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Monetary Policy Credibility and Exchange Rate Pass-Through

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Abstract

A long-standing conjecture in macroeconomics is that recent declines in exchange rate pass-through are in part due to improved monetary policy performance. In a large sample of emerging and advanced economies, we find evidence of a strong link between exchange rate pass-through to consumer prices and the monetary policy regime's performance in delivering price stability. Using input-output tables, we decompose exchange rate pass-through to consumer prices into a component that reflects the adjustment of imported goods at the border, and another that captures the response of all other prices. We find that price stability and central bank credibility have reduced the second component.

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I. INTRODUCTION

The empirical literature has reported wide variation in exchange rate pass-through across countries and over time, with many papers documenting a generalized decline over the past few decades (Campa and Goldberg, 2005). Taylor (2000) put forth the conjecture that improvements in monetary policy performance—reflected in stronger nominal anchors and low, stable inflation—result in an endogenous reduction in the exchange rate pass-through to consumer prices. The argument is that the extent to which a firm decides to pass along an increase in its costs is lower where inflation expectations are well anchored.

This paper provides an empirical test of Taylor's hypothesis. We find evidence that price stability and greater monetary policy credibility have significantly reduced exchange rate pass-through to consumer prices. We then construct benchmarks for the amount of pass-through that can be attributed to the price response of foreign goods and services at the border. While the literature has estimated that monetary policy credibility plays a small role in determining pass-through to prices at the border, we find that it plays an important role in reducing the exchange rate pass-through to prices of domestically-produced goods and services.

We begin by estimating models of exchange rate pass-through to consumer prices in a sample of 62 emerging and advanced economies. We document substantial heterogeneity in exchange-rate pass-through across countries, including across income levels and regions, confirming a series of stylized facts that have appeared in the literature. Using rolling-window regressions, we find that exchange rate pass-through to consumer prices has fallen over the past few decades in all country groups, with the largest falls registered in emerging economies.

In the rest of the paper, we explore the role of imported goods and of monetary policy performance in explaining the heterogeneity in estimates of exchange rate pass-through to consumer prices. A change in the exchange rate is expected to trigger an adjustment in relative prices between tradeable and non-tradeable goods and services, and a transitory change in consumer price inflation.[1] The size of this *first-round* effect will depend on how

[1] Burstein, Eichenbaum, and Rebelo (2005) show that the usual decomposition of consumer prices into tradeable and non-tradeable components that relies on retail prices can be misleading for pass-through analysis. The reason is that the retail price of tradeable goods includes two sizeable non-tradeable components: distribution costs—including wholesale and retail services, marketing, advertising, and local transportation services—and local goods that are produced only for the local market. These components reflect the pricing of locally-produced goods and services that are unlikely to be arbitraged in international markets, while prices of imported goods at the border better capture the pricing behavior of "pure" traded goods.

much the local-currency price of imported goods adjusts at the border, and on the share of these goods in domestic consumption, including their role as inputs in the local production of consumer goods. When other prices in the economy—including retail markups, distribution costs, wages, and the price of non-tradeable goods—also react to the exchange rate movement, we refer to the presence of *second-round* effects on consumer prices.

An important empirical limitation is that aggregate price indices are not constructed along these conceptual terms. While many countries produce an index of retail tradable goods prices, it has been documented that approximately half the retail price of the average tradable good is made up of local distribution costs and markups (Burstein, Eichenbaum and Rebelo, 2005). Additionally, imported inputs are factors of production for domestically-produced consumer goods and services that may or may not be tradable. Following Burstein, Eichenbaum, and Rebelo (2005) and Gopinath (2015), we use input-output tables to compute the share of domestic consumption that has been imported for each country in our sample. This measure includes imported consumer goods, as well as the imported inputs that are used in domestically-produced goods. We employ a recently produced global input-output database to generate time-varying measures for each country in our sample, and compare these to our pass-through estimates.

We construct two benchmarks for first-round effects. The first imposes the assumption that exchange rate pass-through to import prices is complete, and is thus directly determined by the import content of domestic consumption. The second relaxes the complete pass-through assumption, and corresponds to the product of the import content and an estimated pass-through coefficient to import prices.

While there are indications that pass-through to imported goods prices may have fallen to some extent, this has taken place alongside an increase in the importance of imported goods and inputs in overall consumption. Taken together, the large reductions in exchange rate pass-through to consumer prices are difficult to account for based on the sensitivity of prices at the dock. We also document a substantial amount of cross-country and time variation in our measure of second-round effects, and find that they are substantial for a large set of economies. Among emerging economies, we find that second-round effects have fallen substantially over time, explaining most of the fall in overall exchange rate pass-through over the past few decades.

We then explore how our estimates of exchange rate pass-through are related to measures of monetary policy performance, including credibility. The literature on the determinants of exchange rate pass-through has found evidence that pass-through to overall consumer prices is associated with the level and volatility of inflation (e.g. Gagnon and Ihrig, 2001; Choudhri and Hakura, 2006).[2] We confirm this result, and complement it with additional evidence based on the behavior of inflation expectations. Following Dovern, Fritsche, and Slacalek (2012) and Capistrán and Ramos-Francia (2010), we proxy for monetary policy credibility using the degree of disagreement among professional forecasters of inflation. We find that, for a given level and volatility of inflation, greater credibility of monetary policy acts to reduce the degree of exchange rate pass-through to consumer prices.

Another strand of the literature has studied exchange rate pass-through to import prices, finding that macroeconomic factors —including variables associated with monetary policy performance—have played only a minor role in explaining the wide variation across countries and over time (Campa and Goldberg, 2005; Frankel, Parsley, and Wei, 2012).[3] This paper complements both strands of the literature by focusing on the role of monetary policy credibility in determining the price response of domestically-produced goods and services (including distribution costs and markups), which are more likely influenced by the domestic inflationary environment than prices at the border. To do so, we regress our estimates of second-round effects on measures of monetary policy credibility. We find that greater monetary policy credibility affects overall exchange rate pass-through to consumer prices primarily through reductions in second-round effects.

The rest of the paper is organized as follows. Section II describes our empirical approach to estimate exchange rate pass-through to overall consumer prices. Section III describes our data and presents the results of our pass-through estimations. Section IV describes the construction of benchmark estimates of first-round effects, and contrasts these to our estimates of overall exchange rate pass-through. Section V explores the role of monetary policy performance in explaining exchange rate pass-through to consumer prices, placing emphasis on credibility and its role in determining second-round effects. Finally, Section VI concludes.

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[2] Theoretical work has also argued that, as average inflation or inflation volatility increase, so does exchange rate pass-through to aggregate prices—although at a decreasing rate—as firms adjust prices more frequently (Devereux and Yetman, 2010). Bouakez and Rebei (2008) estimate a dynamic general equilibrium model for the Canadian economy and conclude that the decline of consumer price pass-through can be largely attributed to the adoption of inflation targeting.

[3] Devereux, Engel, and Storgaard (2004) argue that improvements in the monetary environment may lead to lower pass-through to import prices, as foreign firms may choose the currency of invoicing by taking into account monetary performance in the importing economy. Campa and Goldberg (2005) and Frankel, Parsley, and Wei (2012) found that while higher inflation and exchange rate volatility are associated with higher pass-through to import prices, they are not of first-order importance in explaining its cross-country and time variation.

II. Exchange Rates and Consumer Prices: Empirical Strategy

We begin our empirical analysis with an estimation of the overall impact of a currency depreciation on consumer prices in a sample of 31 advanced and 31 emerging market economies from January 2000 to December 2015.[4] The reduced-form specification is a variant of standard empirical models (see Campa and Goldberg, 2005; Gopinath, 2015). We estimate cumulative responses in a panel setting using Jordà's (2005) local projection method:

$$p_{i,t+h-1} - p_{i,t-1} = \alpha^h + \sum_{j=0}^{J} \left(\beta_j^h \Delta neer_{i,t-j} + \gamma_j^h \Delta oil_{i,t-j} + \delta_j^h \Delta food_{i,t-j} + \vartheta_j^h gap_{i,t-j} + \varphi_j^h \Delta mPPI_{i,t-j}\right) + \sum_{j=1}^{J} \rho_j^h \Delta p_{i,t-j} + \mu_i^h + \varepsilon_{i,t}^h, \quad (1)$$

where $p_{i,t}$ denotes the natural logarithm of the consumer price level in country i and period t (such that the dependent variable measures cumulative inflation between $t-1$ and $t+h$); $neer$ denotes the natural logarithm of the import-weighted nominal effective exchange rate; oil and $food$ denote the natural logarithm of international oil and food prices in U.S. dollars, respectively; gap denotes the output gap (proxied by the cyclical component of industrial production); and $mPPI$ the natural logarithm of the import-weighted producer price index of countries from which country i imports, which proxies for the cost of production in trading partners. Δ denotes a first difference operator; μ_i are country fixed effects; and $\varepsilon_{i,t}$ is a random disturbance.

We follow the increasingly common practice of estimating pass-through from changes in the nominal effective exchange rate, since it more closely summarizes the set of relative price adjustments that can be expected to affect the consumer price index. This choice is not innocuous, since bilateral exchange rate dynamics often diverge significantly from those of the nominal effective exchange rate, and the closeness of their relationship varies a great deal over time and across countries. Panel A of Figure 1 shows the distribution of country-specific pairwise correlations between monthly changes in the nominal effective exchange rate and the bilateral exchange rate against the U.S. dollar over three-year rolling windows starting in 1993. These correlations have frequently been far from unity in several economies, with the median correlation being smaller than 0.5 in many cases. This distinction is likely becoming more relevant over time, as the United States' share of global imports has fallen substantially over the last five decades (Figure 1, Panel B).[5]

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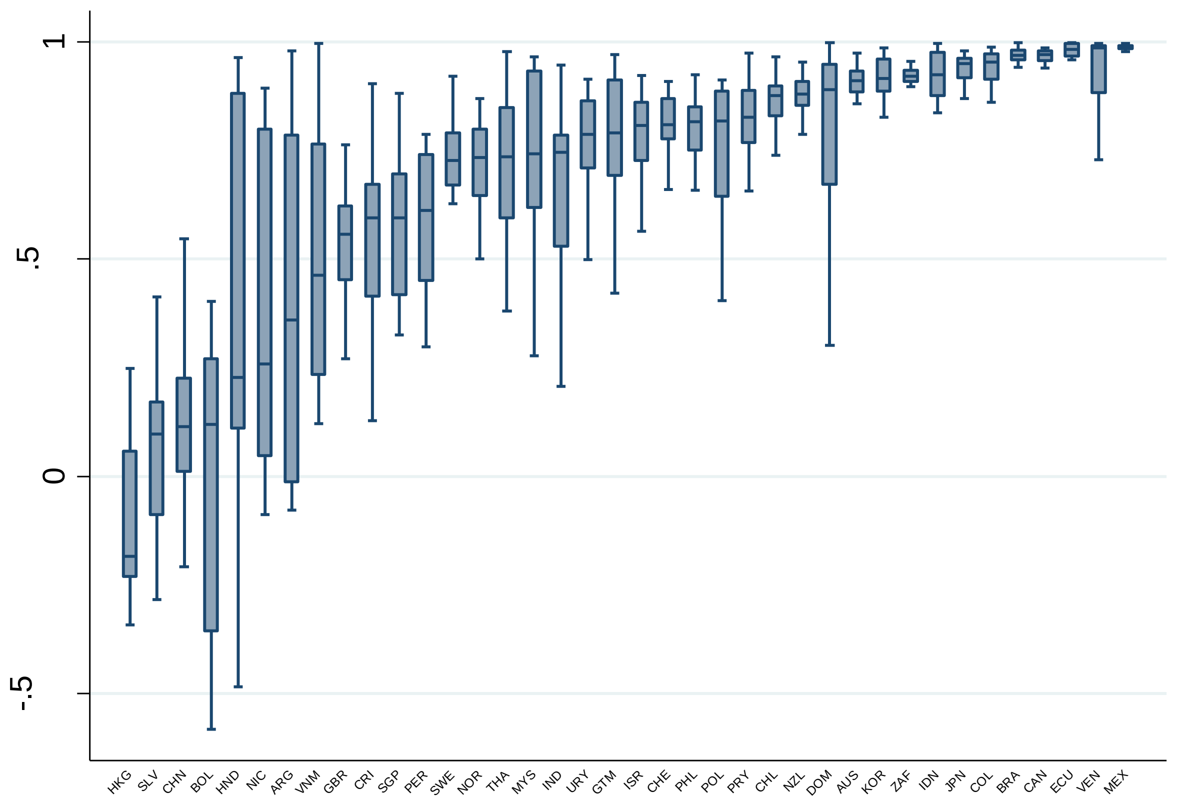
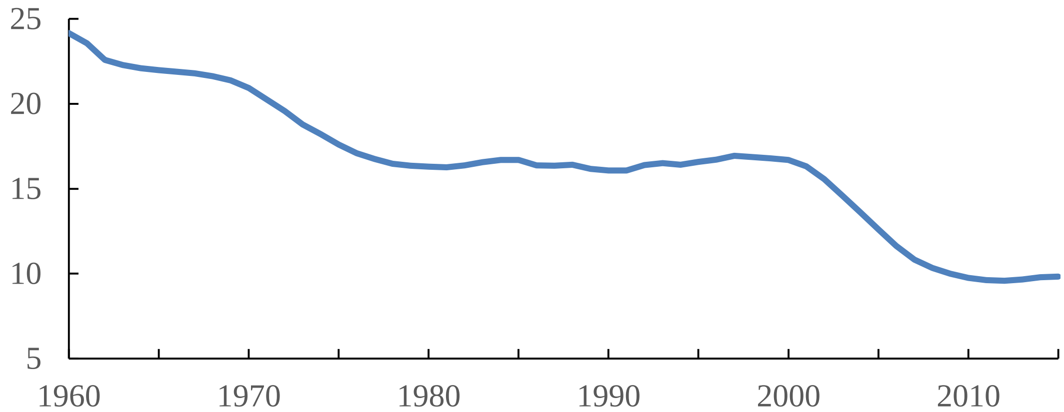
[4] Section III provides additional details on the sample and the construction of the variables used in the analysis.
[5] For completeness, we report pass-through estimates from the bilateral exchange rate against the U.S. dollar in Table A2.

Figure 1. The Correlation between Bilateral and Effective Nominal Exchange Rates and the Importance of the United States in World Trade Flows

A. *Distributions of Rolling Correlations between Bilateral Exchange Rate and NEER*



B. *Share of Imports from the United States in Total World Imports (percent)*



Sources: Bloomberg, L.P.; Haver Analytics; and authors' calculations.
Note: Panel A shows correlations between the nominal effective exchange rate and the bilateral exchange rate against the U.S. dollar for each country over three-year rolling windows starting in 1993. The rectangles and the central marker denote the interquartile range and the median of its distribution, respectively. Panel B shows the five-year moving average of the annual share of total imports from the United States over total world import (excluding the United States).

Following Gopinath (2015), we depart from the usual approach of constructing a nominal effective exchange rate index weighted by total trade, instead weighting bilateral exchange rates by lagged import flows that vary annually. This approach is more appropriate to capture the impact of a currency depreciation on domestic prices, since the composition of exports by destination can differ substantially from the composition of imports by origin.

We include six lags in our specification, which is estimated by ordinary least squares using data at monthly frequency. However, there is considerable uncertainty surrounding the timing of the inflationary effects from depreciation, owing to differences in microstructures across sectors and countries, including different degrees and nature of nominal rigidities. This can be reflected in non-linearities in the response of consumer prices to a depreciation or in a different lag structure across countries. Since we conduct panel and country-specific regressions and for simplicity use the same specification, a flexible estimation method that is robust to misspecification is desirable. The choice of using the local projections method—rather than a vector autoregressive model, for instance—follows primarily from this objective.[6]

To illustrate the implementation and strengths of the local projections method, consider the case of a variable of interest y_t that is known to follow an autoregressive process of unknown order. If we assume that the variable follows a simple AR(1) specification, $\Delta y_t = \alpha + \delta \Delta y_{t-1} + \varepsilon_t$, then the cumulative impulse response from a unit innovation in ε_t after *h* periods is given by $1 + \hat{\delta} + \hat{\delta}^2 + \cdots + \hat{\delta}^h$. In turn, estimation of the impulse response by local projections is implemented by fitting a separate regression for each horizon of interest, $1, 2, \ldots, h$: $\Delta y_{t+1} = \alpha_1 + \rho_1 \Delta y_{t-1} + \varepsilon_t$, $\Delta y_{t+2} = \alpha_2 + \rho_2 \Delta y_{t-1} + \varepsilon_t$, …, $\Delta y_{t+h} = \alpha_h + \rho_h \Delta y_{t-1} + \varepsilon_t$, where the dependent variable is advanced by an additional period in each step. The cumulative impact after *h* periods is equal to $1 + \hat{\rho}_1 + \hat{\rho}_2 + \cdots + \hat{\rho}_h$.[7]

Both methods provide consistent estimates of the impulse response, so long as the model is correctly specified. However, as the number of regressors, lags, and forecast horizon *h* increase, the traditional method becomes increasingly sensitive to even slight specification errors, which can lead to bias in $\hat{\delta}$ and make the calculation of its standard error more complex. In contrast, Jordà (2005) and Teulings and Zubanov (2014) present Monte Carlo simulations showing the local projections method to be more robust to misspecification.

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[6] See Jordà (2005) for a discussion of each aspect of the method.

[7] Note also that the local projections method does not impose smoothness on the impulse response, as is the case under a traditional VAR approach, allowing us to uncover any non-linearity in the impulse response function. Local projections also accommodate estimation of other non-linearities and interactions. See Caselli and Roitman (2016) for an application to non-linear exchange rate pass-through in emerging economies.

The local projections method requires some additional steps to improve efficiency and reduce any potential biases. First, the error term follows a moving average process of order $h-1$ by construction, so it requires an estimator that is robust to serial correlation. Second, the local projections method implies a loss in efficiency that increases with the horizon h. Jordà (2005) suggests that efficiency can be significantly improved by including the residual from the estimation corresponding to horizon $h-1$ as an additional regressor in the estimation for horizon h.[8] It turns out that adding the residual from the regression for horizon $h-1$ also addresses a potential bias identified in Teulings and Zubanov (2014).[9]

Our estimated response reflects the cumulative impact of an innovation in the nominal effective exchange rate on the consumer price index.[10] We do not take a stand on the underlying source of variation in the exchange rate, and responses we report should thus be interpreted as conditional on the average constellation of shocks that moved the exchange rate during the sample period. Some recent studies have sought to identify structural shocks to the exchange rate that are orthogonal to commodity prices and other variables included in the model (for instance, Albagli, Naudon, and Vergara, 2015; Forbes, Hjortsoe, and Nenova, 2015), allowing for an estimated rate of pass-through that is conditional on a particular structural shock. We avoid this route because of the inherent difficulty in identifying structural shocks in real time. Given the considerable uncertainty regarding the source of any given currency fluctuation, reduced-form estimates based on average behavior over long periods provide a good starting point to inform policy discussions.

III. Data Description and Estimation Results

Sample coverage and summary statistics are reported in Table 1. The dependent variable in equation (1) corresponds to the (seasonally adjusted) headline consumer price index, as reported in the IMF's *International Financial Statistics* and by Haver Analytics. International oil and food prices correspond to composite indices in U.S. dollars reported in the IMF's *World Economic Outlook*. The output gap is approximated by the cyclical component of

[8] This procedure has been implemented in a different context by Faust and Wright (2011), who show that augmenting a forecasting model with ex-post forecast errors observed between t and $t+h$ improves forecast accuracy by reducing the variance of the error term.
[9] Teulings and Zubanov (2014) show that not controlling for innovations in the regressors between periods t and $t+h$ when estimating the impulse response at horizon h can bias the local projection estimates of the impulse response. However, innovations in those regressors are included in the error term, which means that augmenting the regression with the residual from the previous stage regression $(h-1)$ can approximate the solution proposed by Teulings and Zubanov (2014) to address this problem.
[10] Since we have defined the dependent variable in our regression equation (1) in cumulative terms, the value of the cumulative impulse response is provided directly by the estimate of β_0^h.

Table 1. Summary Statistics

A. *Economies in Sample*

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

B. *Summary Statistics (1995-2016)*

	Emerging economies				Advanced economies			
Variables	N	Mean	Std. Dev.	Quartiles	N	Mean	Std. Dev.	Quartiles
$\Delta p_{i,t}$	7,691	0.7	1.9	[0.2, 0.8]	8,292	0.2	0.4	[0.0, 0.3]
$\Delta NEER_{i,t}$	7,512	0.3	3.6	[-0.8, 0.9]	7,992	-0.1	1.4	[-0.7, 0.5]
$gap_{i,t}$	7,191	0.0	4.6	[-1.9, 2.4]	8,131	0.0	4.6	[-1.9, 2.3]
$\Delta mPPI_{i,t}$	7,512	0.4	0.8	[0.0, 0.7]	7,992	0.2	0.6	[-0.1, 0.6]

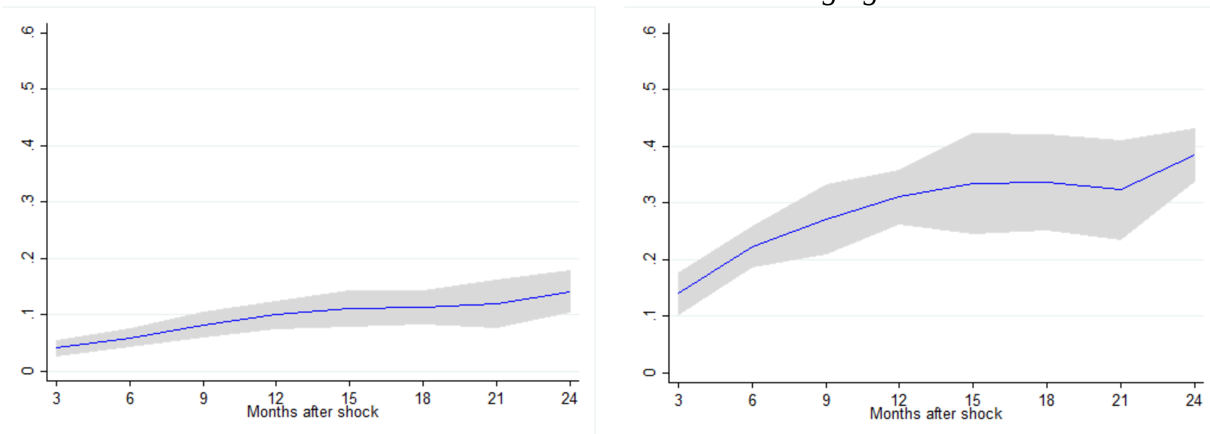
Source: Authors' calculations.

industrial production, which is available for a larger number of countries than quarterly GDP. 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.

The multilateral nominal effective exchange rate ($NEER_{i,t}$) is constructed as a weighted average of the bilateral exchange rate of each trading partner vis-à-vis the U.S. dollar, weighted by their import shares. More precisely, the monthly percentage change $\Delta neer_{i,t}$ for country *i* at time *t* is given by:

Figure 2. Cumulative Impulse Response of Consumer Prices following a Nominal Effective Depreciation of 1 percent (percent)

A. *Advanced Economies* B. *Emerging Market Economies*



Note: Cumulative impulse response of headline consumer prices to a 1 percent innovation in the nominal effective exchange rate estimated using local projection methods. Shaded bands correspond to 95-percent confidence intervals.

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

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, measured at annual frequency.

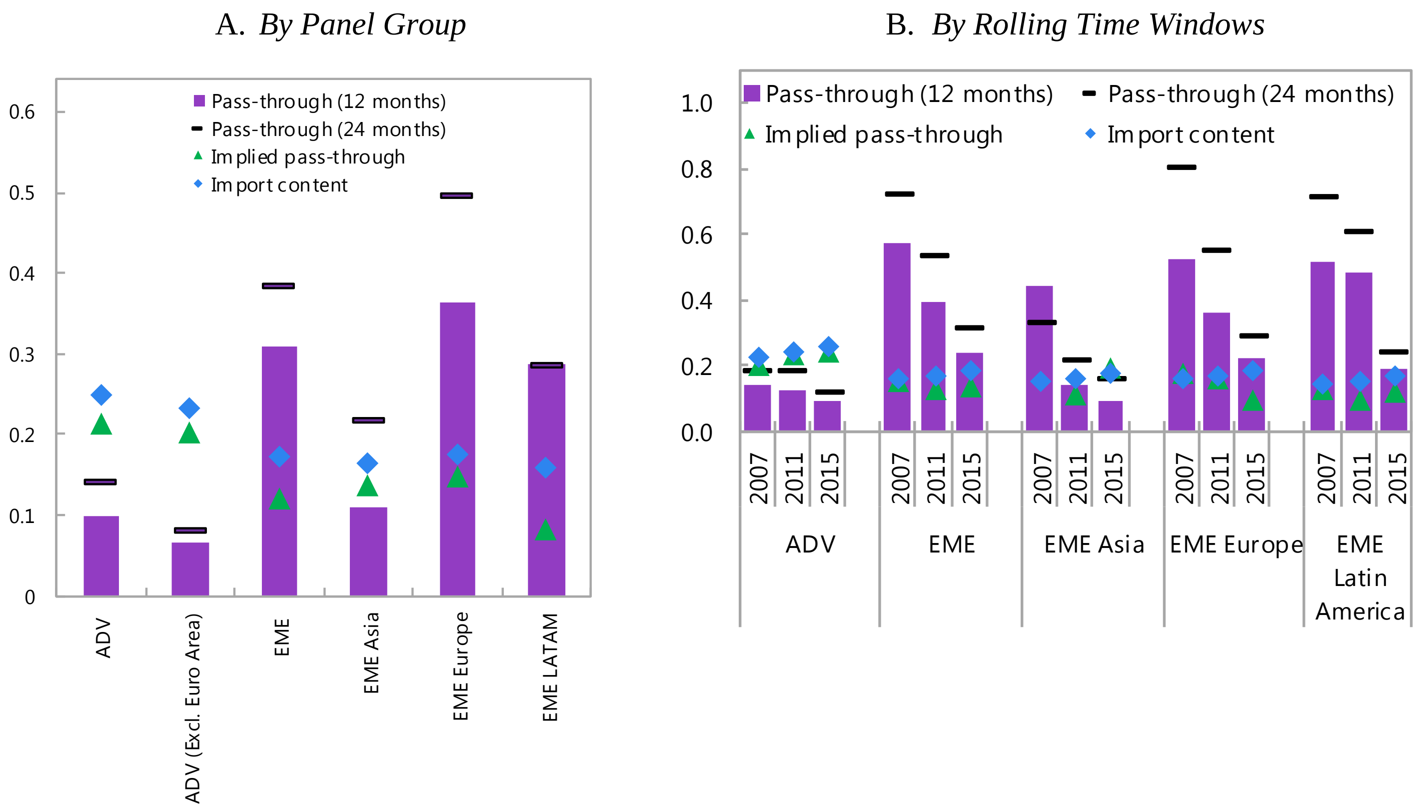
Using the same import weights $\omega_{ij,t}$, the monthly change in the cost of production in country i's import partners is proxied by:

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

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

Figure 2 reports the cumulative impulse responses of headline consumer prices to a 1-percent innovation in the nominal effective exchange rate and the corresponding 95-percent confidence bands, under the baseline sample that runs from January 2000 to December 2015. We start by reporting panel estimates with countries pooled according to their income-based designation of advanced versus emerging market economies. We focus our discussion on pass-through coefficients corresponding to the cumulative percentage increase in the headline

Figure 3. Exchange Rate Pass-through by Panel Group and Over Time



Sources: Authors' calculations.
Note: Cumulative response of headline consumer prices (in percentage points) to a one percent innovation in the nominal effective exchange rate after one and two years. Import content corresponds to the ratio of imported private consumption (including direct imports and the import content of domestically produced goods consumed locally) to total private consumption. Implied pass-through refers to the product of the import content of consumption and the estimated exchange rate pass-through to import prices after one year.

CPI one and two years after each percentage point increase in the nominal effective exchange rate. There are important differences between estimates when countries are pooled by income group. The estimated pass-through is lower for advanced economies than for emerging markets, with the cumulative impact after two years reaching 0.13 for the former, and 0.39 for the latter.

In Figure 3, Panel A reports estimates for emerging market economies by region, including Asia, Europe, and Latin America. We estimate separate impulse response functions for each panel of these country groups, using the local projection method in equation (1). Among emerging markets, the pass-through is lower for Asia (0.2), than for Latin America (0.28), and Europe (0.5). There are also differences in the speed of adjustment of consumer prices. For advanced economies outside the euro area, the process is relatively fast and quite smooth, with the bulk of the price response taking place within 12 months. Among emerging economies, the speed of pass-through varies by region. While it is quite fast among Latin American economies, where the effect peaks after 9 months, the response of prices is much more gradual in emerging Europe and Asia.

To explore whether there is also evidence of declining exchange rate pass-through over time, we run panel regressions in three different subsamples of 12 years starting in 1995, 1999, and 2003. In Figure 3, Panel B reports the results for the two-year cumulative exchange rate pass-through to consumer prices of a one-percent innovation in the nominal effective exchange rate. Consistent with other studies, we find that the exchange rate pass-through to consumer prices has systematically decreased in all country groups over the past two decades. This has been the case in both advanced and emerging economies, though the decline has been more pronounced in the latter. It is also true across regions, with important reductions in pass-through estimated for emerging Asia, Europe, and Latin America. In Latin America, for example, the average pass-through has fallen to only one-third of its 1995–2006 levels. Finally, Figure 3 also includes values for our benchmarks based on import content, which will be described and discussed in Section IV.

To explore the heterogeneity across economies, we estimate country-specific models for the pass-through to consumer prices over the same baseline sample period (2000-15):

$$p_{t+h-1} - p_{t-1} = \alpha^h + \sum_{j=0}^{J}\left(\beta_j^h \Delta neer_{t-j} + \gamma_j^h \Delta oil_{t-j} + \delta_j^h \Delta food_{t-j} + \vartheta_j^h gap_{t-j} + \varphi_j^h \Delta mPPI_{t-j}\right) + \sum_{j=1}^{J} \rho_j^h \Delta p_{t-j} + \varepsilon_t^h. \qquad (2)$$

Table 2 reports the pass-through estimates for each economy in our sample.[11,12] In line with the literature, there is substantial heterogeneity in the magnitude of the estimated exchange rate pass-through across countries: point estimates at a two-year horizon range from negative (although not statistically significant) to larger than unity for a handful of emerging economies.

[11] 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 corresponds to private analysts' estimates.
[12] While the focus on multilateral exchange rates is well justified and common in the literature, we report the pass-through estimates from the bilateral exchange rate against the U.S. dollar in Table A1. More precisely, we substitute $neer_t$ in equation (2) with e_t, the natural logarithm of the country's bilateral exchange rate.

Table 2. Estimates of Exchange Rate Pass-through by Individual Economy

Economy	Pass-through after 12 months			Pass-through after 24 months			Benchmark: Import Content
	beta	s.e.	p-value	beta	s.e.	p-value	
Advanced Economies							
Australia	0.03	0.04	0.46	0.05	0.05	0.29	0.16
Austria	0.28	0.10	0.00	0.25	0.11	0.03	0.26
Belgium	0.19	0.12	0.12	0.00	0.15	0.99	0.28
Canada	-0.02	0.03	0.41	-0.02	0.04	0.66	0.17
Czech Republic	0.13	0.05	0.01	0.06	0.04	0.12	0.27
Denmark	0.16	0.11	0.14	0.10	0.17	0.57	0.23
Estonia	0.48	0.21	0.02	0.22	0.31	0.49	0.30
Finland	0.31	0.08	0.00	0.55	0.19	0.00	0.18
France	-0.03	0.07	0.66	-0.18	0.07	0.01	0.19
Germany	0.08	0.06	0.20	-0.01	0.06	0.87	0.19
Greece	0.18	0.06	0.00	0.08	0.14	0.57	0.21
Hong Kong SAR	0.52	0.17	0.00	1.28	0.29	0.00	0.63
Ireland	0.25	0.07	0.00	0.55	0.16	0.00	0.34
Israel	0.19	0.07	0.01	0.07	0.09	0.44	0.21
Italy	-0.03	0.09	0.78	-0.16	0.14	0.27	0.15
Japan	0.07	0.02	0.00	0.17	0.04	0.00	0.10
Korea	0.08	0.03	0.01	0.14	0.05	0.01	0.18
Latvia	0.26	0.15	0.08	0.68	0.32	0.04	0.22
Lithuania	0.39	0.13	0.00	0.64	0.27	0.02	0.30
Luxembourg	-0.13	0.17	0.45	-0.19	0.25	0.44	0.52
Netherlands	0.17	0.06	0.00	0.21	0.12	0.09	0.24
New Zealand	0.03	0.03	0.28	0.05	0.04	0.27	0.17
Norway	0.07	0.06	0.22	-0.02	0.07	0.74	0.24
Portugal	0.61	0.16	0.00	0.63	0.30	0.04	0.30
Singapore	0.20	0.16	0.21	-0.41	0.26	0.11	0.34
Slovak Republic	-0.12	0.15	0.43	-0.25	0.24	0.31	0.29
Slovenia	0.58	0.09	0.00	1.15	0.17	0.00	0.28
Spain	0.53	0.10	0.00	0.43	0.20	0.03	0.16
Sweden	0.11	0.03	0.00	0.17	0.06	0.01	0.22
Switzerland	0.09	0.02	0.00	0.25	0.05	0.00	0.33
United Kingdom	0.13	0.04	0.00	0.19	0.08	0.03	0.22
United States	0.05	0.09	0.60	0.11	0.14	0.41	0.08

Economy	Pass-through after 12 months			Pass-through after 24 months			Benchmark: Import Content
	beta	s.e.	p-value	beta	s.e.	p-value	
Emerging Economies							
Argentina	0.55	0.13	0.00	0.36	0.11	0.00	0.11
Bolivia	0.19	0.15	0.23	0.30	0.23	0.20	0.17
Brazil	0.10	0.03	0.00	0.23	0.04	0.00	0.08
Bulgaria	0.70	0.18	0.00	0.72	0.41	0.09	0.20
Chile	0.06	0.04	0.11	0.11	0.05	0.03	0.16
China	0.34	0.09	0.00	0.42	0.20	0.04	0.06
Colombia	0.07	0.02	0.00	0.02	0.03	0.35	0.18
Costa Rica	0.32	0.14	0.02	0.68	0.31	0.03	0.18
Ecuador	0.53	0.05	0.00	0.72	0.08	0.00	0.15
El Salvador	0.73	0.40	0.07	1.16	0.75	0.13	0.17
Guatemala	0.41	0.10	0.00	0.95	0.16	0.00	0.13
Honduras	0.90	0.35	0.01	0.95	0.68	0.16	0.21
Hungary	0.23	0.05	0.00	0.26	0.09	0.00	0.23
India	0.09	0.05	0.07	0.18	0.12	0.13	0.05
Indonesia	0.19	0.04	0.00	0.33	0.08	0.00	0.14
Malaysia	0.06	0.07	0.40	0.09	0.10	0.39	0.39
Mexico	0.05	0.03	0.05	0.08	0.03	0.01	0.12
Pakistan	0.68	0.19	0.00	1.33	0.37	0.00	0.04
Panama	0.26	0.16	0.10	0.50	0.25	0.05	0.22
Paraguay	0.28	0.05	0.00	0.41	0.07	0.00	0.28
Peru	0.13	0.06	0.05	0.10	0.13	0.42	0.08
Philippines	0.07	0.08	0.42	0.13	0.16	0.40	0.15
Poland	0.21	0.03	0.00	0.28	0.06	0.00	0.18
Romania	0.25	0.12	0.04	0.31	0.23	0.18	0.17
Russia	0.18	0.06	0.01	0.46	0.14	0.00	0.14
South Africa	0.24	0.05	0.00	0.35	0.08	0.00	0.15
Thailand	-0.16	0.13	0.21	-0.24	0.13	0.06	0.18
Turkey	0.42	0.05	0.00	0.56	0.08	0.00	0.15
Ukraine	0.67	0.15	0.00	0.50	0.30	0.09	0.23
Uruguay	0.03	0.05	0.50	0.06	0.06	0.33	0.12

Note: Beta represents the cumulative response of headline consumer prices to a 1-percent innovation in the nominal effective exchange rate after 12 months and 24 months respectively, estimated with monthly data over 2000-2015. The import content corresponds to the share of household final consumption that is imported (including direct imports and the import content of domestically produced goods) averaged over the same sample (2000-2015).

IV. BENCHMARKS FOR FIRST-ROUND PASS-THROUGH

We go on to explore different aspects of the heterogeneity in exchange rate pass-through to consumer prices. The literature has documented that the prices of locally-produced goods and services and those of pure traded goods (e.g. import prices at the border) respond differently following a change in the exchange rate (Burstein, Eichenbaum, and Rebelo, 2005). We decompose the exchange rate pass-through to consumer prices into two components. The first component reflects the contribution of imported goods prices, measured at the border, which we label as first-round effects. The second component captures the response of all other prices in the consumption basket, including the distribution and retail margins on imported goods, which we denote second-round effects.

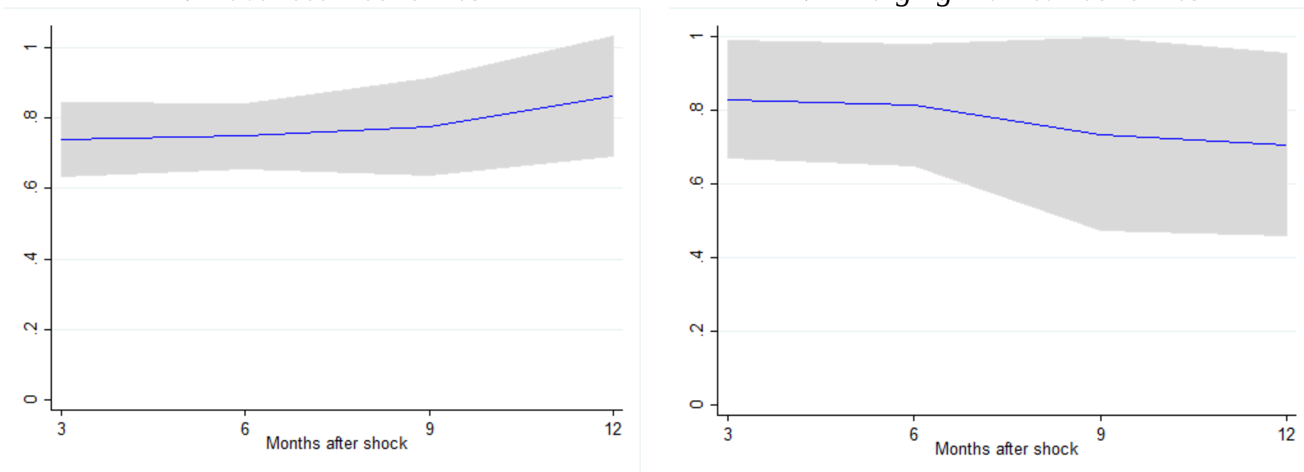
Under perfectly competitive markets, it is generally the case that the exchange rate pass-through to import prices is complete. As such, the expected first-round effect of a depreciation on consumer prices corresponds directly to the import content of final household consumption. However, some studies have documented evidence of incomplete pass-through to import prices (see, for instance, Campa and Goldberg, 2005, and Gopinath, 2015), and a number of mechanisms have been proposed to support this possibility. For instance, under imperfect competition, market power allows firms to "price to market" by adjusting their profit margins in response to the wealth and substitution effects triggered by the currency movement. Alternatively, firms may choose the currency of invoicing in order to minimize costs incurred from price adjustment.[13] Finally, consumers may substitute away from foreign products towards domestic varieties when these exist.

Nevertheless, we start by constructing a benchmark for first-round effects under the assumption that pass-through to import prices is complete. Two factors motivate starting with this benchmark. First, while pass-through to import prices has been found to be far from complete in the United States, empirical evidence from other economies suggests a higher degree of pass-through to import prices (e.g. Campa and Goldberg, 2005). Figure 4 reports panel estimates of the exchange rate pass-through to import prices in our sample, estimated using a specification similar to (1), but where import prices in local currency are used as the dependent variable. The pooled estimates of pass-through to import prices are close to complete both in advanced and emerging market economies. This finding is supported by results from individual economy regressions similar to equation (2). While point estimates differ across countries, the null hypothesis of complete exchange rate pass-through to import prices cannot be rejected at a 95-percent confidence level in 29 of 40 countries in our sample.

[13] Devereux, Engel, and Storgaard (2004) argue that agents will choose to price their goods in the currency that most reliably holds its value. Accordingly, delivering price stability is expected to trigger an endogenous fall in the pass-through of the exchange rate to import prices.

Figure 4. Cumulative Impulse Response of Import Prices Following a Nominal Effective Depreciation of 1 percent (percent).

A. *Advanced Economies* B. *Emerging Market Economies*



Note: Cumulative impulse response of import prices in local currency to a 1 percent innovation in the nominal effective exchange rate estimated using local projection methods. Shaded bands correspond to 95-percent confidence intervals.

Second, while data on import content are available for a large number of countries, import price series are less widely available. Furthermore, authors have raised concerns about the comparability of import price series across countries and over time due to important methodological differences (Burstein and Gopinath, 2014). To complicate matters, commonly used data sources do not always indicate the currency of denomination, such that cross-country work requires careful inspection and manipulation. In most cases, import prices are reported directly in local currency by the source country, while in others, they must be converted to local currency using the average exchange rate over the corresponding month.[14]

To ensure that our conclusions are robust to allowing for incomplete pass-through to import prices, we also construct a second benchmark using our own estimates of the exchange rate pass-through to import prices. To construct our benchmarks empirically, we use data from the Eora multi-region input-output tables (see Lenzen and others, 2012, 2013). The import content of final consumption is the sum of two components. First, a *direct* component that corresponds to imports of final consumption goods—that is, demand from resident households for nonresident sectors' production in input-output tables. Second, an *indirect*

[14] The sample of countries with available import price data, the data sources, and the currency in which the original data is reported, are documented in Table A1.

component that accounts for the value of imported inputs used in the production of domestic goods absorbed by local households. This component is computed as the product of the value of output in each domestic sector that is absorbed by resident households and the share of imported inputs in that sector's output value.

Figure 5 shows that the import content of consumption expenditure has steadily increased in many economies over the past 20 years. The figure also shows that while the direct component dominates, the indirect component can be sizable. The import content in advanced economies is above that of emerging markets, a difference that is partly explained by a few small but highly open advanced economies (such as Luxembourg and Singapore).

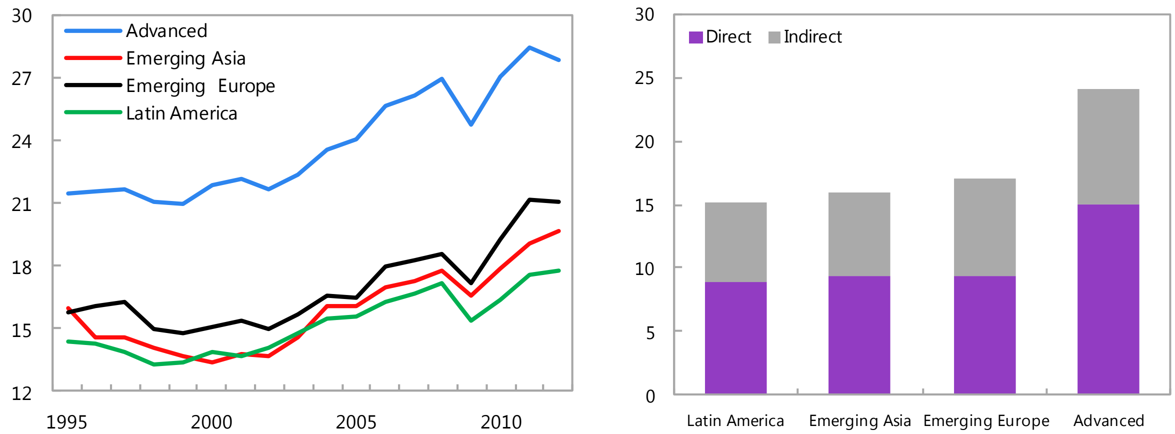
Some studies in the literature have used more widely available metrics of import content such as measures of trade openness. For instance, Choudhri and Hakura (2006) and Gagnon and Ihrig (2004) use the ratio of imports to GDP as a proxy for the import content in consumption, and find no statistical link between pass-through estimates and this import share. However, an aggregate openness metric such as the ratio of imports to GDP also includes imports of non-consumption goods, consumptions goods that are absorbed by the government, and goods that are re-exported to other final destinations. Since none of these components are included in the domestic consumption basket, it may provide an imprecise proxy for understanding exchange rate pass-through to the consumer price index.

Figure 6 confirms this concern by showing that the import-to-GDP ratio can vary a great deal from our metric based on input-output tables, leading to an overstatement of openness in the vast majority of cases. In 2010, economies that had an import content of consumption of about 20 percent according to input-output tables had import-to-GDP ratios ranging from less than 20 percent to close to 70 percent. Likewise, economies with an import content close to 40 percent have ratios of import-to-GDP ratio as large as 170 percent. Of relevance for the topic of exchange rate pass-through, there is reason to think that this dissociation has deepened over time. As participation in global value chains has grown substantially in certain regions, including Eastern Europe and East Asia, gross trade flows have grown faster than net flows. As such, it may be the case that the divergence between trade and input-output based metrics of openness has grown accordingly.

Figure 5. Import Content of Private Consumption

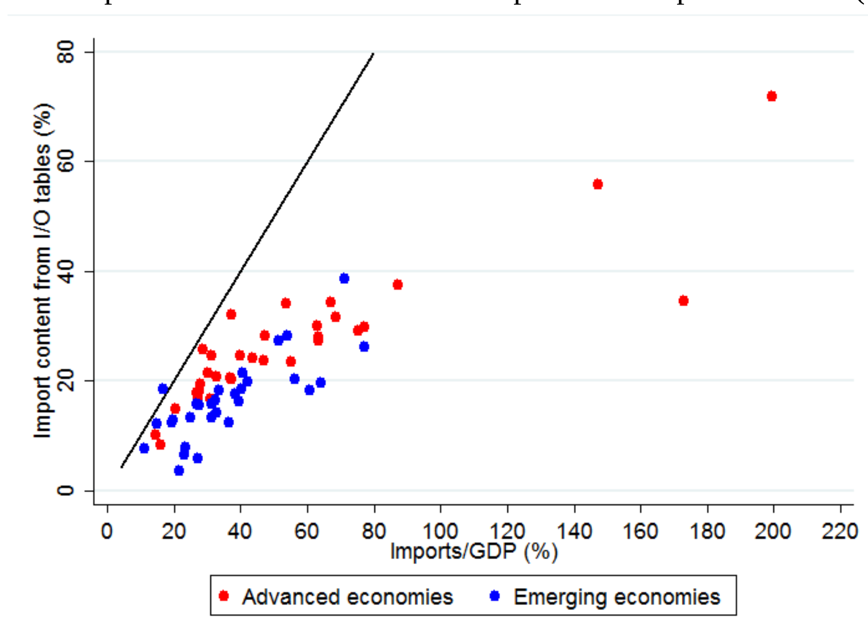
A. *Import Content over Time (percent of total household consumption)*

B. *Direct and Indirect Average Import Content (percent of total household consumption)*



Sources: Eora MRIO; and authors' calculations.
Note: Direct imports correspond to the share of imports of final consumption goods in total private consumption. 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. Total import content is the sum of both components.

Figure 6. Import Content of Private Consumption and Imports to GDP (2010)



Sources: Eora MRIO; IMF *World Economic Outlook*; and authors' calculations.

How do our estimates of exchange rate pass-through to consumer prices compare to our benchmarks? Alongside the pass-through estimates in Figure 3, we also report the average value of the two benchmarks: the import content of consumption, and the product of the import content and our estimated pass-through to import prices, labeled "import content" and "implied pass-through," respectively.[15] For advanced economies, the estimated pass-through is below both benchmarks. Moreover, the import content is above the implied pass-through, suggesting the presence of incomplete exchange rate pass-through to import prices.[16] Among emerging markets, we find that estimates of pass-through are generally above both benchmarks, suggesting the presence of sizable second-round effects on consumer prices.

Two additional observations emerge from the comparison of our benchmarks with the time-varying pass-through estimates reported in Figure 3, Panel B. First, the difference between overall exchange rate pass-through to consumer prices and both benchmarks has narrowed substantially in emerging market economies, suggesting that second-round effects are less pervasive than in the past. Second, the generalized decline in overall exchange rate pass-through to consumer prices cannot be accounted for by changes in the role of import prices. Average pass-through to consumer prices among emerging market economies declined by 0.33 between the first and last estimation windows. During that period, our measure of implied pass-through declined by only 0.01 in these economies—driven by a decline in pass-through to import prices that more than offset the increase in the import content of consumption shown in Figure 5. That is to say, only about 5 percent of the documented decline in pass-through to consumer prices can be accounted for by changes in first-round effects, with the remainder associated with falling second-round effects.

The rightmost column in Table 2 reports the average import content for each economy in our sample over the estimation period of 2000 to 2015. There is considerable heterogeneity of second-round pass-through effects across economies. In Figure 7, Panel A reports the histogram for the 62 estimates of second-round effects at a horizon of 24 months in our baseline sample. A roughly even number of economies display positive and negative second-round effects (33 and 29, respectively). Likewise, Panel B reports the histogram of second-round effects for the 40 economies for which we were able to obtain import price data. Since pass-through to import prices is generally somewhat smaller than one, the distribution is shifted to the right, with only three negative values and a larger concentration of economies between 0 and 0.2.

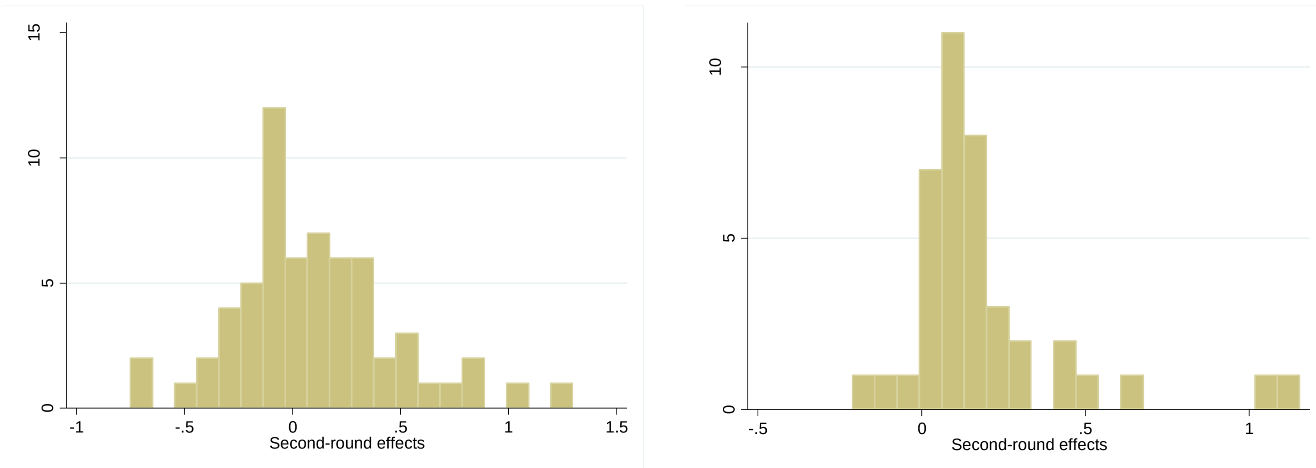
[15] While some point estimates for pass-through to import prices are slightly above one in our sample (similarly to findings in Choudhri, Faruqee, and Hakura, 2005; and Ca'Zorzi, Hahn, and Sánchez, 2007), complete pass-through cannot be rejected in those cases.

[16] Imports within the euro area are included in our measures of import content. One could expect this would worsen the divergence between the import content and the empirical estimates. However, the estimated pass-through for advanced economies remains below the benchmarks even when euro area countries are excluded.

Figure 7. Histogram of Estimated Second-Round Effects

A. *Assuming Complete Pass-through to Import Prices*

B. *Based on Estimated Pass-through to Import Prices*



Source: Authors' estimates.
Note: Distribution of second-round effects for the 62 economies (Panel A) and 40 economies (Panel B).

V. Exchange Rate Pass-Through and Monetary Policy Performance

In the previous sections, we documented a substantial amount of cross-country and time variation in exchange rate pass-through, alongside a good deal of heterogeneity in our benchmarks of first-round effects. In this section, we explore the role of monetary policy performance in determining exchange rate pass-through coefficients. The hypothesis we test is whether, by delivering price stability and better coordinating inflation expectations, monetary policy can lead to a reduction in overall exchange rate pass-through to consumer prices by reducing second-round effects.

To test this hypothesis, we follow a two-stage procedure in the spirit of Campa and Goldberg (2005). In a first stage, we gather our time-varying estimates of exchange rate pass-through for each economy, generated by estimating equation (2) in rolling 12-year windows starting in January of each year since 1995. In a second stage, we explore whether these estimates are related to common proxies of monetary policy performance. To this end, we regress $\hat{\beta}^{12}_{0,i,\tau}$ on a set of explanatory variables $\boldsymbol{X}_{i,\tau}$, measured as the average for the corresponding window τ and country i.[17] In all specifications, we include a full set of time fixed effects (ς_τ)

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[17] We use the inverse of the variance of the estimated pass-through coefficient as weights to give more weight to those coefficients estimated more precisely in the first-stage regressions. We restrict the sample to those countries that have data for all variables in $\boldsymbol{X}_{i,\tau}$.

Table 3. Determinants of Exchange Rate Pass-Through

Dep. var: $\widehat{\beta}_{0,i,\tau}^{12}$	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Mean inflation	0.014***						-0.012***	-0.001
	(0.001)						(0.004)	(0.006)
Std. dev. inflation		0.014***					-0.001	0.011**
		(0.001)					(0.003)	(0.004)
Mean NEER depreciation			0.014***				-0.002	-0.004
			(0.001)				(0.003)	(0.003)
Std. dev. NEER				0.003***			0.000	0.000
				(0.000)			(0.000)	(0.001)
Std. dev. short-term forecasts					0.019***		0.018***	-0.006
					(0.002)		(0.006)	(0.009)
Log of mean disagreement						0.129***	0.126***	0.086**
						(0.009)	(0.020)	(0.039)
Time F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country F.E.	No	No	No	No	No	No	No	Yes
Observations	327	327	327	327	327	327	327	327
Countries	41	41	41	41	41	41	41	41
Time windows	9	9	9	9	9	9	9	9
R^2-adjusted	0.56	0.61	0.54	0.51	0.60	0.64	0.66	0.84

Source: Authors' calculations.

Note: The dependent variable is the estimate of second-round effects for each country i and window τ at a 12-month horizon, using the baseline benchmark for first-round effects. The regressions are estimated by weighted least squares, with observations weighted by the inverse variance of the ERPT pass-through estimates.

corresponding to the windows of estimation, in order to capture common shocks that may have induced a generalized change for all countries in pass-through estimates:

$$\widehat{\beta}_{0,i,\tau}^{12} = \theta \boldsymbol{X}_{i,\tau} + \varsigma_{\tau} + \epsilon_{i,\tau}. \tag{3}$$

Table 3 reports the estimation results for the determinants of cumulative pass-through to consumer prices after 12 months. Columns (1) to (4) show the role of the level and volatility of key nominal variables when these are introduced sequentially. Standard measures of price stability such as the mean and standard deviation of the inflation rate are positively related to our estimates of exchange rate pass-through, a result that is in line with the findings of Choudhri and Hakura (2006) and Gagnon and Ihrig (2004). The coefficients are statistically significant and also economically important: a 1 percent increase in the mean rate of inflation is associated with a pass-through response that is 1.4 percent stronger. Following Campa and Goldberg (2005), we also consider the median depreciation and standard deviation of the multilateral exchange rate, finding that both are associated with higher exchange rate pass-through.

The level and volatility of nominal variables may provide an incomplete picture of monetary performance. At the microeconomic level, price-setters' decisions about whether to pass along a given change in the exchange rate to domestic consumers are likely to be forward-looking. Indeed, Taylor's (2000) argument for endogenous pass-through derives from the idea that pricing decisions will depend on the perceived persistence of an inflationary shock, which is in turn intimately linked to the degree of anchoring of inflation expectations. As such, characteristics of expectation formation about future inflation may also be informative for pass-through dynamics. As a first measure, we consider the variability of consensus inflation forecasts at a 12-month horizon. We find that where forecasts of inflation are more volatile, exchange rate pass-through is higher.

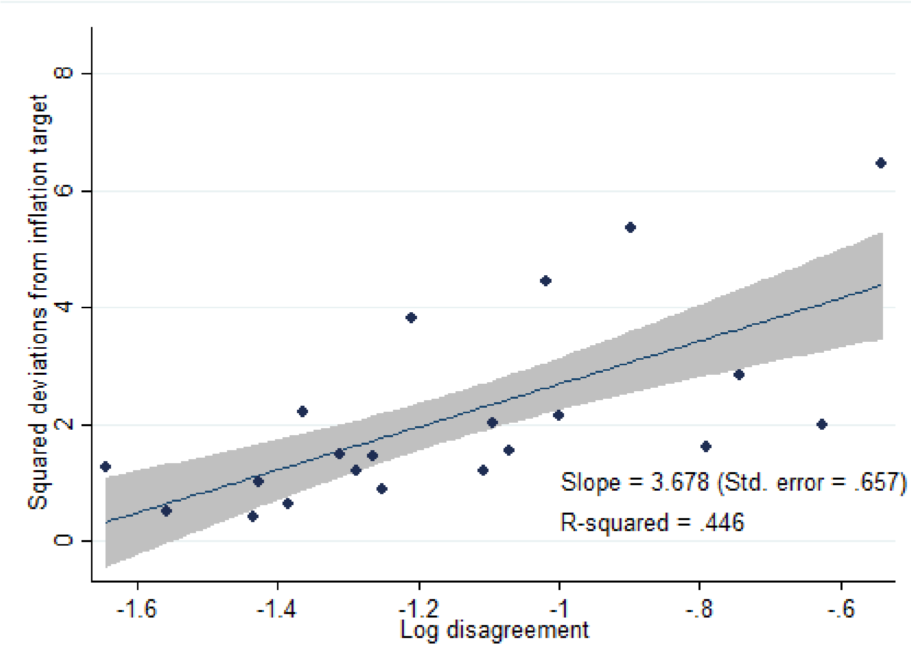
Dovern, Fritsche, and Slacalek (2012) propose that disagreement among professional forecasters of inflation reflect greater credibility of monetary policy—an important factor behind improved monetary policy performance—and find that it is related to measures of central bank independence among G7 economies.[18] Relatedly, Capistrán and Ramos-Francia (2010) estimate that the adoption of inflation targeting reduces the degree of forecast disagreement among developing economies, arguing that this reflects a more predictable monetary policy that is able to better coordinate expectations. Following this literature, we measure disagreement based on the inflation forecasts of individual professional forecasters that are compiled monthly by Consensus Economics. These forecasts are published as fixed-event forecasts for inflation in the current and upcoming calendar year. Since disagreement of fixed-event forecasts decreases over the calendar year as the forecast horizon is reduced, we follow the common approach of combining these forecasts linearly into a synthetic 12-month fixed horizon. Our measure of disagreement corresponds to the standard deviation across these forecasts, and is available at monthly frequency for 41 countries in our sample.

A predictable and credible monetary policy should lead to lower inflation and to closer coordination among forecasters regarding the future path for inflation, since agents have a common understanding of how the central bank will react to any given shock. It is true that the inverse is not necessarily true: agents could agree that the central bank will miss its target, such that there is low disagreement but also a lack of credibility. Promisingly, Figure 8 shows a strong correlation between forecast disagreement and the average (squared) deviation of inflation from central bank targets between 2000 and 2015.[19] In turn, better-anchored inflation expectations could make firms less likely to pass along movements in the

[18] Disagreement among forecasters also captures factors besides monetary policy performance. The variability of shocks affecting the economy is also expected to increase disagreement among forecasters. However, Dovern, Fritsche, and Slacalek (2012) show that the relationship between disagreement and central bank independence is robust to controlling for macroeconomic volatility.

[19] Since only inflation-targeting central banks announce explicit targets for inflation, the sample shrinks considerably.

Figure 8. Disagreement Among Professional Forecasters of Inflation
and Mean Deviation of Inflation from Target



Source: Authors' calculations.
Note: The vertical axis shows mean squared deviations of inflation from inflation targets over 2000-15. The horizontal axis shows log mean disagreement among professional forecasters of inflation over the same sample. The grey area denotes a 95 percent confidence interval.

exchange rate. This result is confirmed in Table 3, column 6, which documents a strong and significant positive relationship between log disagreement and exchange rate pass-through.

These alternative measures of monetary performance are correlated among themselves, since they capture related aspects of price stability. For instance, Mankiw, Reis, and Wolfers (2003) and Capistrán and Ramos-Francia (2010) document that forecast disagreement is increasing in the level of inflation. In column 7, we include all explanatory variables in the same specification. Interestingly, disagreement seems to act as a good summary measure for the role of price stability in the determination of pass-through. Conditional on the first and second moment of nominal variables, lower forecast disagreement remains associated with smaller exchange rate pass-through to consumer prices. The overall fit of the model changes little between specifications reported in columns 6 and 7: conditional on the degree of disagreement among professional forecasters of inflation, our other measures of price stability offer limited additional information about exchange rate pass-through. The coefficient on disagreement also remains economically meaningful: a decline in disagreement from the top to the bottom of the interquantile range would be associated with a decline in pass-through of about 0.07 percentage points.

As the overall fit of these estimations makes clear, there are likely to be many factors besides monetary performance that affect the degree of exchange rate pass-through. Many of these are likely structural characteristics of local markets, such as the degree of competition among importers and domestic producers, and their exclusion from the specification could give rise to omitted variable bias. Another concern is reverse causality, since high pass-through may itself create an environment of high and volatile inflation that is more difficult to forecast.

To address these concerns, we introduce country fixed effects in the specification reported in column 8. Given the dimensionality of the data, the within-group estimator is quite conservative: country fixed effects account for a large share of overall variation in the data, as there are only nine estimation windows for each country in the sample and these overlap substantially. Still, we find that the variability of inflation and the degree of forecast disagreement remain positively related to exchange rate pass-through, while the coefficient on forecast disagreement remains large. The inclusion of the volatility of actual and expected inflation in the specifications—whose coefficients are reported in columns 7 and 8—further mitigates reverse causality concerns, since difficulties with forecasting inflation would likely be associated with higher actual and expected inflation.

Does monetary policy credibility affect pass-through beyond the border?

If improved monetary policy credibility has indeed reduced exchange rate pass-through to consumer prices, is this due to a reduced sensitivity of imported or domestically-produced goods and services? Past empirical literature has found that monetary policy credibility does affect exchange rate pass-through at the border, but that it plays a relatively minor role (Campa and Goldberg, 2005). Further, we documented in Section IV that the magnitude of the fall in implied pass-through is unable to account for the much larger fall in exchange rate pass-through. If monetary credibility acted exclusively through the reduced sensitivity of imported goods prices, we would be led to conclude that it has played only a minor role in the reduction of overall pass-through.

To explore the role that monetary policy credibility may have played in the sensitivity of domestically-produced goods prices, we use our benchmarks to construct time-varying estimates of second-round effects for each country i and window τ at horizon h = 12:

$$\widehat{\Omega}_{i,\tau} = \widehat{\beta}^{12}_{0,i,\tau} - \delta_{i,\tau},$$

Table 4. Determinants of Second-Round Pass-Through Effects

Dep. var: $\widehat{\Omega}_{i,\tau}$	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Mean inflation	0.018***						-0.005	0.001
	(0.002)						(0.005)	(0.006)
Std. dev. inflation		0.015***					0.002	0.010**
		(0.001)					(0.004)	(0.004)
Mean NEER depreciation			0.018***				0.008**	-0.004
			(0.002)				(0.004)	(0.003)
Std. dev. NEER				0.003***			-0.000	0.000
				(0.000)			(0.001)	(0.001)
Std. dev. short-term forecasts					0.021***		0.004	-0.006
					(0.002)		(0.007)	(0.009)
Log of mean disagreement						0.142***	0.095***	0.074*
						(0.011)	(0.024)	(0.039)
Time F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country F.E.	No	No	No	No	No	No	No	Yes
Observations	327	327	327	327	327	327	327	327
Countries	41	41	41	41	41	41	41	41
Time windows	9	9	9	9	9	9	9	9
R^2-adjusted	0.39	0.39	0.40	0.31	0.40	0.44	0.45	0.84

Source: Authors' calculations.

Note: The dependent variable is the estimate of second-round effects for each country *i* and window τ at a 12-month horizon, using the baseline benchmark for first-round effects. The regressions are estimated by weighted least squares, with observations weighted by the inverse variance of the ERPT pass-through estimates.

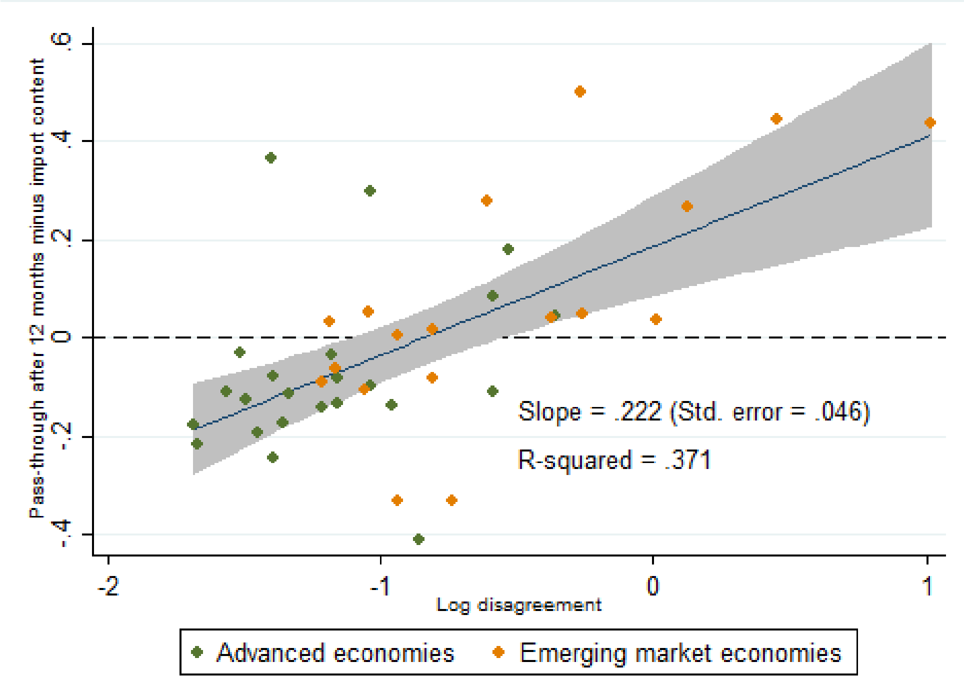
where $\widehat{\beta}^{12}_{0,i,\tau}$ is the estimated pass-through at a horizon of 12 months, and $\delta_{i,\tau}$ is the benchmark for the expected first-round effects of a depreciation on consumer prices (computed as the average for the corresponding window τ and country *i*). The first benchmark corresponds to the import content of consumption and the second to its product with country-specific estimates of the exchange rate pass-through to import prices.

We repeat our second stage regression to explore whether these estimates of second-round effects, $\widehat{\Omega}_{i,\tau}$, are related to common proxies for monetary policy performance. To this end, we regress $\widehat{\Omega}_{i,\tau}$ on the same set of explanatory variables $\boldsymbol{X}_{i,\tau}$, measured as the average for the corresponding window τ and country *i*: [20]

$$\widehat{\Omega}_{i,\tau} = \theta \boldsymbol{X}_{i,\tau} + \varsigma_\tau + \epsilon_{i,\tau} \ .$$

[20] We use the inverse of the variance of the estimated pass-through coefficient as weights to give more weight to those coefficients estimated more precisely in the first-stage regressions. We restrict the sample to those countries that have data for all variables in $\boldsymbol{X}_{i,\tau}$.

Figure 9. Disagreement Among Professional Forecasters of Inflation and Second-round Effects from Depreciations



Source: Authors' calculations.
Note: The vertical axis shows estimates of second-round effects from changes in the exchange rate, constructed as the difference between the country-specific pass-through estimates one year after a one-percent increase in the nominal effective exchange rate, in percentage points, and the average import content for the baseline sample (2000-15). The horizontal axis shows log mean disagreement among professional forecasters of inflation over the same sample. The grey area denotes a 95 percent confidence interval.

We first use a set of second-round effects ($\widehat{\Omega}_{i,\tau}$) constructed assuming complete pass-through to import prices. As shown in Figure 9, there is a strong cross-sectional correlation between forecast disagreement and our second-round effects. This result is confirmed by the regression results reported in Table 4 (columns 6 to 8). The relationship is also economically meaningful. A decline in the degree of disagreement from the top to the bottom of the interquartile range in our sample is associated with a decline in pass-through of about 0.10 percentage point, which is about one-third of the second round effects estimated at the largest decile.

We then estimate the regressions using our second benchmark for first-round effects, which uses our own estimate of the exchange rate pass-through to import prices (Table 5).[21] The

[21] The sample is smaller than that of Tables 3 and 4 since fewer countries have monthly import price data for the whole period.

Table 5. Determinants of Second-Round Pass-Through Effects, using Alternative Benchmark

Dep. var: $\hat{\Omega}_{i,\tau}$	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Mean inflation	0.018***						0.003	-0.009
	(0.003)						(0.010)	(0.011)
Std. dev. inflation		0.023***					0.036**	0.078***
		(0.004)					(0.015)	(0.014)
Mean NEER depreciation			0.021***				0.013*	-0.007
			(0.003)				(0.007)	(0.005)
Std. dev. NEER				0.004***			0.001	-0.000
				(0.001)			(0.001)	(0.002)
Std. dev. short-term forecasts					0.020***		-0.044**	-0.049***
					(0.004)		(0.017)	(0.018)
Log of mean disagreement						0.202***	0.108*	0.171**
						(0.024)	(0.061)	(0.075)
Time F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country F.E.	No	No	No	No	No	No	No	Yes
Observations	169	169	169	169	169	169	169	169
Countries	29	29	29	29	29	29	29	29
Time windows	9	9	9	9	9	9	9	9
R^2-adjusted	0.22	0.20	0.23	0.17	0.16	0.30	0.32	0.79

Source: Authors' calculations.
Note: The dependent variable is the estimate of second-round effects for each country *i* and window τ at a 12-month horizon, using the alternative benchmark for first-round effects. The regressions are estimated by weighted least squares, with observations weighted by the inverse variance of the ERPT pass-through estimates.

main findings remain broadly unchanged when we allow for incomplete pass-through to import prices. When the explanatory variables are introduced sequentially (columns 1 through 6), they all remain significant. The coefficient on disagreement of inflation forecasts is even larger than under the baseline benchmark, and remains strongly significant—and even larger—when all explanatory variables are included together (column 7) and the specification also includes country fixed effects (column 8). That is to say, for a given level and volatility of inflation and the exchange rate, a more credible monetary policy substantially reduces exchange rate pass-through to consumer prices beyond the border.

VI. Concluding Remarks

We revisit a longstanding question in macroeconomics on the determinants of the response of consumer prices to currency depreciations. We propose an empirical decomposition of pass-through based on the component of the exchange rate pass-through that reflects the pricing of imported goods at the dock. This allows us to infer the response of the remaining, domestically-produced goods and services, which we label as second-round effects. Using data from global input-output tables, we document how a generalized fall in exchange rate pass-through has taken place despite an increase in the import content of domestic consumption. Given only modest declines in pass-through to import prices, we conclude that reductions in second-round effects are largely responsible for the decline in overall pass-through to consumer prices.

We then explore the role of monetary policy performance in explaining cross-country and time-variation in the rate of exchange-rate pass-through. Alongside traditional measures of price stability, such as the level and variability of inflation, we introduce additional aspects of monetary performance, such as the degree of disagreement among professional forecasters of inflation. We interpret this measure as an indicator of monetary policy credibility and find it to be statistically significant and economically important in explaining exchange-rate pass-through. An increase in disagreement among professional forecasters of inflation from the 25th to the 75th percentiles of our sample is associated with an increase in the estimated pass-through coefficient by 0.1. This is a sizable change, given that the average cumulative pass-through after two years is about 0.3 in the sample. We then use our benchmarks to investigate which component of pass-through is most influenced by monetary policy credibility, and find that these variables hold considerable sway over second-round effects.

This result provides evidence in support of a longstanding conjecture that the improvement of monetary policy frameworks by establishing strong nominal anchors has led to lower exchange rate pass-through to consumer prices. In particular, this appears to have substantially reduced pass-through to the prices of domestically-produced goods and services among emerging countries over the last two decades. An important policy implication is that, in countries where central bank credibility has been established, it may now be less costly for monetary policy to stabilize inflation and real activity, while at the same time allowing the exchange rate to play a key role in helping the economy adjust to external shocks.

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ANNEX

Table A1. Import Price Data Sources

Economy	Source	Local Currency	Economy	Source	Local Currency
Austria	Haver Analytics / Eurostat	Yes	Brazil	Haver Analytics / FUNCEX	No
Belgium	Haver Analytics / Eurostat	Yes	Colombia	Haver Analytics / BANREP	Yes
Canada	Haver Analytics / StatCan	Yes	El Salvador	Haver Analytics / BCR	No
Czech Republic	Haver Analytics / CSO	Yes	Hungary	Haver Analytics / CSO	Yes
Denmark	Haver Analytics / IFS	Yes	Indonesia	Haver Analytics / BPS	Yes
Estonia	Haver Analytics / Eurostat	Yes	Lithuania	Haver Analytics / Eurostat	Yes
Finland	Haver Analytics / Eurostat	Yes	Malaysia	Haver Analytics / DSM	No
France	Haver Analytics / Eurostat	Yes	Mexico	Haver Analytics / BMEX	No
Germany	Haver Analytics / Eurostat	Yes	Paraguay	Haver Analytics / BCP	Yes
Greece	Haver Analytics / Eurostat	Yes	Peru	Haver Analytics / BCRP	No
Hong Kong SAR	Haver Analytics / HKCSD	Yes	Poland	Haver Analytics / CSO	Yes
Ireland	Haver Analytics / Eurostat	Yes	Thailand	Haver Analytics / MoC	Yes
Italy	Haver Analytics / Eurostat	Yes	Turkey	Haver Analytics / TRSTAT	No
Japan	Haver Analytics / JPCSD	Yes			
Korea	Haver Analytics / NSO	Yes			
Latvia	Haver Analytics / Eurostat	Yes			
Luxembourg	Haver Analytics / Eurostat	Yes			
Netherlands	Haver Analytics / Eurostat	Yes			
Portugal	Haver Analytics / Eurostat	Yes			
Singapore	Haver Analytics / DoS	Yes			
Slovak Republic	Haver Analytics / Eurostat	Yes			
Slovenia	Haver Analytics / Eurostat	Yes			
Spain	Haver Analytics / Eurostat	Yes			
Sweden	Haver Analytics / SCB	Yes			
Switzerland	Haver Analytics / SFSO	No			
United Kingdom	Haver Analytics / IFS	Yes			
United States	Haver Analytics / BLS	Yes			

Source: Authors’ compilation.
Note: Local currency denotes whether the import price data is directly reported in local currency by the source.

Table A2. Estimates of Pass-through from Bilateral Exchange Rate

Economy	Pass-through after 12 months			Pass-through after 24 months			Benchmark:
	beta	s.e.	p-value	beta	s.e.	p-value	Import Content
Australia	0.03	0.03	0.36	0.04	0.04	0.26	0.16
Austria	0.03	0.02	0.08	0.00	0.03	0.91	0.26
Belgium	0.02	0.03	0.51	-0.06	0.04	0.09	0.28
Canada	-0.03	0.02	0.20	0.00	0.04	0.96	0.17
Czech Republic	0.03	0.03	0.21	0.00	0.03	0.96	0.27
Denmark	0.02	0.03	0.46	-0.02	0.04	0.64	0.23
Estonia	-0.01	0.07	0.86	-0.21	0.08	0.01	0.30
Finland	0.08	0.03	0.01	0.10	0.06	0.11	0.18
France	-0.03	0.02	0.20	-0.06	0.02	0.01	0.19
Germany	-0.01	0.02	0.58	-0.04	0.03	0.11	0.19
Greece	0.06	0.03	0.02	0.03	0.06	0.65	0.21
Hong Kong SAR							
Ireland	0.07	0.03	0.01	0.17	0.07	0.01	0.34
Israel	0.23	0.06	0.00	0.11	0.06	0.08	0.21
Italy	-0.03	0.03	0.35	-0.08	0.05	0.13	0.15
Japan	0.05	0.02	0.04	0.14	0.05	0.01	0.10
Korea	0.04	0.03	0.14	0.07	0.04	0.10	0.18
Latvia	-0.15	0.07	0.04	-0.26	0.17	0.13	0.22
Lithuania	0.11	0.07	0.10	0.05	0.16	0.74	0.30
Luxembourg	-0.04	0.04	0.23	-0.08	0.05	0.11	0.52
Netherlands	0.04	0.03	0.18	0.08	0.06	0.19	0.24
New Zealand	0.01	0.02	0.66	0.01	0.04	0.86	0.17
Norway	0.06	0.03	0.03	0.00	0.04	1.00	0.24
Portugal	0.09	0.03	0.00	0.13	0.06	0.04	0.30
Singapore	-0.30	0.10	0.00	-0.72	0.19	0.00	0.34
Slovak Republic	-0.06	0.04	0.09	-0.16	0.06	0.01	0.29
Slovenia	0.06	0.04	0.11	0.15	0.06	0.02	0.28
Spain	0.11	0.03	0.00	0.07	0.05	0.18	0.16
Sweden	0.05	0.02	0.00	0.07	0.03	0.04	0.22
Switzerland	0.03	0.01	0.03	0.05	0.03	0.14	0.33
United Kingdom	0.07	0.03	0.02	0.08	0.08	0.32	0.22
United States							

Economy	Pass-through after 12 months			Pass-through after 24 months			Benchmark:
	beta	s.e.	p-value	beta	s.e.	p-value	Import Content
Argentina	0.33	0.13	0.01	0.30	0.12	0.01	0.11
Bolivia							
Brazil	0.10	0.03	0.00	0.23	0.05	0.00	0.08
Bulgaria	0.06	0.09	0.52	-0.12	0.17	0.49	0.20
Chile	0.03	0.04	0.40	0.06	0.07	0.41	0.16
China	-0.05	0.24	0.82	-0.79	0.69	0.25	0.06
Colombia	0.06	0.02	0.00	0.02	0.03	0.43	0.18
Costa Rica	0.17	0.16	0.28	0.50	0.36	0.17	0.18
Ecuador							
El Salvador							
Guatemala	0.15	0.16	0.35	1.01	0.26	0.00	0.13
Honduras	0.34	0.96	0.72	-1.34	2.93	0.65	0.21
Hungary	0.06	0.03	0.05	0.05	0.04	0.30	0.23
India	0.08	0.06	0.14	0.11	0.14	0.44	0.05
Indonesia	0.17	0.03	0.00	0.31	0.06	0.00	0.14
Malaysia	0.01	0.07	0.91	-0.12	0.11	0.31	0.39
Mexico	0.05	0.03	0.04	0.07	0.03	0.04	0.12
Pakistan	0.42	0.27	0.13	0.76	0.43	0.08	0.04
Panama							
Paraguay	0.26	0.05	0.00	0.46	0.10	0.00	0.28
Peru	0.12	0.08	0.14	-0.02	0.08	0.84	0.08
Philippines	-0.01	0.08	0.87	-0.05	0.11	0.63	0.15
Poland	0.12	0.03	0.00	0.13	0.05	0.01	0.18
Romania	0.11	0.07	0.12	0.10	0.10	0.33	0.17
Russia	0.20	0.08	0.01	0.54	0.14	0.00	0.14
South Africa	0.21	0.04	0.00	0.29	0.08	0.00	0.15
Thailand	-0.17	0.08	0.05	-0.28	0.09	0.00	0.18
Turkey	0.42	0.06	0.00	0.61	0.08	0.00	0.15
Ukraine	0.78	0.14	0.00	0.21	0.28	0.47	0.23
Uruguay	0.12	0.05	0.02	0.19	0.10	0.07	0.12

Note: Beta represents the cumulative response of headline consumer prices to a 1-percent innovation in the nominal bilateral exchange rate vis-à-vis the U.S. dollar after 12 months and 24 months respectively, estimated with monthly data over 2000-2015. The import content corresponds to the share of household final consumption that is imported (including direct imports and the import content of domestically produced goods consumed locally) averaged over the same sample (2000-2015).