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Brazil—Monetary Policy

Monetary Policy and the Last Crusade

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- **Given the difficulty of estimating unobservable variables, we present six different methods to calculate the Brazilian neutral real interest rate. The four long-term approaches estimate that the neutral rate is between 5.2% and 5.9%, while the two short-term approaches estimate the neutral rate within a range of 3.4% to 4.1%.**
- **Currently, the ex-ante real interest rate (DI-Swap 1-year yield minus inflation expectation 12-months ahead) is slightly above 3%, which is close to the lower bound of our range of estimates for the neutral rate and means an expansionary monetary policy.**
- **The ex-ante real rate normalization to the long-term neutral real rate must occur when the economy grows at its potential. We see two possible ways to conduct that normalization: (1) the long-term neutral rate remains on a downward trend, converging to the actual ex-ante real rate level; or (2) by adjusting the ex-ante real rate by raising the benchmark overnight Selic rate.**
- **We forecast the Selic rate at 7.5% p.a. at the end of both 2017 and 2018, which means an ex-ante real rate at around 3%. We acknowledge there is room for the interest rate to run below those levels, but at the cost of closing faster the output gap, and hastening the normalization process (bringing the real rate to the long-term neutral rate level).**
- **According to our estimates, the Brazilian output gap will be zero at the end of 2018. Looking at 2019 onwards, the signal of monetary policy will depend on the deepness of fiscal reforms approved.**

Introduction

There is a heated debate regarding the so-called "neutral" (or "natural" or "terminal") real interest rate around the world, for the U.S., European Union, emerging countries, and of course, for Brazil as well.

We will assume in this report that the neutral interest rate[1] is the rate at which real GDP is growing at its trend rate, without affecting inflation. In this sense, a neutral real interest rate serves as a benchmark by which to measure whether monetary policy is tight (above the neutral level) or loose (below the neutral level).

Neutral rates appeared to decline across the world and in most emerging countries over the past decades, due to systemic and idiosyncratic reasons. In our opinion, this is demonstrated by the downward trend in real policy rates. In the table below, we calculated the ex-post real interest rate (target interest rate minus CPI % change y/y) of several emerging countries, and Brazil, between 2003 and 2017. On average (excluding Brazil) between 2005 and now, ex-post real interest rates declined 116 bps in our sample of countries. In Brazil, it fell 320 bps.

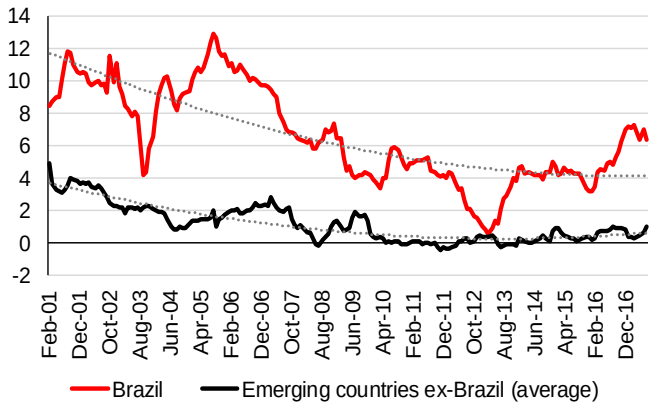
[1] Swedish economist Knut Wicksell was the first to define this metric in 1898. According to Wicksell, the natural rate is the interest rate at which prices are stable: if the market interest rate (the policy rate) is at the economy's natural level, it implies price and economic stability.

Emerging countries ex-post real interest rate (2003 to 2017)

Country	Last Value	Lowest	Average	Highest
Brazil	6.4	0.6	6.6	13.0
Turkey	-1.6	-4.8	-1.1	2.2
Mexico	0.5	-1.2	0.6	3.7
India	6.3	-3.4	0.8	6.3
South Africa	0.3	-1.5	2.0	8.3
Poland	-6.2	-0.7	2.6	11.6
Colombia	3.1	-1.7	1.2	4.0
Peru	0.8	-2.0	0.9	4.8
Chile	1.0	-2.7	0.6	4.0
Czech Republic	-5.3	-3.7	-0.4	2.9
South Korea	-1.4	-2.0	0.5	2.9
China	-1.2	-4.9	-0.3	4.4
Thailand	1.8	-5.2	0.2	5.9
Malaysia	-0.2	-4.6	0.4	4.5
Indonesia	-7.9	-3.3	4.9	15.6
Russia	4.9	-4.1	1.0	5.4
Australia	-2.2	-1.0	1.5	4.9

Sources: Bloomberg and Santander estimates.

Brazil ex-post real interest rate



In our view, the neutral and basic (or policy) interest rates remain very high in Brazil. Nevertheless, our model suggests that the policy interest rate will be further reduced, and it will be held below neutral for some time, mainly due to economic activity weakness (or the large output gap). In short, we do not see any inflationary pressures in the medium to long-term horizon that would support a cautious monetary policy in the short term. According to the Focus survey (from the Central Bank of Brazil), market inflation expectations stand at 3.5% for 2017, 4.2% for 2018, 4.25% for 2019 and 4.0% for 2020 (all below or at target inflation), while the GDP growth expectations stand at 0.34% for 2017, 2.0% for 2018, 2.5% for 2019 and 2.5% for 2020 (reflecting expectations of a very gradual and smooth economic recovery).

Given the difficulty of estimating unobservable variables, we prefer to present in this report a range of estimates for Brazil's neutral interest rate based on: (i) the Taylor rule model; (ii) statistical filters; (iii) the yield curve; and (iv) macro/fundamentals-based models. For the latter two estimation methodologies, we updated the models presented by Pirrelli R. and Roache S.K (2014)[2].

This report seeks to estimate an upper and lower bound for the neutral real interest rate in Brazil. In addition, we discuss the possibility of the short-run equilibrium neutral rate diverging from the long-run equilibrium neutral rate, where the shocks that affect the economy explain this difference. We believe that the models' outcomes are useful for suggesting (i) how much the basic interest rate can be reduced; (ii) how long the basic rate discounted to the inflation expectation might remain below the long-term neutral real rate (in the case that the short-term real neutral rate is different from and lower than the long-term rate); and (iii) when the real basic interest rate should be normalized to the long-term neutral rate of equilibrium.

The Models

First, we ran a Taylor-rule model, as employed by the majority of publications regarding the neutral rate estimation. The mindset behind this methodology is that central banks typically take into consideration both inflation and economic activity when setting interest rates, especially if the monetary authority follows an inflation-targeting regime, as activity is known to have an impact on inflation. As such, the policy rate decision attempts to set the interest rate near its neutral level using inflation and economic growth information. Here, we are applying the simple version of the dynamic Taylor rule expressed as:

$$i_t = i^* + \beta_1(\pi_t^e - \pi_t^*) + \beta_2 \gamma_t + \varepsilon_t \qquad (1)$$

where i_t is the basic interest rate; π_t^e is the expectation for inflation 12 months ahead; π_t^* is the inflation target; γ_t is the output gap; and ε_t is the residual, assumed with respect to the usual econometric hypotheses. In that framework, i^* is a constant

[2] Pirrelli R. and Roache S.K. in the IMF Working Paper "*Time-Varying Neutral Interest Rate – The Case of Brazil*", May 2014.

representing the level of the interest rate that would prevail in the absence of both inflation and output gaps, meaning the neutral level.

One problem in employing that structure is that it only calculates a single-point estimate for the neutral rate. We overcome this limitation by employing a recursive estimation using rolling windows. We ran two sizes of rolling windows – one at 10 years and another at 8 years – in order to see how much the recent recessionary cycle might have affected the neutral rate. Indeed, the shorter window unveiled a significant impact of the economic recession coupled with inflation convergence towards the target. The data series range used in the both exercises is from 4Q01 to 2Q17 (on a quarterly frequency). The estimations were performed using the Generalized Method of Moments (GMM) model, with lagged values of the variables on the right side of the equation as instruments, in order to solve the inherent problem of endogeneity in the equation above.

In an attempt to obtain a data series for the common unobservable time-varying neutral, solving the problem of structural models that provide an average estimate for the parameter, we applied a simple approach. We filtered the ex-ante real interest rate (DI-Swap 1-year yield minus inflation expectations 12 months ahead) by the Hodrick-Prescott (HP) statistical filter, trying to obtain a trend for the series that could represent the neutral real-rate data series. The data series range used is from January 2002 to June 2017 (on a monthly frequency). The big problem with this approach is the end-point bias, as the long end of the trend obtained by the statistical filter is heavily affected by the last data of the series (i.e., the trend could be affected by the cycle).

Thus, in another attempt to obtain a data series of the common unobservable time-varying neutral, we ran a yield-curve model using the state-space framework for estimating a stochastic common trend model based on Perrelli and Roache's study from 2014. We applied a system of four equations – two signal equations (observable variables) and two state equations (unobservable variables, called 'latent') in order to extract a data series of the neutral rate.

The idea behind this Kalman-filter model is that short-term and long-term interest rates are determined by observable variables, such as inflation expectations, the output gap, international interest rates (systemic shocks) and idiosyncratic shocks, as well as by a common unobservable variable that is the time-varying neutral rate.

Here, we defined the signal equations for the short-term interest rate (yield of contract DI-Swap 3-month) and long-term interest rate (yield of 10-year National Treasury bond) as:

$$i_t^{3m} = c(1)\pi_t^e + c(2)\gamma_t + c(3)us_t^{3m} + sv1 + \mu_{1,t} \qquad (2)$$

$$i_t^{10y} = c(5)\pi_t^e + c(6)us_t^{10y} + c(7)\theta_t + sv1 + sv2 + \mu_{2,t} \qquad (3)$$

And, the state equations expressed as:

$$sv1 = sv1(t-1) + \qquad (4)$$

$$sv2 = c(10) + c(11)sv2(t-1) + \varepsilon_{2,t} \qquad (5)$$

where i_t^{3m} is the BZ DI-Swap 3-month ; π_t^e is the expectation for inflation 12 months ahead; γ_t is the output gap; us_t^{3m} is the 3-month yield of U.S. Treasury bonds; i_t^{10y} is the yield of 10-year BZ National Treasury bonds; us_t^{10y} is the 10-year yield of U.S. Treasury bonds; θ_t is the Brazilian 5-year CDS spread; $sv1$ represents the neutral rate; and $sv2$ represents the term premium. The data series range used is from January 2003 to June 2017 (on a monthly frequency).

Last, but not least, we ran fundamentals-based long-term and short-term equilibrium real interest rate models. As mentioned in the introduction, systemic and idiosyncratic factors could drive changes in the neutral rate. In these models, the neutral rate is determined by macro-fundamental variables following Basdevant, Björksten and Karagedikli (2004)[3] and Pirrelli R. and Roache S.K (2014). We applied a Fully Modified Least Square model (FMOLS) for both equations, since this method modifies the least square to account for serial correlation effects and for the endogeneity in the regressors. The data series used for both equations ranges from January 2003 to June 2017 (on a monthly frequency).

The long-term neutral real rate is expressed as:

$$r_t = \beta_1 us_t^{3m} + \beta_2 us_t^{10y} + \beta_3 \pi_{t-1}^{gap} + \beta_4 credit_{t-3} + \beta_5 debt_{t-1} + \beta_6 \theta_{t-1} + \varepsilon_t \qquad (6)$$

[3] Basdevant, O, Björksten, N, Karagedikli, O. "*Estimating a Time Varying Neutral Interest Rate for New Zealand*", Reserve Bank of New Zealand Discussion Paper. February, 2004.

where r is the ex-ante real interest rate (DI-Swap 1-year discounted to the inflation expectation 12 months ahead); us^{3m} is the U.S. 3-month Libor rate; us^{10y} is the 10-year yield of U.S. Treasury bonds; π^{gap} is the difference between current inflation and target inflation; $credit$ is the outstanding-credit-to-GDP ratio; $debt$ is the gross-public-debt-to-GDP ratio; θ is the Brazil 5-year CDS (credit default swap, a country risk measure); and ε is white noise error. All estimated coefficients were found statistically significant and presented the expected signal (positive values for β_1, β_2, β_3, β_5, β_6 and negative value for β_4). The estimates for the dynamic long-term neutral interest rate were obtained by multiplying the estimated coefficients by the respective actual values of each explanatory variable, for each period.

The short-term neutral real rate is expressed as:

$$r_t = r_t^{lr} - \left(\frac{1}{\rho_3}\right)(\rho_2 y_t^e + \rho_4 rer_{t-12} + \rho_5 gov_t + \rho_6 bndes_t) \qquad (7)$$

which comes from the following equation:

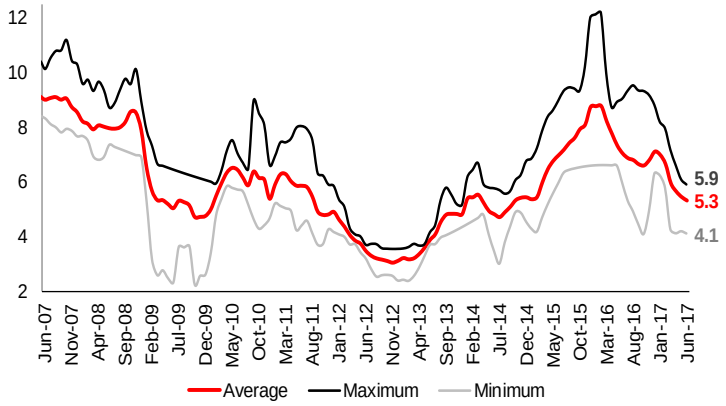
$$y_t = \rho_1 y_{t-1} + \rho_2 y_t^e + \rho_3\left(r_{t-1} - r_{t-1}^{lr}\right) + \rho_4 rer_{t-12} + \rho_5 gov_t + \rho_6 bndes_t + \varepsilon_t \qquad (8)$$

where r is the ex-ante real interest rate (DI-Swap 1-year discounted to the inflation expectation 12 months ahead); r^{lr} is the long-term neutral interest rate (previously estimated by applying equation 6); y is the domestic output gap, based on the Central Bank's Economic Activity Index, a monthly proxy for GDP; y^e is the international output gap, based on the industrial production indicator released by the CPB Netherlands Bureau for Economic Policy Analysis; rer is the real exchange rate gap; gov is the real federal government expenditures gap; $bndes$ is the BNDES (Brazilian Bank for Economic and Social Development) real disbursements gap. We applied the Hodrick-Prescott statistical filter to extract the trend of the time series (in simple terms, $gap = actual - trend$).

The short-term real neutral rate corresponds to the equilibrium at which real GDP grows at its trend rate (domestic output gap is zero) without inflation deviating from the target. Thus, by applying that definition, we take the domestic output gap as zero (i.e., g_t and g_{t-1} = 0) and calculate the short-term neutral rate (r_t) by multiplying the estimated coefficients by the respective actual values of each explanatory variable, for each period, according to equation (7).

The Results

Outcomes from Our Models (on a monthly basis)



Estimates for the period from 2002:1 to 2017:6

Method	Last Value	Lowest	Average	Highest
HP statistical filter	**5.9**	3.6	5.2	6.6
Yield curve	**5.7**	2.4	6.2	9.5
10-year Taylor rule	**5.7**	5.7	7.3	8.1
Fundamentals-based long term	**5.2**	2.9	5.3	8.0
8-year Taylor rule	**3.4**	2.8	5.8	7.3
Fundamentals-based short term	**4.1**	2.9	5.4	12.2

Source: Santander estimates.

The charts above present our estimates for Brazilian neutral real interest rates obtained with the aforementioned methods. Our range of estimates confirmed that the neutral rate in Brazil has been declining since the end of 2016, after a long period of sharp increase.

Given the difficulty of estimating unobservable variable, our four long-term approaches estimate that the current (column "last value") neutral real rate is between 5.2% and 5.9%. From the model least sensitive to monetary policy decisions (the Taylor rule model) to the one most sensitive to monetary policy (the HP filter on ex-ante real rate), moving through the long-term equilibrium real interest rate and yield curve models, all models pinned the neutral real rate within this range. Regarding the short-term approaches, the neutral rate estimates range between 3.4% and 4.1%.

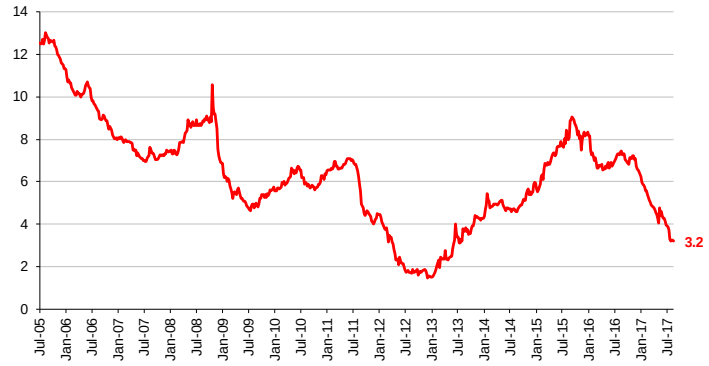
Overall, the results obtained from the different approaches are consistent directionally. Nevertheless, domestic and international shocks could lead to significant differences in short-term and long-term neutral rates. Currently, the large output gap and slowdown in government expenditures and BNDES disbursements mostly explain the lower levels seen in the short-term metrics.

Moreover, we also highlight the matching points of both short-term and long-term curves throughout the sample period. **Therefore, both short and long-term rate should converge in time.**

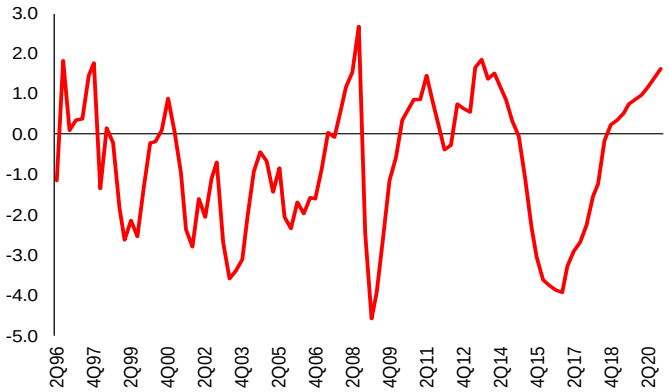
Conclusion

Currently, the ex-ante real rate (DI-Swap 1-year yield minus inflation expectations 12-months ahead) is at around 3%, which is close to the lower bound of our range of estimates. **In our opinion, the ex-ante real rate could be at or below the short-term neutral real interest for a while. The economy growing below its potential allows for a loose monetary policy.** The ex-ante real rate normalization to the long-term neutral real rate must occur when the economy grows at its potential, in order not to pressure inflation. According to our estimates, the Brazilian output gap will be zero only at the end of next year, taking into account GDP growing at a pace of 2.5%.

Ex-ante real interest rate



Output Gap



Sources: Santander estimates.

There are two possible ways to conduct the normalization of the real interest rate: (1) the long-term neutral rate remains on a downward trend, converging to the actual ex-ante real rate level, or (2) by adjusting the ex-ante real rate by raising the basic rate. We see the resumption of the fiscal reform agenda, specifically the approval of the social security reform as a *sine qua non* condition for the long-term neutral rate to remain on a downward trend. The second option happens if the fiscal reform agenda is not approved.

That said, we forecast the Selic rate at 7.5% p.a. at the end of 2017 and 2018, which implies an ex-ante real rate at around 3%, considering our inflation forecasts for this period. We agree that there is room for the ex-ante real rate to dip below the level we are now forecasting, but only for a limited period, and with a cost of more rapidly reducing the output gap, hastening the normalization process of the real rate to the long-term neutral rate. From 2019 onwards, the signal of monetary policy will depend on the deepness of fiscal reforms approved.

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