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Economic Research:

Inflation Targeting In Latin America: What Have We Learned?

Chief Latin America Economist:
Joaquin Cottani, New York 212-438-0603; joaquin.cottani@spglobal.com

Latin America Economist:
Elijah Oliveros-Rosen, New York (1) 212-438-2228; elijah.oliveros@spglobal.com

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Since the mid-1990s, the central banks of a large number of emerging market economies (EMs) have adopted inflation targeting (IT) to reduce and stabilize inflation following the example of advanced economies (AEs) such as New Zealand, Canada, the U.K., Sweden, and Australia. In Latin America, the first countries to introduce IT were Brazil, Chile, and Colombia in 1999. They were followed by Mexico (2001), Peru (2002), and more recently, Uruguay (2007).

Two decades after the IT trend started in EMs, and despite chronic inflation slippages in Brazil and Uruguay, the reputation of IT in Latin America is still very solid. Two reasons for it are the lack of better alternatives and the significantly better inflation performance in the countries that adopted IT than in the past.

However, one area in which IT has not been as successful, not just in Latin America but in other regions as well, is in protecting financial markets and real output in peripheral economies from the effects of external shocks including monetary expansion in the AEs. Despite flexible exchange rates and countercyclical monetary policies, aggregate demand (AD) instability in response to foreign shocks has increased in Latin America, contradicting some of the assumptions on which IT is based.

At the core of these assumptions is the so-called "trilemma," which states that small open economies (SOEs) can't simultaneously have exchange rate stability, independent monetary policies, and free capital mobility. One of the three objectives must be sacrificed. If free capital mobility is a given, the only way for SOEs to have monetary independence is by letting the nominal exchange rate (NER) float. The combination of exchange rate flexibility and a central bank policy that leans against international winds using the short-term interest rate as the main instrument should be enough—so the argument goes—to isolate these economies from all but the most brutal external shocks allowing SOEs, including EMs, to pursue their own independent objectives.

The events of the last two decades, starting with the Asian crisis of 1997, indicate that flexible exchange rates and countercyclical monetary policy—the two cornerstones of IT along with central bank accountability, policy transparency, and the targeting of inflation itself—are not enough to cushion the impact on GDP of, say, quantitative easing in the U.S. or macroeconomic rebalancing in China. According to Rey (2015), what EMs face today is not a trilemma but a dilemma: to have independent monetary policies, they must find ways to reduce cross-border capital mobility, or at least neutralize its pervasive influence on domestic asset and credit markets (see note 1).

Ms. Rey's concern is not new; it has been expressed by many economists many times before over the last two decades (see note 2). An extensive literature on so-called macroprudential policies addresses this concern. Examples of these policies are various forms of capital controls and limits on bank leverage, such as variable loan-to-deposit ratios. Of course, none of these monetary policy "additives" is without problems. Not only they add complexity to the design of monetary policy, which goes against the idea of simplicity and transparency that is central to IT, but they can also create other distortions and be "arbitraged" by market participants.

Notice the difference between this debate and the one taking place in AEs in relation to monetary policy effectiveness. There, the issue is usually framed in terms of the "liquidity trap" afflicting these economies and goes beyond traditional monetary policy since short-term interest rates have hit the zero lower bound in those countries. The challenge is how to fight deflation with unconventional monetary policy instruments without destabilizing financial markets. The prevailing view among central bankers is that price and financial stability are two separate objectives, which need to be tackled using two different instruments, namely, expansionary monetary policy to prevent deflation, and high capital requirements to prevent speculative asset market bubbles from forming. This view is currently under attack from two different camps. The first one are neo-Keynesian economists who doubt monetary policy, even if it's unconventional, can do enough to make the global economy grow faster. The second one are banks and other financial intermediaries, whose bottom-line results suffer from the one-two punch combination of low interest rates and high capital requirements. The first camp would like to see more aggressive fiscal expansion including "helicopter money drops" and the second camp claims that higher interest rates and lower capital requirements are the way to go.

In contrast, deflation doesn't pose an existential threat to Latin American countries. Instead, inflation needs to be monitored closely, unless it becomes a bigger problem. Complaints about monetary policy are not about its effectiveness to control inflation—this is generally taken for granted—but about its ability to protect AD from foreign shocks. However, this raises two questions. First, why is monetary policy less effective to stabilize AD in EMs than in AEs? Second, how can monetary policy stabilize inflation when it can't stabilize AD?

In this article, we provide a plausible answer to both questions using Latin America's experience with IT as a background. In response to the first question, we argue that contrary to what happens in advanced SOEs real exchange rate (RER) depreciation is typically contractionary in EMs (RER appreciation is expansionary). While this is only true in the short run (in the long run the opposite happens), it causes AD in EMs to be more vulnerable to foreign shocks than in AEs. Counter-cyclical monetary policy aggravates this vulnerability by magnifying the destabilizing short-term effects of RER appreciation and depreciation on AD, hence on real output.

Regarding the second question, we note that even if IT can't neutralize the effect of an external shock on AD, it can still neutralize the effect on inflation, albeit temporarily and at the expense of RER stability. To wit, an increase in the monetary policy rate (MPR) reduces inflation mainly by inducing domestic currency appreciation. This creates a temptation among central banks to hike the MPR when shocks are favorable, to enhance NER appreciation, and when they are unfavorable, to reduce NER depreciation, which inevitably results in RER overvaluation. If one believes, as we do, that RER overvaluation is a significant deterrent of growth, IT or at least the pure version of it characterized by full exchange rate flexibility and proactive interest rate management in response to external shocks is suboptimal for EMs.

The experience of Latin American countries with IT seems to support this hypothesis. The best-performing "inflation targeter" in the region, in terms of inflation and real GDP, is Peru due to its highly unorthodox version of IT for about 15 years. Peru's version is characterized by limited exchange rate flexibility amid a semi-dollarized financial system, an MPR that exhibits moderate fluctuations around a marginally positive real level, and the central bank's use of macro-prudential policies, particularly in the form of variable marginal reserve-requirement ratios, to control domestic credit expansion. At the other end of the spectrum, the worst IT performer is Brazil, mainly due to an inability to control domestic credit despite the central bank's active interest rate management.

Brief History Of Inflation Targeting In Latin America

Under IT, several countries in Latin America saw a sharp improvement in inflation performance. Table 1 shows the extent of this improvement since 1981 by comparing average inflation levels before and after the adoption of IT and relative to other countries in the region that did not follow that path. Since IT requires the NER to be flexible, periods are differentiated according to the exchange rate regime that prevailed in each of them.

Table 1

Economic Performance Under Alternative Exchange Rate Regimes

	Average of:	Inflation	Growth
ARGENTINA			
Adjustable Peg	1981-1991	729.1	(0.0)
Currency Board	1992-2001	4.2	2.8
Adjustable Peg	2002-2016	20.7	3.2
BRAZIL			
Adjustable Peg	1981-1994	792.9	2.0
Semi-fixed Peg	1995-1999	19.3	2.2
Flexible Rate (IT)	2000-2016	6.8	2.5
CHILE			
Semi-fixed Peg	1981-1983	19.0	(3.4)
Crawling Peg	1984-1998	15.7	6.8
Flexible Rate (IT)	1999-2016	3.4	3.6
COLOMBIA			
Crawling Peg	1981-1998	23.3	3.5
Flexible Rate (IT)	1999-2016	5.6	3.6
ECUADOR			
Adjustable Peg	1981-2000	40.8	2.2
Dollarization	2001-2016	6.8	3.7
MEXICO			
Adjustable Peg	1981-1987	75.7	1.3
Semi-fixed Peg	1988-1994	30.8	3.6
Crawling Peg	1995-2000	22.0	3.3
Flexible Rate (IT)	2001-2016	4.2	2.2
PERU			
Adjustable Peg	1981-2001	606.4	1.6
Flexible Rate (IT)	2002-2016	3.0	5.6
URUGUAY			
Adjustable Peg	1981-2006	41.8	1.8
Flexible Rate (IT)	2007-2016	8.1	4.6

Table 1

Economic Performance Under Alternative Exchange Rate Regimes (cont.)

	Average of:	Inflation	Growth
VENEZUELA			
Adjustable Peg	1981-2016	44.2	1.6

Source: S&P Global Ratings

While inflation decreased significantly in the six countries that adopted IT, this also happened in other cases where alternative disinflationary regimes were implemented, notably Argentina (1991-2001) under a currency board system and Ecuador (since 2000) under dollarization. On the other hand, the countries' use of adjustable, crawling, or semi-fixed (soft) pegs pushed up average inflation.

What currency boards, dollarization, and IT have in common is the elimination of the inflation tax as a mechanism to finance fiscal deficits. This reaffirms the well-established notion that high inflation (double digits or more) has always been a monetary phenomenon with entrenched fiscal roots in Latin America. Ceasing issuing money to finance the fiscal deficit would gradually reduce inflation to single digits, regardless of whether inflation is explicitly targeted or not. What makes IT different than hard pegs including dollarization is exchange rate flexibility, which makes the financial system more resilient to currency attacks when external monetary and financial conditions deteriorate, as it happened in Argentina in 2001 and is currently happening in Ecuador.

When we look at the specifics of IT in the five large Latin American economies that adopted it, we find significant differences in exchange rate flexibility and countercyclical interest rate activism, which makes us wonder whether local central banks were looking at the same manual. Table 2 classifies the individual regimes according to these two criteria. Exchange rate flexibility refers not to how much the NER actually fluctuates, but to how much the central bank intervenes in the foreign exchange (FX) market buying and selling foreign reserves or offering exchange rate protection through derivatives. The two concepts are not equivalent because the NER may fluctuate significantly for different reasons despite the central bank's efforts to reduce its volatility. We characterize NER flexibility as almost full in Chile and Mexico, elevated in Brazil and Colombia, and moderate in Peru, where a high level of dollarization in the financial system constrains NER flexibility. Interest rate activism, on the other hand, refers to the elasticity of response of the policy rate with respect to the deviation of inflation from its target, which we measure by estimating an implicit Taylor-rule (TR) for each country (see note 3). The elasticity estimates are reported in Table 3. Monetary policy was highly active in Brazil and Colombia, less so in Chile and Mexico, and least active in Peru.

Table 2

IT Regimes In Latin America Are Not Identical

	BRAZIL	CHILE	COLOMBIA	MEXICO	PERU
Exch. rate flexibility	Medium	High	Medium	High	Low
Monetary activism	High	Medium	High	Medium	Low

High ER Flexibility = Low FX market intervention, and viceversa Source: S&P Global Ratings

Table 3

Taylor Rule Coefficients

	BRAZIL	CHILE	COLOMBIA	MEXICO	PERU
Inflation (t-1)	0.770	0.115	0.554	0.193	0.074
GDP gap (t-1)	0.247	0.588	0.641	0.359	0.660
Real exch. rate (t-1)	(0.062)	0.040	0.011	(0.016)	(0.077)

Coefficients reflect % quarterly change in policy rate in response to a 1pp change in lagged values of inflation, GDP gap, and RER. Source: S&P Global Ratings

Interestingly, the country with the least active monetary policy and the least flexible exchange rate, Peru, was the one with the best inflation and growth performance (see Table 1), lowest vulnerability to external shocks (see Table 4), and lowest NER volatility (see Chart 1).

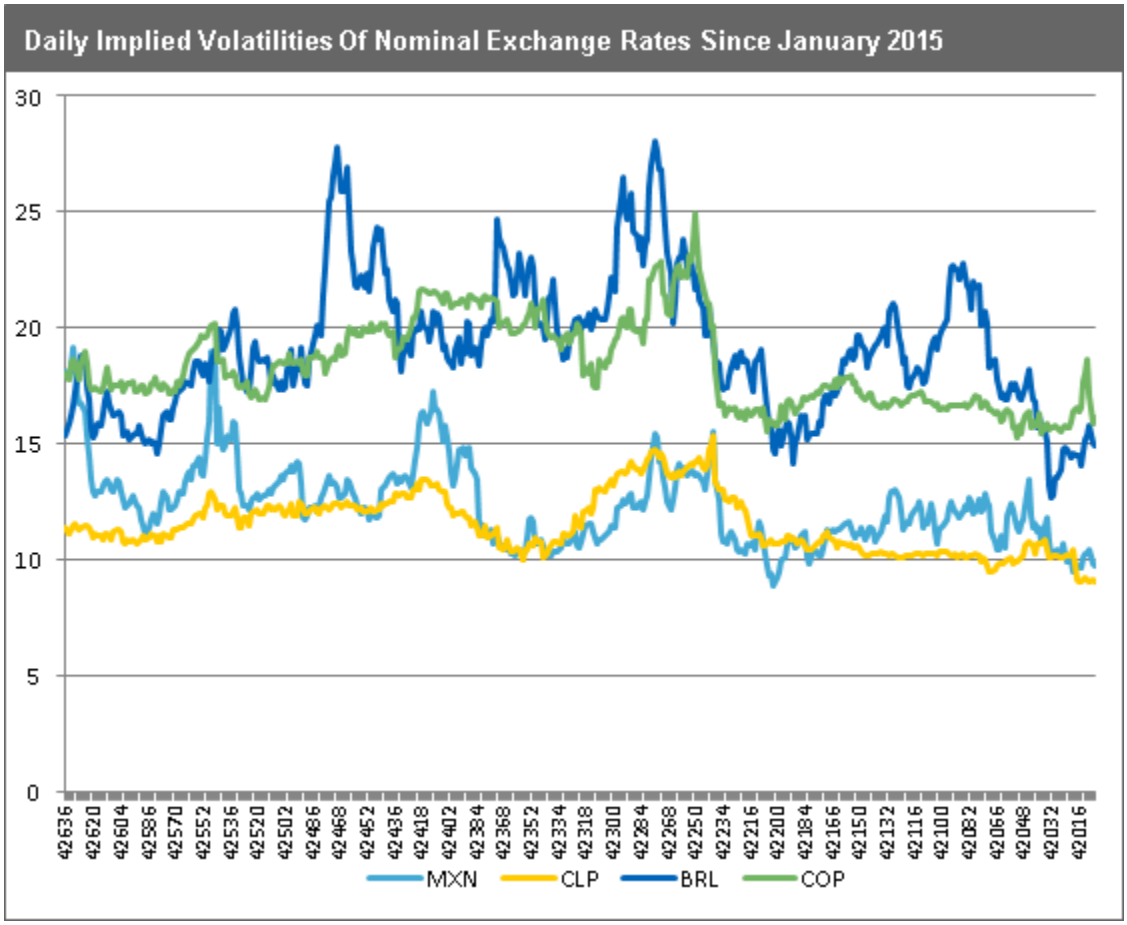
Table 4

Vulnerability To External Shocks

	BRAZIL	CHILE	COLOMBA	MEXICO	PERU
World imports	10.17	4.88	7.02	6.19	4.54
VIX	(5.92)	(5.13)	(4.36)	(3.79)	(1.05)

Coefficients reflect % growth in dollar GDP in response to 10pp growth in world imports and 10 point VIX increase, respectively. Source: S&P Global Ratings; see Cottani and Oliveros (2016a and 2016b).

Chart 1



The Problem With "Pure IT" In EM

"Pure IT" presupposes full exchange rate flexibility and pro-active MPR management in response to shocks including external ones. In turn, full exchange rate flexibility implies a symmetrical response by the monetary authority to exchange rate appreciation and depreciation pressures, as opposed to asymmetrical response, which means intervening more when the exchange rate moves in one direction than when it moves in the other.

For pure IT to be optimal, we need to assume that the only macroeconomic deviation that matters is that of inflation relative to a target. If other deviations, such as that of the RER relative to its long-run equilibrium level, matter, too, pure IT is no longer optimal or, at least, not necessarily so.

The preoccupation of policymakers with price stability sometimes makes them forget that a low and stable rate of inflation is not a policy objective in itself, but a means to achieving a higher and more sustainable real growth rate. While there is ample consensus in the economics profession that low and stable inflation promotes stronger and more durable growth, there is also a fairly high degree of consensus, especially in EMs, that RER instability and misalignment hinder long-term economic growth. Thus, if achieving the first goal means sacrificing the other, any monetary policy that doesn't negotiate the ensuing tradeoff cannot be regarded as optimal.

Our assertion that pure IT is suboptimal in EMs is based on the observation that it reduces inflation by overvaluing the RER. Suppose that global trade and financial conditions improve, causing asset prices and the value of the domestic currency to increase in terms of the U.S. dollar. Most macroeconomic textbooks teach that RER appreciation is contractionary because it causes net exports to fall, and vice versa. This and the fact that the central bank can control the short-term interest rate imply that IT can be a super shock absorber. The fact that it isn't suggests that something is wrong with the conventional story being told. The faulty link, in our view, is that RER appreciation is not contractionary as textbook models assume but expansionary, if not for every economy at least for EMs. While a more appreciated RER still causes net exports to fall, it also causes real wages to rise and the cost of servicing the foreign debt to decrease. Both effects boost domestic spending, which together with the wealth effect of the increase in asset prices and the reduction in the cost of capital and credit, cause the economy to overheat, especially in the absence of countercyclical fiscal and macroprudential policy responses.

While real GDP overheats, inflation doesn't necessarily rise because NER appreciation puts deflationary pressure on domestic prices, which helps central banks keep inflation at bay especially if policy rates are raised. The central bank faces a dilemma. If it hikes interest rates, the domestic currency can become overvalued. But if it doesn't, inflationary expectations may rise, affecting the central bank's credibility and possibly complicating monetary policy going forward.

What's the best course of action? This is where intuition is more important than the supposedly well-calibrated models that inform central bankers' decisions. Since these models are likely to put more weight on central bank credibility than on potential growth, for which there may be not even be an equation, following the model will almost surely lead to a hike in the policy rate. Inflation will fall, but only because it's being repressed by an overvalued currency.

Meanwhile, the loss in external competitiveness will come to haunt the economy when the favorable shock reverses.

When this inevitably happens, causing the NER and the RER to depreciate as a result of it, few EM central banks fail to intervene in the FX market or cut the policy rate to ensure symmetry in the way monetary policy responds to external shocks. Rather, most EM central banks choose to keep the policy rate at the same level or even increase it to prevent inflation acceleration due to a higher rate of depreciation.

As an example of this, consider how Brazil's central bank (BCB) has been responding to changes in global trade and financial conditions since 2004. Excluding the short-term blip in real output due to the U.S. subprime crisis, the last 12 years can be divided into two separate periods: an expansionary one from mid-2004 to mid-2011, in which real GDP increased at 5.2% annually fueled by high commodity prices and easy monetary conditions in AEs, and a contractionary one that started in the third quarter of 2011 and in which real GDP increased at a paltry 0.6% per year despite further monetary easing abroad mainly because of a persistent decline in the external terms of trade.

As shown in Table 5, external conditions represented by terms of trade (TOT) changes and the average level of the risk-adjusted foreign interest rate (RAFIR) were not too different in Brazil from those in other Latin American countries such as Chile and Colombia. However, RER behavior in response to these changes was. Specifically, real appreciation during the cyclical expansion was higher in Brazil than in Chile and Colombia, and real depreciation during the cyclical contraction was lower. As we argued elsewhere, the main factor explaining this difference was the level of the short-term real interest rate, particularly when compared to RAFIR (see note 4). While the gap between these two real rates averaged +4.4% in Brazil in 2004-2016, the equivalent figures were -0.3% in Chile and -0.7% in Colombia.

Table 5

Indicators Of External Conditions, Monetary Policy, And Economic Performance

	% TOT	RAFIR	RIR	RIR-RAFIR	% REER	% GDP	% CPI
3Q04-2Q11							
Brazil	39.7	3.3	8.3	5.0	92.3	4.4	5.2
Chile	65.5	1.6	0.7	(0.9)	22.9	4.4	3.7
Colombia	59.5	3.0	1.9	(1.0)	33.8	4.7	4.6
Mexico	13.3	2.3	2.7	0.4	(5.1)	2.3	4.3
Peru	57.4	2.6	0.9	(1.7)	(4.2)	6.8	2.6
3Q11-2Q16							
Brazil	(17.4)	1.4	4.8	3.4	(11.5)	0.6	6.8
Chile	(13.8)	0.2	1.1	0.9	(21.9)	3.5	3.4
Colombia	(17.5)	0.7	1.1	0.4	(21.6)	4.4	3.3
Mexico	(26.4)	0.9	0.3	(0.6)	(14.3)	2.7	3.6
Peru	(18.5)	0.5	0.6	0.1	7.8	4.5	3.4

% TOT: terms of trade appreciation from beginning to end of period. RAFIR: average risk-adjusted foreign real interest rate (real US policy rate + EMBI spread), RIR: average domestic real interest rate (policy). % REER: real effective exchange rate appreciation from beginning to end of period. % GDP: average real GDP growth. % CPI: average consumer inflation. Source: S&P Global Ratings.

Three empirical facts are worth noting. First, at more than 5% annually during the expansionary part of the commodity cycle, Brazilian growth exceeded potential by a significant margin meaning that the economy overheated during this period. Second, despite the overheated economy, the BCB was able to control inflation better during this period than during the contractionary one that followed. Third, just as 5% is too high an estimate of potential growth for Brazil

from the vantage point of 2004, 0.6% is definitely less than most economists would have guessed in 2011. This and the fact that post-2011 growth performance was significantly weaker in Brazil than in most other countries in Latin America that suffered the same luck as far as commodity prices and other external conditions are concerned, suggests that the decline in Brazil's potential growth was not only due to external factors but also to domestic ones.

These empirical facts are consistent with the narrative sketched in the introduction, which is developed in more analytical detail in the appendix. To wit, overheating during the expansion (failure of IT to act as a shock absorber) can be explained by RER appreciation being expansionary rather than contractionary in the near term. Having lower inflation when the economy is booming than when it's contracting can be explained by nominal appreciation being deflationary, and vice versa. Finally, the more severe decline in Brazil's potential growth compared to other countries can be explained by an overactive monetary policy, which stimulated (and continue to stimulate) the overvaluation of the Brazilian currency in real effective terms.

In sum, Brazil's experience with IT suggests that raising or maintaining high short-term real interest rates when external conditions are favorable and not reducing them sufficiently when conditions become unfavorable is bad monetary policy. While it may help to reduce inflation in the short run, it does it at the cost of magnifying AD fluctuations and reducing potential real GDP growth.

Fixing IT

If pure IT doesn't work for EMs, what's an "impure" version that does? Surely, expansionary RER appreciation (contractionary RER depreciation) is not a reason to prefer fixed over flexible exchange rates since both leave the economy unprotected against external shocks. However, exchange rate flexibility does not need to be full or symmetrical for IT to work. The key is to avoid the appreciation bias that pure IT has, and the way to do this is to limit nominal and real appreciation while still controlling inflation during booms through a combination of sterilized intervention, higher reserve requirements, and policy rate cuts while facilitating real depreciation when booms turn into busts by intervening in the FX market as little as possible and, if necessary, lowering reserve requirements and raising the policy rate. In other words, just the opposite of what the pure IT manual suggests.

Two Different Views On Monetary Policy In EMs

Traditional View

- Monetary policy, defined as an autonomous change in the short-term interest rate, affects domestic inflation through its effect on aggregate demand and expectations.
- Monetary policy affects real output and employment in the short run because domestic prices and expectations are "sticky." In the long run, monetary policy is neutral; it can change inflation but not real variables.
- The goal of monetary policy is to achieve low and stable inflation because this is the best it can do to stimulate economic growth.
- Exchange rate flexibility ensures monetary autonomy in SOEs even if cross-border capital mobility is high.
- The combination of flexible exchange rates and countercyclical monetary policy helps absorb external shocks.
- If the NER is flexible, the real exchange rate RER can't be overvalued or undervalued, except temporarily due to adjustment lags. Since overvaluation is ruled out, there can be no permanent effect on real growth resulting from monetary policy alone.
- If real output is demand-determined, which can only happen in the short run, real depreciation is expansionary, since it improves external competitiveness, while real appreciation is contractionary for the opposite reason.
- In real output is supply-determined, which happens in the long run, and the NER is flexible, the RER affects aggregate demand composition between domestic and foreign goods or between tradables and nontradables, but not its level.
- Empirical studies reveal that in economies where financial markets are less developed, the relationship between the exchange rate and the short-term interest rate is not too strong, presumably because domestic and foreign assets are not as close substitutes as in AEs.

Alternative View (EM Reality Check)

- A tight monetary policy, defined as a short-term interest rate in excess of the foreign short-term interest rate adjusted for differences in inflation and exchange rate risk, reduces inflation not so much because it contracts AD, but because it causes the NER and, by extension, the RER to appreciate.
- Domestic and foreign monetary assets are close substitutes even in EMs, meaning that a small increase in the short-term interest rate can cause a large appreciation in the NER, and vice versa. The fact that this is not empirically apparent is due to simultaneous causality between the two variables.
- In the short run, real appreciation is expansionary on AD, while real depreciation is contractionary because the income and balance-sheet effects associated with both outweigh the substitution (external competitiveness) effect. However, in the medium and long runs, the opposite is true because the competitiveness effect prevails.
- RER overvaluation is possible even if the NER and domestic prices are perfectly flexible given that RER overvaluation measures the difference between short- and long-term equilibrium RERs, where the latter is the level consistent with internal equilibrium and long-term external solvency.
- RER overvaluation is a growth retardant and the result of inconsistent monetary, fiscal, and income policies.

Appendix: Transmission Channels of External Shocks and Monetary Policy

How are external shocks and monetary policy transmitted to asset prices, real GDP and inflation in EMs? Understanding this helps us to evaluate whether or not central banks respond optimally to external shocks. To frame the discussion, we need to lay out a model that describes how the economy operates at the macro level. While central banks use models of varying degrees of sophistication, they all more or less share the same basic building blocks. These are:

(1)	Phillips Curve	$\pi = \pi(y, e)$ (+ +)
(2)	IS equation	$y = y(x, R, e)$ (+ - ?)
(3)	Proximate RIR	$R = R(x, f, r)$ (- - +)
(4)	RER	$e = e(x, f, r)$ (- - -)

where:

- ¶: inflation deviation from target
- y: real GDP deviation from potential (aka, output gap)
- R: real interest rate (RIR) relevant for consumption and investment decisions;
- e: real exchange rate (RER) as deviation from long-run equilibrium level
- x: real external shock (x>0 if favorable, x<0 if unfavorable)
- f: financial external shock (f>0 if favorable, f<0 if unfavorable)
- r: real policy interest rate as deviation from neutral

The signs above the explanatory variables indicate the direction in which changes in these variables affect the explained or dependent ones. The model is Keynesian in fashion since domestic prices are "sticky" and real output is demand determined. Equation (1) postulates that the inflation gap is an increasing function of the output gap and the RER. Using the RER level, rather than nominal depreciation as an argument of inflation, is a simplification. It means that when nominal depreciation occurs, both the RER and inflation increase because domestic prices adjust sluggishly.

According to Equation (2), AD for goods and services is a direct function of real external shocks, the proximate RIR, and the RER. An exogenous increase in export prices or export volume is an example of a real external shock. It influences AD directly because net exports are a component of AD. By "proximate" RIR we mean the one that influences domestic spending directly, rather than indirectly as the policy rate does. In reality, there is not one such RIR, but a vector of them including the ones banks charge on domestic lending as well as the (real) yields on corporate bonds and equity. Since all of these rates tend to move in the same direction in response to changes in economic conditions, it is analytically safe to lump them into a single variable R. An increase in the latter means that credit conditions are tighter, hence AD decreases. Finally, an increase in e (RER depreciation) has an ambiguous effect on AD that depends on whether the expenditure-switching effect dominates or is dominated by the counter-signed income and balance-sheet effects, as discussed in the text.

Unlike real external shocks, financial ones only impact AD indirectly via changes in R and e. An example of a favorable external financial shock (increase in f) is a reduction in the Fed Funds rate. Another example is a decrease in global risk aversion. These shocks increase the demand for domestic assets relative to foreign ones reducing R and e; and the same is true for a favorable real shock, as reflected by Equations (3) and (4). Finally, another determinant of R and e is monetary policy. An increase in the policy rate r increases R and reduces e.

More on asset markets

Equations (3) and (4) are derived from the assumption that asset markets are in equilibrium. Implicitly, we are postulating that there are three distinct asset classes in the economy: safe domestic assets, which yield a deterministic real return r (remember there's no uncertainty regarding inflation); risky domestic assets, for which the expected real rate of return is R; and foreign assets, whose expected real return is the foreign real interest rate plus the expected real rate of depreciation.

As we said before, favorable external shocks, real as well as financial, make domestic assets more attractive for global investors. This is true for safe and risky domestic assets, so the demand for both increases. If the exchange rate is flexible and the central bank controls the short-term interest rate, e falls (the RER appreciates) and the same happens with R. On the other hand, if e is inflexible, either because the nominal rate is inflexible or because the pass-through to domestic prices is high, the RER doesn't appreciate, meaning that some other variable (in addition to R) must fall since, otherwise, asset markets won't balance. This variable is r and the general principle behind it is that monetary policy autonomy (the ability of the central bank to control r) requires RER flexibility.

However, there are two important qualifiers. First, controlling r is not the same as controlling R. Second, capital controls and sterilized intervention make it possible for the central bank to manage r and e simultaneously, although how effectively and for how long is a separate issue (see note 5). Regarding the first point, the critical parameters are Rx, Rf, and Rr, namely, the partial derivatives of R with respect to x, f, and r embedded in Equation (3). If the first two coefficients are high in absolute value (risky domestic asset prices are very responsive to external conditions) but the third one is low (risky and safe domestic assets are imperfect substitutes), monetary policy has limited power to control the RIR that actually matters, namely, R. Regarding the second point, the idea is that the central bank can reduce the absolute values of ex, ef, and er—the coefficients of Equation (4)—by controlling capital mobility or by intervening and sterilizing.

Vulnerability to external shocks: Expansionary versus contractionary RER depreciation

The recursive nature of the structural model formed by Equations (1) - (4) makes it easy to analyze the full impact of external shocks on AD, hence real output. Consider, for example, a reduction in x (negative real shock). If the RER is flexible, the total derivative of y with respect to x is

$$(5) \qquad \frac{dy}{dx}_{(e:\,flex)} = y_x + y_R R_x + y_e e_x \; > 0$$

where the first term is the partial derivative representing the direct or impact effect and the other two terms are the indirect effects transmitted through R and e. From the model, we know that the first two terms are positive while the third term is negative or positive depending on whether real depreciation is expansionary (ye>0) or contractionary

(ye<0). The conventional assumption is that real depreciation is expansionary, in which case the flexible e, together with the central bank's grip on r, acts as an external shock absorber. For example, suppose the RER was constant. This would not only prevent the expansionary real effect from materializing, but would also trigger a contractionary reduction in r, namely,

$$(5') \qquad \frac{dy}{dx}_{(e:\,fixed)} = y_x + y_R R_x + y_R R_r r_x \; > 0$$

Since yR<0 and rx<0, the third term is positive, implying that the full negative effect of the external shock on real output is stronger than before meaning that the economy is more vulnerable if the RER is inflexible than if it's flexible.

Suppose that we drop the assumption that ye>0 and assume ye<0 instead. As we discussed in the main text, this is a more realistic assumption for EMs, at least in the short run. Now the third term of Equation (5) is positive, hence it's no longer necessarily true that the economy (by which we mean real GDP) absorbs external shocks better when e is flexible than when it's fixed. While this is not a reason to prefer fixed over flexible exchange rates, it explains why RER flexibility has not lived up to the promise of protecting, let alone isolating, EM economies from external shocks.

Effect of RER flexibility on growth

One thing is the effect RER flexibility has on the output gap and another thing is the effect it has on long-term growth. For the latter, the only thing that matters is that the RER is not persistently overvalued. We can express this by saying that growth is a decreasing function of ¶ and an increasing function of e. Since the only rationale for stabilizing inflation around a target is the effect that low and stable inflation has on growth, adding RER stability and correct RER alignment into the objective function has the potential of creating a tradeoff between the two variables. More specifically, destabilizing the RER in order to stabilize inflation is suboptimal.

Monetary policy effectiveness

What's the effect of a decrease in the real policy rate on real output when the RER is flexible? In this case, the relevant expression is

$$(6) \qquad \frac{dy}{dr} = y_R R_r + y_e e_r \; < 0$$

Once again, whether ye is positive or negative matters. If ye<0, monetary policy is less effective. A reduction in r reduces R, but it also increases e. While the first effect is expansionary, the second one is contractionary, hence y increases less, particularly if er is large (high substitutability between foreign and domestic safe assets) compared to Rr (low substitutability between safe and risky domestic assets).

Expressions (5) and (6) imply that trying to stabilize real output through monetary policy when external shocks are the main source of instability and RER depreciation is contractionary requires large changes in policy rates, which exacerbate RER instability. Mathematically, the derivative of r with respect to x such that y=0 is Equation (5) divided by Equation (6). If ye<0, the numerator is larger and the denominator is lower than if ye>0. This and Equation (4) imply that e is more unstable.

Targeting inflation

The basic idea behind IT is that central banks must worry not about protecting real output from external shocks but about keeping inflation on target when the shocks occur. Suppose that an improvement in the terms of trade threatens to accelerate inflation by increasing AD. Under pure IT, the problem of the central bank is

$$(7) \qquad \frac{dr}{dx}_{(\pi=0)} = -\frac{d\pi/dx}{d\pi/dr}$$

namely, how much to increase the policy rate in order to keep inflation on target, where the numerator of Equation (7) is the effect of the external shock on inflation when monetary policy is constant and the denominator is the effect of monetary policy on inflation in the absence of shocks. Doing the math, we get

$$(8) \qquad \frac{dr}{dx}_{(\pi=0)} = -\frac{\pi_y(y_x+y_R R_x+y_\theta s_x)+\pi_\theta s_x}{\pi_y(y_R R_v+y_\theta s_v)+\pi_\theta s_v}$$

While this may look like a complicated formula, the meaning is actually straigtforward. An improvement in the terms of trade expands AD, which in turn increases inflation but also appreciates the RER, which in turn reduces inflation. On the other hand, an increase in the policy rate unambiguously reduces inflation because it contracts AD and it also appreciates the RER. A central bank that only cares about inflation will hike the policy rate no matter what, even if doing so causes the RER to become overvalued, hurting long term growth in the process. On the other hand, a central bank that cares about inflation stability only as a means to achieve higher long-term growth must also be concerned with inflation and RER stability and, as a result, its approach to exchange rate flexibility and monetary policy management will be more nuanced.

Notes

1). Helene Rey, "Dilemma not Trilemma: The Global Financial Cycle and Monetary Policy Independence," NBER, May 2015.

2). See, for example, the bibliographic references listed in Ms. Rey's paper (op. cit.).

3). Specifically, we run an OLS (ordinary least squares) regression of the policy rate on the inflation gap and the output gap, adding the RER as a third regressor to capture any feedback that may exist from this variable to the policy rate.

4). See "What's Behind Brazil's Economic Woes," Ratings Direct, September 18, 2015.

5). Sterilized intervention consists of buying foreign reserves and selling domestic bonds to neutralize the effect of capital inflows on the exchange rate and the short-term interest rate when international conditions are favorable, and vice versa.