Inflation targeting and the real exchange rate trend: Theoretical discussion and empirical evidence for developed and developing countries*

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Abstract

Economic literature shows evidence that a competitive real exchange rate (RER), i.e., slightly undervalued, is key for development in developing countries. This paper discusses the connections between inflation targeting (IT) regimes and RER trends in economies highly open to capital flows. Following Rodrik's (2008), the RER trend is estimated for a sample of 31 out of the 38 developed and developing countries using IT today. Covering the period 2000-2019, we showed that all developed and Latin American developing countries had an RER overvaluation trend, while the European, Asian and African (South Africa) developing countries registered an undervaluation trend in the same period. Through a dynamic panel data model, we tested and validated the following hypotheses, which are, to the best of our knowledge, a seminal contribution: in Latin American developing countries, whose ITs are centered on the main objective of pursuing price stability, the RER overvaluation trend, a by-product of this monetary policy regime, is driven by higher interest rate differentials to the US and is harmful to their economic growth; in developed countries, this trend is not explained by their IT framework, but by their high per capita income level, which reflects their high average labor productivity and development pattern (the so-called Harrod-Balassa-Samuelson effect). Yet, the trend of real exchange rate undervaluation in Asian and European developing countries and South Africa reflects their governments'ability to combine a more flexible inflation targeting regime with a floating but managed exchange rate system aimed at preserving a competitive and stable real exchange rate in the long term.

Keywords: Inflation targeting; competitive real exchange rate; real exchange rate trend; developed countries; developing countries.
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They were the other romantics in darkness
They made a cult of another Middle Age located in the future, not in the past
Being incapable of following the blah, blah babel of economics recited on television
These irreducible atheists simulated a religion
(Caetano Veloso, "The other romantics", lyrics of his Brazilian song, 1989)

All contrasts are within Man
(Machado de Assis, "Esau and Jacob", 1904)

1. Introduction

The theoretical and empirical literature shows sound evidence that a competitive real exchange rate – close to its equilibrium level, but slightly undervalued – is key for economic development (Kaldor, 1970, Balassa, 1982; 1993; Williamson, 2003; Rodrik, 2008; Berg and Miao, 2010; Bresser-Pereira, 2020). However, maintaining a competitive and stable real exchange rate level depends on a country's exchange rate policy as well as its coordination with its other macroeconomic features, such as the monetary policy regime and the degree of capital openness, among others. Flexible (even managed) exchange rate regimes and a high degree of capital openness are the rules for most countries in the world economy today. Since many of them adopt implicit or explicit inflation targeting regimes, ensuring a competitive real exchange rate depends on the framework and the degree of autonomy of their monetary policy. Policymakers' ability to coordinate monetary policy with the other spheres of macroeconomic policy, especially fiscal and exchange rate policies, is also vital.

Latin American countries, for example, that adopt inflation targeting (IT) regimes conform fairly well to an issue that was identified by Rey (2015): they do not face a trilemma (impossibility of simultaneously pursuing monetary policy stability, exchange rate stability, and free capital mobility), but a dilemma. That is, because of the low liquidity premium of their currencies, they are not able to have monetary policy autonomy without some degree of capital control. In the case of Brazil, for instance, Nassif, Feijó, and Araújo (2020: 767) provide empirical evidence that, because of its "significant differential between domestic and external interest rates as well as the high degree of capital mobility, the country has alternated periods of excessive capital inflows and an appreciation trend of its domestic currency with other periods of capital flights and sudden exchange rate depreciation throughout the global financial cycles". In the long run, the Brazilian real exchange rate has been overvalued and its trajectory has been highly

volatile.[1] This is particularly concerning because theoretical and empirical literature conclude that in developing countries an overvalued currency over the long term reduces economic growth (Razin, 1996; Razin and Collins, 1999; Dollar and Kraay, 2003; Prasad, Rajan and Subramanian, 2006).

Accordingly, our paper seeks to provide three contributions: first, to reaffirm the importance of keeping a competitive real exchange rate to ensure a successful catching-up trajectory in developing countries; second, by taking into account the central role of a competitive real exchange rate for economic development, to analyze, at the theoretical level, the connections between monetary policy under inflation targeting (IT) and real exchange rate trends in economies highly open to capital flows — which is presently the case of most countries in the global economy; and third, to provide empirical evidence on the trend of the real exchange rate (i.e., if it shows an overvaluation or undervaluation trend) in developing and developed countries which manage their monetary policy using IT.

The hypothesis that this study preliminarily tests is, to the best of our knowledge, an original contribution: in the context of a hierarchical international monetary and financial system and a high degree of openness to capital flows, developing countries under a very rigid and conservative IT framework – that is, one centered on the exclusive objective of pursuing price stability over time – tend to show an overvaluation trend of their currencies driven basically by a higher interest rate differential to the US; whereas in developed countries, the overvaluation trend is not necessarily explained by this monetary policy regime, but by their high level of per capita income, which reflects, in turn, their high average labor productivity (Obsfeld and Rogoff, 1996). In other words, since the overvalued trend in developed countries reflects their high level of productivity (the so-called Harrod-Balassa-Samuelson effect), it is not harmful to their long-term economic performance. In the case of developing countries, however, the overvaluation trend is damaging because it reduces the productivity of tradable goods, especially those produced domestically and subjected to international competition, as well as exportable goods. By reallocating part of aggregate demand to imports, the overvaluation trend in

[1] In a seminal paper, Nassif, Feijó and Araújo (2011) introduced the concept of "optimal" real exchange rate, being a real exchange rate slightly undervalued that is able to, ceteris paribus, sustain long-term economic growth. In this paper, the authors showed econometric evidence that the overvaluation trend of Brazilian currency vis-à-vis a foreign currencies' basket, in the period 2000-2011, was explained by high internal interest rate differentials in comparison to the US interest rate. For additional details on the concept and estimation of the "optimal" real exchange rate, see also Nassif, Feijó and Araújo (2017).

developing countries also discourages investment and reduces economic growth, as confirmed by empirical evidence (see Marcato and Ultremare, 2017, for the Brazilian case).

It is worth stressing that several recent studies have also shown the impacts of large net capital inflows on the real exchange rate overvaluation trend of developing countries. As evidenced by Botta, Yajima, and Porcile (2023), during periods of international economic boom (*bonanza*), large net capital inflows (especially in the form of portfolio investments and international credit) in developing countries have led to a tendency for real exchange rate overvaluation and deleterious impacts such as consumption booms, loss of competitiveness in the manufacturing sector, and premature deindustrialization. Yet Bortz (2018) and Kaltenbrunner and Painceira (2018) showed that in the absence of capital controls, Latin American economies have been severely damaged by large net capital inflows, which have caused exchange rate volatility and long-term overvaluation trend, premature deindustrialization, and low economic dynamism. However, unlike our objective, none of these studies aimed to empirically test whether the factors inherent to the tendency for currency overvaluation in developing countries are associated with the peculiarities of the inflation targeting regime or the productivity level of these countries.Although seeking to provide empirical evidence on the real exchange rate trend of developing and developed countries under IT, we recognize that we are dealing with one of the most challenging empirical problems in open macroeconomics. The difficulty lies in the fact that the equilibrium real exchange rate is not an observed variable. In recent decades, several methodologies have been developed to estimate the long-term equilibrium value for the exchange rate to understand whether this variable has followed an appreciation or depreciation trajectory over time. In this paper, we follow Rodrik's (2008) methodology and build an equilibrium real exchange rate series with the correction of the real exchange rate made through each country's per capita income, a proxy for capturing the Harrod-Balassa-Samuelson effect (Obstfeld and Rogoff,1996: 212).[2]

The remainder of this paper is organized as follows. Section 2 presents and critically discusses the debate on the role of a competitive real exchange rate in economic development. Section 3 presents a relatively detailed analysis of the connections between monetary policy and real exchange rate trends in the context of large capital movements.

[2] Despite its simplicity, Rodrik's (2008) methodology for estimating misalignments is recognized and appropriate because the real exchange rate is adjusted by a structural and real variable.

Section 4 estimates econometric evidence on the trend of real exchange rates in both developed and developing countries using IT. Section 5 draws the main conclusions and policy implications.

2. Competitive real exchange rate and economic development: arguments and issues

The arguments in favor of ensuring a competitive real exchange rate level for sustaining economic development are relatively well discussed in the theoretical literature and confirmed by most empirical evidence. From the theoretical perspective, there are several channels through which a slightly undervalued currency related to foreign trade partners' currencies sustains economic growth. First, increasing the relative price of tradable goods and services, in comparison with the non-tradable (notably the traditional services), tends to stimulate resource allocation to the former. While the size of the non-tradable sector is restricted to the domestic market, a competitive real exchange rate tends to stimulate investment and output in the tradable goods and services (domestic and exports), and, through direct and indirect effects, a derived demand in the non-tradable sector (e.g., transportation, construction, logistics, etc.) [Williamson, 2003]. Second, as Balassa and associates (1982) argue in their classic book, a competitive real exchange rate induces a structural change in a developing country over time, by shifting resources from primary and commodity manufacturing sectors to higher technologically sophisticated manufacturing subsectors. Third, from a structuralist point of view, since these subsectors are characterized by dynamic economies of scale and have the highest potential to generate and spread technical progress to the economy as a whole, in the end, a competitive real exchange rate tends to boost productivity and economic growth (Kaldor, 1966; 1970; Gala, 2008; Ros, 2013; Bresser-Pereira, 2020).

Note that until here, we have been referring to the real exchange rate level, not its fluctuation over time. Some authors (e.g., Diaz-Alejandro, 1963; 1965) argue that a real depreciation of the exchange rate – that is, an increase in the real exchange rate level, supposedly departing from an overvalued level –, by reducing real wages and aggregate consumption, not only negatively impacts economic growth but also redistributes income from workers to capitalists. However, in the theoretical model developed by Ros (2013, Ch. 10 and 11), these results are found in the short/medium run, but not in the long run. In Ros's (2013, Ch.11) model, real depreciation only reduces output growth if its negative effect on real wages is not accompanied by an increase in investment and productivity.

Thus, in the long run, the first-round effects of a drop in real wages on growth are offset by the increase in the expected profit rate, which, in turn, boosts investment, capital accumulation, aggregate productivity, and economic growth.[3] Ros's arguments are in line with new developmentalism's ones (see Bresser-Pereira, Oreiro e Marconi; 2015; Bresser-Pereira, 2020).

Ribeiro, McCombie, and Lima (2016) present one of the few theoretical models aimed at exploring the relationships between real depreciation and growth but incorporate the channels for which the former also affects income distribution between capitalists and workers. It is a balance-of-payments-constrained growth model in which both income-elasticity of demand for exports and imports are endogenous to technical progress and income distribution. The model concludes that the net impact of real depreciation on growth is ambiguous: it tends to boost technical change and output growth only if the wage share is relatively high in income distribution; when the wage share is low, a real appreciation would be better for accelerating economic growth. Either way, this theoretical result is counterintuitive since an overvalued currency for a long period tends to shift a significant share of the rise in domestic demand to imports and, therefore, cause a drop in investments. This is the result of Williamson's (2003: 7) model, which shows that "the direct impact of appreciation on investment will be negative".

Independent of their above-mentioned theoretical paper, Ribeiro, McCombie, and Lima (2020: 408) provide econometric estimates for 54 developing countries in the period 1990-2010 and show that, by raising income inequality, "the indirect impact of undervaluation on growth is negatively signed". However, the authors (op. cit.: 414) are cautious with these results, claiming that their "empirical findings show the necessity of further testing of the relationship between RER [the real exchange rate] and growth with different control variables and different datasets (…);" and that "at the end of the day, the impact of undervaluation on growth is an open empirical question."

This claim suggests that the ambiguous effects of real devaluations are only solved through empirical evidence. Indeed, most of the empirical studies confirm the hypothesis

[3] Williamson (2003) presents a different model whose results are similar to Ros's (2013). It is interesting to note that Williamson (2003) breaks with his previous vision on the role of the real exchange rate. In his well-known concept of fundamental equilibrium exchange rate (FEER), the real overvaluation would not negatively affect growth if policymakers were able to ensure both internal (low inflation and full employment) and external balance (balance of payments equilibrium). In practice, according to the FEER approach, an overvalued currency is consistent with long-term growth if policymakers are able to pursue sound fundamentals that provide a sustainable financing of current-account deficits through net capital flows (Williamson, 1995).

of a negative correlation between an overvalued currency and long-term growth (Razin, 1996; Razin and Collins, 1999; Dollar and Kraay, 2003; Prasad, Rajan and Subramanian, 2006). And most of them also show that a slightly undervalued currency (that is, a stable and competitive real exchange rate level) accelerates and sustains economic development in developing countries (Gala, 2008; Rodrik, 2008; Berg and Miao, 2010; Glüzmann, Levy-Yeyati, and Sturzenegger 2012; Razmi, Rapetti, and Skott, 2012; Guzman, Ocampo and Stiglitz, 2018; Pereira and Missio, 2022).

Despite this evidence, the problem remains of how to ensure and sustain a competitive real exchange rate level over time. This depends not only on the exchange rate regime but also on the exchange rate policy. In a creative but conventional book, Corden (2002) argues that the choice of a particular regime (fixed, floating, or intermediates) is directly associated with a particular "approach" or specific ends to be reached by the economic policy (especially by the exchange rate policy).

Following the same line of reasoning, Williamson (2003) suggests the "development strategy approach" to the exchange rate. This approach, which surprisingly follows the new developmentalism's principles (Bresser-Pereira and Nakano, 2003, Bresser-Pereira, 2008; Bresser-Pereira, Oreiro and Marconi, 2015; Bresser-Pereira, 2020), is in line with the need to reach a stable level for the competitive real exchange rate to sustain economic development as well as a successful catching-up trajectory. Williamson (op. cit.) suggests that the key to reaching a such long-term goal is not only the chosen exchange rate regime but also (or mainly) the exchange rate policy that is managed and associated with it.[4]

Let us take Brazil as an illustrative case. During the fixed exchange rate system of the Bretton Woods era (1944-1973), Brazil adopted an inventive exchange rate policy destined to keep the competitive real exchange rate relatively stable over time. This policy, named "*minidesvalorizações",* was a variation of the crawling-peg regime. Given some estimation of the Brazilian competitive real exchange rate level, the nominal exchange rate of Brazil's currency against the US dollar was adjusted in relatively short intervals (from 14 to 80 days) according to the difference between the Brazilian inflation

[4] This Williamson argument is surprising to say the least, for his fundamental equilibrium exchange rate (FEER) concept is used to support a strategy of economic growth based on current account deficits (that is, dependent on foreign savings), which is radically rejected by the new developmentalism (see Williamson, 1985). However, in another paper, Williamson (2003: 14) argues in favor of keeping competitive real exchange rates to sustain economic development. In fact, according to this author "indeed, the very best policy (in terms of maximizing growth) appears to be a small undervaluation".

index and the inflation indices of its main trade partners (Suplicy, 1974). According to several empirical evaluations, this exchange rate policy, which lasted from 1968 to 1979, was successful in keeping the level of the Brazilian competitive real exchange rate relatively stable during the period (Suplicy, 1974; Almeida e Bacha, 1999).[5]

Under a flexible exchange rate regime and large capital mobility, the problems become much more complicated for the stability of developing countries' real exchange rates. In practice, the ability of a floating exchange rate to work independently of monetary and fiscal policy is far from following the assumptions and results of the Mundell-Fleming model. Since this immensely popular textbook model assumes instantaneous equilibrium, one could expect that, under a flexible exchange regime and large capital flows, an expansionist monetary policy (e.g., an increase in money supply or a drop in policy interest rates) would provoke a benign capital outflow, in such a way that the depreciation of the exchange rate would shift the IS curve upwards (through the rise of net exports), expand output and employment, and restore the balance-of-payments equilibrium. Since the price level is given and there is no place for continuous time in the Mundell-Fleming model, this would be an expected and benign instantaneous equilibrium.

In practice, however, as the Mundell-Fleming model does not distinguish the nature and differentiated effects of long-term capital (foreign direct investment, long-term lending, etc.) from short-term speculative financial capital, capital flows in developing countries are highly destabilizing and pro-cyclical (Ocampo, Spiegel, and Stiglitz, 2008; Stiglitz, 2008). During booms, despite falling domestic interest rates (though relatively higher than external interest rates), excessive capital inflows tend to overvalue these countries' domestic currencies for a long period and, therefore, reduce the competitiveness of tradeable goods as well as augmenting their current account deficits. In the meantime, sudden massive capital outflows can arise in response to either the worsening of fundamentals or to an expected internal or external shock, followed by a sharp depreciation of their exchange rates. Note that, contrary to the Mundell-Fleming predictions, such depreciations generally mean exchange rate overshooting that forces central banks to increase interest rates to deter capital outflows and inflation pass-through. The result is recession and financial bankruptcies. This stylized fact fits several

[5] Although this exchange rate policy continued throughout the 1980s, it is not appropriate to characterize this later version as "*minidesvalorizações*", since the adjustment mechanism became practically automatic in response to chronic inflation rates that marked that later period.

developing countries, namely Brazil's economic history since the mid-1990s, showing that, differently from the Mundell-Fleming predictions, monetary policy in this group is not autonomous and independent of exchange rate policy.

Brazil can be highlighted as a stylized fact that illustrates well the translation of a very rigid and conservative IT framework in a world of large capital flows. Since the adoption of IT, the Brazilian regime has been managed in a very inflexible way. For instance, in the aftermath of Lehman Brothers' failure, considered by many as the mark of the 2008 global financial crisis, the Brazilian Central Bank's (BCB) monetary policy committee was much more concerned about unanchored inflation expectations than the significant drop in real output and the rise in unemployment. Contrary to most central banks in the world, the BCB kept basic interest rates unchanged between September 2008 and January 2009. This decision, which reinforced the contractionary effects of the global crisis, was partially responsible for the 0.2% drop in real GDP. Recently, reacting to the rise in inflation rates predominantly explained by supply shocks and global supply chain shortages, the BCB was responsible for one of the highest and quickest increases in the basic interest rate in the world, from 2% in January 2021 to 13.75% in March 2023 (corresponding to an ex-ante real interest rate of 7.7%). By March 2023, this ultraorthodox monetary policy continued to be justified through unanchored inflation expectations – around 5.55%, according to *Ipeadata*, even though the actual annual consumer inflation rate had already dropped to 4.65% (*IBGE data*), against an inflation target of 3.25% – and the high open unemployment level (7.9%). Notwithstanding, the extremely high Brazilian interest rates were not (and are still not) able to attract large capital inflows and provoke a new appreciation trend. This time seems to have been different and a rare exception because of the uncertainty that has persisted after the pandemic crisis and around the Ukraine war. However, unless the Brazilian macroeconomic framework is changed, the overvaluation exchange rate trend might emerge again as soon as the world economy signalizes a new bonanza period.

As we will discuss in the next section, the interaction between inflation targeting regimes (mainly the inflexible ones) and large openness to capital movements in a hierarchical international monetary system narrows still more the space for monetary policy autonomy, making it much more complicated to ensure the stability of real exchange rates, unless government authorities introduce a mix of exchange rate policy instruments (exchange markets interventions, macroprudential instruments, and capital controls).

3. Competitive real exchange rate and degree of policy autonomy in developing economies

We start this section with a brief analysis of inflation targeting, the leading monetary policy guide in contemporary economies. After, we critically discuss how conventional literature connects the interest rate and the exchange rate movements.

3.1 Inflation Targeting Regime

Since the early 1990s, several countries have adopted IT to coordinate agents' inflationary expectations. In practical terms, IT is a regime of monetary policy where central banks manipulate the policy rate to affect aggregate demand and the overall economy. Thus, it is assumed that inflation and economic activity move together and that a slowdown of economic activity should bring the inflation rate down to the target. Two central relationships should be strongly observed so that monetary policy under IT is efficient: first, a relationship between real interest rates and aggregate demand,[6] and second, a direct connection between aggregate demand (reflected in the level of unemployment) and inflation. In other words, there should be efficient transmission mechanisms from the policy rate (a nominal short-term interest rate) to the real interest rate, and then, by affecting aggregate demand, to prices in such a way that inflation can be controlled as expected.

The foundations of the IT regime are built on the new-classical macroeconomic framework based on monetary neutrality, rational expectations, continuous market equilibrium, and flexibility of prices and labor supply determined by real wages. The most important assumption of the new-classical model is the existence of an inflationary bias, that is, the monetary authority's incentive to create an inflationary surprise to reduce unemployment to levels below its natural rate.[7] The inflationary bias would occur because

[6] Although central banks directly fix the short-term nominal interest rates, their main goal is, given inflationary expectations, also to affect the forward structure of real interest rates.

[7] As it is well acknowledged, the natural rate of unemployment, a concept introduced by Friedman (1968), is the rate of unemployment that does not accelerate inflation rates over time. According to Friedman (op.cit.: 8, emphasis added), it is "the level that would be ground out by the Walrasian system of general equilibrium equations, provided there is imbedded in them the actual structural characteristics of the labor and commodity markets, **including market imperfections**, stochastic variability in demands and supplies, the cost of gathering information about job vacancies and labor availabilities, the costs of mobility, and so on". Friedman argues (and since then, it has been accepted by the mainstream) that the natural rate of unemployment is compatible with Wicksell's (1898) natural (real) rate of interest. However, since Wicksell's natural rate of interest is determined by the equilibrium between saving and investment under

of a discretionary behavior of the monetary authority seeking to maximize the social welfare function at each moment in time. Such conduct would lead to inefficient results because it would be inconsistent in the long term (Calvo, 1978, and Barro and Gordon, 1983). In this sense, the new-classical theory builds arguments to sustain that the monetary authority's action should be based on rules to the detriment of discretion. Therefore, adopting a monetary rule would be a solution to minimizing the inflationary bias.

Bernanke et al. (1999) argue that the monetary authority should have a solid stimulus to follow the monetary rule because it would reduce the cost of disinflation and establish its reputation. This reasoning concludes that the persistence of inflation is due to the loss of reputation of the monetary authority. An IT is understood, then, as a set of institutional norms and procedures that, based on the announcement of a numerical value for the inflation target and assuming efficient mechanisms of transmission, would guide rational agents' expectations and bring inflation to its target with little social costs.[8]

The general acceptance of the IT as the primary monetary policy helped to build another consensus in macroeconomics, called the "new macroeconomic consensus", and led by the New-Keynesians in the 1990s. This new consensus, though, accepts the non-neutrality of monetary policy in the short term (short-term Philips curve sloping down) but maintains its neutrality in the long run (vertical Philips curve).[9]

After adopting the IT, the monetary authority's main concern becomes stability in the general price level. The effectiveness of monetary policy is measured based on the deviations of actual inflation and/or inflation expectations from the target.

The classical article by Taylor (1993) offers an operation rule to set the policy rate at each moment based on a linear function, expressed as the observed inflation rate, an equilibrium interest rate (the Wicksellian natural rate, not observed but derived from

conditions of overall perfect competition and full employment, while Friedman's natural rate of unemployment assumes imperfect competition in labor markets, the theoretical alignments of both natural rates are misleading.

[8] It is worth mentioning that recent literature on the IT refers to "Integrated Inflation Target", meaning that the monetary authority should be concerned with both price and financial stability. See, for example, Agénor and Pereira da Silva, 2019.

[9] The New Keynesian school also abandons the assumption of continuous market equilibrium, opening the research agenda to market imperfections and asymmetric information and, therefore, providing some space for discretionary economic policies.

macroeconomic models[10]), plus a weighted sum of two deviations: the observed (or expected) inflation and the target, and the actual GDP and potential (not observed) GDP.[11]

Central banks that adopt inflation targets do not do so in the same way. They may use a different institutional design, governance structure, and way of conducting monetary policy.[12] Features, such as the speed of convergence of both actual and expected inflation to target and the weights given to fluctuations in employment and output as well as to exchange rate and interest rate volatility, define, to a large extent, whether the IT is more or less flexible.

Under strict IT, central banks only aim to achieve the inflation target, attributing zero weight (or very close to zero) to any output or employment variability. Thus, when inflation or inflation expectations deviate from the inflation target, the central bank tries to converge inflation and inflation expectations back to the target as quickly as possible. This requires considerable changes in the main policy instrument — money (i.e., the interest rate). Under a flexible IT, central banks adopt a gradualist strategy in which they lengthen the horizons and seek to reach the inflation target further in the future. The adopted gradualism, or implicit flexibility, can be explained by the central bank's concern with the stability of output and employment, the volatility and misalignment of the exchange rate, the trajectory of the interest rate, and the uncertainties about the actual state of the economy.

In sum, the degree of autonomy of the monetary authority to set the policy rate to control inflation depends on, first, the choice of strategy to bring inflation to target, and second, on the transmission mechanisms, which depend on several factors. The connection between monetary policy and the exchange rate, one of the transmission mechanisms of monetary policy, will be seen next.

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[10] Arestis and Sawyer (2008: 294), in a critical review, argue that: "The use of interest rates to target inflation is based on two propositions. First, that there is a knowable and achievable equilibrium real rate of interest (natural rate of interest) which is consistent with constant inflation and supply-side equilibrium (zero output gap). Second, that variations in the nominal policy interest rate influence aggregate demand which in turn sets the rate of inflation". And conclude that (…) "the NCM [New Consensus Macroeconomics] is indeed an unreliable guide for policy."

[11] The output gap is the main reference for the existence of demand pressures. Changing productive capacity in a lasting way requires changes in real variables, preferences, and technologies.

[12] As Mishkin and Schmidt-Hebbel (2002: 175) point out, "inflation targeters vary widely about implementation features, including the target price index, target width, target horizon, escape clauses, accountability of target misses, goal independence, and overall transparency and accountability of the conduct of policy."

3.2 The connection between interest rate and exchange rate

As discussed in the previous section, the importance of a competitive real exchange rate for economic development is well-established in the theoretical literature. The structuralist and the new-developmental literature, particularly, stresses that the real exchange rate should be kept at a competitive level and with a stable trajectory for promoting the diversification of the tradable goods sectors, especially those with knowledge spillovers for the creation of forward and backward linkages. Economic and social development, in this sense, is understood as a productive transformation resulting in higher levels of aggregate productivity. The competitive real exchange rate is a critical price in this process (Guzman et.al., 2018; Bresser-Pereira, 2020).

However, the behavior of the real exchange rate depends not only on macroeconomic policy management but also on the degree of openness to international trade and capital flows in a hierarchical international monetary and financial system. Therefore, from the global economy's perspective of trade and financial integration, there should be a clear connection between macroeconomic policy, especially monetary policy, and the determination of the real exchange rate.

The traditional Mundell-Fleming model explains the connection between monetary policy and the exchange rate. This model states that monetary autonomy would be an expected result for a small economy under a floating exchange rate and free capital mobility. Nevertheless, in a hierarchical international monetary and financial system, this monetary policy space is narrowed, mainly in economies with non-convertible currencies. The currency hierarchy framework is one in which convertible currencies are the ones issued by core, developed, economies (core currencies, positioned at the top of the hierarchical pyramid), while non-convertible ones are those issued by the periphery, developing, economies (peripheral currencies, positioned at the base). Because core currencies are characterized by having a higher liquidity premium than peripheral ones, when the degree of uncertainty in the international financial markets increases, peripheral currencies are the ones that primarily suffer from the flight to quality.[13]

A consequence of the financial integration of developing economies is that it subordinates them to the liquidity cycles determined by core economies issuing

[13] For a Keynesian explanation of the currency hierarchy, see De Paula et al. (2017).

currencies at the top of the currency hierarchy.[14] This means that financial integration implies financial asymmetry related to the international liquidity cycle, and in the words of Ocampo (2003), periphery economies are "business-cycle takers."

Given this international macroeconomic context, it becomes clear that the autonomy of developing economies, issuing peripheral currencies, to set the interest rate to stabilize prices and control aggregate demand is significantly constrained by free capital flows. The monetary authority may be prone to accommodate changes in the direction of capital flows using the interest rate differential. In countries characterized by very low flexibility in inflation targeting, like Brazil for instance, in the face of rising inflationary expectations, the monetary authority is compelled to adopt a round of interest rate rises, which tends to attract foreign capital, especially of a speculative nature. As a consequence, exchange rates appreciate and inflationary pressures cool off. Under a rigid IT framework, monetary authorities are more willing to tolerate trends toward real exchange rate appreciation, keeping the interest rate differential positive, since an overvalued currency accelerates the convergence of actual inflation to the target and, consequently, the reputation of the monetary authority is increased (Kregel, 1999; Flassbeck, 2001; Bresser-Pereira and Nakano, 2003; Nassif, Feijó and Araújo, 2020).

In another situation, if high instability in the foreign exchange market is observed, the threat of a devaluation puts pressure on the domestic interest rate to keep domestic assets attractive. Therefore, an appreciation of the exchange rate is expected. As the domestic interest rate rises, the systematic increase in the interest rate differential represents an additional incentive to sustain the excessive capital inflow to the financing of the current account.[15] Hence, under unstable expectations about the exchange rate behavior, the expectation of exchange rate appreciation should be added to the yields obtained from the interest rate differential.[16] The hierarchy of currencies in the

[14] Rey (2015), in a sound empirical work, shows that the financial cycle of financially integrated periphery economies follows the liquidity cycle of the developed economies, which is the main reason the former lose monetary autonomy, no matter the exchange rate regime chosen.

[15] Bresser-Pereira et al. (2022) argue that the high exchange rate volatility and the real appreciation trend are outcomes observed in developing economies that follow a strategy to grow with foreign savings and free capital flows. However, as pointed out by Arestis (2006), and others, after decades of capital account liberalization in most economies, the results of financial liberalization experiences are not reassuring.

[16] According to Rossi (2014), the main financial speculative strategy, today, in the foreign exchange market is to carry out trade operations. This is a financial strategy in which the liability position is built on a low interest rate currency (core currencies), and the asset position is built on a higher interest rate currency (peripheral currencies). The speculator expects that the exchange rate will continue to overvalue. So, they can realize the expected profits, benefit from the higher interest rate, and convert the gains at an overvalued exchange rate. Therefore, the speculative feature of the carry trade operation creates foreign exchange appreciation biases which influence the dynamics of the future foreign exchange market.

international financial markets thus explains the narrowing of monetary policy autonomy through the increase in exchange rate volatility and the trend toward higher real interest rates and real exchange rate appreciation in developing countries with free capital flows.

A direct impact of the subordinate position in the international monetary and financial system is the accumulation of foreign reserves. This has become a common practice for developing economies, especially after the series of currency and banking crises during the second half of the 1990s. Carvalho (2009) shows that the accumulation of reserves works as a liquidity cushion to protect economies against adverse short-term changes in the balance of payments and allows for the accommodation of sudden demands for foreign currency. According to the author, the accumulated reserves can give some "breath" to economic authorities trying to avoid the worst consequences of a sudden stop. Therefore, it is a necessary policy instrument for widening policy space.[17]

Hence, different from the conventional wisdom, the subordination of developing economies to the international liquidity cycle largely explains the connection between monetary policy and exchange rate movements in the short term. Developing economies financially integrated into a hierarchical financial system tend to keep their currency tied to the international commodities market dynamics and capital flows, over which they have little control. The commitment of the central banks of these economies to price stability subordinates monetary policy and exchange rate policy to price stability. Thus, moments of reversal or instability in the liquidity cycle reinforce restrictive monetary policies and the use of exchange rate policy to avoid the negative impact of exchange rate depreciation on domestic prices, regardless of the negative implications of these policies on aggregate demand in the short term, and on the formation of private expectations guiding long-term decisions. This suggests that there is no trend toward equalizing the nominal interest rate as assumed by the parity of the interest rate theorem in a financially asymmetrical environment. In developing economies, narrowing the policy space implies that the real exchange rate tends to not only be volatile but also show an appreciation trend in the long run, limiting growth and development.[18]

Summing up, the combination of monetary policy with low autonomy, due to dependence on international flows in a hierarchical financial system, and a floating

[17] Needless to say, considering all else equal, such a policy strategy can worsen governmental fiscal results if the domestic interest rate is higher than the US interest rate.
[18] See Correa and Feijo (2022), who associate the external financial opening in Brazil and the advance of the financialization process with premature industrialization.

exchange rate demands more policy instruments than only the policy rate to achieve a competitive real exchange rate to promote structural change and increase aggregate productivity. As suggested by Nassif et al. (2017), to achieve a real exchange rate that is competitive and stable, the exchange rate policy should be coordinated with other macroeconomic policies, including macroprudential measures and capital controls, as well as industrial policy.

4. Inflation targeting regime and real exchange rate trend: Empirical evidence for developed and developing countries

This empirical section is devoted to showing evidence from a sample of developed and developing countries whose monetary policy is characterized by inflation targeting (IT). Our sample is representative, as it covers 31 out of the 38 developed and developing countries that currently adopt IT, from different regions (Europe, Latin America, Asia, and Africa) and with different frameworks.[19] To showcase these, this section is divided into two parts. The first discusses some core elements of the IT adopted by developed and developing countries, divided into the following country groups: developed (New Zealand, Canada, Australia, United Kingdom, Sweden, Israel, Czech Republic, South Korea, Iceland, Norway, and Japan), Latin American developing countries (Brazil, Chile, Colombia, Costa Rica, Mexico, Peru, Uruguay, Guatemala, and Paraguay), European developing countries (Poland, Hungary, Romania, Turkey, Serbia, Russia, and Kazakhstan), Asian developing countries (Thailand, Philippines, and Indonesia), and African developing countries (South Africa).[20] The second part deals specifically with RER trends in these groups of countries.

4.1 Inflation targeting regime in developed and developing countries

The adoption of IT involves some important choices, including but not limited to: (i) the objective of the monetary policy and the degree of independence of the central bank; (ii) the public announcement of the quantitative target for inflation; (iii) the

[19] Jahan (2017: 73) describes all 38 the countries adopting IT nowadays. See the corresponding table in this report.

[20] The groups of developed and developing countries follow the International Monetary Fund's classification.

definition of the price index to be used; (iv) the type of target (which can be a specific target or a band); and (v) the time horizon in which the goal must be achieved.

Table 1 highlights the main features of the above-mentioned countries' IT, namely the date of adoption, the central bank's main objectives, the time horizon to reach the target, the target type, and the authority responsible for setting the target.

As the first column of the table shows, developed countries were the first to adopt IT as a framework for monetary policy in the late 1980s and 1990s. Latin American developing countries followed suit by adopting this regime as a way of conducting monetary policy in the late 1990s and throughout the 2000s.

As discussed in the previous section, the choice of IT is based on the recognition that the main objective of monetary policy is to maintain a low and stable inflation rate. This means that, in many countries, especially in Latin America, the practice of monetary policy reflects solely and exclusively the goal of ensuring price stability. In Brazil, for example, the objective of full employment was only incorporated recently, but even so, as a secondary goal; and in Colombia, interpreting a constitutional provision, the Supreme Court determined that the Colombian Central Bank could not ignore the objective of full employment in the management of monetary policy. However, this decision is not always recognized by the Central Bank board.[21] Yet, in more flexible versions of IT, especially in developed as well as some Asian and European developing countries, the goal of monetary policy is not restricted to price stability but is also extended to a set of other mandates such as economic growth, low unemployment, social well-being, and financial stability, among others.

[21] The authors give thanks to a Cambridge Journal of Economics referee for reminding us of this point.

Table 1: Monetary policy framework in countries adopting inflation targeting

Country and date of ITR adoption	Legal mandate	Target horizon	CB operational independence	Target type and measure	Target set by
New Zealand, December 1989*	Low and stable inflation and maximum employment	Medium-term	Yes	Range; HCPI	G and CB
Canada, February 1991*	Economic and financial welfare.	Renewed for five years until the end of 2021	Yes	P + T; HCPI	G and CB
Australia, June 1993*	Currency stability, full employment, economic prosperity, and welfare	Medium-term	Yes	Range; HCPI	G and CB
United Kingdom, October 1992*	Price stability, economic growth, and employment	At all times	Yes	Point; HCPI	G
Sweden, announced January 1993; applied 1995*	Price stability, economic growth, and employment	Two years	Yes	Point; HCPI	CB
Israel, informally 1992, formally 1997*	Price stability and support the Government's economic policy	Two years	Yes	Range; HCPI	G and CB
Czech Republic, Dec. 1997*	Price stability and support economic policies for sustainable economic growth.	Medium-term, 12–18 months	Yes	P + T; HCPI	CB
Poland, 1998**	Price stability and support Government economic policies	Medium-term	Yes	P + T; HCPI	CB
South Korea, 1998*	Price stability	Three years	Yes	P + T; HCPI	G and CB
Brazil, June 1999**	Price stability	Yearly Target	Yes	P + T; HCPI	G and CB
Chile, September 1999**	Currency stability and normal functioning of domestic and foreign payments.	Around two years	Yes	P + T; HCPI	CB
Colombia, October 1999**	Maintaining currency purchasing power.	Medium-term	Yes	Range; HCPI	CB
South Africa, Feb. 2000**	Protect the value of the currency and sustainable economic growth	On a continuous basis	Yes	Range; HCPI	G
Thailand, May 2000**	Promote monetary stability and	Eight quarters	Yes	P + T; HCPI	G and CB

	formulate monetary policies				
Costa Rica, 2000**	Price stability	24 months	Yes	Point; HCPI	G
Hungary, Jun. 2001**	Price stability	Medium-term	Yes	Point; HCPI	CB
Iceland, Mar. 2001*	Price stability and support the government's main economic policy	On average	Yes	Point; HCPI	G and CB
Mexico, 2001**	The purchasing power of the Mexican currency	Medium-term	Yes	P + T; HCPI	CB
Norway March 2001*	Low and stable inflation, output, and employment.	Medium-term	Yes	Point; HCPI	G
Philippines, Jan. 2002**	Price stability, balanced and sustainable growth	Medium-term	Yes	P + T; HCPI	G and CB
Peru, January 2002**	Preserve monetary stability	At all times	Yes	P + T; HCPI	CB
Uruguay 2002**	Price stability	18-24 months	Yes	Range; HCPI	CB
Indonesia, Jul. 2005**	The stability of the rupiah value	Medium-term	Yes	P + T; HCPI	G and CB
Romania, Aug. 2005**	Price stability and support of the general economic policy.	Medium-term	Yes	P + T; HCPI	G and CB
Guatemala, 2005**	Price stability.	End of year	Yes	P + T; HCPI	CB
Turkey, Jan. 2006**	Price stability	Multi years (3 years)	Yes	P + T; HCPI	G and CB
Serbia, Informally Sep. 2006, formally Jan. 2009**	Price stability, financial stability and support economic policy	Medium-term	Yes	P + T; HCPI	G and CB
Paraguay 2011**	Price stability and financial system stability	18-24 months	Yes	Range; HCPI	CB
Japan, 2013*	Price stability and economic development.	Medium to long-term	Yes	HCPI	CB
Russia, 2015**	Price stability and financial system stability	12 months	Yes	HCPI	CB
Kazakhstan, 2015**	Price stability	6-8 quarters	Yes	HCPI	CB

Notes: *: Developed countries; **: Developing countries; HCPI – Headline Consumer Prices Index; G – Government; CB – Central Bank; P+T – Point/Target.
Source: Authors' elaboration based on Hammond (2012) and National Central Banks (2022).

As drawn from the second column of Table 1, while the objective of monetary policy in Latin American countries is consistent with rigid and stricter versions of IT, which focuses on price stability, in the group of developed and several Asian and

European developing countries, and South Africa as well, the target of price stability is also accompanied by a commitment to maintaining economic growth. Canada's Central Bank (CB), for example, also aims at promoting the country's "economic and financial welfare". The Australian CB also seeks to reach "full employment, economic prosperity, and welfare". The Bank of England also aims at boosting economic growth and job creation. New Zealand's CB, which had restricted its main monetary policy's goal to "low and stable inflation" until 2018, has since made "an amendment to the Reserve Bank of New Zealand Act (1989) [by adding to its mandate] supporting maximum sustainable employment".[22] The only exception in this group of countries is South Korea, whose CB drives its monetary policy directed to the single mandate of pursuing price stability.

It is worth mentioning that in the case of Brazil, the Central Bank Autonomy Law of February 2021 expanded the objectives of the Brazilian CB, which, in addition to ensuring price stability, must also ensure the stability and efficiency of the financial system, establish smooth fluctuations in the level of economic activity and encourage full employment. However, as previously emphasized, since these additional goals were legally established as secondary mandates, in practice monetary policy has been focusing on maintaining price stability.

Concerning the independence of the central bank to conduct monetary policy, Hammond (2012) points out that, as the objective of price stability is generally established by law, the independence of objectives, in terms suggested by Rogoff (1985), becomes a second order issue in the definition of IT regimes. Rogoff (1985) proposes the creation of a central bank that is independent to set and choose both objectives and instruments. That is, the central bank should be free to define the final goals of monetary policy as well as the appropriate instruments to be used to achieve them.

However, it is worth stressing that central banks in countries adopting IT have operational autonomy. In other words, as monetary policy managers, they are free to choose the instruments necessary to reach the previously established inflation target. In theoretical terms, this is consistent with Walsh's (1985) suggestion that the central bank is independent to choose only its economic policy instruments, but not its legal objective.

Regarding the time horizon to achieve the inflation target, it is important to remark that most countries adopt a medium-term convergence period, between two and three years. These medium-term horizons provide greater flexibility to the IT regime, as they

[22] This information can be accessed at the Reserve Bank of New Zealand website https://www.rbnz.govt.nz/monetary-policy/about-monetary-policy/inflation.

anchor inflation expectations while allowing for short-term divergences from the stipulated target. An important aspect in choosing the time horizon for the convergence of inflation to target is the extension of monetary policy transmission mechanisms. If the process through which monetary policy decisions are transmitted to aggregate demand, real output, and inflation is slow, the central bank is not able to influence inflation in the short term. In this regard, as Table 1 shows, Brazil and Russia are the only countries that have an annual target as the convergence horizon. Particularly, in the Brazilian experience with IT, when the economy suffers shocks, Brazil's Central Bank (BCB) needs to quickly react to them to reach the inflation target within the established horizon.

Another important feature of the IT regime is the definition of a specific target or band. The one-off target, while implying a stricter regime, can also be more difficult to achieve. Establishing the target in the form of bands, on the other hand, gives greater flexibility to the monetary regime, facilitating its achievement. Table 1 shows that, in general, countries opt for both, that is, a one-off target with lower and upper tolerance limits for inflation.

The definition of the price index is also an important issue for the IT regime because the adopted index can be a full index or a measure of core inflation. All the selected countries of this study use the consumer price index as a measure of inflation, notably because of its monthly frequency. However, despite using the headline index, many central banks also look at measures of core inflation as an indicator of the inflationary pressures in the economy. Hammond (2012) highlights that Australia, Canada, the Czech Republic, Hungary, Norway, Poland, Sweden, and Turkey publish core inflation forecasts and not just overall inflation. These core inflation measures are characterized by the exclusion of volatile items that are more sensitive to different types of shocks in the inflation calculation, such as food and energy. The use of core inflation aims at reducing price index volatility and, therefore, at avoiding excessive use of monetary policy in the event of supply shocks.

Finally, regarding the establishment of the target, Table 1 shows that in several countries, the inflation target is established jointly between the government and the Central Bank. In fourteen of them, the Central Bank defines the inflation target, of which only Sweden and Japan are classified as developed economies. Lastly, of all the countries described in Table 1, the United Kingdom, South Africa, Costa Rica, and Norway are the only ones where the government alone is responsible for setting the inflation target.

4.2 Empirical evidence: real exchange rate trend in countries under inflation targeting (2000-2019)

To analyze the trend of the real exchange rate in countries that adopt IT, this paper uses the exchange rate undervaluation index as proposed by Rodrik (2008). The author proposes the calculation of an exchange rate undervaluation index in three steps. The first step is to use data on exchange rates (XRAT) and purchasing power parity (PPP) conversion factors from Penn World Tables 10 (Heston, Summers, and Atina 2021) to calculate a real exchange rate (RER) as follows:

$$ln\ RER_{it} = ln(XRAT_{it} / PPP_{it}) \quad (1)$$

where *i* is an index for country *i* and *t* is an index for the time (year); XRAT and PPP are expressed as units of national currency per US dollar. When the RER is greater than one, it indicates that the currency's value is lower (more undervalued) than indicated by the PPP.

However, in practice, non-tradable goods are also cheaper in poorer countries due to the Harrod-Balassa-Samuelson effect (Harrod, 1933; Balassa, 1964; Samuelson 1964), requiring an adjustment for the long-term productivity differential between high-income and low-income countries, which leads to trend deviations between exchange rates and the PPP.

Therefore, a second step consists of considering the Harrod-Balassa-Samuelson effect. This is done by regressing the real exchange rate (RER) on the GDP per capita (RGDPCH),[23] also drawn from Penn World Tables 10:

$$ln\ RER_{it} = lnRGDPCH_{it} + f_t + u_{it} \quad (2)$$

where f_t is the fixed effect for the time and u_{it} is the error term.

The last step is to estimate Rodrik's (2008) undervaluation index, which is calculated by the difference between the RER and the estimated rate adjusted by the Harrod-Balassa-Samuelson effect:

[23] Following Obstfeld and Rogoff (1996: 212), we use each country's per capita income as a proxy for capturing the Harrod-Balassa-Samuelson effect.

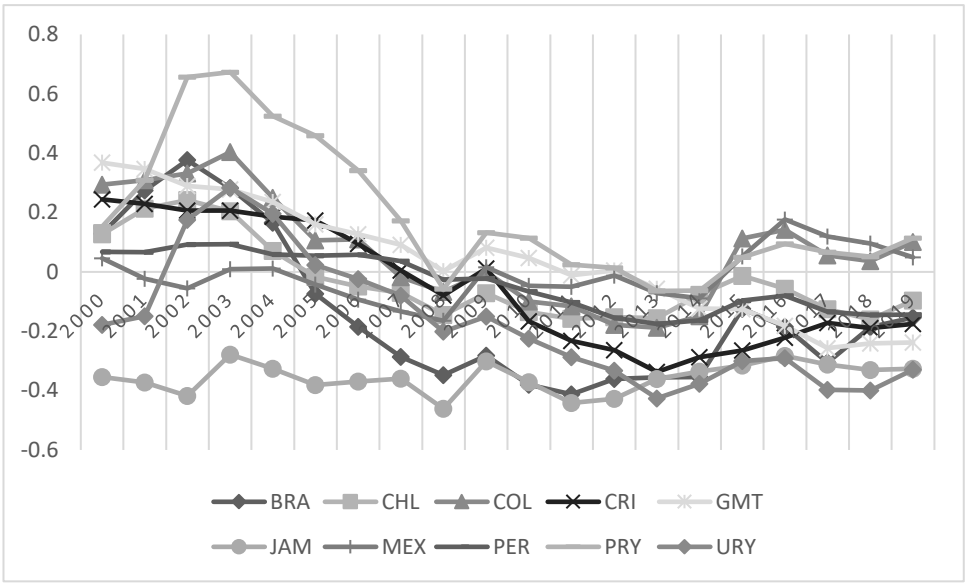
$$ln\ UNDERVAL_{it} = lnRER_{it-} - ln\ RER_{it\ estimated} \quad (3)$$

where $ln\ RER_{it\ estimated}$ are the predicted values of equation (2).

According to Rodrik (2008), this methodology permits UNDERVAL to be comparable across countries over time. Whenever UNDERVAL exceeds unity, it indicates that the exchange rate is set in such a way that goods produced domestically are cheap in dollar terms: the currency is undervalued. When UNDERVAL is below unity, the currency is overvalued.

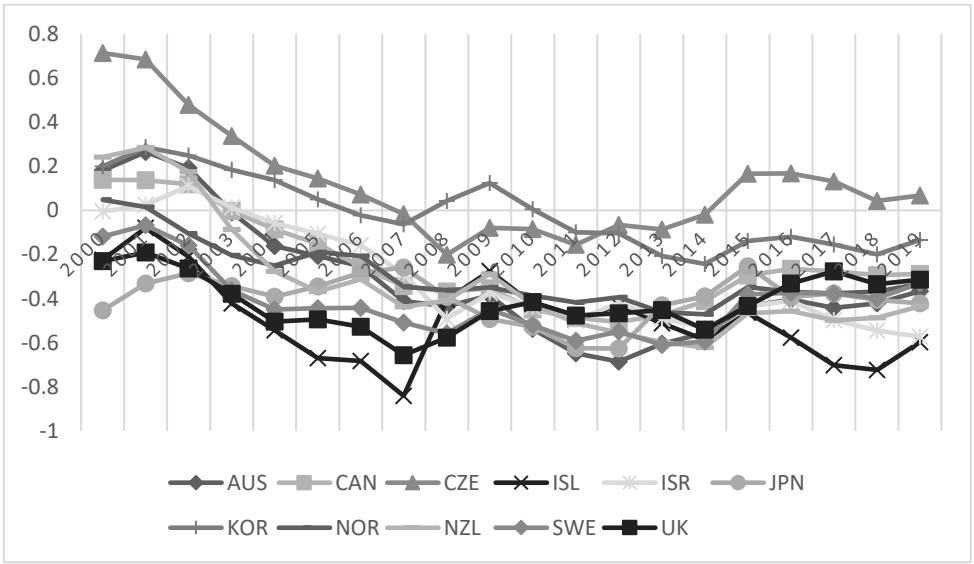
This methodology proposed by Rodrik (op. cit.) will be used to analyze the trend of the real exchange rate in the previously listed developed and developing countries in the period 2000-2019, during which these countries have introduced and consolidated their monetary policy under IT. The series resulting from equation 3 are shown in Figures 1 and 2, respectively displaying the Latin American countries and the developed countries groups. As the series are in logarithms (LN_UNDERVAL), zero becomes the dividing line: below zero means overvaluation, and above zero, undervaluation. Thus, in Figures 1 and 2, the "zero" axis represents the real exchange rate equilibrium as suggested by Rodrik (op. cit.), a level consistent with the level of labor productivity in each country.

Figure 1 – Real exchange rate trend in Latin American developing countries under IT (2000-2019)



Notes – Acronyms are: BRA (Brazil); CHL (Chile); COL (Colombia); CRI (Costa Rica); GMT (Guatemala); JAM (Jamaica); MEX (Mexico); PER (Peru); PRY (Paraguay); and URY (Uruguay); The horizontal axis indicates Years.
Source: Authors' estimates.

Figure 2 – Real exchange rate trend in developed countries under IT (2000-2019)



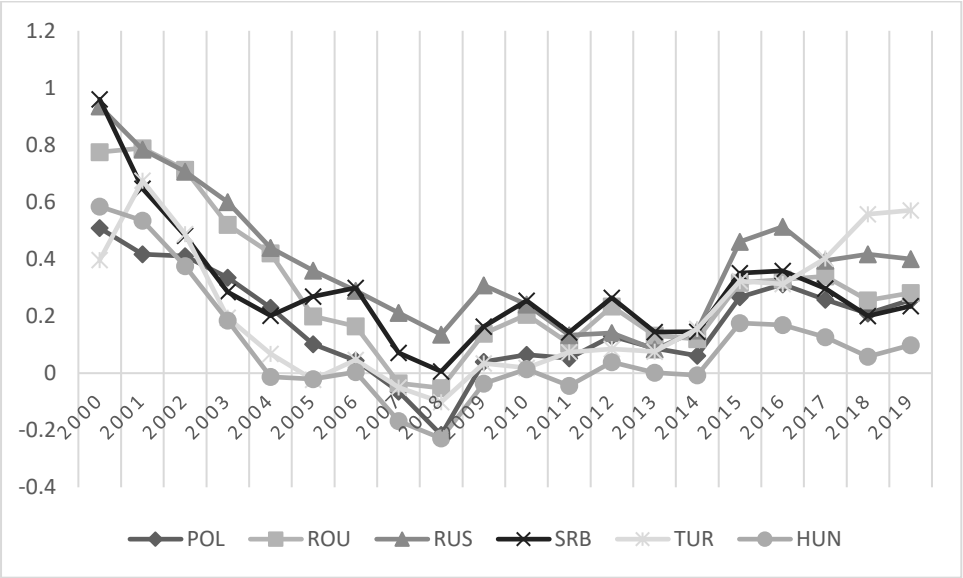
Notes – Acronyms are: AUS (Australia); CAN (Canada); CZE (Czech Republic); ISL (Iceland); ISR (Israel); JPN (Japan); KOR (South Korea); NOR (Norway); NZL (New Zealand); SWE (Sweden); and UK (United Kingdom). The horizontal axis indicates Years.
Sources: Authors' estimates.

Figure 1 shows that most of the Latin American developing countries under IT followed a real overvaluation trend of their currencies. One can notice as well that this trend was initially positive in practically all of them before becoming negative. The behavior of the Mexican, Colombian, and Paraguayan RERs appears to deviate from that appreciation trend. However, since the undervaluation of Mexican and Colombian currencies in the final years of the series might reflect a shock effect, it is not possible to confirm that these countries have reversed their long-term overvaluation trend. Even in the case of Paraguay, a country where the deviation of the real exchange rate from equilibrium has been very close to zero in recent years, it is possible to observe the tendency of the exchange rate to appreciate in real terms.

Regarding the developed countries under IT (Figure 2), they all show a tendency to reduce the positive deviation (real exchange rate undervaluation) to a negative deviation (real exchange rate overvaluation). In some cases, the trend is quite clear, with some countries systematically remaining in the negative deviation after crossing the zero line, which may suggest that this is indeed a by-product of the IT regime. In practice, however, all of them show a persistent overvaluation trend.

Concerning other developing countries that use IT, Figures 3, 4, and 5 illustrate the behavior of the real exchange rate trend in European, Asian, and African (i.e., South Africa) countries, respectively. In the case of European developing countries (Figure 3), there was initially a tendency towards real exchange rate overvaluation, but after the 2008 global financial crisis, this trend was towards a real exchange rate undervaluation, considering that all of them showed a real exchange rate higher than the corrected exchange rate by the Balassa-Samuelson effect. Figure 3 clearly shows that all the relative lines of the graphs are above the zero axis.

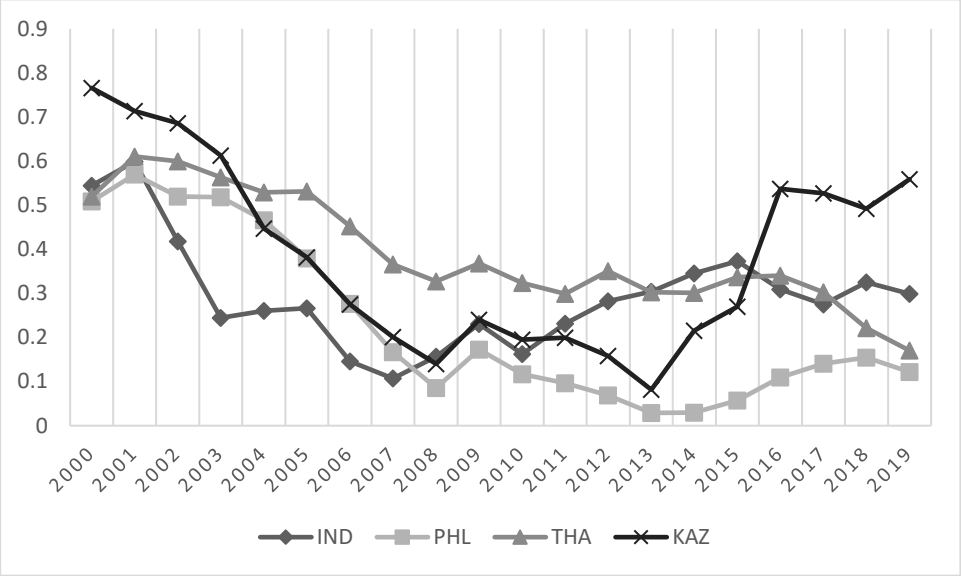
Figure 3 – Real exchange rate trend in European developing countries under IT (2000-2019)



Notes – Acronyms are: POL (Poland); ROU (Romania); RUS (Russia); SRB (Serbia); TUR (Turkey); and HUN (Hungary). The horizontal axis indicates Years.
Sources: Authors' estimates.

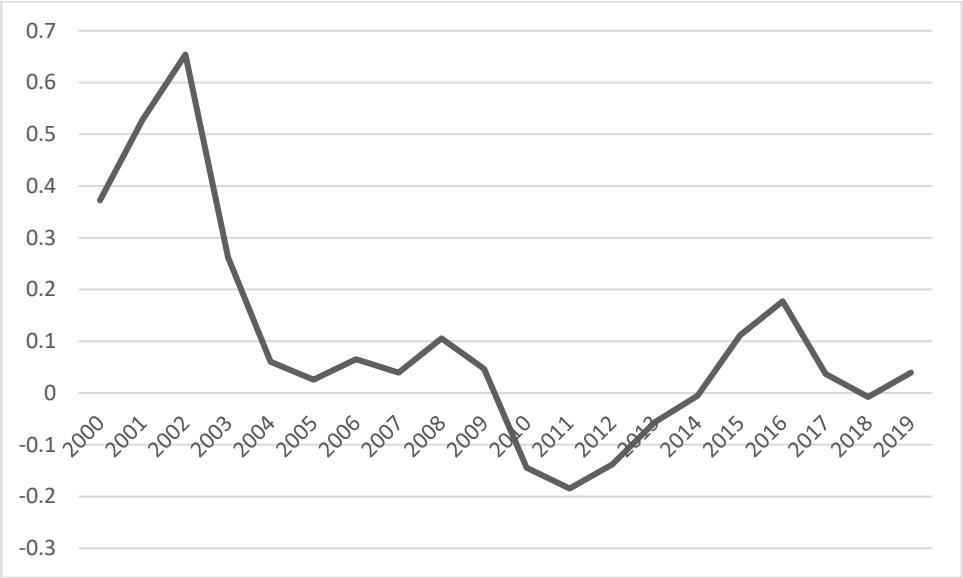
Yet all Asian developing countries (Figure 4) have a real exchange rate higher than that corrected by the Balassa-Samuelson effect, despite showing a real overvaluation many Asian developing countries is based on competitive real exchange rates through which their domestic currencies tend to be undervalued (Gala, 2007; Rodrik, 2008).

Figure 4 – Real exchange rate trend in Asian developing countries under IT (2000-2019)



Notes – Acronyms are: IND (Indonesia); PHL (Philippines); THA (Thailand); and KAZ (Kazakhstan). The horizontal axis indicates Years.
Sources: Authors' estimates.

Figure 5 – Real exchange rate trend in South Africa (2000-2019)



Note – The horizontal axis indicates Years.
Sources: Authors' estimates.

Regarding South Africa, Figure 5 shows that despite following a real appreciation trend along the time series, its real exchange rate remained undervalued in most of the analyzed period. This result is surprising, as South Africa is reported to suffer from the Dutch disease (Faulkner, Christopher, and Makrelov, 2013). However, two factors explain the ability of South African governments to keep competitive real exchange rates since the 2000s: first, as described in Table 1, monetary authorities in this African country conduct IT in a more flexible way by establishing the main goals to "protect the value of the currency and sustainable economic growth" and by reaching the target on a "continuous basis"; and, second, as a consequence of this more flexible monetary policy, South Africa was able to register very low real interest rates between 2000 and 2010 (only 1.9% per year).[24]

4.3 Further empirical evidence and discussion

The previous results showed that among the 31 countries adopting IT, all developed and Latin American developing countries analyzed (a total of 11 and 10 countries, respectively) registered a real exchange rate overvaluation trend, while all the

[24] Data from the South African Reserve Bank, https://www.resbank.co.za/en/home/what-we-do/statistics.

European, Asian and African (i.e., South Africa) developing countries showed an undervaluation trend.

These results lead us to some questions: Are these trends of real exchange rate overvaluation in the developed countries associated with their monetary policy regime under IT, as we supposed to be the case of Latin American developing countries? Or do they reflect their much higher levels of productivity, which tend to benignly overvalue currencies due to the Harrod-Balassa-Samuelson effect? If the latter is the case, the overvaluation trend of these currencies, far from damaging the economic development of these countries, would express their higher economic efficiency level.

A procedure for answering these questions is to test this study's main hypotheses: the overvaluation trend of developing countries' currencies under IT is driven by their higher interest rate differential related to the US in a context of a high degree of openness to capital flows; whereas the overvaluation trend of developed countries' currencies is not necessarily explained by the IT monetary regime, but by their high level of per capita income, which reflects, in turn, their high average labor productivity.

To test these hypotheses, we estimate dynamic panel data models for the 31 countries under IT in our sample, separating them into two groups: the first having the developed countries (11 countries); and the second having the developing ones (20 countries).

The econometric methodology adopted uses a dynamic panel data model and the Generalized Method of Moments (GMM), more specifically the System GMM estimator developed by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). According to Roodman (2009), such estimators are appropriate when using panel data when there are the following: (i) a number of periods lower than the number of individuals; (ii) a linear functional relationship; (iii) a delayed dependent variable, that is, one influenced by its past values; (iv) explanatory variables that are not strictly exogenous, that is, pre-determined and/or endogenous; (v) individual fixed effects; (vi) heteroscedasticity and autocorrelation within groups of individuals; and (vi) the possibility of internal instruments based on their own lagged variables or external instruments.

The estimated equation was as follows:

$$REER_{it} = REER_{t-1it} + INTEREST_{it} + RGDPCH_{it} + Z_{it} + \mu_{it} \quad (4)$$

where *REER* is the real effective exchange rate; *INTEREST* is the policy rate of the inflation targeting model; *RGDPCH* is the GDP per capita (following Obstfeld and Rogoff, a proxy for productivity, which captures the Harrod-Balassa-Samuelson effect); *Z* represents the control variables, that is, other determinants of the real exchange in addition to interest rates and productivity, such as *IC* (commodity price index), *INFLATION* (inflation rate), *GRI* (global risk index), and *UCDP* (a proxy for the existence of global conflicts calculated by the Uppsala Conflict Data Program); and *i* and *t* refer to the country and the year, respectively. The term μ incorporates unobserved country-specific fixed effects and an error term. The series and data sources are described in Table A1 in the Appendix. The results of equation 4 are summarized in Table 2, for developing countries, and in Table 3, for developed countries, where 4 different equations were estimated that vary according to the different controls that were introduced in the basic model.[25]

[25] Details on the results and all the econometric tests can be disposable by the authors upon request.

Table 2 - Determinants of the real exchange rates in developing countries under IT

VARIABLES	(1) *lnREER*	(2) *lnREER*	(3) *lnREER*	(4) *lnREER*
L.lnREER	0.868***	1.017***	0.999***	0.972***
	(0.093)	(0.091)	(0.103)	(0.096)
L.lnINTEREST	-0.049**	-0.096***	-0.039*	-0.045**
	(0.020)	(0.030)	(0.021)	(0.020)
L.ln RGDPCH	-0.119***	-0.036	-0.051	-0.037
	(0.038)	(0.043)	(0.038)	(0.044)
L.lnIC	-0.062**			
	(0.027)			
L.lnINFLATION		0.074***		
		(0.027)		
L.lnGRI			-0.028**	
			(0.011)	
L.lnUCDP total				-0.029
				(0.036)
Constant	1.531***	0.310	0.949	0.704
	(0.548)	(0.600)	(1.239)	(0.504)
Sargan Test	0.143	0.356	0.111	0.181
AR (1) Test	0.0000	0.0000	0.0000	0.0000
AR (2) Test	0.23	0.18	0.17	0.632
Instrument	11	11	9	11
Observations	379	379	379	379
Number of countries	20	20	20	20

Standard errors between parentheses
*** significant at 1% level;
** significant at 5% level;
* significant at 10% level.
Source: Authors' estimates.

Table 2 shows that in developing countries the interest rate is the central variable to determine the real exchange rate in the four estimated models. Table 3 indicates that in the group of developed countries the main variable to explain the exchange rate is the proxy variable for productivity.

In the group of developing countries (Table 2), the commodity price index variables were negative and significant, while the global risk index and inflation variables were positive and significant in explaining their real exchange rate level. In the group of developed countries, the proxy for the existence of global conflicts and inflation were

positive and significant in explaining the real exchange rate. Many other variables could be used as controls in the model, but it is worth highlighting that regardless of the four controls used, the main results of the model were maintained.

Table 3 - Determinants of the real exchange rate in developed countries under IT

VARIABLES	(1) *lnREER*	(2) *lnREER*	(3) *lnREER*	(4) *lnREER*
L.lnREER	1.033***	1.044***	1.000***	1.052***
	(0.106)	(0.106)	(0.104)	(0.102)
L.lnINTEREST	-0.028	-0.034	-0.018	-0.034*
	(0.021)	(0.024)	(0.020)	(0.020)
L.lnRGDPCH	-0.233**	-0.242***	-0.244***	-0.250***
	(0.103)	(0.092)	(0.087)	(0.093)
L.lnIC	0.007			
	(0.025)			
L.lnINFLATION		0.212***		
		(0.025)		
L.lnGRI			-0.936	
			(0.710)	
L.lnUCDP total				0.302***
				(0.045)
Constant	2.314**	2.388***	3.888***	2.437***
	(0.997)	(0.870)	(1.484)	(0.838)
Sargan Test	0.251	0.125	0.300	0.671
AR(1) Test	0.000	0.000	0.000	0.000
AR(2) Test	0.183	0.163	0.367	0.196
Instruments	11	9	11	11
Observations	207	207	207	207
Number of countries	11	11	11	11

Standard errors between parentheses
*** significant at 1% level;
** significant at 5% level;
* significant at 10% level.
Source: Authors' estimates.

Finally, to provide consistency to the GMM estimator, the instruments used in the model must be valid. In this sense, Arellano and Bond (1991) suggest two tests: (i) the Sargan test, whose null hypothesis is that the instruments are over-identified; and (ii) the

autocorrelation test, to verify whether the differentiated error presents a second-order autocorrelation.

The generated estimates crucially depend on the validity of the instruments used to identify endogenous variables. To verify this, the Sargan test was carried out to check the joint validity of the instruments used. Failure to reject the test's null hypothesis indicates that the instruments used are robust. Thus, the tests for the six models indicate that the restrictions used are valid. The serial autocorrelation test examines the hypothesis that the error term is not serially correlated. More specifically, it is tested whether the differentiated error term is serially correlated in the second order (by construction, the differentiated error term is probably serially correlated in the first order, even if the original error term is not). The tests indicate that the null hypothesis of no second-order serial correlation in the differentiated error term cannot be rejected.

Our results can be summarized as follows. The econometric tests validate our main hypothesis that the tendency towards real exchange rate overvaluation in developed countries, by reflecting their higher level of average productivity in the global economy, is not necessarily harmful to economic development. Yet, in developing countries in Latin America, the tendency towards overvaluation, observed in the period 2000-2019, can be interpreted as a by-product of their rigid inflation targeting regimes, whose framework is heavily centered on the objective of pursuing price stability vis-à-vis other objectives such as output growth and employment.

Empirical tests also show that, unlike Latin American countries, none of the developing countries in Asia, Europe, or even South Africa under IT have shown an overvaluation trend of their real exchange rate. In the case of Asia, this result is not surprising, since several studies have emphasized that the governments of these countries have been able to combine a more flexible inflation targeting regime with a floating but managed exchange rate regime, that is, one that manages a mix of instruments, such as interventions in the spot and future exchange markets, ad hoc capital controls, etc., aimed at preserving a competitive and stable real exchange rate in the long term (Gala, 2006, Rodrik, 2008). Yet, the European developing countries under IT have also been able to keep their currencies tendentially undervalued, and this ability could be explained by two reasons: first, differently from the Latin American developing countries, most of them (and also, South Africa) have IT regimes characterized by a more flexible framework (see Table 1); and second, as suggested by Belhocine et al. (2016), despite adopting floating exchange rates regimes, all of them make frequent interventions in the exchange markets

to preserve competitive real exchange rates and avoid overvaluation of their currencies. Since the 2008 global financial crisis, the IT regime has been criticized because it is based on the fundamental hypothesis that inflation is essentially a monetary phenomenon (Arestis and Sawyer, 2008a, Taylor, 2010). As the debate has not concluded on which monetary policy framework is more appropriate for ensuring price stability and sustained long-term economic growth, our empirical evidence suggests that Latin American developing countries under IT should mirror the experiences of Asian and European developing ones and pursue a more flexible monetary regime and use more instruments to control inflation as well as reducing the burden on the real exchange rate misalignment. For countries with very rigid IT, we suggest, in addition to fixing an inflation target more compatible with structural economic conditions, pursuing not only price stability but also output growth and full employment.

5. Conclusion and policy implications

The strategic role of keeping a competitive real exchange rate – that is, a domestic currency slightly undervalued to its long-term real equilibrium – for sustaining economic development and the catching up trajectory in developing countries is quite sound in the theoretical and empirical literature in development economics.

Yet, keeping a stable and competitive real exchange rate is not an easy task in a world of large capital movements. As stressed by Rey (2015), the behavior of the world's interest rate movements is highly conditioned and determined by the tendency of the US's Federal Reserve (Fed) interest rate. In the boom cycle, falling domestic interest rates (though relatively higher than external interest rates) tend to shift excessive capital outflows from the US to other countries and, therefore, to appreciate their domestic currencies. This is particularly damaging for developing countries, as overvaluation deteriorates the competitiveness of tradeable goods as well as generating large current account deficits. As evidenced by Botta, Yajima, and Porcile (2023), during periods of international economic boom (*bonanza*), large net capital flows (especially in the form of portfolio investments and international credit) to developing countries have led to a tendency for currency overvaluation and deleterious impacts such as consumption booms, loss of competitiveness in the manufacturing sector, and premature deindustrialization. Meanwhile, sudden massive capital outflows can arise in response to either the worsening of fundamentals or to an expected internal or external shock, followed by a sharp

depreciation of developing countries' exchange rates. Contrary to the Mundell-Fleming predictions, such depreciations generally translate into exchange rate overshooting that forces central banks to increase interest rates to deter capital outflows and inflation pass-through. This is proof that central banks' autonomy to fix basic interest rates is illusory. In countries using inflation targeting, which has become the by-product monetarist mantra for managing monetary policy, this lack of autonomy is much more pronounced, especially in those with very low flexibility in their IT.

Our analysis in this paper reaffirms the existing literature on the strategic role of keeping a competitive real exchange rate for economic development in peripheral developing countries. This is supported by our empirical evidence on the real exchange rate trend in countries using IT. By dividing the countries into groups, developing and developed, we were able to test our central hypothesis: developing countries with rigid IT frameworks tend to show an overvaluation trend of their currencies driven basically by a higher interest rate differential related to the US in a context of a high degree of openness to capital flows. This has been the case for Latin American developing countries.

In contrast, developing countries with a more flexible IT framework have been able to keep competitive real exchange rates and avoid domestic currency overvaluations – this has been the case in Asian and several European developing countries as well as in South Africa. In developed countries under IT, the overvaluation trend is not necessarily explained by the monetary regime, but by their high level of per capita income, which reflects, in turn, their high average labor productivity.

The consequence of the overvaluation trend in Latin American developing countries is to condemn them to lower dynamism and lower productivity growth in comparison to developed economies. [26] Recent studies As for developed economies, in contrast, their top position on the international monetary and financial hierarchy allows them greater monetary autonomy and the appreciation trend of their exchange rate reflects their relative higher productivity. These findings reaffirm Nassif, Feijó, and Araújo's

[26] According to the International Monetary Fund's World Economic Outlook Database (April 2023), the real GDP's average growth rate in Latin American countries was only 2.4% per year in the period 2000-2022, against 5.2% in emerging markets and developing economies as a whole, and 3.6% in the world.

(2020) conclusion according to which short-term macroeconomic policies in developing countries highly open to capital flows have long-term effects on growth dynamics.

Our study suggests some policy implications for developing countries under IT. Although IT has been criticized as an appropriate monetary policy for ensuring both price stability and full employment, especially since the 2008 global financial crisis, this theoretical debate has yet to come to a more conclusive outcome. Therefore, we suggest a toolkit for developing countries with a very rigid IT institutional structure (e.g., Brazil's): fixing an inflation target more compatible with structural economic conditions (i.e., not very low targets), pursuing both price stability and full employment (instead of only an inflation target), enlarging the time horizon for reaching the target to at least the medium run, and using a core inflation measure that captures the tendency of prices and disregards disturbances resulting from temporary shocks captured through the use of full indices, among others. It is worth stressing, however, that even these suggestions for the monetary framework cannot be sufficient for avoiding the overvaluation trend in the context of high external financial openness. Thus, the recommended toolkit could be complemented by ad hoc capital controls, a policy instrument no longer seen as a rebellious one even by the International Monetary Fund (IMF).

Some authors, like Yellen (2014), suggest that monetary policy can have exchange rate stability as one of its goals. The empirical evidence presented in this research showed that, when lacking an appropriate mix of intervention instruments in the exchange markets, the real exchange rate tends to appreciate and, despite its benefits for controlling prices, overvaluation can create many problems for developing economies. In this sense, the adoption of measures that allow for the management of the exchange rate and lead this variable to more appropriate levels inclined to economic growth is essential and should encompass the reduction of the interest rate, the purchase of international reserves, and the adoption of ad hoc capital controls.

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APPENDIX

Table A1 – Variable Description

Variable	Description	Source
INFLATION	Inflation rate.	IMF (2023).
GRI	Global risk index	Vision of Humanity (2023)
INTEREST	Policy interest rate.	BIS and National Central Banks
REER	Real effective exchange rate	
IC	Commodities prices	IMF (2023).
UCDP	Proxy for Global Conflicts calculated by *Uppsala conflict data program*	UCDP (2023).
RGDPCH	GDP per capita (a proxy for productivity)	Penn World Table