variables like future inflation, GDP or exchange rate, but not with confidence variables, such as BCI and CCI.

As Carvalho (1988) stated, short-run expectations can be regarded as endogenous, once the past works as a guide, whereas long-term expectations are exogenous because there is no good lead for them, besides confidence. The empirical outcomes show that Selic determination by BCB takes both types of expectations into account, with confidence being important in the long-run, as it is key for long-term expectations. This is due to the important role they have on the determination of the base rate.

Conclusion

This article aimed at analyzing the role of expectations in Brazil's Selic determination. We started by discussing the relationship between expectations and central banks' rate, taking into consideration that the interest rate spread is determined over the base rate, when agents define market rates. This Post Keynesian theoretical framework gave birth to a Taylor Rule extended with expectations, which was able to empirically model the role of expectations on base rate determination.

After that, an ARDL model, together with a bounds approach for cointegration, was formalized to assess the relationship between expectations and Selic determination, in the short and long-run. In the long-run, all basic expectation variables (inflation, exchange rate, market rates and GDP), were statistically significant, except for GDP in one model. Our extended models, including consumer and business confidence, showed that both variables were also important for Selic determination. Moreover, IPCA and GDP, two common variables in a standard Taylor Rule, lost statistical significance in the long-run Selic determination, when expectations were regarded. The future market rate was statistically significant in all long-run regressions. Lastly, the specific analysis for President Rousseff's term showed that her swinging monetary policy disturbed expectations.

The short-run analyses also confirmed the statistical significance of all basic expectations, despite business and consumer confidence losing importance. This outcome indicated that the Brazilian monetary authority seems to consider expectations more related to macroeconomic variables, rather than more sensible and intangible expectations, like consumer and business confidence, in the short-term.

Thus, these results let us conclude that expectations mattered considerably for the BCB Selic determination, from 2001 to 2017, like our theoretical framework suggested. All empirical results were extensively favorable to the role of expectations on the determination of the Brazilian base rate, in the short and long-run.

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