Macro Special

Will the BRL Continue to Appreciate?

Highlights

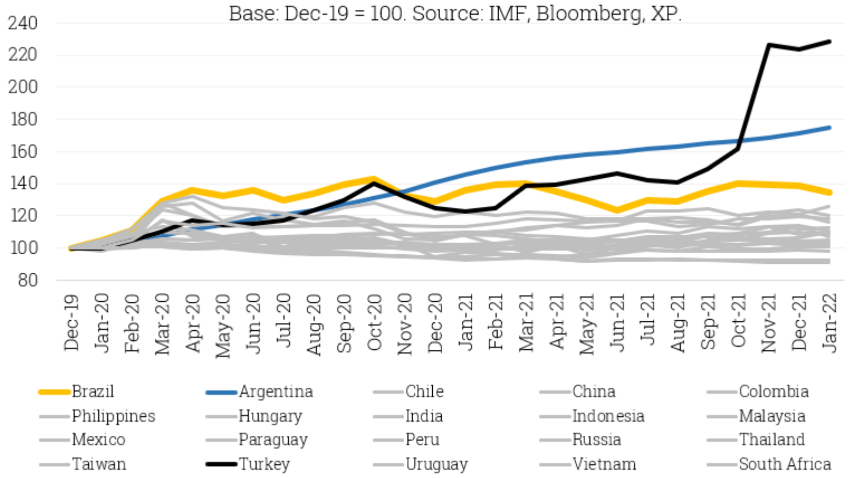
- *Despite the good performance in recent sessions, the Brazilian Real (BRL) underperformed the most within emerging market currencies during the two years of the pandemic;*
- *Our models, using domestic and external variables, suggest the BRL could be trading between 4.2 and 4.75 reais to the dollar;*
- *We understand that the pandemic brings a particularly opaque economic outlook for the country, considering its fragile fiscal position and the mounting demand for expenditures with social programs and infrastructure that next government will face;*
- *Thus, we believe that the currency misalignment will continue, at least until the economic guidelines for next government to be clearer (our official forecast still points to the nominal exchange rate at 5.7 reais to the dollar this year-end, and 5.3 at the end of 2023);*
- *But our research shows that the "gravity" of the Brazilian currency is towards appreciation. If, for any reason, the probability of a responsible fiscal policy beyond the elections increases, we may see the BRL currency continuing to strengthen;*

Introduction: the "Ugly Duckling"

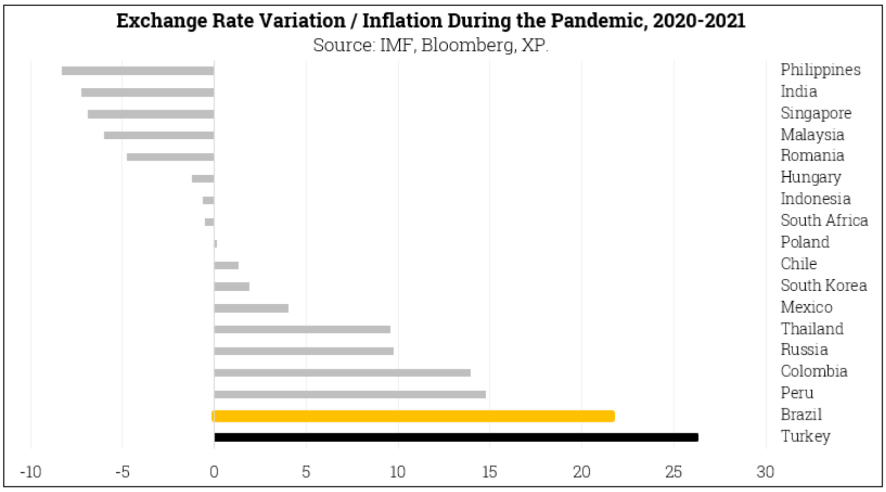
Despite the good performance in recent sessions, the Brazilian Real (BRL) underperformed the most within emerging market currencies during the two years of the pandemic. In nominal terms, the BRL weakened nearly 40% in 2020-2021, beating only Argentina (it always feels good for Brazilian to beat Argies) and Turkey in a group of EM countries selected by Bloomberg.

Exchange Rate Depreciation in Emerging Economies During the Pandemic (vs. USD).

Base: Dec-19 = 100. Source: IMF, Bloomberg, XP.



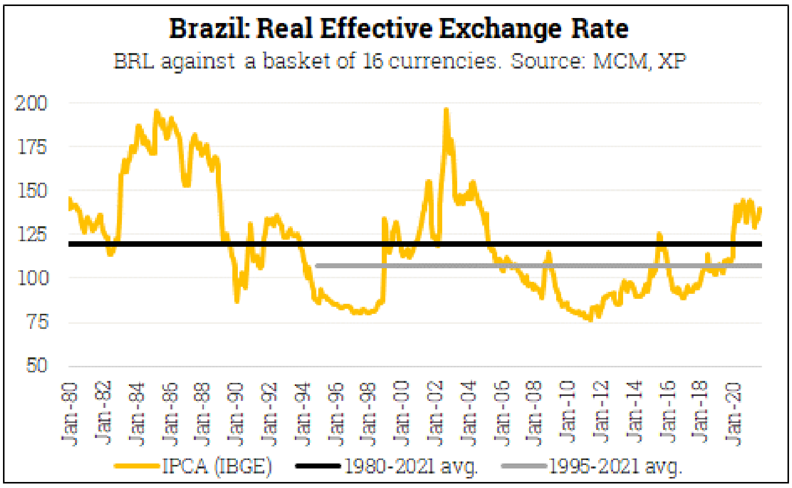
When adjusting for CPI inflation accumulated in 2020 and 2021, the BRL remains the "ugly duckling" (not considering the "very ugly duckling" Turkey). The Brazilian currency depreciated 22% more than inflation. Peruvian and Colombian currencies depreciated around 15%, while the currencies from Russia and Thailand weakened circa 10% based on the same gauge. The other emerging countries showed numbers around zero or in the negative territory, meaning that inflation was higher than the FX depreciation in the period.



Is it reasonable for the BRL to have had such an underperformance? How undervalued could the Brazilian currency be? This report tries to shed some light on this topic (rather tricky, as always when it comes to exchange rate).

Historical Perspective

At first glance, the BRL looks undervalued in real terms. The chart below shows the Real Effective Exchange Rate index for Brazil since 1980. At the end of 2021, the index was 15% weaker than the full-period average and 29% more depreciated than the post-Plano Real average[1].



This divergence from the historical average emerged during the pandemic, as described above. Before the Covid-19 crisis, Brazilian REER was exactly at the 95-21 average, and a bit stronger (8%) than the 80-21 average.

But as widely documented by economic literature, to look (only) at historical averages is a poor analysis. We should also take into consideration other economic variables, such as the current account balance, international financial position, fiscal sustainability, terms of trade, productivity gain differentials (among others) to assess whether the real exchange rate is misplaced - see, for instance, Edwards, S. (2018). *Finding equilibrium: on the relation between exchange rates and monetary policy*.

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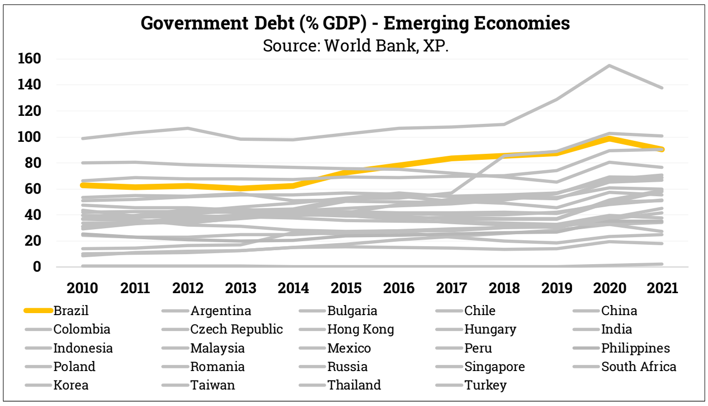
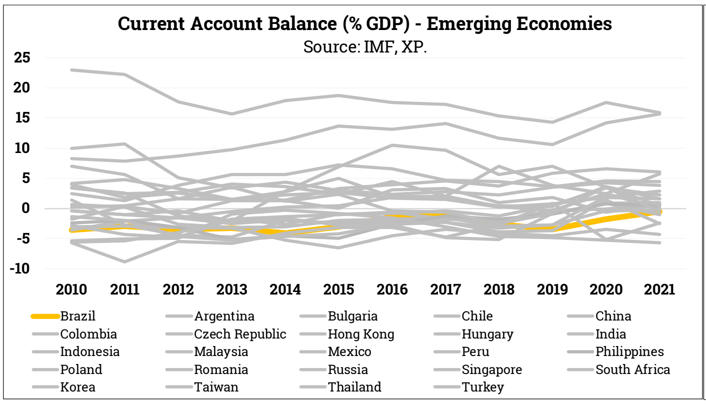
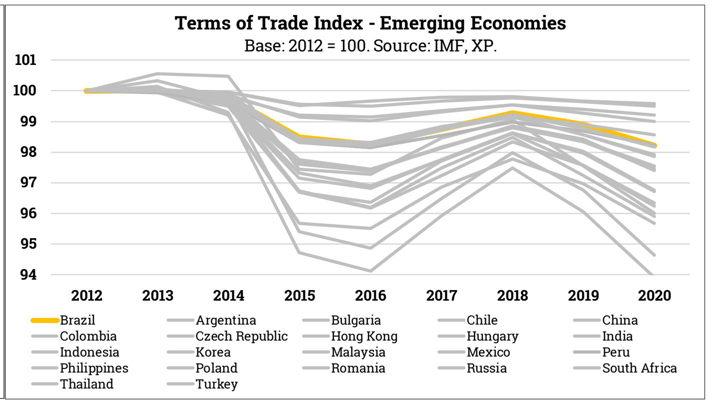
[1] Plano Real was the monetary reform that ended with hyperinflation in Brazil, in 1994.







The following sessions conduct this analysis.

Nominal Exchange Rate and the Pandemic Shock

In order to predict the nominal exchange rate dynamics, analysts usually build econometric models based on financial assets. In the short term, allocation choices guide the behavior of the currency, representing the investors' seeking for profits.

Among a large set of econometric models developed to anticipate nominal FX movements (with different variables and statistical methods), we show in this report a representative specification. We basically want to put into numbers what has been widely discussed by experts and perceived by households and companies: after the pandemic, Brazilian Real is out of place, that is, the currency has devalued beyond what its fundamentals would indicate.

The variables used in our representative econometric model for FX are shown in the equation below (on a monthly basis), where BRL_t represents the Brazilian nominal exchange rate at month *t*: $\boldsymbol{BRL_t} \approx \beta_1 DXY_t + \beta_2 CDS_t - \beta_3 CRB_t - \beta_3 IntDif_t + c$

BRL - Nominal Exchange Rate: the pair of Brazilian Real per US Dollar.

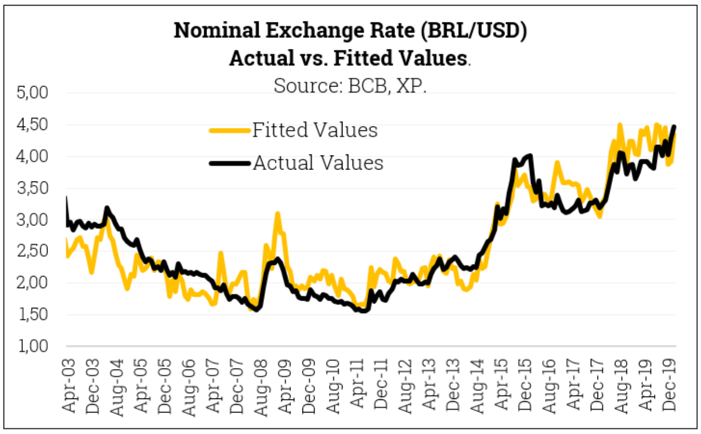
DXY - Dollar Index: it shows the strength of the US dollar against a basket of developed currencies. In the case of Brazil, an emerging country, the stronger the US dollar, the more our currency is penalized (devalued). Thus, the estimated coefficient linked to this variable is expected to show a positive sign.

CDS – 5-year Credit Default Swap: a metric associated with country risk. The higher the CDS, the greater the country risk and lower the potential for attracting foreign resources. Thus, we expect here a positive sign.

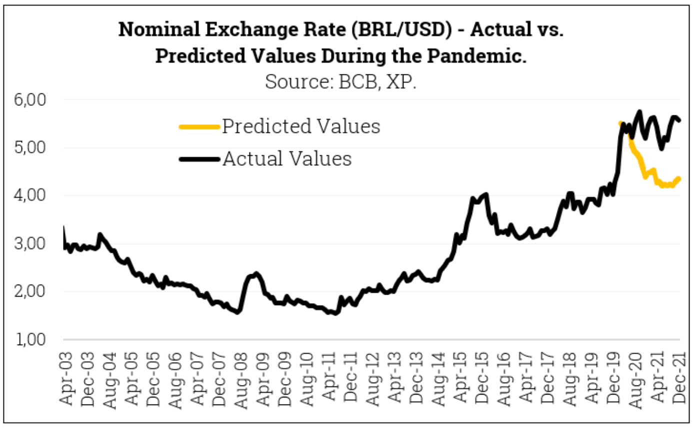
CRB – Commodity Prices: an average of international commodity prices (spot index). The higher the CRB, the greater Brazilian exports value and, as a consequence, the larger the supply of foreign currencies. Thus, we expect a negative sign.

IntDif - Interest Rate Differential: the greater the difference between the local rate and the international risk-free rate (here we adopt the US Fed Funds Target Rate), the greater the expected foreign currency flow into the country and, accordingly, the more appreciated the domestic exchange rate. Thus, we expect a negative sign.

First, we used monthly data ranging from October 2001 to January 2020 for the estimation process, one month before the WHO (World Health Organization) officially announced the pandemic outbreak. The model parameters showed the expected signs and statistical significance (p-value below 5%).



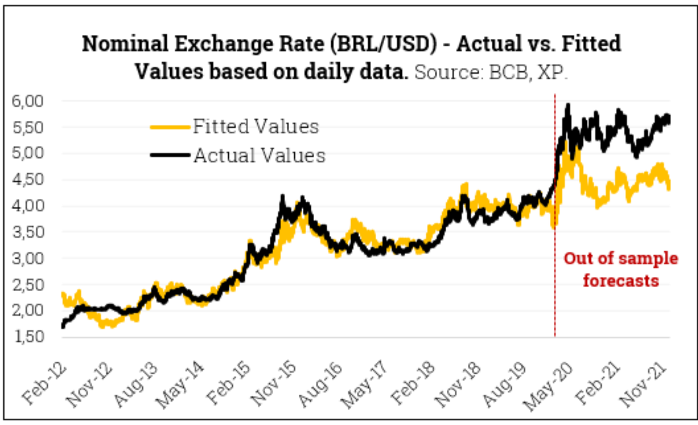
When using the same model for predicting the nominal exchange rate for the period of February 2020 to January 2022 ("out-of-sample" forecasts), nonetheless, we note a large discrepancy from its actual values. **On average, the difference was nearly 15% for the last two years (versus 2.5% for the Oct01-Jan20 period). As per our estimated model, Brazilian FX would have ended 2021 at BRL/USD 4.35 (far below the actual value of BRL/USD 5.58).**

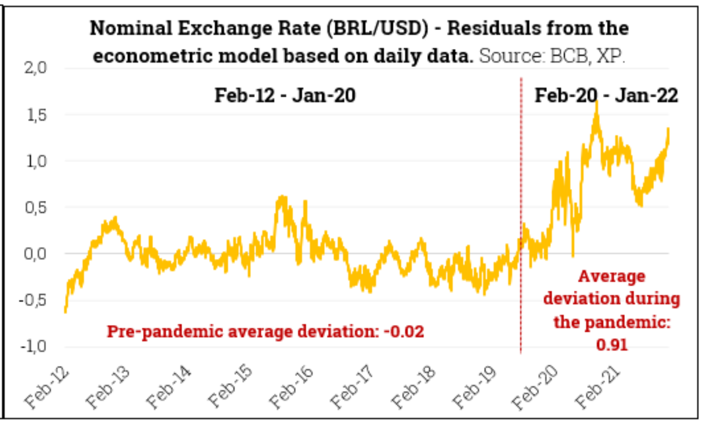


Even with other econometric specifications for the Brazilian FX, the main result holds: a significant mismatch between predicted and actual values during the Covid-19 crisis period. For instance, considering our model based on daily data[2] for the period ranging from February 26, 2012 to January 26, 2022, the average residual jumped from -0.02 in the period between Feb-12 and Jan-20 to 0.91 in the period between Feb-20 and Jan-22.

That said, should we really affirm that the Brazilian Real is weaker compared to what is indicated by economic fundamentals? For answering this question, we have to look deeper into the Real Effective Exchange Rate (REER) dynamics.

[2] The econometric specification considers daily data for Ibovespa (the major Brazil's stock market index) in addition to the variables presented in the model on a monthly basis (DXY, CDS, IntDif).





Real Exchange Rate and the Currency Misalignment

For estimating the equilibrium real exchange rate and the likely currency misalignment (persistent undervaluation) in the Brazilian economy during the pandemic, we adopted different combinations of economic variables and methodologies. We present below the list of indicators used in our tests and estimation process.

Variable	Description	Source	Expected Sign	Economic Intuition
TOT- Terms of Trade	Ratio between Brazil's export prices and import prices	Funcex	-	Higher export prices than import prices implie trade balance surplus (commercial foreign currency inflows)
NEL - Net External Liabilities	Ratio between International Investment Position and Total GDP	Central Bank of Brazil and Ministry of Economy	+	In the long term, high NEL indicate that a country structurally needs external financial support.
PROD – TFP Growth Differential	The difference in growth rates of total factor productivity (TFP) between Brazil and the average of emerging countries	The Conference Board	-	A component for measuring potential economic growth. Literature shows that stronger economic growth usually implies currency appreciation
INT – Interest Rate Differential	The contrast in interest rates between 5-year government bonds from Brazil and the United States	B3 and Bloomberg	-	Higher interest rates attract foreign capital and appreciate the domestic exchange rate
NTT – Non-Tradables vs. Tradables	The ratio between non-tradables and tradables inflation based on Brazil's CPI	IBGE	-	If services prices rise faster than industrial prices, the exchange rate strengthens
DEBT – Public Debt Differential	The difference of public debt-to-GDP ratio between Brazil and the average of emerging countries	The World Bank	+	Higher the government debt differential, the higher the risk perceived by investors and other financial market participants
CDS (Sovereign Risk)	Credit Debt Swap spread	Bloomberg	+	Higher the sovereign risk, lower the incentives to invest resources in the country

In the present report, we focus on the development of BEER (Behavioral Equilibrium Exchange Rate) models, which combine structural and cyclical factors aiming at evaluating the currency misalignment[3]. Under this approach, the main goal is not to seek a long-term exchange rate that leads to the convergence of the current account balance at a certain equilibrium level. In fact, the FEER (Fundamental Equilibrium Exchange Rate) models are most commonly used for assessing the exchange rate dynamics in the general macroeconomic equilibrium.

As broadly discussed in the specialized literature, real exchange rates should move back towards their equilibrium in the medium run, annulling the currency misalignment. Nonetheless, nominal and structural rigidities may hinder adjustment and lead to a long-lasting deviation. Given the significant changes caused by the pandemic, especially the persistent imbalances between supply and demand, we opted to implement the BEER models.

Our estimation process considers the sample period ranging from 4Q2002 to 4Q2021 (on a quarterly basis). Three different econometric methods were applied: (A) FMOLS – Fully Modified Ordinary Least Squares; (B) VEC – Vector Error Correction; and (C) GMM – Generalized Method of Moments. The models presented below were taken as robust for measuring exchange rate misalignment over time. That said, we do not intend to discuss which would be the best econometric framework for this type of exercise, since all methods have

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[3] For further discussion, see (i) Berkowitz, J., and Giorgianni, L. (2001). *Long-Horizon Exchange Rate Predictability?*; (ii) Siregar, R. (2011). *The concepts of Equilibrium Exchange Rate: A Survey of Literature*; and (iii) Ribeiro, L., and Pessôa, S. (2016). *Modelos de Câmbio Real para a Economia Brasileira* (in Portuguese).

limitations and the estimation of an unobservable economic variable is not trivial - especially under atypical conditions such as those brought about by the pandemic.

In short, the estimates obtained from those three different frameworks ranged from 18% to 33% regarding currency misalignment at the end of 2021. Accordingly, the current "equilibrium" exchange rate (applying the results to the nominal pair) would be in the interval from BRL/USD 4.20 to BRL/USD 4.75.

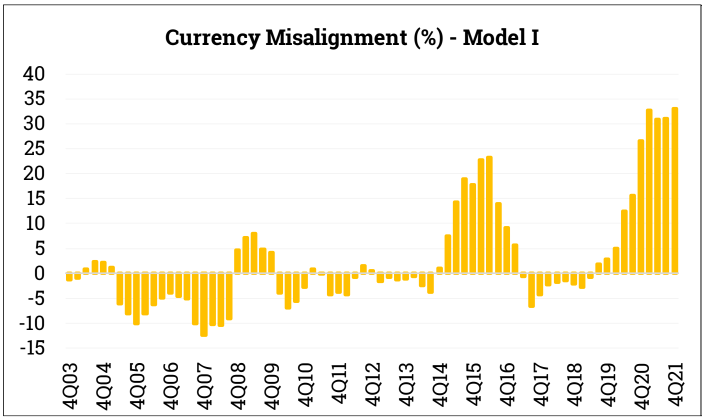
MODEL I:

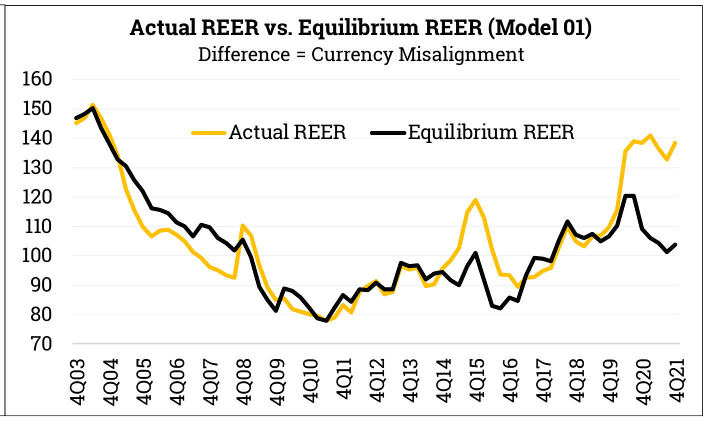
$$\boldsymbol{log}(\boldsymbol{REER_t}) \approx \beta_1 log(NEL_{t-1}) - \beta_2 log(TOT_t) - \beta_3 log(PROD_t) + \beta_4 log(CDS_t) - \beta_5 log(INT_t) - \beta_6 log(TRI_t) + c$$

Method: FMOLS

Currency misalignment at the end of 2021 = 33%

"Equilibrium" (no misalignment) nominal exchange rate = BRL/USD 4.20





By considering an alternative version of the model without CDS and interest rate differential in the econometric specification, the estimate of currency misalignment is even higher: nearly 40%, which would be compatible with an "equilibrium" nominal exchange rate of around BRL/USD 3.95 at the end of last year.

MODEL II:

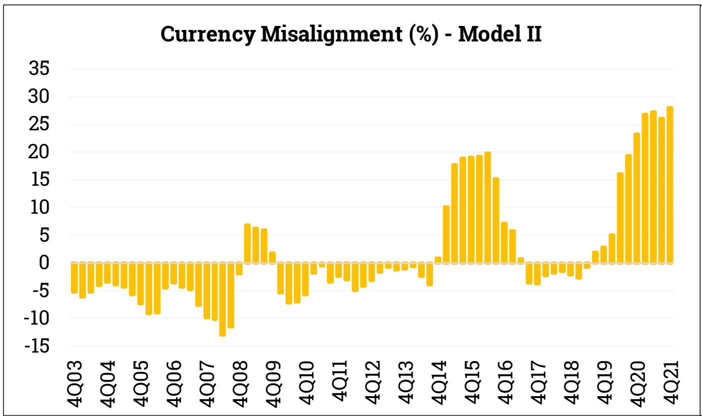
$$\boldsymbol{log}(\boldsymbol{REER_t}) \approx \beta_1 log(NEL/TF_{t-1}) - \beta_2 log(TOT_t) - \beta_3 log(PROD_t) + \beta_4 log(DEBT_t) - \beta_5 log(NTT_t) + c$$

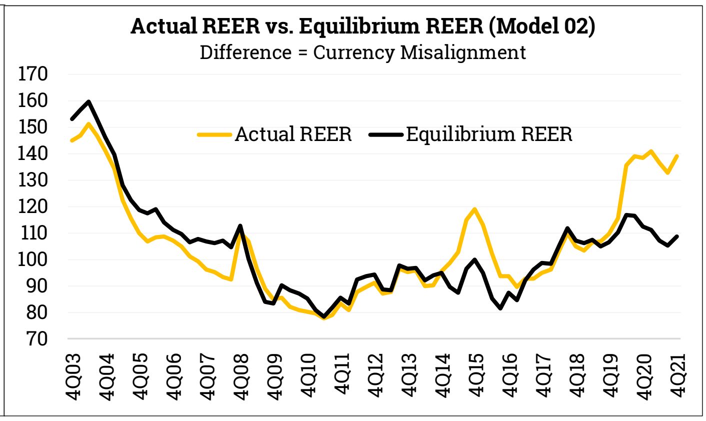
Where: $TF - Trade\ Flow = the\ sum\ of\ exports\ and\ imports\ value$

Method: FMOLS

Currency misalignment at the end of 2021 = 28%

"Equilibrium" (no misalignment) nominal exchange rate = BRL/USD 4.35





MODEL III:

$\boldsymbol{log(REER)}$; $log(NEL)$; $\log(TOT)$; $log(PROD)$

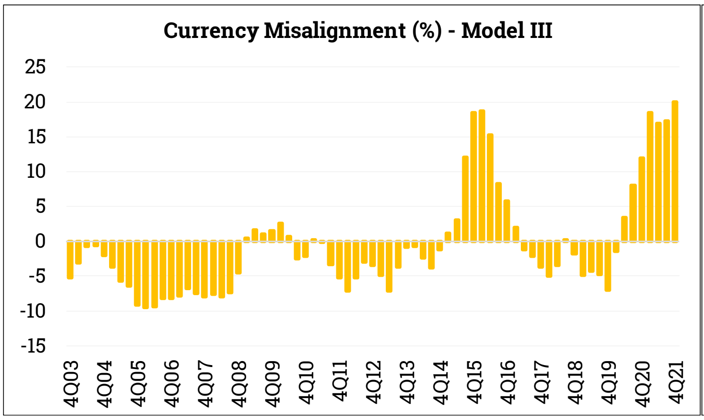
Method: VEC (selection of 2 lag periods)

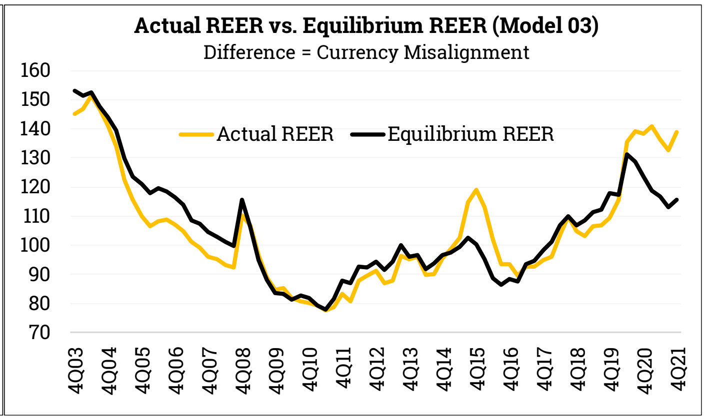
Generic specification:

$$\Delta Y_t = \alpha\beta' Y_{t-1} + \sum_{i=1}^{p-1} \tau_i \, \Delta Y_{t-1} + \epsilon_t \Delta_t$$

Currency misalignment at the end of 2021 = 21%

"Equilibrium" (no misalignment) nominal exchange rate = BRL/USD 4.62





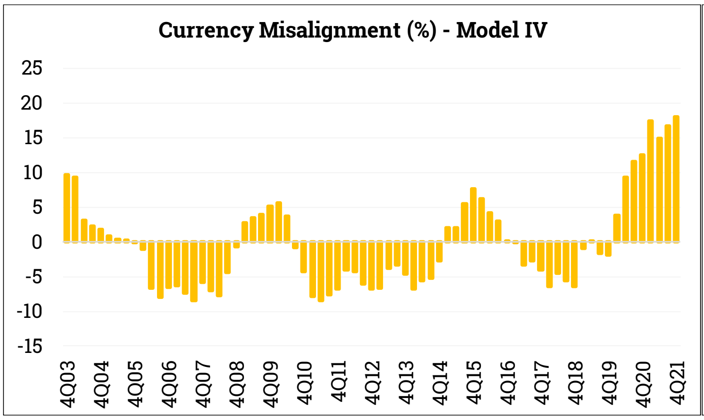
MODEL IV:

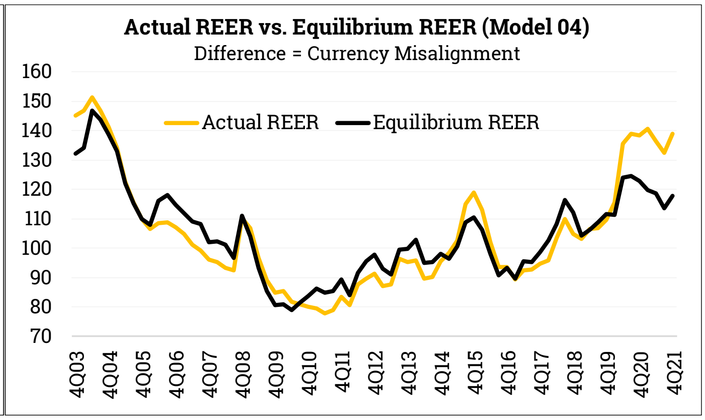
$\boldsymbol{log(REER_t)} \sim \beta_1 log(NEL_{t-1}) - \beta_2 log(TOT_t) + \beta_3 log(CDS_t) - \beta_4 log(NTT_t) - \beta_5 log(INT_t) + c$

Method: GMM (1-period lagged variables were used in the instrument list)

Currency misalignment at the end of 2021 = 18%

"Equilibrium" (no misalignment) nominal exchange rate = BRL/USD 4.74





Conclusions and Final Remarks

Using different methods and specifications, we show in this report that the BRL is weaker than justified by economic fundamentals. The Brazilian exchange rate ended 2021 at 5.6 reais to the dollar, and improved a bit in January, to 5.3. Our exercises suggest it should be between 4.2 and 4.75 reais to the dollar. In our view, all the imbalances and uncertainties caused by the (unprecedented) Covid-19 crisis help to explain, to some extent, the large currency misalignment in the recent period.

Indeed, other empirical works suggest that the BRL was hit more severely since 2020 due to the pandemic dynamics in the country (see, for instance, Ribeiro, L. *Taxa de Câmbio sob fogo amigo*. Blog do IBRE). These effects are not fully captured in the models, even considering risk factors such as the Brazilian CDS spreads.

Still, we keep our view that the FX will continue to hover around current levels in the coming quarters. That's because we believe that fiscal and political risks (perhaps also not fully captured in the modeling for the "equilibrium" REER) will continue to drive Brazilian assets at least until close to the elections. Empirical evidence shows that the BRL can be detached from fundamentals for a long time.

The possibility of a much hawkish US Fed could also play a role in preventing the BRL to converge to its "fair value", in our opinion.

Anyway, this note shows the "gravity" of the Brazilian currency towards appreciation. If, for any reason, the probability of a responsible fiscal policy beyond the elections increases, we may see the BRL currency continuing to strengthen.

Caio Megale – Chief-Economist

Rodolfo Margato – Economist

Alexandre Maluf – Macro Strategist

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