STATE-DEPENDENT EXCHANGE RATE PASS-THROUGH*

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Abstract

Since 2020, the world economy has been hit by three related shocks: elevated uncertainty, multi-decade high inflation, and significant U.S. monetary policy tightening. The latter has also led to a strong depreciation of local currencies against the US dollar in many countries. Drawing on the experience of a large sample of advanced and emerging market economies over the past 30 years, we document that the rate of pass-through from the exchange rate to domestic prices is state-dependent and significantly larger during periods of high inflation and uncertainty, and when exchange rate depreciations are driven by U.S. monetary policy tightening. These results suggest that the magnitude of current exchange rate pass-through into prices is likely to be significantly larger than historically.

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1. Introduction

An extensive empirical literature has estimated the sensitivity of domestic prices to fluctuations in the exchange rate. The rate of exchange rate pass-through has been found to have declined significantly over the past several decades, associated with the changing composition of imported goods (Campa and Goldberg 2005), the prevalence of price stability (Choudhri and Hakura 2006), and the increased credibility of monetary policy (Carrière-Swallow and others 2021). It has also been found to depend on the nature of the shock that causes the exchange rate depreciation (Forbes, Hjortsoe, and Nenova 2018; García-Cicco and García-Schmidt 2020).

Do these findings remain valid? The COVID-19 pandemic has led to an unprecedented surge in economic uncertainty (Ahir, Bloom and Furceri 2022). It has also marked the end of a long period of relatively stable prices initiated in the early 2000s with the widespread adoption of inflation targeting and great moderation. In 2021, pandemic-related supply chain disruptions (Carrière-Swallow and others 2023) and strong demand from unprecedented fiscal and monetary policy expansion pushed inflation above central bank targets in many economies (Gopinath 2022). By early 2022, spiking commodity prices following Russia's invasion of Ukraine had pushed inflation rates up further, reaching multi-decade highs in Australia, Canada, the United States, United Kingdom, European Monetary Union, and many emerging economies in Latin America and Eastern Europe. When the Federal Reserve began tightening its monetary policy more aggressively in mid-2022 to reign in high inflation, the US dollar gained strength against other currencies. Around the world, central banks already dealing with high inflation faced concerns that depreciating currencies could cause additional price pressures. With elevated uncertainty and the resurgence of global inflation, would the low rates of exchange rate pass-through documented in the recent literature prevail?

This paper provides new estimates of conditional exchange rate pass-through into domestic prices. Using a common local projections specification and a large sample of 50 advanced and emerging market economies since 1990, we estimate exchange rate pass-through into consumer prices, import prices, and inflation expectations, and explore how these vary across countries and over time. We explore the role of country-specific characteristics in determining the rate of pass-through, such as the geographic region, level of development, and the share of imports denominated in US dollars. We then condition the responses on the state of the economy, including the stage of the business cycle, the degree of economic uncertainty, the prevailing level of inflation, and the anchoring of inflation expectations. We also consider the role of the sign and size of the currency fluctuation, as well as the source of the shock that provoked it, focusing on the role of US monetary policy.

We uncover several findings that provide insights about the current strength of exchange rate pass-through. First, on average, a depreciation of one percent of the local exchange rate against the US dollar leads to an increase in domestic prices of 0.16 percent after one year. The result varies substantially across countries, with average pass-through in advanced economies of 0.08 percent after one year and of 0.3 in emerging market economies. Pass-through to import prices materializes more quickly and is more homogeneous across income levels, averaging about 0.7 percent after only one month. Exchange rate fluctuations are also found to pass through to inflation expectations, which rise by 0.08 percentage points after six months, with a stronger response in emerging markets (0.12) than in advanced economies (0.03).

We then use complementary approaches to examine how the rate of pass-through depends on the state of the economy. For each variable capturing a relevant characteristic, we estimate pass-through rates for samples above and below the median, in bins corresponding to quartiles, and in regimes defined using smooth-transition functions. We document that pass-through into consumer prices and inflation expectations are increasing in the level of economic uncertainty, which may reflect that firms are less willing to adjust their mark-ups after suffering an increase in costs during these periods. Pass-through is also increasing in the level of inflation and in the level of disagreement among professional forecasters of inflation, providing support for Taylor's (2000) hypothesis that the incidence of the exchange rate is endogenous to the credibility of monetary policy.

Our paper also investigates how pass-through varies according to the share of imports that are invoiced in US dollars. Consistent with Gopinath and others (2020), we find that countries with higher USD invoice share of imports experienced more significant pass-through into import prices.

Like Caselli and Roitman (2019), we uncover non-linear relationships between exchange rates and domestic prices. The rate of exchange rate pass-through rises with the size of the exchange rate fluctuation, and materializes faster following depreciations than appreciations. An implication of the latter is that the recovery of a local currency following a depreciation is not followed by offsetting effects on prices until about a year later, leaving strong transitory impacts on inflation.

Finally, we examine how exchange rate pass-through depends on the source of exchange rate fluctuations. Previous papers have estimated shock-dependent pass-through using country-specific SVAR models with sign and zero restrictions to identify global and domestic shocks

(Forbes, Hjortsoe, and Nenova 2018; Ha, Stocker, and Yilmazkuday 2020). In contrast, to identify the inflationary effects of exchange rate movements provoked by US monetary policy shocks, our identification approach uses a difference-in-differences strategy combined with instrumental variables.

To construct our instrument, we start by using a series of U.S. monetary policy shocks that have been externally identified by Jarociński and Karadi (2020) using the unanticipated change in rates within high-frequency windows around FOMC announcements. This approach to identifying monetary policy shocks has been widely used in the empirical literature since the pioneering work of Kuttner (2001). However, while these monetary policy shocks are thought to be exogenous to the state of the US economy—and, plausibly, to the state of the economy in other countries—they will affect the price level in other economies through multiple channels besides the exchange rate, including by affecting external demand conditions and global commodity prices. Including them as instruments for exchange rate fluctuations would thus violate the exclusion restriction, leaving the first-stage residuals correlated with the second stage regressor of interest. To isolate their impact on prices through the exchange rate, we employ a difference-in-differences approach as in Nunn and Qian (2014). We include time fixed effects to capture common factors affecting prices across countries, including the average effect of the US monetary policy shocks, and we interact the US monetary policy shocks with a country-specific measure of capital account openness. This difference-in-differences estimator provides the relative impact of the exchange rate on prices in economies with an open capital account—where US monetary is expected to provoke a movement of the exchange rate through the portfolio investment channel—compared to those with a closed capital account. In doing so, it allows us to identify the impact of US monetary policy shocks on domestic prices operating through the exchange rate channel *alone*.

The results suggest that the pass-through is about three times larger when exchange rate fluctuations are provoked by U.S. monetary policy shocks than when they are provoked by other drivers. Reassuringly, this result is well aligned with the findings of Forbes, Hjortsoe, and Nenova (2018) and Ha, Stocker, and Yilmazkuday (2020) who employ a different identification strategy and method for estimating impulse-responses. As discussed by Forbes, Hjortsoe, and Nenova (2018), if firms expect a contraction in future demand—as for example, in the case of US monetary tightening—they would be less willing to reduce mark-ups following a currency appreciation and would pass-through higher prices.

Our results have strong implication for policy makers and for economic models using linear estimates of exchange rate pass-throughs. On the policy front, our results suggest that recent exchange rate movements may have stronger impacts on domestic prices than previous estimates would imply, and that stronger monetary tightening may be needed to address the resulting inflation pressures. On the modeling front, they suggest that models should be able to generate a larger response of domestic prices to exchange rates for high levels of inflation and uncertainty.

1.1. Literature Review

There is vast literature on exchange rate pass-through into prices. In a survey paper, Burstein and Gopinath (2014) explain how variable mark-ups cause insensitivity of prices to exchange rate developments. Then, they review the empirical literature and show that exchange rate pass-through into consumer prices is lower than into import prices at the border, and also that the pass-through into border prices varies considerably across countries.

Previous studies of state-dependent pass-through have yielded several important results. Taylor (2000) put forward the conjecture that the rate of exchange rate pass-through is endogenous to the credibility of the monetary regime, which could be proxied by the degree of price stability that had been recently delivered. Examining the role of the inflationary environment on exchange rate pass-through across a sample of 71 advanced and emerging economies, Choudhri and Hakura (2006) find strong evidence that pass-through rises with average inflation. Using a sample of 62 advanced and emerging market economies, Carrière-Swallow and others (2021) examine the time- and country-varying nature of exchange rate pass-through. They first document a decline in the degree of exchange rate pass-through despite an increase in import content of domestic consumption. In support of Taylor's (2000) conjecture, they find that better-coordinated inflation expectations of professional forecasters—a proxy for the central bank's credibility—are associated with significantly lower rates of exchange rate pass-through into prices. Recently, Cheikh, Zaied, and Ameur (2023) analyze the influence of geopolitical risk on exchange rate pass-through for the period from September 2020 to August 2022. Using the geopolitical risk (GDP) index of Caldara and Iacoviello (2022) as a threshold, they find that high geopolitical uncertainty around the Ukrainian crisis had likely increased exchange rate pass-through into prices. Our exploration of uncertainty deviates from their approach in important ways. Instead of using a geopolitical uncertainty variable, we employ a country-specific measure that captures a much broader measure of economic uncertainty over a longer time period. This allows us to study a much larger sample, rather than having to focus on the recent experience since October 2020.

Gopinath, Itskhoki, and Rigobon (2010) explain the role of the currency of invoicing in determining the rate of exchange rate pass-through into import prices. Gopinath and others (2020) construct a new dataset of bilateral price and volume indices for more than 2,500 country pairs and estimate that pass-through into import prices is increasing in the share of imports that are invoiced in US dollars. This result is consistent with the theoretical argument that prices tend to be sticky in the currency of invoicing, which gives the US dollar a large role in international pricing decisions.

Caselli and Roitman (2019) use a local projections specification to estimate exchange rate pass-through, focusing on the nonlinearities and asymmetries in pass-through from the nominal effective exchange rate onto headline CPI for a panel of 28 emerging markets. They find that depreciations lead to stronger pass-through than appreciations, and that pass-through becomes stronger when the exchange rate depreciates by more than 24 percent over a year.

Our paper also contributes to the literature analyzing the variation in pass-through depending on the sources generating exchange rate fluctuations. Forbes, Hjortsoe, and Nenova (2018) focus on the United Kingdom and find that different sources of exchange rate shocks affect the price response differently. They develop a SVAR framework for a small open economy and find that exchange rate pass-through is low in response to domestic demand shocks and relatively high in response to domestic monetary policy shocks. Ha, Stocker, and Yilmazkuday (2020) estimate country-specific structural factor-augmented VAR models for 55 economies to study the pass-through from shocks to global and domestic monetary policy, demand, supply, and exchange rate shocks as a function of country characteristics. They find that monetary policy shocks are associated with stronger pass-through than other domestic shocks. Ours is the first study that identifies US monetary policy shocks using a difference-in-differences instrumental variables approach, which we argue provides more precise estimates of the exchange rate channel.

The rest of the paper is organized as follows. Section 2 describes the data and explains empirical specifications. Section 3 presents main results and discusses robustness checks. Section 4 concludes.

2. Data and Empirical Specifications

2.1. Data

Our baseline sample contains monthly data from January 1990 to December 2022 and covers 46 countries, of which 28 are classified as advanced economies and 18 as emerging market economies (Tables 1.1 and 1.2). We determine the sample based on the joint availability of country-month observations for consumer prices, import prices, and inflation expectations. In a robustness exercise, we also consider a larger unbalanced sample of 141 countries for which consumer price data are available. Table 2 describes the sources and definitions of all variables used in the paper and Table 3 presents the summary statistics.[1]

We consider several state-dependent variables in our regressions: (i) monthly inflation, computed as the (lagged) yearly change in log consumer prices; (ii) quarterly GDP growth (in deviation from country mean) and output gap (computed using the Hodrick-Prescott filter with a smoothness parameter equal to 1600; (iii) monthly uncertainty indexes from Ahir, Bloom, and Furceri (2022);[2] (iv) a monthly indicator of inflation uncertainty based on the level of disagreement among professional forecasters of inflation from Consensus Forecasts;[3] and (v) the average share of imports invoiced in US dollars in each country, from the dataset compiled by Boz and others (2022).[4]

The analysis of shock dependence is based on the monthly U.S. monetary policy shock series from Jarociński and Karadi (2020) and annual capital account openness measures from Quinn and Toyoda (2008).[5] The methodology of Jarociński and Karadi (2020) is closely related to proxy VARs that use high-frequency interest rate surprises as external instruments to identify monetary policy shocks as in Gertler and Karadi (2015). The main difference in these U.S. monetary policy shock series is that they separate out central bank information shocks from monetary policy shocks (Figure A1). Quinn and Toyoda (2008) compute a measure of capital account openness using granular information about capital and financial account measures reported in the IMF's

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[1] We exclude from all estimations the observations for which the dependent variable lies below the 1st percentile or above the 99th percentile of the sample's empirical distribution. Upon inspection, these observations generally belong to episodes of hyperinflation or economic collapse. To ensure that extreme events are not driving our results, we also drop the episodes of inflation above 50 percent (year-on-year), and depreciations or appreciations larger than 30 percent (month-on-month).

[2] Monthly uncertainty indexes are available from 2008 onwards. We use quarterly uncertainty indexes for pre-2008 period.

[3] Following Brito, Carrière-Swallow, and Gruss (2018), we calculate the interquartile range across individual forecasts of inflation. For each forecast, we compute a synthetic one-year ahead forecast using a linear combination of the forecasts for the current and next calendar years.

[4] Note that for USD invoice share of imports and forecast disagreement on inflation expectations, we use country average observations since there is a limited variation in these variables over time.

[5] We also use updated capital account openness indexes from Chinn and Ito (2006).

Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). They synthesize this information into an annual score that take values between 0 and 100 for each country through 2014.

2.2. Empirical Specifications

Baseline Specification

To estimate the average exchange rate pass-through into prices across countries, we follow Jordà (2005) and estimate impulse response functions from local projections as follows:

$$p_{i,t+h} - p_{i,t-1} = \beta_h \Delta ER_{i,t} + \Sigma_{l=0}^{12} \theta_l^Z M_{i,t-l} + \delta_i + \delta_t + \epsilon_{i,t}, \tag{1}$$

where $p_{i,t}$ is the log price index of interest (consumer price index, import price index, or expectations about the future consumer price index) and $\Delta ER_{i,t}$ is the change in the log bilateral exchange rate against the US dollar for country *i* at time *t*. The coefficient β_h denotes the (percent) response of prices to a one percentage point change in local currency against the US dollar at a horizon of *h* months. The vector $M_{i,t}$ contains country-specific control variables and 12 lags of each. Following Burstein and Gopinath (2014), we control for the output gap, lagged inflation, lagged change in exchange rate, as well as the trade-weighted producer price index of export partners.[6] δ_i are country fixed effects, included to control for time-unvarying unobservable characteristics, as well as for cross-country differences in average inflation. δ_t are time fixed effects, which account for common time-varying shocks (e.g., VIX, U.S. monetary policy shocks, world energy and food prices).

Advanced economies (AEs) vs. emerging market and developing economies (EMDEs)

To assess whether the exchange rate pass-through varies across income groups, we estimate the following specification:

$$p_{i,t+h} - p_{i,t-1} = \beta_h^{AE} AE\, \Delta ER_{i,t} + \beta_h^{EMDE} (1 - AE)\, \Delta ER_{i,t} + \Sigma_{l=0}^{12} \theta_l^Z M_{i,t-l} + \delta_i + \delta_t + \epsilon_{i,t}, \tag{2}$$

[6] The output gap controls for demand-side factors and is defined as the deviation of real GDP from its HP-filtered trend. Trade partners' weighted producer price index is included to control for cost-push shocks.

where AE is equal to 1 if country *i* is an advanced economy (based on the IMF's World Economic Outlook classification) and zero otherwise. β_h^{AE} and β_h^{EMDE} capture the magnitude of the exchange rate pass-through at various horizons *h* for the average advanced and emerging market country, respectively.

State-dependent specification

We consider four alternative specifications to examine whether the exchange rate pass-through varies with the state of the economy. The first two specifications are estimated using the following regressions:

$$p_{i,t+h} - p_{i,t-1} = \beta_h^{high} D_{it} \Delta ER_{i,t} + \beta_h^{low}(1 - D_{it})\Delta ER_{i,t} + \Sigma_{l=0}^{12} \theta_l^Z M_{i,t-l} + \delta_i + \delta_t + \epsilon_{i,t}, \quad (3)$$

where D_{it} is equal to 1 if the state variable (e.g., lagged inflation, output gap, uncertainty) is above the sample median or average. The set of control variables is augmented by the dummy D_{it}. β_h^{high} and β_h^{low} capture the magnitude of the exchange rate pass-through at various horizons *h* when the state variable is relatively high and low, respectively.

The third specification follows Auerbach and Gorodnichenko (2012) and Tenreyro and Thwaites (2016). It is similar to equation 3, but allows the regimes to vary smoothly between high and low states:

$$p_{i,t+h} - p_{i,t-1} = \beta_h^{low} F(z_{it}) \Delta ER_{i,t} + \beta_h^{high}\left(1 - F(z_{it})\right)\Delta ER_{i,t} + \Sigma_{l=0}^{12} \theta_l^Z M_{i,t-l} + \delta_i + \delta_t + \epsilon_{i,t} \quad (4)$$

$$F(z_{it}) = \frac{exp^{-\gamma z_{it}}}{(1 + exp^{-\gamma z_{it}})}, \quad (5)$$

where z is the state variable normalized to have zero mean and a unit variance. That is, $z_{i,t} = \frac{x_{i,t} - \bar{x}}{\sigma_x}$, where $\bar{x}$ is the sample average and σ_x is the standard deviation. $F(z_{it})$ is the corresponding smooth transition function. The weights assigned to each regime vary between 0 and 1 according to the weighting function $F(z_{it})$, so that $F(z_{it})$ can be interpreted as the probability of being in each regime. For instance, $F(z_{it}) \cong 1$ corresponds to a situation when inflation (output gap, uncertainty, etc.) is very low—that is, z reaches the maximum negative value, while $F(z_{it}) \cong 0$ corresponds to a situation when the inflation (output gap, uncertainty, etc.) is very high—that is, z reaches the maximum positive value. This approach is equivalent to the smooth-transition model developed by Granger and Terasvirta (1993). The advantage of this approach is twofold. First, compared with a model in which each exchange rate shock would be interacted with a measure of the regime, it permits a direct test of whether the effect of shocks varies across different regimes. Second, compared to equation (3) it allows the effect of the shocks to change smoothly between low and high regimes by considering a continuum of states to compute the impulse response functions, thus making the response more stable and precise. Also in this case, we augment the set of control to include the smooth transition function.

Finally, the specification uses a non-parametric way to estimate non-linearity in pass-though:

$$p_{i,t+h} - p_{i,t-1} = \beta_h^g I[x_{it} \in G\ ]\Delta ER_{i,t} + \Sigma_{l=0}^{12} \theta_l^Z M_{i,t-l} + \delta_i + \delta_t + \epsilon_{i,t}, \quad (6)$$

where I is an indicator function which assumes value 1 when the state variable x_{it} belongs to a specific bin (quartile) of the distribution, which we refer to as group *G*. Compared to equations (3) and (4), this specification does not impose any functional form to capture non-linearity and allows a better understanding of the specific values of the state variables that affect the magnitude of the pass-through.

Shock-dependent specification

We examine whether the direction (sign) of the change in the bilateral exchange rate produces different pass-through rates by estimating the following specification:

$$p_{i,t+h} - p_{i,t-1} = \beta_h^+ D_{it}^+ \Delta ER_{i,t} + \beta_h^- (1 - D_{it}^+) \Delta ER_{i,t} + \Sigma_{l=0}^{12} \theta_l^Z M_{i,t-l} + \delta_i + \delta_t + \epsilon_{i,t}, \quad (7)$$

where D_{it}^+ is a dummy variable that takes value 1 for an appreciation of the bilateral exchange rate, and zero otherwise.

Next, we examine whether the magnitude of pass-through depends linearly on the size of the bilateral exchange rate movement by including the square of the exchange rate shock:

$$p_{i,t+h} - p_{i,t-1} = \beta_h \Delta ER_{i,t} + \vartheta_h \Delta ER_{it}^2 + \Sigma_{l=0}^{12} \theta_l^Z M_{i,t-l} + \delta_i + \delta_t + \epsilon_{i,t}, \quad (8)$$

where the pass-through elasticity for each level of $\Delta ER_{i,t}$ is given by $\frac{\partial(p_{i,t+h}-p_{i,t-1})}{\partial \Delta ER_{i,t}} = \beta_h + 2\,\vartheta_h$.

Finally, to assess the exchange rate pass-through stemming from exchange rate fluctuations caused by US monetary policy tightening, we adopt a difference-in-differences instrumental variables approach (Nunn and Qian 2014). We start by using externally-identified shocks to US monetary policy, $US\ MP\ Shock_t$. While plausibly exogenous to domestic prices and exchange rates, these shocks will affect the domestic price level through several channels other than the exchange rate. To enforce the exclusion restriction, we rely on the theoretical assumption that the exchange rate is mainly affected by US monetary policy shocks through the portfolio investment channel, requiring a relatively open capital account to operate.[7] Our instrument consists of the interaction between U.S. monetary policy shocks and the indicator of capital account openness:

$$Instrument_{i,t} = Quinn_i \times US\ MP\ Shock_t. \tag{9}$$

Since the Quinn and Toyoda (2008) measure is highly skewed to the left of the distribution in our sample (Figure A2), we use a dummy variable ($Quinn_i$) that is equal to 1 if the average capital account indicator is above the 10th percentile of the cross-country distribution. Our IV strategy reads as follows:

$$p_{i,t+h} - p_{i,t-1} = \beta_h\,\widehat{\Delta ER_{i,t}} + \Sigma_{l=0}^{12}\theta_l^Z M_{i,t-l} + \delta_i + \delta_t + \epsilon_{i,t}, \tag{10}$$

with

$$\Delta ER_{i,t} = \beta_h^1 Instrument_{i,t} + \Sigma_{l=0}^{12}\theta_l^Z M_{i,t-l} + \delta_i + \delta_t + \epsilon_{i,t}. \tag{11}$$

The analysis controls for country and time fixed effects and can therefore be seen as a difference-in-differences estimator, with identification achieved between outcomes for countries with open capital accounts versus those with relatively closed capital accounts. In particular, the use of time-effects controls for the effect of US monetary policy shocks on domestic inflation that is not mediated through the exchange rate. They also control for other global factors correlated with US monetary policy shocks, including shifts in risk premia. Similarly, the country fixed effects control for time-invariant unobserved characteristics that could be related with the degree of capital

[7] We also restrict the sample to countries with relatively flexible exchange rate regimes, since those with fixed regimes would not be expected to see their exchange rates respond to external shocks. To do so, we drop observations with values of the Ilzetzki, Reinhart, and Rogoff (2019) measure of 5 and above.

account openness. In addition to satisfying the exclusion restriction criteria by construction, our instrument is also strong with an F-test above 10 for each of the estimation horizons (Figure 10C).

3. Results

3.1. Baseline Results

Figure 1 presents the evolution of (log) consumer prices following a one-percent depreciation of the local currency against the US dollar (equivalent to 0.45 standard deviation of the percent change in the bilateral exchange rate). The horizontal axis denotes the number of months following the exchange rate depreciation; the solid line displays the average estimated response, and shaded areas denote 90 and 95 percent confidence bands, respectively. The results suggest currency fluctuations have sizeable and persistent effects on consumer prices. We find that a 10 percent depreciation is associated with an increase in the level of consumer prices by about 0.5 percent within one month and rises to about 1.6 percent after one year. This effect is highly statistically significant, and consistent with previous estimates in the literature (Burstein and Gopinath 2014). The size of the effect almost doubles when we estimate equation (1) using a larger sample of countries (Figure A3). As we will discuss later, this is driven by the higher exchange pass-through in developing economies compared to advanced economies, given the predominance of the former in the larger sample.

These results are robust to alternative thresholds for excluding outliers and alternative lag orders. Recall that in our baseline estimations we exclude dependent variables below the 1st percentile or above the 99th percentile of its empirical distribution. In Figure A8, we replicate Figure 1 for a sample that excludes data below the 5th percentile and above the 95th percentile. We also estimate equation (1) using 6 and 24 lags of the change in consumer prices and bilateral exchange rate, instead of the baseline of 12 lags. In Figure A9, we display the impulse-response function using these alternative lag orders, finding similar pass-through coefficients across horizons.

To understand better the transmission channels of the effect of the exchange rate on domestic prices and their persistence, we present in Figure 2-3 the effects on import prices and inflation expectations. Figure 2 reports the response of import prices to exchange rate depreciations. The response is much faster than for consumer prices—it reaches 0.7 percent already after one month—and is also persistent--remaining at 0.7 percent one year after the exchange rate shock. Figure 3 report the response of inflation expectation, which, as expected, is much smaller than for consumer and import prices and peaks at 7 months after the exchange rate shock. At the same time, it is also persistent, with a 10 percent depreciation leading to a 0.7 basis point increase in inflation expectations.

Heterogeneity across countries

Figure A4 shows the results obtained estimating Equation (2). The top-left panel report the estimated pass-through for AEs and the top right for EMDEs. Looking at the figure, it is immediately evident that the pass-through is much larger (about three times) in EMs than AEs, and the result is robust to using both baseline and large sample (bottom panels). Interestingly, this striking difference is not evident for import prices (Figure A5)—the responses of import prices are similar between AEs and EMDEs, if anything more persistent in the former—but it is striking for inflation expectations (Figure A6): a 1 percent depreciation leads to a 0.3 percentage point increase in expected inflation in AEs compared to 1.2 percentage points in EMDEs. This result is consistent with Bems and others (2021) and suggests that central banks in AEs have a stronger ability to keep inflation expectations anchored and mitigate second-round effects following cost-push shocks. This in turn may also affect the large difference in the inflation response between the two groups of countries.

Finally, we estimate a version of equation (2) where we consider region specific dummies. The results reported in Figure A7 show that pass-through is smallest in Asia and Europe, and largest in Latin America. However, the differences in pass-through coefficients across regions are not statistically significant.

3.2. State-Dependence of Exchange Rate Pass-Through

We begin by presenting the state-dependent results for the level of inflation as the state variable. Figure 3 reports four panels, each corresponding to a separate specification: (i) panel A for the specification with the sample split at the median; (ii) panel B for the specification with the sample split at the average; (iii) Panel C using the semi-parametric approach based on quartiles; and (iv) Panel D for the smooth transition function. For each panel, we report the estimated coefficients, together with the associated 68-percent confidence bands. We plot tighter bands to better highlight the differences in the estimates, but in Table 4 we report formal tests for the difference in coefficients using standard econometric thresholds.

The results reported in Figure 3 and Table 4 suggest that the magnitude of the pass-through is dependent and increasing with the level of inflation, which is consistent with previous evidence (Choudhri and Hakura 2006). In addition, the increase in pass-through does not vary linearly with the level of inflation. This is especially evident in Panel C, where the magnitude is relatively similar across the first three quartiles but becomes significantly larger—both economically and statistically—for the fourth quartile. The fourth quartile corresponds to an initial level of inflation that is above 3.8 percent, which is lower than the level of inflation that most countries have experienced since 2021. This implies that inflation pressures stemming from current appreciations, other things equal, are much larger than previously estimated.

Next, we test whether the rate of pass-through depends on the stage of the business cycle. Figures 4.1 and 4.2 show that the pass-through coefficient is not different across rates of GDP growth or for different levels of the output gap. Indeed, Table 4.2 confirms that the difference across groups is not statistically significant. However, we do find that the pass-through into inflation expectations is stronger when the output gap is larger (Figure A21).

Estimating Equation (2) using the uncertainty index compiled by Ahir, Bloom, and Furceri (2022), Figure 5 shows that exchange rate pass-through is stronger when countries are experiencing higher uncertainty. This finding is robust in all our alternative specifications. Using uncertainty indexes for all countries in our estimation sample, Figure A28 presents the time series for the median, 25^{th}, and 75^{th} percentiles of the cross-country distribution. The figure shows that median uncertainty approached its pandemic high during 2022 following the invasion of Ukraine. The level of uncertainty over the 2020-22 period is approximately double the average value over the period of 2000-10, which is the basis for many of the pass-through estimates in the existing empirical literature.

Using inflation forecast disagreement levels from Consensus Economics, Figure 6 presents that pass-through is significantly higher in countries with higher disagreement on one-year ahead inflation forecasts. The estimation results from quartiles suggest that the largest marginal effects occur when inflation forecast disagreement exceeds the 75^{th} percentile, at which point there is a steep jump in the pass-through coefficient. These episodes of very high forecast disagreement are associated with periods of high and volatile inflation, and capture periods in which central bank credibility was low.

Furthermore, and in line with Boz and others (2019), we find that exchange rate pass-through is higher in countries with a larger share of imports invoiced in US dollars (Figure 7). The size of this difference is economically significant, with the rate of pass-through doubling from 0.1 percent for countries below the sample median to over 0.2 percent for those above the sample median. This evidence is also apparent for pass-through to import prices (Figure A16), which reaches 0.8

percent for countries above the median, but is only 0.5 for those below the median. This finding provides strong evidence in support of the dominant currency pricing theory.

3.3. Shock-Dependent Exchange Rate Pass-Through

We now present how the rate of pass-through depends on the source, sign, and size of the exchange rate shocks. Investigating the asymmetry in exchange rate pass-through (appreciation vs. depreciation) by estimating equation (7), Figure 8 suggests that pass-through materializes faster following depreciations than appreciations over the first six months, but their impacts converge within about a year. Table 9 confirms the statistical significance of asymmetry in exchange rate pass-through at short horizons. The strength of this asymmetry is less pronounced than what was documented by Caselli and Roitman (2019), who focused on a sample of emerging market economies.

Equation (8) includes a quadratic term that allows for the exchange rate pass-through to vary nonlinearly with the size of the exchange rate fluctuation. Figure 9A displays that the coefficient of quadratic term ϑ_h is positive and significant for horizons between 0 and 10 months, implying that the pass-through is stronger when the size of the exchange rate fluctuation is larger. The economic significance of the non-linearity is moderate, with the rate of pass-through after 12 months rising from 0.16 percent for a depreciation of 1 percent, to 0.175 for a depreciation of 10 percent, and to about 0.2 for a depreciation of 25 percent (Figure 9B). The result is broadly in line Caselli and Roitman (2019), who find evidence for a threshold effect by which the rate of pass-through increases for depreciations that exceed 24 percent.

When we instrument for exchange rate fluctuations that are caused by U.S. monetary policy shocks, we find that the rate of pass-through deviates from the average coefficients based on our reduced-form specifications. Figure 10 (Panel A) shows that a U.S. monetary policy tightening of 100 basis points causes the exchange rate to depreciate by an average of 5 percent for countries with a flexible exchange rate and open capital account. This result is consistent with the portfolio balance channel, whereby a declining interest rate differential versus the U.S. leads to capital outflows and a depreciation of the local currency. The Kleibergen-Paap rk Wald F-statistic—which is equivalent to the F-effective statistic for non-homoskedastic errors in the case of one endogenous variable and one instrument (Andrews, Stock, and Sun 2019)—varies between 10.2 and 10.4 for horizons between six months and one year, which suggests that our instrument is relatively strong. Panel B shows that pass-through is much stronger when exchange rate fluctuations are caused by U.S. monetary policy shocks. The pass-through coefficient becomes significant by the fifth month and reaches 0.5 after one year. This compares to the average pass-through coefficient from Figure 1 of 0.16 at the same horizon, and is consistent with the finding of Forbes, Hjortsoe, and Nenova (2020) that monetary policy shocks are associated with significantly higher pass-through in a cross-section of countries.

Note that our dummy variable on capital account openness is constant for each country. While this variable tends to be stable over time for most countries, there are cases in which capital account openness varies substantially. In a robustness check, we allow for this possibility by allowing the dummy variable to vary every five years for each country. Specifically, we separate the sample of countries at the tenth percentile of the cross-country capital account openness measure for every five-year period. Estimation results using this strategy are reported in Figure A27, and do not affect our result. We reach the same conclusion when we conduct the same exercise using the Chinn-Ito index of capital account openness, with results reported in Figure A28.

4. Conclusion

The world economy has recently been hit by three related shocks. Uncertainty reached its historical peak during the COVID-19 pandemic, and after abating, it surged again following Russia's invasion of Ukraine and remains at elevated levels. After decades of widespread price stability, inflation has risen well above central bank targets in most major economies. And finally, the Federal Reserve and European Central Bank have implemented the most aggressive monetary tightening cycle in the past 25 years. These factors have led to a strong depreciation of local currencies against the US dollar in many countries, stoking concerns that pass-through will put additional pressure on prices.

Drawing on the experience of a large sample of advanced and emerging market economies over the past 30 years, we document that the rate of pass-through from the exchange rate to domestic prices is state-dependent. While pass-through is relatively low on average, it tends to be significantly larger during periods of high inflation and elevated uncertainty. We also estimate how exchange rate pass-through depends on the source of the shock and are the first to do so using a difference-in-difference instrumental variables approach. We find that the rate of pass-through triples when an exchange rate depreciation has been driven by U.S. monetary policy tightening.

Taken together, our results suggest that the magnitude of current exchange rate pass-through into prices is likely to be significantly larger than historically.

References

Ahir, Hites, Nicholas Bloom, and Davide Furceri, 2022. "The World Uncertainty Index," NBER Working Paper 29763. National Bureau of Economic Research: Cambridge, MA.

Andrews, Isaiah, James H. Stock, and Liyang Sun, 2019. "Weak Instruments in Instrumental Variables Regression: Theory and Practice," *Annual Review of Economics* 11: 727–53.

Auerbach, Alan J. and Yuriy Gorodnichenko, 2012. "Measuring the Output Responses to Fiscal Policy," *American Economic Journal: Macroeconomics* 4(2): 1–27.

Bems, Rudolfs, Francesca Caselli, Francesco Grigoli, and Bertrand Gruss, 2021. "Expectations' Anchoring and Inflation Persistence," *Journal of International Economics* 132: 103516.

Boz, Emine, Camila Casas, Georgios Georgiadis, Gita Gopinath, Helena Le Mezo, Arnaud Mehl, and Tra Nguyen, 2022. "Patterns of Invoicing in Global Trade: New Evidence", *Journal of International Economics* 136: 103604.

Brito, Steve, Yan Carrière-Swallow, and Bertrand Gruss, 2018. "Disagreement about Future Inflation: Understanding the Benefits of Inflation Targeting and Transparency," IMF Working Paper 18/24. International Monetary Fund: Washington, DC.

Burstein, Ariel and Gita Gopinath, 2014. "International Prices and Exchange Rates," Chapter 7 in *Handbook of International Economics Vol. 4*: 391–451.

Caldara, Dario and Matteo Iacoviello, 2022. "Measuring Geopolitical Risk," *American Economic Review* 112(4): 1194–225.

Carrière-Swallow, Yan, Bertrand Gruss, Nicolas E. Magud, and Fabián Valencia, 2021. "Monetary Policy Credibility and Exchange Rate Pass-Through," *International Journal of Central Banking* 17(3): 61–94.

Carriere-Swallow, Yan, Pragyan Deb, Davide Furceri, Daniel Jiménez, and Jonathan Ostry, 2023. "Shipping Costs and Inflation," *Journal of International Money and Finance* 130: 102771.

Caselli, Francesca and Agustin Roitman, 2019. "Nonlinear Exchange Rate Pass-Through in Emerging Markets," *International Finance* 22(3): 279–306.

Cheikh, Nidhaleddine Ben, Younes Ben Zaied, and Hachmi Ben Ameur, 2023. "Recent Developments in Exchange Rate Pass-Through: What Have We Learned from Uncertain Times?" *Journal of International Money and Finance* 131: 102805.

Choudhri, Ehsan U. and Dalia S. Hakura, 2006. "Exchange Rate Pass-Through to Domestic Prices: Does the Inflationary Environment Matter?" *Journal of International Money and Finance* 25(4): 614–39.

Forbes, Kristen, Ida Hjortsoe, and Tsvetelina Nenova, 2018. "The Shocks Matter: Improving Our Estimates of Exchange Rate Pass-Through," *Journal of International Economics* 114: 255–75.

Forbes, Kristen, Ida Hjortsoe, and Tsvetelina Nenova, 2020. “International Evidence on Shock-Dependent Exchange Rate Pass-Through,” *IMF Economic Review* 68: 721–63.

García-Cicco, Javier and Mariana García-Schmidt, 2020. “Revisiting the Exchange Rate Pass-Through: A General Equilibrium Perspective,” *Journal of International Economics* 127: 103389.

Gertler, Mark and Peter Karadi, 2015. “Monetary Policy Surprises, Credit Costs, and Economic Activity,” *American Economic Journal: Macroeconomics* 7(1): 44–76.

Gopinath, Gita, Oleg Itskhoki, and Roberto Rigobon, 2010. “Currency Choice and Exchange Rate Pass-Through,” *American Economic Review* 100(1): 304–36.

Gopinath, Gita, Emine Boz, Camila Casas, Federico J. Díez, Pierre-Olivier Gourinchas, and Mikkel Plagborg-Møller, 2020. “Dominant Currency Paradigm,” *American Economic Review* 110(3): 677–719.

Gopinath, Gita, 2022. “How Will the Pandemic and War Shape Future Monetary Policy?” Remarks made at the Jackson Hole Economic Policy Symposium, August. Federal Reserve Bank of Kansas City.

Granger, Clive W.J. and Timo Terasvirta, 1993. *Modelling Non-Linear Economic Relationships*. Oxford University Press.

Ha, Jongrim, Marc Stocker, and Hakan Yilmazkuday, 2020. “Inflation and Exchange Rate Pass-Through,” *Journal of International Money and Finance* 105: 102187.

Ilzetzki, Ethan, Carmen M. Reinhart, and Kenneth S. Rogoff, 2019. “Exchange Arrangements Entering the Twenty-First Century: Which Anchor Will Hold?” *Quarterly Journal of Economics* 134(2): 599–646.

Jarociński, Marek and Peter Karadi, 2015. “Deconstructing Monetary Policy Surprises—The Role of Information Shocks,” *American Economic Journal: Macroeconomics* 12(2): 1–43.

Jordà, Òscar, 2005. “Estimation and Inference of Impulse Responses by Local Projections,” *American Economic Review* 95(1): 161–82.

Kuttner, Kenneth, 2001. “Monetary Policy Surprises and Interest Rates: Evidence from the Fed Funds Futures Market,” *Journal of Monetary Economics* 47(3): 523–44.

Nunn, Nathan and Nancy Qian, 2014. “U.S. Food Aid and Civil Conflict,” *American Economic Review* 104(6): 1630–66.

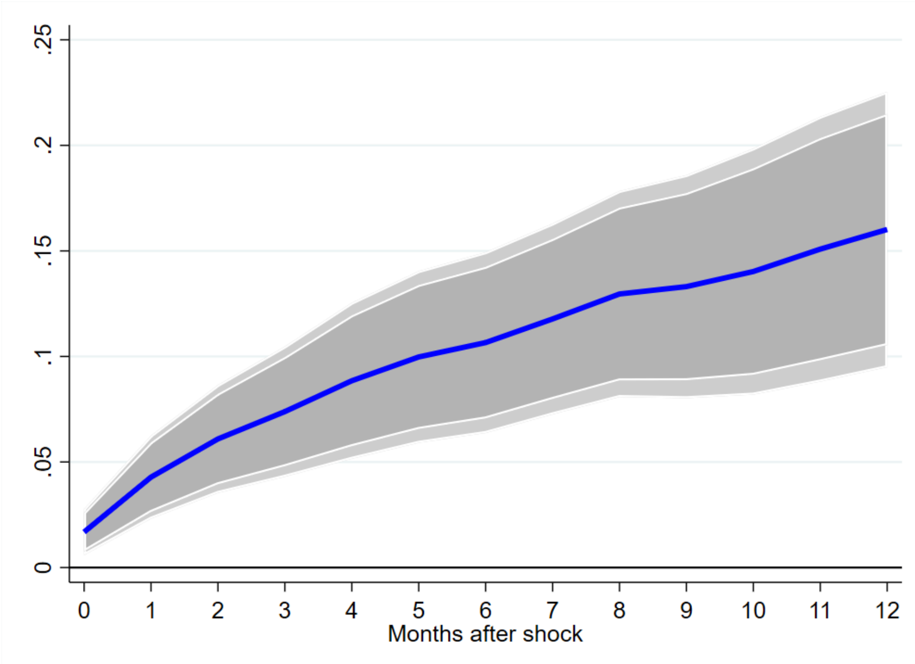
Quinn, Dennis P. and Maria Toyoda, 2008. “Does Capital Account Liberalization Lead to Growth?” *Review of Financial Studies* 21(3): 1403–49.

Taylor, John B., 2000. “Low Inflation, Pass-through, and the Pricing Power of Firms,” *European Economic Review* 44(7): 1389–408.

Tenreyro, Silvana and Gregory Thwaites, 2016. “Pushing on a String: US Monetary Policy Is Less Powerful in Recessions,” *American Economic Journal: Macroeconomics* 8(4): 43–74.

Figures

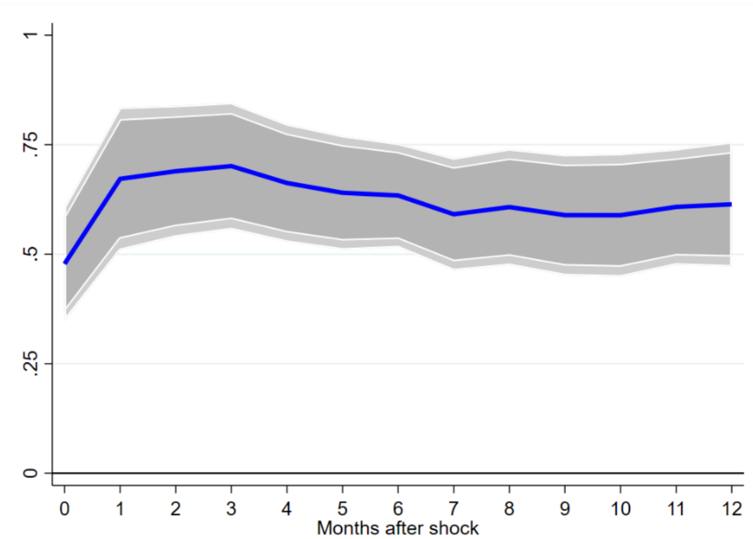
Figure 1: Average exchange rate pass-through: consumer prices



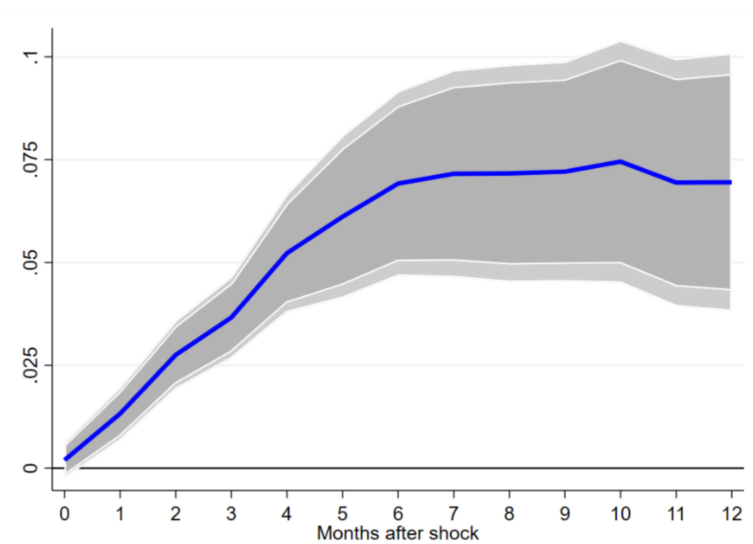
Note: The solid blue line presents the impact of a one percent increase (depreciation) in local currency/USD on a percent change in consumer prices. The dark shaded region indicates the 90 percent confidence band; the light shaded region indicated the 95 percent confidence band.

Figure 2: Average exchange rate pass-through to import prices and inflation expectations

A. Import Prices

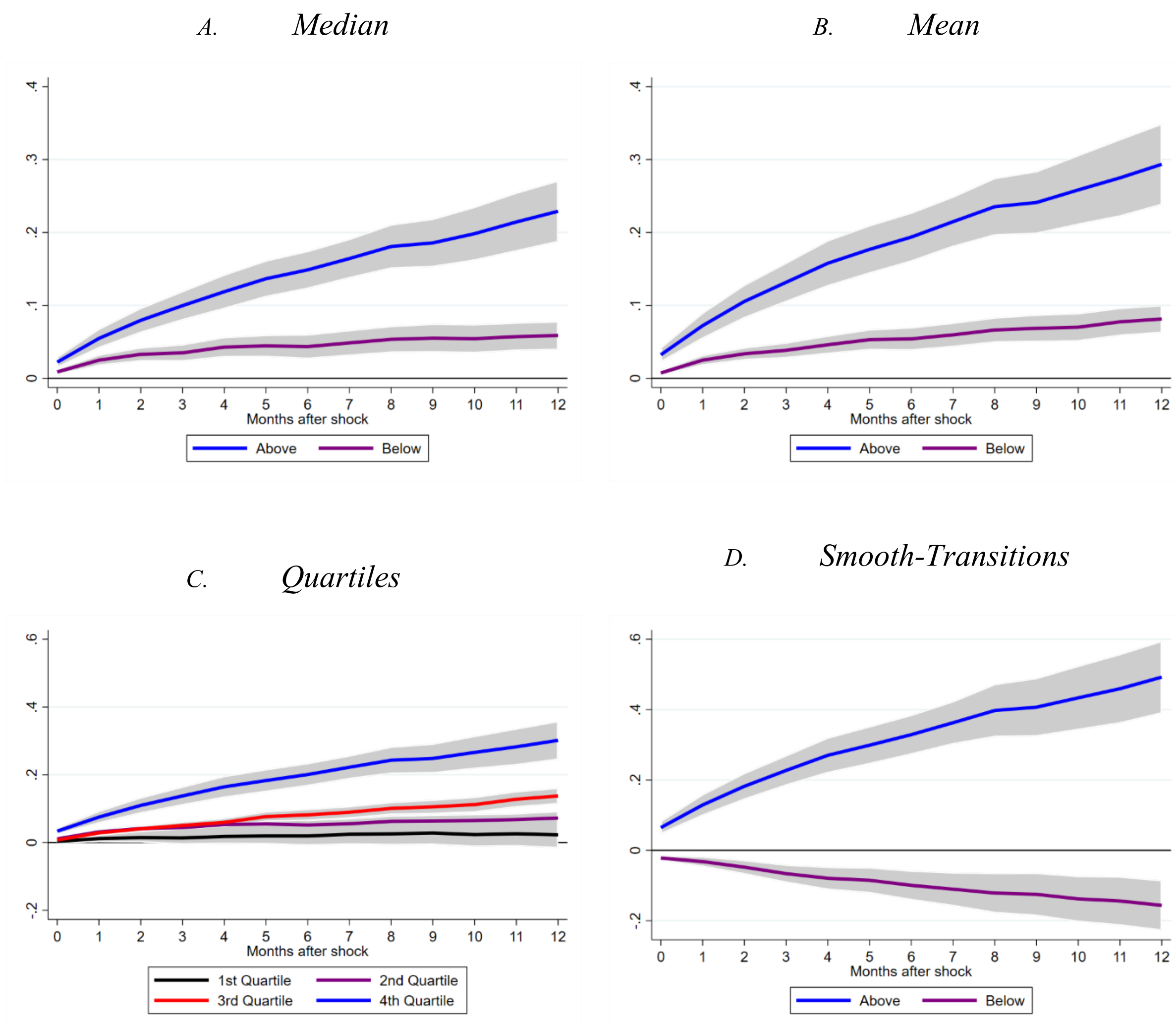


B. Inflation Expectations



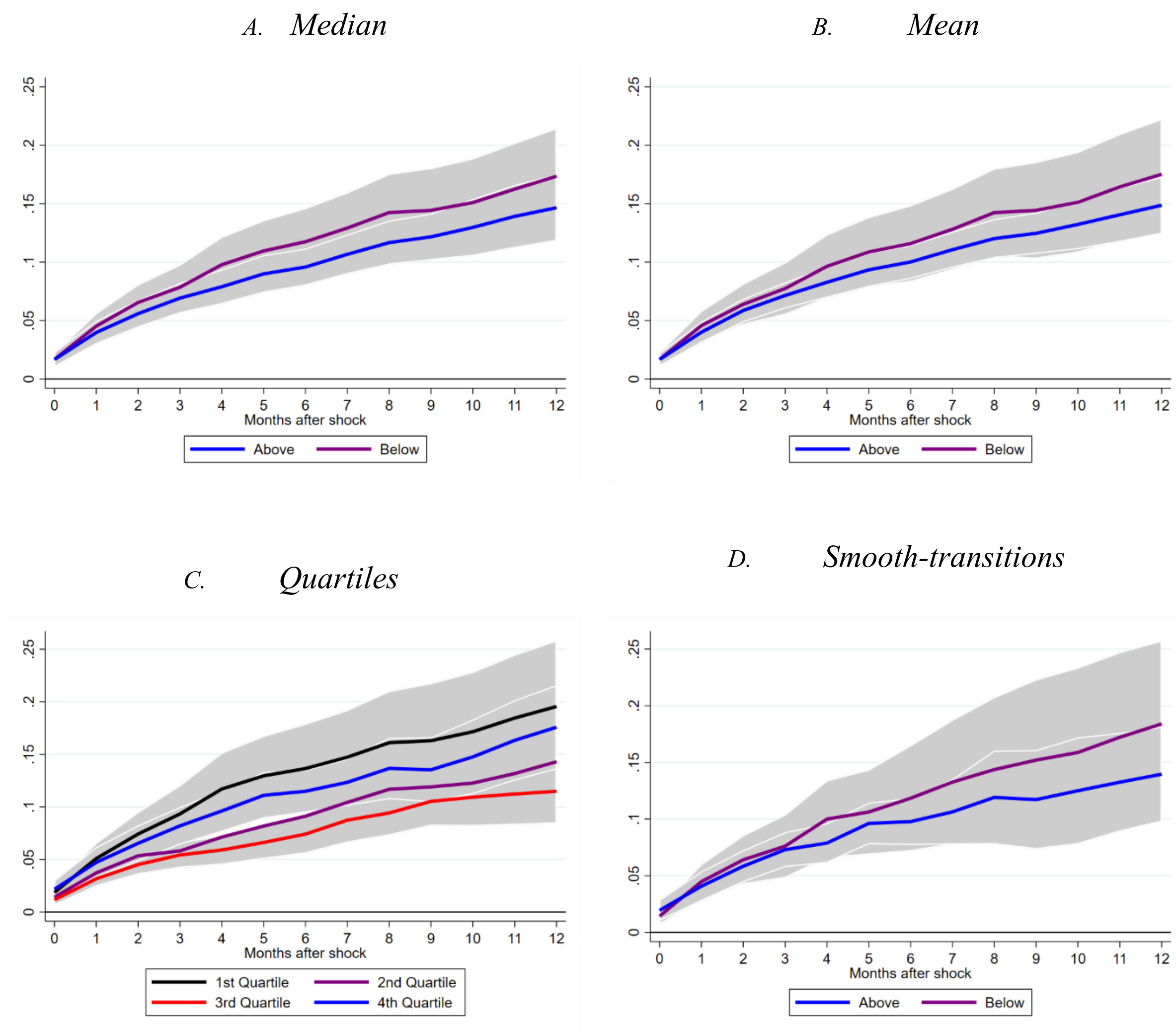
Note: The solid blue line in panels presents the impact of a one percent increase (depreciation) in local currency/USD on a percent change in import prices (Panel A) and inflation expectations (Panel B). The dark shaded region indicates the 90 percent confidence band; the light shaded region indicated the 95 percent confidence band.

Figure 3: Role of current inflation



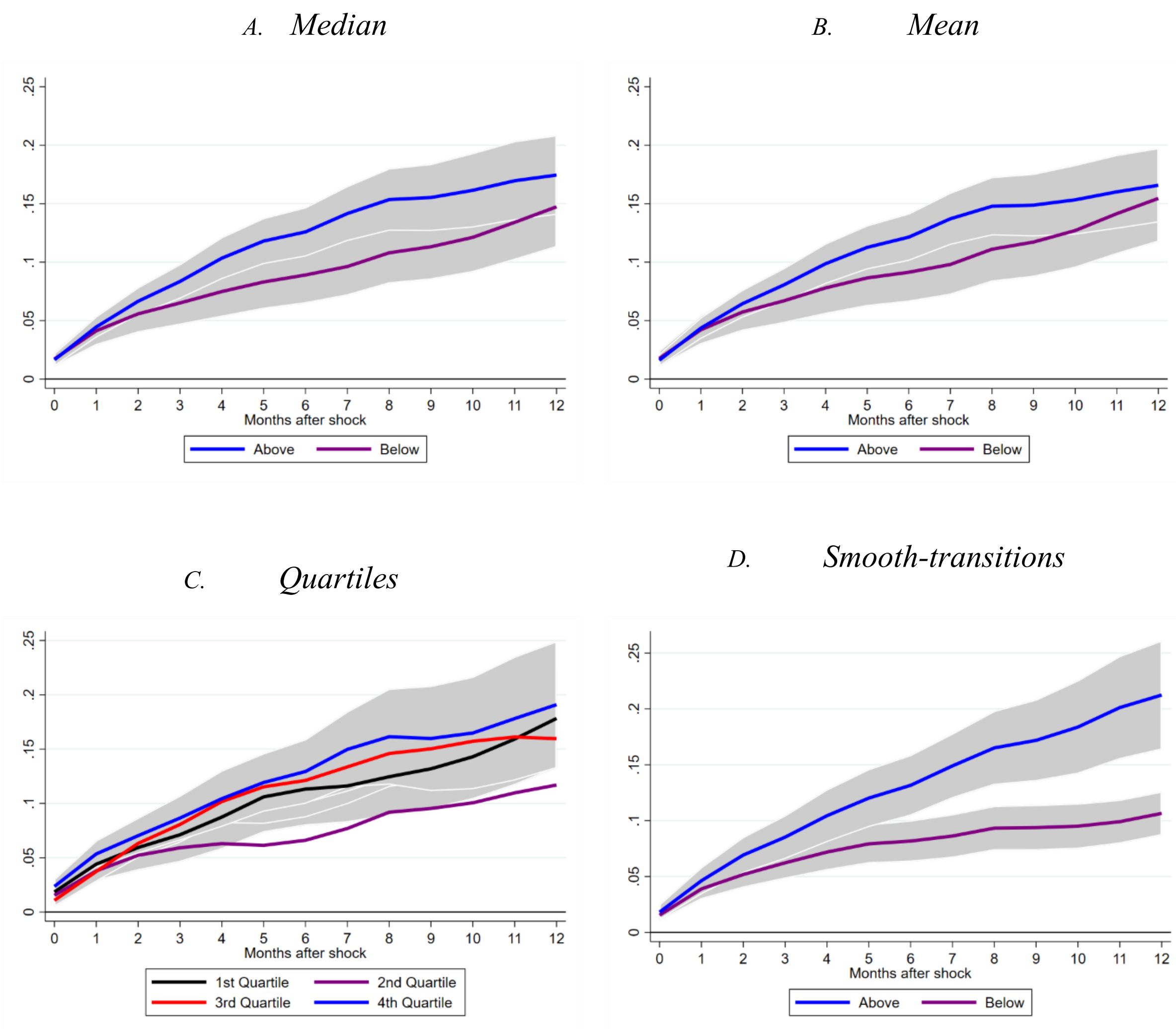
Note: The figures present the impact of a one percent increase (depreciation) in local currency/USD on a percent change in consumer prices across different groups with current inflation. The dark shaded region indicates the 68 percent confidence band.

Figure 4.1: Role of the business cycle — GDP growth



Note: The figures present the impact of a one percent increase (depreciation) in local currency/USD on a percent change in consumer prices across different groups with real GDP growth. Real GDP growth rates are the deviation of quarterly (YoY) rates from country average. The dark shaded region indicates the 68 percent confidence band.

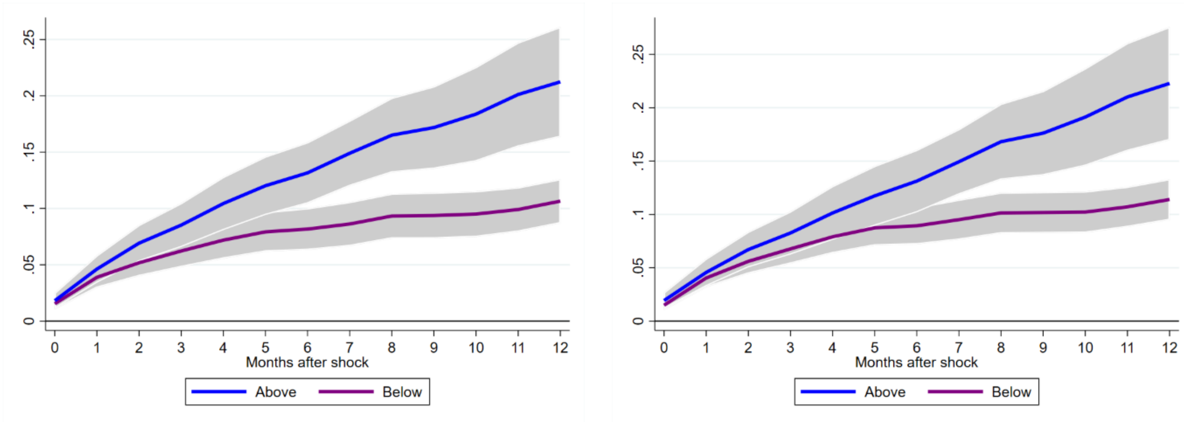
Figure 4.2: Role of the business cycle — output gap



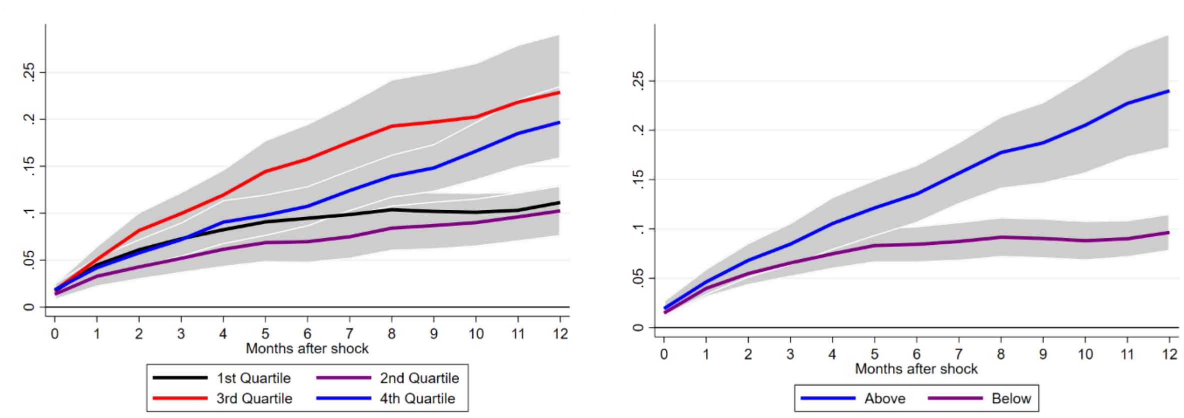
Note: The figures present the impact of a one percent increase (depreciation) in local currency/USD on a percent change in consumer prices across different groups with quarterly output gap of country. Output gap series are the deviations of real GDP from their HP filtered trend. The dark shaded region indicates the 68 percent confidence band.

Figure 5: Role of uncertainty

A. Median *B. Mean*

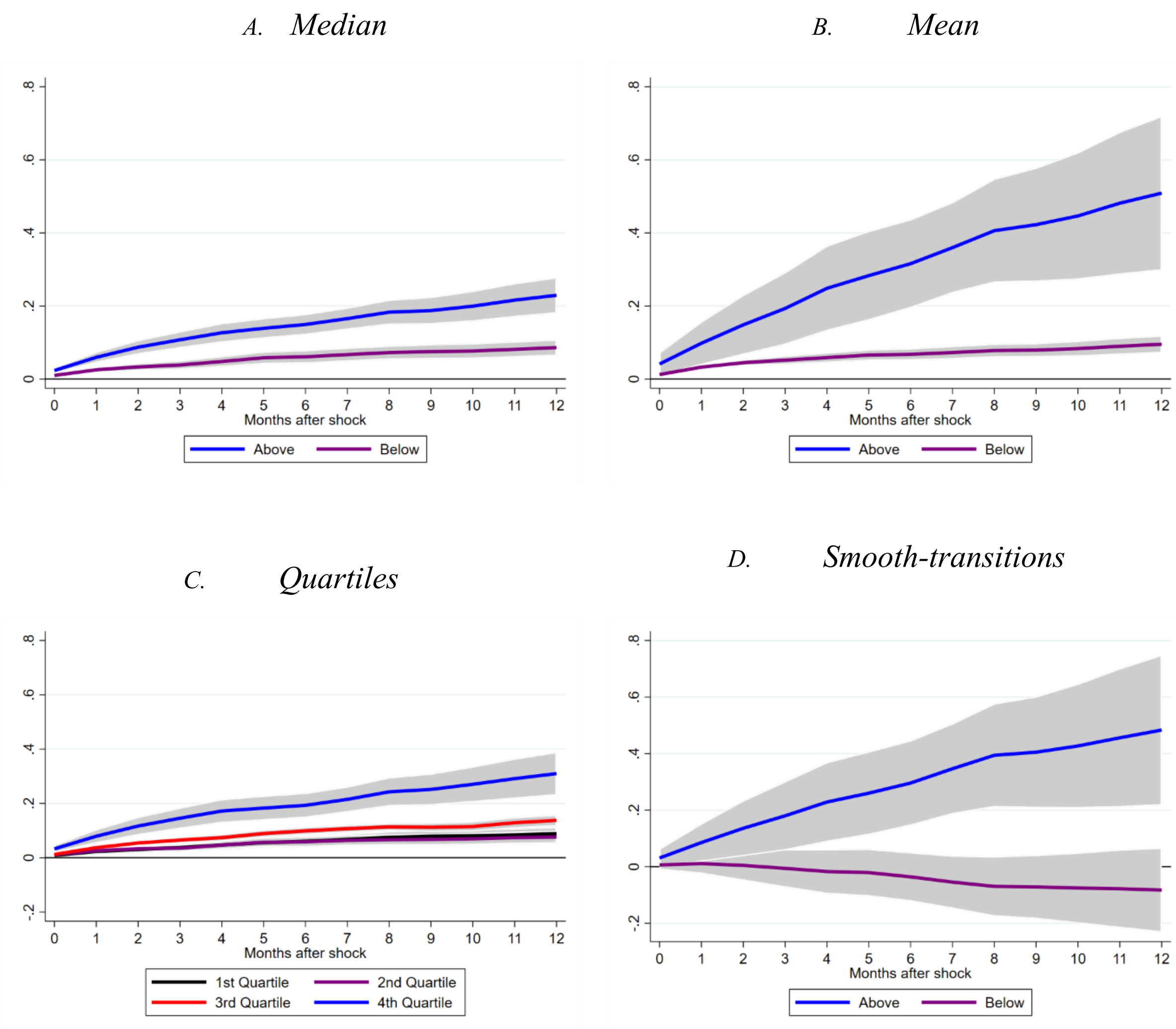


C. Quartiles *D. Smooth-transitions*



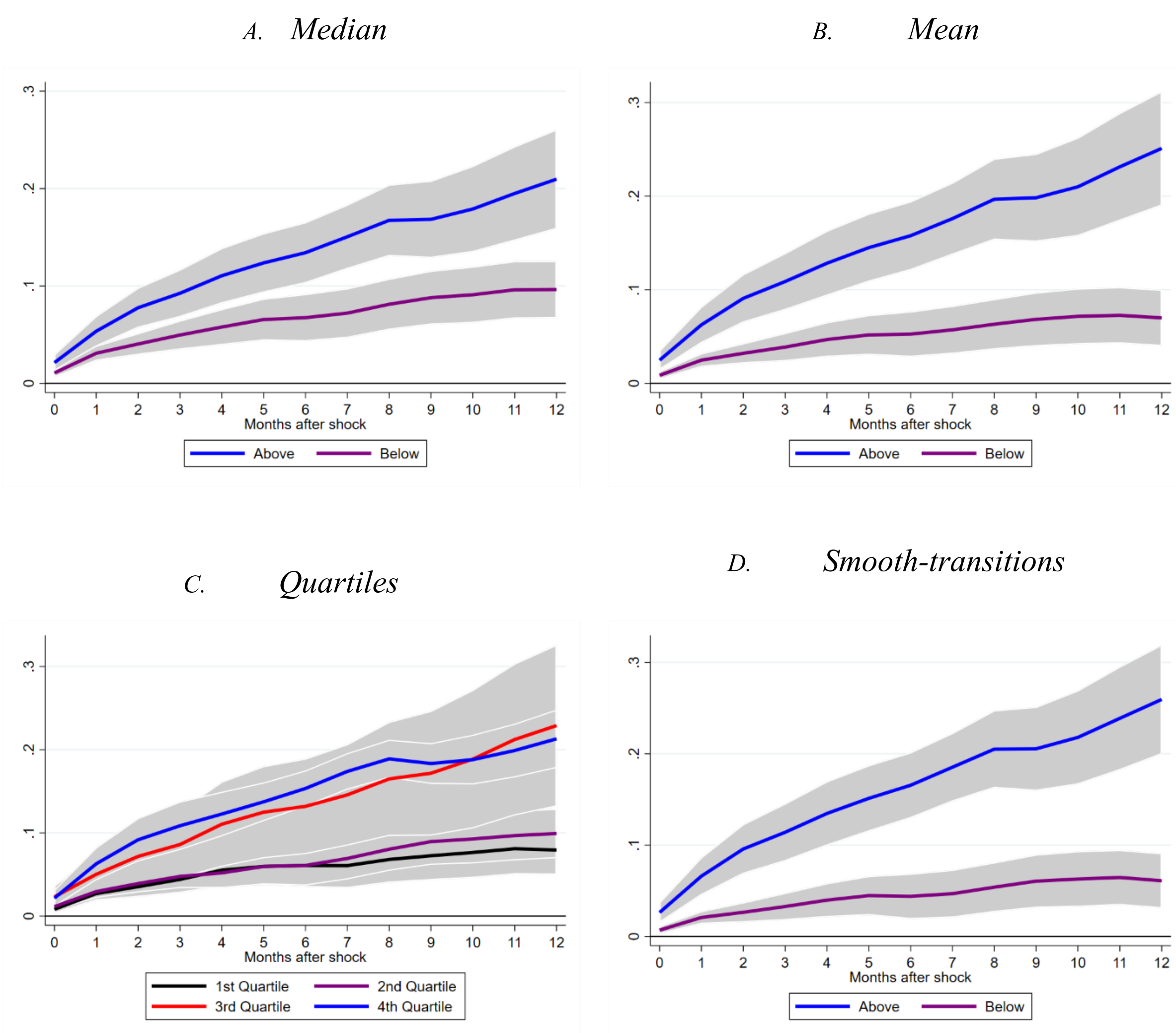
Note: The figures present the impact of a one percent increase (depreciation) in local currency per USD on a percent change in consumer prices across different groups with current uncertainty in the country. Monthly uncertainty series are from Ahir, Bloom, and Furceri (2022). The dark shaded region indicates the 68 percent confidence band.

Figure 6: Role of inflation uncertainty — disagreement



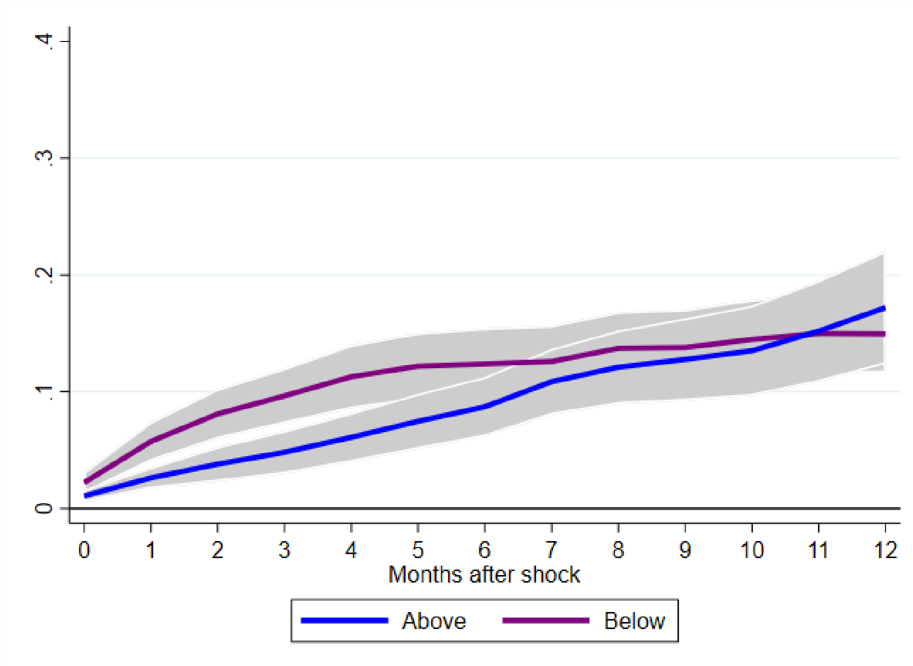
Note: The figures present the impact of a one percent increase (depreciation) in local currency/USD on a percent change in consumer prices across different groups with country level inflation disagreement. Disagreement among professional forecasters of inflation are constructed as in Brito, Carrière-Swallow, and Gruss (2018). The dark shaded region indicates the 68 percent confidence band.

Figure 7: Role of the share of imports invoiced in US dollars



Note: The figures present the impact of a one percent increase (depreciation) in local currency/USD on a percent change in consumer prices across different groups with average USD invoice share of imports in a country. USD invoice share are from Boz and others (2022). The dark shaded region indicates the 68 percent confidence band.

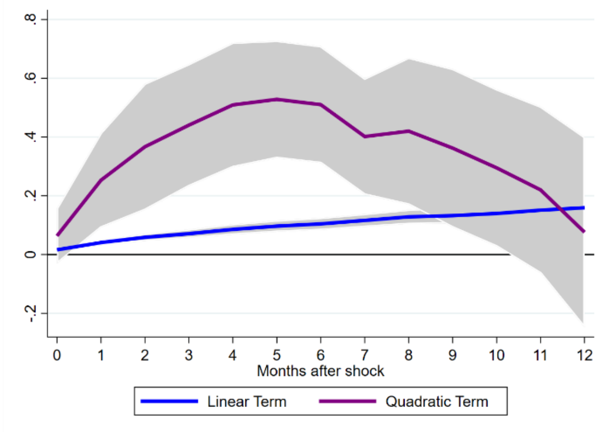
Figure 8: Pass-through from currency appreciation vs depreciation



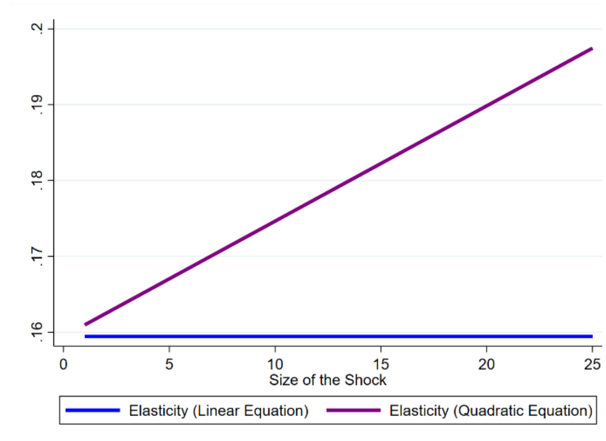
Note: The figures present the impact of a one percent increase (depreciation) in local currency/USD on a percent change in consumer prices for observations when there is a depreciation (purple) vs appreciation (blue). The dark shaded region indicates the 68 percent confidence band.

Figure 9: Pass-through nonlinearity

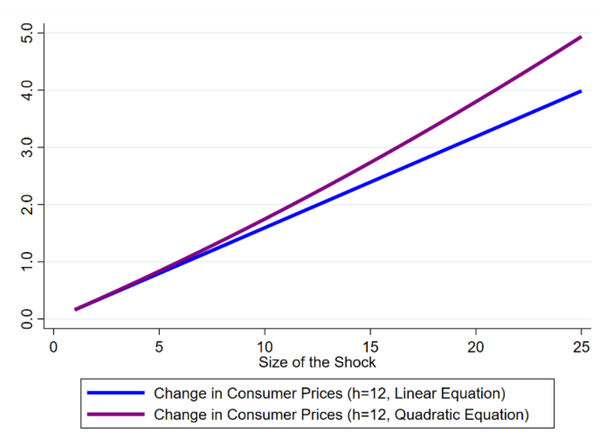
A. Linear and quadratic terms



B. ERPT elasticity $\left({}^{\partial \Delta \pi_{i,t+12}}\big/_{\partial \Delta ER_{it}}\right)$

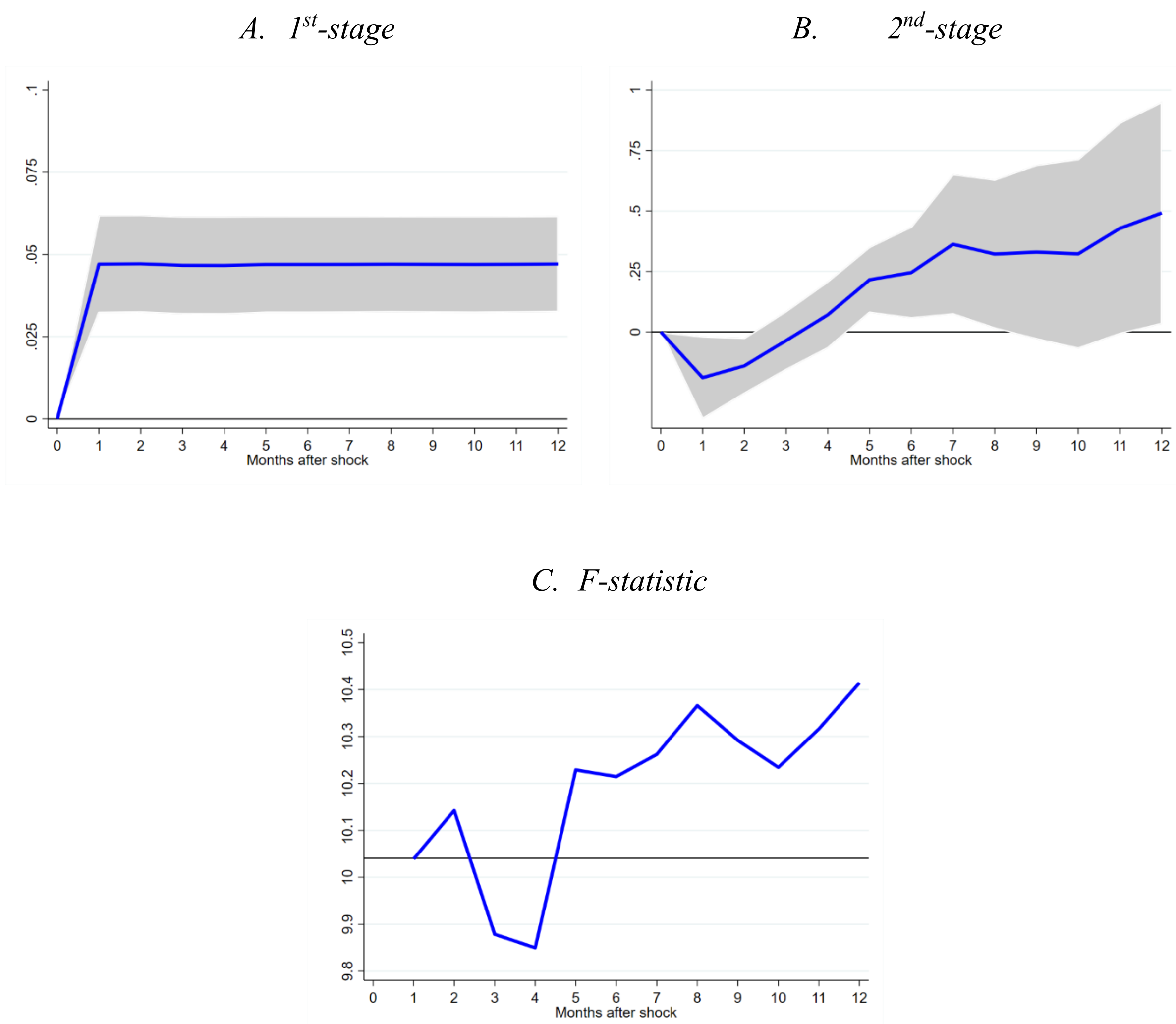


C. Price response to a 1 percent depreciation after 12 months



Note: Panel A: Blue line represents the coefficient of linear term, and the purple line denotes the coefficient of quadratic term from estimation of equation (8). The dark shaded regions indicate the 90 percent confidence band. Panel B: Using the coefficients from estimating equation (8) from the 12-month horizon, we plot the elasticity term $\frac{\partial \Delta \pi_{t+12}}{\partial \Delta ER_t} = \beta_{12} + v_{12} \times 2 \times \Delta ER_{it}$ against the size of the shock varying from 1 percent to 25 percent. Panel C: The purple and blue line presents the percent change in the price level for each size of exchange rate depreciation varying between 1 percent to 25 percent (horizontal axis).

Figure 10: Shock dependence — U.S. monetary policy shock



Note: Panel A presents the β coefficient from the first stage. The positive coefficient implies a depreciation following a U.S. monetary policy tightening shock. Panel B presents the β_h from the second stage. The coefficients show the response of prices when exchange rate fluctuations are caused by the U.S. monetary policy shocks. Panel C presents the F-statistic from the first stage.

Tables

Table 1.1: Country sample — advanced economies

Country	Consumer Prices	Import Prices	Inflation Expectations	Country	Consumer Prices	Import Prices	Inflation Expectations
Australia	1990M1-2022M9	1990M1-2022M12	1990M1-2022M12	Japan	1990M1-2022M12	1990M1-2022M12	1990M1-2022M12
Austria	1990M1-2022M12	2000M1-2022M12	1990M1-2022M12	Korea	1990M1-2022M12	1990M1-2022M12	1990M1-2022M12
Belgium	1990M1-2022M12	1995M1-2022M12	1990M1-2022M12	Latvia	1990M12-2022M12	2011M1-2022M12	1998M5-2022M12
Canada	1990M1-2022M12	1997M1-2022M12	1990M1-2022M12	Lithuania	1990M12-2022M12	2006M1-2022M12	1998M5-2022M12
Cyprus	1990M1-2022M12	2000M1-2022M12	2004M7-2022M12	Netherlands	1990M1-2022M12	1990M1-2022M12	1990M1-2022M12
Czech Republic	1991M1-2022M12	1998M1-2022M12	1995M1-2022M12	New Zealand	1990M1-2022M9	1990M1-2022M12	1990M1-2022M12
Denmark	1990M1-2022M12	2007M1-2022M12	1990M1-2022M12	Portugal	1990M1-2022M12	2000M1-2022M12	1990M1-2022M12
Estonia	1992M1-2022M12	1998M1-2022M12	1998M5-2022M12	Singapore	1990M1-2022M12	1990M1-2022M12	1990M11-2022M12
Finland	1990M1-2022M12	1995M1-2022M12	1990M1-2022M12	Slovak Republic	1993M1-2022M12	2009M1-2022M12	1995M1-2022M12
France	1990M1-2022M12	1999M1-2022M12	1990M1-2022M12	Slovenia	1992M1-2022M12	2006M1-2022M12	1995M1-2022M12
Germany	1990M1-2022M12	1990M1-2022M12	1990M1-2022M12	Spain	1990M1-2022M12	1990M1-2022M12	1990M1-2022M12
Greece	1990M1-2022M12	2000M1-2022M12	1993M6-2022M12	Sweden	1990M1-2022M12	1990M1-2022M12	1990M1-2022M12
Ireland	1990M1-2022M12	1990M1-2022M12	1990M1-2022M12	Switzerland	1990M1-2022M12	1990M1-2022M12	1990M1-2022M12
Italy	1990M1-2022M12	1996M1-2022M12	1990M1-2022M12	United Kingdom	1990M1-2022M12	1997M1-2022M12	1990M1-2022M12

Source: Authors' calculations.

Table 1.2: Country sample — emerging market economies

Country	Consumer Prices	Import Prices	Inflation Expectations	Country	Consumer Prices	Import Prices	Inflation Expectations
Argentina	2012M7-2022M12	2004M1-2022M12	1993M3-2022M12	Malaysia	1990M1-2022M12	2001M1-2022M12	1990M11-2022M12
Armenia	1992M12-2022M12	2006M12-2022M12	2007M5-2022M12	Mexico	1990M1-2022M12	1990M1-2022M12	1990M1-2022M12
Brazil	1990M1-2022M12	1990M1-2022M12	1990M1-2022M12	Peru	1990M1-2022M12	1994M1-2022M12	1993M3-2022M12
Bulgaria	1990M5-2022M12	2000M1-2022M12	1995M1-2022M12	Philippines	1990M1-2022M12	1990M1-2022M12	1994M12-2022M12
Chile	1990M1-2022M12	2003M1-2022M12	1993M3-2022M12	Poland	1990M1-2022M12	1996M6-2022M12	1990M11-2022M12
China	1990M1-2022M12	2005M1-2022M12	1994M12-2022M12	Romania	1990M10-2022M12	2000M1-2022M12	1995M1-2022M12
Hungary	1992M1-2022M12	2003M2-2022M12	1990M11-2022M12	Thailand	1990M1-2022M12	1990M1-2022M12	1990M11-2022M12
India	2001M1-2022M12	1990M1-2022M12	1994M12-2022M12	Turkey	1990M1-2022M12	2000M1-2022M12	1995M1-2022M12
Indonesia	1990M1-2022M12	1998M1-2022M12	1990M11-2022M12	Ukraine	1991M8-2022M12	2013M1-2022M12	1995M1-2022M12

Source: Authors' calculations based on data from Haver Analytics and Consensus Economics.

Table 2: Data sources

Definition	Source	Note
Bilateral Exchange Rate	Haver Analytics	Local currency per US dollar
Consumer Price Index	Haver Analytics	
Import Price Index	Haver Analytics	Expressed in local currency
Inflation Expectations	Consensus Economics	Forecasts for period average headline CPI inflation
USD Invoice Share	Boz and others (2022)	
Inflation Uncertainty-Disagreement	Brito, Carrière-Swallow, and Gruss (2018)	Synthetic 12-months-ahead (weighted average of current and next year forecasts)
Uncertainty	Ahir, Bloom, and Furceri (2022)	
Output Gap	World Economic Outlook	October 2022 vintage

Source: Authors' calculations.

Table 3: Summary statistics

Variable	N	Mean	Std. Dev.	25th Percentile	Median	75th Percentile
Consumer Prices (y/y % change)	12,495	3.08	4.30	1.09	2.24	3.83
Import Prices (y/y % change)	12,495	2.78	9.39	-2.31	1.90	7.04
Inflation Expectations (% one-year ahead)	12,495	3.12	4.07	1.52	2.32	3.52
Exchange Rate (m/m % change)	12,495	0.007	2.22	-1.16	0.01	1.3
Uncertainty Index	12,034	0.19	0.19	0.06	0.14	0.28
USD Invoice Share (%, country average)	7,226	44.01	25.73	22.90	32.60	71.50
Inflation Forecast Disagreement (country average)	10,992	1.19	4.57	0.25	0.38	0.51
GDP Growth (%, deviation from country mean)	12,383	0.71	4.44	0.15	0.72	1.35
Output Gap (deviation from country mean)	12,495	-0.01	2.56	-0.96	0.01	1.16

Source: Authors' calculations.

Table 4: Inflation

Median		Mean		Quartiles		Smooth-Functions	
Horizon	p-value: $\beta_{above} = \beta_{below}$	Horizon	p-value: $\beta_{above} = \beta_{below}$	Horizon	p-value: $\beta_4 = \beta_1$	Horizon	p-value: $\beta_{above} = \beta_{below}$
0	.0474105	0	.0060347	0	.0056226	0	.0012703
1	.0143056	1	.0039175	1	.0015159	1	.0005352
2	.0040884	2	.0011165	2	.000742	2	.0001565
3	.000735	3	.000444	3	.0003653	3	.0000479
4	.0007618	4	.000435	4	.0002685	4	.0000651
5	.0001218	5	.0002004	5	.0001326	5	.0000562
6	.0000616	6	.0000924	6	.0000883	6	.0000408
7	.0000511	7	.0000668	7	.0001273	7	.0000531
8	.0001134	8	.0001352	8	.0003488	8	.0002223
9	.0001593	9	.0002317	9	.0006677	9	.0004702
10	.0000997	10	.00019	10	.0005717	10	.0005494
11	.0000731	11	.0002874	11	.0006478	11	.0006707
12	.0000387	12	.0001921	12	.0056226	12	.0004604

Source: Authors' calculations.

Table 5.1: Growth - GDP

Median		Mean		Quartiles		Smooth-Functions	
Horizon	p-value: $\beta_{above} = \beta_{below}$	Horizon	p-value: $\beta_{above} = \beta_{below}$	Horizon	p-value: $\beta_4 = \beta_1$	Horizon	p-value: $\beta_{above} = \beta_{below}$
0	.982985	0	.9898194	0	.6363268	0	.688013
1	.4457705	1	.4919272	1	.7429889	1	.847077
2	.2865373	2	.6419416	2	.5360331	2	.8276721
3	.4248433	3	.6967469	3	.525757	3	.9259313
4	.1927809	4	.4772917	4	.3554173	4	.6000378
5	.2009525	5	.4591361	5	.4550534	5	.8174044
6	.2411653	6	.5111349	6	.4966421	6	.7278257
7	.267083	7	.4946286	7	.522891	7	.7308231
8	.2648593	8	.4370991	8	.5816184	8	.8004259
9	.3718133	9	.5320417	9	.5791622	9	.7447321
10	.3937118	10	.5308345	10	.6311103	10	.7630297
11	.3427677	11	.4354202	11	.6569368	11	.7104484
12	.294344	12	.4110838	12	.6835126	12	.6623057

Source: Authors' calculations.

Table 5.2: Growth - Output Gap

Median		Mean		Quartiles		Smooth-Functions	
Horizon	p-value: $\beta_{above} = \beta_{below}$	Horizon	p-value: $\beta_{above} = \beta_{below}$	Horizon	p-value: $\beta_4 = \beta_1$	Horizon	p-value: $\beta_{above} = \beta_{below}$
0	.8934448	0	.7717475	0	.4811032	0	.634372
1	.7040491	1	.866958	1	.5136059	1	.9930422
2	.3442352	2	.5166958	2	.6043662	2	.5772766
3	.1578355	3	.2770652	3	.5260746	3	.298002
4	.0436113	4	.1323937	4	.5118235	4	.131255
5	.0083158	5	.0506011	5	.5745338	5	.0467898
6	.013803	6	.0407052	6	.5120725	6	.0454319
7	.0071019	7	.016679	7	.2186474	7	.0200336
8	.0211437	8	.0497298	8	.2873942	8	.0553419
9	.0299803	9	.0905811	9	.4290803	9	.0877089
10	.0262518	10	.133664	10	.5311815	10	.1096065
11	.0448824	11	.2929897	11	.6064923	11	.2372087
12	.1282696	12	.5525578	12	.7409409	12	.5345007

Source: Authors' calculations.

Table 6: Uncertainty

Median		Mean		Quartiles		Smooth-Functions	
Horizon	p-value: $\beta_{above} = \beta_{below}$	Horizon	p-value: $\beta_{above} = \beta_{below}$	Horizon	p-value: $\beta_4 = \beta_1$	Horizon	p-value: $\beta_{above} = \beta_{below}$
0	.5880957	0	.3718478	0	.7731234	0	.4765808
1	.3843448	1	.5070211	1	.6998763	1	.5179365
2	.1584718	2	.3068398	2	.7439929	2	.3407582
3	.1374133	3	.2786394	3	.9413577	3	.2915585
4	.0848247	4	.199067	4	.5746535	4	.1739469
5	.0471255	5	.1316517	5	.5947892	5	.1060873
6	.0243988	6	.0505732	6	.3213933	6	.0396433
7	.0146789	7	.0254071	7	.0704483	7	.0168134
8	.0190963	8	.0280201	8	.0380449	8	.0166313
9	.019077	9	.0252863	9	.0222373	9	.0158466
10	.0204122	10	.0242132	10	.0154449	10	.0165888
11	.0157147	11	.0190391	11	.0080057	11	.0122677
12	.0180473	12	.0182664	12	.0097343	12	.0136534

Source: Authors' calculations.

Table 7: Inflation Uncertainty - Disagreement

Median		Mean		Quartiles		Smooth-Functions	
Horizon	p-value: $\beta_{above} = \beta_{below}$	Horizon	p-value: $\beta_{above} = \beta_{below}$	Horizon	p-value: $\beta_4 = \beta_1$	Horizon	p-value: $\beta_{above} = \beta_{below}$
0	.0630722	0	.3633688	0	.0692543	0	.6191503
1	.0141429	1	.2708939	1	.0243588	1	.4690406
2	.0058679	2	.2130698	2	.0107289	2	.3892342
3	.0030565	3	.1652493	3	.00659	3	.3278306
4	.0026633	4	.1162817	4	.0049741	4	.265217
5	.0030745	5	.0884659	5	.0058829	5	.2261455
6	.0020468	6	.0525583	6	.0056456	6	.1638233
7	.0019027	7	.0322895	7	.0046735	7	.117967
8	.0023572	8	.0321707	8	.0049097	8	.1130785
9	.0038434	9	.0397028	9	.0073214	9	.1289019
10	.0041441	10	.0500864	10	.0078558	10	.1490841
11	.0043905	11	.0585444	11	.0092207	11	.168408
12	.0050509	12	.0643462	12	.0104003	12	.1773222

Source: Authors' calculations.

Table 8: USD Invoice Share

Median		Mean		Quartiles		Smooth-Functions	
Horizon	p-value: $\beta_{above} = \beta_{below}$	Horizon	p-value: $\beta_{above} = \beta_{below}$	Horizon	p-value: $\beta_4 = \beta_1$	Horizon	p-value: $\beta_{above} = \beta_{below}$
0	.1338817	0	.1048452	0	.1856863	0	.0923907
1	.1017968	1	.0491608	1	.0675907	1	.0349717
2	.0620568	2	.0323364	2	.0417131	2	.0223176
3	.0815847	3	.0382197	3	.0406423	3	.0235074
4	.0634481	4	.0329718	4	.031234	4	.0154366
5	.0557801	5	.0186593	5	.0094522	5	.0074035
6	.041473	6	.0117241	6	.0029146	6	.0032803
7	.0319034	7	.0095747	7	.0007625	7	.0023663
8	.0400991	8	.0122956	8	.0009545	8	.0041643
9	.0691922	9	.0227206	9	.0042642	9	.0096105
10	.0675083	10	.0268044	10	.0114821	10	.0114172
11	.0615376	11	.0195544	11	.0085487	11	.0088893
12	.0447393	12	.0128635	12	.0042049	12	.0051024

Source: Authors' calculations.

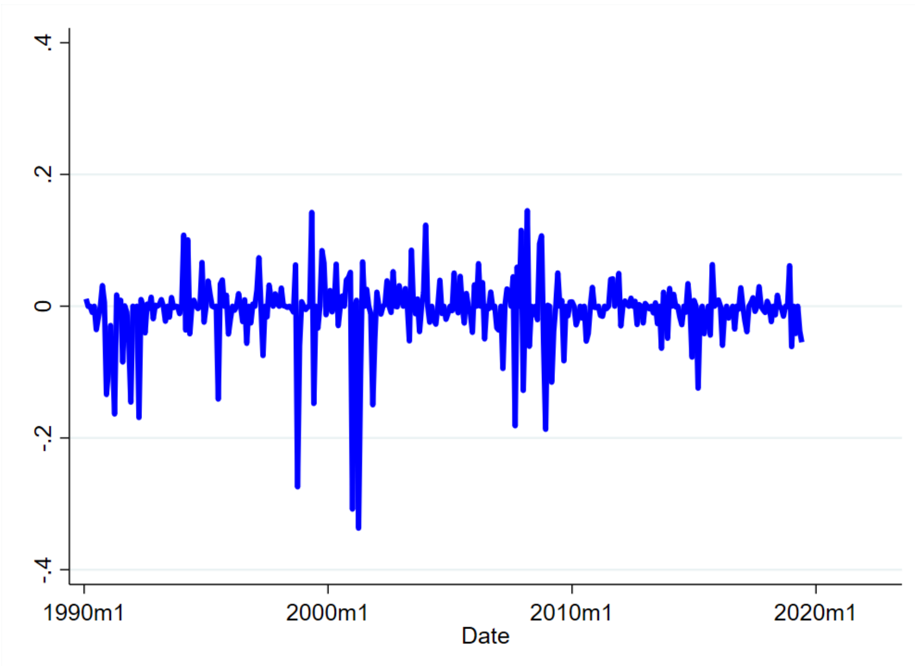
Table 9: Appreciation vs. Depreciation

Horizon	p-value: $\beta_{Appreciation} = \beta_{Depreciation}$
0	.5330642
1	.3179867
2	.2368264
3	.1049418
4	.0551027
5	.0322834
6	.0731297
7	.3022735
8	.4300055
9	.5013484
10	.4385757
11	.4272155
12	.5751259

Source: Authors' calculations.

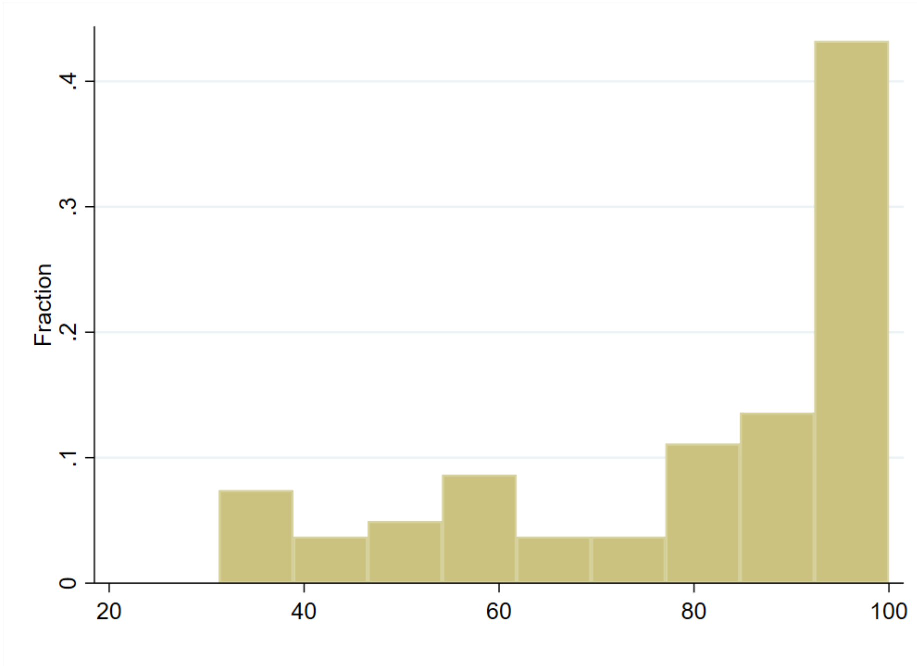
Appendix

Figure A1: U.S. Monetary Policy Shocks by Jarocinski and Karadi (2020)



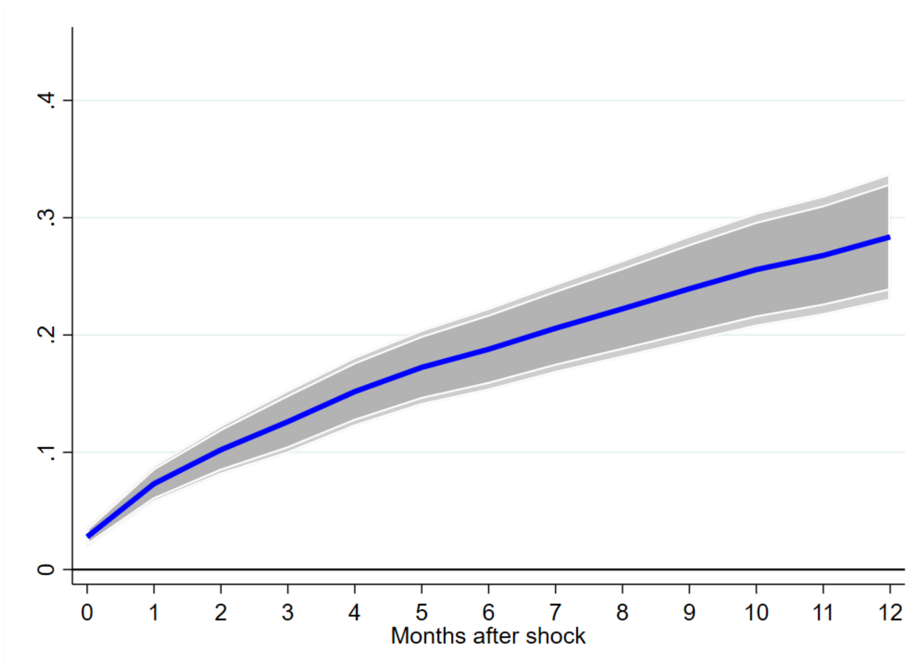
Source: Jarocinski and Karadi (2020).

Figure A2: Cross Country Distribution of Quinn and Toyoda (2008) Index



Source: Quinn and Toyoda (2008).

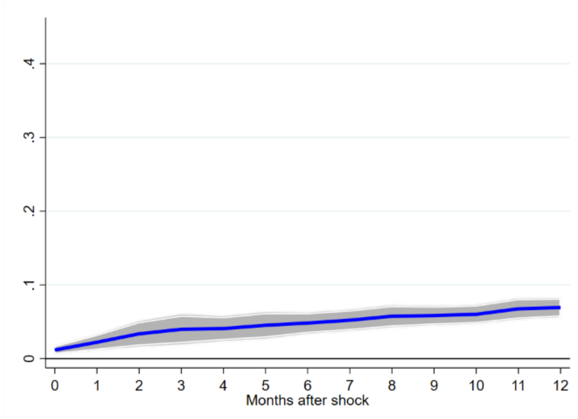
Figure A3: Average Exchange Rate Pass-Through -Consumer Prices (Larger Sample)



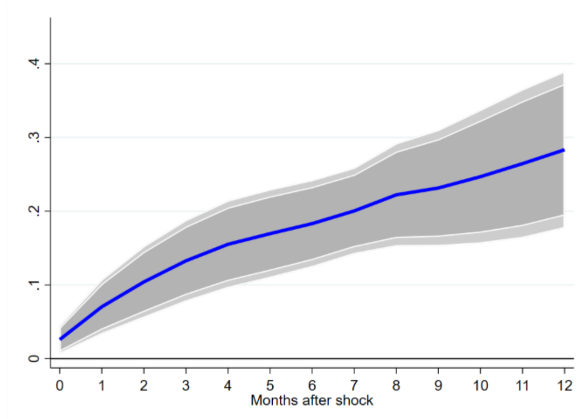
Note: The chart uses data from a larger sample of 141 countries. The solid blue line presents the impact of a one percent increase (depreciation) in local currency/USD on a percent change in consumer prices. The dark shaded region indicates the 90 percent confidence band; the light shaded region indicated the 95 percent confidence band.

Figure A4: Advanced economies vs Emerging market economies

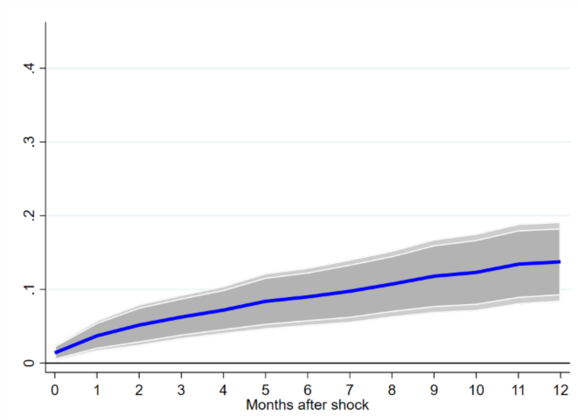
A. Baseline Sample – AEs



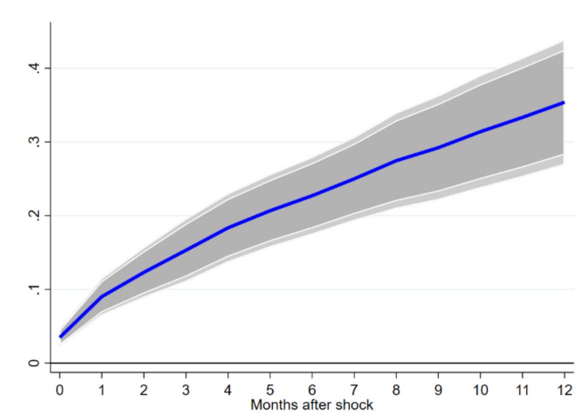
B. Baseline Sample - EMEs



C. Large Sample – AEs



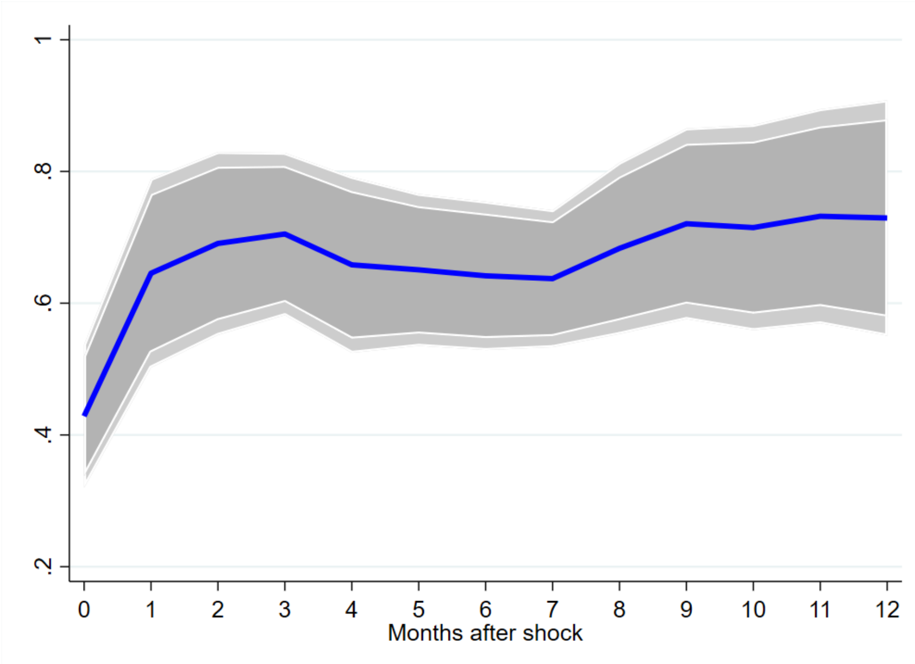
D. Large Sample – EMEs



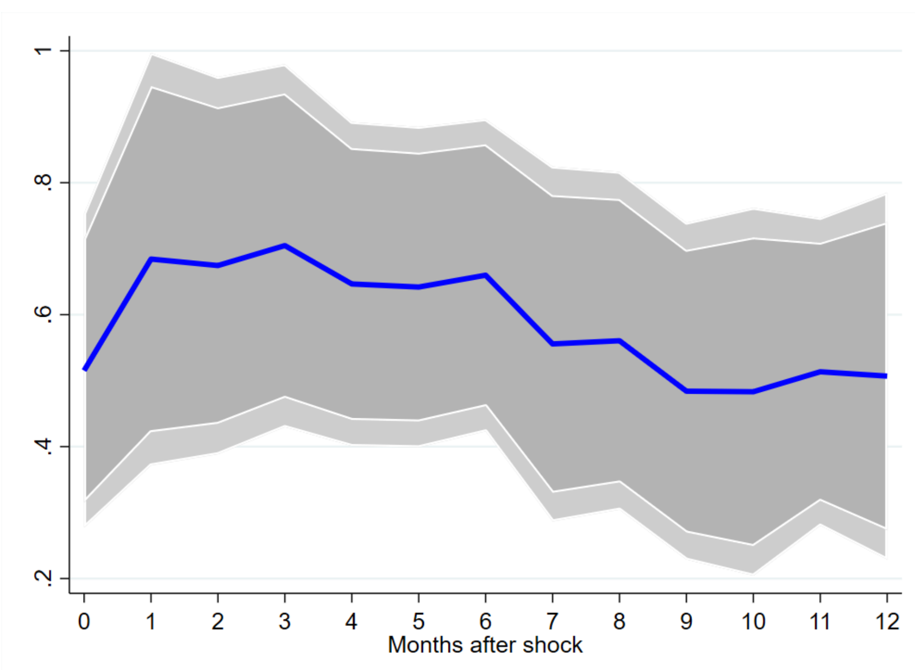
Note: Baseline results are from 46 countries and large sample consists of 141 countries. The solid blue line presents the impact of a one percent increase (depreciation) in local currency/USD on a percent change in consumer prices. The dark shaded region indicates the 90 percent confidence band; the light shaded region indicated the 95 percent confidence band.

Figure A5: Advanced economies vs Emerging market economies – Import Prices

A. Advanced Economies



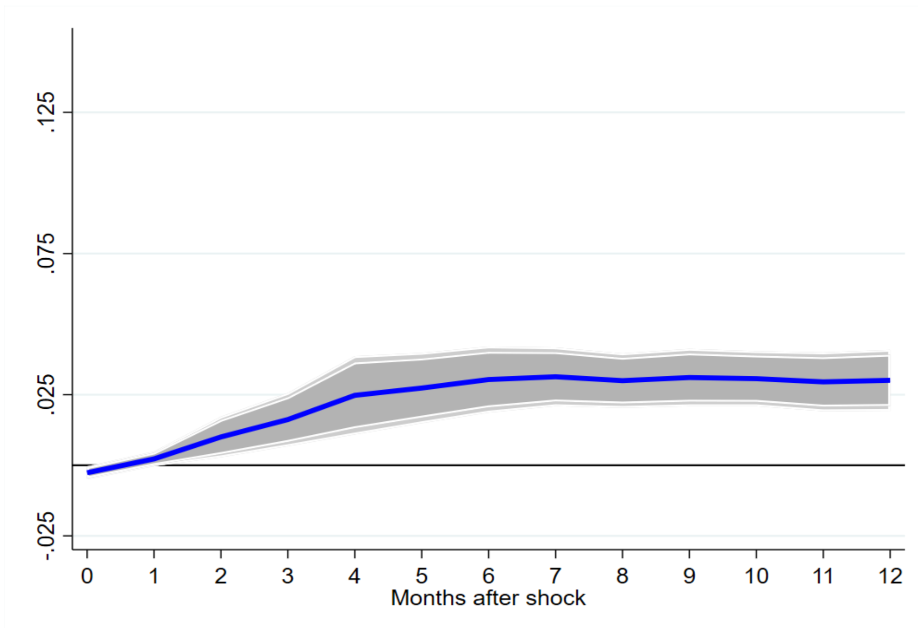
B. Emerging Market Economies



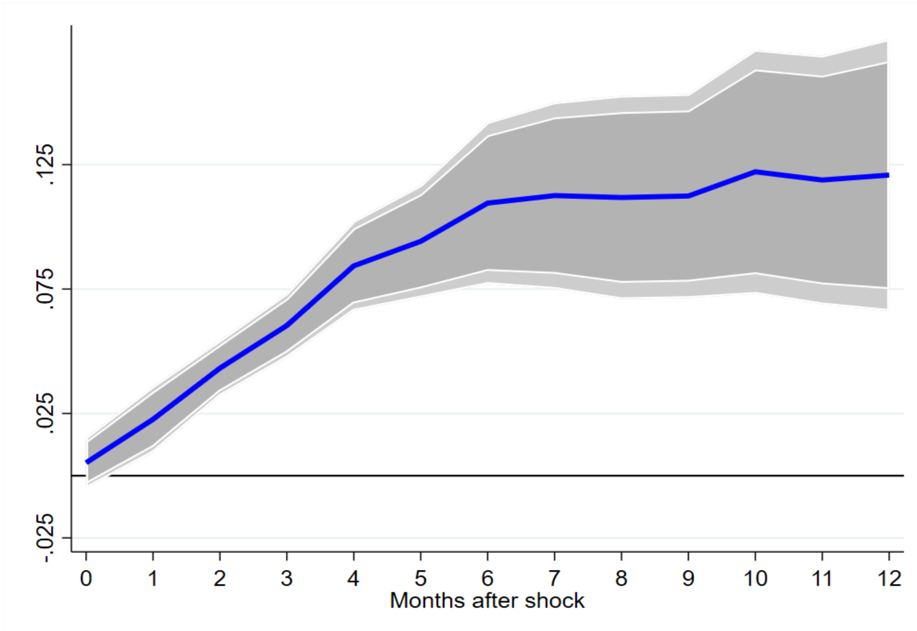
Note: Country sample is shown in Table 1.1 and 1.2. The solid blue line presents the impact of a one percent increase (depreciation) in local currency/USD on a percent change in consumer prices. The dark shaded region indicates the 90 percent confidence band; the light shaded region indicated the 95 percent confidence band.

Figure A6: Advanced economies vs Emerging market economies – Inflation Expectations

A. Advanced Economies



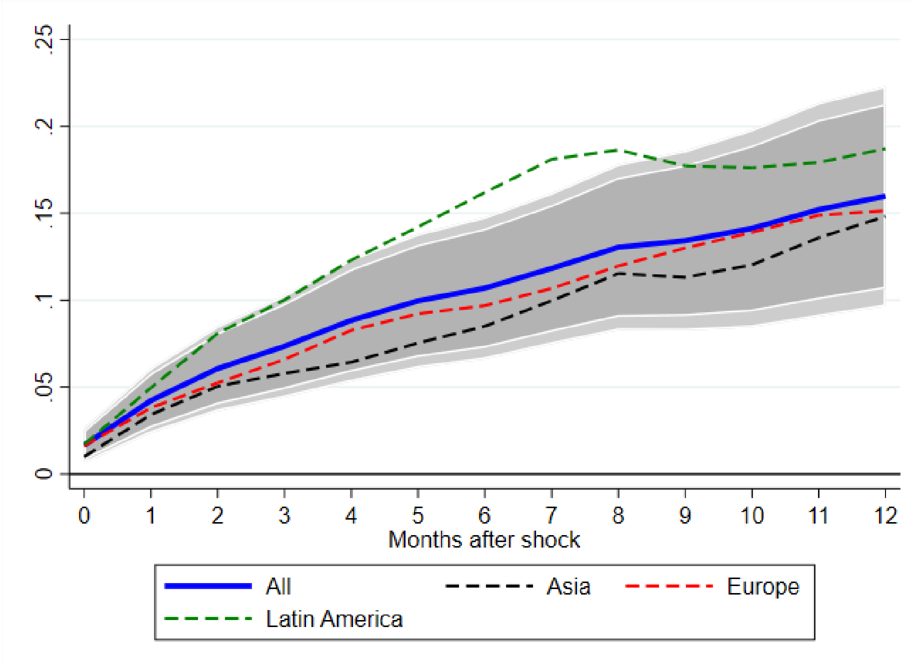
B. Emerging Market Economies



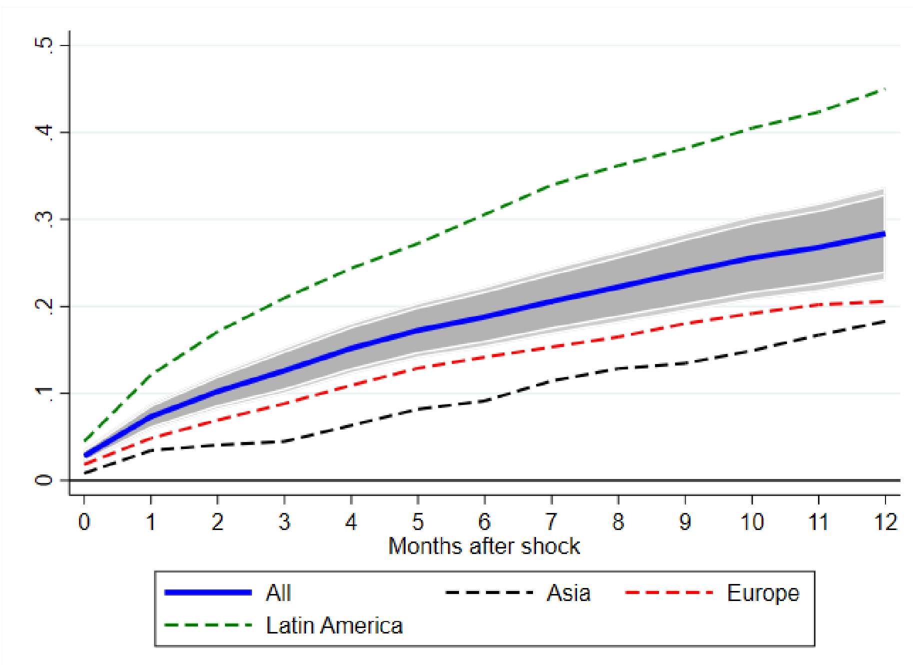
Note: The solid blue line presents the impact of a one percent increase (depreciation) in local currency/USD on a percent change in consumer prices. The dark shaded region indicates the 90 percent confidence band; the light shaded region indicated the 95 percent confidence band.

Figure A7: Across different Regions

A. Baseline

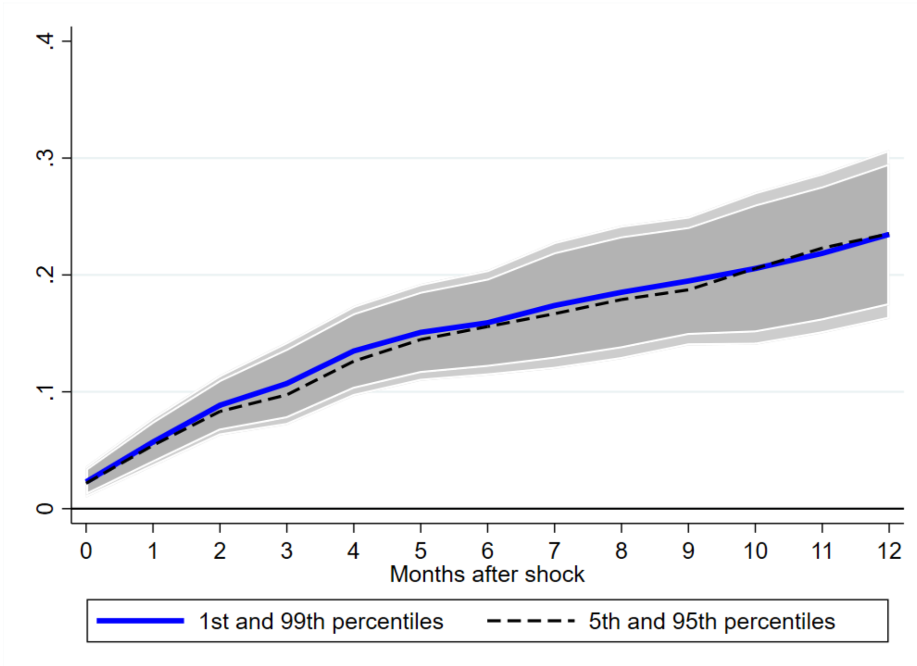


B. Large Sample



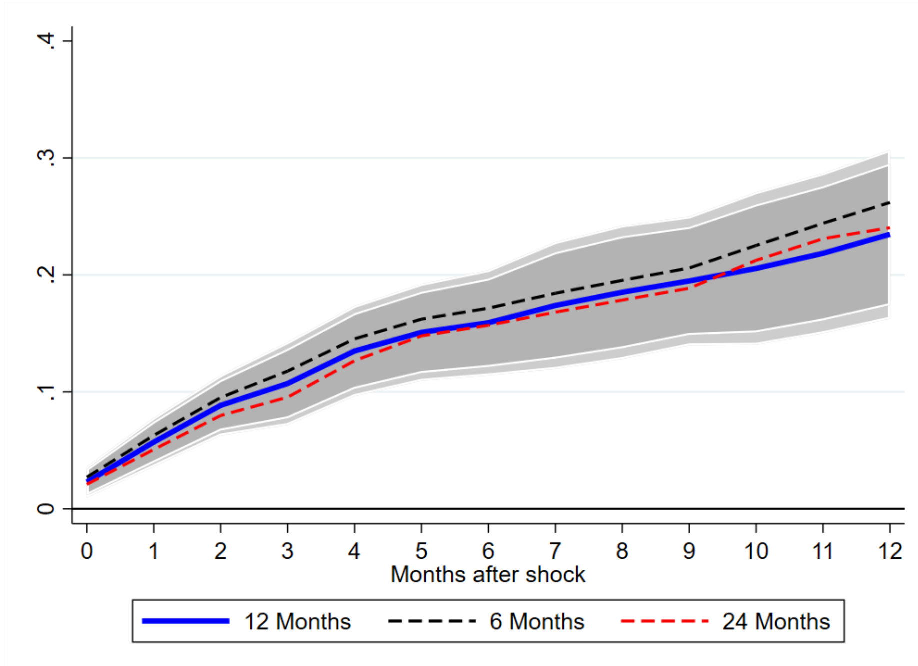
Note: The solid blue line presents the impact of a one percent increase (depreciation) in local currency/USD on a percent change in consumer prices. The dark shaded region indicates the 90 percent confidence band; the light shaded region indicated the 95 percent confidence band.

Figure A8: Alternative Trimming of Sample



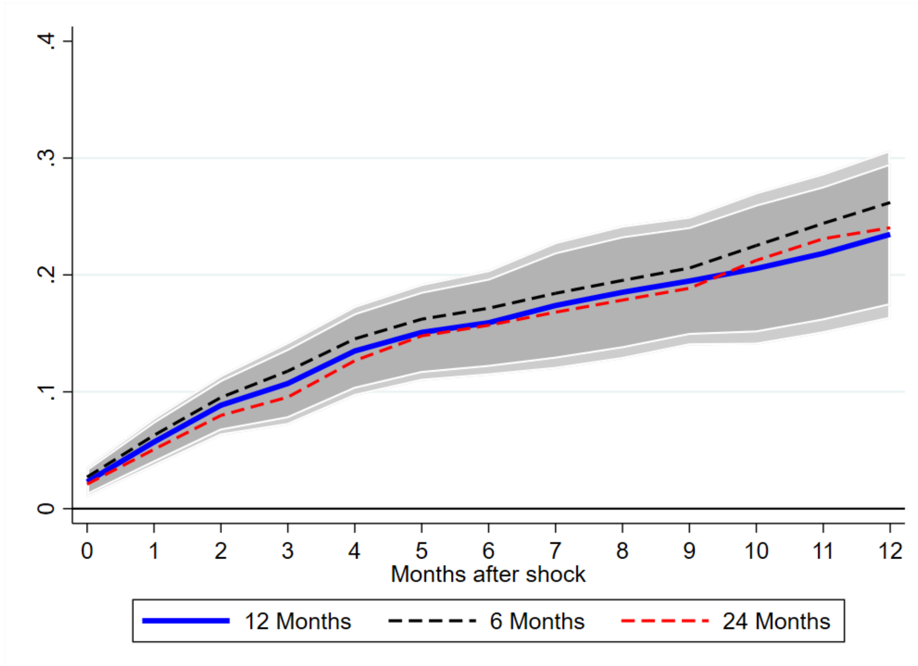
Note: The solid blue line presents the impact of a one percent increase (depreciation) in local currency/USD on a percent change in consumer prices. The dark shaded region indicates the 90 percent confidence band; the light shaded region indicated the 95 percent confidence band.

Figure A9: Alternative Lags



Note: The solid blue line presents the impact of a one percent increase (depreciation) in local currency/USD on a percent change in consumer prices. The dark shaded region indicates the 90 percent confidence band; the light shaded region indicated the 95 percent confidence band.

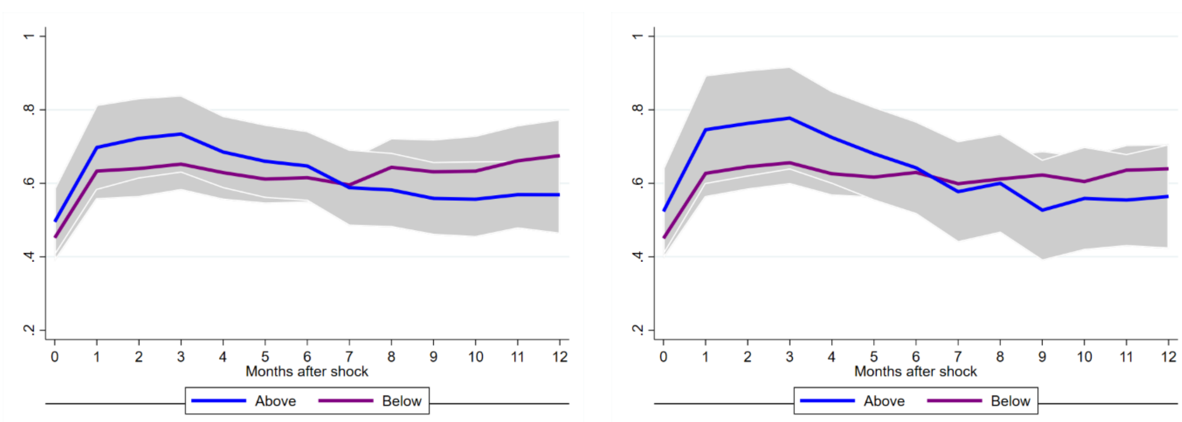
Figure A10: Dropping Trade Partners' Weighted Producer Price Index



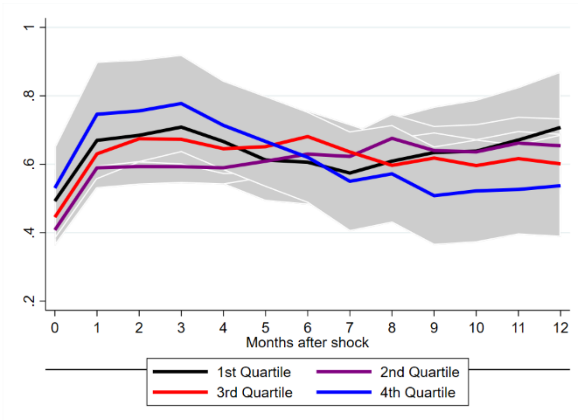
Note: The solid blue line presents the impact of a one percent increase (depreciation) in local currency/USD on a percent change in consumer prices. The dark shaded region indicates the 90 percent confidence band; the light shaded region indicated the 95 percent confidence band.

Figure A11: Role of Current Inflation – Import Prices

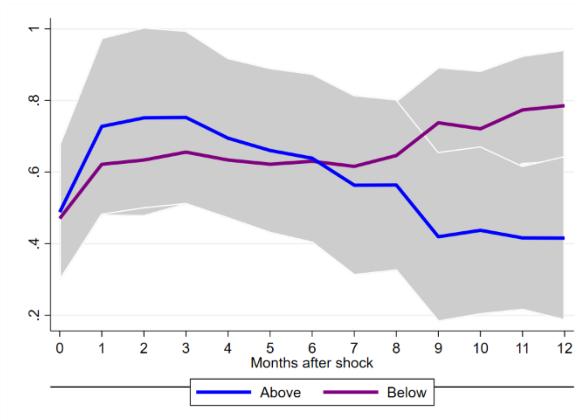
A. Median *B. Mean*



C. Quartiles



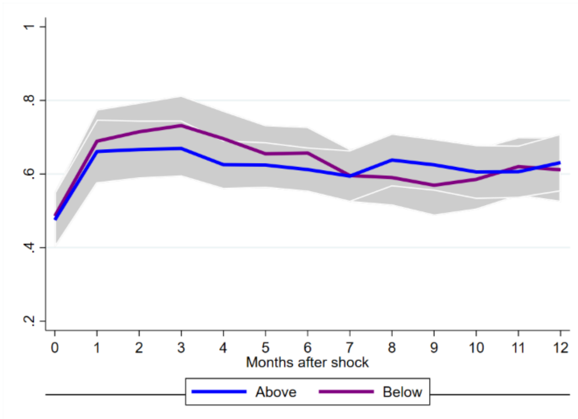
D. Smooth-transitions



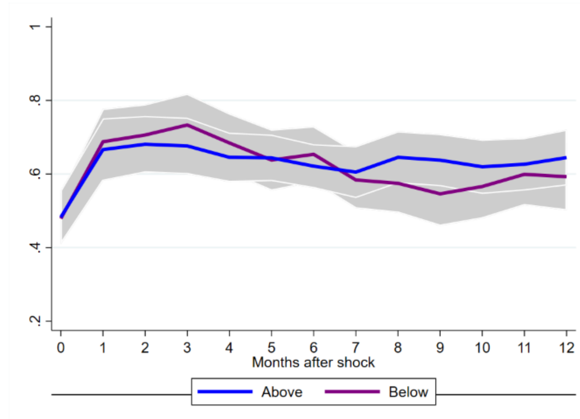
Note: The figures present the impact of a one percent increase (depreciation) in local currency/USD on a percent change in import prices across different groups with current inflation. The dark shaded region indicates the 68 percent confidence band.

Figure A12: Role of Growth – GDP – Import Prices

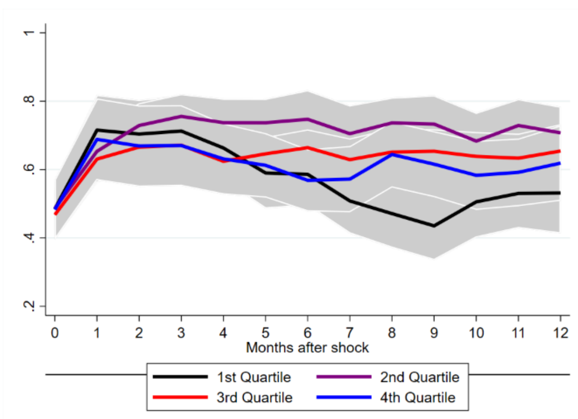
A. *Median*



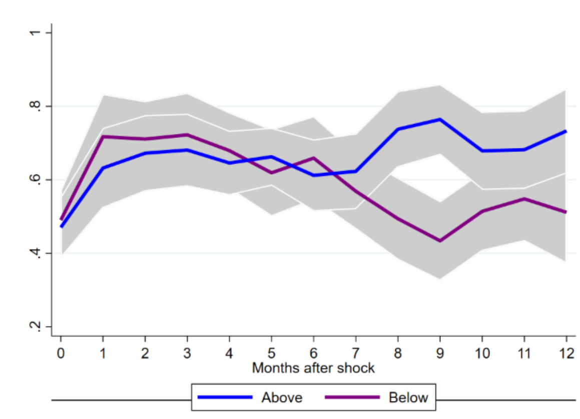
B. *Mean*



C. *Quartiles*

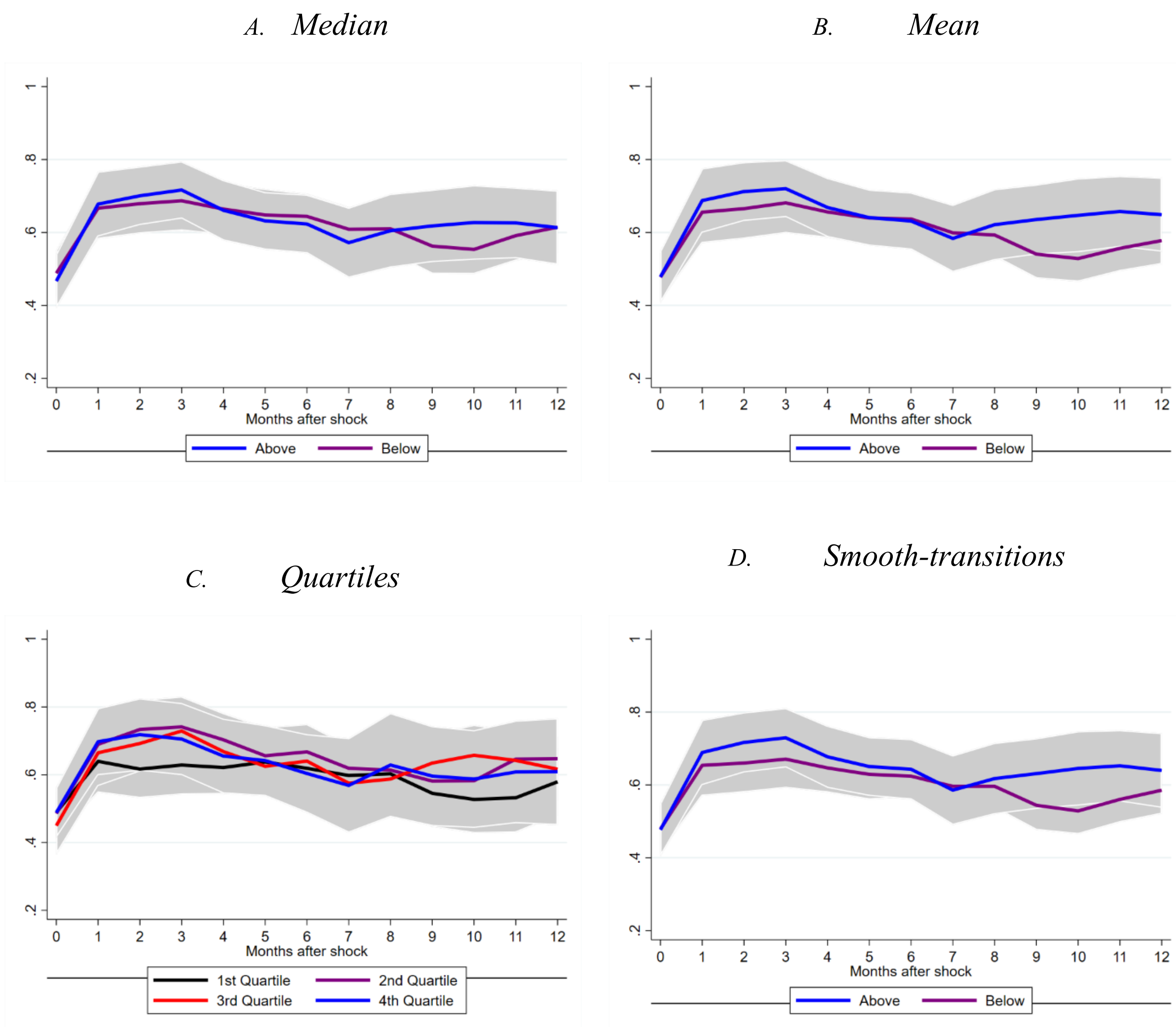


D. *Smooth-transitions*



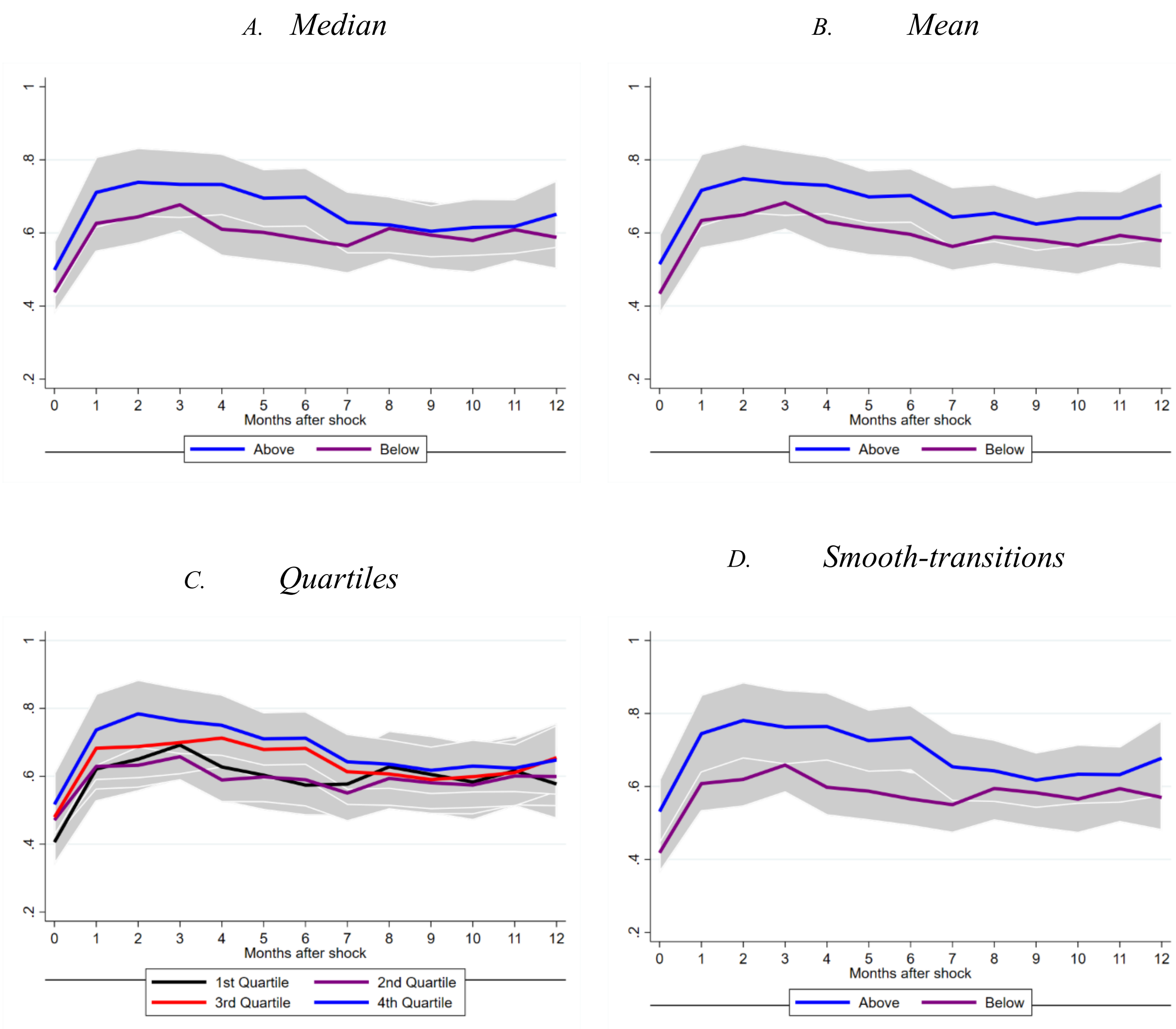
Note: The figures present the impact of a one percent increase (depreciation) in local currency/USD on a percent change in import prices across different groups with real GDP growth. Real GDP growth rates are the deviation of quarterly (YoY) rates from country average. The dark shaded region indicates the 68 percent confidence band.

Figure A13: Role of Growth- Output Gap – Import Prices



Note: The figures present the impact of a one percent increase (depreciation) in local currency/USD on a percent change in consumer prices across different groups with quarterly output gap of country. Output gap series are the deviations of real GDP from their HP filtered trend. The dark shaded region indicates the 68 percent confidence band.

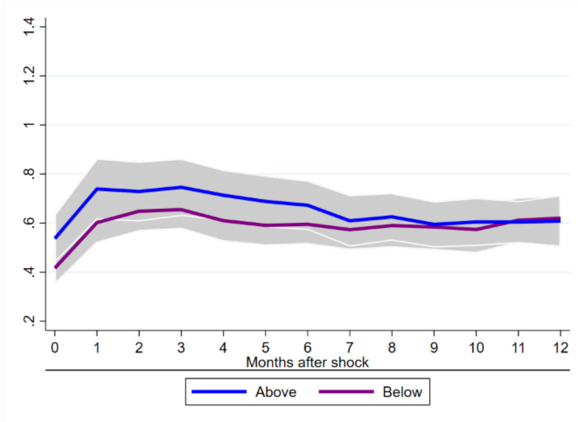
Figure A14: Role of Uncertainty – iMPORT pRICES



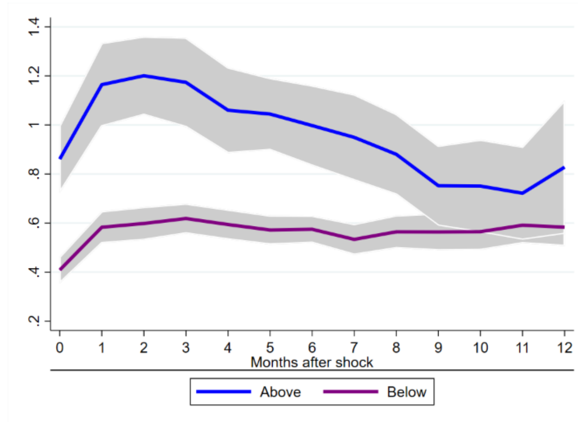
Note: The figures present the impact of a one percent increase (depreciation) in local currency/USD on a percent change in import prices across different groups with current uncertainty in the country. Monthly uncertainty series are from Ahir, Bloom, and Furceri (2022). The dark shaded region indicates the 68 percent confidence band.

Figure A15: Role of Inflation Uncertainty (Disagreement) – Import Prices

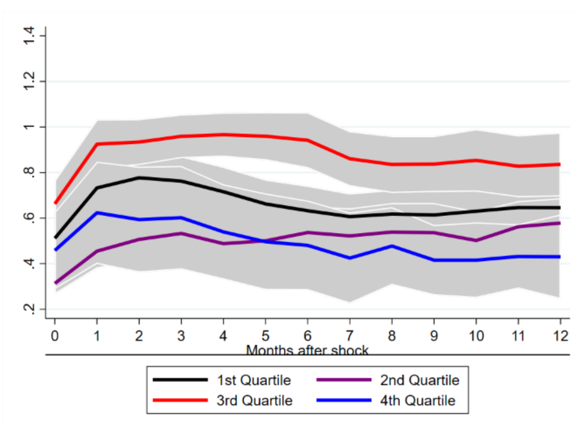
A. Median



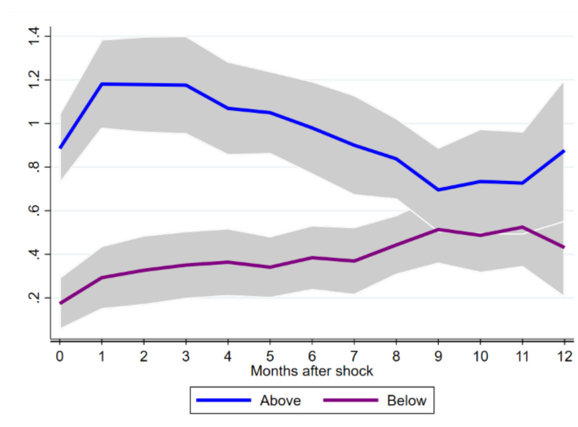
B. Mean



C. Quartiles

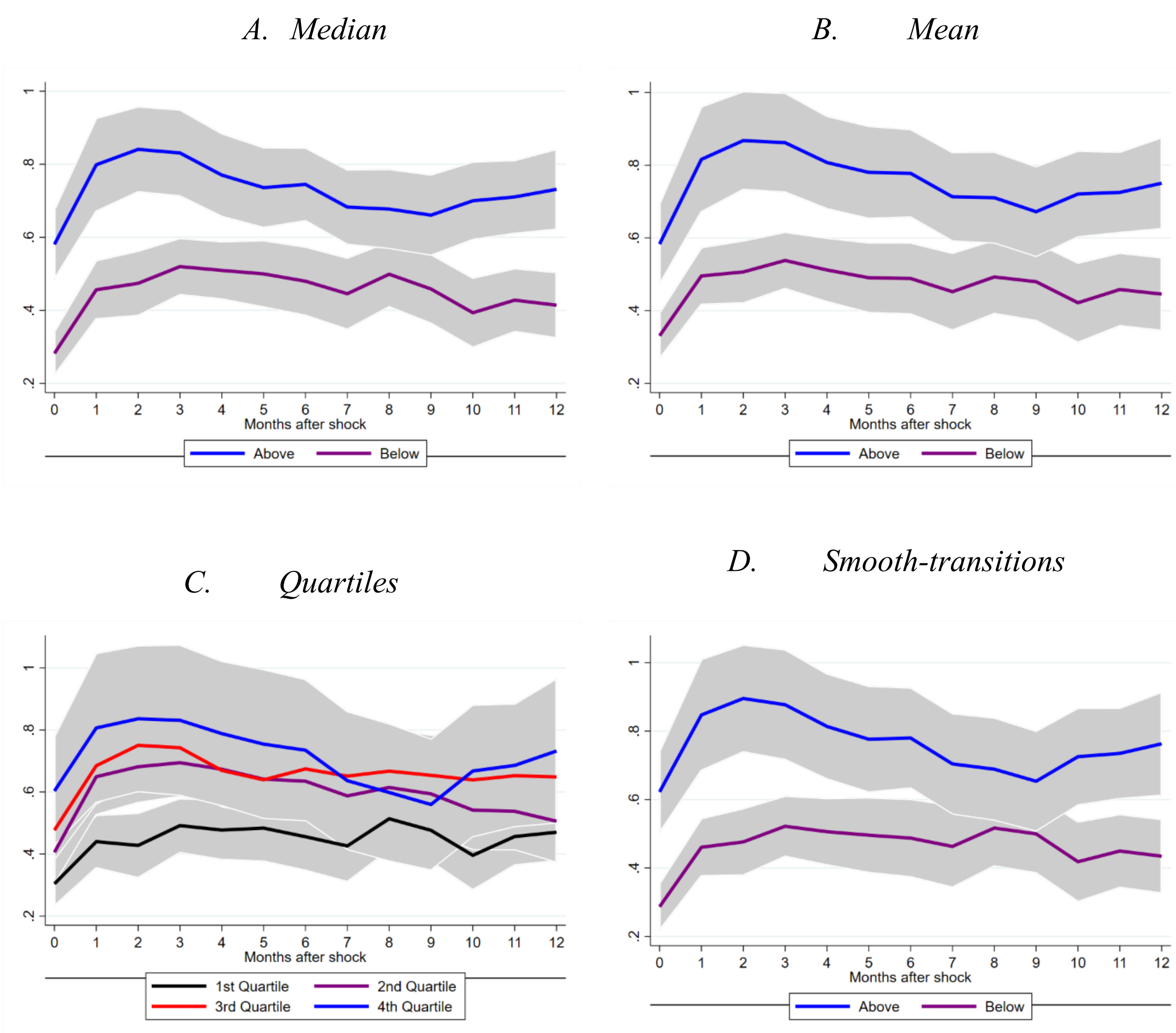


D. Smooth-transitions



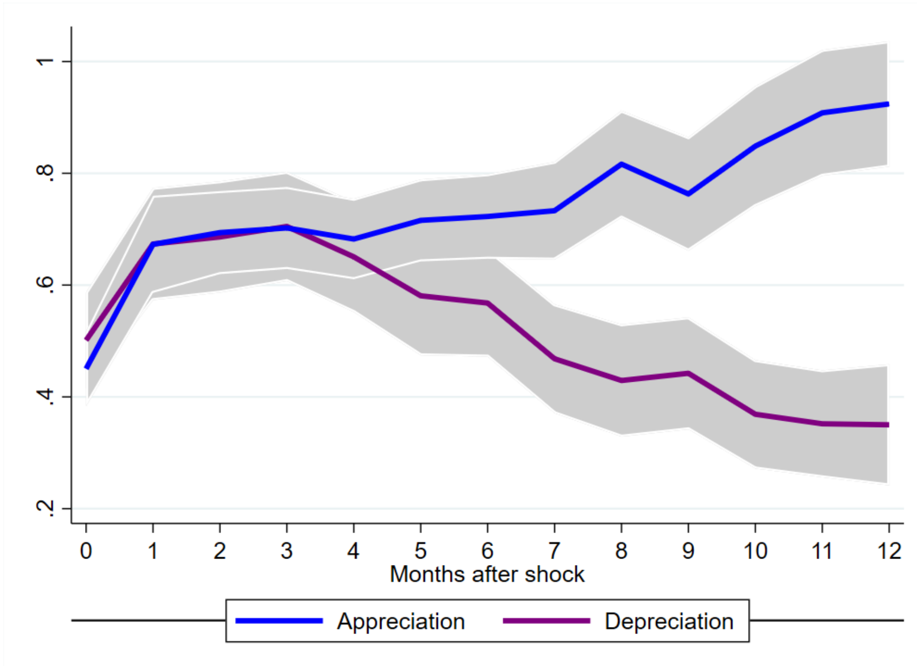
Note: The figures present the impact of a one percent increase (depreciation) in local currency/USD on a percent change in import prices across different groups with country level inflation disagreement. Inflation uncertainty series are from Brito et al., (2021). The dark shaded region indicates the 68 percent confidence band.

Figure A16: Role of USD Invoice Share – Import Prices



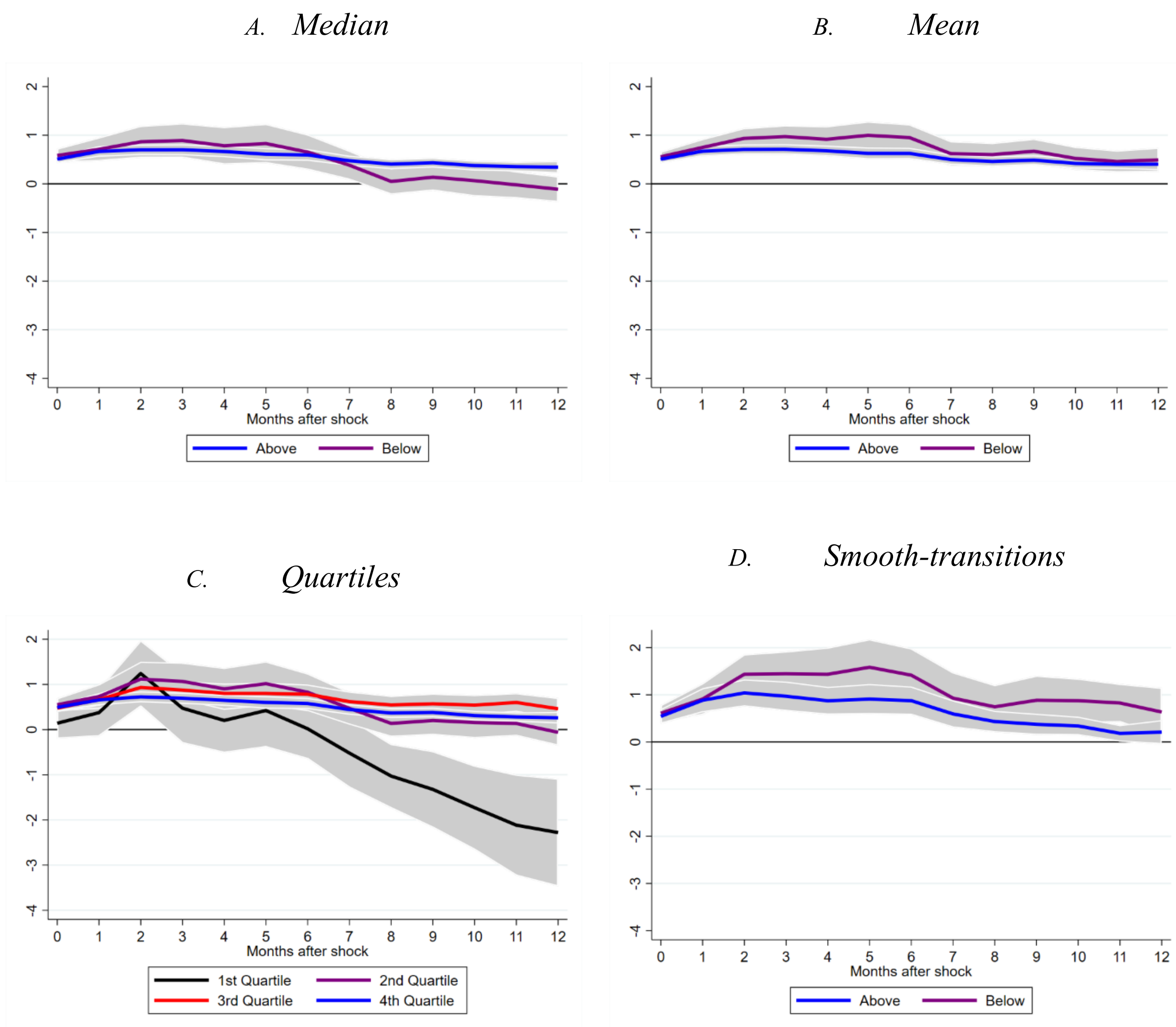
Note: The figures present the impact of a one percent increase (depreciation) in local currency/USD on a percent change in import prices across different groups with average USD invoice share of imports in a country. USD invoice share are from Boz et al., (2022). The dark shaded region indicates the 68 percent confidence band.

Figure A17: Appreciation vs Depreciation – Import Prices



Note: The figures present the impact of a one percent increase (depreciation) in local currency/USD on a percent change in consumer prices for observations when there is a depreciation (purple) vs appreciation (blue). The dark shaded region indicates the 68 percent confidence band.

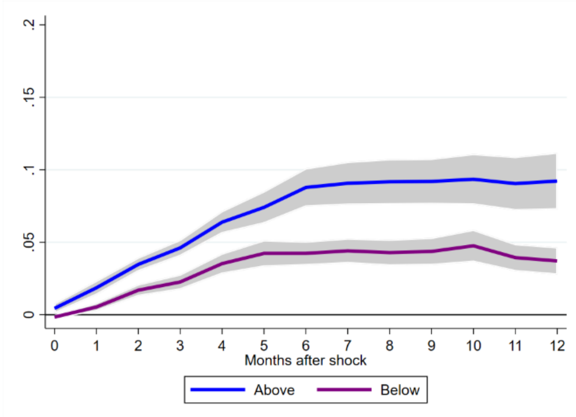
Figure A18: Depreciation Nonlinearity – Import Prices



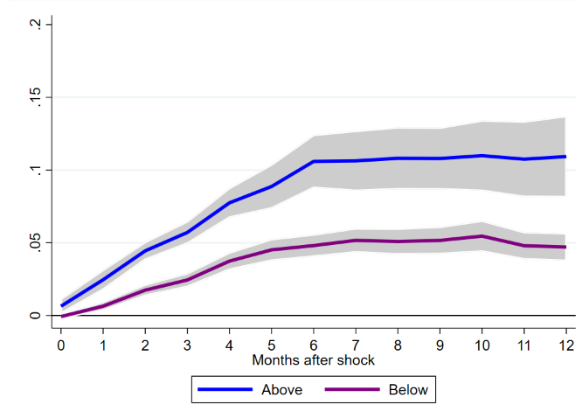
Note: The figures present the impact of a one percent increase (depreciation) in local currency/USD on a percent change in import prices across different groups with the depreciation level. The dark shaded region indicates the 68 percent confidence band.

Figure A19: Role of Inflation – Inflation expectations

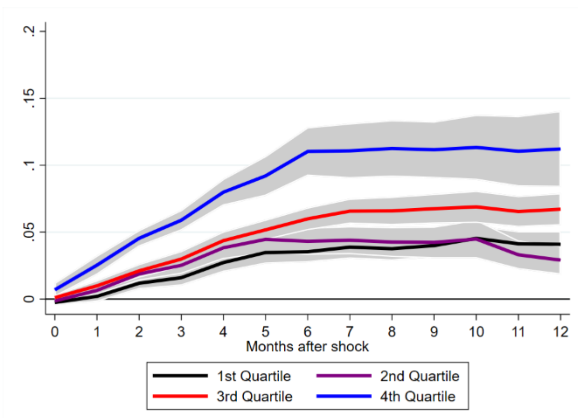
A. Median



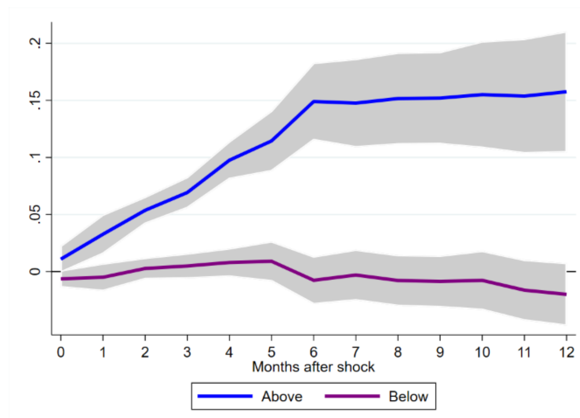
B. Mean



C. Quartiles



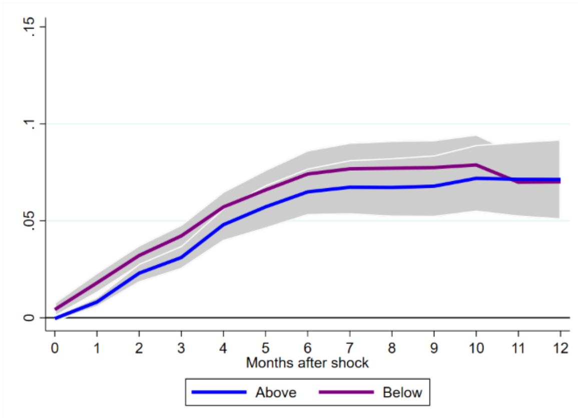
D. Smooth-transitions



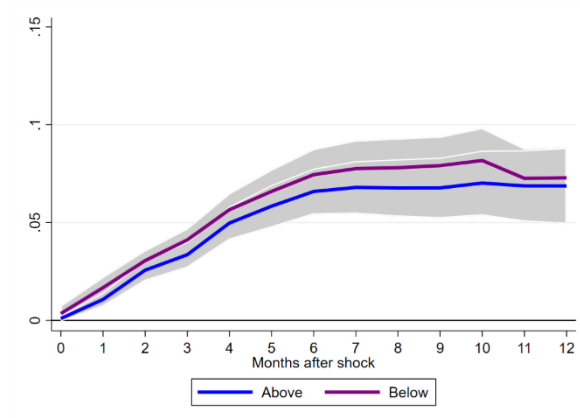
Note: The figures present the impact of a one percent increase (depreciation) in local currency/USD on a percent change in inflation expectations across different groups with current inflation. The dark shaded region indicates the 68 percent confidence band.

Figure A20: Role of Growth – GDP – Inflation Expectations

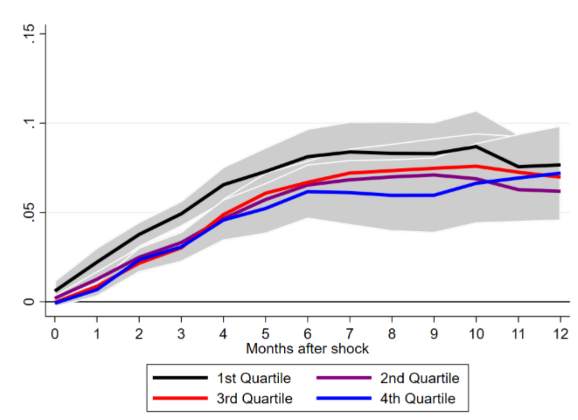
A. Median



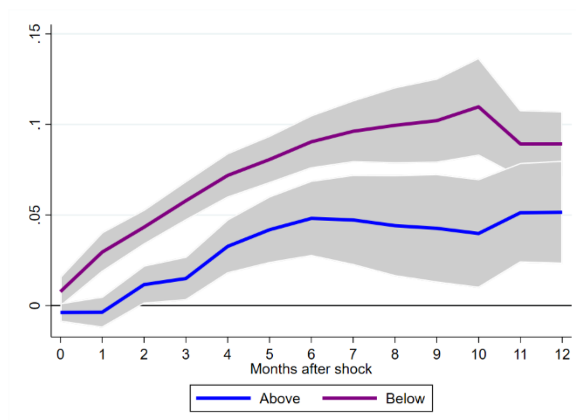
B. Mean



C. Quartiles



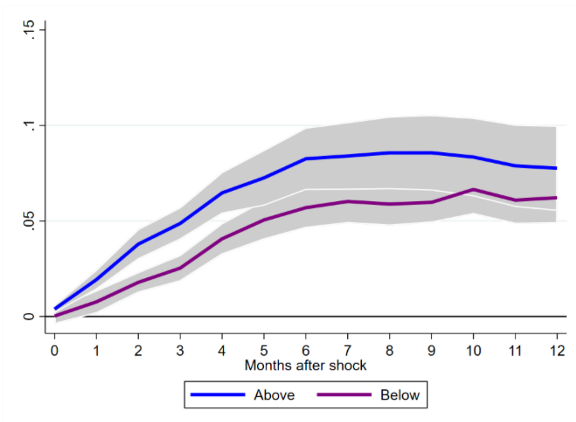
D. Smooth-transitions



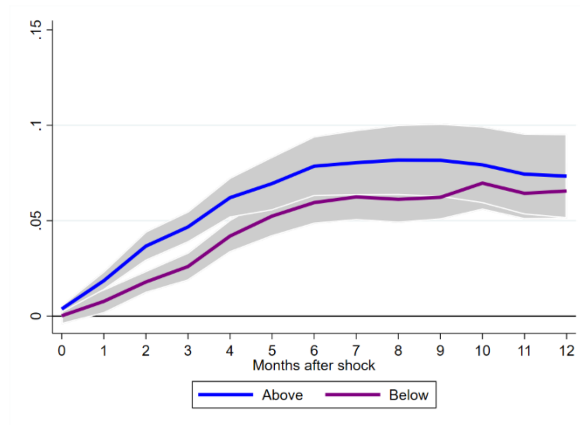
Note: The figures present the impact of a one percent increase (depreciation) in local currency/USD on a percent change in inflation expectations across different groups with real GDP growth. Real GDP growth rates are the deviation of quarterly (YoY) rates from country average. The dark shaded region indicates the 68 percent confidence band.

Figure A21: Role of Growth – Output Gap – Inflation Expectations

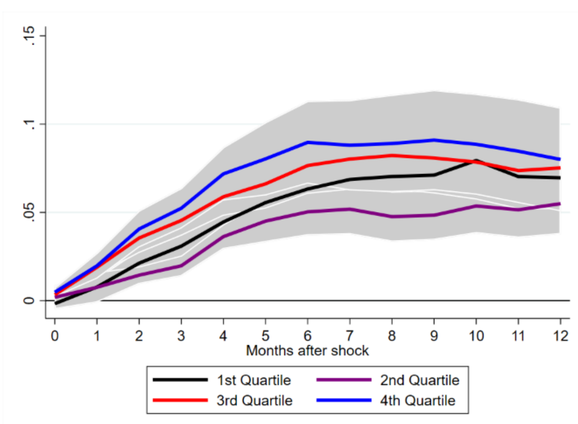
A. *Median*



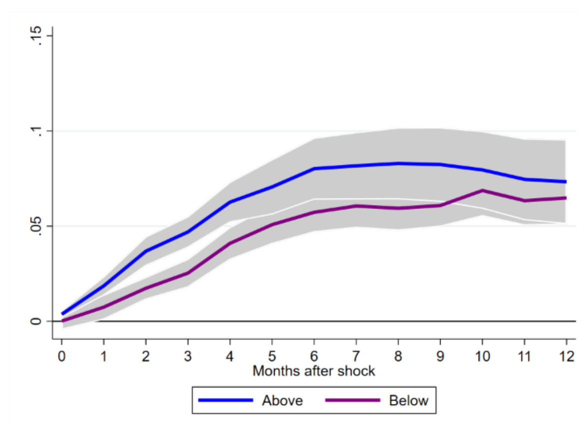
B. *Mean*



C. *Quartiles*



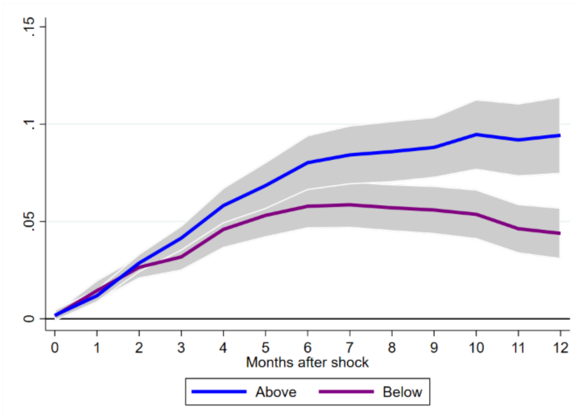
D. *Smooth-transitions*



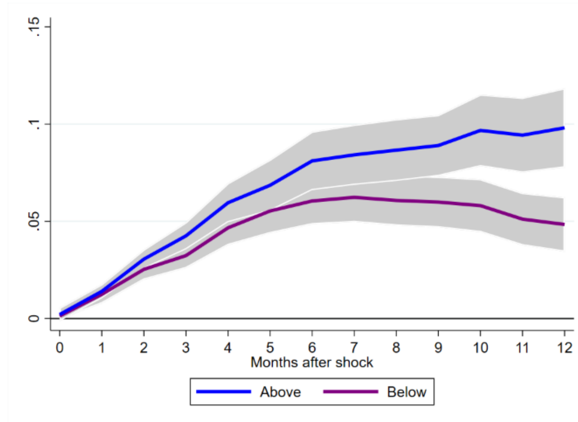
Note: The figures present the impact of a one percent increase (depreciation) in local currency/USD on a percent change in inflation expectations across different groups with quarterly output gap of country. Output gap series are the deviations of real GDP from their HP filtered trend. The dark shaded region indicates the 68 percent confidence band.

Figure A22: Role of Uncertainty – Inflation Expectations

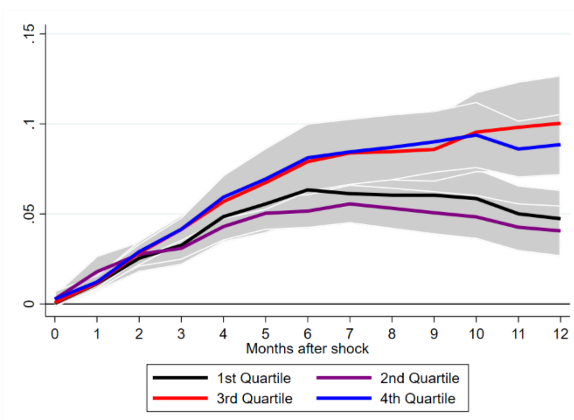
A. *Median*



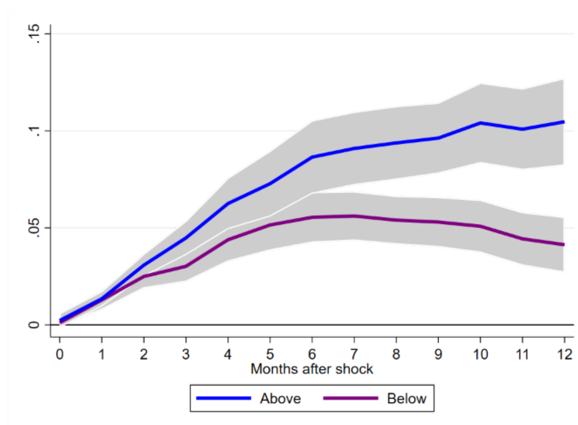
B. *Mean*



C. *Quartiles*



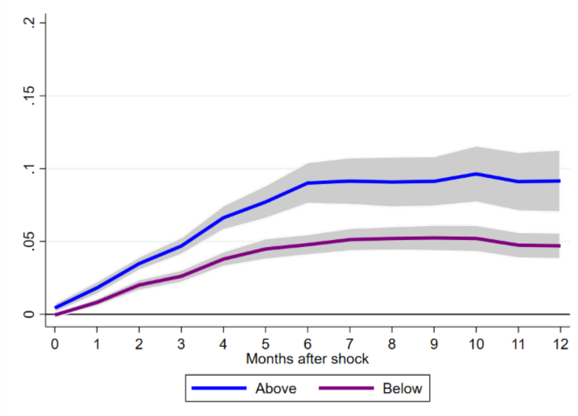
D. *Smooth-transitions*



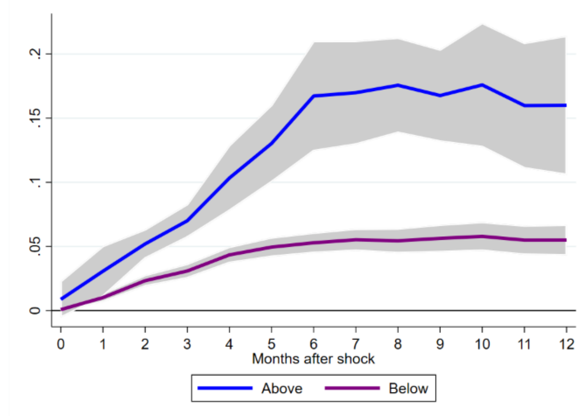
Note: The figures present the impact of a one percent increase (depreciation) in local currency/USD on a percent change in inflation expectations across different groups with current uncertainty in the country. Monthly uncertainty series are from Ahir, Bloom, and Furceri (2022). The dark shaded region indicates the 68 percent confidence band.

Figure A23: Role of Inflation Uncertainty – Disagreement - Inflation Expectations

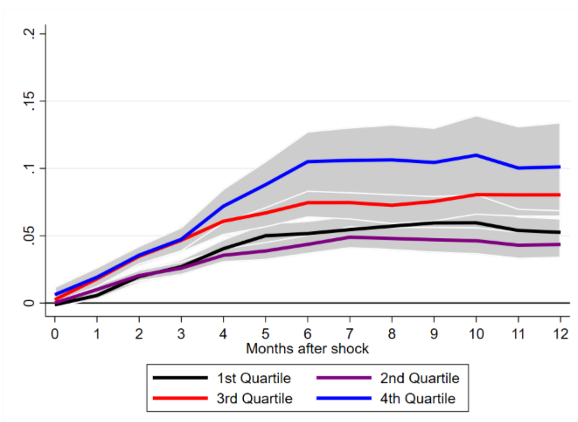
A. Median



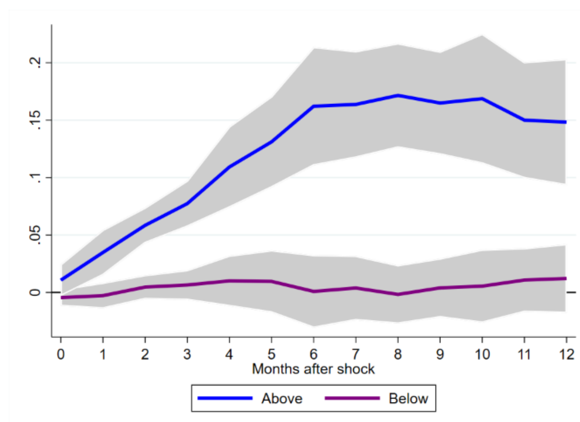
B. Mean



C. Quartiles

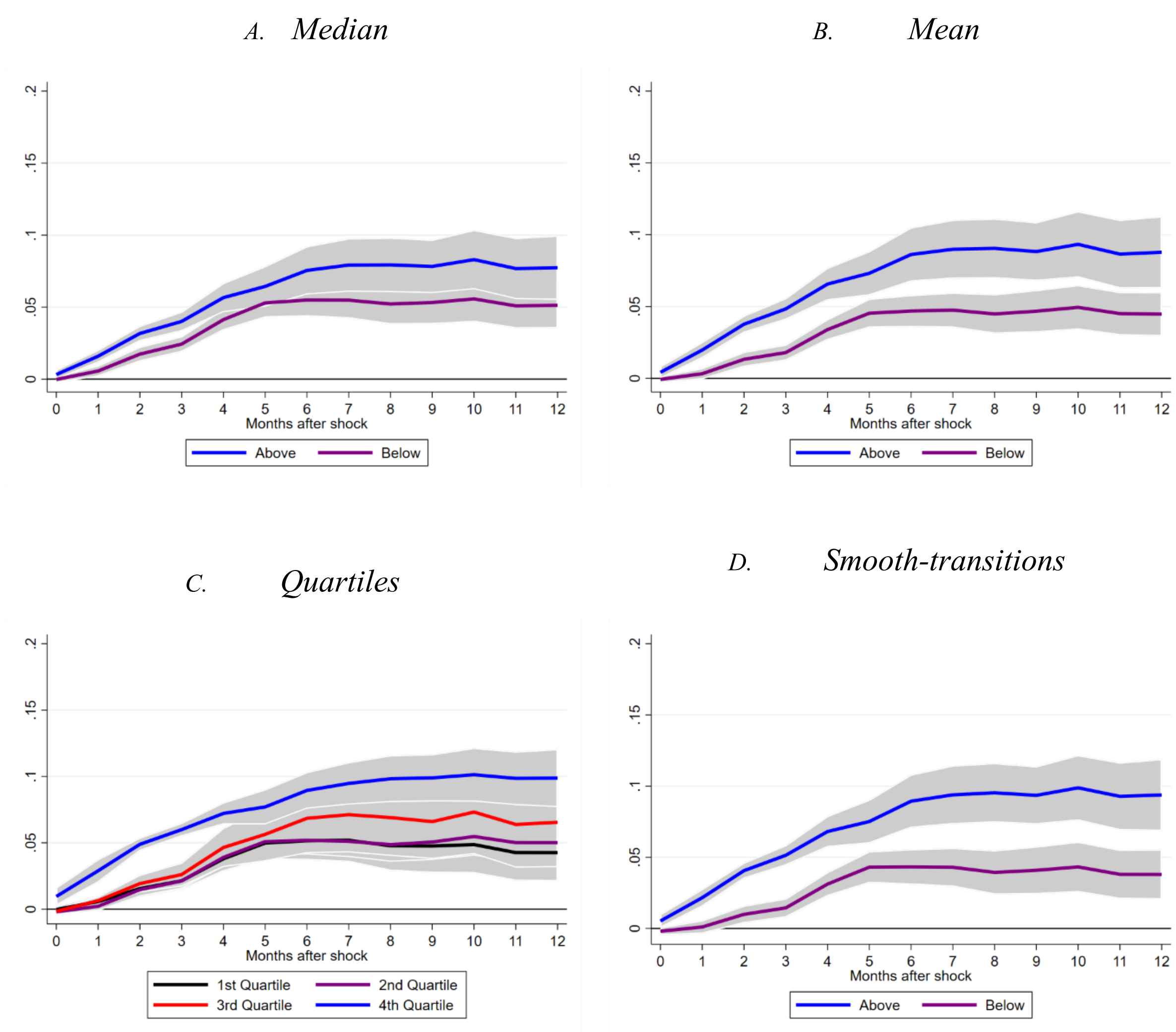


D. Smooth-transitions



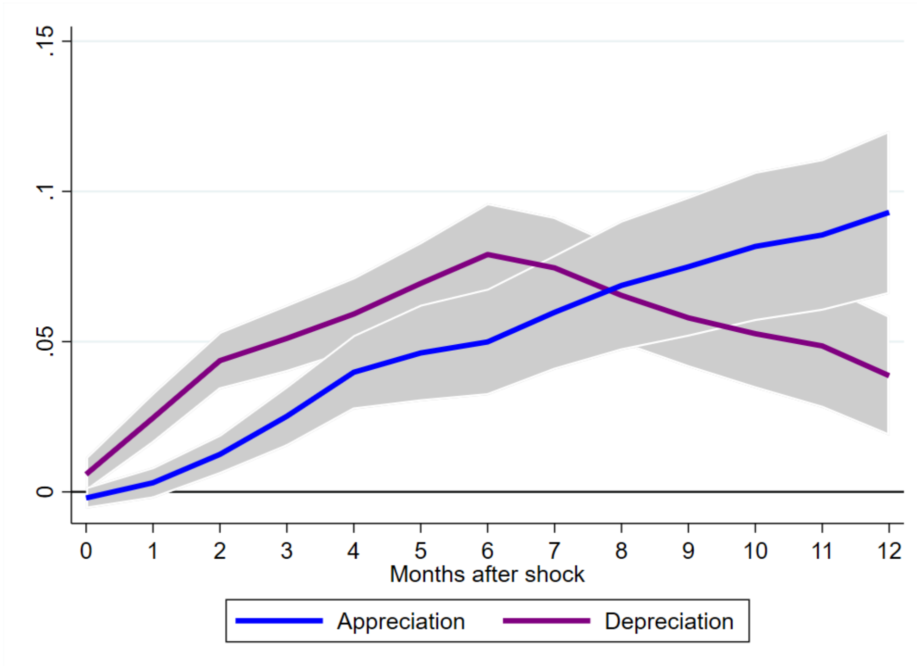
Note: The figures present the impact of a one percent increase (depreciation) in local currency/USD on a percent change in inflation expectations across different groups with country level inflation disagreement. Inflation uncertainty series are from Brito et al., (2021). The dark shaded region indicates the 68 percent confidence band.

Figure A24: Role of USD Invoice Share



Note: The figures present the impact of a one percent increase (depreciation) in local currency/USD on a percent change in inflation expectations across different groups with average USD invoice share of imports in a country. USD invoice share are from Boz et al., (2022). The dark shaded region indicates the 68 percent confidence band.

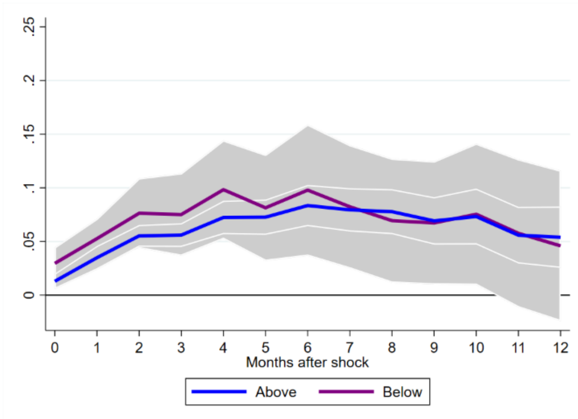
Figure A25: Appreciation vs Depreciation – Inflation Expectations



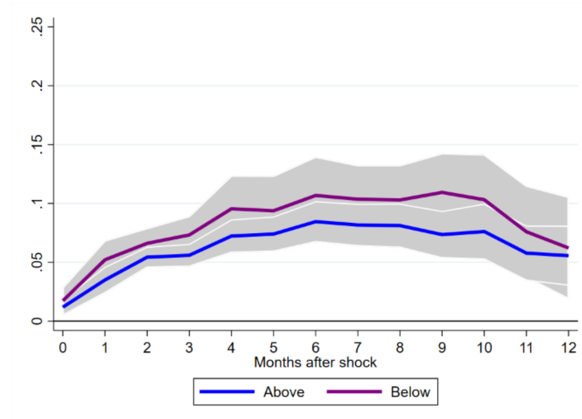
Note: The figures present the impact of a one percent increase (depreciation) in local currency/USD on a percent change in inflation expectations for observations when there is a depreciation (purple) vs appreciation (blue). The dark shaded region indicates the 68 percent confidence band.

Figure A26: Depreciation Nonlinearity – Inflation Expectations

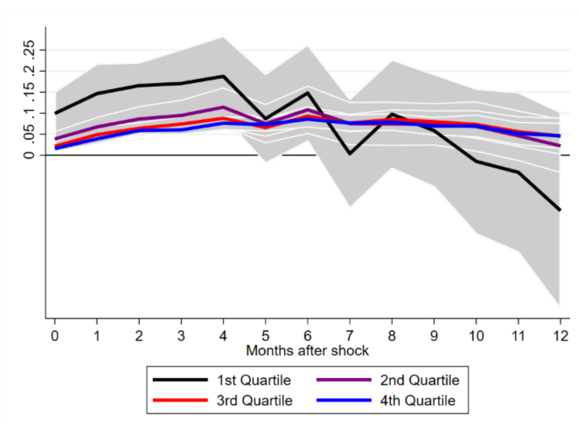
A. Median



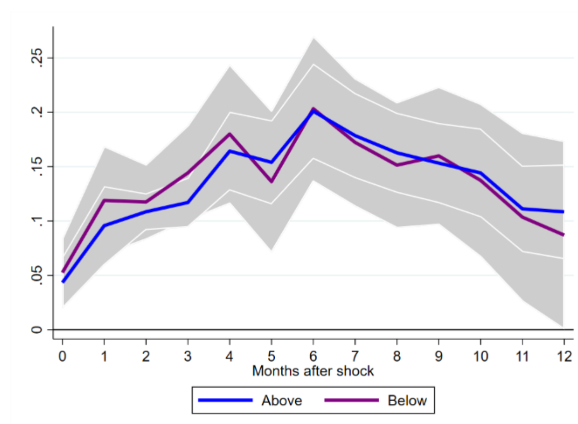
B. Mean



C. Quartiles

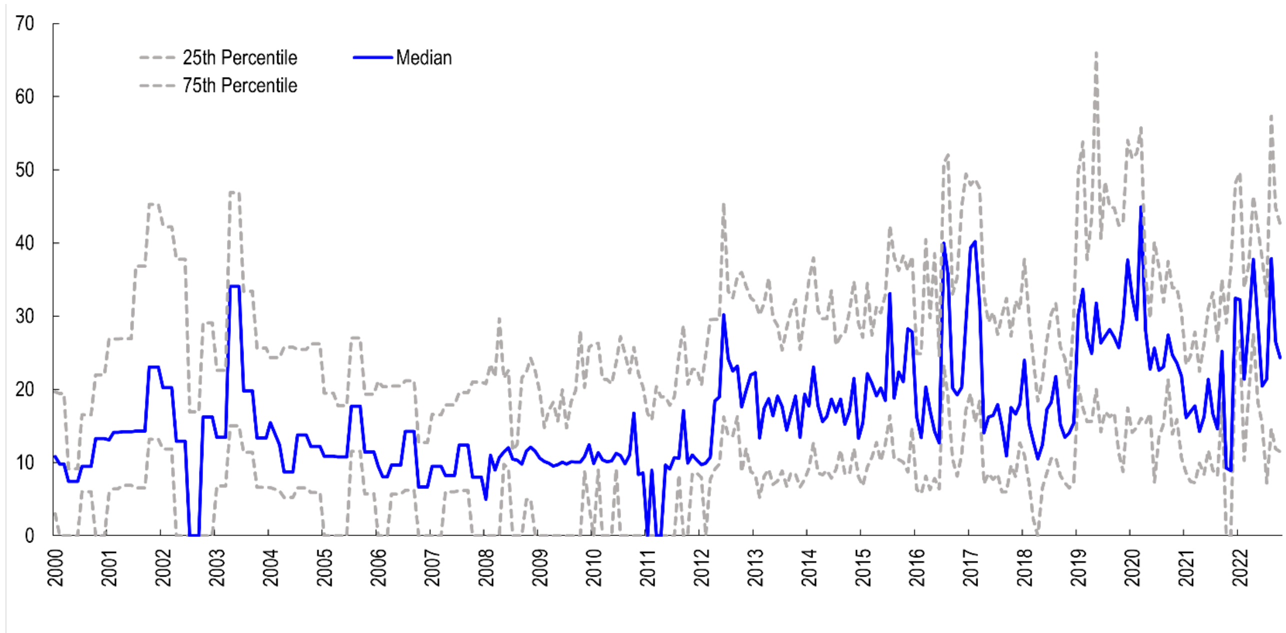


D. Smooth-transitions



Note: The figures present the impact of a one percent increase (depreciation) in local currency/USD on a percent change in inflation expectations across different groups with the depreciation level. The dark shaded region indicates the 68 percent confidence band.

Figure A28: Distribution of country-level uncertainty



Source: World Uncertainty Index database constructed by Ahir, Bloom, and Furceri (2022).