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Non-Linear Exchange Rate Pass-Through in Emerging Markets

by Francesca G. Caselli and Agustin Roitman

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Abstract

This paper estimates exchange rate pass-through to consumer prices in emerging markets focusing on non-linearities and asymmetries. We document non-linearities and asymmetries in the transmission of exchange rate fluctuations to prices using local projection techniques to obtain state dependent impulse responses in a panel of 28 emerging markets. We find significant evidence of non-linearities during episodes of depreciation greater than 10 and 20 percent. More specifically, we find that, after one month, the exchange rate pass-through coefficient is equal to 18 and 25 percent respectively, compared to a coefficient of 6 percent in the linear case. We also investigate the role of temporary vs. permanent shocks and the adoption of an inflation targeting regime in the transmission from exchange rate movements to prices. We perform a set of robustness checks, addressing the presence of outliers and potential endogeneity concerns.

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1 Introduction

The aim of this paper is to estimate exchange rate pass-through (ERPT) to domestic prices in emerging markets (EMs) focusing on three specific dimensions: non-linearities, asymmetries and the relationship with the monetary policy regime. More specifically, we test the following hypotheses: is ERPT larger during episodes of high depreciation? Is ERPT symmetric during period of appreciation and depreciation? What is the effect of the adoption of inflation targeting on the magnitude of ERPT?

Using local projection techniques, we estimate state dependent impulse responses for the exchange rate pass-through to consumer prices in a panel of 28 emerging countries. We find, in line with the literature that the yearly ERTP in EMs is equal to 22 percent, on average. Since we are interested in analysing the magnitude of pass-through during periods of high depreciation, we augment the baseline model with interactions terms to test whether exchange rate pass-through is larger when depreciation is higher than a specific threshold. We find significant evidence of non-linearities during episode of depreciation greater than 10 percent and 20 percent. More specifically, we find that after one month the exchange rate pass-through coefficient is equal to 18 percent and 25 percent respectively, compared to a coefficient of 6 percent in the linear case. We also test the presence of asymmetries in the transmission from exchange rate movements to consumer prices and we find that the response of inflation is asymmetric. Moreover, we investigate the role of the inflation environment in the transmission of exchange rate shocks to prices, confirming the well-known result that adopting inflation targeting reduces the degree of pass-through. In addition, we test whether permanent large depreciation shocks have a different effect than temporary ones. We find that when the exchange rate depreciates by more than 20 percent and the episode lasts for more than 3 months, the ERPT coefficient reaches 32 percent after 3 months. For completeness we also estimate exchange rate pass-through in a panel of advanced economies and our results are in line with the literature. We perform a battery of robustness checks where we take into consideration the presence of outliers (using median regressions) and the potential endogeneity between inflation and exchange rate movements.

Correctly understanding how exchange rate changes affect inflation in emerging markets is an important task for policy makers. In fact, many EMs have been changing their monetary frameworks and/or exchange rate regimes during the last 20 years. Countries operating under currency boards, or with currencies pegged to the US dollar decided to introduce more flexibility and allow the exchange rate to fluctuate. Depending on the degree of exchange rate flexibility of the new frameworks in each country, exchange rates have experienced a transition period toward more flexibility and in some cases a new nominal anchor (different from the exchange rate) was chosen. Flexible exchange rate regimes, and specifically inflation targeting (IT), have recently been the predominant framework in many EMs. Given that exchange rate and inflation dynamics are different under IT (compared to more rigid exchange rate regimes), it is essential to understand how domestic prices will move under flexible rate regimes. Moreover, the degree of ERPT directly affects the effectiveness of monetary policy under flexible exchange rates and thus the efficacy of expenditure switching mechanism. At the same time, exogenous shocks such as oil prices shocks, and/or uncertainty shocks (i.e., geopolitical tensions) can also affect exchange rate fluctuations and hence domestic inflation. The US Federal Reserve exit from unconventional monetary policies might trigger changes in the direction of capital flows, affecting interest rates and exchange rates around the world. Figure 1 shows the effects of tapering talks in some EMs currencies during summer 2013, and the effects of oil prices decline coupled with geopolitical uncertainty in the fall 2014. The Russian Ruble, for instance, depreciated by 90 percent during 2014, and about 70 percent in just 6 months (July-December 2014).

The remainder of the paper is organized as follow: Section 2 reviews the relevant literature. Section 3 shows some stylized facts and discusses some potential theoretical channels for non-linearities and asymmetries. The local projection technique and the baseline model are presented in Section 4 and 5. Section 6 presents the empirical results for the linear model and for the specifications in which we allow for non-linearities and asymmetries. In section 7 we perform some robustness checks and we address the potential endogeneity in the relationship between inflation and depreciation. Section 8 includes policy implications and concluding remarks.

2 Literature Review

The relationship between the exchange rate regime and the evolution of domestic prices has been at the center of the early literature on ERPT in EMs. For instance, Calvo and Reinhart (2002) highlight large pass-through and liability dollarization, as the main reasons behind the so called "fear of floating". Hausmann et al. (2006) also identify high levels of exchange rate pass-through as one of the reasons for central banks to be concerned about exchange rate movements. They also underscore the so called "original sin", which refers to the fact that currency mismatches also can lead to fear of floating, since a depreciation, through an increase in the value of liabilities, can have detrimental effects on output.

Taylor (2000), similarly, links the degree of ERPT to the inflation environment and more specifically to the presence of inflation targeting. After the adoption of an IT framework, countries tend to experience a lower pass-through. The rationale is that IT succeeds in keeping inflation low and this, through expectations of persistent low inflation, pushes firms to keep their prices broadly constant in order to be able to remain competitive. In other words, a low inflation environment causes a reduction in firms pricing power that in turn leads to a decline in ERPT. Choudhri and Hakura (2006) test the Taylor hypothesis on a sample of 71 advanced and developing countries from 1979 to 2000. They find evidence of a positive correlation between exchange rate and CPI inflation. Gagnon and Ihrig (2004) test the same hypothesis on 20 industrial countries between 1971 and 2003, and find a decline in pass-through related to adoption of IT. Edwards (2006) investigates whether IT has influenced the exchange rate as a shock absorber focusing on the distinction between prices of tradable and non-tradable goods. He finds that a reduction in the ERPT after the adoption of IT for all price indices considered, but the decline is larger for consumer price indices than for producer price indices. Mishkin and Schmidt-Hebbel (2007), using data on 21 industrial and EM targeters and 13 industrial non-targeters, employ a panel vector autoregression (VAR) model to compare impulse response functions across different country groups, depending on whether a country has inflation targeting in place, or not. They find that pass-through is lower for targeters. Coulibaly and Kempf (2010) test the Taylor hypothesis on 27 emerging markets (15 targeters and 12 non-targeters) by using panel VAR techniques and recursive identification. They find that for IT countries the ERPT to consumer, import and producer prices has decreased after the adoption of IT. While for non targeters there is no significant change in pass-through.

Less is known about the role of non-linearities and asymmetries in the transmission mechanism from exchange rate to inflation in emerging markets. Bussière (2013) tests the presence of non-linearities and asymmetries for the G7 economies. He focuses on trade prices (export and import prices) and finds evidence of both mechanisms, even though, in terms of magnitude, there is high heterogeneity across countries. Frankel et al. (2012) find that there is a threshold effect for large devaluations: they find that depreciations above 25 percent have a proportionately larger pass-through effect. They also find evidence of asymmetries: they cannot reject the hypothesis that appreciations are not passed through at all, suggesting downward price rigidity. On the contrary, Carranza et al. (2009) find that, in dollarized economies, due to balance sheet effects, a large real depreciation can counterbalance the positive competitiveness and imported inflation effects through a dramatic drop in aggregate investments. Burstein et al. (2005) analyse the behaviour of inflation after nine large post-1990 contractionary devaluations. They observe that the rate of inflation is relative low compared to the magnitude of the devaluation. They argue that this pattern is due to distribution costs and substitution of imports towards low quality domestic products. These are some of the economic reasons why non-linearities can arise in the occurrence of drastic depreciations/appreciation. We will review further theoretical channels behind asymmetries and non-linearities in Section 3.

3 Stylized facts and theoretical underpinnings for asymmetries and non-linearities

In this section we look at some stylized facts to get a first look at the unconditional relationships present in our data. We begin by comparing emerging to advanced economies. Figure 2 shows that emerging markets appear to be different from advanced economies (AEs) in terms of inflation levels, volatility, and the relationship between inflation and exchange rate movements, as well as the relationship between inflation volatility and exchange rate volatility. Figure 2 plots the average inflation, depreciation/appreciation, and the corresponding volatility for each country, over the sample period 1980-2014. There are at least 4 stylized facts worth mentioning that distinguish EMs from AEs: Not surprisingly, inflation appears to be higher and more volatile in EMs, compared to AEs. Higher inflation seems to be associated with higher depreciation rates in EMs, compared to AEs. Depreciation rates appear to be positively associated with depreciation volatility, whereas for AEs there is no apparent relationship, and finally depreciation volatility and inflation volatility appear to be positively associated in EMs, which does not appear to be the case for AEs.

The empirical literature generally agrees that ERPT is higher in emerging markets than in advanced ones. One possible reason is linked to the Taylor hypothesis: emerging markets tend to have higher rates of inflation and therefore higher pass-through. Ca'Zorzi et al. (2007) argue that another potential explanation can be that the private sector in EMs has fewer hedging instruments available. In a not fully competitive market, this could imply that exchange rates fluctuations are transmitted more into prices. Moreover, emerging markets often price their imports in foreign or international currencies, whereas advanced economies like the US tend to import goods denominated in their own currency. This factor might also explain why emerging markets tend to present a higher pass-through than advanced economies. On the other side, as already mentioned, recent empirical studies have recorded a decrease in ERPT in EMs too. This has been explained through to the adoption of IT.

One element that distinguishes EMs from AEs is their exposure and sometimes vulnerability to terms of trade shocks. Often times, commodities account for a large share in production and exports of many EMs. Terms of trade shocks are sometimes translated to abrupt and relatively large fluctuations in exchange rates. Another important element that distinguishes EMs from AEs is the share of commodity prices (i.e., food and fuel) in their consumer price index (CPI) baskets. Typically, EMs have larger shares of (imported) food and fuel in their CPI baskets compared to AE. Commodity prices fluctuations can be big and volatile, hence introducing sudden and often large movements in exchange rates, domestic import prices and domestic inflation.

ERPT is usually assumed in the literature to be both linear and symmetric, however many microeconomic factors might generate directional and size asymmetries. Some recent studies (Bussière 2013, Frankel et al. 2012 and Pollard and Coughlin 2004) highlight the presence of asymmetries, meaning that depreciations may generate a different price reaction than appreciations, and non-linearities, suggesting that big movements in the exchange rate might have a more than proportional effect than small changes. Bussière (2013) underlines several potential channels that might generate asymmetries and non-linearitites. First, export prices are normally downward rigid, making it easier for exporters to increase their markup than to decrease it. This implies that when the exchange rate depreciates, exporters increase their export prices more than they decrease them when there is an appreciation. This also means that depreciations have a larger effect than appreciations on import prices. To understand why, it useful to think about a depreciation on the import side as an appreciation on the export side: exporters, facing an appreciation of the exchange rate and constrained by downward prices rigidity, will be able to absorb only a part of the currency movements in their markup, implying a higher pass-through on the importers' side. This assumption also has implications for potential non-linearities in the sensitivity of prices to exchange rate movements. If exporters face a large appreciation it will be even more difficult to adjust their mark-up accordingly and this will trigger an even higher pass-through on the importers' side.

Another factor that we must take into account to explain different reactions of exporting firms to different degree of exchange rate movements is the performance (productivity) of the firm or the quality of exported products. These channels are highlighted in Berman et al. (2012) who review several theoretical models that generate endogenous and heterogeneous pricing-to-market where firms with higher productivity are able to offset a higher portion of the exchange rate movement . An interesting case is when distribution costs and quality differences are introduced together. In this version of the Corsetti and Dedola (2005) model developed by Berman et al. (2012), higher quality goods have higher mark ups implying that the price elasticity to an exchange rate change is higher for higher quality products. This type of microeconomic structure might also generate non-linearities in the response of import prices to large depreciations. Again, we can think about a big depreciation on the importer side as a large appreciation on the exporter side. Faced with a big movement in the exchange rate, exporting firms specialized in low quality products will exit the market leaving high-quality firms as the only ones operating in the export market. High-quality firms will then be able to absorb the exchange rate movement in their mark-ups implying a lower pass-through on the import side. This mechanism will generate a smaller pass-through for big depreciation on the importer side. On the contrary, if the exporter market is populated by small firms with small mark-ups, they will not be able to absorb the large appreciation, passing on destination prices more of the exchange rate movement. To summarize, assumptions on the quality of the products imported by a country and on the mark-ups of the exporting firms might generate implications for the non-linearities in the ERPT coefficient.

Another source of asymmetries and non-linearities is the upward rigidity of export quantities. Exporting firms that face a depreciation and that are operating at full capacity may find it difficult to increase their sales increasing their production capacities. Therefore they might react by increasing their mark-up instead of setting up a new plant, and this will result in a lower pass-through on the importer side. Aron et al. (2014), in an exhaustive literature review of ERPT in developing countries, review also these channels confirming, however, that only few studies have investigated these channels, especially for developing countries. Frankel et al. (2012), for instance, in one of the extension to their baseline empirical analysis test for the presence of asymmetries and non-linearities for developing countries and indeed find that there is a threshold effect for big devaluations that are associated with a higher pass-through on import prices. However, they argue that this effect "goes in the wrong way" since they expect that large devaluations should have a smaller effect on prices. They also find strong evidence of asymmetries between devaluation and appreciation that they justify with the presence of downward wage rigidity. Pollard and Coughlin (2004) analyze asymmetries and non-linearities at the industry level for the United States. They find evidence of asymmetric behavior in two-digit and three-digit industries but not at the total manufacturing level, suggesting that the size of the asymmetry varies across industries. For instance, they find that the quantity constraint binds for chemical and petroleum related industries. Given these different responses across industries, the aggregate results might not give any evidence of asymmetry. Finally, they also find that pass-through on import prices is higher when there are large movements in the exchange rate.

We now check if our data suggest the presence of non-linearities and asymmetries in the unconditional relationship between inflation and prices. A positive number on the horizontal axis means a depreciation, whereas a negative one corresponds to an appreciation. We first observe in figure 3 (top left and top right) that the slope of the unconditional relationship between inflation and depreciation is steeper when the exchange rate depreciates by more than 10 or 20 percent. This suggests a non linear relationship between inflation and depreciation when the depreciation is higher than a certain threshold. The steeper slope is more evident in the comparison between normal times and episodes of more than 10 percent with respect to episodes of 20 percent. Second, we also check if the relationship between inflation and depreciation is different for countries operating under an inflation targeting regime and countries that are non-targeters. We observe in figure 3 that, the pass-through coefficient is higher for non-targeters (bottom left panel). This is line with the Taylor hypothesis mentioned before. We finally compare appreciation and depreciation episodes (bottom right panel): we observe that inflation does not react symmetrically during episodes of depreciations compared to episodes of appreciation. We will more formally investigate all this hypothesis in the empirical analysis.

4 Empirical model: local projections

We adopt Jordà (2005) local projection method (LPs) to estimate the dynamic response of inflation to exchange rate movements allowing for non - linearities and asymmetries. We will refer to asymmetries as the difference between appreciation and depreciation episodes and non-linearities as: i) depreciation above or below certain thresholds, and ii) countries operating under IT vs. others without an explicit IT framework.

LPs are a flexible semi-parametric technique to estimate impulse responses. which directly estimate a sequence of linear projections of the future value of the dependent variable on the current information set (Kilian and Kim, 2011). There has been a growing interest in LPs because of their flexibility and easy implementation. Many studies, especially, in the fiscal policy literature, have been adopting this technique to obtain impulse responses that depend on the state of the economy. For instance, Auerbach (2013) explore state dependent spending fiscal spillovers multipliers using LPs on a panel of OECD countries and find that they are particularly high in recessions. Ramey and Zubairy (2014) estimate state - dependent government spending fiscal multipliers. Impulse responses vary depending on the amount of slack in the economy and on whether the distance of interest rates to the zero lower bound. Jarotschkin and Kraay (2013) use local projections methods to study the dynamic response of real exchange rate to aid inflows. Jordà and Taylor (2013) use this technique to document the effects of austerity on macroeconomics aggregates and Jordà et al. (2013) adopt this approach to measure the effects of excess credit on several macroeconomic variables.

The main advantage of the LPs technique is its flexibility for tracing the dynamic response of variables to a shock. LPs methods (as opposed to a standard vector autoregressive model (VAR)) do not involve any non-linear transformation of the estimated slope coefficients to obtain impulse responses and dynamic multipliers depend only on the quality of the local approximation (Jordà et al., 2013) .

Compared to VARs, LPs regressions do not constraint the shape of the impulse response functions and hence are more robust to lags misspecification. If the VAR is a good approximation of the data generating process (DGP), then this is the optimal procedure for all time horizons. However, if the VAR is a poor representation of the DGP, impulse response functions (IRFs) are biased (Ronayne, 2011). The bias comes from two sources: i) the small-sample bias of the estimates of the VARs slope parameters and ii) the additional bias induced by the non-linear transformation of the estimated parameters (Kilian and Kim, 2011). Since LPs impulse responses are estimated through ordinary least squares (OLS), it is easier to extend the analysis to panel data allowing for interactions terms. This specific feature allows to explicitly capture asymmetries and non-linearities in a simple way, and this is the main reason why we choose LPs over VARs. In addition, since they require a simple OLS estimation they directly provide the appropriate inference and they do not require asymptotic approximations or numerical techniques. Finally, panel VAR are generally overparametrized (Canova and Ciccarelli, 2009).

LPs methods have limitations too. First, as the forecasting horizon increase, observations from the end of the sample are lost. Second, the IRFs obtained from LPs methods might show significant oscillations at longer horizons. Ramey (2012) compares LPs IRFs relative to structural VARs IRFs, and dynamic simulations. She finds equivalent results for the first 16 quarters, even though the dynamic LPs responses are more erratic. However, at longer horizons, LPs produce substantial oscillations that are not present in the other two methods. Due to the limitations of LPs methods in small samples, highlighted by Kilian and Kim (2011) we use monthly data, to guarantee the longest possible sample.

5 Baseline model

The local projection technique generates new estimates for each forecast horizon h, regressing the dependent variable at $t+h$ on the available information set at time t. IRFs are obtained as a subset of the estimated slope coefficients of the projections. The baseline specification for the linear model is the following:

$$(1) \quad \Delta CPI_{i,t+h} = \alpha_h + \sum_{s=1}^{p} \rho_{s,h} \Delta CPI_{i,t-s} + \beta_h \Delta NEER_{it} + \mu_h crisis_t + \sum_{s=1}^{p} \gamma_{s,h} \Delta CPI^*_{i,t-s} + \varepsilon_{i,t+h}$$

Where ΔCPI is the yoy percent change in the CPI of country i at time t, $\Delta NEER$ is the yoy percent change in the nominal effective exchange rate, *crisis* is a dummy equal to one from 2009 to 2012 to proxy for the financial crisis, ΔCPI^* is the percent change in foreign prices, extracted from the Relative Price Index (RPI) reported in the Information Notice System (INS) database [1]. We also include 3 lags of the dependent variable. [2] The rationale to include the lags of the dependent variable at time $t-p$ is that the local projections are a way of characterizing the sequence of conditional expectations at time t i.e. $E[y(t+h)|t]$. Simply put, it is important to avoid that shock is capturing dynamics from omitted variables. ε is an error term capturing all other sources of variation in inflation between t and $t+h$.

[1] $CPI^* = CPI/RPI$

[2] We tested the number of lags country by country and we found that, on average, the correct number of lags is 3.

The coefficient β_h traces the response of inflation at time $t+h$ to a depreciation/appreciation occurred in time t. A very similar specification, within a country-by-country VAR estimation is implemented by Choudhri and Hakura (2006) and by Kohlscheen (2010) (in this latter case foreign prices are not included in the estimation).

Estimation of equation (1) presents a number of challenges. The first challenge is related to the overlapping nature of data: since percent changes are computed yoy with monthly data, the error term has, by construction, a moving average form that prevents standard statistical inference. Serial correlation is also introduced because of lagging and successive leading of the dependent variable. Moreover, it is difficult to assume that the error terms are cross-sectionally independent. To control for both serial correlation and cross-sectional dependence we adopt the Driscoll-Kraay standard errors.Driscoll and Kraay (1998) propose a nonparametric covariance matrix estimator that generates heteroskedasticity and autocorrelation-consistent standard errors that are also robust to cross-sectional dependence.

The second challenge is related to stationarity of the DGP. IRFs obtained from VARs and LPs are equivalent provided that the data generating process is stationary. For this reason, we estimate the relationship in differences. Moreover, to guarantee stationarity we exclude periods of hyperinflation (similar to Bussière et al. (2014)). Following Fischer et al. (2002) we exclude periods when yoy percent changes are larger than 100. We implement a battery of stationarity/unit root tests that confirm that our data are stationary (Table 1). We perform the Maddala and Wu (1999), both in the Phillips and Perron and in the Augmented Dickey Fuller versions (ADF). These tests assume that the autoregressive component is common to all panels and the null hypothesis is that all panels contain a unit root. The assumption that all the panels share the same autoregressive component is quite strong. To overcome this limitation we also implement the Im et al. (2003) test that allows for a panel specific autoregressive component. This test is based on the mean of individual DF (or ADF) t-statistics of each unit in the panel. Also in this case the null hypothesis is that all the panels are non-stationary. To take into account the likely cross dependence across panels, we implement the t-test proposed by Pesaran (2006). This latter is a standard Dickey Fuller DF (or augmented DF) augmented with the cross section averages of lagged levels and first-differences of the individual series.

The third challenge is the potential endogeneity existing between depreciation and inflation. It is possible that the rate of depreciation is not exogenous and correlated with the error term. Structural VAR models in the exchange rate literature offer only a partial solution to the problem since the identification is mainly reached through short run restrictions on the contemporaneous coefficients (i.e. recursive identification by Choleski decomposition (Ca'Zorzi et al. 2007). However, as pointed out by Edwards (2006), this type of identification scheme makes assumptions on the timing of the effects of the exchange rate on prices that are often too restrictive. As pointed out by Meese and Rogoff (1983) and Edwards (2006), finding a good instrument for the rate of depreciation is also complicated because most exogenous variables are not correlated with the exchange rate. Consequently, the majority of studies on exchange rate pass-through rely on OLS. We will address more comprehensively endogeneity issues in the last section when we will discuss the direction of the potential bias.

6 Results

6.1 Linear model

We estimate our baseline model for the full sample of emerging markets (28 countries). We find that exchange rate pass-through on consumer prices is around 22 percent after 12 months after the initial shock and it reaches 25 percent after two years.[3] These results are in line with the literature: Choudhri and Hakura (2006) report an ERPT coefficient of 14 percent after 1 quarter, 24 percent after 4 quarters and 27 percent after 20 quarters. They also show results for different inflation regimes: countries with higher inflation rates report higher ERPT, around 50 percent after 4 quarters. Bussière and Peltonen (2008) find that the pass-through on import prices is 35 percent after 1 quarter, suggesting a lower pass-through on consumer prices. Kohlscheen (2010) estimates ERPT coefficients using a recursively identified VAR for 8 EMs with floating exchange rate regimes. He finds that pass through is equal to 5 percent, 17 percent, 20 percent, 24 percent (after 3, 6, 9, 12 months).[4]

6.2 Non-linearities

In this section we investigate whether the response of prices during period of high depreciation is more than proportional with respect to normal times (i.e average exchange rate movements). We define an episode of *high* depreciation with two alternative criteria,

[3] This means that for a depreciation of 100 percent yoy inflation would increase by 22 percent.
[4] For a complete review and other ERPT estimates see Aron et al. (2014).

as follows: 1) When the monthly yoy percent change is larger than 10 percent 2) When the monthly yoy percent change is larger than 20 percent. We choose these two thresholds in light of the magnitude of recent depreciations in emerging markets after the tapering talks (Figure 1). We build a dummy variable *depisode* with the following definition:

$$depisode = \begin{cases} 1 & \text{if } \Delta NEER > 0 \text{ and } \Delta NEER > \Psi \\ 0 & \text{otherwise} \end{cases}$$

Ψ is a threshold defined according to (1) and (2)

$$(2) \quad \Delta CPI_{i,t+h} = \alpha_h + \sum_{s=1}^{p} \rho_{p,h} \Delta CPI_{i,t-s} + \beta_h \Delta NEER_{it} + \mu_h crisis_t + \sum_{s=1}^{p} \Delta \gamma_{s,h} CPI^*_{i,t-s} + \theta_h \Delta NEER_{it} \times depisode_{it} + \gamma_h depisode_{it} + \varepsilon_{i,t+h}$$

Figures 5 illustrates the distribution of high depreciation episodes over time and across countries. For most of the countries, it is easy to see that: i) high depreciation episodes have been quite frequent (as opposed to rare events) since 1990, and ii) the frequency of this episodes, in particular when defined as higher than 20 percent, has been reduced during the last 10 years. Note that introducing the interaction term between the dummy variable *depisode* and the rate of depreciation, we allow the coefficient β_h to be different across periods of "high" depreciation versus "normal times".

Figure 7 and 6 show the results for the two types of episodes and the coefficient on the difference between the non-episode coefficient and the episode one. We first notice that the responses of inflation during episodes of large depreciation are statistically different from responses during normal times. In the case of 10 percent depreciations the effect of prices is significant for almost a year, while for larger episodes of 20 percent and above the effect is significant for 7 months. ERPT for depreciations' episodes of 10 percent is equal to 40 percent after 6 months and 57 percent after 12 months, while in normal times it is 10 percent. This means that yoy inflation increases by 4 percentage points in the 6 months after a 10 percent depreciation episode. Episodes of 20 percent depreciation show an ERPT coefficient of 44 percent after 6 months and 45 percent after 12 months. Similar results are discussed in Frankel et al. (2012), who find that depreciation of 25 percent are found to have proportionately larger pass-through effect. An interesting aspect, shown in the dynamics of the IRFs, is that the response of inflation to big depreciation episodes is faster than during normal times. We observe that after 1 month from the initial shock ERPT is almost 20 percent and it reaches 40 percent after 6 months. The upward trend in the ERPT coefficient underlines the permanent nature of a depreciation of this magnitude. Depreciations of 20 percent and more have an even faster effect on prices. This might be driven by the lower wedge between importers and consumers during period of big depreciations. Faced by such a large movement in the exchange rate, importers might be forced to pass it to consumers. We will investigate this hypothesis in the last section of the paper.

6.3 Asymmetries

In this section we analyse whether the effect of a depreciation is exactly the opposite of an appreciation of the same size. We explained several channels that can generate asymmetries between depreciation and appreciation episodes in previous sections. In order to explicitly account for this asymmetry between appreciation and depreciation we use the following specification:

$$
\begin{aligned}
(3) \quad \Delta CPI_{i,t+h} &= \alpha_h + \sum_{s=1}^{p} \rho_{p,h} \Delta CPI_{i,t-s} + \beta_h \Delta NEER_{it} + \mu_h crisis_t \\
&+ \sum_{s=1}^{p} \Delta\gamma_{s,h} CPI^{*}_{i,t-s} + \theta_h \Delta NEER_{it} \times ddepr_{it} + \gamma_h ddepr_{it} + \varepsilon_{i,t+h}
\end{aligned}
$$

Where *ddepr* is defined as follows:

$$
ddepr = \begin{cases} 1 & \text{if } \Delta NEER > 0 \\ 0 & \text{otherwise} \end{cases}
$$

The results indicate that there is significant evidence of asymmetries in the first 8 months after the initial shock: we do not observe a symmetric reaction of inflation to a 1 percent depreciation. Instead we note that appreciation episodes generate a positive reaction in inflation that is not significant. Depreciation episodes are characterized by about 38 percent pass-through after 12 months compared to less than 10 percent for appreciation episodes.

6.4 Targeters vs non-targters

As already mentioned in the previous sections, a large strand of the literature has been linking the degree of exchange rate pass-through to the inflation environment. A common result is that inflation targeting, succeeding in keeping inflation low, causes a reduction in firms pricing power that in turn leads to decrease in ERPT (Choudhri and Hakura 2006, Edwards 2006 and Mishkin and Schmidt-Hebbel 2007). We also test this hypothesis in out sample of emerging markets with the following specification:

$$(4) \quad \Delta CPI_{i,t+h} = \alpha_h + \sum_{s=1}^{p} \rho_{p,h} \Delta CPI_{i,t-s} + \beta_h \Delta NEER_{it} + \mu crisis_t + \sum_{s=1}^{p} \Delta\gamma_{s,h} CPI^*_{i,t-s} + \theta_h \Delta NEER_{it} \times IT_{it} + \gamma_h IT_{it} + \varepsilon_{i,t+h}$$

Where IT is a dummy equal to one if the country is an inflation targeter. [5] Our results also support this idea and show that the pass-through for inflation targeters is considerably lower than for non-inflation targeters, which actually display more than 20 percent pass-through after 12 months.

7 Robustness

We test the robustness of our results along several dimensions. We start addressing the issue of reverse causality between inflation and depreciation discussing the direction of the potential bias. We then test whether permanent episodes of high depreciation are different from temporary ones. Finally we perform other robustness checks addressing the presence of outliers.

7.1 Addressing endogeneity

One of the challenges in the estimation of an aggregate exchange rate pass-through regression is the potential endogeneity between inflation and depreciation. As already mentioned, it is very difficult to disentangle a causal relationship between depreciation and inflation. It is very difficult to find good instruments for $\Delta NEER$, especially for countries with a floating exchange rates (Edwards 2006): most exogenous variables are not strongly correlated with

[5] The dates of the adoption of the IT regime are listed in Table 3.

the change in the exchange rate. Even if we implement structural VARs, the restrictions that we have to impose are not very convincing. Therefore to attenuate our concerns about reverse causality, we derive the direction of the bias in our regression.

To start, it is important to make several considerations: first it is likely that small countries with a pegged exchange rate display a weaker endogeneity in the relationship between inflation and depreciation since their monetary policy is completely devoted to keep the peg. It is reasonable to assume that countries not following an inflation targeting regime are likely to have a peg. Therefore it is realistic that the countries in the non-targeters sample display a weaker problem of reverse causality, while inflation targeters might react more easily to nominal depreciations through their independent monetary policy. To understand whether these results are indeed unbiased, it is useful to understand the direction of the possible bias. We can do so by writing a simple bivariate model [6]:

$$(5) \quad \Delta CPI = \alpha + \beta \Delta NEER + \varepsilon$$

$$(6) \quad \Delta NEER = \delta + \gamma_i \Delta CPI + \nu$$

This means that the rate of depreciation might be determined by inflation. The index i stands for the type of monetary policy regime: inflation targeters (or floaters) and non-targeters (countries with a pegged exchange rate). In the extreme case of γ_i equal to zero, the model does not suffer from a reverse causality problem. We expect $\gamma_{IT} > \gamma_{NON-IT}$. The OLS estimator is given by:

$$(7) \quad \hat{\beta} = \frac{\beta \sigma_\nu^2 + \gamma_i \sigma_\varepsilon^2}{\sigma_\nu^2 + \gamma^2 \sigma_\varepsilon^2}$$

The bias of the OLS estimator is:

$$(8) \quad B_i = E(\hat{\beta}) - \beta = \frac{\gamma_i(1 - \beta\gamma_i)}{\sigma_\nu^2/\sigma_\varepsilon^2 + \gamma_i^2}$$

Knowing that $0 < \beta < 1$ (incomplete ERPT) and assuming that $0 < \gamma < 1$ (which is

[6] For a similar exercise see Panizza and Presbitero (2014)

reasonable), we obtain: $B_{IT} > B_{NON-IT}$, meaning that the targeters should suffer from a higher upward bias than non-targeters (as already discussed). This tells us that targeters should display a higher coefficient than non-targeters. This is clearly not the case in Figure 9, where we show the coefficient for the two sub-samples. If our model suffers from an endogeneity issue we would observe to opposite pattern in the ERTP coefficient of targeters and non-targeters. These results therefore attenuate our concerns about reverse causality in the estimation of pass-through coefficients.

7.2 Permanent vs temporary episodes

We extend our analysis studying whether the response of domestic prices changes during periods of permanent depreciation. Importers at the dock might be forced to passthrough to retailers and consumers if they realize that a large depreciation is going to last for several months since they will not be able to absorb the fluctuations in their mark-ups. We define a permanent episode when the exchange rate depreciates by 20 percent for more than 3 consecutive months. We find that in this baseline case that ERPT is higher than 40 percent after 6 months and then becomes insignificant (Figure 11). We try three other possible combinations (depreciation of more than 20 percent for more than 6 months, depreciation of more than 10 that lasts more than 3 or 6 months) and we report the results in Figure 12. We also report the episodes distribution and we note that Turkey presents a higher number of episodes than the average (Figure 10). For this reason we re-estimate the four models without Turkey. The results in Figure 12 show slightly lower coefficients for the sample without Turkey but remain in line with the baseline model.

7.3 Dealing with outliers

We want to be sure that our results are not driven by outliers in the dependent variable. We already dropped the episodes of hyper-inflation as in Fischer et al. (2002) but we want to formally control for outliers. Figure 13 plots the cumulative distribution of the yoy inflation rate and we observe that our sample is quite asymmetrical. We therefore implement a median regression that instead of minimizing the sum of squared of the residuals, minimizes the absolute value of the sum of the residuals. Median regressions allow for a richer characterization of the dependent variable, assessing the effect of the independent variables on the whole distribution of the dependent variable. We compute bootstrapped standard errors. We observe that the results are in line with the baseline specification, with the ERPT highly significant but slightly slower than before. When we look at non-linearities introducing interaction terms the results hold and show a higher significance than in the baseline case. In terms of magnitude, for the 20 percent episodes the ERPT coefficient is significantly higher than the baseline case and it reaches almost 100 percent after 20 months.

To compare our results with the literature we also estimate exchange rate pass-through for a sample of 27 advanced economies. We confirm the result that ERPT is lower for advanced economies and it is equal to 6 percent after 1 year (see Figure 17).

7.4 Dealing with omitted variables

To address potential omitted variable bias in our empirical estimation, we implement a series of robustness checks. Being aware that high depreciation periods might coincide with sovereign or debt crises, we augment our baseline model with the crises variables provided by Laeven and Valencia (2012). Moreover, following Leduc and Wilson (2012), we introduce in the regression country fixed effects, that should control for time specific time trends. Controlling for these latter is potentially important since countries that have accelerating inflation could also have persistently depreciating currencies. Thus, country-specific shocks could be positively correlated with country-specific trends and omitting such trends could lead to a positive bias on the impulse response coefficients of the exchange rate pass-through to consumer prices. The obtained results controlling for banking and sovereign crises, and country specific time trends are presented in Figure 18. They show that the ERPT coefficients are robust to this most restrictive specification, with both magnitudes and significance level in line with previous results. Similar findings hold for the comparison of targeters vs non-targeters. Figure 19 shows that the results that compare the two different monetary policy regimes are robust to the inclusion of banking and sovereign debt crises and country fixed effects.

8 Conclusion and policy implications

Policy makers and practitioners have a natural interest on appropriate policy responses to shocks. In an attempt to stabilize aggregate demand fluctuations, often times the focus (especially for monetary policy) is on short term policy responses. A crucial element that should characterize an appropriate and timely policy response is the need to acknowledge that nominal (and real) variables do not respond always in the same fashion to specific shocks. Both the exchange rate regime, as well as the size (and nature) of specific shocks affect the ability of small open economies to react and adjust to such exogenous fluctuations. Hence appropriate policy responses should fully incorporate the "non-linear" nature underlying dynamic responses of nominal and real variables. The empirical literature generally agrees that ERPT is higher in emerging markets than in advanced ones, but less is known about the role of non-linearities and asymmetries. Our results contribute to filling a void of research on ERPT in emerging economies.

In this paper we have investigated the role of asymmetries and non-linearities in the reaction of domestic prices to changes in the nominal exchange rate. We have been asking the following questions: are depreciations of magnitude greater than 10 percent or 20 percent different from normal times? Have depreciations a symmetric effect compared to appreciations? The ERTP coefficient is different from countries that adopted an inflation targeting vis à vis non-targeters? Our findings suggest that the reaction of domestic prices during "big" depreciation is faster and more pronounced. More specifically, we find that during depreciation of more than 10 percent and 20 percent ERPT is equal to 40 percent compared to a coefficient of 20 percent during normal times. We find evidence of asymmetries and also confirm the well documented result that the adoption of inflation targeting reduces the degree of ERPT. The results are robust when we address the potential reverse causality between inflation and depreciation and when we take into consideration outliers.

The main policy implication to be drawn from the evidence presented in this paper is that policy makers should exert caution in conducting monetary policy after (and during) depreciation episodes, especially after (and/or during) changes in the economy's nominal anchor. The intuition is simple: nominal variables can react differently (in terms of size, speed, transmission mechanisms, adjustments, etc.) under alternative exchange rate regimes, and depending on the size of the shocks. Appropriate policy reactions should take this into consideration and avoid assuming time invariant, and/or state independent parameters to characterize the response of nominal variables after depreciations episodes. A natural implication of our findings is that monetary authorities should be cautious when assessing the transmission (and speed) of exchange rate shocks to inflation. Premature or delayed policy rate movements, without sufficient evidence and understanding of non-linear and state contingent dynamics could prove detrimental for price stability and impose a risk to anchor inflation expectations.

References

Aron, J., Macdonald, R., Muellbauer, J., 2014. Exchange rate pass-through in developing and emerging markets: A survey of conceptual, methodological and policy issues, and selected empirical findings. Journal of Development Studies 50(1), 101–143.

Auerbach, A. J. & Gorodnichenko, Y., 2013. Fiscal multipliers in recession and expansion, in: Fiscal Policy After the Financial Crisis. Alberto Alesina and Francesco Giavazzi.

Berman, N., Martin, P., Mayer, T., 2012. How do different exporters react to exchange rate changes? The Quarterly Journal of Economics 127(1), 437–492.

Burstein, A., Eichenbaum, M., Rebelo, S., 2005. Large devaluations and the real exchange rate. Journal of Political Economy .

Bussière, M., 2013. Exchange rate pass-through to trade prices: The role of nonlinearities and asymmetries*. Oxford Bulletin of Economics and Statistics 75(5), 731–758.

Bussière, M., Delle Chiaie, S., Peltonen, T.A., 2014. Exchange rate pass-through in the global economy: The role of emerging market economies. IMF Economic Review 62(1), 146–178.

Bussière, M., Peltonen, T.A., 2008. Exchange rate pass-through in the global economy: the role of emerging market economies .

Calvo, G.A., Reinhart, C.M., 2002. Fear of floating. Quarterly Journal of Economics 117(2), 379–408.

Canova, F., Ciccarelli, M., 2009. Estimating multicountry var models*. International Economic Review 50(3), 929–959.

Carranza, L., Galdon-Sanchez, J.E., Gomez-Biscarri, J., 2009. Exchange rate and inflation dynamics in dollarized economies. Journal of Development Economics 89(1), 98–108.

Ca'Zorzi, M., Hahn, E., Sánchez, M., 2007. Exchange rate pass-through in emerging markets. ECB Working Paper No 739, March 2007 .

Choudhri, E.U., Hakura, D.S., 2006. Exchange rate pass-through to domestic prices: does the inflationary environment matter? Journal of International Money and Finance 25(4), 614–639.

Corsetti, G., Dedola, L., 2005. A macroeconomic model of international price discrimination. Journal of International Economics 67(1), 129–155.

Coulibaly, D., Kempf, H., 2010. Does inflation targeting decrease exchange rate pass-through in emerging countries? .

Driscoll, J.C., Kraay, A.C., 1998. Consistent covariance matrix estimation with spatially dependent panel data. Review of economics and statistics 80(4), 549–560.

Edwards, S., 2006. The relationship between exchange rates and inflation targeting revisited. Technical Report. National Bureau of Economic Research.

Fischer, S., Sahay, R., Végh, C.A., 2002. Modern hyper-and high inflations. Technical Report. National Bureau of Economic Research.

Frankel, J., Parsley, D., Wei, S.J., 2012. Slow pass-through around the world: a new import for developing countries? Open Economies Review 23(2), 213–251.

Gagnon, J.E., Ihrig, J., 2004. Monetary policy and exchange rate pass-through. International Journal of Finance & Economics 9(4), 315–338.

Hausmann, R., Panizza, U., Rigobon, R., 2006. The long-run volatility puzzle of the real exchange rate. Journal of International Money and Finance 25(1), 93–124.

Im, K.S., Pesaran, M.H., Shin, Y., 2003. Testing for unit roots in heterogeneous panels. Journal of econometrics 115(1), 53–74.

Jarotschkin, A., Kraay, A., 2013. Aid, disbursement delays, and the real exchange rate. World Bank Policy Research Working Paper (6501).

Jordà, Ò., 2005. Estimation and inference of impulse responses by local projections. American economic review pp. 161–182.

Jordà, Ò., Schularick, M., Taylor, A.M., 2013. When credit bites back. Journal of Money, Credit and Banking 45(s2), 3–28.

Jordà, Ò., Taylor, A.M., 2013. The time for austerity: estimating the average treatment effect of fiscal policy. Technical Report. National Bureau of Economic Research.

Kilian, L., Kim, Y.J., 2011. How reliable are local projection estimators of impulse responses? Review of Economics and Statistics 93(4), 1460–1466.

Kohlscheen, E., 2010. Emerging floaters: pass-throughs and (some) new commodity currencies. Journal of International Money and Finance 29(8), 1580–1595.

Laeven, L., Valencia, F., 2012. Systemic banking crises database: An update .

Leduc, S., Wilson, D., 2012. Roads to prosperity or bridges to nowhere? theory and evidence on the impact of public infrastructure investment. Technical Report. National Bureau of Economic Research.

Maddala, G.S., Wu, S., 1999. A comparative study of unit root tests with panel data and a new simple test. Oxford Bulletin of Economics and statistics 61(S1), 631–652.

Meese, R.A., Rogoff, K., 1983. Empirical exchange rate models of the seventies: Do they fit out of sample? Journal of international economics 14(1), 3–24.

Mishkin, F.S., Schmidt-Hebbel, K., 2007. Does inflation targeting make a difference? Technical Report. National Bureau of Economic Research.

Panizza, U., Presbitero, A.F., 2014. Public debt and economic growth: is there a causal effect? Journal of Macroeconomics 41, 21–41.

Pesaran, M.H., 2006. Estimation and inference in large heterogeneous panels with a multifactor error structure. Econometrica 74(4), 967–1012.

Pollard, P.S., Coughlin, C.C., 2004. Size matters: asymmetric exchange rate pass-through at the industry level. University of Nottingham Research Paper (2004/13).

Ramey, V.A., 2012. Comment on roads to prosperity or bridges to nowhere? theory and evidence on the impact of public infrastructure investment, National Bureau of Economic Research.

Ramey, V.A., Zubairy, S., 2014. Government spending multipliers in good times and in bad: Evidence from us historical data. Technical Report. National Bureau of Economic Research.

Ronayne, D., 2011. Which impulse response function? Warwick Economic Research Paper No. 971 .

Taylor, J.B., 2000. Low inflation, pass-through, and the pricing power of firms. European economic review 44(7), 1389–1408.

Figures and Tables

Figure 1: Exchange rate movements after the tapering announcement

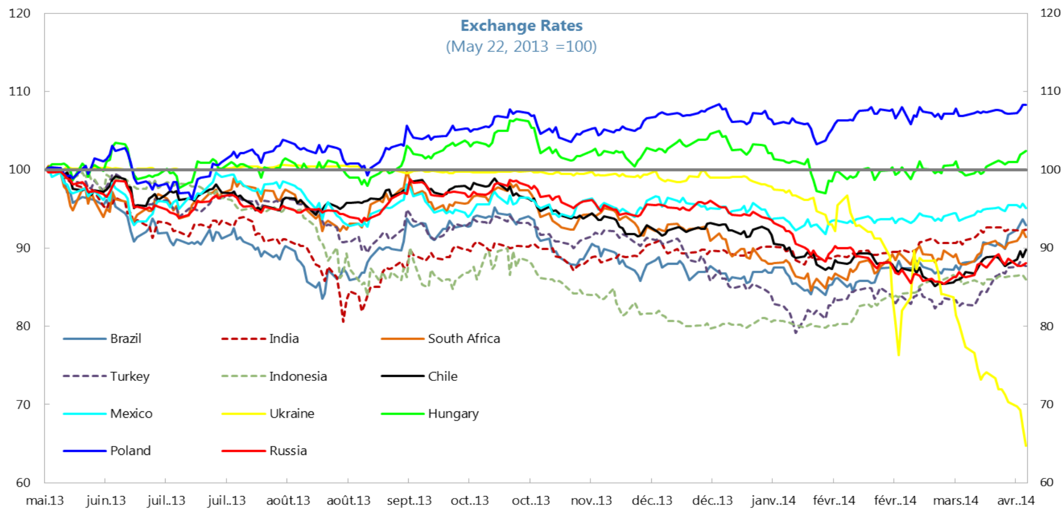


Figure 2: Depreciation and Inflation in EMs and AEs

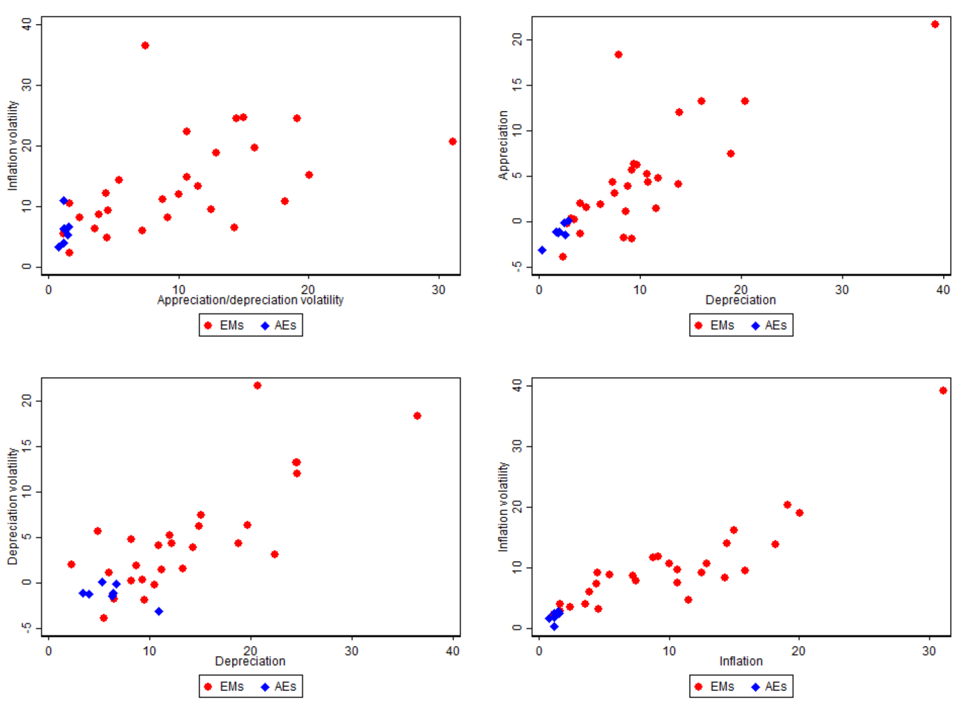


Figure 3: Stylezed Facts - Non-linearities

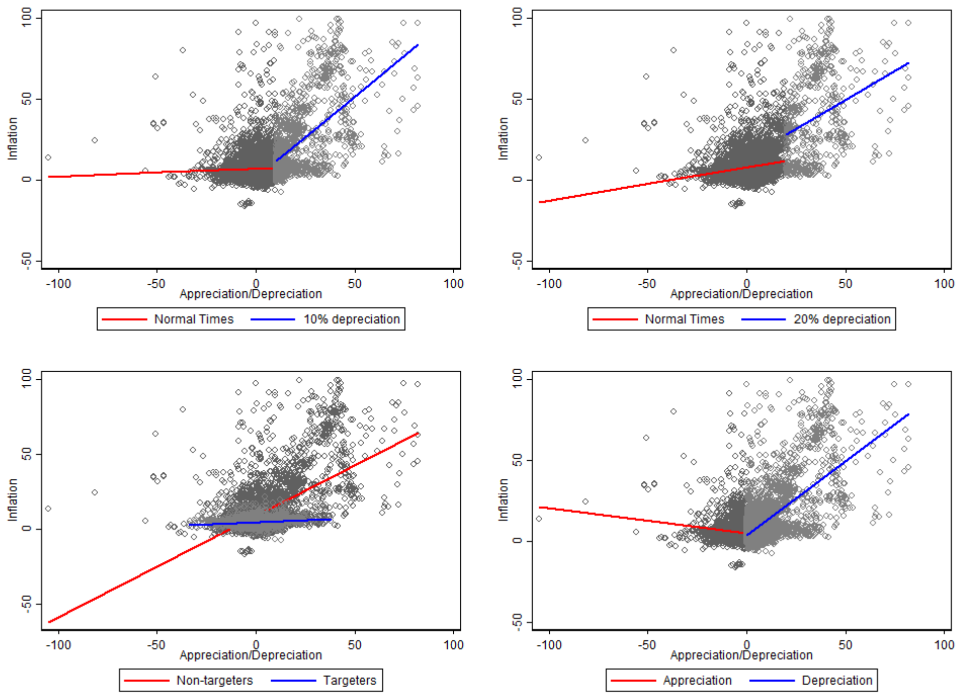


Table 1: Stationarity tests

	Inflation		Exchange rate change	
Fischer - PP	Statistic	p-value	Statistic	p-value
Inverse chi-squared(56)	591.59	0.00	333.80	0.00
Inverse normal	-17.11	0.00	-13.89	0.00
Inverse logit t(144)	-30.61	0.00	-17.36	0.00
Modified inv. chi-squared	50.61	0.00	26.25	0.00
Fischer - ADF				
Inverse chi-squared(56)	306.27	0.00	416.17	0.00
Inverse normal	-11.50	0.00	-15.24	0.00
Inverse logit t(144)	-14.84	0.00	-21.48	0.00
Modified inv. chi-squared	23.65	0.00	34.03	0.00
Im-Pesaran-Shin				
Wtbar	-10.92	0.00	-14.82	0.00
Pesaran CADF				
Ztbar	-9.41	0.00	-13.39	-2.08

Figure 4: Exchange rate pass-through - Linear model

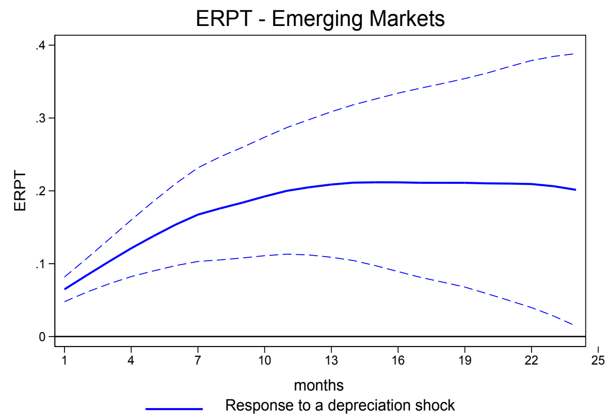


Table 2: ERPT coefficient - Linear model

Horizon - months	ERTP	Std. Error
1	0.07	0.00
12	0.22	0.05
14	0.26	0.10

Figure 5: Depreciation and Inflation in EMs and AEs

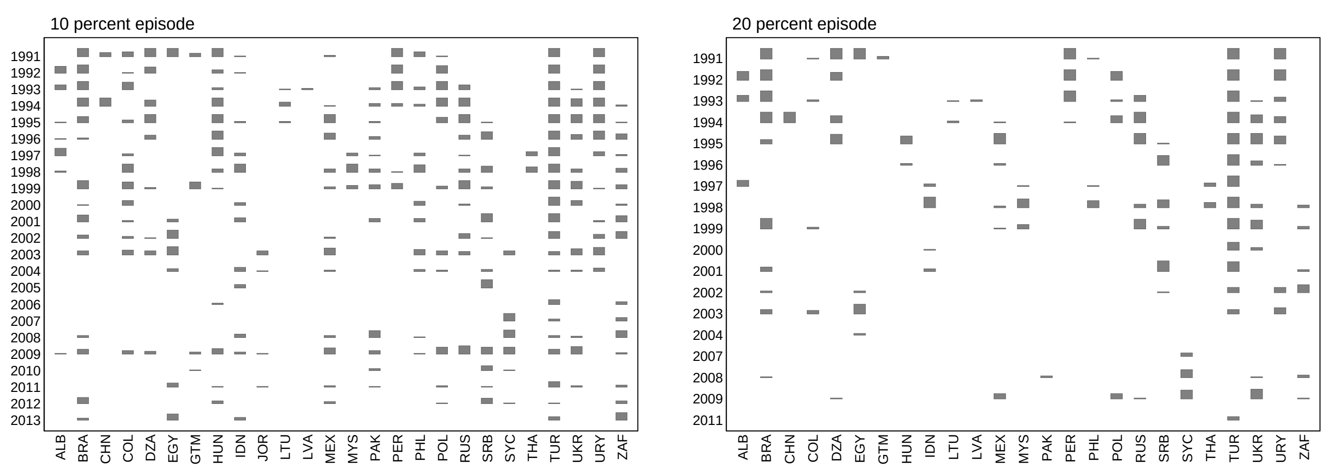


Figure 6: Exchange rate pass-through during 20 percent depreciation episodes

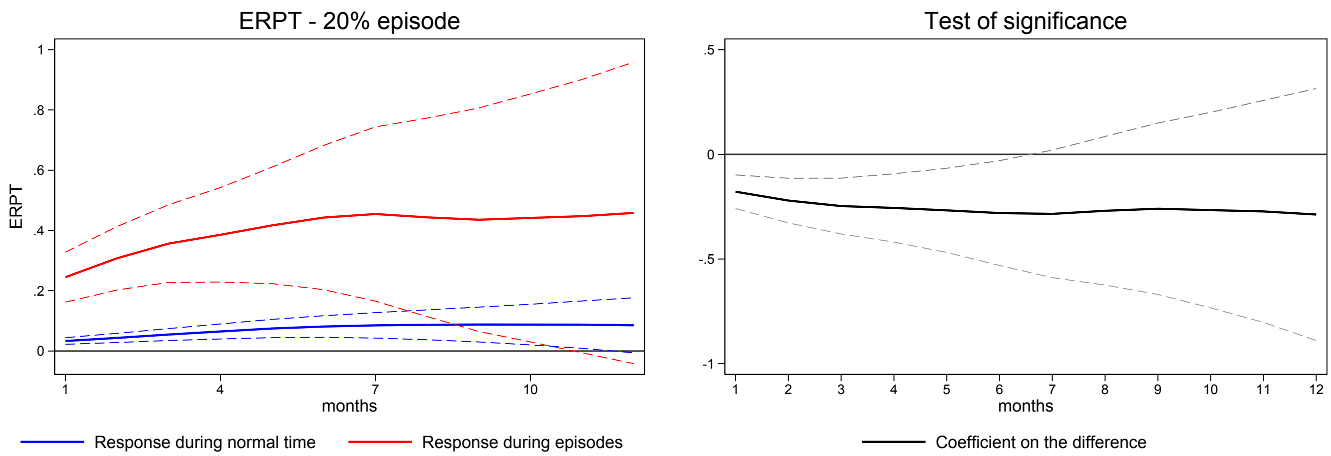


Figure 7: Exchange rate pass-through during 10 percent depreciation episodes

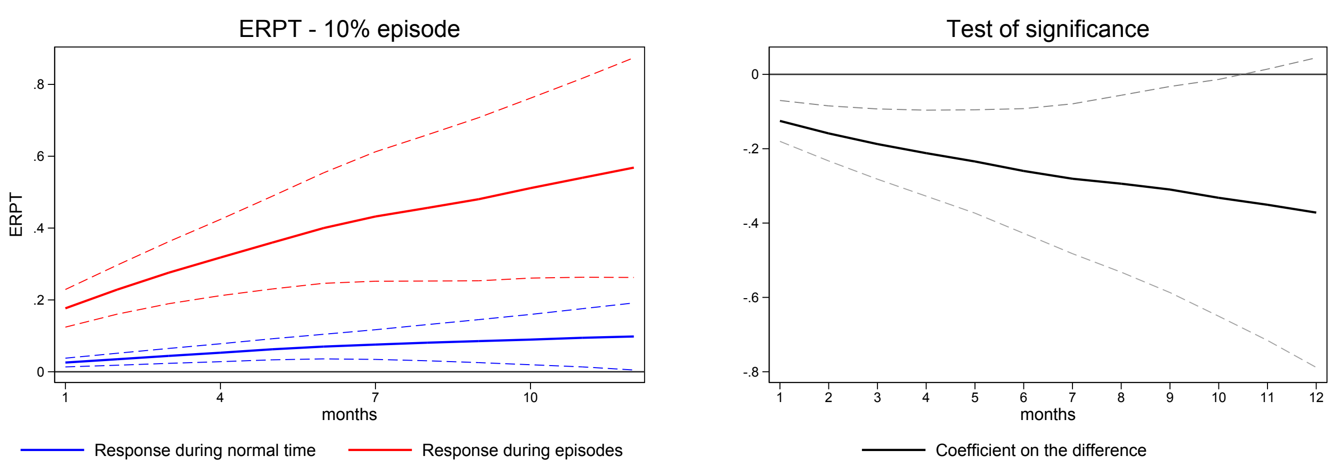


Figure 8: Exchange rate pass-through during appreciation vs depreciation

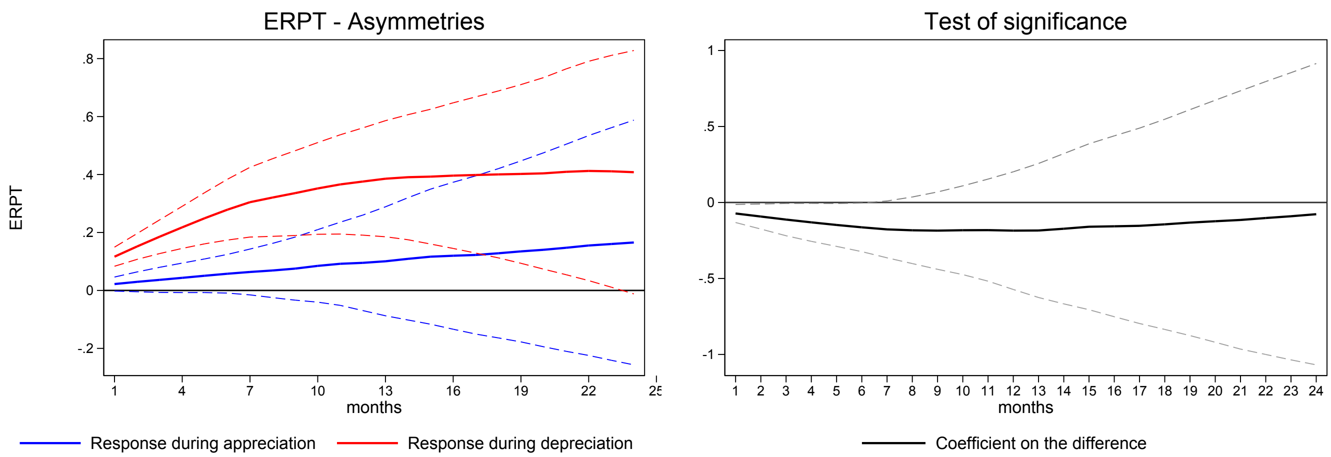


Table 3: IT adoption dates

Country	Start of IT
Brazil	1999m6
Chile	1999m9
Colombia	1999m10
Guatemala	2005m1
Hungary	2001m6
Indonesia	2005m7
Mexico	2001m1
Peru	2002m1
Philippines	2002m1
Poland	1998m10
Serbia	2006m9
South Africa	2000m2
Thailand	2000m5

Figure 9: Exchange rate pass-through: targeters vs non-targeters

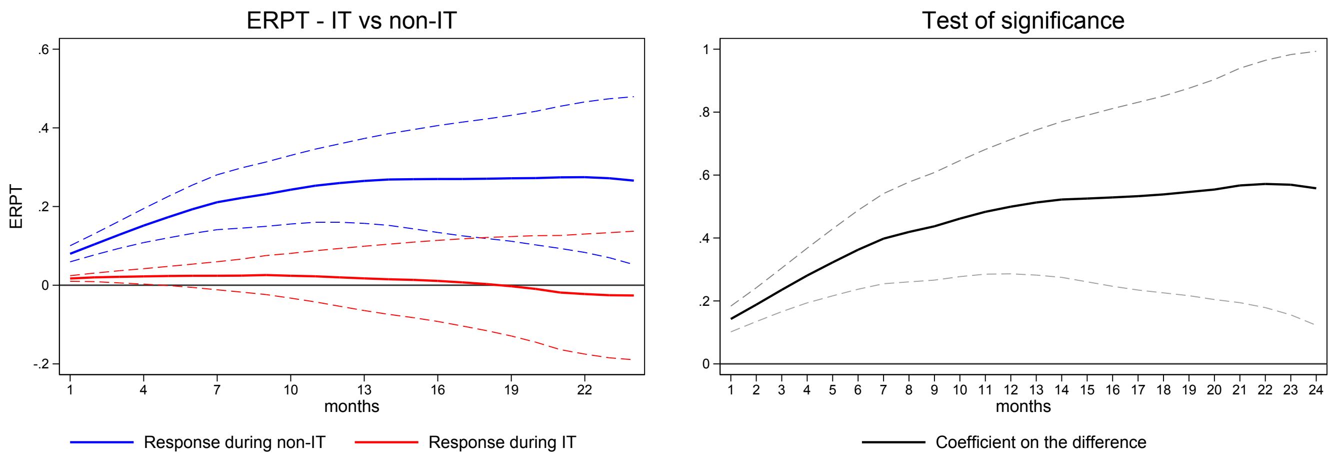


Figure 10: Distribution of permanent episodes

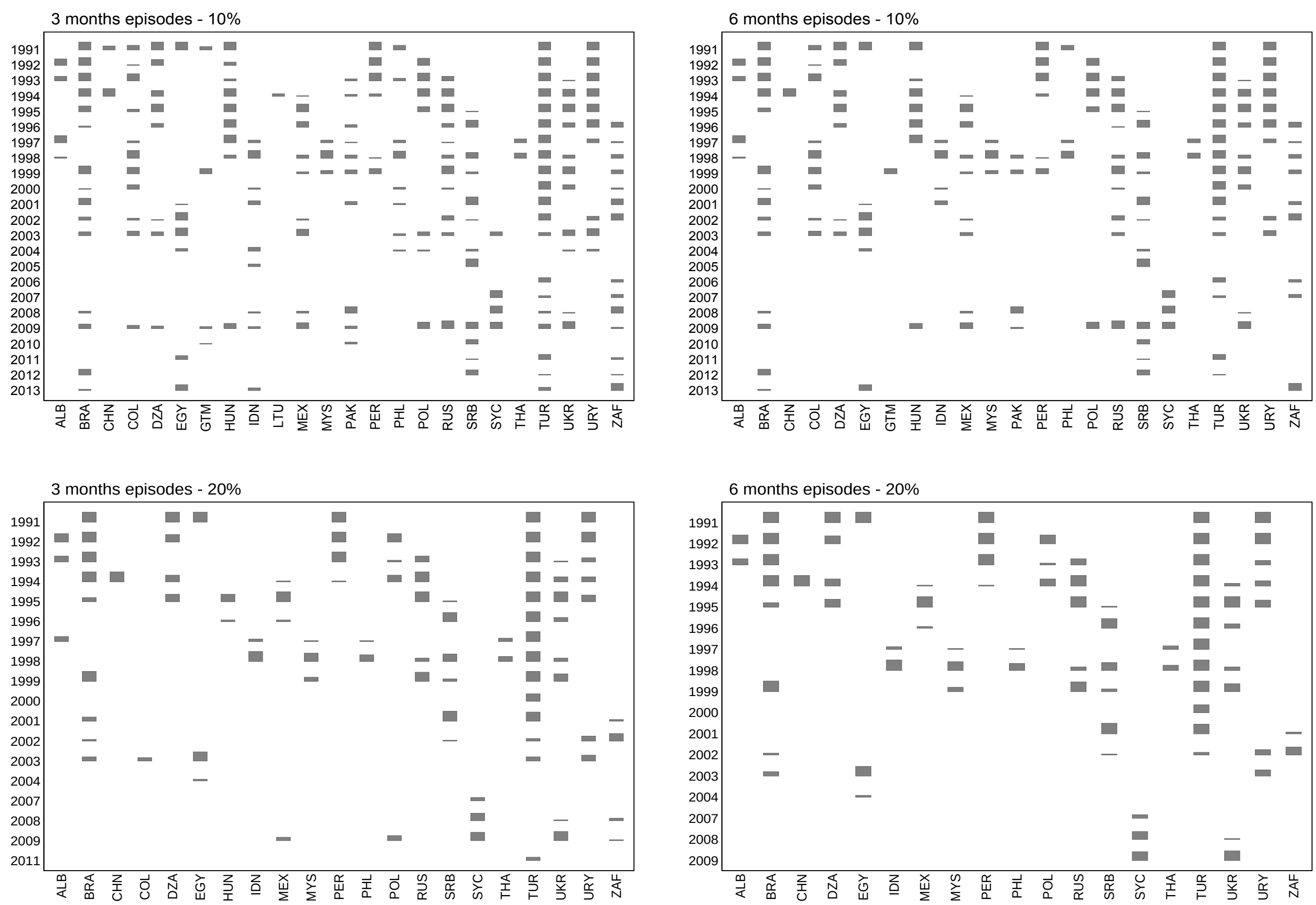


Figure 11: Exchange rate pass-through: permanent vs temporary (3 percent episodes)

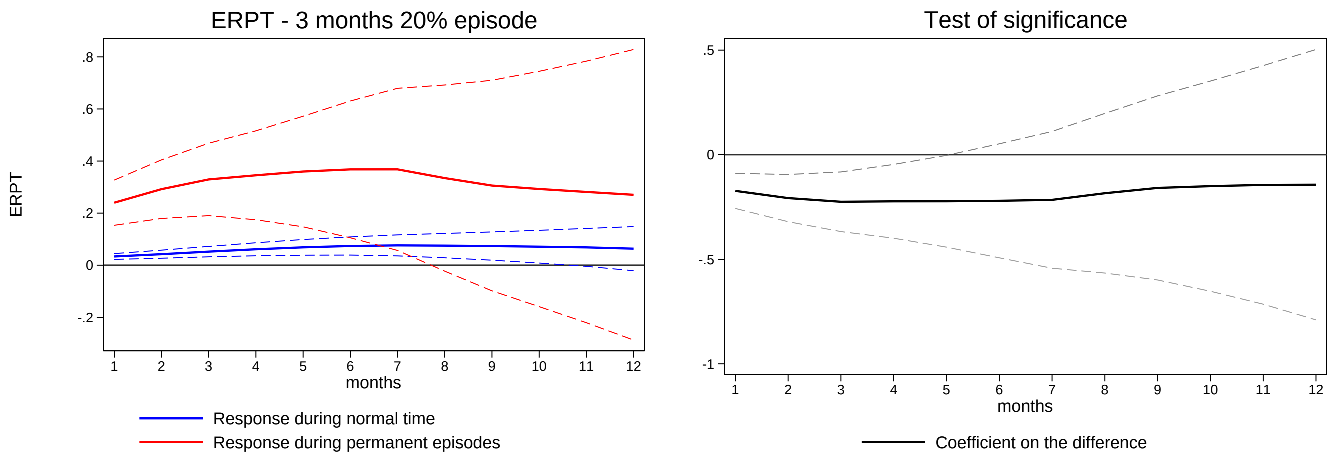


Figure 12: Exchange rate pass-through: permanent vs temporary (all episodes)

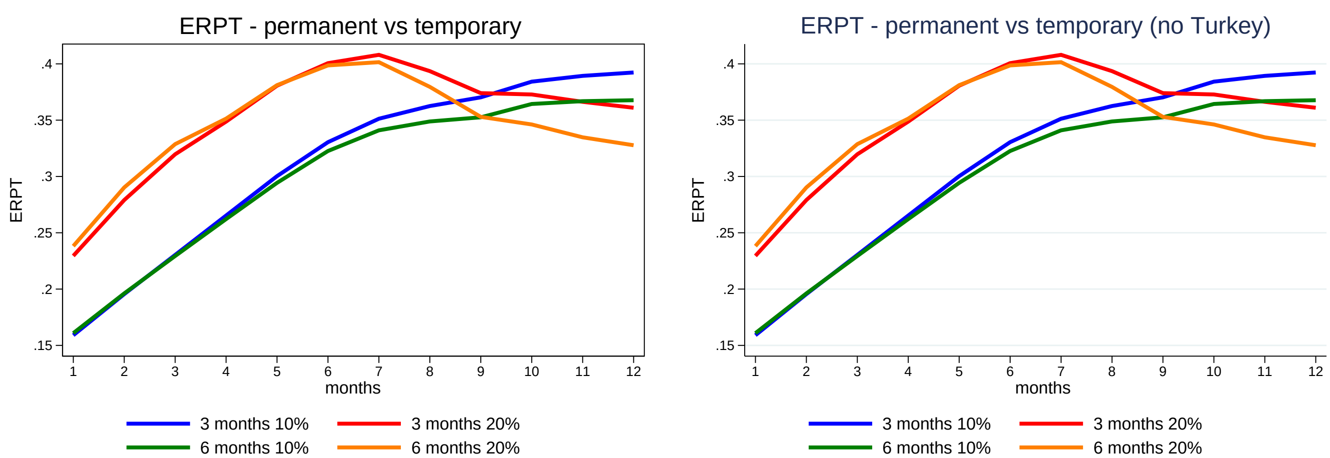


Figure 13: Distribution of the inflation variable

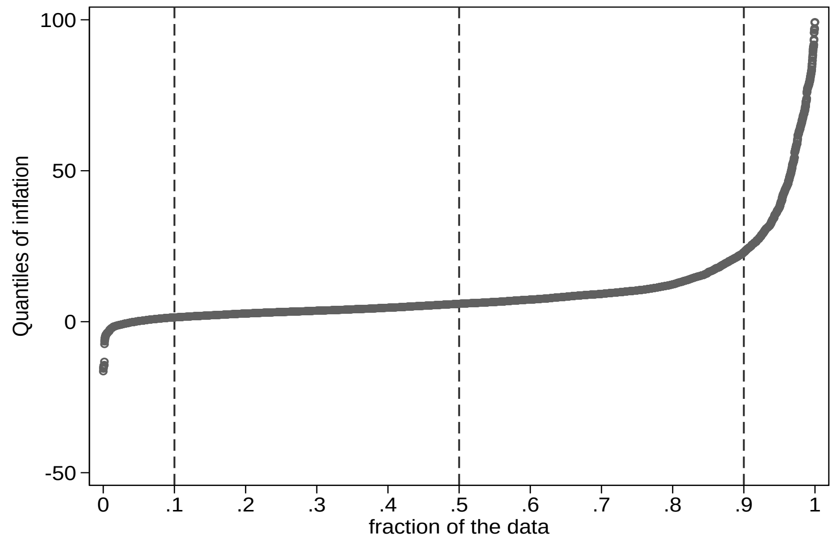


Figure 14: Median regression - linear specification

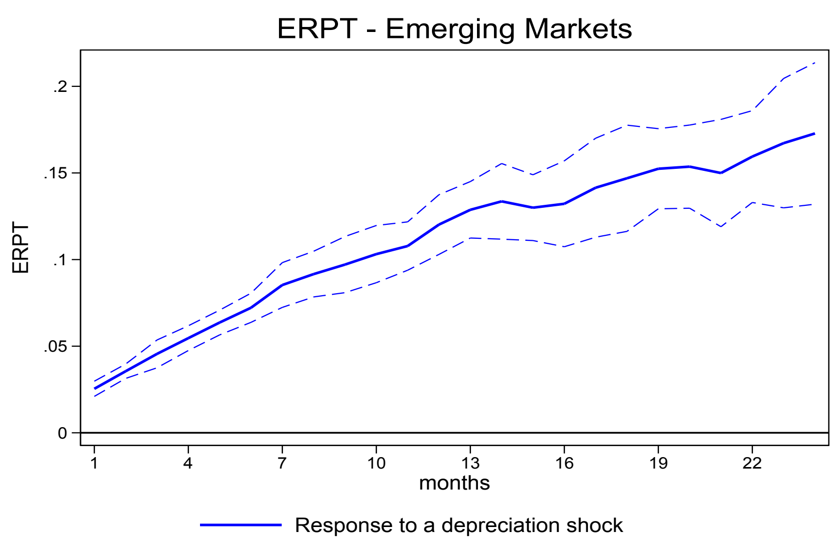


Figure 15: Median regression - 10 percent episodes

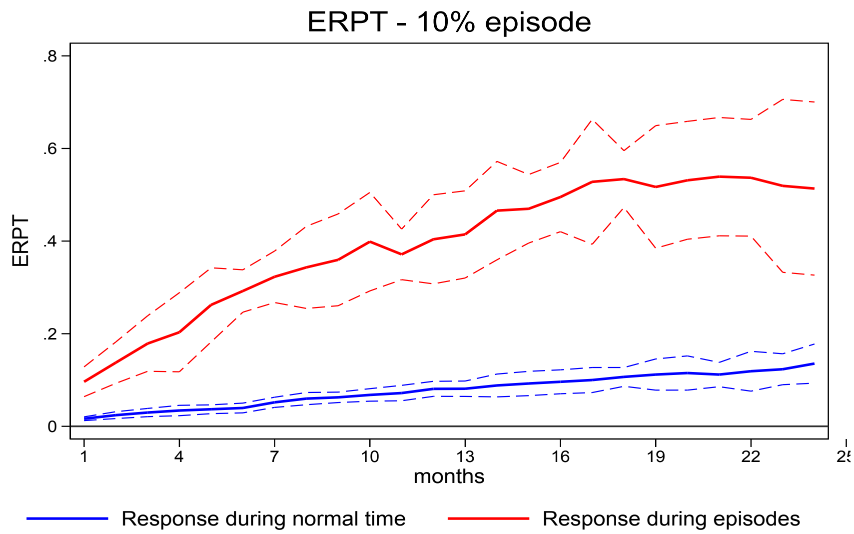


Figure 16: Median regression - 20 percent episodes

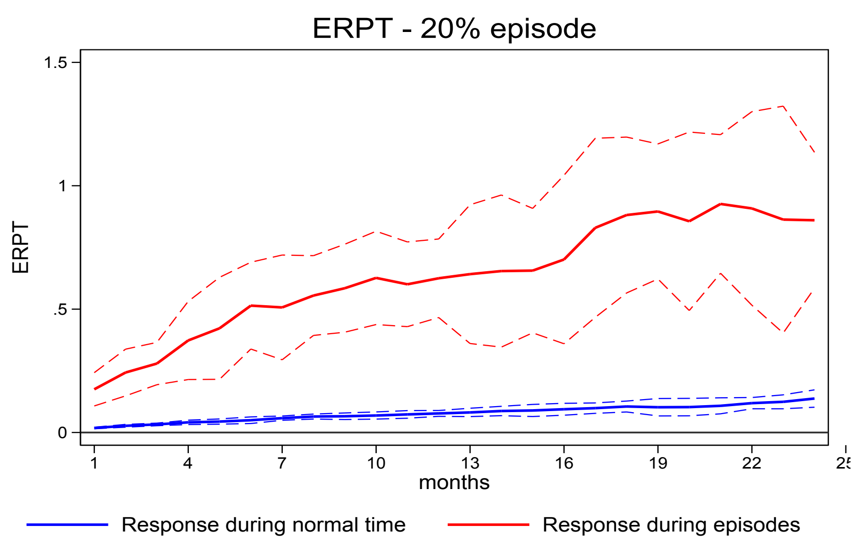


Figure 17: Exchange rate pass-through - Advanced Economies

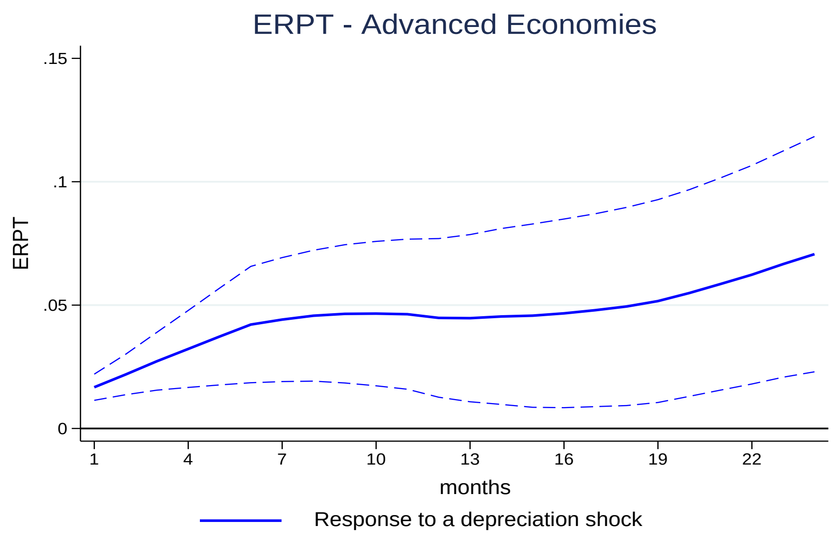


Figure 18: Exchange rate pass-through - dealing with omitted variables

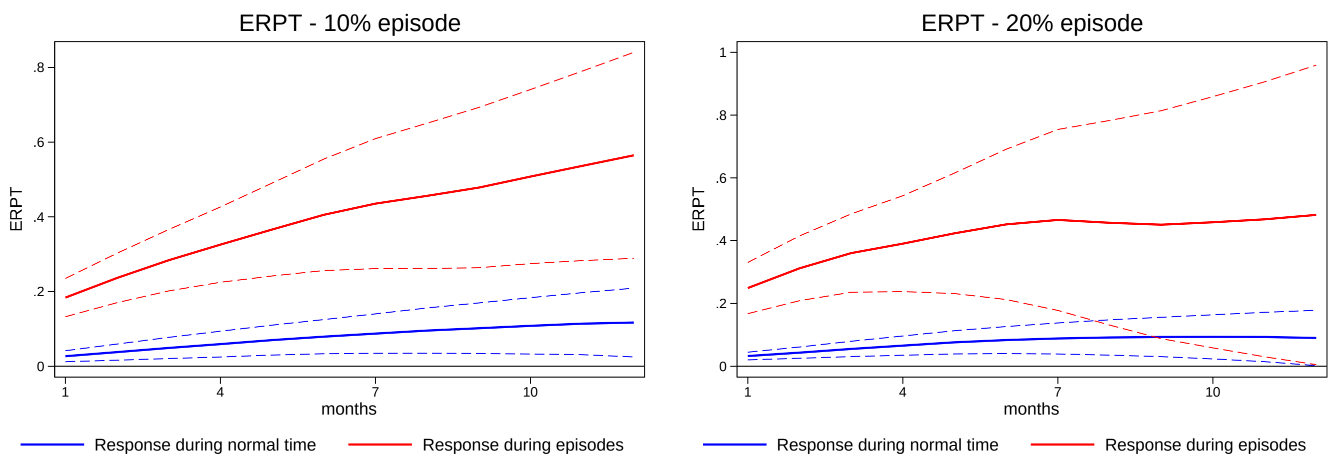
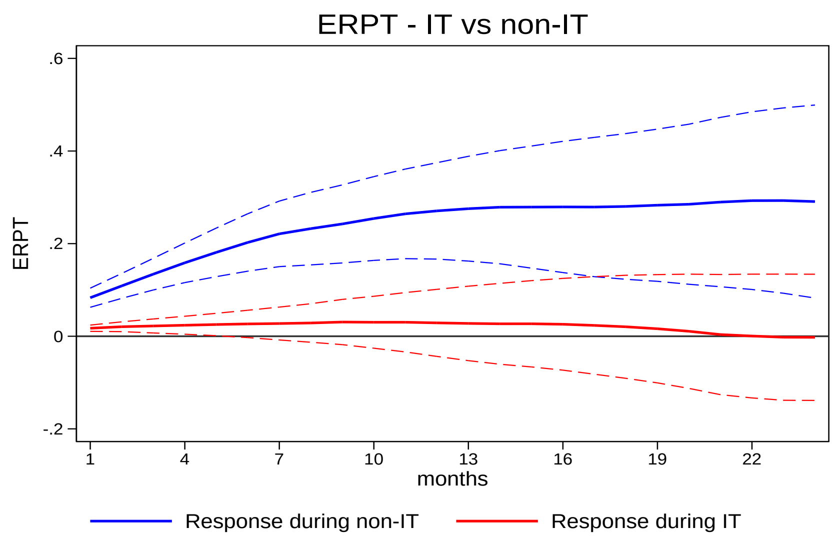


Figure 19: Targeters vs non-targeters - dealing with omitted variables



Appendix

Table 4: Data sources

Variable	Data source	Description
CPI	IMF - IFS	Consumer price index (2010=100)
NEER	Bruegel	Nominal effective exchange rate
RPI	IMF - INS	Domestic CPI / weighted averages of the CPI of partner countries

Table 5: Summary statistics

	Depreciation		Depreciation	
Country	mean	sd	mean	sd
Albania	3.15	22.38	7.51	10.62
Algeria	6.25	14.86	9.69	10.60
Brazil	18.34	36.45	7.83	7.47
Chile	-3.84	5.51	2.39	1.14
China	0.36	9.30	3.18	4.54
Colombia	1.42	11.13	11.58	8.75
Egypt	3.90	14.26	8.78	5.41
Guatemala	1.13	5.96	8.57	7.22
Hungary	4.80	8.15	11.77	9.14
Indonesia	4.33	18.79	10.73	12.89
Jordan	-1.33	6.34	4.05	3.53
Latvia	-1.92	9.48	9.13	12.47
Lithuania	-1.73	6.49	8.34	14.32
Malaysia	-0.23	10.44	2.81	1.57
Mexico	5.26	11.99	10.71	10.04
Pakistan	5.64	4.88	9.19	4.47
Peru	6.40	19.66	9.41	15.81
Philippines	1.93	8.71	6.04	3.84
Poland	4.13	10.86	13.76	18.16
Russian Federation	13.27	24.59	16.09	15.01
Serbia	13.28	24.43	20.35	19.08
Seychelles	1.60	13.26	4.71	11.48
South Africa	4.36	12.16	7.28	4.38
Thailand	0.21	8.16	3.51	2.38
Tunisia	2.02	2.25	4.07	1.60
Turkey	21.75	20.71	39.20	31.12
Ukraine	12.04	24.52	13.91	14.42
Uruguay	7.51	15.11	18.96	20.02

Figure 20: Depreciation and Inflation in EMs and AEs

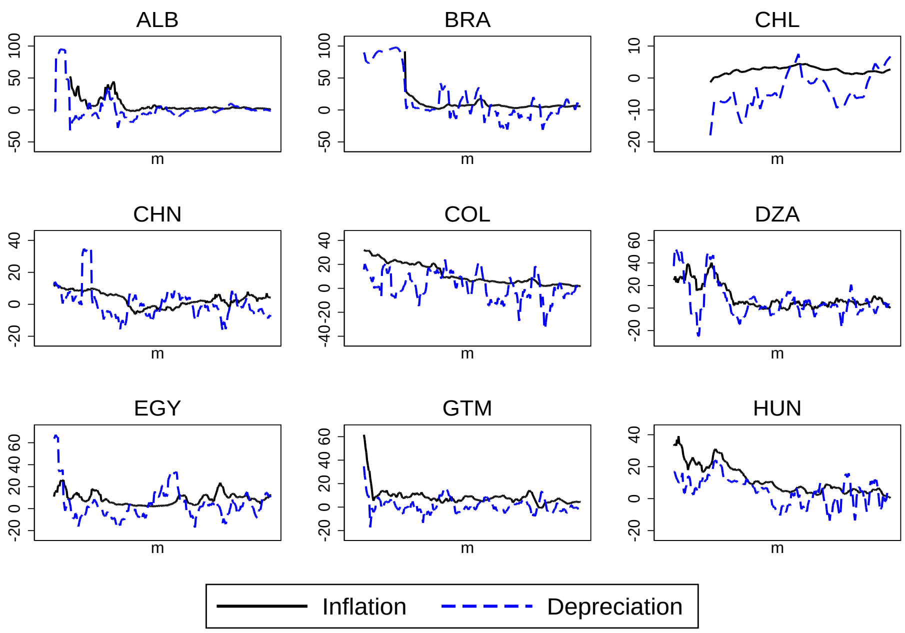


Figure 21: Depreciation and Inflation

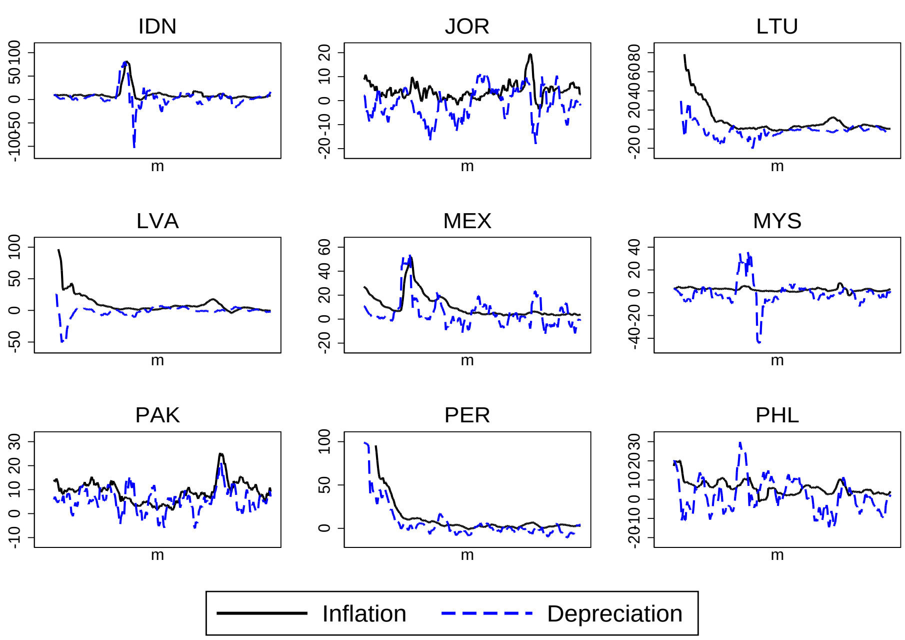


Figure 22: Depreciation and Inflation