

## Is Inflation Targeting destabilizing? Lessons from Latin America

*A meta de inflação é desestabilizadora?  
Lições da América Latina*

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RESUMO: Este artigo argumenta que vários aspectos da estrutura produtiva e das políticas macroeconômicas dos países latino-americanos, quando combinados com a Regra de Taylor, podem produzir volatilidade excessiva do produto e um viés para a sobrevalorização da taxa de câmbio real. Com base em um modelo simples Demanda Agregada – Oferta Agregada, mostramos que este é um resultado provável quando: a) a elasticidade da taxa de juros real da demanda é baixa; b) as depreciações têm fortes efeitos contracionistas; e c) o repasse da taxa de câmbio é relativamente grande. Essas condições implicam que as depreciações são contracionistas e têm um forte efeito sobre a inflação.

PALAVRAS-CHAVE: Metas de Inflação; depreciações contracionistas; medo de flutuar.

ABSTRACT: This paper argues that several aspects of the productive structure and the macroeconomic policies of Latin American countries, when combined with a Taylor Rule, may produce too much output volatility and a bias towards real exchange rate overvaluation. Relying on a simple Aggregate Demand – Aggregate Supply model, we show that this is a likely outcome when: a) the real interest rate elasticity of demand is low; b) depreciations have strong contractionary effects; and c) the exchange rate pass-through is relatively large. These conditions imply that depreciations are contractionary and a have a strong effect on inflation.

KEYWORDS: Inflation Targeting; contractionary depreciations; fear of floating.

JEL Classification: E31; E52; E58.

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## INTRODUCTION

Inflation Targeting is the main game in Town. Nowadays, at least 37 countries around the globe use that policy regime.<sup>1</sup> When Inflation Targeting is operative, the central bank usually sets a basic rate and promises to adjust it to keep inflation under control. The main goal is to signal a commitment with price stability, to anchor expectations. When the official target is credible, the central bank can also smooth supply side shocks, for example by allowing a temporary deviation from the inflation target.

Although Inflation Targeting is considered a sound macroeconomic approach, some countries have failed to implement it successfully. The recent examples of Argentina and Turkey show that, despite the adoption of a fully-fledged Inflation Targeting regime, inflation remained above the targets. Inflation Targeting is highly resilient and very few countries have abandoned, but this was not the case in Argentina and Turkey, as the authorities eventually changed the policy framework.

This does not necessarily imply that Inflation Targeting is flawed. It is also possible that some of preconditions for its success were not met, for example the absence of fiscal dominance. Sometimes governments conduct a reasonable fiscal policy, but there are other complications that limit the effectiveness of monetary policy as a stabilization tool. In some other instances, Inflation Targeting seems to work reasonably well, but a closer inspection shows that the Taylor Rule needs to be complemented with “unconventional” policy tools, somehow deviating from the main script (see for example, Céspedes et al., 2014). In fact, the number of macroprudential policies in countries that use Inflation Targeting has been growing steadily (see BIS, 2019, chapter 2) and institutions such as the BIS or the IMF are starting to consider a valuable tool that can complement traditional stabilization policies (BIS, IMF and FSE, 2016).

The goal of this paper is to shed light on the lack of effectiveness of Inflation Targeting in some Latin American, countries considering a specific problem: contractionary effects from depreciations. Relying on a simple Aggregate Demand – Aggregate Supply model, we depart from the conventional framework by exploring the effects of the presence of contractionary and strongly inflationary effects from exchange rate depreciations. The main take-home point is that Inflation Targeting combined with a fully open capital account and flexible exchange rate regime can destabilize output and inflation. Instability is more likely when: a) the real interest

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<sup>1</sup> Agenor and Luiz Pereira da Silva (2019, chapter 2, page 19) count 37 cases between 1990 and 2016. The full list includes: New Zealand (1990), Canada (1991), United Kingdom (1992), Australia (1993), Sweden (1995), South Korea (1998), Czech Republic (1998), Poland (1999), Brazil (1999), Chile (1999), Colombia (1999), South Africa (2000), Thailand (2000), Mexico (2001), Norway (2001), Iceland (2001), Hungary (2001), Peru (2002), Philippines (2002), Guatemala (2005), Uruguay (2005), Indonesia (2005), Romania (2005), Turkey (2006), Armenia (2006), Ghana (2007), Israel (2007), Albania (2009), Serbia (2009), Georgia (2009), Moldova (2010), Paraguay (2011), Uganda (2011), Japan (2012), Russia (2015), India (2015), Argentina (2016).

rate elasticity of demand is low; b) depreciations have strong contractionary effects; and c) the exchange rate pass-through is relatively large. These factors are prominent among Latin American countries with poorly developed financial systems and a long history of nominal volatility.

The rest of this paper is structured as follows. Second section presents a review of the related literature. Third section comments on some recent Latin American case studies and formulates a baseline model that is analyzed mainly using graphical tools. Fourth section discusses the model, considering the exchange rate cycles that are typical in Latin America. The last section concludes.

## LITERATURE REVIEW

This section comments on the literature. Today's most popular macro model is the so-called *New Consensus Model*, which combines contributions from New Classical and New Keynesian economics. In these traditions, macroeconomic relations are derived from "first principles", output and employment gravitate towards their equilibrium levels and money is neutral in the long-run.

The *New Consensus Model* is a variant of the Aggregate Demand – Aggregate Supply model, and it includes an IS curve, a monetary policy rule, and an expectations-augmented Phillips Curve (see for instance, Carlin and Soskice, 2015). The main novelty vis-à-vis the old approach is the idea that DSGE models can be constructed by little or no reference to the money supply. The profession eventually produced a consistent model based on a monetary policy rule that does not include money at all, but with explicit microfounded (Galí, 2008; Woodford, 2003).

It was often believed that monetary policy rules based on targeting an interest rate create instability (Sargent and Wallace, 1975), but the implicit assumption was that the nominal interest rate is held constant. In standard DSGE models, a monetary policy rule that satisfies the "Taylor Principle" (Taylor, 1993) can ensure that the rate of inflation is stabilized, and the economy will converge to a unique equilibrium. The intuition is that the central bank should react to changes in inflation by increasing or decreasing the target interest rate by more. Otherwise, the real interest rate will fall (increase) when there is a positive (negative) demand shock, in a destabilizing fashion.

An important question is how stabilization policy should be conducted (Benigno and Woodford, 2003; Schmitt-Grohé and Uribe, 2004a, 2004b, 2006). The classical problem is "time inconsistency", which typically arises when there is a tension between the conduct of fiscal and monetary policies, for instance if due to the presence of distortionary taxation output is low, so the central bank has an incentive to pursue an "opportunistic" monetary expansion. It is known that a time consistent solution can be achieved via some precommitment to specific policies (Perssons et al., 2006). An appealing solution is to delegate monetary policy to an independent central bank, which for instances plays by the rules of Inflation Targeting.

Most models that describe how Inflation Targeting operates usually assumes

a Ricardian, namely a passive, fiscal policy. In other words, the budget constraint of the government is satisfied for all price paths (see Woodford, 2003). The terminology “passive” and “active” follows the contribution of Leeper (1991). The empirical literature does not necessarily support the assumption that fiscal policy is passive (see for instance, Muscatelli et al., 2004), others have suggested that the entire path of fiscal surpluses and deficits is enough to pin down the price level and inflation (Cochrane, 2001).

Post-Keynesian authors have embraced the *New Consensus Model* to criticize it. While some of them believe that the central bank should not stabilize the economy using monetary policy, others consider that a short-term interest is a valuable counter cyclical tool, but only when it is complemented with other policies (Rochon and Setterfield, 2007).<sup>2</sup> The main difference between the standard *New Consensus Model* and the Post-Keynesian version is that the former considers that there is no unique NAIRU or natural rate of unemployment, that exist independently of the past evolution of aggregate demand (Michl, 2018).

In its different incarnations, the literature on Inflation Targeting often assumes that opening the economy hardly changes the big picture. Indeed, there is some discussion on whether the central bank should intervene in the foreign exchange market (see Ball, 1999), and the consensus seems to be that the central bank should not have an explicit exchange rate target, but it should take its evolution into account in order to stabilize inflation and output (Edwards, 2006). However, this literature assumes that devaluations are always expansionary, even in the short-run (Galí and Monacelli, 2005). It is known that this is not always the case (see Bahmani-Oskooee and Mitez, 2003).<sup>3</sup>

Does Inflation Targeting always work? The theoretical literature has shown that in many instances it does not. The best-known example is the so-called zero lower bound that constraints monetary policy. When the central bank is unable to cut the monetary policy rate, despite deflationary pressures, output and employment may persistently deviate from full-employment levels (Benhabib et al., 2001). Other complications can easily arise. For example, Calvo (2016) argues that when liquidity considerations affect potential output, the central bank treat to increase the real interest rate to control inflation may not be fully credible. Consequently, Inflation Targeting may fail to work smoothly and inflation may lie persistently above or below the target (see also Calvo, 2017). In the presence of liquid bonds, the Taylor

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<sup>2</sup> From this second group, some authors have even claimed that Post-Keynesian economics is fully compatible with Inflation Targeting (Setterfield, 2007; Tadeu Lima and Setterfield, 2008; Mota dos Santos, 2011).

<sup>3</sup> The traditional contractionary depreciation hypothesis put forward by Díaz-Alejandro (1965) and Krugman and Taylor (1978) relied on the effects of devaluations on income distributions, but the modern literature have emphasized the presence of balance sheet effects due to liability dollarization. The contractionary depreciation hypothesis was developed during a period where fixed or semi-fixed exchange rates were the norm. But the contractionary effects can easily be added to an otherwise standard IS-LM-BP model (see Céspedes et al., 2003).

Principle fails when prices are perfectly flexible, but it is completely irrelevant in the sticky prices case.

In a similar vein, the presence of “chronic inflation” may produce a slow converge of expected inflation to the target, possibly with some important output costs, thus rendering Inflation Targeting an ineffective mechanism to achieve disinflation (Calvo, 2017). This is not surprisingly, given that Inflation Targeting works mainly as a “lock-in” mechanism to kept inflation in check, once it was reduced by a more compressive stabilization policy (Di Tella, 2019).

Libman (2018a) shows that when depreciations have short-run contractionary effects on output and employment, a standard Taylor Rule will destabilize output and inflation.<sup>4</sup> In a similar vein, Blanchard (2004) argues that if public sector debt is large enough (which implies fiscal dominance), an increase in the real interest rate may lead to an increase in the likelihood of default, triggering an exchange rate depreciation which increases inflation, in a perverse fashion.<sup>5</sup>

Does Inflation Targeting reduce inflation with little output costs costs or without an increase in output volatility? Taylor (1994) develops an analysis of the inflation - output volatility trade-off, which exists due to the slow adjustment of prices. The monetary policy regime can determine where on the trade-off curve the economy lies: more stable output usually involves less stable inflation, while more stable inflation implies less stable output. It is often argued that Inflation Targeting reduced both output and inflation volatility (i.e., the tradeoff curve shifts towards the origin). But as shown by Ball and Sheridan (2003), the adoption of Inflation Targeting does not seem to affect macroeconomic outcomes in OECD countries. After the early 1990s, performance improved all over the world and in some of the targeters inflation decreased by a larger amount. However, this difference is explained by the fact that targeters performed worse than non-targeters before the early 1990s. Once we control for the presence of regression to the mean, there is no evidence that Inflation Targeting matters.

In a related contribution, Mishkin and Schmidt-Hebbel (2007) suggests that Inflation Targeting helps countries achieve lower inflation in the long run, have smaller inflation response to oil-price and exchange-rate shocks, strengthen monetary policy independence, improve monetary policy efficiency, and obtain inflation outcomes closer to target levels. At least some of the benefits of Inflation Targeting are larger when inflation targeters have achieved disinflation and are able to make their inflation targets stationary. However, the favorable results for inflation does not suggest that countries that have adopted Inflation Targeting have attained better performance relative to a control group of highly successful non-inflation targeters.

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<sup>4</sup> We stick to the following convention: the exchange rate is the number of units of domestic currency per unit of dollars, so a reduction in the exchange rate is an appreciation, while an increase is a depreciation.

<sup>5</sup> According to Blanchard (2004), his argument represents the macroeconomic environment of Brazil during 2002-2003.

A contribution of Blanchard and Galí (2007) shows that when there are no real rigidities and no supply side shocks, stabilizing output is equivalent to stabilizing inflation. This is the so-called “Divine Coincidence”. Thus, when the main source of fluctuations are demand shocks and the labor market does not display any rigidities, an Inflation Targeting regime can easily stabilize inflation with no output cost. However, in the presence of supply side shocks, Cecchetti and Ehrmann (2002) explains that Inflation Targeting may increase output volatility, because central banks are usually less tolerant to inflation volatility than to output volatility.

To summarize, the literature argues that Inflation Targeting can anchor inflationary expectations with little or no output cost, perhaps barring some special cases and provided if there is coordination between fiscal and monetary policies. When these preconditions are met, the literature argues that Inflation Targeting may improve the output – inflation volatility trade-off, although some empirical papers cast some doubts.

## INFLATION TARGETING IN LATIN AMERICA

The so-called “Second Globalization” allowed Latin American countries to adopt several reforms that involved the removal of trade barriers, the deregulation of domestic labor and goods markets, and the liberalization of the domestic financial system and the capital account of the balance of payments. These policies were very often implemented in conjunction with stabilization packages, in desperate attempts to control inflation. Most of these packages included a fixed or semi-fixed exchange rate regime and ended in a spectacular collapse. In the initial stages, economic activity soared, as the massive influx of short-term capital in a context of a slowly declining inflation, led to a reduction in interest rates and an appreciation of the real exchange rate (Taylor, 1998). Eventually, those packages led to a currency crash and most of the time to severe financial crisis.

After the demise of fixed exchange rate regimes during the late 1990s and the early 2000s, Latin American countries switched to a combination of Inflation Targeting and more flexible exchange rate arrangements. The capital accounts of the balance of payments remained relatively open, but some countries adopted macroprudential regulations to cushion volatile capital flows. The main case studies in the region are Brazil, Chile, Colombia, Mexico, and Peru. While Chile and Colombia started to target inflation in 1991, they formally adopted Inflation Targeting during 1999, the same year as Brazil. Mexico and Peru followed in 2001 and 2002.<sup>6</sup>

The outcomes were certainly better than in past in many regards (i.e., crises were avoided), but the evolution of output, employment, inflation and income distribution varied. The international context and the specific policies adopted by

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<sup>6</sup> Other countries in the region adopted Inflation Targeting, including Uruguay (2005), Guatemala (2005), Paraguay (2011), and more recently, Argentina (2016-2018).

each country affected the outcomes in a significant way, including the group that adopted Inflation Targeting. To evaluate policies, several features of Latin American economies should be considered, including for instance: a) more flexible exchange rate regimes than in the past; b) more open capital accounts (and more liberalized domestic financial systems) than in the past; c) a low real interest rate elasticity of demand;<sup>7</sup> d) the presence of contractionary effects from currency depreciations; and e) a significant pass-through from exchange rate to prices (albeit it seems to have fallen recently, see Ghosh, 2013).

Traditional demand and supply shocks may have different effects, and when the central bank targets inflation very aggressively (disregarding the output-gap) too much volatility of output and employment may follow. Moreover, although the Taylor Rule may include both inflation and output, the omission of the latter is not uncommon in the Latin American context. According to Moura and Carvalho (2010) only a few central banks seem to care about output fluctuations (mainly Chile), and one of them does not use Inflation Targeting. Moreover, some of the estimations reported by Libman (2018b) show little effect of the output gap on the reaction functions of the central banks in Brazil, Chile, Colombia, Mexico and Peru. Ros (2015) confirms this result for Mexico, but Dancourt (2015) finds otherwise for Peru.

The main intuition can be summarized as follows. Suppose there is a positive demand side shock that triggers inflationary pressures (for instance employment expands and wages tend to increase). The reaction function of the central bank will imply an increase in the real interest rate. With an open capital account and a flexible exchange rate regime, this will trigger a nominal and a real exchange rate appreciation. Due to the contractionary effects of depreciations, an appreciation will expand demand even more. This will reinforce the original demand shock, although if the pass-through from exchange rates to prices is large enough, inflation will be kept in check.

Consider next a negative supply side shock, which reduces output and increases inflation. If the central bank is concerned mainly with price stability, an increase in the real interest rate is required. This will counteract the original negative shock, as the real exchange rate appreciates reducing inflationary pressures, but it will also trigger an expansion of demand (which adds further inflationary pressures). Thus, the real exchange rate will keep appreciating until inflation is equal to the target. However, the overall effect is an expansion of output and employment, and provided that the central bank is only concerned with price stability the story ends there.

The case studies in Latin America illustrate some of these complications. As documented by Montane et al. (2020), Inflation Targeting performed worse in Brazil

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<sup>7</sup> Due to a relatively low level of financial intermediation, the credit channel of monetary policy is rather weak (compared for instance with the exchange-rate channel). As a result, in Latin America (perhaps with the exception of Chile) aggregate demand has always been rather insensitive to changes in interest rates (see Barbosa-Filho; 2008; Frenkel, 2008, and Galindo and Ros, 2008).

and Mexico. In contrast, it seemed to work well in Peru,<sup>8</sup> and to a lesser extent, in Chile and Colombia. Interestingly, they found that depreciations are short-run contractionary in Brazil and Mexico, and the pass-through from exchange rate to prices seems to be more important (albeit to a lesser extent in Mexico). Likewise, a study by García Lázaro and Perrotini (2014) that show that Inflation Targeting succeed in Latin America by creating pressures towards exchange rate appreciation, captures very nicely similar concerns. More precisely, it shows that some countries of the region are still relying on exchange rate changes to keep inflation in check, and this may have significant implications for the evolution of output and employment under Inflation Targeting.

Consider the Brazilian case. The central bank struggled to maintain inflation inside the band. When the exchange rate depreciated, it missed the target, and when the target was met, the exchange rate appreciated. Moreover, during the expansion phase (2003-2010), there was a nominal and real exchange rate appreciation (Barbosa-Filho, 2015; Serrano and Summa, 2015). A plausible reason is that exchange rate depreciations have contractionary and inflationary effects (see Summa, 2016). Mexico also had trouble in sustaining economic growth, although the inflation rate remained inside the band. In both countries the central banks seem to feel unsafe when the exchange rate tends to depreciate, but they welcomed exchange rate appreciations, presumably due to their expansionary and anti-inflationary effects.

Argentina illustrates the destabilizing effects of Inflation Targeting, when combined with an open capital account and a flexible exchange rate regime. During the 2000s the economy boomed, but inflation accelerated. The domestic currency become increasingly overvalued and to avoid a large depreciation, the authorities have imposed restrictions on the sales and purchases of foreign exchange in 2011. After a period of stagnation, the government elected in 2015 removed the foreign exchange controls, implemented a large depreciation and adopted Inflation Targeting plus a flexible exchange rate regime. Unfortunately, the targets were extremely ambitious and failed to take into account the presence of inertial inflation. Thus, the large depreciation that took place at the end 2015 resulted in a contraction of output with higher inflation during 2016. In 2017, inflation stabilized, the real exchange rate appreciated slightly induced by an increase in short-term capital flows that were attracted by the high interest rate, and output expanded. In the 2018, there was a reversal of the inflows and the exchange rate collapsed, resulting in another round of output contractionary with additional inflationary pressures. The government resorted to the IMF and Inflation Targeting was abandoned.

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<sup>8</sup> The Peruvian financial system is highly dollarized, but nevertheless Inflation Targeting seems to work smoothly. On top of the very favorable prices for metals and a mining boom, the central bank complemented a monetary policy rule with two other tools: reserve requirements for domestic and foreign currency denominated liabilities and systematic interventions in the foreign exchange market. Moreover, the central bank reaction function seems to include the output-gap (Dancourt, 2015 and 2017). Dollarized economies do not tolerate large exchange rate fluctuations, due to the strong balance sheet effects, which imply, among other things, that depreciations are probably contractionary.

To summarize, the adoption of Inflation Targeting in Latin America was associated with a reasonable improvement in performance in terms of output and inflation (at least in some countries), and there was some room for improving income distribution, a reduction of poverty, and so on (Moreno-Brid and Garry, 2016). However, the characteristic of most of the economies in the region suggest that the reaction to different shocks could be different than in developed and other emerging and low-income incomes.

Some Latin American countries are still relying on exchange rate appreciations to keep inflation inside the bands. This can only work if the international context allows the authorities to let the exchange rate to appreciate, and there could undesirable consequences when the exchange rate increases.

## A model

In this section we laid out a simple Aggregate Demand – Aggregate Supply model, to illustrate some possible destabilizing effects of Inflation Targeting. To keep things as simple as possible, and for comparison purposes with the New Consensus Model, we stick to a very basic framework. Imagine an open economy that produces an imperfect substitute of the single homogeneous good that can be traded or used for domestic purposes (i.e., consumption and investment), and where output is demand determined, at least in the short-run.

Demand for the domestic good depends on the real interest rate and the real exchange rate, as well as on some other factors. Employment depends positively on demand, and assuming a constant labor productivity, and setting it equal to one, we can loosely identify output with employment. The inclusion of the real exchange rate in the output equation can be explained in different ways and can be associated with several effects. For example, it can be associated with the traditional substitution effects that make depreciations expansionary (by increasing exports and reducing imports), but also with the re-distributive effect and the balance sheet effect (which can make them contractionary). Additionally, a currency depreciation may affect inflation if worker's cost of living depends on the price of imported goods.

It is often presumed that a higher (lower) real interest rate and a lower (higher) real exchange rate will cut demand. If the capital account of the balance of payments is sufficiently open, a higher real interest rate will also create a pressure towards real exchange rate appreciation. Hence, when monetary policy is tight, demand falls both because the direct effect on the real interest rate, but also due to the indirect effect on the real exchange rate. It follows that if the central bank targets inflation using a Taylor Rule, it can succeed in stabilizing the economy after a demand shock: excess demand for goods will be counter with a higher real interest rate and a real exchange rate appreciation. But it is often the case that depreciations have short-run contractionary effect, and thus the real exchange rate appreciation will increase aggregate demand. In this scenario, a tight policy creates two opposite effects on output: a contractionary effect due to the higher real interest rate, and an expansionary effect due to the lower level of the real exchange rate. This is the main intuition behind our story.

Let us proceed to present the model. The specification is kept as simple as possible and all the main variables (output, inflation, the real exchange rate and the real interest rate) are defined in logarithms (except for interest rates and inflation) and as “deviations from equilibrium”. A similar effect can be accomplished by normalizing the equilibrium level of all the variables to one (and their logs to zero). Thus, output is also the output gap, inflation is also the deviation from the inflation target, the real interest rate is also its deviation from the natural rate, and the real exchange rate is also the real exchange misalignment.

More precisely, let demand  $y$  is a function of the real interest rate  $r$ , the real exchange rate  $Q$ , and some shocks  $u$  (i.e., fiscal policy, animal spirits, foreign demand, and so on):

$$(1) \quad y = \beta_1 r + \beta_2 Q + u$$

with  $\beta_1 < 0$ ,  $\beta_2 > 0$  or  $\beta_2 < 0$ , and  $u \sim N(0, \sigma_u^2)$ . Notice that, once the zero mean shock dies out,  $r = 0$  and  $Q = 0$ , so the output gap vanishes  $y = 0$ .

The dynamics of inflation depend on output, the real exchange rate, and some shock  $x$ . This is an open economy version of the Phillips curve:

$$(2) \quad \pi = \delta_1 y + \delta_2 Q + x$$

with  $\delta_1 > 0$ ,  $\delta_2 \geq 0$  and  $x \sim N(0, \sigma_x^2)$ . Notice that we allow for the case where exchange rate shocks do not affect inflation (i.e.,  $\delta_2 = 0$ ). In our set-up,  $x$  can account, for instance, for the presence of changes in workers’ militancy or other supply side shock. If the real exchange rate is in equilibrium and the output gap is zero, inflation is equal to the target or  $\pi = 0$ .

The equations (1) and (2) conform an aggregate demand – aggregate supply framework, given the real rate and the real exchange rate. To complete the model, we need to spell-out how  $r$  and  $Q$  are determined. Under Inflation Targeting, the central bank sets the real rate as a function of inflation and output.<sup>9</sup>

$$(3) \quad r = \alpha_1 \pi + \alpha_2 y$$

with  $\alpha_1 > 0$  and  $\alpha_2 > 0$ . When inflation and output are equal to their equilibrium levels, the real interest rate is equal to the natural rate or  $r = 0$ .

To model the behavior of the real exchange rate, the literature on Inflation Targeting usually assumes a relatively open capital account and a flexible exchange rate regime. In this type of set-up, the real exchange is a negative function of the difference between the domestic and the international real interest rate, which we assume is equal to the domestic natural rate (and consequently also equal to zero):

$$(4) \quad Q = \tau r + v$$

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<sup>9</sup> The central banks set the nominal rate in order to set the real rate at a desired level. If we instead assume that the central bank targets the real rate, the main take home points are still valid.

with  $\tau < 0$  and  $v \sim N(0, \sigma_v^2)$ . Notice the parameter  $t$  measures the effect of monetary policy on the level of the real exchange rate, so it implicitly captures factors such as the degree of capital account openness and how flexible is the exchange rate policy. For instance, a central bank that limits capital mobility or that it engages in sales and purchases of foreign exchange, will be represented by a low size of  $\pi$ . This parameter will play an important role in the model, as it governs how fast the real exchange rate converges to its equilibrium level. When the real interest rate is equal to the natural rate and the shock dies out, the real exchange rate misalignment vanishes or  $Q = 0$ .

The terms  $u$ ,  $v$  and  $x$  are errors terms with zero mean and constant variance. They represent a demand, supply, and an exchange rate shock. For simplicity, we assume that the central bank fully controls the real interest rate, so there is no shock term in equation (3).

In the following analysis, we assume that full employment output remains constant barring the supply side shocks with a zero mean, so the central bank presumably can stabilize both  $y$  and  $\pi$ . We are aware that some of these equilibrium concepts have been questioned by the literature (output, the real interest rate and the real exchange rate), but we assume them to be exogenously determined to obtain a simplified model. Our goal is to highlight how the destabilizing forces operate, even if potential output, the natural rate of interest, and the equilibrium real exchange rate, are well defined and known by the central bank. The presence of path-dependence will over complicate the set-up without adding interesting insights. The interested reader may want to consult the literature reviewed in the second section.

Now we can analyze the effect of different shocks. We consider a positive demand-side shock and a negative supply-side shock, but we should keep in mind that because the model is linear, a similar logic applies to negative demand-side and positive supply-side shocks. We consider three cases: i) expansionary depreciations ( $\beta_2 > 0$ ) and very low pass-through from the exchange rate to prices ( $\delta_2 \approx 0$ ); ii) contractionary depreciations ( $\beta_2 < 0$ ) and very low pass-through from the exchange rate to prices ( $\delta_2 \approx 0$ ); and iii) contractionary depreciations ( $\beta_2 < 0$ ) and a significant pass-through from the exchange rate to prices ( $\delta_2 > 0$ ).

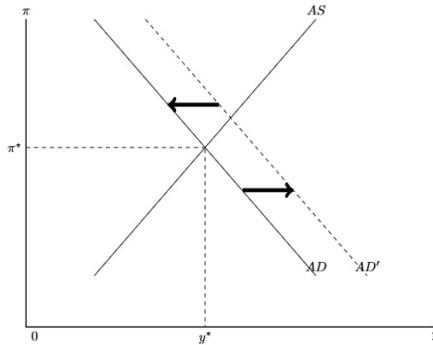
Although the full solution of the model and the behavior of the economy when there are deviations from equilibrium requires a more complex formulation, we intuitively explore in some detail a plausible dynamic considering the response of the central bank. To keep things simple, we reason step by step, but a more realistic model can easily include lags.

## Demand-side shocks

We now illustrate how the model works after a positive demand shock. Consider Figure 1, which illustrates the effect of an exogenous shock that shifts the AD curve out (i.e., an increase in  $u$ ). In the standard case depreciations are expansionary. When Inflation Targeting is operative, the central bank should increase the real

interest to off-set the shock, so the AD curve shifts back, both because of the higher real rate, but also because of the appreciation of the real exchange rate that results. Assuming that the effects of changes in the real exchange rate on inflation are very small, the AS will hardly move (we assume it remains fixed to simplify).

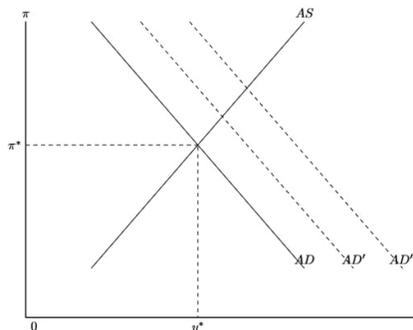
Figure 1: Effect of a Demand Shock. Standard case



This is the more favorable scenario for a central bank in a small open economy: demand shocks can easily be off set by monetary policy, provided that the effect of the real exchange rate appreciation does not move output in the opposite direction (and as we will see, if the effects of the real exchange rate on inflation are mild). This is an open economy version of the “Divine Coincidence”.

A more complex scenario is depicted in Figure 2. This figure shows the strongly contractionary depreciation case, assuming once again no effect of the real exchange rate on inflation. After the shock, the AD curve shifts out to AD'. But if the central bank increases the real rate, the real exchange rate appreciates. If the positive effect of the real exchange appreciation on demand is stronger than the negative effect of a higher real rate, then the AD shifts out even more to AD''. Thus, both output and inflation are destabilized if the authorities follow a standard Taylor Rule.

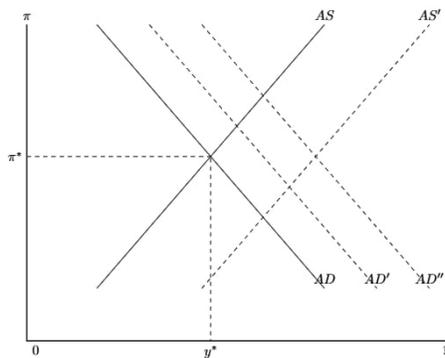
Figure 2: Effect of a Demand Shock. Strongly contractionary depreciations case



The critical condition to obtain the case represented in Figure 2 is given by  $|\beta_1| < |\beta_2\tau|$ . In other words, when the effect of the real rate on demand is stronger than the effect of the real rate on demand that operates through the real exchange rate; notice that a high degree of capital account openness and a highly flexible exchange rate policy, combined with contractionary effects from depreciation, make the verification of the condition more likely. When  $\beta_2 > 0$ , because  $\tau_2 < 0$ , a higher real rate always cut demand, but if  $\beta_2 < 0$  (which implies contractionary depreciations), a higher real rate may increase demand. Notice that this will imply that the divine coincidence is no longer valid. However, and even if  $|\beta_1| > |\beta_2\tau|$ , so the total effect on demand is negative, the presence of contractionary effects from depreciations somehow weakens the transmission mechanism of monetary policy. Because the total effect of a change in the real rate on aggregate demand is much lower than when depreciations are expansionary, after any shock that requires a change in monetary policy, the central bank will need to change the interest rate very aggressively. In other words, the link between output and inflation becomes much more tenuous and this may challenge the implementation of Inflation Targeting if for some other reason large increases in the real interest rate are undesirable.

Figure 3 shows the effects of the same shock as before, assuming contractionary depreciations, but also including the effects of the real appreciation on inflation. As the real exchange rate appreciates, the AS curve shifts out: cheaper imports will lower inflation, and thus output increases even more after the same shock. In this case inflation is stabilized, but at the cost of excessive output fluctuations. If the Taylor Rule does not include output or if the weight of output on the reaction function of the central bank is low, real volatility may increase by the adoption of Inflation Targeting, as suggested by Cecchetti and Ehrmann (2002).<sup>10</sup>

Figure 3: Effect of a Demand Shock. Strongly contractionary depreciations case with supply side effects



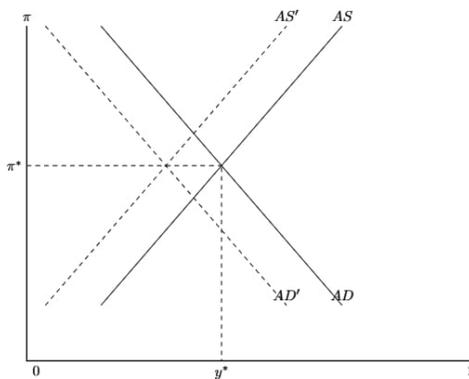
<sup>10</sup> Alternatively, the authorities may want to focus on core inflation. Naturally, to explain what would happen in that case we need a more complex model.

To summarize, in the standard case, inflation and output are stabilized after a demand shock. The central bank should increase the real rate to cut demand, and to restore both the full-employment level of output as well as the inflation target. But once we include non-standard effects on demand and supply the Taylor Rule may not be enough to off-set even the simplest demand shocks.

### Supply-side shocks

In this subsection we illustrate the effects of a supply side shock. Figure 4 shows the standard case after a negative supply shock, which leads to an inward shift of the AS curve. Because inflation is above the target, the central bank increases the interest rate, despite the fall in output. There is a trade-off between output and inflation after a negative supply side shock.

Figure 4: Effect of a Supply Shock. Standard case



Here we assume that the central bank is more concerned about deviations of inflation from the target and does not attempt to stabilize output. However, if the public believes that the target will be met eventually, it is possible to spread the cost of the output shock over time. This can be accomplished in different ways. For example, the inflation target is usually band and inflation should remain inside in a pre-defined time horizon. Thus, if the supply shock is transitory, a credible monetary policy can easily avoid the repercussions of the demand shock, and we will only observe the shift of the AS curve, with no additional contractionary effects from monetary policy. This is a standard theme in the literature.

Notice what happens when we allow for contractionary effects. Figure 5 shows that when depreciations reduce output, hiking the rate will result in an appreciation of the real exchange rate. Assuming a very low pass-through, this effect may expand demand and will have additional inflationary effects. This is a very unpleasant scenario for the central bank, because inflation remains above the target. Output, however, remains stable, thanks to the expansionary effects of the real exchange rate appreciation. If the central bank is solely concerned with inflation, it will prob-

ably keep increasing the real interest rate, but this will keep shifting the AD curve in the wrong direction in a destabilizing fashion.

Figure 5: Effect of a Supply Shock. Strongly contractionary depreciations case

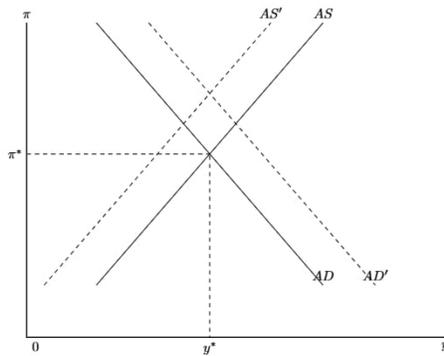


Figure 6 shows the case when depreciations are both contractionary and inflationary. After the supply-side shock, because inflation accelerates and the central bank increases the rate, the real exchange rate appreciates. Because the real exchange rate appreciation exerts a strong positive effect on demand, output increases. Inflation, however, is partially stabilized, as the real appreciation cuts inflation. Thus, if the central bank is extremely concerned about inflation, and it does not care at all about output, it will need to increase the real interest rate even more, shifting the AS curve until inflation reaches the target. Even an output expansion may follow in a desperate attempt to curtail inflation. This is shown in Figure 7.

Figure 6: Effect of a Supply Shock. Strongly contractionary depreciations case with supply side effects

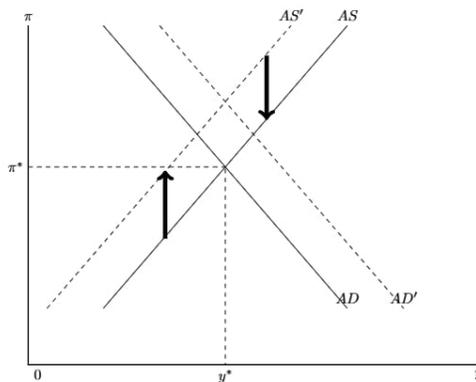
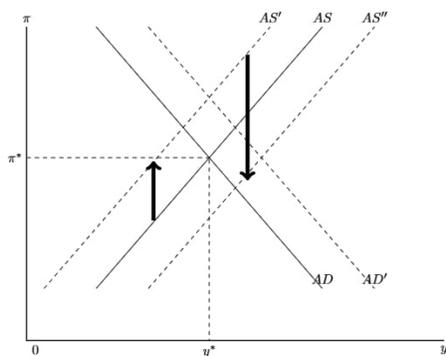


Figure 7: Effect of a Supply Shock. Strongly contractionary depreciations case with supply side effects when the central bank disregard output



To summarize, supply shocks create a trade-off for monetary policy. This is well-known by policy makers, and it is reflected in the literature. Here we have shown that the presence of contractionary depreciations will difficult the correct implementation of monetary policy, as the variables may change in unexpected ways. The central bank may succeed in achieving the stabilization of inflation, but this could come at the of increasing output volatility.

### Exchange rate shocks

The exchange rate shocks will affect the economy, on impact, differently, depending on the nature of depreciations. Consider the standard case, where depreciations are expansionary and the inflationary effects are negligible. This case mimics the effect of a demand shock (Figure 1). After a positive shock, the central bank increases the real rate, so both output and inflation are stabilized.

When depreciations are contractionary, the logic is reversed. An increase in the real exchange (a positive shock) operates like a negative demand shock. If the inflationary effects are strong, a depreciation will shift the AD curve in the direction of lower output, and the AS curve in the direction of higher inflation. But notice this is easily reversed by an increase of the real interest rate. Afterwards, both curves shift back to their original position.

Offsetting exchange rate shocks in the standard case is relatively straightforward. What happens when depreciations are contractionary? After a real depreciation that cuts aggregate demand, the central bank will react by lowering the real rate, destabilizing output. If the exchange rate shocks have strong effects on inflation, then the central bank will react by increasing the real interest rate. This will off-set the effects on inflation, but it will destabilize output.

The previous sub-sections have shown some unpleasant side effect of Taylor Rule when depreciations have contractionary and inflationary effects. A central bank that is extremely concerned with inflation may produce too much output and employment instability, even in the presence of demand shocks. However, this may not be perceived as a problem, as long as output and employment expand. Consequently, the presence of these effects suggests that the central banks in Latin American may favor certain developments in foreign exchange market, and intervene to avoid others. In particular, exchange rate appreciations are typically deemed to be a positive thing.

Indeed, although the exchange rate regimes are de facto much more flexible than in the past, the central banks in the region intervened heavily in the foreign exchange market to cushion large movements in the exchange rate (Chang, 2008). There are good reasons to believe that this type of intervention was not implemented during episodes of appreciations and depreciations with the same intensity. It is often observed that central banks fight excessive exchange rate volatility, but that they are also willing to tolerate some types of exchange rate fluctuations. A typical case involves interventions to avoid exchange rate depreciations, but little effort to combat appreciations.

For example, authors such as Barbosa-Filho (2015), Bresser-Pereira and Gomes da Silva (2008) and Ros (2015) have argued that the central banks of Brazil and Mexico have conducted an asymmetric monetary policy, tightening too much when the economy is booming, and softening too little when deflationary pressures arise. Because the capital account of the balance of payments was extremely open, the implied changes in the interest rate triggered movements in the exchange rate biased in the downward direction. Thus, in addition to the destabilizing effects on output, Inflation Targeting may create excessive volatility of the real exchange rate and an overvaluation bias: the real exchange rate tends to appreciate too much during the up-swing and the central may display “Fear of Floating” (Calvo and Reinhart, 2002).

Libman (2018b) documents this asymmetric nature of monetary and exchange rate policies in the main Latin American Inflation Targeting countries. The overall picture thus suggests that “fear of depreciations” was more likely in Brazil and Mexico, the Chilean central bank seems to have the most flexible exchange rate regime of the five, while the overall picture is mixed for Colombia and Peru.<sup>11</sup>

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<sup>11</sup> Using non-linear econometric techniques, Libman (2018b) tests whether the central banks from these countries were more willing to tolerate appreciations than depreciation, for the period 1999-2015. In Brazil and Mexico exchange rate changes seems to be anchored by an asymmetric band with a lower threshold larger than the upper threshold. In the five countries appreciation were more persistent than depreciations, with the sole exception of Peru, where both appreciations and depreciations were relatively short-lived (i.e., if the exchange rate was appreciating, a depreciation will follow soon, and so on). In Brazil, Mexico and Chile, appreciations were also a highly persistent phenomenon. In all the cases, with the sole exception of Chile, reserve accumulation seems to react to exchange rate

Asymmetric behavior may have implications for macroeconomic stability. For example, the economy may adjust poorly, depending on the signs of some shocks. Thus, a negative real shock (i.e., a fall in the terms of trade) that requires an increase in the real exchange rate (a higher relative price for tradable goods) may not be possible if non-tradable good prices are “sticky” and if the central bank is willing to off-set depreciations. But if the shock has the opposite sign (an appreciation is required, for example is the terms of trade improve) then the economy may adjust smoothly. Alternatively, the presence of asymmetries may be a signal of some underlying problems: for example, in the literature on “fear of floating” the underlying reason to dislike depreciations was inflation. If countries that use Inflation Targeting display “fear of floating” then there are good reasons to believe that expected inflation is not well anchored by monetary policy.

The presence of “fear of floating” is related to the typical boom and bust dynamic that one can often find in Latin American countries. In the model that we developed there is a good reasons why central bank will welcome appreciations, but they will fight depreciations: the nature of the effects of exchange rates on inflation and output.

The evolution of inflation and output may depend on the size of the exchange rate fluctuations. For instance, Berganza et al. (2004, pp. 603-605) show that in times of crisis, when large depreciations usually take place, the effects on the balance sheets are stronger than during normal times. A recent literature has analyzed the role of collateral constraints. As in Schmitt-Grohé and Uribe (2017), the domestic economy is subject to an external debt limit which is a function of the level of gross domestic product in dollars. When the collateral constraint is not binding, the economy behaves as in the standard intertemporal open economy model (i.e., it can fully smooth consumption). A large depreciation may reduce the value of collateral, forcing a reduction in consumption and a current account adjustment. This story can be easily represented by considering that the economy is well-behaved and reacts to demand and supply shocks in the standard ways when shocks are small or when there is a real appreciation, as the case (i) considered, but when the non-standard effects associated with large shocks or real depreciations, the cases (ii) or (iii) become more likely.

These large shocks and the resulting effects of exchange rate fluctuations fit nicely into the typical boom and bust dynamics that Latin American countries experienced in the past. In a Frenkel-Neftci Cycle (Frenkel, 2003; Taylor, 1998), the capital account is opened, most likely as a part of a broad economic reform that involves a stabilization program. Initially, the domestic interest rate is very high, which in a context of a credible fixed or semi-fixed exchange rate, triggers a massive inflow of capital.

Consequently, the domestic economy booms, as the real interest rate fall, and

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depreciations (and not to appreciations), while interest rate shows little sensibility vis-à-vis exchange rate fluctuations.

the real exchange rate appreciates. The current account worsens, but there is plenty of foreign exchange, due to the extremely attractive domestic returns. As external debt piles-up, the turning point becomes closer and closer. Eventually, the balance sheet of firms and financial intermediaries will become short on foreign exchange, and long in domestic assets. The individual risk has become systemic risk.

A sudden shock, triggered for instance by a sudden increase in the Federal Reserve Federal Funds rate, sparks a process of capital flight. A recession develops, as the effects of real exchange rate overvaluation may hurt the tradable sector and the real interest rate starts to increase, so domestic demand falls.

The governments usually choose to play the reputational game with financial markets and multilateral financial institutions, but the risk of a large currency depreciations suggests that the abandonment of the fixed or semi-fixed exchange rate regime is a matter of time. A sudden-stop develops and there is a currency crisis. Depending on the health of the financial system, there could be a financial crisis and even a debt crisis if the public sector cannot obtain the resources to pay the foreign currency denominated debt.

These typical booms and bust cycles were largely absent during the 2000s. The relatively favorable international conditions, including an extremely low international interest rate and favorable terms of trade for agricultural and mining products certainly helped Latin American economies. The accumulation of large war chests of foreign exchange reserves was also of great help. However, the perverse dynamics associated with the external accounts were not avoided altogether, even for countries that have more flexible exchange rate regimes and a large stock of foreign exchange reserves. The large real exchange rate appreciations were eventually corrected by external factors, and the risk of additional adjustments put Inflation Targeting regimes under stress.

To summarize, the typical Latin American dynamics are fully consistent with the presence of contractionary and inflationary effects from exchange rate depreciations. A sufficiently large increase in the real exchange rate can be associated with credit rationing, so contractionary effects from depreciation may take place only after large shocks, and as shown by Céspedes et al. (2017), central banks may wish to offset large shocks. This requires not only a large stock of foreign exchange reserves, but also other tools that may help to cushion these large shocks, during the upswing, including macro-prudential regulations, fiscal and income policies, and capital controls.

## CONCLUSIONS

In this paper we have claimed that Inflation Targeting in Latin America may produce excessive fluctuations of output and employment. The main argument was examined using a simple Aggregate Demand – Aggregate Supply framework, where the central bank targets inflation using a short-term interest rate and where the exchange rate floats freely. Inspired by the recent regional experience, we consider

several combinations of the parameters, depending on whether a real depreciation has contractionary and inflationary effects, to study the effects of demand, supply, and exchange rate shocks.

We arrived at the following conclusions. When depreciations are contractionary and inflationary, a policy that involves fine tuning the economy using a short-term rate will produce too much output volatility when the economy is hit by demand and supply shocks. It is well-known that supply side shocks may create a trade-off between output and inflation stabilization. But the mere presence of contractionary effects complicates the implementation of monetary policy, even after a demand shock.

This does not mean that the central bank will fail to achieve its inflation target. The central bank can succeed in stabilizing inflation, in particular if the effects of the real exchange rate on inflation are large. However, the resulting changes in the real exchange rate may create complications in the long-run, especially when the interventions in the foreign exchange market are adopted to prevent only large appreciations. Although this scenario may be accompanied by an expansion of output and employment, balance of payments problems may develop.

The main message is that the specific details of Latin American economies matter. Due to the nature of the domestic financial system, the contractionary and inflation effects from exchange rate depreciations, and the current macroeconomic policies, it can be argued that Inflation Targeting can increase output volatility, especially if the central bank disregards output fluctuations.

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