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**A relação entre taxa de lucro e taxa de câmbio no Brasil:
2000-2023**

**A note on the profit rate-exchange rate nexus in Brazil:
2000-2023**

**la relación entre la tasa de ganancia y la tasa de cambio en
Brasil: 2000-2023.**

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Resumo: Esta nota explora a relação entre as taxas de lucro e seus determinantes, e a taxa de câmbio real na economia brasileira de 2000 a 2023. Com base na teoria marxista, examinamos os impactos das desvalorizações e apreciações cambiais na taxa de lucro. Os resultados mostram uma relação não linear e em forma de U entre essas variáveis. A taxa de câmbio subvalorizada conduz a uma taxa de lucro mais elevada devido a um aumento na parcela dos lucros, apesar de um declínio na produtividade do capital. A taxa de câmbio apreciada também resulta numa maior taxa de lucro, ao aumentar a produtividade do capital, embora reduza a participação nos lucros. Além disso, observamos uma associação em forma de U entre as taxas de câmbio e o crescimento do PIB. Esta pesquisa destaca a complexa dinâmica entre as taxas de câmbio e as taxas de lucro, fornecendo informações valiosas para os formuladores de políticas brasileiros à medida que eles navegam nas políticas econômicas e cambiais.

Palavras-chave: Taxa de câmbio; Taxa de lucro; Economia brasileira.

Abstract: This note explores the relationship between profit rates and their determinants, and the real exchange rate in the Brazilian economy from 2000 to 2023. Drawing on classical-Marxian theory, we examine the impacts of exchange rate devaluations and appreciations on profit rates. Our findings reveal a non-linear, smile-shaped relationship between these variables. Specifically, an undervalued exchange rate leads to a higher profit rate due to an increase in the profit share, despite a decline in capital productivity. Conversely, an appreciating exchange rate also results in a higher profit rate by boosting capital productivity, though it reduces the profit share. Additionally, we observe a U-shaped association between exchange rates and GDP growth. This research highlights the complex dynamics between exchange rates and profit rates, providing valuable insights for Brazilian policymakers as they navigate economic and exchange rate policies.

Keywords: Exchange rate; Profit Rate; Brazilian economy.

Resumen: Esta nota explora la relación entre las tasas de ganancia y sus determinantes, y el tipo de cambio real en la economía brasileña desde el año 2000 hasta 2023. Basándonos en la teoría clásica-marxista, examinamos los impactos de las devaluaciones y apreciaciones del tipo de cambio sobre las tasas de ganancia. Nuestros hallazgos revelan una relación no lineal, en forma de sonrisa, entre estas variables. Específicamente, un tipo de cambio infravalorado conduce a una tasa de ganancia más alta debido a un aumento en la participación de las ganancias, a pesar de una disminución en la productividad del capital. Por el contrario, un tipo de cambio apreciado también resulta en una tasa de ganancia más alta al impulsar la productividad del capital, aunque reduce la participación de las ganancias. Además, observamos una asociación en forma de U entre los tipos de cambio y el crecimiento del PIB. Esta investigación destaca la dinámica compleja entre los tipos de cambio y las tasas de ganancia, proporcionando perspectivas valiosas para los formuladores de políticas brasileños mientras navegan por las políticas económicas y de tasa de cambio.

Palabras clave: Tasa de cambio; Tasa de ganancia; Economía brasileña

Introduction

In the classical-Marxian tradition, the profit rate is the primary driver of capital accumulation. Firms base their investment decisions on the expected profit rate, which depends on current profitability. Building upon the work of Weiskopf (1999), there is a growing body of literature that examines the determinants of the profit rate and capital accumulation in the Brazilian economy (Marquetti et al. (2023); Klein and Rugitsky, 2021; Marquetti et al. 2020; among others). The critical determinants of the profit rate include the profit share, potential capital productivity, and capacity utilization.

The new developmentalist literature also considers the profit rate being determined by these three variables. However, it emphasizes the role of the real exchange rate on the profit share through its effects on the markup for tradable goods (Bresser-Pereira et al. 2014, Feijó and Araújo 2024). The devaluation of the real exchange rate allows domestic firms to expand their markup as the price of imported goods in domestic currency increases. As a result, the profit share rises⁵. The same occurs with the profit rate if the other components of the profit rate remain constant.

The Dutch disease, a phenomenon commonly observed in resource-rich countries, can lead to an uncompetitive real exchange rate for manufacturing sectors, particularly those utilizing advanced technologies (Bresser-Pereira, 2022). This occurs due to the appreciation of the national currency driven by high revenues from natural resource exports. Additionally, pursuing high interest rates to avoid capital flight and attract international capital exerts further pressure for exchange rate appreciations, thereby reducing the markup and profit share in the tradable sector. Consequently, the profit rate within the tradable sector, particularly in manufacturing, experiences a decline, resulting in reduced capital accumulation and impeding technological advancements. This phenomenon contributed to the process of premature deindustrialization in Brazil, characterized by a declining share of manufacturing output and employment in the overall economy.

There is a growing literature on the effects of the real exchange rate on capital accumulation and economic growth (Krugman and Taylor 1978; Frenkel and Taylor 2006; Missio et al. 2015; Blecker 2023, among others). Missio et al. (2015) pointed out the three main results of this literature. Firstly, the undervalued real exchange rate is associated with

⁵ The profit share (π_t) and the markup (μ_t) are related following the equation $\pi_t = \frac{\mu_t}{1+\mu_t}$.

higher output growth. Secondly, these relationships are predominantly observed in developing countries. Thirdly, the relationship between the real exchange rate and growth is nonlinear; moderate undervaluations tend to stimulate growth, and excessively strong undervaluations can have adverse effects, potentially undermining economic performance.

Ribeiro et al. (2020) argue that two conflicting effects characterize the relationship between changes in the real exchange rate and output growth. Firstly, undervaluation positively affects output by stimulating technological progress and knowledge spillovers. Secondly, undervaluation increases income inequality and thereby hampers output growth. They criticize the literature for not explicitly considering the adverse distributional effects of undervaluation on growth. However, the authors failed to raise the possibility of a nonlinear relationship between real exchange rate and economic growth.

In the classical-Marxian tradition, the real exchange rate exerts contradictory impacts on the profit rate, influencing capital accumulation and economic growth. Specifically, an undervalued exchange rate increases the profit share and raises the price of capital goods. This configuration boosts the profit share but declines capital productivity. In contrast, an overvalued exchange rate depresses the profit share while reducing the cost of capital goods, diminishing the profit share but enhancing capital productivity. The overall effect of the real exchange rate on the profit rate, and consequently on capital accumulation and economic growth, hinges on the relative strengths of these opposing effects and their interplay with other economic variables. This framework provides a perspective on the nonlinear relationship between an undervalued real exchange rate and economic growth, as displayed by Missio et al. (2015).

This note presents a preliminary investigation into the relationship between the profit rate, its determinants, and the real exchange rate in the Brazilian economy from 2000 to 2023. We know that empirical studies have yet to explore these connections in depth. While related, the work of Marconi et al. (2020) primarily examines the relationship between the real exchange rate and profit margins rather than directly addressing the broader determinants of the profit rate. This investigation will fill that gap by analyzing how these economic factors interrelate within the 2000-2023 period.

The article is organized into three sections besides this introduction. The second section discusses how the profit rate, its determinants, and the real exchange rate are measured. The exchange rate is measured in direct quotation, indicating how many local currency units are needed to buy one foreign currency. The third section presents the

empirical investigation based on visualization instead of econometric analysis. The fourth section concludes this note.

2. The profit rate-exchange rate nexus

The profit rate is computed by the ratio between the profits (Z) generated in a given period, a flow variable, and total advanced capital (K), a stock variable. This broad definition of the profit rate is dubbed by Duménil and Lévy (1993) as the profit rate à la Marx. The profit rate is calculated as:

$$r_t = Z_t / K_t. \quad (1)$$

Weisskopf (1979) proposed a decomposition of the profit rate that allows analysts to determine whether changes over time are due to variations in the profit share (π), the potential productivity of capital (ρ), the level of capacity utilization (u), or a combination of them. The method can stress the variable that drives the changes in the profit rate. This decomposition can be expressed as:

$$r_t = \left(\frac{Z_t}{X_t}\right) * \left(\frac{X_{Pt}}{K_t}\right) * \left(\frac{X_t}{X_{Pt}}\right) = \pi_t \rho_t u_t, \quad (2)$$

where X is net output, and X_p is net potential output. The variables are measured at current prices. The profit share (π), a proxy for the rate of surplus value, reflects the effects of income distribution between capital and labor on the profit rate, whereas the potential output-capital ratio (ρ), a proxy for the organic composition of capital, mirrors the effects of technology. This idea resembles Marx's (1981) analysis of the profit rate in terms of distribution and technology. The level of capacity utilization (u) reflects changes in the aggregate demand.

The profit rate path is related to three factors that explain the sources of crisis in a capitalist economy (Weisskopf, 1979). First, the decline in the profit share is due to workers' greater bargaining power, with wages rising faster than labor productivity. Second, the potential productivity of capital declines due to the increasing organic composition of capital associated with technical change and capital accumulation. Third, the level of capacity utilization declines due to reduced aggregate demand.

The profit share can be decomposed as:

$$\pi_t = \left(\frac{Z_t}{X_t}\right) = \left(\frac{X_t - W_t}{X_t}\right) = \left(1 - \frac{W_t}{X_t}\right) = 1 - \frac{w_t}{x_t} = 1 - \frac{w_t}{p_t^x x_{Ct}} \quad (3)$$

where w is the average nominal wage, x is the nominal labor productivity, pX denotes the GDP deflator, and x_C is the real labor productivity. The growth rate of profit share is given by:

$$g_{\pi_t} = g_{p_t^X} - g_{w_t} + g_{x_{Ct}}. \quad (4)$$

Considering the hypothesis that exchange rate depreciation positively impacts the GDP deflator more than nominal wage and does not affect real labor productivity, it increases the profit share. Conversely, in the case of exchange rate appreciation, there is a higher negative impact on the GDP deflator than on the nominal wage, which leads to a decline in the profit share. Thus, an undervalued exchange rate typically results in a higher profit share.

Following Marquetti et al. (2020), the potential output capital ratio can be written as:

$$\rho_t = \frac{p_t^X X_{Pt}}{\sum_{s=0}^L d_s p_t^K I_{t-s}} = \frac{p_t^X X_{Pt}}{p_t^K \sum_{s=0}^L d_s I_{t-s}} = \frac{p_t^X}{p_t^K} \frac{X_{Pt}}{\sum_{s=0}^L d_s I_{t-s}} = \frac{p_t^X}{p_t^K} \frac{X_{PCt}}{K_{Ct}} = p_t^R \rho_{Ct} \quad (5)$$

where p^C denotes the price of capital goods, X_{PC} is the potential output at constant prices, K_C is the capital stock at constant prices, p_t^R is the relative price between the GDP deflator and the price of capital goods, and ρ_C the potential productivity of capital at constant price. The growth rate of the potential output capital ratio is:

$$g_{\rho_t} = g_{p_t^X} - g_{p_t^K} + g_{\rho_{Ct}} \quad (6)$$

Exchange rate fluctuations affect the potential output-capital ratio through changes in the GDP deflator and the price of capital goods, with a reduced impact on the real potential output-capital ratio. Typically, exchange rate devaluation has higher effect on the price of capital goods, which largely consist of tradable goods, compared to the GDP deflator, which encompasses prices across both tradable and nontradable sectors. Moreover following structuralists, a steep price inelastic demand for capital goods is a stylized fact in Brazil and many other countries of Latin American countries (Câmara and Vernengo, 2004). Conversely, exchange rate appreciation has lower impact on the GDP deflator compared to the price of capital goods. A higher exchange rate is associated with a lower potential output capital ratio.

The impacts of exchange rate movements on the profit rate are difficult to untangle. A devalued exchange rate typically corresponds with a higher profit share but a lower potential output capital ratio. Conversely, an overvalued exchange rate often leads to a lower profit

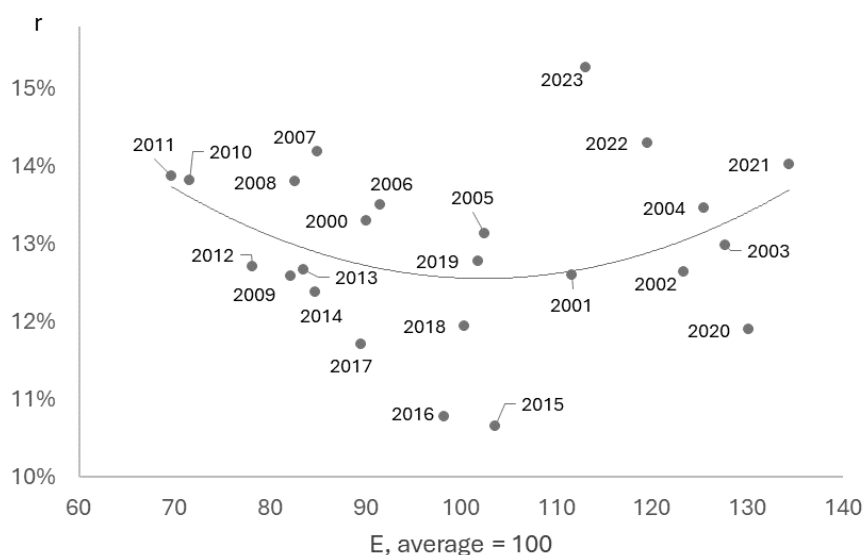
share and a higher potential output-capital ratio. These observations indicate a nonlinear relationship between the exchange rate and the profit rate, suggesting that overvalued and undervalued exchange rates are associated with higher profit rates.

3. Empirical nexus between profit rate and real exchange rate

The data source for the variables is Marquetti et al. (2023). For the real exchange rate, denoted as E , we used the real effective exchange rate IPCA index provided by the Brazilian Central Bank dataset (2024). This index has an average value of 100 for the period 2000-2023.

Figure 1 shows the pair (E, r) and its nonlinear fit for the period 2000-2023. As expected, it exhibits a 'smile' shaped curve. The profit rate tends to be higher for both undervalued and overvalued exchange rates. However, understanding the complex relationship between these two variables requires more than simply observing their changes. A more detailed analysis, examining the association between the exchange rate and other variables that impact the profit rate is necessary.

Figure 1: The pair (E, r) and its fit: 2000-2023.

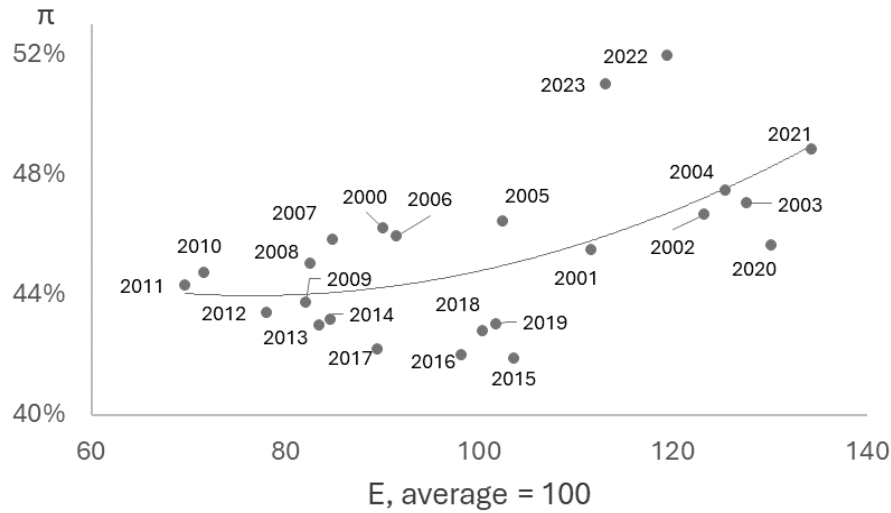


Source: Marquetti et al (2023) and Banco Central (2024).

Figure 2 illustrates the correlation between the real exchange rate and profit share. As anticipated, a positive relationship is evident, indicating that profit share tends to increase when the exchange rate is undervalued. This finding aligns with insights from the new

developmentalist literature. To fully understand the dynamics of profit share, however, it is crucial to examine more closely the other variables that influence it.

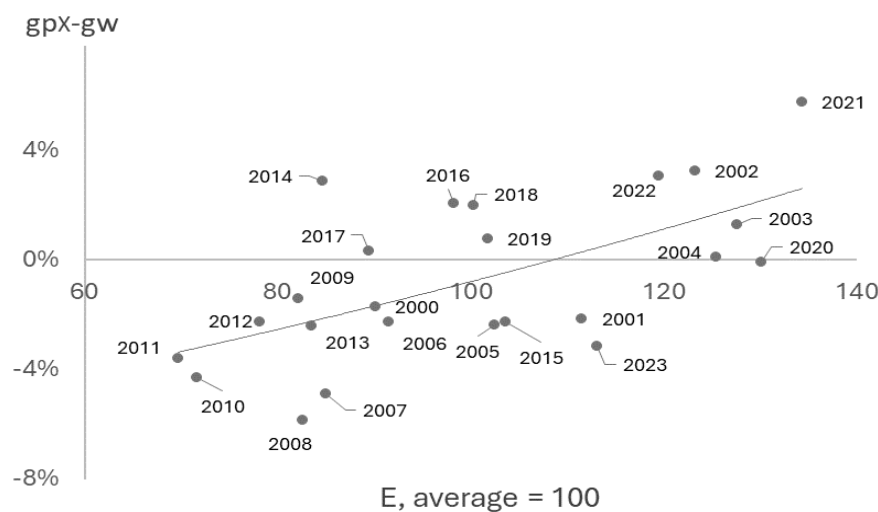
Figure 2: The pair (E, π) and its fit: 2000-2023.



Source: Marquetti et al (2023) and Banco Central (2024).

To better understand this complex relationship, we should examine the decomposition of the profit share as outlined in Equation 3. Figure 3 demonstrates that the gap between GDP growth and the nominal average wage growth positively correlates with the devaluation of the real exchange rate. This suggests that exchange rate devaluations tend to affect the GDP deflator more significantly than wages, thereby enhancing the profit share.

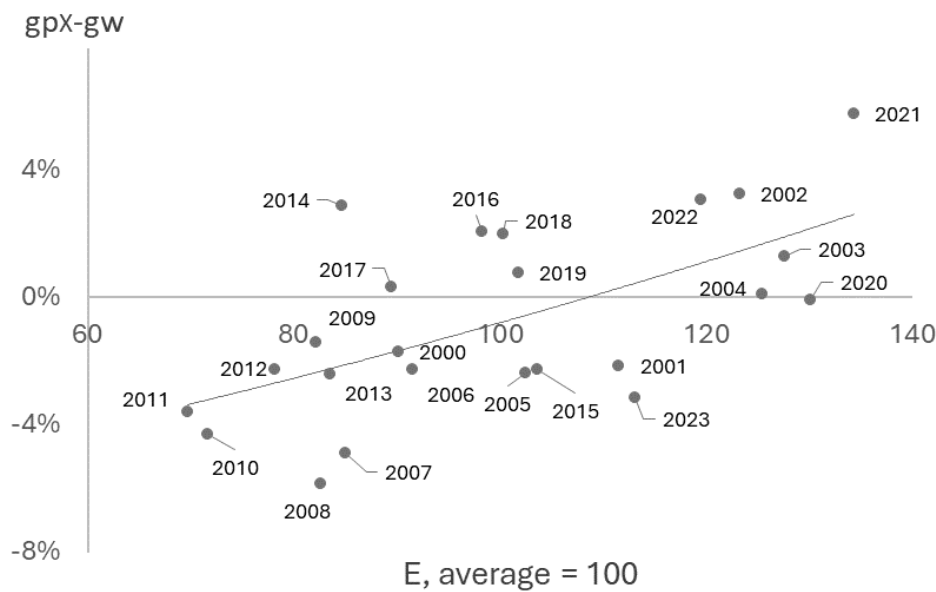
Figure 2: The pair (E, π) and its fit: 2000-2023.



Source: Marquetti et al (2023) and Banco Central (2024).

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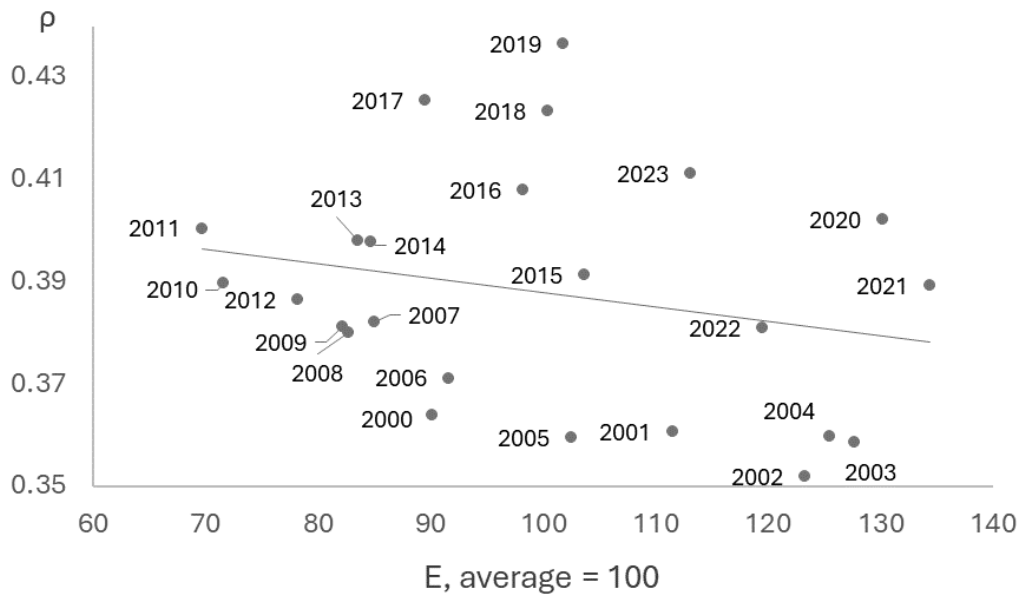
Figure 3: The pair (E, gpX-gw) and its fit: 2000-2023.



Source: Marquetti et al (2023) and Banco Central (2024).

The relationship between the real exchange rate and potential capital productivity (or the potential output-capital ratio) is illustrated in Figure 4. It reveals a linear negative correlation, indicating that an increase in the exchange rate corresponds to a decrease in potential capital productivity. In essence, it shows that currency devaluation reduces potential capital productivity, which negatively affects the profit rate when other variables are held constant.

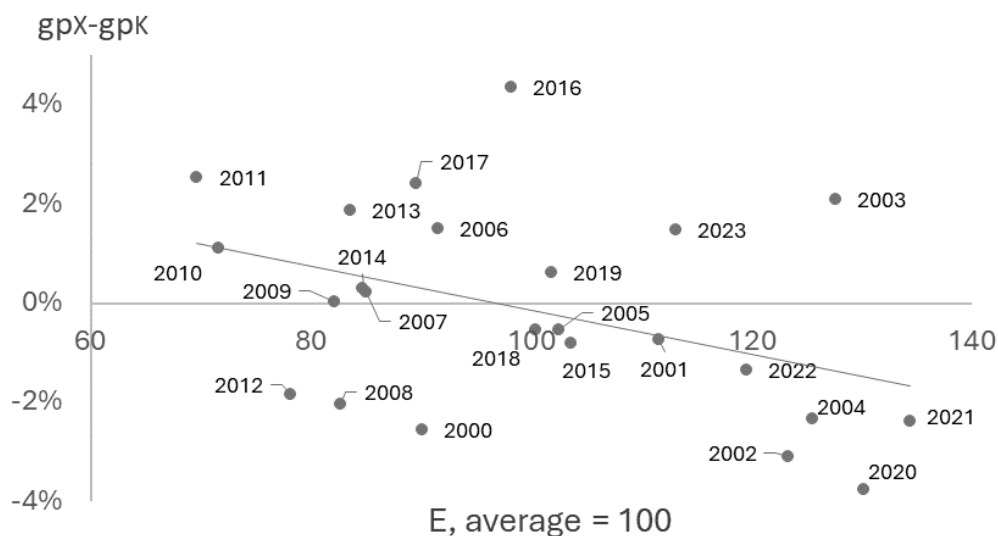
Figure 4: The pair (E, ρ) and its fit: 2000-2023.



Source: Marquetti et al (2023) and Banco Central (2024).

Figure 5 shows that exchange rate devaluations tend to have a stronger effect on the price of capital goods than on the GDP deflator. As mentioned in section 2, the negative relationship displayed in the graph aligns with our expectations. This pattern emerges because the GDP deflator includes prices of tradable and nontradable goods, while the price of capital goods encompasses mainly tradable goods. Moreover, a high dependency on the imports of capital goods is a stylized fact in Brazil (Câmara and Vernengo, 2004).

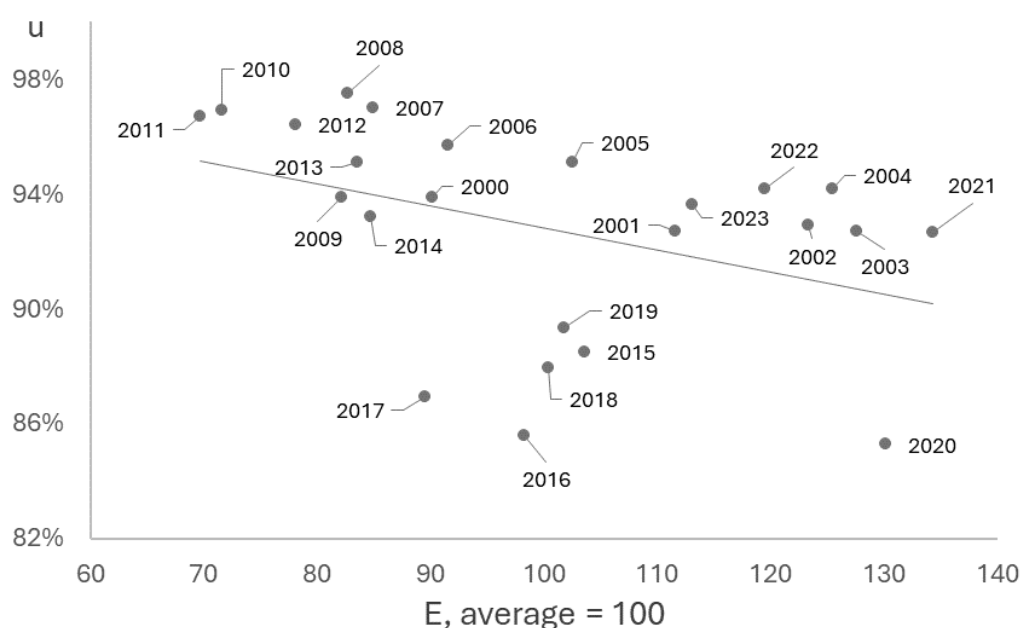
Figure 5: The pair $(E, gpX-gpK)$ and its fit: 2000-2023



Source: Marquetti et al (2023) and Banco Central (2024)

Figure 6 illustrates the relationship between the real exchange rate and the level of capacity utilization, the last component of Equation 3. A negative association is observed, indicating that as the currency becomes more undervalued, the level of capacity utilization decreases. Conversely, high capacity utilization tends to coincide with an overvalued exchange rate. It's important to note that the figure depicts the association between the variables, not causality.

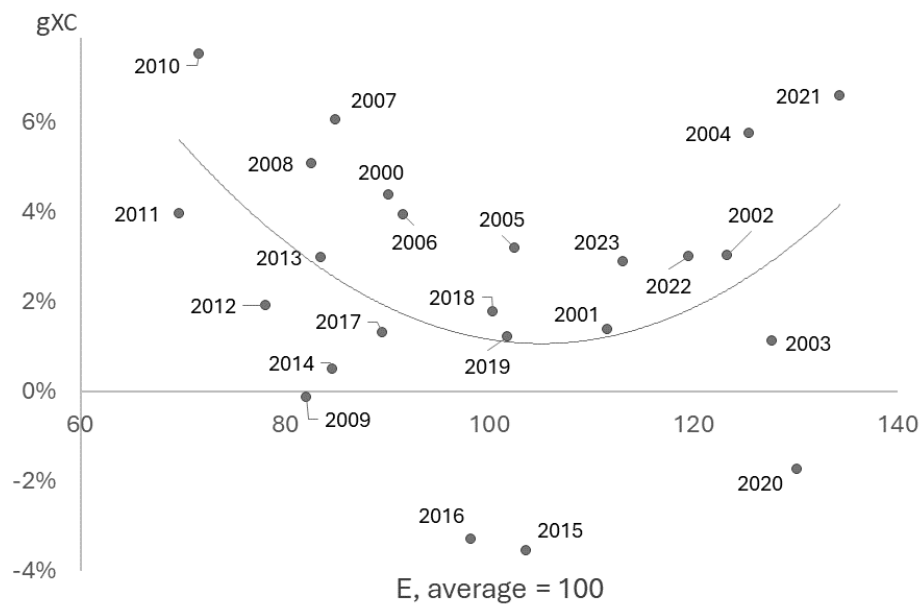
Figure 6: The pair (E, u) and its fit: 2000-2023



Source: Marquetti et al (2023) and Banco Central (2024)

Finally, Figure 7 depicts a U-shaped relationship between the real exchange rate and the real GDP growth rate for the 2000-2023 period. This "smile" pattern indicates that the growth rate is higher at both overvalued and undervalued exchange rates, similar to the positive association observed between profit rate and growth rate. This finding suggests that economic growth might be driven by different factors depending on the exchange rate. At an overvalued exchange rate, internal demand, particularly wages, might play a more significant role in propelling growth. Conversely, when the exchange rate is undervalued, external demand likely becomes the stronger driver.

Figure 7: The pair (E, gXC) and its fit: 2000-2023



Source: Marquetti et al (2023) and Banco Central (2024)

The relationship between the exchange rate and the profit rate is complex. In this paper, we focus on the effects of the exchange rate on the determinants of the profit rate. However, it's worth noting that the profit rate also influences the exchange rate through both productive and financial channels, a question that is beyond the scope of our current discussion.

Conclusion

This article examined a critical aspect of the Brazilian economy: the interplay between profit rates, their components, and exchange rates. Using a Marxian framework, we analyzed the dynamics of profit rates, their determinants, and exchange rates from 2000 to 2023. A high profit rate is crucial for capital accumulation and economic growth. However, the impact of exchange rate devaluations on profit rates is complex and depends on which factors dominate.

Our key findings reveal a non-linear, "smile-shaped", relationship between profit rates and exchange rates. Consistent with new developmentalist theory, currency devaluations can improve profit share in the short term. This occurs because exchange rate devaluations tend to increase the GDP deflator more than nominal wages. However, a devalued currency can

also diminish the potential productivity of capital due to its greater impact on capital prices compared to the GDP deflator. We also found a positive correlation between an overvalued currency and the level of capacity utilization. Interesting, there was a non-linear, U-shaped, association between the real exchange rate and GDP growth rate over the period 2000-2023.

These findings highlight that exchange rate devaluations have a multifaceted impact on profit rates, capital accumulation and therefore economic growth. Understanding these dynamics is crucial for policymakers and economists shaping Brazilian economic and exchange rate policy. Our analysis suggests that an overvalued exchange rate often leads to a lower profit share but a higher potential output-capital ratio.

While this study focuses on the exchange rate, it's important to acknowledge the additional role of terms of trade in shaping profit rates and capital accumulation, particularly for commodity-dependent economies. As Marquetti et al. (2024) suggest, terms of trade fluctuations significantly impact these dynamics. Brazil's recent reprimarization, with its increased reliance on commodity exports like soybeans, iron ore, and oil, exemplifies this point. Favourable terms of trade tend to boost profit rates and appreciate the exchange rate, conversely, deteriorating terms of trade have the opposite effect.

Marquetti et al. (2020) highlight which the rise in profit rates in the early XXI Century coincided with the increase in the output-capital ratio and the decline in profit share. The period witnessed strong growth in commodity prices, allowing an expansion in real wage and higher capacity utilization. There was an appreciation of the exchange rate. The Brazilian economy's outlook appeared positive, however, the falling commodity prices after financial crises ultimately led to a decline in Brazilian growth.

It's possible that the exchange rate appreciation might have initially fostered a higher output-capital ratio, the rise in real wage and capacity utilization, enabling a temporary conciliation between worker and capitalist interests. A rising output-capital ratio can accommodate both profit and wage increases. However, this conciliation becomes unsustainable as external conditions shifted and real wages continued to rise. As the exchange rate depreciated, the fall in wage share became the primary strategy in avoiding further decline in profitability.

Failure to grasp these dynamics can lead to mistaking cyclical movements for structural changes. This may have occurred in Brazil during the XXI Century. This hypothesis could explain the difficulties faced by governments following the commodity price boom's collapse in the late 2010s. Further research is needed to better understand the complex interplay between exchange rates and profit rate.

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