THE ROLE OF DOLLARIZATION ON EXCHANGE RATE PASS-THROUGH IN EMERGING MARKETS: EVIDENCE FROM PANEL VAR MODEL

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Abstract

Exchange rate dynamics have been significant determinant of inflation movements in emerging markets regarding the exchange rate pass-through (ERPT). However, recent observations and empirical findings point out the argument that there appears to be decoupling between inflation tendencies and exchange rate changes in the post-crisis period. Our proposition is that abovementioned decoupling might be due to the heterogeneity in dollarization levels. Hence, in this paper, we aim to assess the role of dollarization on ERPT for 14 emerging countries for the period of 2010-2018. Our methodology utilizes panel vector autoregression (panel VAR) model, Granger causality tests and forecast error variance decomposition analysis to investigate the relation between exchange rate and consumer price inflation. The findings under different empirical strategies show that depreciation shocks coming to exchange rate have created statistically and economically significant responses in inflation for high dollarization countries, whereas the responses are insignificant when dollarization tendencies are low. Our findings emphasize that policymakers in emerging countries would be more advantageous in achieving price stability by abating the dollarization levels in the economy.

Keywords: Exchange rate pass-through, dollarization, Panel VAR, Granger causality test, forecast error variance decomposition

JEL Classification: C5, E3

GELİŞMEKTE OLAN ÜLKELERDEKİ KUR GEÇİŞKENLİĞİNDE DOLARİZASYONUN ROLÜ: PANEL VEKTÖR ÖZBAĞLANIM MODELİYLE BULGULAR

Öz

Enflasyondaki kur geçişkenliği gelişmekte olan ülkelerdeki fiyat hareketlerinin önemli belirleyicilerinden birisidir. Öte yandan, daha yakın zamandaki bulgular küresel finansal kriz sonrası dönemde enflasyon eğilimi ile kur değişimleri arasındaki ilişkinin zayıfladığına işaret etmektedir. Bu bağlamda, 2010-2018 dönemi için gerçekleştirilen bu çalışmada 14 gelişmekte olan ülkeden oluşan bir örneklem için dolarizasyonun enflasyondaki kur geçişkenliği üzerindeki etkisi analiz edilmektedir. Döviz kuru ve tüketici enflasyonu arasındaki ilişki panel vektör özbağlanım modeli, Granger nedensellik testi ve öngörü hata varyans ayrıştırması kullanılarak araştırılmaktadır. Farklı ampirik spesifikasyonlara ait bulgular, kurda değer kaybı yönünde yaşanan şokların yüksek dolarizasyona sahip ülkelerde enflasyon üzerinde ekonomik ve istatistiksel olarak anlamlı tepki oluşturduğunu göstermektedir. Diğer yandan, düşük dolarizasyona sahip ülke grubunda tepkiler anlamlı bulunmamaktadır. Sonuçlar dolarizasyonu azaltacak adımların, fiyat istikrarına ulaşmak noktasında gelişmekte olan ülkelerdeki politika yapıcılar için faydalı olduğuna işaret etmektedir.

Anahtar Kelimeler: Kur geçişkenliği, dolarizasyon, Panel VAR, Granger nedensellik testi, öngörü hata varyans ayrıştırması

JEL Sınıflaması: C5, E3

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1. Introduction and Literature Review

Movements in exchange rates have been the subject of macroeconomic analysis and policymaking for a long time. Given the fact that flexible exchange rate regimes coupled with inflation targeting have been the predominant policy framework in many emerging markets, information embedded in exchange rate developments became valuable for decision makers. Apart from the factors of inflation persistence and supply-side shocks, exchange rate dynamics stand as an influential determinant of inflation developments, particularly in emerging markets. This concept is widely referred as exchange rate pass-through (ERPT) in the literature. In fact, Goldberg et al. (1997) define ERPT as "the percentage change in local currency import prices resulting from a one percent change in the exchange rate between the exporting and importing countries". While earlier studies in this literature focus on the degree of ERPT to import prices which was based on the law of one price theory (Irandoust, 2000; Campa and Goldberg, 2005), later studies analyzed ERPT to consumer and producer prices as well (McCarthy, 2007). In this study, we examine the recent ERPT trends in emerging economies in the post-crisis period with a particular focus on the role of dollarization. Our proposition is that the differences in terms of the level of dollarization might play a role in this discussion.

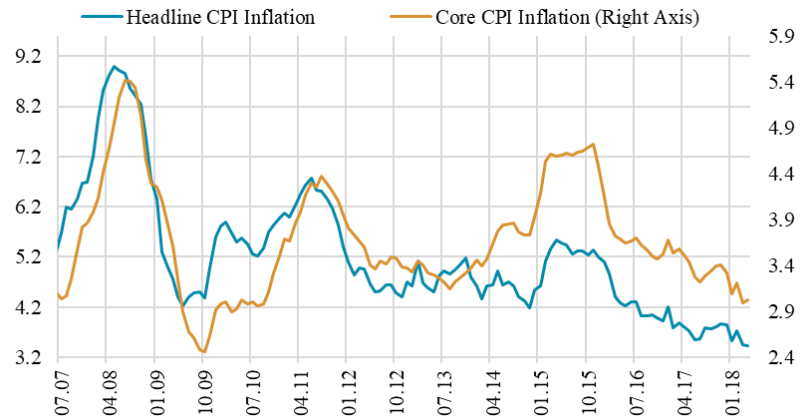
The effect of ERPT on price stability can function with respect to several channels. The most direct channel works through imported consumer goods. In many economies, price developments are measured by tracking the changes in the general price level of a representative consumer basket. Since such consumer price baskets also include imported goods, any weakening in exchange rate is transmitted to the direct price increases in this basket. Furthermore, exchange rate may also affect the inflation through imported inputs used in the production such as energy and other intermediate goods. This mechanism is termed as cost channel. Especially in countries where imported components are extensively used in production activities, the ERPT appears to be stronger. Apart from import and cost channels, exchange rate variations might also have an impact on the pricing behavior via indexation channel. In other words, dollarization might have direct effects on the pricing mechanism of tradable goods, but it might have indirect implications like setting a benchmark increase rate for wages, non-tradables, and expected returns in EMs particularly in higher uncertainty periods which is called as indexation channel.

In this context, empirical literature has been concentrated on the determinants and measurement of ERPT in both cross-country studies and individual country cases. In terms of the determinants, trade openness (Campa and Goldberg, 2005; Ghosh, 2013), inflationary environment (Taylor, 2000), credibility of monetary policy (Lopez-Villavicencio and

Mignon, 2016), volatility of currency movements (Campa and Goldberg, 2005; Kohlscheen, 2010) and composition of imports (Campa and Goldberg, 2002) are found to be influential factors for the extent of ERPT among many others. In terms of the methodology, while some studies utilize single equation regression techniques and panel data estimations, majority of the works in the literature utilizes vector autoregression (VAR) models to overcome the possible endogeneity problem between inflation rate and exchange rate. VAR models are also useful in terms of the identification of causal relationships along the pricing on distribution chains (from import prices to producer prices and consumer prices). Since VAR models are flexible to analyze lead-lag relations, they are also used to assess the degree of ERPT over time and to forecast the inflationary pressures in the case of currency depreciations. Hence, this method has been used in single country studies conducted for emerging markets to analyze the role of exchange rates in inflation developments in the case of Brazil (Kolhscheen, 2010), Turkey (Kara and Öğünç, 2012), India (Kapur and Behera, 2012), Mexico (Espada, 2013), Poland (Arratibel and Michaelis, 2014), Peru (Winkelried, 2014), Chile (Justel and Sansone, 2015), Czech Republic (Hajeka and Horvarth, 2016) and Russia (Ponomarev et al., 2016) in addition to several other developing countries.

Despite the fact that literature and historical experiences establish a strong link between currency movements and local price developments, recent observations point out the argument that there appears to be decoupling among, inflation tendencies, the effectiveness of ERPT and exchange rate changes. When trends in the post-crisis period are examined, emerging markets appear to follow sort of deflationary process where both headline and core measures of price increases have declined significantly (Figure 1). Same time period can also be characterized with sizeable depreciation phases in exchange rates, particularly in emerging markets. Table 1 indicates the length and magnitude of such shocks that occurred aftermath of the global financial crisis. Average maturity of these depreciation waves is around 23 months and resulted loss of value in the local currencies averaged to be around 64%.

Figure 1: Average Annual Inflation Rates for Developing Countries



Source: Bloomberg, Authors' Calculations.

Table 1: Recent Phases of Exchange Rate Depreciations in Selected EM Countries in Post-Crisis Period

Countries	Maturity (Months)	Loss of Value of the Domestic Currency (Percent)
S. Africa	47.4	122.6
Brazil	13.0	83.2
Chile	33.0	55.31
Colombia	18.7	82.4
Indonesia-1	28.8	42.5
Indonesia-2	18.2	28.2
India-1	25.6	53.6
India-2	30.2	15.1
Mexico	27.2	61.7
Russia-1	7.1	98.4
Russia-2	8.1	62.6
Average	23.4	64.2

Source: Bloomberg, Authors' Calculations.

Furthermore, evidence presented in recent works of literature points out that inflation dynamics that went to considerably low levels might also be associated with decreasing ERPT. Jasova et al. (2016) advocates this argument. In that paper, evolvement of ERPT in both developed and developing countries is analyzed with the data belonging to 1994-2015 period with dynamic panel data methods that also consider nonlinearities in terms of the specification. They particularly argue that declining ERPT in EM countries corresponds to the declining inflation level. Similar to this view, Mihaljek and Klau (2008) assess the

emerging economies and speculate that declining trends in both level and variability of inflation paved the way for lower ERPT. There are also single-country works investigating this issue such as Aleem and Lahiani (2014). They focus on the Mexican case and use threshold VAR method to identify that ERPT is more prominent in the high inflation regime.

However, the analysis made on the aggregate level might hinder the role of dollarization. In highly dollarized economies, in addition to the tradable goods, there is greater chance that services and non-tradable goods can also be priced in terms of foreign currency. Thus, it is more likely that ERPT might be stronger in highly dollarized countries, compared to less dollarized peers. In fact, empirical literature has shown that ERPT to consumer prices being stronger if dollarization levels are considerably high (Reinhart et al., 2014; Sadeghi, et al., 2015).

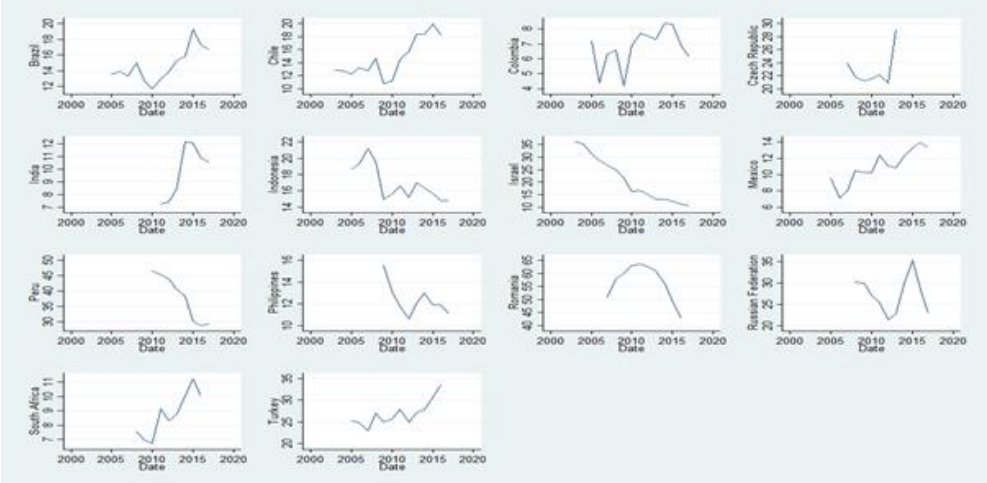
Despite the fact that on the aggregate level emerging markets are in better position compared to the dynamics of early 2000s (when inflation targeting regime was started to be embraced as common policy framework) in terms of inflation-exchange rate nexus, we argue that ERPT is still a significant factor behind inflation developments in highly dollarized countries, which is a phenomena neglected by the analysis made on the aggregate level.

In this framework, dollarization is defined as the situation where local currency has lost its functions of store of value, unit of account and means of exchange, so economic agents tend to prefer foreign currencies to benefit from their comparably high performance in terms of functions of money (Sahay and Vegh, 1995). We mainly focus on the financial dollarization that can be explained as the dominant utilization of a hard currency in the denomination of financial assets and liabilities. Hence, we try to fill in this gap in the literature and aim to empirically show that ERPT is still stronger in high dollarization emerging markets than countries with low dollarization in the post-crisis era. Our study also innovates on the methodological front. We use panel VAR model to assess the heterogeneity in ERPT which tooks both cross sectional and time series features of the data into consideration. This type of methodology does not only incorporate the panel structure into ERPT analysis, but it also deals with the endogeneity problem that might arise between inflation and exchange rate. Next section introduces our data, model and empirical identification strategy. Section 3 provides and discusses the empirical results, while last section concludes.

2. Data and Methodology

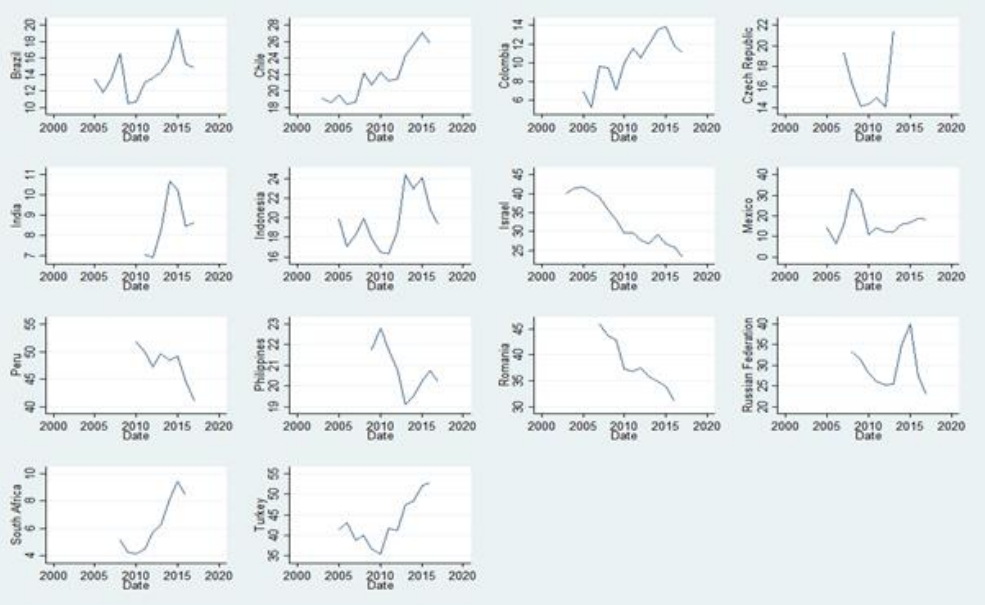
We measure the recent dollarization trend in emerging markets through annual data obtained from the IMF Financial Soundness Indicators database by retrieving "the ratio of FX loans to total loans extended by the banking sector" and "the ratio of FX liabilities to total liabilities of the banking sector" for 14 emerging countries (Figure 2 and 3). These ratios are similar to the ones used in the empirical literature to define the financial dollarization. Basso et al. (2011) aim to assess the asymmetric impact of ability to access foreign funding on dollarization and define the FX loans/total loans and FX deposits/total deposits as dependent variables. Using a cross-country regression, Naceur et al. (2015) measure financial dolarization in terms of dolarized loans and deposits as we adopted in this study.

Figure 2: FX Loans to Total Loans: Individual Country Data



Source: IMF Financial Soundness Indicators.

Figure 3: FX Liabilities to Total Liabilities: Individual Country Data



Source: IMF Financial Soundness Indicators.

In order to differentiate the impact of dollarization on ERPT, we have divided the sample into two categories based on the dollarization ratios. We calculated the average dollarization levels for all countries and then rank them in a descending order. The median value of the sample discriminates countries as high and low dollarization economies[4]. With this categorization, we have run two different panel VAR estimations. The differences in the impact of dollarization have been extracted by comparing and contrasting impulse-response functions, Granger causality tests as well as forecast error variance decompositions under four different identifications (Table 2).

[4] High dollarization countries according to FX loans to total loans: Chile, Czech Republic, Indonesia, Peru, Romania, Russia and Turkey.

Table 2: Empirical Identification Strategies

Empirical Strategy	Categorization for Dollarization	Exchange Rate
1	FX Loans to Total Loans Ratio	Nominal
2	FX Loans to Total Loans Ratio	Real Effective
3	FX Liabilities to Total Liabilities Ratio	Nominal
4	FX Liabilities to Total Liabilities Ratio	Real Effective

In this study, our specification is inspired from the New Keynesian Phillips Curve (NKPC) framework and the model of McCarthy (2007). We base our analysis on inflation, output gap, government bond interest rates, exchange rates and energy prices. Our sample is chosen to cover the period between January 2010 and March 2018 with monthly data. To keep track of the price changes, we have collected consumer price indices of 14 developing countries from the Bloomberg database. Then, monthly logarithmic changes on those indices are taken as inflation variable.

In order to run the estimation by utilizing monthly data, we need a proxy for output gap, as most common way to calculate output gap is through quarterly GDP data. To this end, we have applied Hodrick-Prescott (HP) Filter to industrial production indices. We have investigated the national central bank or statistical institute databases of countries as sources of data. HP Filter can be described as a smoothing method by which long term trend component of a time series can be extracted. Our definition of output gap is the cycle component (de-trended series) obtained from this process. That measure represents to what extent economic activity in sample countries deviates from the long-term trend or potential growth so as to represent the demand-side forces for inflation dynamics.

To proxy for the monetary policy stance, yields on 2 year government bonds are collected and converted to monthly frequency with simple averaging. Level data for bond yields appear to be non-stationary so they are used in the estimation equation in the form of differences. Global energy price movements are represented by the logarithmic changes in Brent oil prices.

Lastly, our main interest of currency movements (FX) have been represented via two different measures: nominal and real exchange rates. Nominal bilateral exchange rates of emerging markets with respect to USD have been taken from Bloomberg database at daily frequency and then have been converted to monthly through simple averaging. Real effec-

tive exchange rates, on the other hand, are retrieved in Bank for International Settlements (BIS) database. Monthly logarithmic changes are considered as covariates in the model. Summary statistics are provided in the Appendix.

Our model can be illustrated as follows, from equation (1) to (3):

$$Y_{it} = \begin{bmatrix} \pi_{it} \\ X_{it} \\ \Delta i_{it} \\ FX_{it} \\ Brent_t \end{bmatrix} \quad (1)$$

$$Y_{it} = A_1 Y_{it-1} + A_2 Y_{it-2} + \cdots + A_p Y_{it-p} + u_i + e_{it} \quad (2)$$

$$E[e_{it}] = 0; E[e'_{it} e_{it}] = \boldsymbol{\Sigma}$$
$$E[e'_{it} e_{is}] = 0, for\ t > s \quad (3)$$

In above model, FX_{it} represents monthly appreciation or depreciation of local currencies against USD, whereas Δi_{it} stands for changes in market interest rate. Furthermore, X_{it} and π_{it} denote the output gap and monthly inflation of emerging economies respectively. $Brent_t$ proxies for global energy prices. u_i represents country fixed effects. Error term e_{it} is assumed to be the idiosyncratic disturbance. In this setup, Cholesky decomposition of variance-covariance matrix to obtain impulse-responses has been conducted with the ordering in which inflation is assumed to be the most endogenous and exchange rate is taken as the most exogenous variables.

Lag length for each specification is chosen individually as a result of the investigation of the proposed consistent moment and model selection criterion by Andrews and Lu (2001) for GMM models. Furthermore, from earlier studies in terms of ERPT, it is known that majority of the effect caused by exchange rate changes has been transmitted to pricing dynamics within a year. Data is also investigated for possible seasonalities and it is observed that no significant seasonality exists. In order to have reliable results from panel VAR, the variables should be stationary. To check that, Im et al. (1997) panel unit root test is applied and all variables are found to be panel stationary after transformations (see Appendix). In other words, null hypothesis of “all panels contain unit roots” has been rejected

in favor of stationarity. Estimations are conducted with "pvar" routine in Stata developed by Abrigo and Love (2015) via using the generalized method of moments (GMM). Impulse-response functions are orthogonalized and 90% confidence intervals are constructed with Monte-Carlo simulation with 200 draws[5].

3. Empirical Results

Impulse-response functions under first empirical identification strategy (in which dollarization ratio is "FX loans to total loans" and currency movements are proxied by nominal exchange rate") are provided in Figure 4-5 for high and low dollarization economies respectively.

Any impulse (in the form of depreciation) coming to nominal exchange rate results in a positive response in inflation for EM economies with high dollarization. Confidence intervals show that responses are statistically significant up to 4 months. On the other hand, similar shock does not produce statistically significant responses in the case of emerging countries with low dollarization tendencies. Furthermore, we investigated the Granger causality tests. In terms of nominal exchange rate movements, in high dollarization countries, exchange rate variable Granger causes inflation variable at conventional 5% significance level. However, there does not exist significant Granger causality from currency movements to inflation dynamics in low dollarization countries. For further interpretation, forecast error variance decomposition (FEVD) results based on a Cholesky decomposition of the residual covariance matrix of the underlying panel VAR model are given in Figure 6. Based on the FEVD estimates, over the 10 months forecast horizon, exchange rate explains almost 6% of the total variation in inflation movements (after controlling for other impacts in the model) for high dollarization economies, while exchange rate has rather smaller role in explaining the variance of inflation in the case of low dollarization.

[5] In order to make sure that stability condition of panel VAR estimates are satisfied, the modulus of each eigenvalue of the estimated model are calculated. As it is shown in the Appendix, models estimated under each specification are stable given the fact that all moduli of the companion matrix lie inside the unit circle.

Figure 4: Impulse-Response Function for High Dollarization Economies

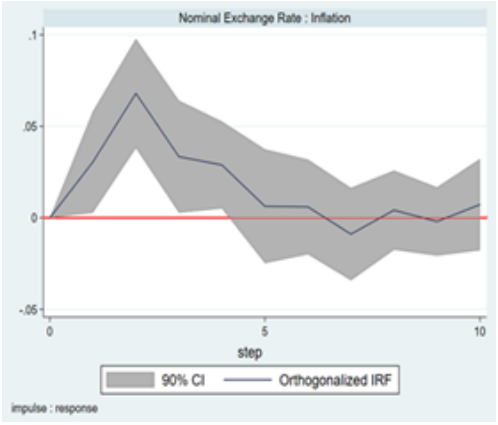


Figure 5: Impulse-Response Function for Low Dollarization Economies

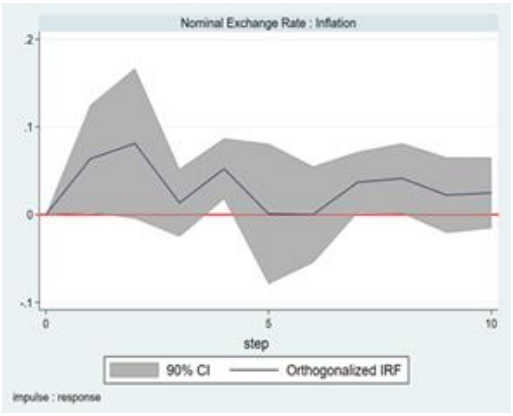
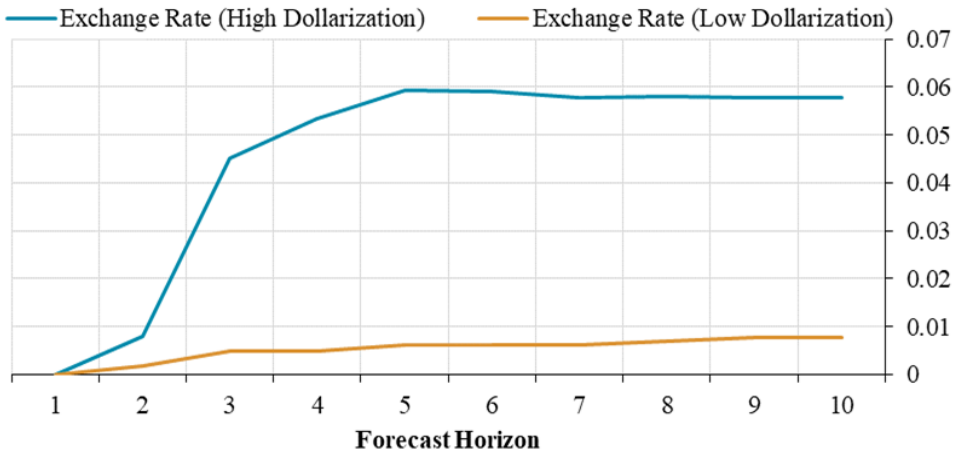


Table 3: Granger Causality Test Results (Empirical Strategy 1)

Direction of the Causality	Test Statistic (Chi-squared)	p-value
High Dollarization		
FX ➔ π	23.57	0.023
Low Dollarization		
FX ➔ π	10.35	0.585

Figure 6: Forecast Error Variance Decompositions for Inflation



By utilizing second empirical strategy where dollarization is still determined based on the overall FX loan ratio of banking sector and exchange rate depreciations are measured by real effective exchange rate data, we try to demonstrate same divergence among country groups whose dollarization tendencies differ from each other in the time interval spanning post-crisis era. Figure 7 and 8 are displaying the impulse response functions. Again, we identify that depreciations measured by declining real effective exchange rate lead to an inflationary pressures as inflation variable creates a statistically significant response to impulses in currency variable up to 4 months in high dollarization sample countries.

One should be careful in interpreting this impulse response, since in the first empirical strategy, nominal exchange rate is used and depreciations are observed when nominal exchange rate increases. On the other hand, in the second empirical strategy, real effective exchange rate is used and because of the calculation of this measure, depreciations in the currency are identified when the real exchange rate decreases. That is why responses in Figure 7 are in the negative territory.

In low dollarization countries, exchange rate shocks are not found to create statistically significant impact. Same conclusion is also supported by Granger causality test results in Table 4 in which exchange rate Granger causes inflation variable at conventional 5% significance level for high dollarization developing economies, but it does not Granger cause at 5% significance level when we take low dollarization countries into consideration. Similar to first strategy, we also present FEVD estimates. As scattered in Figure 9, conditional variance of exchange rate over same horizon explains up to almost 7% of inflation variance given highly-dollarized countries, whereas conditional variance of exchange rate exerts somewhat lesser influence on inflationary dynamics in the case of low dollarization countries.

Figure 7: Impulse-Response Function for High Dollarization Economies

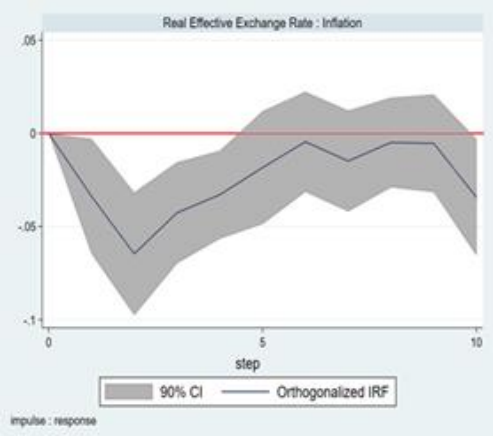


Figure 8: Impulse-Response Function for Low Dollarization Economies

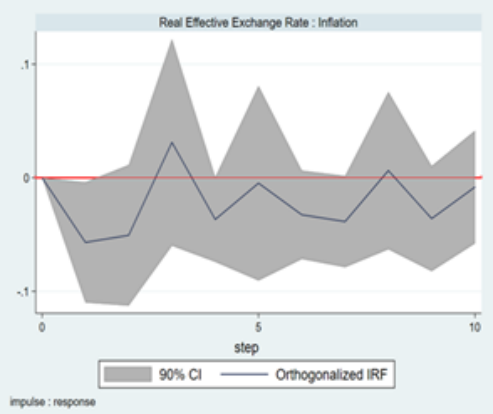
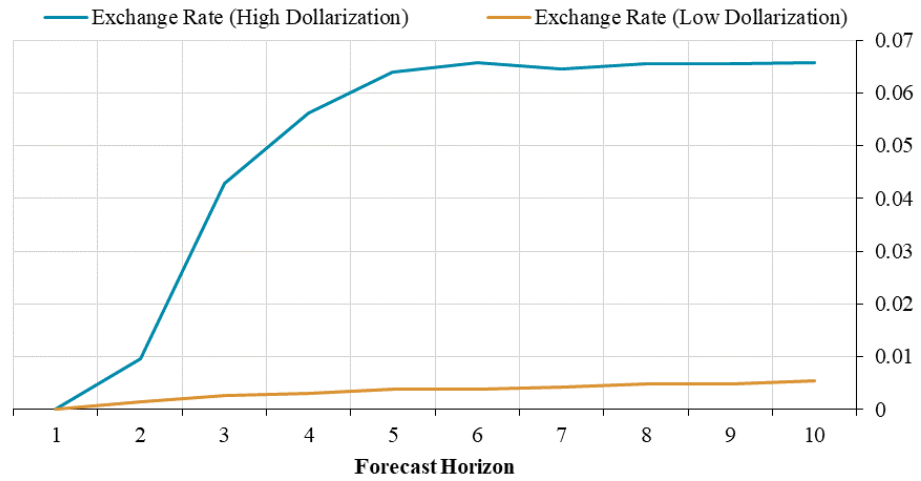


Table 4: Granger Causality Test Results (Empirical Strategy 2)

Direction of the Causality	Test Statistic (Chi-squared)	p-value
High Dollarization		
FX ➔ π	21.38	0.045
Low Dollarization		
FX ➔ π	18.31	0.107

Figure 9: Forecast Error Variance Decompositions for Inflation



We have re-estimated the panel VAR model with the third empirical strategy where dollarization disaggregation is done based on the FX liabilities ratio. Similar to the first strategy, nominal exchange rate shocks produce inflationary pressures with statistical significance for countries with average dollarization ratio being above the threshold of median value of the sample in the post-crisis period. However, again, no robust relation is observed between consumer price increases and nominal exchange rate depreciations when dollarization tendencies are not so strong (Figure 10 and Figure 11). Moreover, while Granger causality from exchange rate to inflation is evident for highly dollarized countries, same relation is insignificant for low dollarization economies (Table 5). FEVD estimations also appear to support this finding as exchange rate explains more sizeable portion of the variation in inflation given high dollarization tendencies (Figure 12).

Figure 10: Impulse-Response Function for High Dollarization Economies

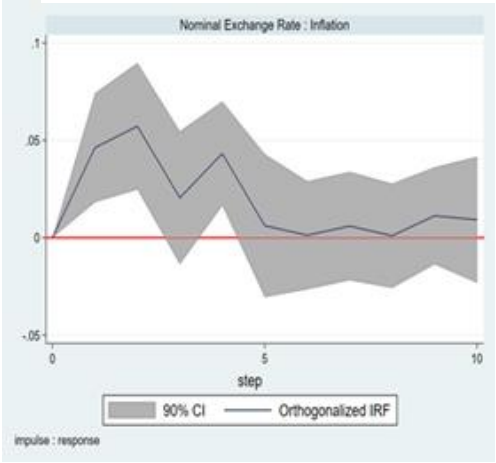


Figure 11: Impulse-Response Function for Low Dollarization Economies

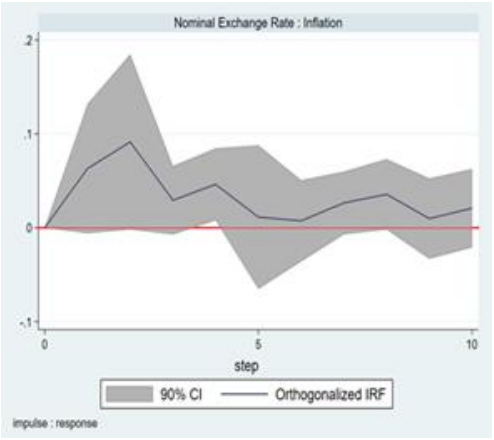
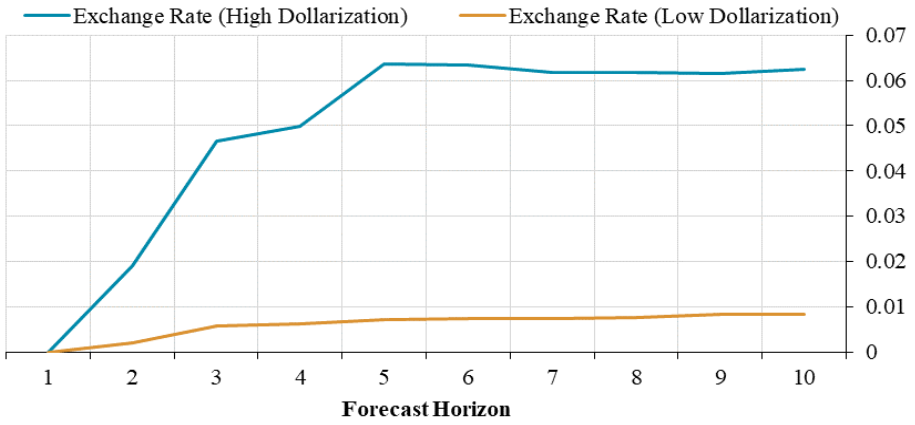


Table 5: Granger Causality Test Results (Empirical Strategy 3)

Direction of the Causality	Test Statistic (Chi-squared)	p-value
High Dollarization		
FX ➔ π	31.45	0.002
Low Dollarization		
FX ➔ π	7.32	0.835

Figure 12: Forecast Error Variance Decompositions for Inflation



As last robustness check, panel VAR modelling methodology is applied to data where dollarization is defined with the FX liabilities ratio and currency movements are being tracked by the real effective exchange rate. In line with what we observe in second strategy, high and low dollarization countries are found to differ in terms of responses of inflation to exchange rate shocks based on magnitude and statistical significance of responses, as shown in Figure 13 and Figure 14. Not surprisingly, Granger causality test results are in line with the same arguments in previous cases (Table 6). FEVD results show that exchange rate movements explain an important part of the variance of inflation variable when high dollarization countries are taken as sample, whereas such as relation is not evident in low dollarization countries.

Figure 13: Impulse-Response Function for High Dollarization Economies

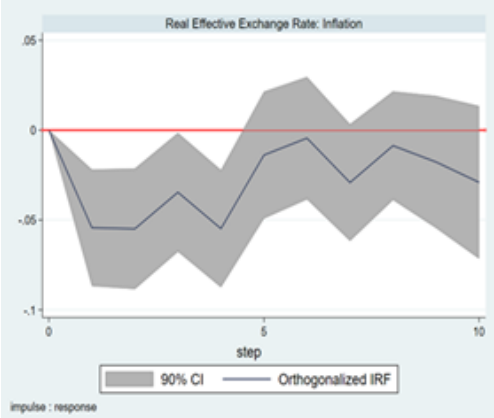


Figure 14: Impulse-Response Function for Low Dollarization Economies

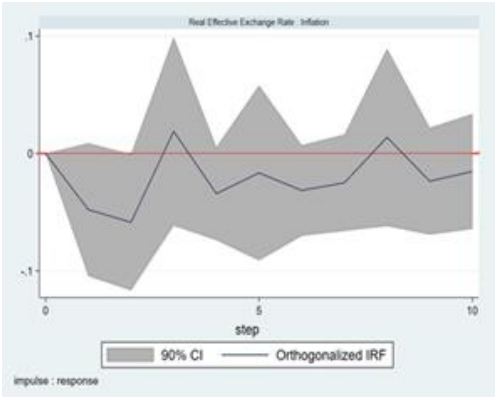
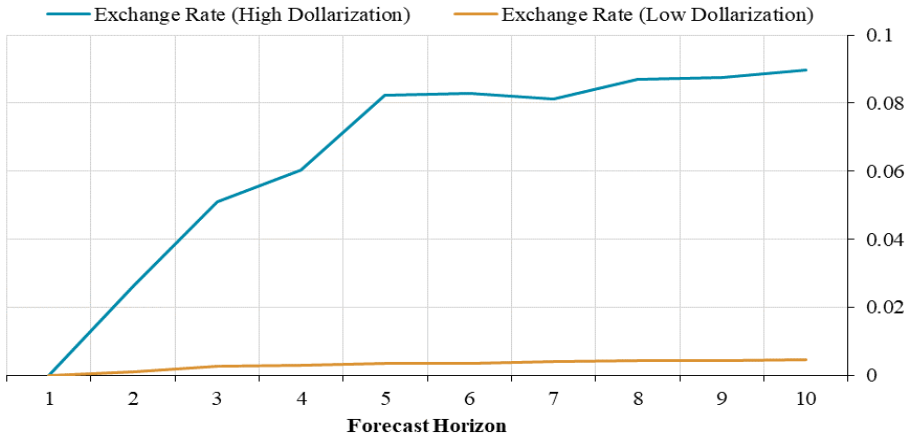


Table 6: Granger Causality Test Results (Empirical Strategy 4)

Direction of the Causality	Test Statistic (Chi-squared)	p-value
High Dollarization	31.77	0.001
FX ➔ π		
Low Dollarization	14.01	0.300
FX ➔ π		

Figure 15: Forecast Error Variance Decompositions for Inflation



4. Robustness Analysis

In this section, we present further econometric analysis about the relevance of dollarization tendencies for ERPT. To begin with, our specification established in the previous parts does not consider oil prices as completely exogenous variables[6]. However, as stated by Abraham and Harrington (2016), Bryne and Lorusso (2019) among many others, spot and futures oil prices are mostly driven by the global supply and demand forces which are unlikely to be influenced by specific country-level dynamics. Hence, we repeat similar analysis by considering oil prices as fully exogenously determined. In this context, similar empirical specifications are utilized as the definition of exchange rate proxies and dollarization ratios differs to construct impulse-response functions, Granger causality tests and variance decom-

[6] We thank the anonymous referee for pointing out this issue.

positions. Results provided in the Appendix show that particular findings relevant to the amplifying effect of dollarization on ERPT stays broadly same, even when oil prices are taken as exogenous.

As another modification to baseline analysis, panel unit root tests are repeated with Pesaran (2003) method to account for possible cros-sectional dependencies. Results provided in the Appendix indicate that the form of the variables included in panel VAR specifications do not suffer from any non-stationarities.

The fact that emerging market pricing dynamics can be driven by common global factors necessitates the utilization of econometric methodologies that can account for such issues[7]. As seen in the literature, domestic inflation developments can be shaped by global synchronization across countries, especially the ones for which trade relations and commodity transactions are heavily interconnected (Borio and Filardo, 2007; Ciccarelli and Mojon, 2010). Such common factors cannot be controlled by baseline estimations. In this context, the dynamic common correlated effects estimator which was conceptualized by Chudik and Pesaran (2015) and operationalized by Ditzen (2016) is utilized. Here, contemporaneous inflation dynamics are investigated by using lagged inflation realizations, output gap, bond yields and currency movements, while estimations are made for sub-categories of EM countries based on different dollarization ratios as well as different exchange rate proxies. Empirical results presented in the Appendix mostly document that the impact of exchange rate on inflation developments is more pronounced for highly dollarized EM countries, except for one case when dollarization is measured by FX banking sector liabilities and currency movements are approximated by real exchange rate changes. Moreover, Pesaran (2015) tests are applied for all estimations to reveal whether or not there exists cross-sectional dependency in longitudinal data of sample countries. It is seen that null hypothesis of weak cross-sectional dependency can be rejected for all cases.

5. Conclusion

It is widely established in the literature that exchange rate is a key determinant of inflation developments in emerging economies, as price changes in these countries are known to be driven more by supply-side factors compared to their advanced counterparties. Despite recent evidence in the cross-country studies advocating that ERPT has declined in the post-crisis period, we still observe sizeable depreciations in emerging market currencies. Considering the moderate course of inflation in emerging markets in the same time interval,

[7] We thank the anonymous referee for emphasizing the importance of this issue regarding empirical results.

we suspect that analysis made on the aggregate panel structures might hide the role of dollarization in inflation changes. To this end, we decided to use two different measures of dollarization which is widely employed in the literature that are FX loans to total loans and FX liabilities to total liabilities. To test our claim, we have created a panel data set and conducted panel VAR estimations for high and low dollarization emerging countries under four empirical strategies in which measurement of dollarization and currency movements differ.

Our results indicate that depreciation shocks coming to exchange rate have created statistically and economically significant responses in inflation for high dollarization countries, whereas the responses are insignificant when dollarization tendencies are low. Granger causality test results are in line with this finding in the sense that the direction of causality takes shape from exchange rate to inflation. Forecast error variance decomposition analysis, on the other hand, validate the intuition that countries that can be characterized by strong dollarization tendencies are faced with the cost-side inflationary pressures driven by currency movements.

Overall, findings underline the continuing importance of currency depreciations on inflationary pressures in emerging markets given the role of dollarization in the post-crisis period. More specifically, to what extent a country dollarizes appears to be significant driver of ERPT, even during relative deflationary period of post-crisis era. Thus, policies aiming to reverse the dollarization tendencies are thought to contribute price stability in emerging markets by diluting the effect of currency shocks on consumer price inflation. In this regard, macroprudential devices limiting the FX indebtedness of the economic agents and containing the use of foreign currencies in financial transactions appear to be at policymakers' disposal.

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7. Appendix

Table 7: Summary Statistics (In Percentages)

Variables	Number of Observations	Mean	St. Dev.	Min	Max
Inflation	1386	0.3188	1.0209	-34.6015	3.0862
Output Gap	1386	0.0167	4.0481	-20.9480	23.0408
Bond Yields	1386	-0.0051	0.5154	-6.6170	5.2654
Nominal Exchange Rate	1386	0.3478	2.5805	-12.9657	20.4020
Real Exchange Rate	1386	-0.0324	2.2463	-16.8165	20.5753
Brent Oil Prices	1386	-0.1209	7.4782	-24.0180	17.1260

Table 8: Panel Unit Root Test Results

Variables	Im-Peseran-Shin Test Statistic (Z-tilda)	p-value
Inflation	-19.1564	0.000
Output Gap	-20.2218	0.000
Bond Yields	-22.5600	0.000
Nominal Exchange Rate	-19.9688	0.000
Real Exchange Rate	-21.6709	0.000
Brent Oil Prices	-19.7368	0.000

Table 9: ADF Time Series Unit Root Test

Variables	ADF Test Statistic	p-value
Brent Oil Prices	-7.493	0.000

Table 10: Pesaran (2003) Panel Unit Root Test Results

Variables	Pesaran Test Statistic (t-bar)	p-value
Inflation	-9.189	0.000
Output Gap	-7.527	0.000
Bond Yields	-11.809	0.000
Nominal Exchange Rate	-11.808	0.000
Real Exchange Rate	-12.509	0.000

Figure 16: Diagnostics for the Stability of Panel VAR Models

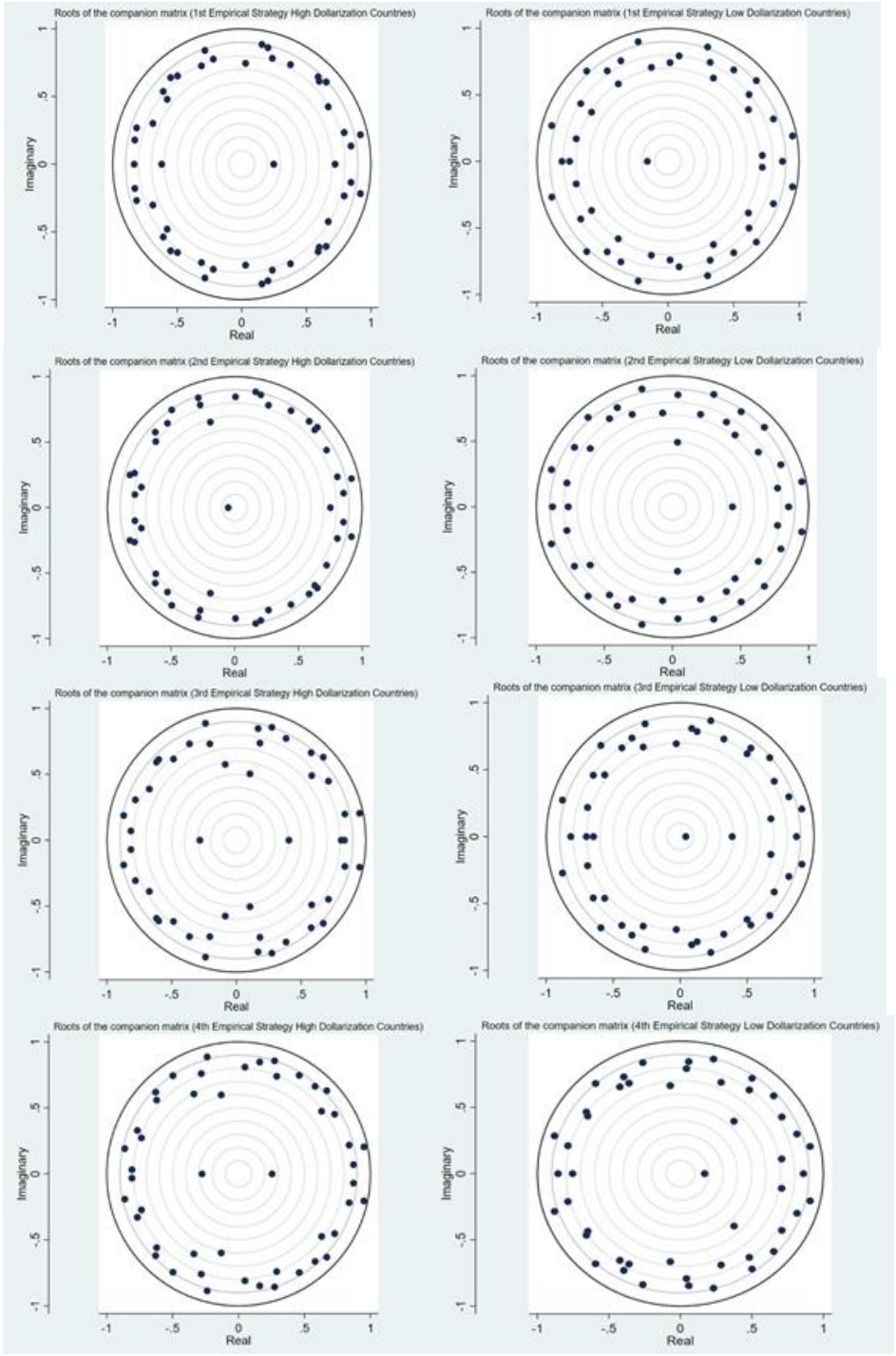


Table 11: Granger Causality Test Results

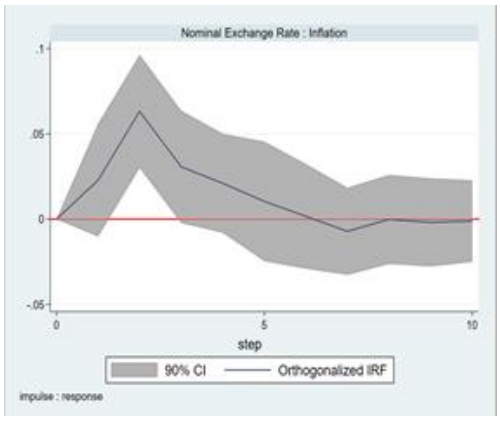
(Oil Prices Taken As Exogenous Variable)

Direction of the Causality	Test Statistic (Chi-squared)	p-value
Empirical Strategy 1		
High Dollarization		
FX ➔ π	17.61	0.007
Low Dollarization		
FX ➔ π	5.36	0.147
Empirical Strategy 2		
High Dollarization		
FX ➔ π	13.75	0.089
Low Dollarization		
FX ➔ π	7.79	0.253
Empirical Strategy 3		
High Dollarization		
FX ➔ π	6.43	0.092
Low Dollarization		
FX ➔ π	4.51	0.289
Empirical Strategy 4		
High Dollarization		
FX ➔ π	9.24	0.161
Low Dollarization		
FX ➔ π	7.76	0.256

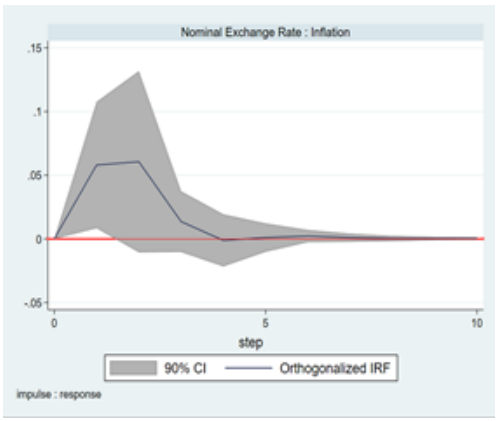
Figure 17: Impulse-Response Functions
(Oil Prices Taken As Exogenous Variable)

Empirical Strategy 1

Impulse-Response Function for High Dollarization Economies

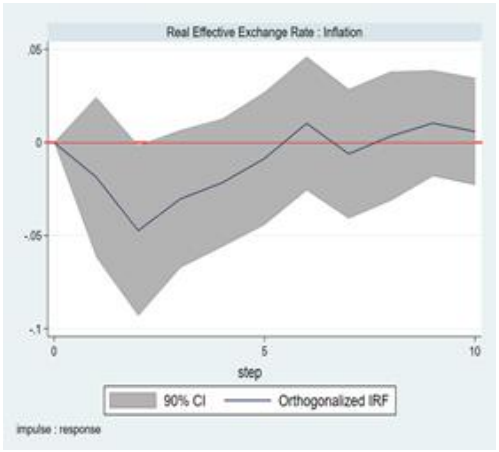


Impulse-Response Function for Low Dollarization Economies

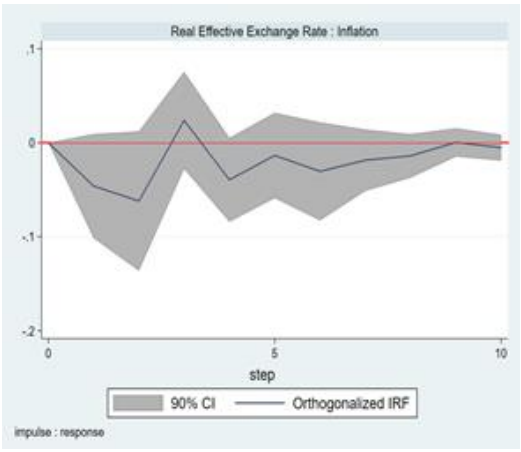


Empirical Strategy 2

Impulse-Response Function for High Dollarization Economies

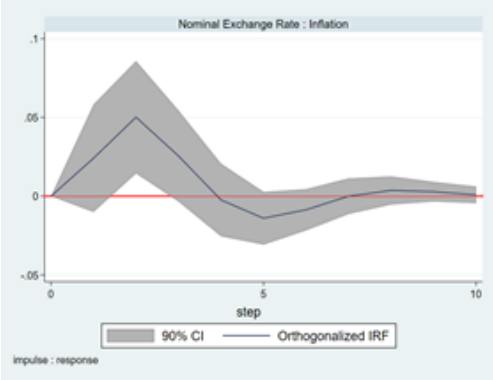


Impulse-Response Function for Low Dollarization Economies

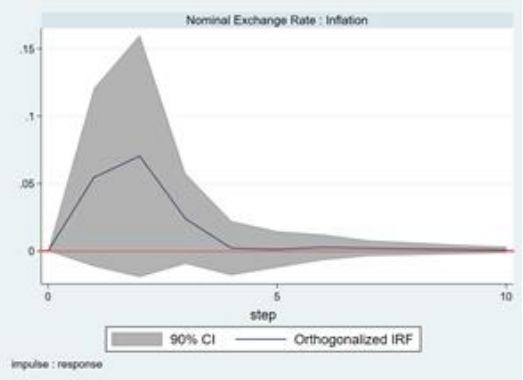


Empirical Strategy 3

Impulse-Response Function for High Dollarization Economies

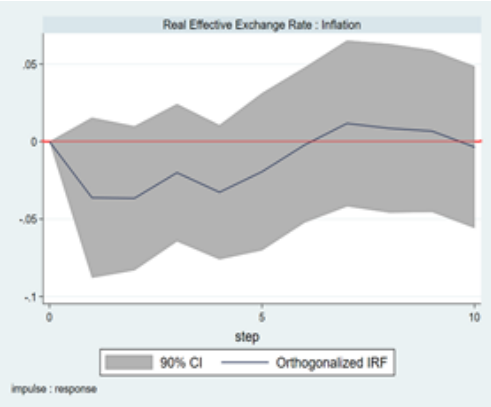


Impulse-Response Function for Low Dollarization Economies



Empirical Strategy 4

Impulse-Response Function for High Dollarization Economies



Impulse-Response Function for Low Dollarization Economies

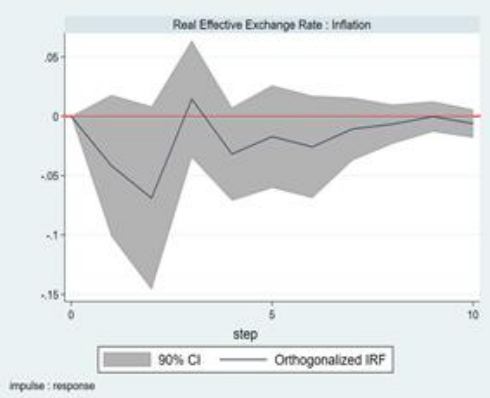


Figure 18: Forecast Error Variance Decompositions for Inflation

(Oil Prices Taken As Exogenous Variable)

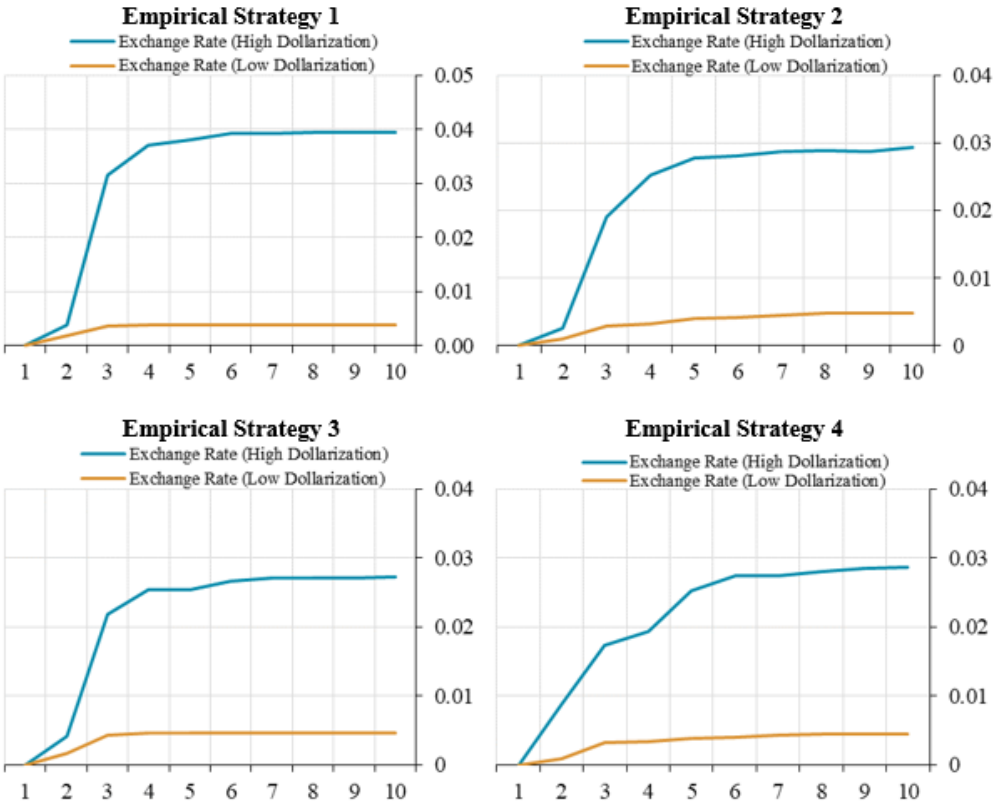


Table 12: Dynamic Common Correlated Effects Estimations (Dollarization Definition: Loans)

Dependent Variable:	High Dollarization Inflation	Low Dollarization Inflation	High Dollarization Inflation	Low Dollarization Inflation
L.Inflation	0.259***	0.338***	0.242***	0.339***
	(0.0710)	(0.0788)	(0.0744)	(0.0803)
Output Gap	-0.00540	0.00537	-0.00353	0.00270
	(0.00398)	(0.00631)	(0.00418)	(0.00530)
Bond Yields	0.153**	0.0957**	0.219***	0.0989**
	(0.0615)	(0.0452)	(0.0764)	(0.0447)
Nominal Exchange Rate	0.0193**	0.0117		
	(0.00851)	(0.0108)		
Real Exchange Rate			-0.0332*	-0.0148**
			(0.0181)	(0.00612)
Observations	714	714	714	714
R-squared	0.794	0.868	0.771	0.868
Number of groups	7	7	7	7

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 13: Dynamic Common Correlated Effects Estimations (Dollarization Definition: Liabilities)

VARIABLES	High Dollarization Inflation	Low Dollarization Inflation	High Dollarization Inflation	Low Dollarization Inflation
L.Inflation	0.251***	0.321***	0.250***	0.324***
	(0.0809)	(0.0891)	(0.0787)	(0.0892)
Output Gap	-0.0117*	0.00255	-0.0106*	0.00249
	(0.00646)	(0.0124)	(0.00643)	(0.00997)
Bond Yields	0.142**	0.103	0.175**	0.136**
	(0.0712)	(0.0632)	(0.0882)	(0.0561)
Nominal Exchange Rate	0.0261***	0.00806		
	(0.00895)	(0.0156)		
Real Exchange Rate			-0.0262	-0.0222
			(0.0207)	(0.0138)
Observations	714	714	714	714
R-squared	0.753	0.856	0.735	0.842
Number of groups	7	7	7	7

Table 14: Pesaran (2015) Test Results for Cross-Sectional Dependence

Specifications	CD Test Statistic	p-value
High Loan Dollarization-Nominal Exchange Rate	-6.516	0.000
High Loan Dollarization-Real Exchange Rate	-6.127	0.000
Low Loan Dollarization-Nominal Exchange Rate	-4.808	0.000
Low Loan Dollarization-Real Exchange Rate	-4.692	0.000
High Liabilities Dollarization-Nominal Exchange Rate	-6.166	0.000
High Liabilities Dollarization-Real Exchange Rate	-5.519	0.000
Low Liabilities Dollarization-Nominal Exchange Rate	-4.717	0.000
Low Liabilities Dollarization-Real Exchange Rate	-4.455	0.000