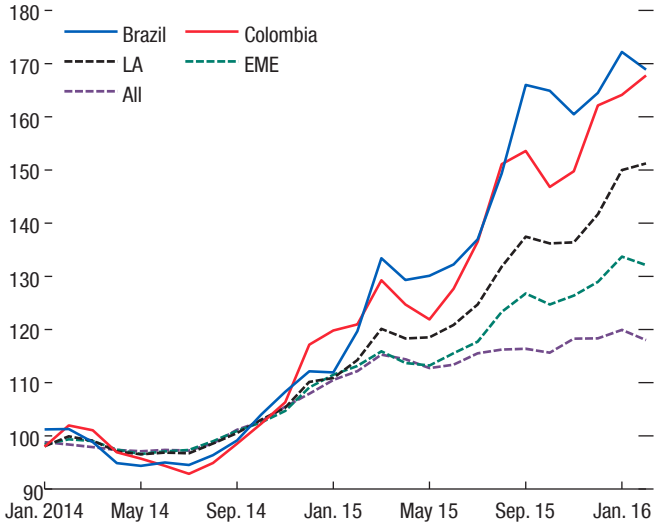
4. Exchange Rate Pass-Through in Latin America

Recent currency depreciations are expected to create inflation pressure across Latin America, though more modest than in the past. Improvements in monetary frameworks over the past two decades have led to substantial and generalized declines in exchange rate pass-through to consumer prices. In countries with credible monetary policy frameworks, policymakers have space to allow relative prices to adjust through exchange rate depreciation without compromising inflation objectives, as long as medium-term inflation expectations remain well anchored. Greater vigilance is warranted in economies that show evidence of sizable second-round effects.

Ongoing monetary normalization in the United States and sharp falls in global commodity prices have been followed by a significant weakening of emerging market currencies, especially in Latin America. The Brazilian real and the Colombian peso, for instance, have depreciated by about 60 percent against the U.S. dollar over the past two years (Figure 4.1)—a sharp and sustained depreciation that stands out from a historical perspective (see Chapter 2, Figure 2.1.1).[1]

Whereas past episodes of sharp depreciations in the region were often triggered by the sudden correction of pent-up imbalances, the recent episode largely reflects policy frameworks that allow exchange rates to respond to a changing external environment. The depreciations are facilitating the region's adjustment to the new reality of lower commodity prices, tighter global financial conditions, and lower world growth.[2]

Figure 4.1. Selected Countries: Nominal Exchange Rate
(Index: 2014 = 100)



Sources: Bloomberg, L.P.; Haver Analytics; and IMF staff calculations.
Note: An increase in the exchange rate indices denotes a depreciation of the domestic currency against the U.S. dollar. "LA" and "EME" are based on the J.P. Morgan Latin America and Emerging Market currency indices, respectively. "All" is based on the J.P. Morgan Dollar Spot Currency Index, which reflects the value of a broad set of currencies against the U.S. dollar. EME = emerging market economies; LA = Latin America.

But, recalling the instability that accompanied large depreciations in the region during the 1980s and 1990s, should we be concerned that the current episodes might summon the old specter of high inflation?

Reassuringly, average inflation has remained stable in the region (Figure 4.2). This reflects the moderating effect of lower oil prices, and the fact that the depreciations are part of a global cycle of dollar strength that has made them more limited in nominal effective terms than U.S. dollar parities imply. However, low average inflation rates hide significant differences across countries. Whereas inflation has increased significantly in Brazil and Colombia, and to a lesser extent in Chile,

Note: This chapter was prepared by Yan Carrière-Swallow, Bertrand Gruss, Nicolás Magud, and Fabián Valencia, under the guidance of Dora M. Iakova. Steve Brito and Alexander Herman provided excellent research assistance. See Carrière-Swallow and others (forthcoming) for technical details.

[1]Throughout this chapter we define the nominal bilateral exchange rate in local currency per U.S. dollar. We refer to a given depreciation of the domestic currency in bilateral (effective multilateral) terms as the extent of the *increase* in the bilateral (effective multilateral) exchange rate.

[2]See Chapter 3 of the April 2015 *Regional Economic Outlook: Western Hemisphere* for a discussion of the role of exchange rate flexibility in buffering the effect of commodity price shocks on public finances and facilitating a smoother external adjustment. See Chapter 3 of the October 2015 *Regional Economic Outlook: Western Hemisphere* for an analysis of exchange rate flexibility and monetary autonomy in small open economies.

Peru, and Uruguay, it has declined in Mexico and some other Central American economies. Inflation expectations have also inched up in some countries, particularly at shorter horizons. In the context of uncertainty about the size and delay of exchange rate pass-through, policymakers in many countries remain concerned that inflation pressures may materialize or increase in the future.

Against this backdrop, this chapter explores the implications of the recent weakening of Latin American currencies for inflation dynamics. It seeks to answer the following questions: How sensitive are consumer prices to exchange rate movements? Has the sensitivity changed over time? What explains the differences across countries and over time? Can recent inflation developments be explained by changes in the nominal exchange rate? Should we expect to see a delayed impact on inflation later this year? And finally, what are the implications for monetary policy?

Exchange Rates and Consumer Prices: Historical Relationships

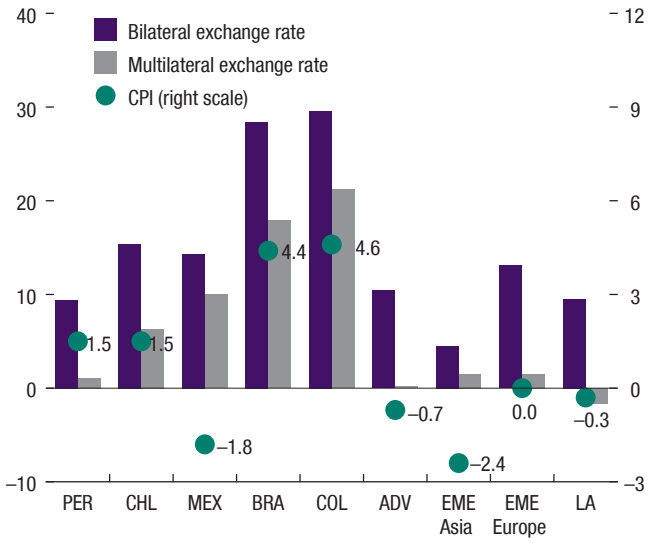
The sensitivity of domestic prices to changes in the exchange rate is generally referred to as exchange rate pass-through, and is an important input for the conduct of monetary policy. A change in the exchange rate normally triggers an adjustment in relative prices between tradable and nontradable goods, provoking a transitory *first-round effect* on inflation. However, this impact can get magnified if rigidities in the labor or product markets, or poorly anchored inflation expectations, lead to *second-round effects* on consumer prices. Generally speaking, policymakers should avoid responding to the normal adjustment of relative prices, but tighten monetary policy if there is evidence of second-round effects.

From a policy perspective, it is thus important both to quantify the overall pass-through to consumer prices, and to assess how much of this effect is due to first- versus second-round effects. Our empirical estimation of the overall impact of a currency depreciation on consumer prices is based on a standard specification (see, for instance, Campa and Goldberg 2005; and Gopinath 2015). The cumulative response is estimated in panel and country-specific settings using Jordà's (2005) local projection method (LPM):[3]

$$p_{i,t+h-1} - p_{i,t-1} = \alpha^h + \sum_{j=0}^{J} \beta_j^h \Delta NEER_{i,t-j} + \sum_{j=1}^{J} \rho_j^h \Delta p_{i,t-j} + \gamma_j^h \Delta X_{i,t} + \mu_i^h + \varepsilon_{i,t}^h \qquad (4.1)$$

where $p_{i,t}$ denotes the natural logarithm of the domestic price level in country i at period

Figure 4.2. Exchange Rates and Inflation during 2014–15
(Percent change in exchange rate, annualized, and difference in 12-month CPI inflation rate, between Dec. 2013 and Dec. 2015)



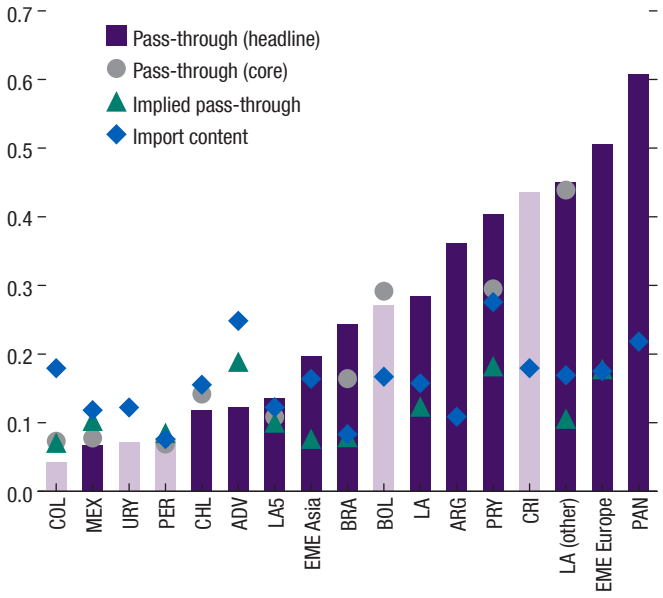
Sources: Haver Analytics; IMF, World Economic Outlook database; and IMF staff calculations.
Note: "Bilateral exchange rate" denotes the nominal exchange rate in local currency per U.S. dollar; "Multilateral exchange rate" refers to an import-weighted nominal effective exchange rate (see Annex 4.1); and "CPI" denotes the aggregate consumer price index. "ADV" and "EME" denote the average for advanced and emerging market economies, respectively, and "LA" the average for Latin American countries (see list of countries in Annex Table 4.1). Data labels use International Organization for Standardization (ISO) country codes, see page 108.

[3]As shown in Jordà (2005), the main advantages of LPM are simplicity, flexibility, and robustness to misspecification compared with standard vector autoregression (VAR) models. Implementation requires running a separate regression for each horizon h of interest, with the cumulative impulse response provided directly by the estimate of β_0^h. Most of our analysis focuses on the cumulative response after two years (h = 24), which is typically considered a measure of long-run pass-through. To improve efficiency, we follow Jordà's (2005) recommendation of including the residual from horizon h – 1 as an additional regressor in the estimation for horizon h. Because the error term may be serially correlated, we use Newey-West standard errors. We include six lags in our regressions.

t; *NEER* the natural logarithm of the trade-weighted nominal effective exchange rate;[4] Δ a first difference operator; μ_i country fixed effects (included only in panel regressions); and $\varepsilon_{i,t}$ a random disturbance. The vector *X* includes a set of control variables (and their lags) that are deemed likely to affect both the exchange rate and inflation, to reduce concerns about omitted variable bias.[5] In our application, *X* includes: international oil and food prices in U.S. dollars; the cost of production in countries from which country *i* imports (proxied by the import-weighted producer price index of trading partners; see Annex 4.1);[6] and local demand conditions (proxied by the cyclical component of industrial production).[7] Our baseline sample uses monthly data from January 2000 to December 2015 and includes 31 advanced and 31 emerging market economies (see Annex 4.1 for the list of countries included).

The bars in Figure 4.3 show the cumulative response of consumer prices two years after a 1 percent increase in the nominal effective exchange rate. Pass-through in Latin America is comparable with estimates for other regions. For the region as a whole, average pass-through to consumer prices is less than 0.3, which is higher than emerging Asia (close to 0.2) but significantly lower than emerging Europe (about 0.5).

Figure 4.3. Exchange Rate Pass-Through Estimates
(Percent)



Source: IMF staff calculations.
Note: The figure shows the cumulative exchange rate pass-through to headline and core (where available) consumer prices two years after a 1 percent increase in the nominal effective exchange rate. Pass-through estimates for individual countries are obtained from country-specific regressions while average regional pass-through correspond to panel model estimates. "Implied pass-through" corresponds to the product of the cumulative exchange rate pass-through to import prices after two years and the country-specific "import content" of domestic consumption (as reported in Figure 4.4). "LA5" denotes estimates from a panel regression for Brazil, Chile, Colombia, Mexico, and Peru; while "LA (other)" corresponds to a panel of the remaining Latin American economies. Solid bars denote statistically significant responses at the 10 percent confidence level. Data labels use International Organization for Standardization (ISO) country codes, see page 108. ADV = advanced economies; EME = emerging market economies.

The estimates show substantial variation across countries. Considering only statistically significant responses among Latin American countries, the estimated pass-through ranges from 0.07 in Mexico to above 0.6 in Ecuador, Guatemala, Honduras, and Panama. The region's largest economies with longstanding inflation-targeting regimes, Brazil, Chile, Colombia, Mexico, and Peru (LA5), exhibit an average pass-through estimate of 0.14 that is in line with estimates for advanced economies and significantly below the rest of Latin America (close to 0.45).[8,9]

[4]Rather than the usual nominal effective exchange rate metrics that are weighted by total trade, we follow Gopinath (2015) and construct an index that is weighted by lagged import flows, and allow these weights to vary each year (see Annex 4.1).

[5]The inclusion of these variables aims at controlling for the effect they have on the dependent variable. Because we are relying on a reduced-form specification, we do not take a stand on the underlying source of variation in the exchange rate. The responses we report should thus be interpreted as reflecting the average constellation of shocks that moved the exchange rate during the estimation sample.

[6]Earlier studies have used world inflation or trade-weighted consumer prices to control for changes in exporting countries' production costs. The drawback of that approach is the preponderance of nontraded goods and services in consumer price indices. Using trade-weighted export prices is also problematic, because these may already reflect exporters' pricing decisions. In line with Gopinath (2015), we use an import-weighted foreign producer price index to mitigate these problems (see Annex 4.1).

[7]The cyclical component of industrial production is computed using a Hodrick-Prescott (HP) filter with smoothing coefficient equal to 129,600 on monthly data. We deal with the end-point bias by linearly extrapolating the HP trend from 2013 to the last two years in the sample.

[8]Whenever we refer to an average pass-through for a group of countries, we cite estimates from panel regressions, whereas estimates for individual countries stem from country-specific time-series regressions. The specification, in terms of lag structure and control variables, is however identical in both types of regressions.

[9]Albagli, Naudón, and Vergara (2015) estimate a pass-through of about 0.2 for the LA5 economies, which is higher than that

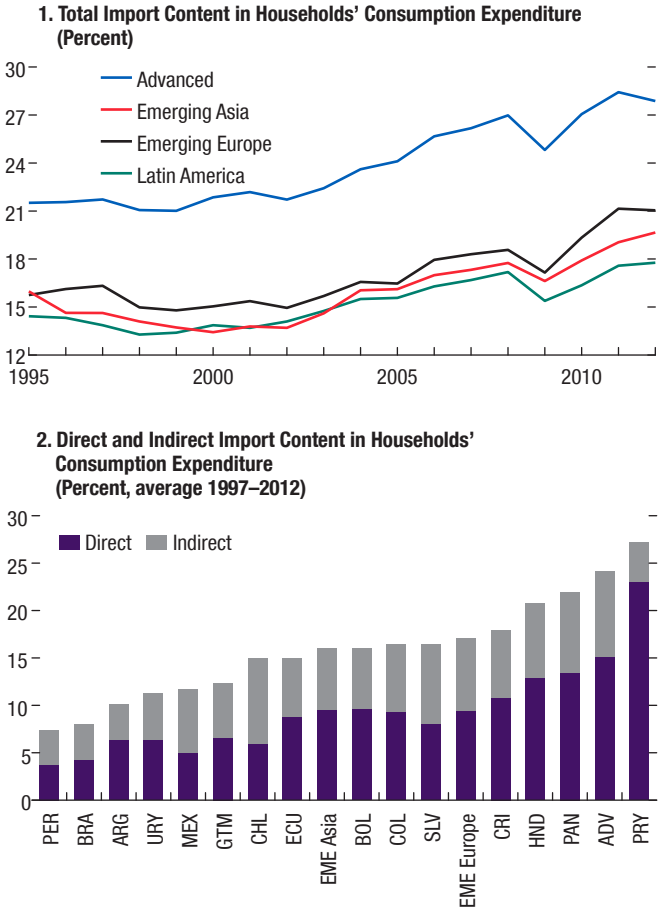
A Benchmark for Exchange Rate Pass-Through

How can we tell whether a given pass-through estimate merely reflects first-round effects—related to relative-price adjustments—or rather suggests evidence of second-round effects? One can think of the exchange rate pass-through process to consumer prices as occurring in two stages. In the first stage, variations in the exchange rate affect local-currency prices of imported goods at the border. In the second stage, changes in import prices are reflected in consumer prices, measured by the consumer price index (CPI).

Under the assumption of complete exchange rate pass-through to import prices, the import content of final household consumption provides a *benchmark* for the expected first-round effects of a depreciation on consumer prices. Like Burstein, Eichenbaum, and Rebelo (2005) and Gopinath (2015), we measure the total import content of households' final demand using input-output tables.[10] Figure 4.4 shows that the average import content in consumption expenditure in Latin America has steadily increased since 2000, but remains lower than in advanced and emerging market economies from other regions. The import content also varies significantly across Latin American countries, with the average share over 1997–2012 ranging from only about 7 percent in Brazil and Peru to above 20 percent in Honduras, Panama, and Paraguay.

Of course, pass-through to import prices might be incomplete, in which case the import content of consumption would overstate first-round effects.[11] To address this issue, we also construct an *alternative benchmark* as the product of the import share and an empirical estimate of exchange rate pass-through to import prices—obtained by replacing consumer prices as the dependent variable in equation (1) with import

Figure 4.4. Import Content of Households' Final Demand



Sources: Eora MRIO; and IMF staff calculations.
Note: The direct import content corresponds to imports of final consumption goods, while the indirect import content accounts for the value of imported inputs used in domestically produced goods that are consumed by domestic households. Data labels use International Organization for Standardization (ISO) country codes, see page 108. ADV = advanced economies; EME = emerging market economies

for other emerging market economies and much higher than for advanced economies. Three methodological features of their work contribute to the difference between our findings: (1) they estimate the pass-through against the U.S. dollar rather than in multilateral terms, (2) they focus on pass-through following autonomous shocks to the exchange rate—that is, exchange rate shocks that were not triggered by external factors such as commodity prices, and (3) the regional averages they report are weighted by GDP, while our panel estimates are simple average effects.

[10]The total import content of domestic consumption includes both (1) the direct import content (that is, imports of final consumption goods) and (2) the indirect import content, which accounts for the value of imported inputs used in domestically produced goods that are consumed by domestic households. See Annex 4.1 for more details.

[11]The empirical literature has indeed found substantial evidence of incomplete pass-through to import prices (see, for instance, Campa and Goldberg 2005), for example, as a result of local-currency pricing, market structure, substitution among alternative domestic and foreign products, and perceptions about the persistence of exchange rate changes.

prices where these are available. This alternative benchmark is generally expected to be smaller than or equal to the first benchmark.[12]

How Do Pass-Through Estimates Compare with These Benchmarks?

For Latin America as a whole, the pass-through estimate reported previously (about 0.3, see Figure 4.3) is much larger than both benchmark measures (between 0.12 and 0.16).[13] This suggests that depreciations in the region have inflation effects that go beyond the expected first-round relative-price adjustments, perhaps by affecting medium-term inflation expectations, and thus the price- and wage-setting behavior of households and firms. There is also evidence that suggests important second-round effects in other emerging market economies, because their average pass-through estimates also exceed the benchmarks. But this is not the case for advanced economies: their average pass-through is only 0.12, while their average import content is 0.25 and the implied pass-through, considering also the sensitivity of prices at the border, is 0.19.

The average for Latin America masks a significant degree of heterogeneity across countries. For the large inflation targeters in the region, there seems to be little evidence of second-round effects. Indeed, the average pass-through estimate is in line with or below our benchmarks. The exception is Brazil, where the estimated pass-through of 0.24 in 2000–15 far exceeds its benchmark of about 0.08, suggesting that second-round effects have been pervasive in the past. To check whether changes in administered prices might be affecting our estimates of pass-through, we reestimate the model using core prices. The conclusion holds: with the exception of Brazil, pass-through estimates to core inflation are in line with benchmarks in the other economies.

In much of the rest of the region, second-round effects appear important, with estimated pass-through significantly above benchmarks, and comparable to the results for emerging Europe. In Argentina, the pass-though estimate is about 0.36 while its import-content benchmark is close to 0.11, and in Ecuador, where the import share is roughly comparable, the pass-through estimate is close to 0.7.[14] The differences with benchmarks in our sample are particularly large among Central American economies, such as El Salvador, Guatemala, and Honduras.[15]

In the region's highly dollarized economies, including Costa Rica, Guatemala, Paraguay, Peru, and Uruguay, the U.S. dollar exchange rate may have more bearing on domestic pricing decisions than the multilateral exchange rate. For these countries, we also report pass-through estimates after 12 months from changes in the bilateral exchange rate (Figure 4.5). In Uruguay, the pass-through from bilateral exchange rate movements is much larger than from changes in the multilateral exchange rate, probably reflecting its high degree of transaction dollarization, and in line with the LA5 average and its benchmark. Both pass-through estimates are comparable in the case of Paraguay and Peru. For Costa Rica and Guatemala, the pass-through from the bilateral exchange rate is much lower than the pass-through from the multilateral rate, but still higher than benchmarks.[16]

[12]Although some point estimates for pass-through to import prices are slightly above one in our sample (similarly to findings in, for instance, Choudhri, Faruqee, and Hakura 2005; and Ca'Zorzi, Hahn, and Sánchez 2007), full pass-through cannot be rejected in those cases. It should be noted, however, that there is significant variation across countries in the procedures used to construct import price indices, which could influence estimates of pass-through at the border and thus our alternative benchmark.

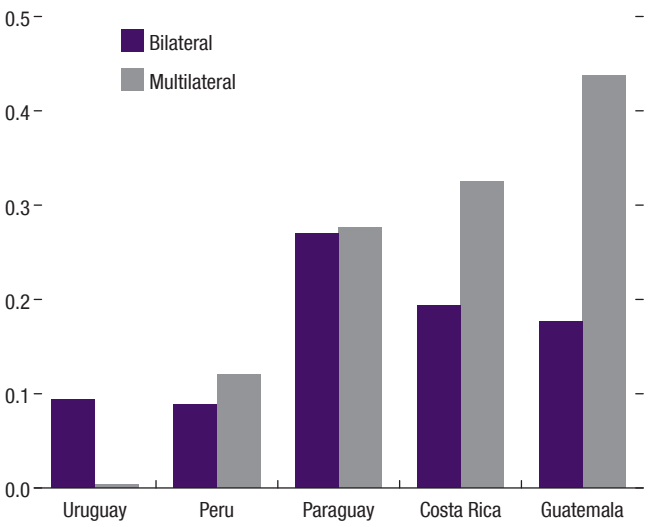
[13]The benchmark and alternative benchmark are denoted as "Import content" and "Implied pass-through," respectively, in Figure 4.3.

[14]The sample for Argentina uses data from January 2000 to December 2010, before a gap between the official and the parallel exchange rate emerged. CPI data after December 2006 correspond to private analysts' estimates.

[15]It should be noted that our estimates reflect historical average effects, and thus do not fully capture improvements in policy frameworks that may have occurred over time.

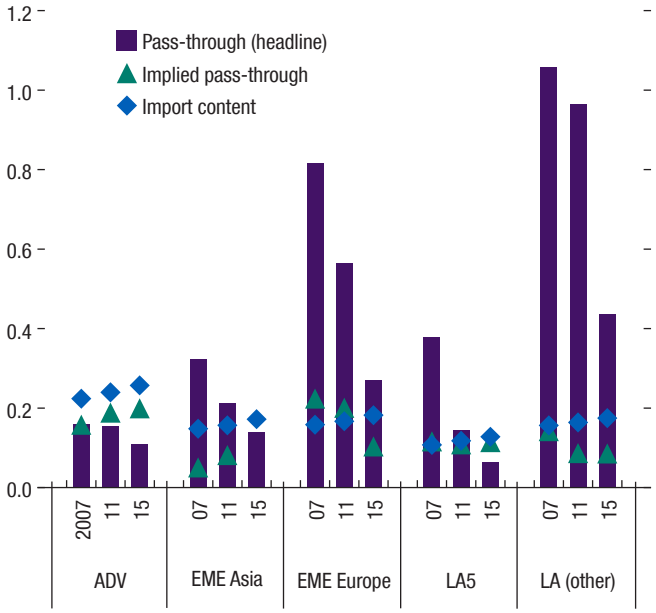
[16]The standard errors from pass-through estimates using the bilateral exchange rage are substantially larger than for estimates using multilateral exchange rates. In fact, the estimates are insignificant at the 10 percent confidence level in all five countries reported in Figure 4.5. The response using bilateral exchange rates in other Latin American countries is either insignificant or similar to the one using multilateral rates—except in Argentina, where the pass-through when using the bilateral exchange rate is about 0.1 lower than when using the multilateral exchange rate.

Figure 4.5. Bilateral versus Multilateral Exchange Rate Pass-Through
(Percent)



Source: IMF staff calculations.
Note: The figure shows the cumulative exchange rate pass-through to headline consumer prices one year after a 1 percent increase in the nominal exchange rate vis-à-vis the U.S. dollar ("Bilateral") or the nominal effective exchange rate ("Multilateral"; see Annex 4.1).

Figure 4.6. Exchange Rate Pass-Through Over Time
(Percent)



Source: IMF staff calculations.
Note: The figure shows the average cumulative exchange rate pass-through to headline consumer prices two years after a 1 percent increase in the nominal effective exchange rate from panel regressions estimated by region over different rolling samples of 12 years, ending on the year indicated in the figure. "Implied pass-through" corresponds to the product of the cumulative exchange rate pass-through to import prices after two years and the country-specific "import content" of domestic consumption (as reported in Figure 4.4). ADV = advanced economies; EME = emerging market economies; LA5 = Brazil, Chile, Colombia, Mexico, and Peru; LA (other) = other Latin American economies.

Have Departures From Benchmark Pass-Through Estimates Narrowed over Time?

We run separate panel regressions over rolling samples of 12 years starting in 1995, 1999, and 2003, and find that the exchange rate pass-through to consumer prices has systematically decreased in all regions (Figure 4.6). The decline is particularly pronounced among emerging market economies, where the average pass-through is much closer to benchmark estimates in the most recent period. In Latin America, the average pass-through has fallen to only one-third of its 1995–2006 level and, among the LA5 economies, it has fallen below 0.10.

Remarkably, this decline in pass-through has taken place despite an increase in the import content of consumption over time. Although the average pass-through to import prices has also declined, the lion's share of the improvement has occurred in the reaction of consumer prices.

Determinants of Exchange Rate Pass-Through: The Role of Monetary Policy

We have documented that exchange rate pass-through varies substantially across countries and has declined markedly over time. What factors might account for these differences? We center our attention on the role that monetary policy has played in attenuating second-round inflation effects following depreciations. In an unstable monetary environment, the impact of currency depreciation on inflation can be amplified by changes in inflation expectations that, in turn, affect price and wage setting decisions. By anchoring medium-term inflation expectations, central banks limit this mechanism and thus reduce the degree and persistence of exchange rate pass-through.

We explore this question following a two-stage procedure similar to Choudhri and Hakura (2006). First, we estimate the degree of exchange rate pass-through *country by country* using equation (4.1).[17] To account for time variation, we estimate these country-specific regressions over rolling samples of 12 years starting in January 1995, obtaining a vector of pass-through estimates for each country in our sample. Second, we regress the full set of country- and time-specific pass-through estimates on a number of potential determinants that have been identified in the literature.[18] To this end, we include the import content of consumption, average inflation, inflation volatility, average depreciation, exchange rate volatility, the persistence of changes in the nominal effective exchange rate, and volatility of inflation forecasts.[19] We then augment the regressions with a proxy for central bank credibility.[20]

The second-stage results are reported in Table 4.1, with all variables found to be statistically significant when introduced separately in the regression. The exchange rate pass-through increases with the level of inflation, its volatility, and with the volatility of inflation expectations. The results also suggest that the larger and the more persistent the change in the exchange rate, or the lower its volatility, the larger the pass-through.[21,22] These results provide indirect evidence of nonlinearities in exchange rate pass-through, some of which have been documented in the literature (for example, Frankel, Parsley, and Wei 2012; Caselli and Roitman 2016). Note that these conclusions largely hold even when all regressors are included simultaneously, despite being highly correlated. However, once we include our proxy for central bank credibility, only credibility and the import content of consumption remain highly significant. Average depreciation remains somewhat significant, but its coefficient is much smaller. Overall, we take this as strong evidence that pass-through decreases with the degree of anchoring of inflation expectations.[23]

The magnitude of the correlation between our proxy of central bank credibility and pass-through is also economically important. An increase of one unit in the credibility index—equivalent to a move from the 25th percentile to the median of central bank credibility within our sample—is associated with a drop in the estimated pass-through of 0.08.

The strong result for the central bank credibility index suggests that a more predictable central bank reaction function is associated with lower average exchange rate pass-through to consumer prices, and one that is closer to its benchmarks. The vanishing significance of most of the determinants once central bank credibility is introduced, also suggests that the nonlinearities discussed above are largely reflecting the same underlying factor: unanchored inflation expectations.

[17]Specifically, we focus on the cumulative exchange rate pass-through to headline inflation after two years.

[18]The set of first-stage estimates used in the second stage is restricted to those that were significant at a 10 percent confidence level. This is a rough approximation to a weighted least squares approach, where insignificant estimates receive a lower weight than more significant ones. The second-stage regression also includes time dummies to control for potential common drivers of pass-through across countries over this period.

[19]All variables are evaluated for the corresponding time period of the estimation window.

[20]Strictly speaking, the index captures the degree of anchoring of inflation expectations at a 12-month fixed horizon using data from Consensus Forecasts surveys (see Annex 4.1). At a sufficiently long horizon, predictable and credible monetary policy should be reflected in low forecast disagreement. Ideally, we would use forecasts at a longer horizon, but these are only available for a handful of countries and at lower frequency.

[21]We tested more formally for asymmetries in exchange rate pass-through by separating depreciations from appreciations in equation (4.1). The results for panel regressions suggest that, in emerging markets, depreciations are associated with a significantly larger pass-through than appreciations. For the LA5 economies, the pass-through from a 1 percent depreciation is about 0.17 after two years (slightly above the average 0.14 response), while it is only 0.04 in the case of an appreciation.

[22]The result on the exchange rate volatility is in line with the hypothesis that a given exchange rate change is less likely to be passed to import prices when such fluctuations are common and transitory (as in Krugman 1989; Froot and Klemperer 1989; and Taylor 2000) and with empirical findings in Frankel, Parsley, and Wei (2012) for advanced economies.

[23]Albagli, Naudón, and Vergara (2015) also find a significant correlation between pass-through and a proxy for central bank credibility based on deviations of inflation from target.

Table 4.1 Second-Stage Estimation Results

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Import share	0.9918***	0.7486***	1.0062***	0.5902***	0.5649**	0.8131***	0.8022***	0.8455***	0.7644***
	(0.1920)	(0.1879)	(0.1904)	(0.1970)	(0.2240)	(0.1933)	(0.1632)	(0.2133)	(0.1890)
Average inflation	0.0293***							0.0273**	–0.0203
	(0.0043)							(0.0122)	(0.0130)
Inflation volatility		0.0227***						0.0237**	–0.0102
		(0.0037)						(0.0093)	(0.0104)
Average depreciation			0.0320***					0.0323***	0.0179*
			(0.0044)					(0.0103)	(0.0098)
Exchange rate volatility				–0.0018*				–0.0068***	–0.0021
				(0.0010)				(0.0014)	(0.0015)
Persistence of exchange rate					1.8574***			0.0307	–1.3675**
					(0.6057)			(0.5818)	(0.5689)
Volatility of inflation forecasts						0.0218***		–0.0386***	0.0260*
						(0.0048)		(0.0135)	(0.0155)
Central bank credibility							–0.0714***		–0.0808***
							(0.0116)		(0.0234)
Number of Observations	425	425	425	425	317	421	292	314	240
R-squared	0.4384	0.4265	0.4463	0.3797	0.3691	0.4042	0.4188	0.5083	0.4376

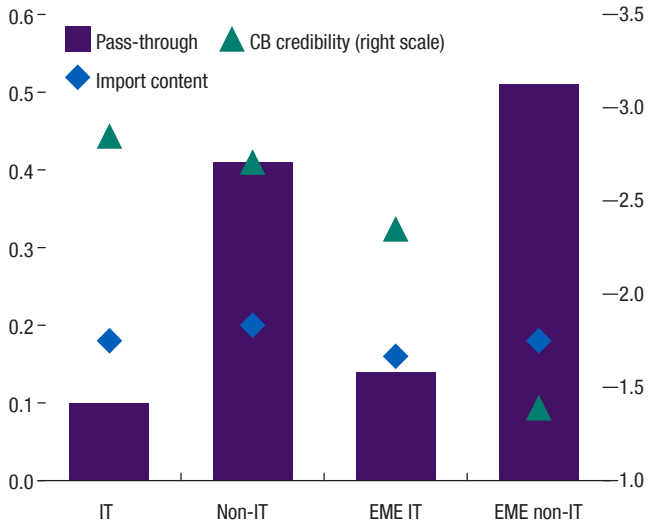
Source: IMF staff calculations.
Note: The dependent variable is the cumulative exchange rate pass-through to headline consumer prices after two years from the first-stage estimates of equation (4.1) for each country over rolling samples of 12 years starting on January of each year since 1995. Only pass-through estimates significant at the 10 percent confidence level are used in the second stage. "Import share" is the average import content of households' consumption expenditure documented in Figure 4.4 over the first-stage estimation sample. "Average inflation" and "Inflation volatility" are the mean and the standard deviation of the monthly percent change in the headline consumer price index, annualized. "Average depreciation" and "Exchange rate volatility" denote the mean and the standard deviation of the monthly percent change in the nominal effective exchange rate, annualized. The "Persistence of exchange rate" is computed by estimating an autoregressive AR(1) process on the monthly nominal effective exchange rate over rolling windows of 24 months and then taking the average autoregressive coefficient over the first-stage estimation window. The "Volatility of inflation forecasts" is the standard deviation of average one-year-ahead inflation forecasts from Consensus Economics over the first-stage estimation sample. The "Central bank credibility" index is constructed from the dispersion among Consensus Economics forecasts, with a higher value denoting lower dispersion (see Annex 4.1). Time fixed effects are included in all specifications.
Standard errors in parentheses.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Over the past two decades, many central banks have adopted inflation targeting precisely to make their decision-making process more explicit and predictable. We explore the relationship between the level of pass-through and monetary regimes by estimating equation (4.1) separately for panels of inflation targeters and others.[24] The results suggest that the exchange rate pass-through is smaller among inflation targeters than noninflation targeters (0.1 versus 0.4), with a larger gap when the sample is constrained to emerging market economies (Figure 4.7). The pass-through estimates for inflation targeters are also much closer to the import-content benchmark than those for noninflation targeters, suggesting that second-round effects are less pervasive among the former. Indeed, inflation expectations are better anchored in economies with inflation targeting regimes than in those with other policy regimes, based on our proxy, and this difference is particularly stark among emerging markets.

Although causal relationships cannot be inferred from these regressions, the estimated correlations suggest that credible monetary policy—supported by an institutional framework that allows central banks to fulfill their mandate independently of fiscal considerations and political pressures—may effectively lower the exchange rate pass-through to consumer prices.

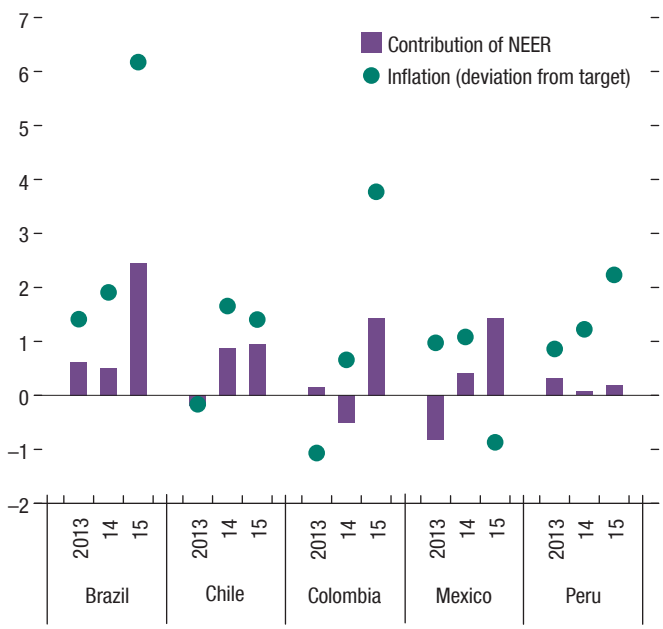
[24]The period of estimation is narrowed to the past 12 years since many emerging markets adopted inflation targeting in the early 2000s.

Figure 4.7. Policy Regimes and Exchange Rate Pass-Through
(Percent)



Source: IMF staff calculations.
Note: The figure shows the average cumulative exchange rate pass-through to headline consumer prices two years after a 1 percent increase in the nominal effective exchange rate from panel regressions by group of countries estimated between January 2003 and December 2015. "IT" refers to countries with an inflation-targeting framework in place; "EME" denotes emerging market economies. "CB credibility" is the average central bank credibility index, as described in Annex 4.1, for each group of countries. "Import content" is as defined in Figure 4.4.

Figure 4.8. LA5: Estimated Contribution of Exchange Rates to CPI Inflation
(Percent)



Source: IMF staff calculations.
Note: The bars show the contribution of the import-weighted nominal effective exchange rate ("NEER"; see Annex 4.1) to consumer price inflation, based on impulse responses from country-specific models. The dots show the deviation of end-of-year annual inflation from the center of the central bank's target range. LA5 = Brazil, Chile, Colombia, Mexico, and Peru.

Recent Inflation through the Lens of Pass-Through Estimates

How much of recent inflation dynamics in Latin America can be explained by currency weakness? In this section, we assess the contribution of changes in the multilateral exchange rate to observed inflation over the past three years. To this end, we use country-specific pass-through estimates for horizons up to 24 months, as well as the actual monthly change in the nominal effective exchange rate between January 2011 and December 2015.[25]

Figure 4.8 summarizes the results of this exercise for the large inflation targeters in Latin America. It suggests that the contribution of the exchange rate depreciation to inflation in Brazil, Chile, Colombia, and Mexico has been increasing over the past two years and was relatively large in 2015—ranging from 1 percentage point in Chile to 2½ percentage points in Brazil. In Peru, the multilateral exchange rate has moved little over the past two years, exerting only a minor influence on inflation.

In Chile, the exchange rate depreciation can account for an important part of the deviation of inflation from its target that emerged over the past two years. In the other countries that have seen an increase in inflation, the results suggest that exchange rate pass-through has played a secondary role. In the case of Colombia and Peru, the increase in inflation can be partially explained by local supply shocks associated with El Niño that affected domestic food prices. In Mexico, the contribution from changes in the exchange rate has been positive since 2014 and was relatively large in 2015, but this effect was more than offset by other factors, including lower commodity prices, a negative output gap, and lower telecommunications service prices on the back of reforms in the sector.

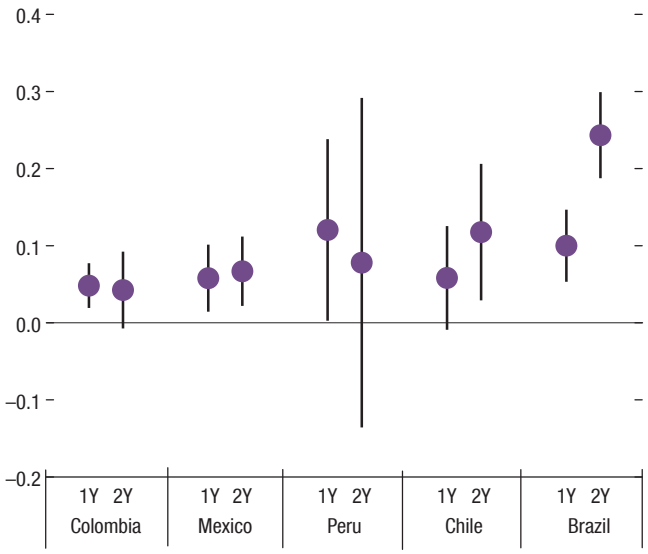
[25]For this exercise, we use the impulse responses computed over a sample window from 2003 to 2015 to capture the lower exchange rate pass-through over the past decade—except for the case of Peru, where we use the full sample owing to concerns about the model's stability.

What Can Be Expected in the Future?

The answer varies across countries in accordance with two factors: the path of the nominal effective exchange rate over the last year, and the delay with which the exchange rate affects consumer prices. Although depreciations among metal exporters largely took place in 2013–14, those of oil exporters happened more recently. We also find significant differences in how quickly a change in the exchange rate affects consumer prices. Figure 4.9 shows the estimated cumulative exchange rate pass-through after 12 and 24 months for the large inflation targeters in Latin America. The pass-through in Brazil and Chile is very gradual, with a cumulative effect after two years that is twice as large as in the first year. In Mexico, the pass-through peaks and stabilizes after one year, while it declines in the second year in Colombia and Peru—and, moreover, the cumulative effect after two years in these two cases is not statistically significant owing to large standard errors.[26]

Together, these findings generally suggest that past depreciation will have only a relatively small additional price effect. In Brazil, however, the response of inflation tends to be slow and the recent depreciation has been particularly large, suggesting a larger remaining impact on consumer prices during 2016. Note that these results are not forecasts of inflation and correspond only to the expected contribution of the exchange rate. Indeed, the other factors in our model will likely continue to counteract inflation pressures in most countries over the coming year.

Figure 4.9. LA5: Exchange Rate Pass-Through Dynamics
(Percent)



Source: IMF staff calculations.
Note: The figure shows the average cumulative exchange rate pass-through to headline consumer prices prices one year (1Y) and two years (2Y) after a 1 percent increase in the nominal effective exchange rate estimated for January 2000 to December 2015. The vertical black lines denote 90 percent confidence intervals. LA5 = Brazil, Chile, Colombia, Mexico, and Peru.

Conclusion and Policy Implications

The sizable currency depreciations observed across many Latin American countries over the past few years have placed upward pressure on inflation, but their impact has been more muted than in the past. The improvement of macroeconomic policy frameworks in many countries in the region over the past two decades, which have established strong nominal anchors, has led to a much lower pass-through of exchange rate depreciations to consumer prices. A direct implication of this result is that it may now be easier for monetary policy to stabilize inflation and real activity, while at the same time allowing the exchange rate to play a key role in adjusting to external shocks. However, second-round effects on inflation remain significant in some countries, particularly in Central America.

Given the magnitude of recent currency movements and the gradual nature of pass-through, some further pressure on consumer prices is likely. Although the appropriate policy reaction is necessarily country specific, the results in this chapter suggest the following common implications:

- In countries with strong central bank credibility and well-anchored medium-term inflation expectations, second-round effects

[26]These differences could reflect several factors, including the reaction of monetary policy. If, for instance, monetary policy reacted strongly enough following movements in inflation triggered by depreciations, the short-term pass-through may be partly reversed over time—potentially ending up below first-round effects.

from movements in the exchange rate are likely to be limited. Therefore, policymakers can allow relative prices to adjust through exchange rate depreciation when faced with an external shock without compromising inflation objectives. Nonetheless, it is important to emphasize that the exchange rate pass-through will remain low so long as monetary authorities continue to ratify the public's expectations that they will deliver their inflation objectives in the medium term.

- In countries where expectations are not well anchored and second-round effects from depreciations are sizable, monetary policy needs to be more proactive to preserve price stability. Over time, as these countries strengthen their policy frameworks and establish a strong track record of meeting their inflation targets, exchange rate pass-through is expected to decline further.

Annex 4.1. Technical Details

Import Content of Households' Consumption Expenditure

The share of import content in households' consumption is estimated from Eora multi-region input-output tables at the world level (see Lenzen and others 2012, 2013). The total value of imports in consumption for a given country and year includes both (1) *direct* imports—that is, imports of final consumption goods—and (2) *indirect* imports—which account for the value of imported inputs used to produce domestic goods absorbed by resident households. The import content of consumption is the sum of direct and indirect imports over households' total consumption expenditure. Direct imports correspond to demand of nonresident sectors' production from resident households in input-output tables. Indirect imports are computed by multiplying the value of output of each domestic sector absorbed by resident households by the share of imported inputs in that sector's output value, and then summing across sectors.

Nominal Effective Exchange Rate and Exporting Countries' Production Cost

The multilateral nominal effective exchange rate (NEER) used in this chapter is based on the bilateral exchange rate of each trading partner vis-à-vis the U.S. dollar, weighted by their import shares. More precisely, the monthly change in NEER for country i at time t is given by:

$$\Delta NEER_{i,t} = \sum_{j=1}^{J} \omega_{ij,t}(\Delta e_{i,t} - \Delta e_{j,t}),\ i \neq j$$

where $e_{i,t}$ is the natural logarithm of country i's bilateral exchange rate (in local currency per U.S. dollar); Δ is the first difference operator; and $\omega_{ij,t}$ is the share of exports from country j to country i in country i's total imports as reported in the IMF's *Direction of Trade Statistics*, lagged one year.

Using the same trade weights $\omega_{ij,t}$, the monthly change in the cost of production in country i's import partners is proxied by:

$$\Delta mPPI_{i,t} = \sum_{j=1}^{J} \omega_{ij,t}\, \Delta PPI_{j,t},\ i \neq j$$

where $PPI_{j,t}$ is the natural logarithm of country j's producer price index.

Central Bank Credibility Index

Like IMF (2015b), we use the degree of anchoring of inflation expectations to construct an index of central bank credibility for country i at time t as:

$$CBC_{i,t} = 1/MA4\delta(\sigma_{i,t})$$

where $MA4\delta(\sigma_{i,t})$ denotes the four-year moving average of the standard deviation of inflation forecasts reported by Consensus Economics at a 12-month fixed horizon. A higher degree of disagreement among forecasters is associated with a lower value of the *CBC* index.

- The dispersion of forecasts serves as a proxy for credibility, since the more predictable a central bank's reaction function is, the less likely are forecasters to disagree about

the future path of inflation. Although the variability of shocks affecting the economy and general macroeconomic uncertainty can also lead to increased dispersion among forecasts, disagreement has been found to be closely related to de jure measures of central bank independence (see Dovern, Fritsche, and Slacalek 2012).

Annex Table A4.1 Sample of Countries

Latin America	Other Emerging Market Economies	Advanced Economies	
Argentina	Bulgaria	Australia	Korea
Bolivia	China	Austria	Latvia
Brazil	Hungary	Belgium	Luxembourg
Chile	India	Canada	Netherlands
Colombia	Indonesia	Czech Republic	New Zealand
Costa Rica	Lithuania	Denmark	Norway
Ecuador	Malaysia	Estonia	Portugal
El Salvador	Pakistan	Finland	Singapore
Guatemala	Philippines	France	Slovak Republic
Honduras	Poland	Germany	Slovenia
Mexico	Romania	Greece	Spain
Panama	Russia	Hong Kong SAR	Sweden
Paraguay	South Africa	Ireland	Switzerland
Peru	Thailand	Israel	United Kingdom
Uruguay	Turkey	Italy	United States
	Ukraine	Japan	

Source: IMF staff compilation.