Hochschule für
Wirtschaft und Recht Berlin
Berlin School of Economics and Law

Institute for International Political Economy Berlin

Foreign price shocks and Inflation Targeting: effects on income and inflation inequality

Authors: Lilian Rolim and Nathalie Marins

Working Paper, No. 207/2023

Foreign price shocks and Inflation Targeting: effects on income and inflation inequality

Lilian Rolim and Nathalie Marins

Institute of Economics, University of Campinas, Brazil.

Abstract

Foreign price shocks have significant effects on functional income distribution and on inflation inequality. By increasing prices in domestic currency that are linked to foreign prices, they increase the profit share in some sectors and reduce real wages, in particular of workers whose consumption basket is more sensitive to the price of certain goods (e.g. food prices for low-wage workers). Based on the conflicting-claims inflation literature, we propose a new extension to this framework by incorporating worker's heterogeneity (in terms of nominal income and consumption patterns) in an open economy model with an inflation-targeting regime. We investigate the impacts of foreign price shocks on income and inflation inequality and analyze how monetary policy influences these outcomes. Our simulation results indicate that a positive foreign price shock increases the profit share and the within-workers inequality (in real terms), since low-wage workers are more affected by these shocks. Yet, such effects are mediated by the strength of the monetary policy's transmission channels (domestic economic activity or nominal exchange rate), indicating that the monetary authority response may exacerbate or attenuate these distributive effects.

Keywords: inflation, inequality, monetary policy, foreign shocks, transmission mechanisms

JEL codes: D3, E12, E31, F41

Acknowledgments

We thank Eckhard Hein, Ryan Woodgate, and the participants of the Monetary Policy and Income Distribution Workshop held in Toronto (Canada) in 2022 for helpful comments and suggestions. LR greatfully acknowledges funding from the Sao Paulo Research Foundation (FAPESP, process number 2018/21762-0). This study was also financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES) – Finance Code 001.

Contact: lilian.rolim@gmal.com; nathalie.marins@gmail.com

1 Introduction

The inflationary impact of foreign price shocks has long been a concern in emerging market and developing economies (EMDE), where the consumption basket and price indexes are more sensitive to the exchange rate and imported inflation. However, after the COVID-19 crisis and the Russia-Ukraine war, increases in food and energy prices have raised global concerns about inflation. In particular, inflation inequality (i.e., the difference in inflation rates between income groups) became a key matter since lower-income households' consumption baskets present a higher portion of these goods (Hobijn and Lagakos, 2005, Ari et al., 2022). Moreover, this price shock is associated with an increase in the revenue of firms in specific sectors, leading to increases in their profit margins and to a redistribution of income (Weber, 2022).

These concerns have sparked a heated debate about the appropriate monetary policy response, especially as many countries adopt the inflation targeting (IT) regime. While some emphasize that the increase in inflation rates for low-income groups is detrimental to their living standard, which would justify a strong response by the monetary policy authorities, others argue that increasing interest rates can have negative consequences in terms of unemployment and income distribution.

Indeed, the effects of monetary policy on income distribution have been studied by post-Keynesian authors following the conflicting-claims inflation model (Rochon and Setterfield, 2007, Rowthorn, 1977). In this perspective, the interest rate is considered an intrinsically distributional variable that can, directly and indirectly, distribute income between different groups. Although most of the literature has focused on a closed economy perspective, contributions in the post-Keynesian literature recognize, both theoretically and empirically, that the exchange rate also has distributive effects (Blecker, 1989, Ribeiro et al., 2017, 2020). Yet, since interest rate changes can exert a relevant impact on the exchange rate (Andrade and Prates, 2013, Kaltenbrunner, 2015), incorporating the exchange rate dynamics to the conflicting-claims inflation model suggests that monetary policy has multiple (and conflicting) partial effects on the functional income distribution (Rolim and Marins, 2022).

In this context, our aim in this paper is to explore the distributive impacts of the monetary policy response to a foreign price shock in a conflicting-claims inflation model by considering two distributive dimensions:[1] functional income inequality and inflation inequality.[2] To do so, we incorporate the possibility of two conflicting partial effects of monetary policy and assume that households belonging to different income groups consume different goods and services, creating the potential for inflation inequality if changes in these prices differ substantially. This comprehensive approach suggests that monetary policy can either exacerbate or attenuate the distributive consequences of a foreign price shock depending on its transmission mechanisms. Therefore, our analysis provides a theoretical framework to understand the distributive effects of the IT regime in the current context wherein many countries are experiencing high inflation rates associated with foreign shocks.

In addition to this introduction, the article is organized as follows. In section 2, we briefly discuss the transmission mechanisms of monetary policy on inflation and income distribution and how it

[1] Our work is closely related to other studies investigating the distributive effect of foreign shocks through the conflicting-claims framework, such as Rolim et al. (2022) and Morlin (2023).

[2] Inflation inequality captures the discrepancies of inflation rates associated with class-specific consumption baskets.

can also affect inflation inequality. In section 3, we develop an inflation model with two classes of workers and simulate the model with different values for the parameters that capture the strength of the transmission mechanisms of monetary policy. Section 4 discusses the simulation results, and section 5 concludes.

2 Foreign shocks and monetary policy: interactions and implications for income distribution and inequality

In post-Keynesian conflicting-claims inflation models, changes in prices are explained by the class conflict between workers and capitalists over the distribution of income. A key contribution of this literature is that inflation dynamics are often associated with movements in income distribution. Since prices are mostly based on costs, this conflict materializes in adjustments in nominal wages and profit margins as each class tries to achieve its desired income. Moreover, in an open economy, imported materials must also be taken into account. Consequently, inflation in this context is explained mainly by rising mark-ups, growth in nominal wages above labor productivity, and changes in the relative prices of imported materials used as means of production (Hein and Vogel, 2008, Hein et al., 2012, Lavoie, 2022).

Since changes in foreign prices depend on external forces and not on domestic demand or other internal variables, monetary policy has *"no or little control over one of the main sources of price inflation in a country"* (Lavoie, 2022, p. 596). However, since monetary policy can influence variables that affect workers' and firms' claims, it can affect both the inflation rate and the income distribution. That is, since changes in interest rate can also affect the nominal exchange rate, it can alter the impact of foreign prices on the domestic inflation rate.

In this section we explore the main channels through which changes in the policy rate can affect the distribution of income and also exert some impact on inflation inequality after responding to a foreign shock. Although there are many transmission mechanisms through which changes in the policy rate operate, as discussed in Rolim and Marins (2022), here we focus on two main channels that act simultaneously on inflation and the wage share:[3] the economic activity channel and the exchange rate channel.

Through the economic activity channel, changes in the policy rate operate through changes in domestic costs. For example, suppose a reduction in the interest rate leads to an increase in economic activity. In that case, this can reduce the unemployment rate and have a positive effect on the bargaining power of workers to negotiate better wages. Firms, in turn, adjust downward their profit margins in this context to preserve their competitiveness (Kalecki, 1971), leading to a higher wage share, but they also try to protect their cost margins by passing on to prices (part of) the cost increases, which leads to higher inflation rates (Rowthorn, 1977). This effect is illustrated in Figure 1a, where for simplicity

[3]For instance, through the 'direct channel' monetary policy redistributes income from debtors to creditors. Yet, this channel does not have a clear effect on inflation. On the other hand, through the cost-channel changes in the policy rate that translate into high debt burdens can be incorporated into higher prices. This affects real wages negatively (Pivetti, 1991, Lima and Setterfield, 2010) and can exert temporary pressures on the inflation rate or a permanent effect depending on how these relations are modeled (for instance, in Hein and Stockhammer (2010)).

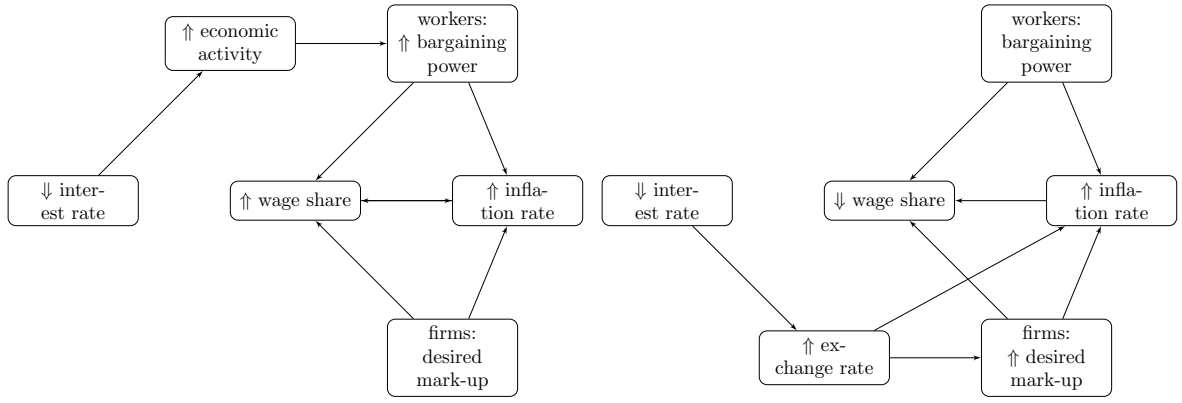
we assume no feedback of the wage share on economic activity. [4] However, an increase in economic activity can also affect the bargaining power of firms and their capacity to pass the increase of cost to prices as they approach full capacity utilization (Rowthorn, 1977). This could lead to uncertain effects on income distribution. Yet, we assume that firms are most likely to respond to higher capacity utilization by increasing output rather than raising prices (by increasing their profit margins). In this case, the effect of demand on nominal wage adjustments through higher workers' bargaining power outweighs the price increases, and a higher wage share is obtained.[5]

On the other hand, a lower interest rate may, *ceteris paribus*, have the opposite effect on the wage share while also increasing the inflation rate through the exchange rate channel. This channel operates through two mechanisms illustrated in Figure 1b. The first is the impact on changes in the nominal domestic currency following risk-adjusted interest rate differential shocks[6]. That is, a reduction in the policy rate can lead to an exchange rate depreciation and have a positive effect on the price level since it makes imported (intermediate and final) goods and private external debt (denominated in foreign currency) more expensive. This increase in the price level, in turn, can have a persistent impact on the inflation rate (Bastian and Setterfield, 2020). If this effect is not counteracted by nominal wage adjustments of the same magnitude, the real wage decreases. The second effect of a domestic currency depreciation is to increase domestic firms' mark-up rates as their international price competitiveness increases (Blecker, 1989, 2011, Ribeiro et al., 2020) and the exports sector's revenues - if we consider that prices (in foreign currency) in the tradables sector are determined by the international level (Rossi and Galbraith, 2016). In the conflicting-claims inflation model, this effect can be considered by assuming that firms' target and realized mark-up rates (or income share) increase with increases in the real exchange rate, thus leading to a reduction in the wage share.

[4] It is worth emphasizing that this channel depends on the interest rate affecting the economic activity, for instance, through investment or durable goods consumption based on credit. The evidence on the strength of this channel is debatable, but our analysis does not depend necessarily on the economic activity channel being the main channel.

[5] As a result, the wage share would be pro-cyclical. In reality, this positive stimulus to the wage share would interact with a tendency towards a counter-cyclical wage share due to overhead labor (Lavoie, 2022), as obtained in many empirical data. Yet, as long as prices are based on normal unit labor costs and workers' bargaining power leads to reductions in the mark-up level, a higher real wage could be obtained even in this case. Since here we abstract from overhead labor, we are capturing only the positive effect of higher workers' bargaining power on the wage share.

[6] The strength of this channel depends on the sensitivity of the exchange rate to the domestic interest rate, which can vary depending on international conditions such as changes in the global risk aversion sentiment. Assuming that exchange rate movements are mostly driven by speculative financial flows, they will be mostly explained by changes in the expected return of international investors of assets denominated in the domestic currency. Besides interest rate differential, this includes expectations about the exchange rate, a country-risk variable and a risk aversion sentiment (Andrade and Prates, 2013, Kaltenbrunner, 2015, Conti et al., 2014, Ramos, 2016). Thus, a reduction of the domestic interest rate that leads to a negative interest rate differential relative to the external rate - assuming that expectation and risk variables do not change - will reduce the return on assets denominated in the domestic currency, attract fewer capital flows and depreciate the exchange rate. An increase in the interest, in turn - *ceteris paribus* - will have the opposite effect.



(a) Economic activity channel (b) Exchange rate channel

Figure 1: Transmission mechanisms of monetary policy

Note: In each subfigure, all variables that are not preceded by an arrow are assumed to remain constant.

Therefore, the final outcome of changes in the policy rate on income distribution depends on the relative strength of the economic activity and the exchange rate channels, while there is always a negative relation between the inflation rate and interest rate if we consider solely these two transmission mechanisms. As discussed in Rolim and Marins (2022), in an inflation targeting regime the result will also be mediated by two other layers related to institutional characteristics of the regime and the source of inflation that triggers a monetary policy reaction.

In the present study, we focus on the specific effects of a monetary policy response to a shock on foreign prices. Theoretically, in conflict-claims inflation models, foreign shocks can affect inflation and income distribution when the economy imports commodities and/or intermediate goods from abroad, that is, when external prices exert some influence on domestic prices. Changes in these exogenously determined prices can directly affect production costs and real wages (Hein and Vogel, 2008, Hein et al., 2012, Lavoie, 2022). Indirectly, through its effect on relative prices between domestic and external products that result in changes of the real exchange rate, foreign shocks can affect firms' desired mark-up (Blecker, 1989, 2011). Thus, while an increase in the real exchange rate can increase domestic firms' profits and competitiveness, increasing their desired and realized mark-up rates, it can also trigger a response of workers as they try to protect their real wages. This relation is captured in an extended way in some models that assume that the real exchange rate also increases the workers' target real wage (Bastian and Setterfield, 2020).

In an inflation targeting regime, when such shock occurs and spreads to the domestic inflation index, it triggers an interest rate increase as a central bank response. As discussed previously, after a foreign price shock, monetary policy can act through the economic activity and the exchange rate channel to fight this inflation pressure, while the final effect on the distribution of income is uncertain.

However, besides the effect on income distribution the foreign shock and the monetary policy response can also affect inflation inequality since workers with different incomes have different consumption baskets. For example, Hobijn and Lagakos (2005) document that the inflation experienced by different household groups in the United States varies widely, with lower-income households being more affected by fluctuations in gasoline prices. In Europe, on the other hand, the rise in energy prices following the Ukraine war has led to regressive effects, as - with few exceptions - poorer households

spend a relatively higher share of their consumption budget on electricity and natural gas (Ari et al., 2022). Moreover, in emerging markets, food prices account for a higher relative share in household consumption baskets than in industrialized countries, making EME price indexes more sensitive to the exchange rate and foreign prices (Farhi, 2007), which is also reflected in inflation differentials between households within these countries, as documented for Brazil (Gouvêa, 2022).

Thus, a shock on foreign prices will have a greater effect on countries with a higher import content and commodity prices in their consumption basket, but will also be more detrimental to low-wage workers who consume a higher share of their income on food and energy prices. These examples of inflation inequality provide important new insights into the relationship between monetary policy and income distribution. While there are different types of inflation, which will have different implications for the different income groups, monetary policy targets an average or representative index for the economy. In this context, monetary policy can attenuate some inequalities generated by foreign shocks, but depending on its transmission mechanisms, it may also create new ones. Thus, the claim that inflation hurts more the poor - and therefore, following many IT regime proponents, fighting inflationary pressures contributes to protecting the poor - can be critically discussed by evaluating its effects in specific contexts. We illustrate how this happens and discuss the policy implications through the simple simulation model built in the next section.

3 The model

We build a conflicting-claims inflation model for a small open economy, wherein there is no productivity growth and workers are divided into two groups with heterogeneous nominal income levels and consumption baskets. There is no government, except for a monetary authority that sets the nominal interest rate and does not intervene in the foreign exchange market. For simplicity, we do not consider any influence of the wage share or of the real exchange rate on economic activity.[7]

3.1 Workers' heterogeneity

Workers are divided into two groups: low- and high-wage workers, which are represented by the subscripts L and H respectively. We assume that the ratio between their nominal wages is constant and equal to $\delta = w_{H,t}/w_{L,t} > 1$.[8] The share of high-wage workers in total employment is fixed and given by $n_H < 0.5$. Consequently, the share of low-wage workers is total employment is given by $n_L = 1 - n_H$.

In addition to heterogeneous nominal wages, workers also differ with respect to their consumption basket. Indeed, low-wage workers consume more tradable goods, whose price is determined by the

[7]This is a relevant simplification relative to post-Keynesian models discussing the relationship between income distribution and economic growth (Dutt, 1984, Blecker, 1989, Bhaduri and Marglin, 1990). Considering these dimensions would add multiple feedback effects that could have implications for the dynamics of the inflation rate and income distribution. While these effects could either strengthen or attenuate our results, our simplifying assumptions are enough to obtain the possibility of conflicting effects of monetary policy depending on the transmission mechanisms.

[8]By keeping δ fixed we can analyze the changes in the real income of each group of workers that arise exclusively from inflation inequality.

foreign price level. Thus, the average price of the consumption basket for each group $w = L, H$ is given by:

$$p_{w,t} = \alpha_w p_{d,t} + (1 - \alpha_w) p_{f,t} e_t \tag{1}$$

where $1 > \alpha_w > 0$ is the share of non-tradable goods in the consumption goods basket for group $w = H, L$, $p_{d,t}$ is the price in domestic currency of non-tradable goods, $p_{f,t}$ is the price in foreign currency of tradable goods, and e_t is the nominal exchange rate. We assume that $\alpha_H > \alpha_L$, since high-wage workers consume a larger share of non-tradable goods than low-wage workers.

Accordingly, the price level of the average consumption basket for workers is given by equation 2. This is a democratic price index because the weight of each worker is equal to one.[9]

$$p_t = (n_H \alpha_H + n_L \alpha_L) p_{d,t} + (1 - (n_H \alpha_H + n_L \alpha_L)) p_{f,t} e_t \tag{2}$$

3.2 Price and wage adjustments

The price of tradable goods follows the price set in the foreign market.[10] It is assumed that this price level grows at a fixed rate given by $\hat{p}_f > 0$. Therefore, the foreign price level in foreign currency is given by:

$$p_{f,t} = p_{f,t-1}(1 + \hat{p}_f) \tag{3}$$

The domestic price component dynamics (equation 4) depends on the domestic inflation rate (equation 5), which is assumed to reflect the class conflict between workers and capitalists. In line with the post-Keynesian conflicting-claims inflation model, firms increase the price level in an effort to achieve their desired wage share and the adjustment speed depends on the difference between their desired wage share ($\omega_{f,t}$) and the actual wage share (ω_{t-1}):

$$p_{d,t} = p_{d,t-1}(1 + \hat{p}_{d,t}) \tag{4}$$

$$\hat{p}_{d,t} = \varphi(\omega_{t-1} - \omega_{f,t}) \tag{5}$$

where $\varphi > 0$ is a fixed parameter capturing the sensitivity of price adjustments to the difference between the desired and realized wage share.

Following Blecker (2011), the desired wage share by firms is assumed to be a decreasing function of the real exchange rate:

$$\omega_{f,t} = \omega_{max} - \psi rer_{t-1} \tag{6}$$

[9] In comparison, a plutocratic index is constructed as a weighted average of all household-specific inflation rates in which the weight given to each household is proportional to its total expenditure (Hobijn and Lagakos, 2005).

[10] For simplicity, it is assumed that all tradable goods are imported goods and that all non-tradable goods are produced domestically. This means that we do not capture the automatic effect of nominal exchange rate depreciations or foreign prices on firms' revenue (Rossi and Galbraith, 2016). Yet, there is a connection between the real exchange rate and firms' profits through their mark-up adjustments (see equations 5 and 6).

where $1 > \omega_{max} > 0$ is the maximum wage share desired by firms, rer_{t-1} is the real exchange rate, and $\psi > 0$ is a parameter capturing the sensitivity of firms' desired wage share to the real exchange rate.[11] This equation creates a link between the real exchange rate and mark-up rates for which empirical support is provided in Berman et al. (2012).

The nominal wage for each group of workers $w = H, L$ grows at the same rate $\hat{w}_t$, as shown in equation 7.[12] Similarly to firms, workers demand nominal wage adjustments in order to try to achieve their desired wage share. Therefore, the nominal wage growth rate depends on the difference between the desired wage share by workers ($\omega_{w,t}$) and the actual wage share:

$$w_{w,t} = w_{w,t}(1 + \hat{w}_t) \tag{7}$$

$$\hat{w}_t = \Omega(\omega_{w,t} - \omega_{t-1}) \tag{8}$$

where $\Omega > 0$ is a fixed parameter capturing the sensitivity of wage adjustments to the difference between the desired and realized wage share.

The wage share desired by workers is also assumed to be an endogenous variable, which increases with capacity utilization rate (Sasaki et al., 2013).[13]

$$\omega_{w,t} = \omega_{min} + \lambda u_{t-1} \tag{9}$$

where $1 > \omega_{min} > 0$ is the minimum wage share desired by workers and $\lambda > 0$ is a parameter capturing the sensitivity of workers' desired wage share to the capacity utilization rate u_{t-1}.

Following Rochon and Setterfield (2007), it is assumed that capacity utilization is a decreasing function of the real interest rate, as follows [14]:

$$u_t = u_0 - \gamma r_t \tag{10}$$

where $1 > u_0 > 0$ is the capacity utilization rate when the real interest rate is equal to zero, $\gamma \geq 0$ is the sensitivity of capacity utilization to the real interest rate, and r_t is the real interest rate.

3.3 Monetary policy

In line with the inflation targeting regime, the monetary authority is assumed to use a single instrument (nominal interest rate) to achieve a single target (inflation rate target). The price index is the democratic price index p_t from equation 2. The nominal interest rate is determined by equation 11, according to

[11] We assume that $\omega_{f,t}$ is insensitive to changes in capacity utilization because firms tend to respond to higher demand by increasing production (rather than increasing prices).

[12] Given the main purpose of this article, which is to analyze the effect of foreign shocks on inflation inequality, we assume that, albeit belonging to different groups, all workers have the same nominal wage adjustment.

[13] The capacity utilization rate is assumed to be a proxy to the employment rate and, consequently, to workers' bargaining power. Blecker (2011) and Sasaki et al. (2013) also assume that the real exchange rate affects the workers' desired wage share. For simplicity, this effect is omitted in our equation.

[14] Therefore we are not explicitly modeling the investment and consumption channels mentioned in the previous section, but implicitly capturing them through the reaction of the capacity utilization rate.

which the interest rate increases (decreases) if the average inflation rate in the last T_p periods is above (below) the target.

$$i_t = i_{t-1} + \rho(\frac{\sum_{i=1}^{T_p} \hat{p}_{t-i}}{T_p} - \hat{p}^T)) \tag{11}$$

where $\rho > 0$ is the sensitivity of the nominal interest rate to the inflation gap, $T_p \geq 1$ is the number of periods considered by the monetary policy rule, $\hat{p}_t$ is the inflation rate considered by the monetary authority (growth rate of p_t), and $1 > \hat{p}^T > 0$ is the inflation rate target.

By definition, the real interest rate is given by equation 12:

$$r_t = \frac{(1 + i_t)}{(1 + \hat{p}_{t-1})} - 1 \tag{12}$$

3.4 Exchange rate

Following the post-Keynesian framework of exchange rate determination, we assume that changes in the interest rate differential lead to portfolio adjustments by investors that have implications for the international capital flows and, consequently, for the nominal exchange rate (Andrade and Prates, 2013, Kaltenbrunner, 2015, Ramos, 2016). This equation leads to an opposite result from the one implied by the uncovered interest rate parity, where interest rate changes are offset by expectations of exchange rate movements. Here, an increase in the domestic interest rate leads to an appreciation of the domestic exchange rate when other risk considerations are kept fixed. [15] Accordingly, the nominal exchange rate depends on the change in the interest rate differential, as reported in equation 13:

$$e_t = e_{t-1} + \xi \sum_{i=0}^{T_e} \Delta i_{t+1-i}^{dif} \tag{13}$$

where $\xi \geq 0$ is a fixed parameter capturing the sensitivity of the exchange rate to changes in the interest differential, $T_e \geq 1$ is the number of periods for exchange rate adjustment to changes in the interest rate differential, $i_t^{dif} = i_f - i_t$ is the interest rate differential, where $1 > i_f > 0$ is the fixed nominal interest rate in the foreign sector.

By definition, the real exchange rate is given by equation 14:

$$rer_t = \frac{e_t p_{f,t}}{p_{d,t}} \tag{14}$$

[15] It is worthwhile mentioning that EMDE's currencies have a lower currency premium and, therefore, are demanded for speculative purposes in periods of low risk aversion, when the international liquidity preference is low (Ramos, 2016). However, we omit this important component in our equation since the analysis of this dimension is beyond the scope of this article.

4 Simulation results

The model described in the previous section is coded in R and three scenarios are simulated to capture different transmission mechanisms of the monetary policy.[16] While only the nominal exchange rate channel is considered in the ER scenario and only the economic activity channel in the UT scenario, both channels operate in the baseline scenario. The parameters that change across the scenarios are reported in table 1.[17]

Table 1: Parameter values

Parameter	Description	Baseline	ER	UT
γ	sensitivity of capacity utilization to the real interest rate	5	0	5
ξ	sensitivity of the nominal exchange rate to changes in the interest rate differential	2	2	0

Note: ER: exchange rate channel, UT: capacity utilization channel.

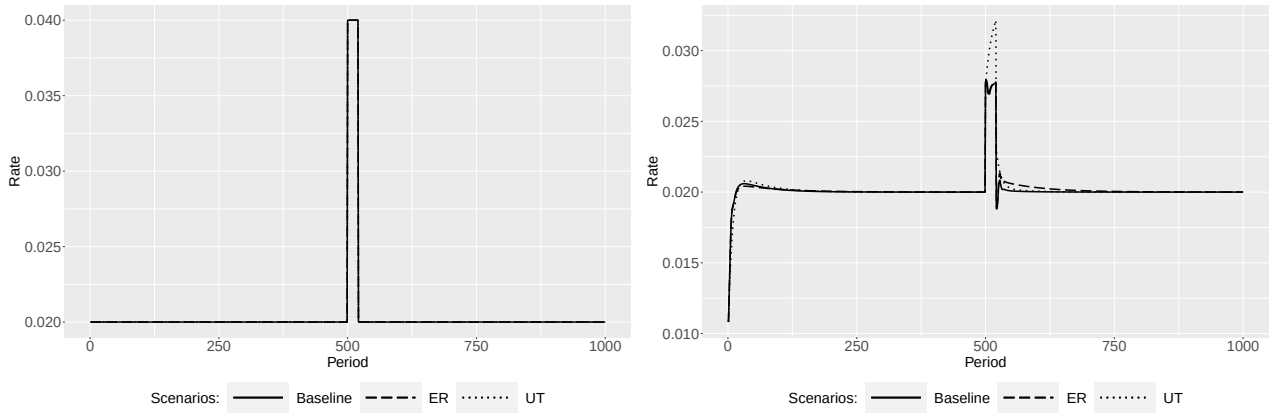
All scenarios are simulated for 1000 periods and subject to a temporary increase in the foreign inflation rate at time $t = 500$ (after the steady state has been reached), which leads to a two percentage points increase in the foreign inflation rate that lasts 20 periods. At $t = 520$, the foreign inflation rate returns to its initial value.

4.1 Inflation rate dynamics

Figure 2 reports the inflation rates for the foreign and domestic sectors. As described above, the positive shock to the foreign inflation rate leads to a higher foreign inflation rate from $t = 500$ to $t = 520$. This shock triggers an inflationary process in the domestic economy, leading to an inflation rate larger than the targeted inflation rate ($\hat{p}^T = 0.02$). This is caused both by the increase in the inflation rate of imported goods and by a change in the terms of the conflict over the domestic income distribution that had been previously established.

[16] Since we are mostly concerned with the distributive effects of monetary policy when reacting to foreign shocks, that is, under the inflation targeting regime, we do not report a no-reaction scenario (which would only capture the distributive impact of the foreign shock). In such a scenario, the results for the main distributive variables (wage share and ratio between real wages) fall between the results for the ER and UT scenarios and do not present the permanent effects captured in the Baseline and UT scenarios. These results are available upon reasonable request.

[17] All parameters and initial values for the baseline configuration are reported in table 2 in Appendix section.



(a) Foreign inflation rate

(b) Domestic inflation rate

Figure 2: Inflation rates

Note: ER: exchange rate channel, UT: capacity utilization channel. The baseline scenario includes both channels.

Indeed, by causing a strong shock to the real exchange rate, the shock to the foreign inflation rate leads to a reduction in the wage share desired by firms (see equation 6), which increases the gap between the wage share desired by firms and that desired by workers. In the post-Keynesian literature, this gap is known as the aspiration gap, and it is directly related to the level of the domestic inflation rate, as it leads to higher nominal wage and price adjustments as each class tries to come closer to its desired share (Lavoie, 2022, Rowthorn, 1977). As shown in Figure 3, at the beginning of the simulation period (before the shock), the aspiration gap slowly adjusted towards a stable value that was compatible with the targeted inflation rate. The shock to the foreign inflation rate increases the aspiration gap above this level, indicating that also the domestic prices are now growing at a higher rate and thus contributing to the increase in the inflation rate experienced by the domestic economy. After the shock, the dynamics of the aspiration gap is also explained by the response of the monetary authority, and it slowly decreases towards the level compatible with the inflation rate target.

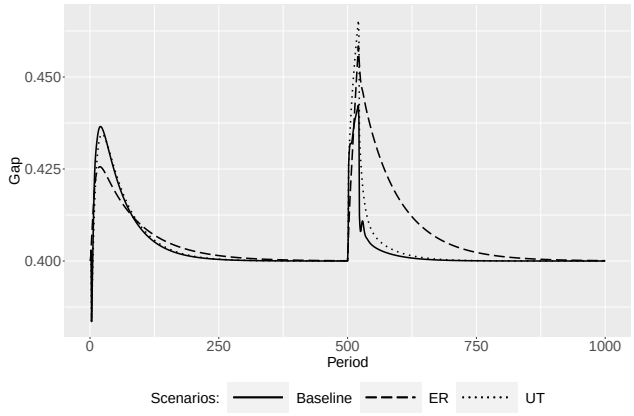
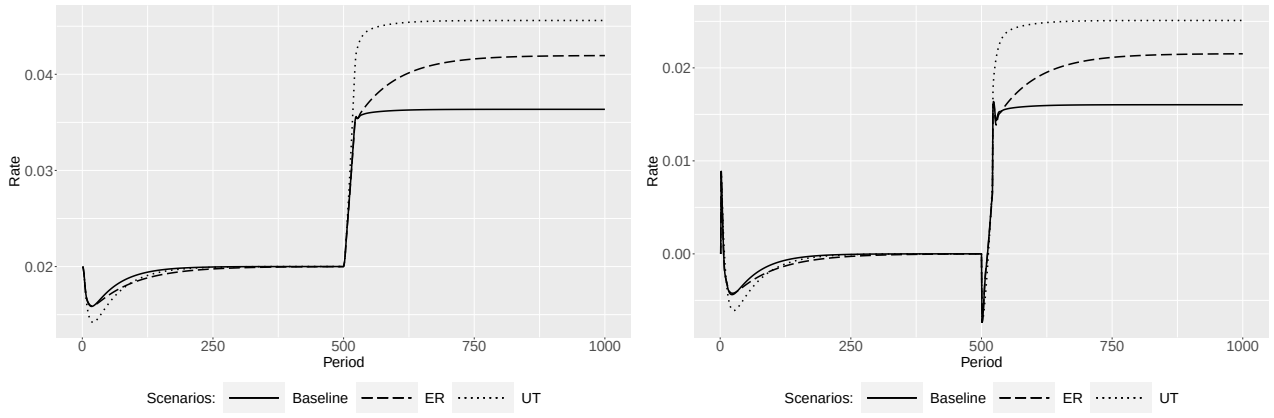


Figure 3: Aspiration gap

Note: ER: exchange rate channel, UT: capacity utilization channel. The baseline scenario includes both channels.

The initial impact of the increase in the foreign inflation on the interest rate is to decrease its real level because of the pass-through effect on the domestic inflation rate (Figure 4). However, under inflation targeting, the monetary authority responds by raising the nominal interest rate. Consequently,

the real interest rate only starts to grow when the increase in the nominal interest rate is large enough to compensate for this effect. In all scenarios, the nominal and real interest rates are kept at a higher level after the shock to the foreign inflation rate in the new steady state. This is because the response of the inflation targeting regime described in equation 11 is such that the interest rate is adjusted only when there is a gap between the actual and targeted inflation rate. When the foreign inflation rate returns to the baseline value, it contributes to the decrease of the domestic inflation rate towards the targeted inflation rate, and the nominal interest rate is no longer adjusted when the target is reached. Yet, there are no factors causing a return of the nominal interest rate back to its initial values, which suggests a long-term effect of the temporary shock to the foreign inflation rate.



(a) Nominal interest rate

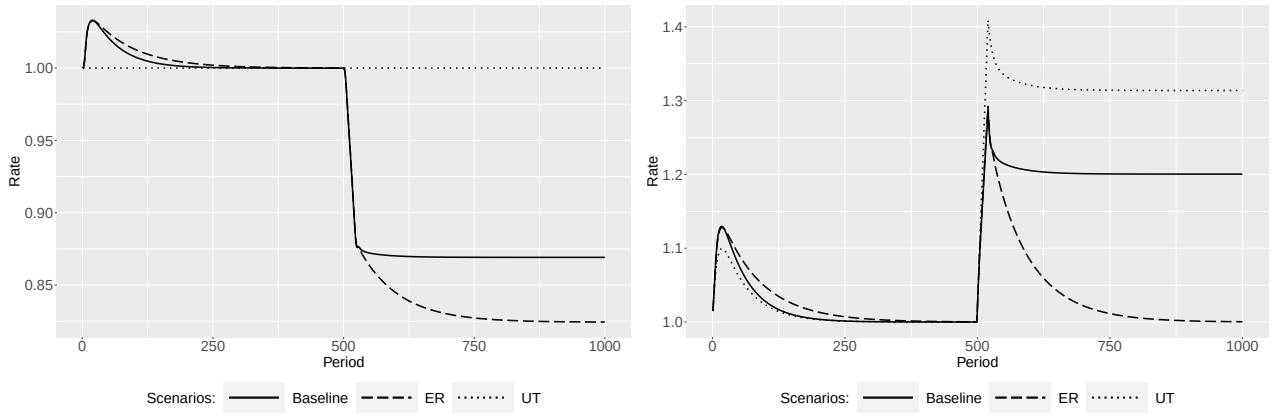
(b) Real interest rate

Figure 4: Interest rates

Note: ER: exchange rate channel, UT: capacity utilization channel. The baseline scenario includes both channels.

The increase in the interest rate is smaller in the baseline scenario than in the other two, which is due to the combination of the two transmission mechanisms that contribute to lowering the domestic inflation rate. This, in turn, means that the inflation target is reached with a weaker response by the monetary authority than would be the case if only one transmission mechanism was in place.

In fact, the dynamics of the model can be further discussed by analyzing the transmission mechanisms of monetary policy. As reported in Figure 5, when the exchange rate channel is active (baseline and ER scenarios), the response of the monetary authority leads to a reduction in the nominal exchange rate. Such reduction is larger in the ER scenario than in the baseline scenario due to the stronger increase in the nominal interest rate in the former, as discussed above. Thus, while all scenarios are characterized by a significant initial increase in the real exchange rate resulting from the large increase in the foreign price level with respect to the domestic price level (increase in the numerator of equation 14 relative to its denominator), when a nominal currency appreciation takes place, the increase in the real exchange rate is much smaller than otherwise.



(a) Nominal exchange rate

(b) Real exchange rate

Figure 5: Exchange rates

Note: ER: exchange rate channel, UT: capacity utilization channel. The baseline scenario includes both channels.

This indicates that the nominal currency appreciation attenuates the effect of the shock on the foreign inflation rate by reducing the size of the real currency depreciation, with important implications for the dynamics of the domestic inflation rate. The nominal currency appreciation reduces the increase in the price of tradable goods when converted to the domestic currency, thus reducing the imported inflation component. While this contributes to the reduction of the domestic inflation rate, there is also an important effect of the smaller increase in the real exchange rate to the aspiration gap, since the extent to which firms reduce their desired wage share will be smaller. Consequently, the real currency appreciation also contributes to the reduction of the domestic inflation rate by reducing the aspiration gap through an adjustment that is mostly related to the firms' behavior.

In comparison, when the economic activity channel is active (baseline and UT scenarios), the response of the monetary authority leads to a reduction in the capacity utilization rate due to the increase in the real interest rate, as observed in Figure 6. This reduction is larger in the UT scenario than in the baseline scenario due to the larger increase in the real interest rate in the former. The decrease in the capacity utilization rate is assumed to lead to an increase in the unemployment level, exerting a negative effect on workers' bargaining power. In the model, this is captured by a decrease in the wage share desired by workers (equation 9). Consequently, this channel contributes to the reduction of the domestic inflation rate by reducing the aspiration gap through a reduction in the wage share desired by workers. As discussed further below, this mechanism concentrates the burden of the inflation control on workers.

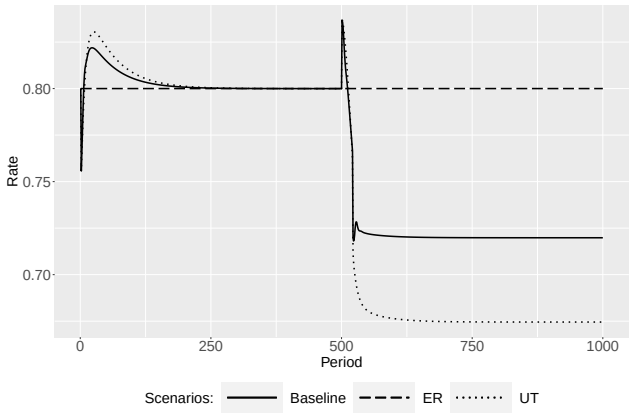


Figure 6: Capacity utilization rate

Note: ER: exchange rate channel, UT: capacity utilization channel. The baseline scenario includes both channels.

Regardless of the transmission mechanisms, the results suggest a long-term effect on key variables such as the nominal exchange rate and the capacity utilization rate, which helps to understand the long-term effect on the interest rate that was discussed above and, in particular, why there are no factors causing a reduction of the interest rate back to its initial level.[18] The main explanation for these long-term effects is the fact that the temporary increase in the foreign inflation rate means a permanent effect on the foreign price level and, unless compensated by other mechanisms, a permanently higher real exchange rate. Since domestic prices adjustments are a positive function of the real exchange rate, a higher level of foreign prices (or nominal exchange rate) leads to inflationary pressures. This permanent (potential) inflationary pressure requires a permanently higher level of the interest rate (unless the real exchange rate reverts back to its initial level).

In the ER scenario, since the exchange rate channel is the only transmission mechanism of the monetary policy, the nominal interest rate increases until it fully compensates for the increase in the foreign price level and reaches the initial real exchange rate, which is the level compatible with the inflation rate target. When such a value is reached, no further increases in the nominal interest rate are required, if an appreciated domestic currency is maintained to compensate for the higher level of foreign prices. This adjustment is not present in the UT scenario, which is why the real exchange rate is kept at a much higher level. Since this leads to a higher inflationary pressures, the inflation target can only be obtained by a keeping a lower capacity utilization rate, as economic activity is the sole transmission mechanism in this case. In other words, in this case it is necessary to keep lower nominal wage growth rates to compensate for the higher real exchange rate. Therefore, the inflationary pressures caused by stronger strength of firms in the conflict over the domestic income distribution (expressed by a higher real exchange rate) is compensated by reducing workers' strength. As the baseline scenario is a combination of the dynamics described for both the ER and UT scenarios, these long-term effects are also observed therein, only with different magnitudes.

[18] More precisely, one could expect that the higher level of the interest rate when the foreign shock is over would cause an inflation rate below the target, thus triggering a new adjustment of the interest rate back to its initial level.

4.2 Income and inflation inequalities dynamics

The previous section emphasized the different natures of the inflation control through monetary policy depending on its transmission mechanisms. We now analyze the implications of these dimensions to inequality captured by two different variables: the wage share and the difference in inflation rates for high- and low- wage workers. While the former captures the functional income inequality, the latter captures the dynamics of the inflation inequality. Combined, they offer a more comprehensive understanding of the effects of foreign inflationary shocks and of the response of the monetary authority.

Figure 7 shows the dynamics of the wage share. In all scenarios, the increase in the foreign inflation rate is accompanied by a decrease in the wage share in the domestic economy, in the short run. As previously discussed, this occurs because this shock leads to a strong increase in the real exchange rate, which tends to benefit firms and cause a change in the functional income distribution towards profits. More precisely, this is associated with a decrease in $\omega_{f,t}$ in equation 6 that, *ceteris paribus*, leads to a lower wage share.

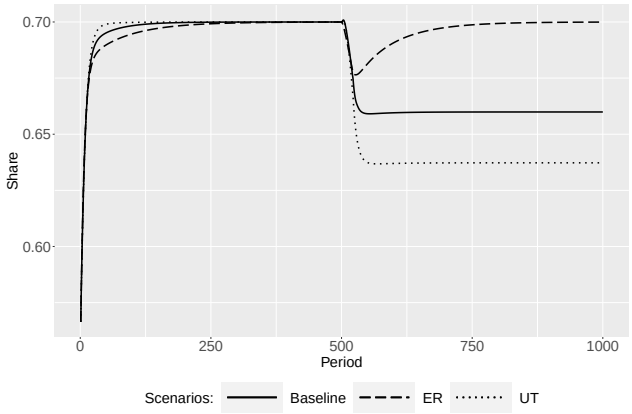


Figure 7: Wage share

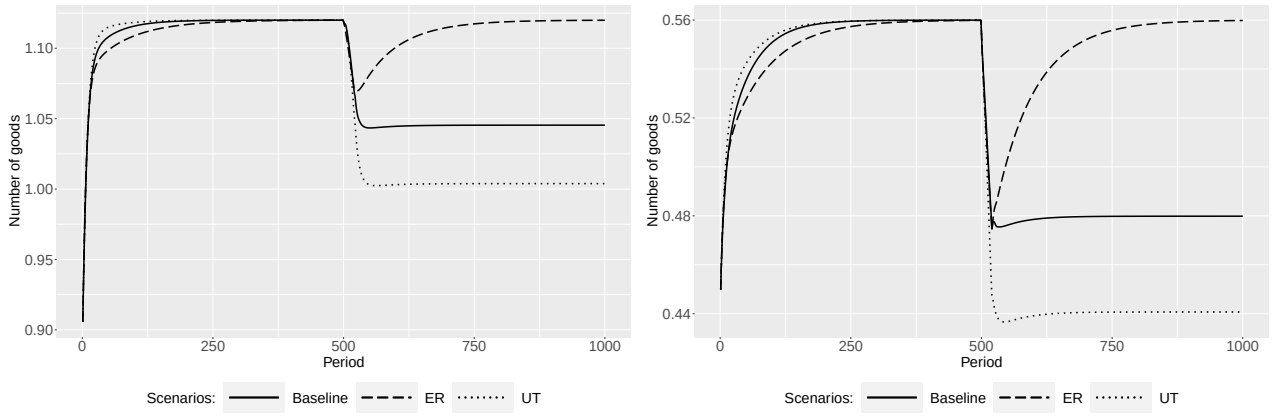
Note: ER: exchange rate channel, UT: capacity utilization channel. The baseline scenario includes both channels.

Nevertheless, the nature of the inflationary control is of primary importance to the long-run dynamics of the wage share. In the ER scenario, the inflation rate is controlled by a nominal currency appreciation, which brings the real exchange rate back to its initial level (Figure 5). Therefore, while the initial shock benefited firms (causing a decrease in $\omega_{f,t}$), the nominal currency appreciation controls the inflation rate through a reduction in the aspiration gap that is generated by increasing $\omega_{f,t}$ back to its initial level (and, thus, closer to the wage share desired by workers). Consequently, the wage share also returns back to its initial level.

The opposite process occurs in the UT scenario, in which the wage share stabilizes at a lower level. As discussed above, in this scenario the inflation rate is controlled by keeping the capacity utilization rate at a lower level. This means that the aspiration gap is reduced through a decrease in the wage share desired by workers ($\omega_{w,t}$ in equation 9), bringing it closer to the wage share desired by firms, which had been decreased by the shock in the foreign inflation rate. Therefore, the increase in interest rates when the economic activity is the sole transmission mechanism of the monetary authority leads to a further decrease in the wage share.

Since the baseline scenario is an average of both effects, the decline in the wage share is not as large as in the UT scenario, but it is also characterized by a lower wage share in the long run, as capacity utilization is permanently kept at a lower level. This suggests that whenever controlling the inflation rate requires a reduction in capacity utilization (and higher unemployment rates), lasting effects on the functional income distribution may arise.

The combination of a lower wage share and higher prices of tradable goods, as well as higher prices of non-tradable goods, leads to a reduction in the real wage of both groups of workers (Figure 8). These real wages are calculated by considering the group-specific consumption baskets and, thus, a larger share of tradable goods for low-wage workers. Consequently, the loss in purchasing power is much larger to the low-wage workers than the high-wage workers, as expressed by the larger decrease in the real wage of the former in comparison to the latter.



(a) High-wage workers

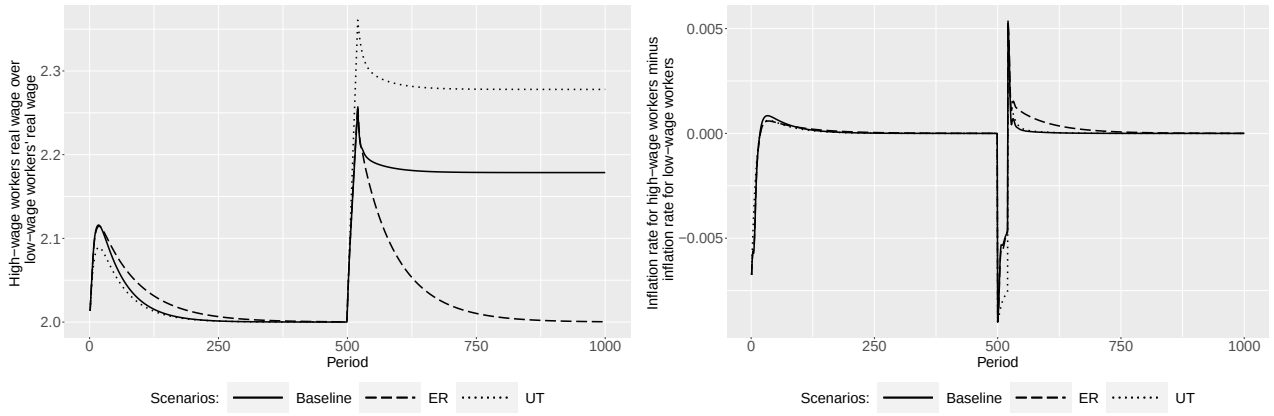
(b) Low-wage workers

Figure 8: Real wages

Note: ER: exchange rate channel, UT: capacity utilization channel. The baseline scenario includes both channels.

This indicates that these workers are experiencing different inflation rates.[19] Indeed, Figure 9 shows that the shock to the foreign inflation rate causes an increase of the real wage of high-wage worker relative to that of the low-wage workers and a lower inflation rate experienced by the high-wage workers relative to that experienced by the low-wage workers. Moreover, the ratio between the real wages increases more in the UT scenario than in the ER scenario, with the baseline representing an intermediate case. This reflects the fact that in the UT scenario the gap between the group-specific inflation rates increases more than in the other scenarios.

[19]Recall that the ratio between their nominal wages is kept constant throughout the simulation periods.



(a) Real wage ratios

(b) Difference in group-specific inflation rates

Figure 9: Inflation inequality indicators

Note: ER: exchange rate channel, UT: capacity utilization channel. The baseline scenario includes both channels.

The dynamics of inflation inequality described in Figure 9 is strongly linked with how inflation is controlled in each scenario or, in other words, the specific transmission mechanisms. In the ER scenario, the inflation rate is controlled by an exchange rate appreciation. While the exchange rate is appreciating ($\Delta e_t < 0$), the price in domestic currency of the tradable goods grows less than the price denominated in domestic currency. This attenuates the higher levels of the foreign inflation rate during the period of the shock. When the shock is over, the domestic currency continues to appreciate for a while (until the real exchange rate reaches its initial value). This continues to reduce the growth rate of the price of tradable goods in domestic currency, which leads to a lower growth rate of tradable goods prices relative to non-tradable goods prices. As a consequence, for some periods after the shock is over the high-wage workers are experiencing a higher inflation rate than the low-wage workers. Overall, in the ER scenario, since there is a lower growth rate of tradable goods prices in domestic currency relative to the other scenarios, the increase in inflation inequality caused by the foreign shock is attenuated.

In contrast, in the UT scenario the inflation rate is controlled through a reduction in the growth rate of nominal wages and, consequently, of domestic prices. Since the domestic prices are more important to the average price level of the high-wage workers' consumption basket, these workers experience inflation rates that are even more distant than that of the low-wage workers. This suggests that, when the inflation rate of domestic prices is reduced to compensate an increase in the average inflation rate caused by a foreign shock, the response of the monetary authority tends to further increase the inflation inequality that was initially generated by the foreign shock.

5 Conclusion

The nature of foreign price shocks means that they are an external factor influencing the class conflict between domestic agents. Their direct effect on the prices of certain goods tends to lead to: i) a real depreciation of the domestic currency; ii) an increase in the inflation rate; iii) an increase in profits in some sectors (increasing the aggregate profit share), and; iv) an increase in inflation inequality, reducing the real wage of workers who are more exposed to these shocks (most likely low-wage

workers). Moreover, as workers seek to protect themselves and firms try to benefit from the higher real exchange rate, there is a secondary inflationary pressure arising from the domestic economy dynamics. When monetary policy responds to these inflationary pressures, it can either worsen or attenuate these distributive effects depending on the strength of its transmission mechanisms.

This offers a very specific example of the interaction between the many layers that impact the distributive effects of monetary policy, as discussed by Rolim and Marins (2022). In the case of foreign price shocks, the reaction of the IT regime can amplify the distributive consequences by not acting directly on the source of the shock (and thus requiring lower bargaining power of workers to fight it), but it may also attenuate these consequences when it is possible to affect the real exchange rate. Therefore, there is no policy prescription that fits all countries when it comes to fighting inflationary pressures created by foreign price shocks. Moreover, it seems inappropriate to claim that fighting inflation is always a tool to protect the poor, in particular if lower economic activity is required, since workers will face higher unemployment and an even lower wage share, while low-wage workers will be in an even worse position relative to high-wage workers.

While we consider these as very robust conclusions that should be taken into consideration when discussing the distributive effects of monetary policy, we highlight two main caveats. First, our model does not capture interest payments to creditors or the effect of interest rates on asset prices, so it represents better the changes in distribution among workers and firms. Secondly, we do not consider the possible effects of the wage share and real exchange rate, which would be related to the type of demand regime (wage- or profit-led), and the effects of real wage inequality on demand. Finally, we recognize that the international context is also relevant. For instance, the sensitivity of the exchange rate to the domestic interest rate can change according to external conditions. Moreover, the exchange rate channel is less effective when all countries are facing an inflationary shock and responding with higher interest rates. Considering these aspects is part of our future research agenda.

References

Andrade, R. P. and Prates, D. M. (2013), 'Exchange rate dynamics in a peripheral monetary economy', **35**(3), 399–416.

Ari, M. A., Arregui, M. N., Black, M. S., Celasun, O., Iakova, M. D. M., Mineshima, M. A., Mylonas, V., Parry, I. W., Teodoru, I. and Zhunussova, K. (2022), *Surging energy prices in europe in the aftermath of the war: How to support the vulnerable and speed up the transition away from fossil fuels*, International Monetary Fund.

Bastian, E. F. and Setterfield, M. (2020), 'Nominal exchange rate shocks and inflation in an open economy: towards a structuralist inflation targeting agenda', *Cambridge Journal of Economics* **44**(6), 1271–1299.

Berman, N., Martin, P. and Mayer, T. (2012), 'How do Different Exporters React to Exchange Rate Changes?', *The Quarterly Journal of Economics* **127**(1), 437–492.

Bhaduri, A. and Marglin, S. (1990), 'Unemployment and the real wage: the economic basis for contesting political ideologies', *Cambridge Journal of Economics* **14**(4), 375–393.

Blecker, R. A. (1989), 'International competition, income distribution and economic growth', *Cambridge Journal of Economics* **13**(3), 395–412.

Blecker, R. A. (2011), 'Open economy models of distribution and growth', *in* E. Hein and E. Stockhammer, eds, 'A modern guide to Keynesian macroeconomics and economic policies', Edward Elgar Cheltenham, pp. 215–39.

Conti, B. M., Prates, D. M. and Plihon, D. (2014), 'A hierarquia monetária e suas implicações para as taxas de câmbio e de juros e a política econômica dos países periféricos', *Economia e Sociedade* **23**(2), 341–372.

Dutt, A. K. (1984), 'Stagnation, income distribution and monopoly power', *Cambridge Journal of Economics* **8**(1), 25–40.

Farhi, M. (2007), 'Análise comparativa do regime de metas de inflação: pass-through, formatos e gestão nas economias emergentes', *Texto para Discussão, Instituto de Economia, UNICAMP* **127**, 1–57.

Gouvêa, R. (2022), 'Large devaluations and inflation inequality: Replicating Cravino and Levchenko (2017) with evidence from Brazil', *Journal of Applied Econometrics* **37**(3), 657–664.

Hein, E., Mundt, M. et al. (2012), *Financialisation and the requirements and potentials for wage-led recovery: a review focussing on the G20*, ILO Working Paper, Conditions of Work and Employment Series, No. 37.

Hein, E. and Stockhammer, E. (2010), 'Macroeconomic policy mix, employment and inflation in a post-keynesian alternative to the new consensus model', *Review of Political Economy* **22**(3), 317–354.

Hein, E. and Vogel, L. (2008), 'Distribution and growth reconsidered: empirical results for six OECD countries', *Cambridge Journal of Economics* **32**(3), 479–511.

Hobijn, B. and Lagakos, D. (2005), 'Inflation inequality in the United States', *Review of Income and Wealth* **51**(4), 581–606.

Kalecki, M. (1971), 'Class struggle and the distribution of national income', *Kyklos* **24**(1), 1–9.

Kaltenbrunner, A. (2015), 'A post Keynesian framework of exchange rate determination: a minskyan approach', *Journal of Post Keynesian Economics* **38**(3), 426–448.

Lavoie, M. (2022), *Post-Keynesian Economics: New Foundations*, 2nd edn, Cheltenham, UK; Northampton, MA, USA: Edward Elgar.

Lima, G. T. and Setterfield, M. (2010), 'Pricing behaviour and the cost-push channel of monetary policy', *Review of Political Economy* **22**(1), 19–40.

Morlin, G. S. (2023), 'Inflation and conflicting claims in the open economy', *Review of Political Economy* (Adv. Access), 1–29.

Pivetti, M. (1991), *An Essay on Money and Distribution*, Springer.

Ramos, R. A. (2016), Financialization and its implications on the determination of exchange rates of emerging market economies, PhD thesis, Université Sorbonne Paris Cité; Universidade Estadual de Campinas.

Ribeiro, R. S. M., McCombie, J. S. L. and Lima, G. T. (2017), 'Some unpleasant currency-devaluation arithmetic in a post Keynesian macromodel', *Journal of Post Keynesian Economics* **40**(2), 145–167.

Ribeiro, R. S., McCombie, J. S. and Lima, G. T. (2020), 'Does real exchange rate undervaluation really promote economic growth?', *Structural Change and Economic Dynamics* **52**, 408–417.

Rochon, L.-P. and Setterfield, M. (2007), 'Interest rates, income distribution, and monetary policy dominance: Post keynesians and the" fair rate" of interest', *Journal of Post Keynesian Economics* **30**(1), 13–42.

Rolim, L. and Marins, N. (2022), 'Inflation targeting regime and income distribution in emerging market economies', *in* S. Kappes, L.-P. Rochon and G. Vallet, eds, 'The Future of Central Banking', Edward Elgar Publishing, Cheltenham, UK, pp. 62 – 83.

Rolim, L. N., Lima, G. T. and Baltar, C. T. (2022), 'The impact of international trade shocks on domestic output, income distribution, and inflation in an agent-based model', *Texto para Discussão, Instituto de Economia, UNICAMP* **441**, 1–30.

Rossi, D. and Galbraith, J. (2016), 'Exchange rates and industrial wage inequality in open Economies', *UTIP Working Paper* **71**, 1–23.

Rowthorn, R. E. (1977), 'Conflict, inflation and money', *Cambridge Journal of Economics* **1**(3), 215–239.

Sasaki, H., Sonoda, R. and Fujita, S. (2013), 'International competition and distributive class conflict in an open economy kaleckian model', *Metroeconomica* **64**(4), 683–715.

Weber, I. M. (2022), 'Big oil's profits and inflation: Winners and losers', *Challenge* (Adv. Access), 1–9.

Appendix: Parameters and initial values in baseline specification

Table 2: Parameters and initial conditions

Parameter	Description	Value
$\alpha_{H,L}$	share of non-tradable goods in the consumption goods basket for group H, L	(0.95, 0.5)
γ	sensitivity of capacity utilization to the real interest rate	5
δ	ratio between high- and low-wage workers' nominal wages	2
λ	sensitivity of workers' desired wage share to the capacity utilization rate	0.5
ρ	sensitivity of the nominal interest rate to the inflation gap	0.1
φ	sensitivity of price adjustments to the difference between the desired wage share by firms and realized wage share	0.1
ψ	sensitivity of firms' desired wage share to the real exchange rate	0.2
Ω	sensitivity of wage adjustments to the difference between the desired wage share by workers and realized wage share	0.1
ω_{max}	maximum wage share desired by firms	0.7
ω_{min}	minimum wage share desired by workers	0.5
ξ	sensitivity of the nominal exchange rate to changes in the interest differential	2
e_0	initial nominal exchange rate	1
i^f	nominal interest rate in the foreign sector	0.02
i_0	initial nominal interest rate	0.02
n_H	share of high-wage workers in total employment	0.25
p_0^d	initial price of non-tradables (in domestic currency)	100
$\hat{p}_{t-i}$	initial inflation rate for $i = 1, ..., T_i$	0.02
$\hat{p}^T$	inflation rate target	0.02
p_0^f	initial price of tradables (in foreign currency)	100
$\hat{p}_{f,t}$	foreign inflation rate	0.02
T_e	number of periods for exchange rate adjustment to changes in the interest rate differential	4
T_p	number of periods considered by the monetary policy rule	4
u_0	capacity utilization rate when the real interest rate is equal to zero	0.8
u_0	initial capacity utilization rate	0.8
$w_{L,0}$	initial nominal wage for low-wage workers	44

Imprint

Editors:
Sigrid Betzelt, Eckhard Hein (lead editor), Martina Metzger, Martina Sproll, Christina Teipen, Markus Wissen, Jennifer Pédussel Wu, Reingard Zimmer

ISSN 1869-6406

Printed by
HWR Berlin

Berlin February 2023