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SPECIAL REPORT – MONETARY POLICY

A Surge in the Natural Rate of Interest

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- The beginning of the easing cycle in Brazil has led to renewed discussions of the terminal level of the policy rate. The natural (or neutral) rate of interest is of paramount importance to this debate. For this reason, we decided to estimate the natural rate using several different methodologies. We break down our estimates into three separate categories, based on the fundamentals used: (i) model-based estimates, (ii) market-based estimates, and (iii) a mixed approach.

- The first noticeable feature we find is a decreasing trend in the rate since the beginning of the series. A few reasons can be argued for this decline — e.g., decreasing productivity or birth rates, or enhanced (relative) macroeconomic stability. In our view, the most relevant is the institutional reforms agenda that has been implemented since 2016. It is noticeable that since 2016, not only has the natural interest rate declined, but there has also been less uncertainty regarding it, as shown by the smaller interval between the maximum and minimum values found using the different methodologies. Another interesting feature is the surge seen in the rate since mid-2020: the rate was 2.9% as of June 2020 and is now at 4.6% as of September 2023.

- We see the average of the model-based estimates as the more structural of our results and find that it greatly resembles the aggregation of all results, painting the same picture overall.

- The average of our market-based estimates is by far the most volatile and most clearly illustrates the perceived increase in risks in the period between 2013 and 2015, followed by the gain in confidence in the subsequent period. The recent bounce-back in the rate is also noticeable, indicating higher risk aversion in the current macro environment.

- The average of our mixed estimates (based on Uncovered Interest Parity) is considerably lower than the averages of our two previous approaches. Even so, the surge since 2020 is also noticeable. This methodology showed that the natural rate of interest was stable overall at around 2.5% from mid-2007 to 2020 but now sits at 3.5%. This increase can be credited to two factors: a potential increase in the international natural rate and an increase in the perceived local fiscal risk.

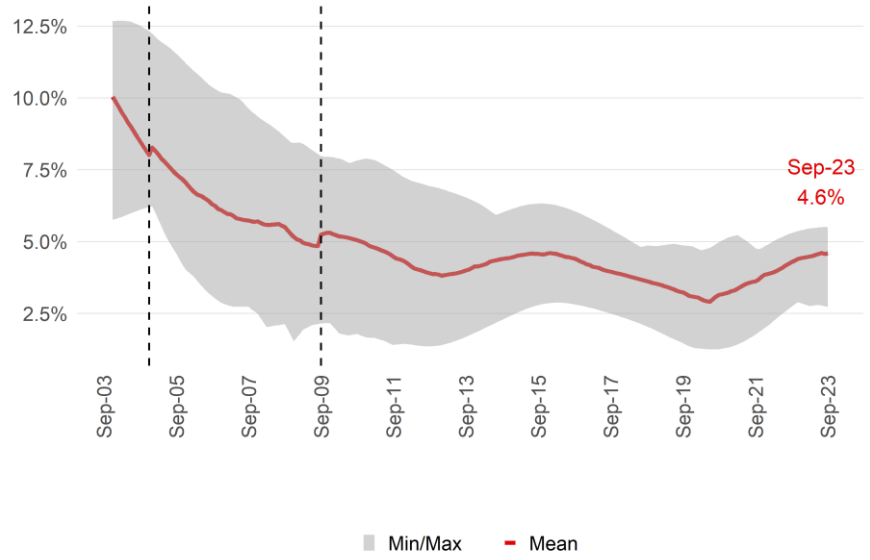
- Combining our results with calculations of the current *ex ante* real policy rate reflects the contractionary monetary policy that has been in place since YE2021. As we see it, if the Brazilian Central Bank (BCB) wishes to curb inflation expectations toward the inflation target, a contractionary stance is still necessary, and therefore the room for loosening is limited, as indicated by the authority. Thus, we believe that 2024 will still be marked by a tight monetary policy (i.e., an *ex ante* real rate higher than the natural rate of interest), albeit at a "smaller" compression rate.

Introduction

The beginning of the easing cycle in Brazil has led to renewed discussions of the terminal level of the policy rate. The natural (or neutral) rate of interest is of paramount importance to this debate. For this reason, we decided to estimate the natural interest rate using several different methodologies. Employing a wide range of approaches should reduce model uncertainty, in our view. We break down our estimates into three separate categories, based on the fundamentals used: (i) model-based estimates, (ii) market-based estimates, and (iii) a mixed approach. To make the presentation as accessible as possible, in the Technical Appendix at the end of this report we detail the methodology we used.

Discussion of Evolution and Breakdown

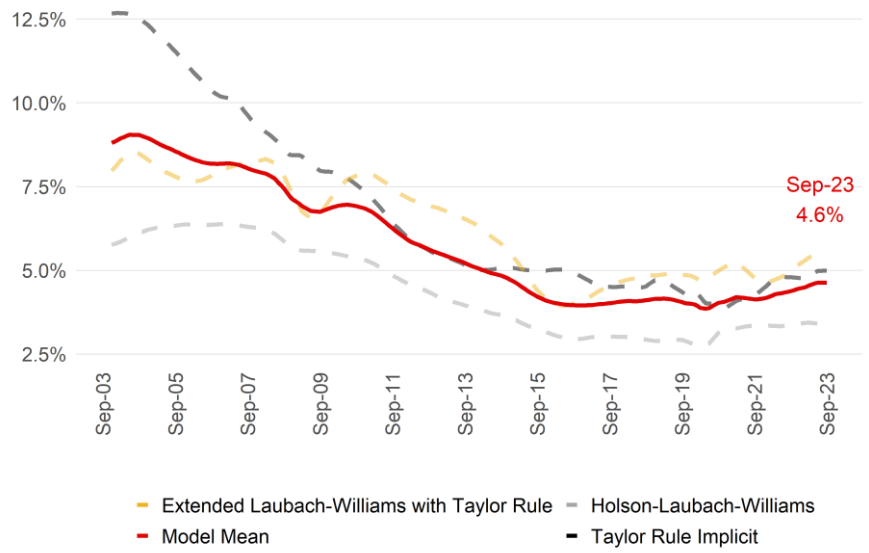
Figure 1 – Natural Rate of Interest (%)



Sources: IBGE, Brazilian Central Bank, Bloomberg, New York Fed, Richmond Fed, Santander.
Note 1: To provide up-to-date/timely results, we use our forecasts for 3Q23 when necessary.
Note 2: The vertical lines separate periods in which further estimates are used due to lack of data in certain periods; in the first section (from 4Q03 to 4Q04), only six estimates are available; in the second (covering 1Q05 to 3Q09), a total of eight estimates are available; in the last section (from 4Q09 onward), all ten estimates are available.

Figure 1 presents our results: the mean of all estimates and the interval between the maximum and minimum values observed among all estimates in each period. **The first noticeable feature from Figure 1 is the declining trend in the rate since the beginning of the series.** A few reasons can be argued for this decline — e.g., decreasing productivity, decreasing birth rates, or enhanced (relative) macroeconomic stability. In our view, **the most relevant is the institutional reforms agenda that has been implemented since 2016. It is noticeable that since 2016, not only there has the rate declined, but there is also less uncertainty regarding it, as shown by the smaller interval between the maximum and minimum values found using the different methodologies. Another interesting feature is the surge in the rate since mid-2020: it was 2.9% as of June 2020 and now stands at 4.6% as of September 2023.** There are several possible reasons for this movement — e.g., higher risk aversion/perception or an increase in the international natural rate of interest. We believe we can identify some of those by looking at the breakdown of our estimates.

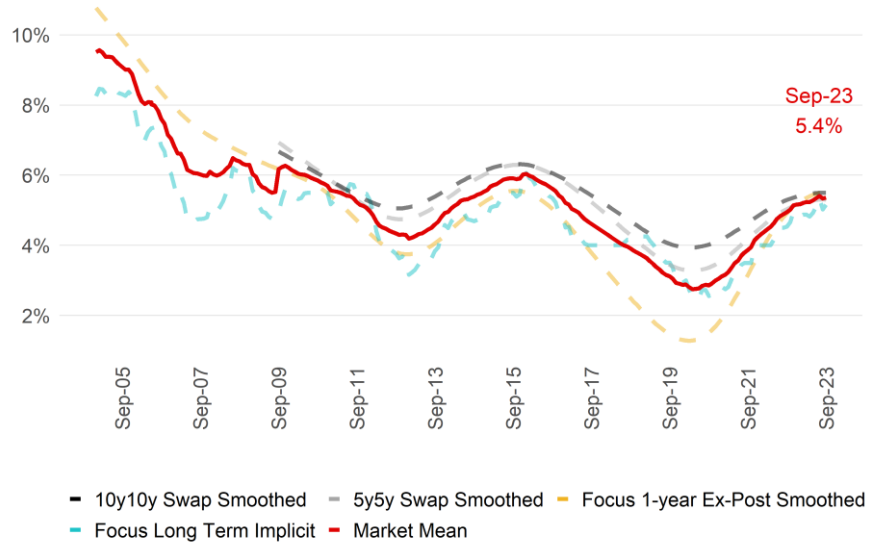
Figure 2 – Model-Based Estimates of Natural Rate of Interest (%)



Sources: IBGE, Brazilian Central Bank, Santander.

Figure 2 presents the estimates from our **model-based approaches and their respective average**. These estimates, which are based on full-fledged econometric models, **have a strong resemblance to those presented in Figure 1 and paint the same picture overall.** In fact, the latest number of this restricted mean even coincides with the unrestricted mean previously presented. However, we note that this number sheds even more light on **the effects of the institutional reforms agenda from 2016, evidenced by the more stable and less uncertain numbers from 2016 until today.** We also note that **the increases since 2020 have been slower and smaller than those shown in Figure 1. We interpret this result as relatively more structural than the ones we discuss next, which are more prone to influence from market sentiment.**

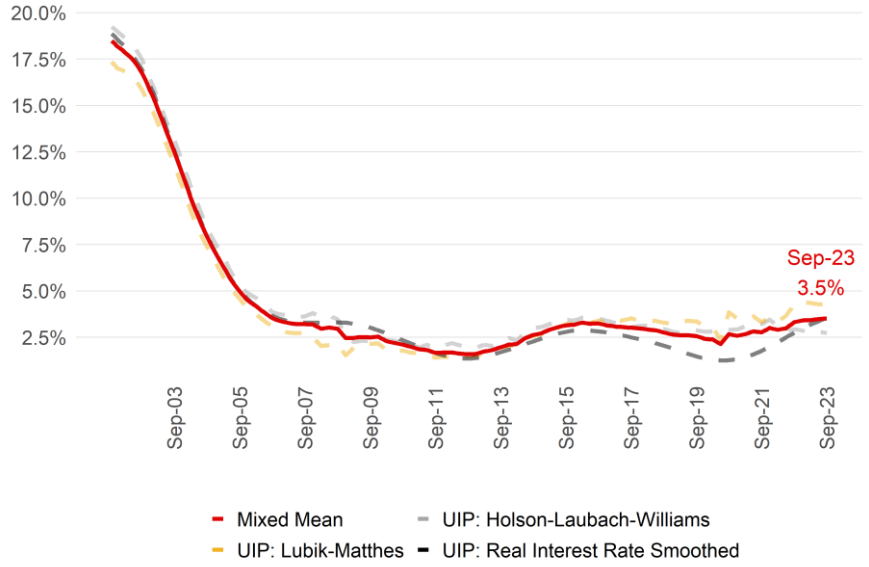
Figure 3 – Market-Based Estimates of Natural Rate of Interest (%)



Sources: Bloomberg, Brazilian Central Bank, Santander.

Next, we turn to **our market-based estimates and their average**, shown in Figure 3. These estimates consider **long-term rates extracted from asset prices and the BCB's Focus market expectations survey**. This category is by far the most volatile. **It also most clearly illustrates the perceived increase in risks in the period 2013-15, followed by the gain in confidence in the subsequent period. The recent bounce-back in the natural interest rate is far more substantial here, indicating higher risk aversion in the current environment.**

Figure 4 – Mixed Estimates of Natural Rate of Interest (%)

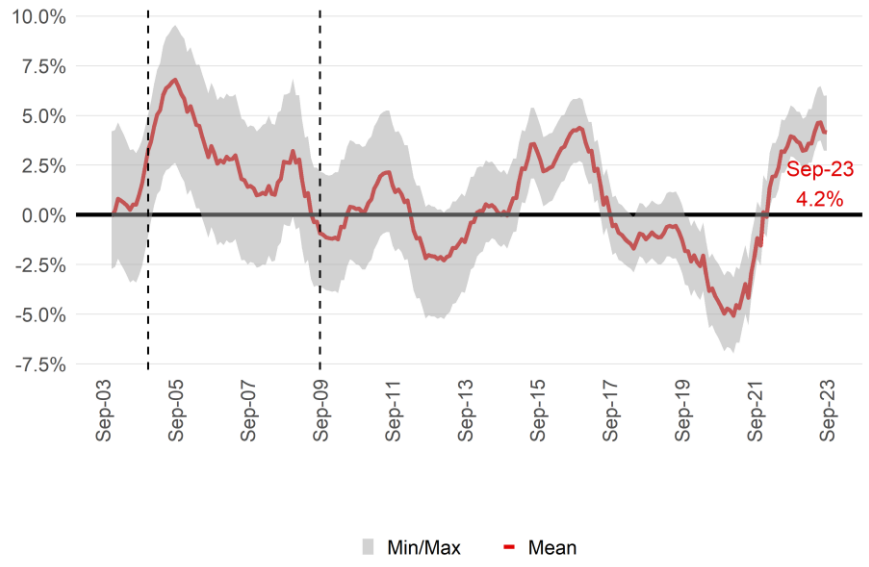


Sources: Bloomberg, New York fed, Richmond Fed, Santander.

Finally, Figure 4 paints the picture of **our mixed estimates and their average**. These estimates are based on Uncovered Interest Parity (UIP). They **estimate the local natural rate departing from the international natural rate (in this case, for the U.S), added to a smoothed five-year CDS spread for local sovereign risk**. Therefore, they can be seen as a combination of our model-based approach (used for the international natural rate estimate) and our market-based approach (used in the local risk premium estimate). **Of the three categories, this category's average is the lowest. Even so, the surge since 2020 is still noticeable. By this methodology, the natural rate of interest was stable overall at around 2.5% from mid-2007 to mid-2020 and now sits at 3.5%. This increase can be credited to two factors: a possible increase in the international natural rate and an increase in the perceived local fiscal risk.** We believe that the reason the mean of this approach leads to a number shy of the previous ones is strongly associated with the debate on the level of the international rate, which is beyond the scope of this analysis. For our purposes, it is sufficient to observe that international conditions have also put upward pressure on the local natural rate.

Policy

Figure 5 – *Ex Ante* Real Policy Rate Gap (%)



Source: Bloomberg.

Combining our results with calculations of the current *ex ante* real policy rate reflects the contractionary monetary policy stance in place since YE2021. Indeed, our estimates indicate that this stance has become even tighter than its 2016 equivalent (albeit similar). These calculations also **show that the easing cycle that preceded the current monetary policy was the loosest stance in 20 years, indicating the magnitude of the BCB's action in the fight against the COVID-19 pandemic.**

In our view, **the easing cycle that is now getting under way has a long way to go to reach the natural rate of interest**. As we see it, given that the current inflation expectations gap for the relevant policy window is at 0.8 p.p. (the highest level at the start of an easing cycle in the last 15 years), **if the BCB wishes to curb inflation expectations towards the inflation target, a contractionary stance is still necessary, and therefore the room for loosening is limited, as indicated by the authority. Thus, we believe that 2024 will still be marked by a tight monetary policy (i.e., an *ex ante* real rate higher than the natural rate of interest), albeit at a "smaller" compression rate.**

Technical Appendix

Model-Based Estimates:

1. Covid-Adjusted Holston-Laubach-Williams (HLW): This estimate follows the three-step procedure proposed by Holston, Laubach, and Williams (2023)[1], with small adjustments. The model is characterized by the equations below. We set the upper and lower boundaries on coefficients a_r and b_y to -0.25 and 0.25, respectively (instead of -0.0025 and 0.025, as in the original proposal). These tougher conditions guarantee convergence and circumvent the issue of an estimated potential growth variance biased toward zero, in line with Moreira and Portugal (2019)[2]. Estimates were quarterly and linearly approximated between months.

$$\tilde{y}_t = a_{y,1}\tilde{y}_{t-1} + a_{y,2}\tilde{y}_{t-2} + \frac{a_r}{2}\sum_{j=1}^{2}\left(r_{t-j} - r^*_{t-j}\right) + \epsilon_{\tilde{y},t}$$

$$\pi_t = b_\pi\pi_{t-1}(1-b_\pi)\pi^e_{t+4} + b_y\tilde{y}_{t-1} + \epsilon_{\pi,t}$$

$$r^*_t = c \cdot g_t + z_t$$

$$y^*_t = y^*_{t-1} + g_{t-1} + \epsilon_{y^*,t}$$

$$g_t = g_{t-1} + \epsilon_{g,t}$$

$$z_t = z_{t-1} + \epsilon_{z,t}$$

2. HLW with Taylor Rule (a la Brand and Mazelis [2019][3] with Santander's Output Gap measure): This model expands the previous one by including a version of the Taylor Rule as presented below. It should help on the identification of the natural rate by considering further information. Here, we opted to include Santander's estimates of the output gap as an observed variable. We estimate the set of equations through a simple Kalman Filter. Estimates were quarterly and linearly approximated between months.

$$i_t = \rho_i i_{t-1} + (1-\rho_i) * \left(r^*_t + \pi^*_t + \rho_\pi(\pi_t - \pi^*_t) + \rho_{\tilde{y}}\tilde{y}_t\right) + \epsilon_{i,t}$$

3. Recursive Regression of Taylor Rule: We estimate the version of a Taylor Rule (presented below) proposed in the BCB's Inflation report of 2Q21 using the recursive approach advocated by Plantier and Scrimgeour (2002)[4]. We estimate r^*_t through a recursive OLS approach and present the intercept as the natural rate estimate. We follow Carvalho, Nechio and Tristão (2021)[5] and use the OLS estimator despite its

[1] See Holston, Laubach, and Williams (2023), *Measuring the Natural Rate of Interest after COVID-19* - Federal Reserve Bank of New York Staff Reports, no. 1063.
[2] See Moreira and Portugal (2019), *Natural Rate of Interest Estimates for Brazil after Adoption of the Inflation Targeting Regime* – UFRGS Working Paper Series No 2257.
[3] See Brand and Mazelis (2019), *Taylor-rule consistent estimates of the natural rate of interest* – ECB Working Paper Series.
[4] See Plantier and Scrimgeour (2002), *Estimating a Taylor Rule for New Zealand with a time-varying neutral real rate* - Reserve Bank of New Zealand Discussion Paper Series No DP2002/06.
[5] See Carvalho, Nechio and Tristão (2021), *Taylor Rule Estimation by OLS* - Journal of Monetary Economics, Volume 124.

endogeneity bias since it should be “proportional to the fraction of the variance of regressors due to monetary shocks” and therefore “limited, given that monetary policy shocks appear to explain only a small fraction of the variance of endogenous variables to which the monetary authority responds, such as inflation and the output gap”. We estimate it using quarterly data and approximate it linearly between months.

$$i_t = \theta_1 i_{t-1} + \theta_2 i_{t-2} + (1 - \theta_1 - \theta_2)[r_t^* + \pi_t^* + \theta_3(\pi_t^e - \pi_t^*)]$$

Model-Based Estimates:

4. Filtered Premium and Inflation Adjusted 5y5y: We run an HP filter[6] on the five-year-ahead implicit real rate from the real interest rate term structure.
5. Filtered Premium and Inflation Adjusted 10y10y: The procedure is the same as the previous one applied to the 10-year-ahead implicit real rate from the real interest rate term structure.
6. Filtered one-year-ahead implied ex-post real rate: We run an HP filter on the 12-month-ahead monthly-average expected ex-post real rate.
7. Long Run Expected Real Rate from the Focus Survey: We extract the long-run implicit real rate from the BCB Focus survey.

Mixed Estimates:

8. HLW for US + Filtered 5y CDS (UIP)[7]: we use New York Fed’s estimates of the natural rate from the U.S. based on Holston, Laubach, and Williams (2023) as a basis for the international natural rate. We then add it to the trend component of the monthly average five-year CDS premium for Brazil, estimated through an HP filter.
9. Lubik-Matthes for US + Filtered 5y CDS (UIP): we use Richmond Fed’s estimates of the natural rate from the U.S. based on Lubik and Matthes (2015) as a basis for the international natural rate. As in the previous estimate, we then add the trend component of the monthly average five-year CDS premium for Brazil, estimated through an HP filter.
10. Filtered Ex-ante Real Rate + Filtered 5y CDS (UIP): We ran an HP filter on Fed ex-ante real rate series. Again, we add the trend component of the monthly average five-year CDS premium for Brazil, estimated through an HP filter.

[6] All HP-filter results used were adjusted for endpoint bias through a simple ARIMA forecast of the relevant series.
[7] For the sake of completeness, it is worth noting that we have also run each of the estimates of the Mixed Estimates section with a filtered EMBI spread. Results are overall equivalent and thus we decided to omit this alternative.

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