The Dollar and Emerging Market Economies: Financial Vulnerabilities Meet the International Trade System*

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Abstract

This paper shows that dollar appreciations lead to declines in GDP, investment, and credit to the private sector in emerging market economies (EMEs). These results imply that the transmission of dollar movements to EMEs occurs mainly through financial conditions rather than net exports, contrary to what would be expected from the conventional Mundell-Fleming model. Moreover, the central role of the U.S. dollar in global trade invoicing and financing - the dominant currency paradigm - and the increased integration of EMEs into international supply chains weaken the traditional trade channel. Finally, as expected if financial vulnerabilities are prominent, EMEs with higher exposure to credit denominated in dollars and lower monetary policy credibility experience greater contractions during dollar appreciations.

JEL classification: F31, F34, F36, F41, F44

Key words: dollar, balance sheet mismatch, dominant currency paradigm, global value chain, monetary policy credibility

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1 Introduction

The predominance of the U.S. dollar (dollar henceforth) in the international trade and financial system have led to increasing focus on the importance of dollar movements for the global economy, especially for emerging market economies (EMEs). Figure 1 shows the relationship between the broad real dollar and average detrended EME GDP (on the left) and EME investment (on the right).[1] Based on these simple correlations, a stronger dollar (and, therefore, weaker EME currencies) is related to weaker GDP and investment in EMEs, contrary to what you would expect from traditional trade channels.[2] This paper focuses on the question: Do these relationships only represent simple correlations, or are there causal channels through which a stronger dollar leads to a contraction of activity in EMEs?

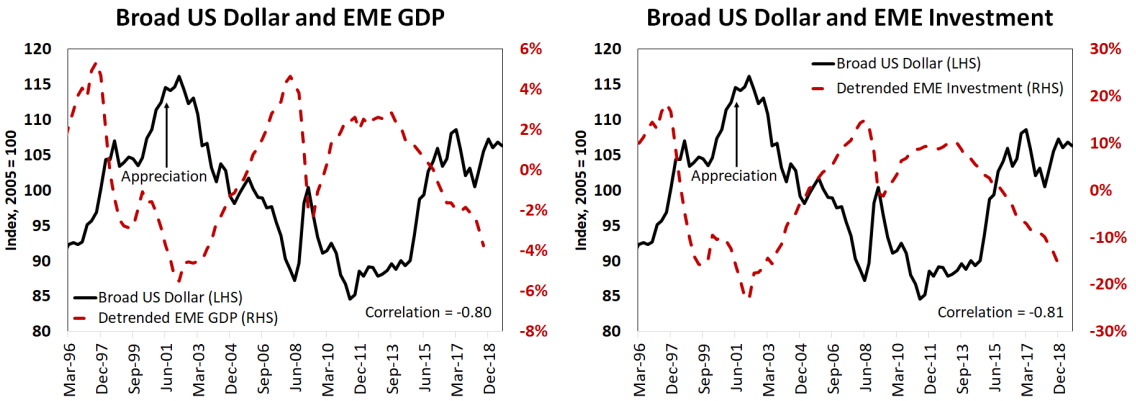

FIGURE 1: Dollar and Emerging Market Economies Business Cycles
Source: National sources and FRED.

I answer this question using a structural empirical model to evaluate quantitatively the effects of movements in the broad real dollar on business cycles fluctuations in EMEs and the different transmission channels of these effects. More specifically, my analysis proceeds in two stages. First, I estimate a panel VAR system with

[1] The broad real dollar is a weighted average of the foreign exchange value of the U.S. dollar against the currencies of a broad group of major U.S. trading partners in real terms (adjusted using consumer price indexes).

[2] The conventional textbook trade channel states that a depreciation of the local currency makes exports relatively cheaper and imports more expensive. This results in higher net exports and a shift of consumers away from imported goods toward domestic ones.

thirteen EMEs.[3] I show that dollar shocks are important sources of business cycle fluctuations in EMEs, and positive dollar shocks (dollar appreciations) lead to declines in GDP, investment, and real credit to the private sector and to an increase in EME sovereign spreads.

In the second part of my analysis, I evaluate the importance of the different channels through which dollar movements can be transmitted to the real economy. More specifically, I evaluate the importance of four previously studied mechanisms. The first two, dominant currency pricing and global value chain integration, weaken the effects of the traditional trade channel, while the other two, balance sheet vulnerabilities and lack of monetary policy credibility, can revert its effects

(i) ***Dominant currency pricing*:** The prevalence of dollar invoicing in trade leads to trade prices being sticky in dollars rather than in local currency, mitigating the effects of dollar movements on exports while amplifying their effects on imports;

(ii) ***Global value chain integration*:** Increased integration into international supply chains leads trade flows to be less sensitive to exchange rate movements, as the higher import content of exports causes imports and exports to tend to move together.

(iii) ***Balance sheet vulnerabilities*:** If an economy has substantial dollar-denominated debt, dollar appreciations expand the domestic-currency value of liabilities relative to assets, weakening balance sheets and tightening financial conditions;

(iv) ***Lack of monetary policy credibility*:** Countries with low monetary policy credibility have higher exchange rate pass-through to domestic inflation, which might require additional monetary policy tightening after dollar appreciations.

After constructing indices to quantitatively rank the countries in terms of the importance to them of each mechanism, I split them in two groups, one with rela-

[3] I prefer to use the panel data methodology because it increases the efficiency and power of the analysis, as individual countries' VARs would have too many parameters compared to the time series length.

tively high exposure and other with relatively low exposure to each of the indices, and reestimate the panel VAR for each of the two groups. The analysis shows that, regardless of how we divide the countries, dollar appreciations lead to GDP, investment, and credit contractions in EMEs and have negligible effects on exports. Moreover, countries with relatively higher integration in global value chains have a smaller contraction of imports, as you would expect with a higher import content of exports, while countries with higher dollar invoicing have a greater contraction on imports, also as expected. Finally, countries with higher balance sheet vulnerabilities and lower monetary policy credibility experience greater contractions in GDP, investment, and imports, suggesting that both balance sheet vulnerabilities and lack of monetary policy credibility are important in generating the contractionary effects of dollar appreciations in EMEs.

It is important to note that this paper does not ultimately identify the fundamental sources of fluctuations in the dollar, which is an asset price and consequently can be affected by a myriad of factors. Indeed, it is difficult to disentangle the sources of exchange rates movements more generally. For example, there is a vast literature about the so-called "exchange rate disconnect puzzle", namely that macroeconomic fundamentals are largely disconnected from exchange rates, especially over short horizons (Meese and Rogoff (1983), Obstfeld and Rogoff (2000), Itskhoki and Mukhin (2019)).[4] The paper's main objective is to understand how EMEs respond to movements in the broad real dollar, irrespective of their source, and which characteristics are more relevant to the transmission of dollar fluctuations to EMEs' real variables. .

This paper is related to a growing body of the literature that studies the role of the dollar as the world's dominant currency. Goldberg and Tille (2009) and Gopinath (2016) document the ample use of the dollar in trade invoicing. Additionally, Boz et al. (2018) show that the presence of a 'dominant currency' affects the transmission of exchange rate fluctuations to terms-of-trade, export and import quantities, and

[4]To alleviate concerns about the endogeneity of the dollar, I control for other variables usually related to the global financial cycle such as the VIX, a measure of global uncertainty, the U.S. 2-year real interest rate, and U.S. real GDP.

the exchange rate pass-through into import prices. Indeed, Bruno, Kim, and Shin (2018) show that the combination of the 'dominant currency paradigm' with the fact that most of trade credit is denominated in dollars - what they call the working capital channel of trade fluctuations - implies a negligible effect or even a contraction on exports after a local currency depreciation. I contribute to this literature by showing that exports barely move in EMEs after dollar appreciations, in line with the works of Boz et al. (2018) and Bruno, Kim, and Shin (2018) in the 'dominant currency paradigm' and the working capital channel of trade fluctuations. I also show that imports contract more in EMEs with a higher share of dollar trade invoicing after dollar appreciations, again in line with the predictions of the 'dominant currency paradigm'.

This paper also supports the findings of the literature that studies the increasing relevance of international supply chains, as shown, for example, by Johnson and Noguera (2017). On the theoretical side, Amiti, Itskhoki, and Konings (2014) develop a theoretical framework that predicts that firms with high import shares and high market shares have low exchange rate pass-through into their export prices, and they confirm the model predictions using Belgian firm-product-level data on imports and exports. On the empirical side, Johnson (2014) shows that using value-added exports in place of gross exports has three implications: (i) countries appear less exposed to foreign expenditure changes; (ii) at the sectoral-level, the manufacturing sector looks substantially less exposed, and non-manufacturing sectors look substantially more exposed to foreign shocks; and (iii) the importance of shocks originating in particular export destinations differs. Moreover, he shows that integration in international supply chains changes how movements in the exchange rate are transmitted to export prices, depending also on the import content of exports. I contribute to this literature by showing that indeed higher integration in global value chains weakens the traditional trade channel of exchange rate movements, consistent with exports and imports moving more in tandem.

The paper is also related to the literature that challenges the conventional textbook notion that a depreciation of the currency is expansionary through its effect on

net exports by arguing that financial channels can go the other way and more than offset the trade channel. For example, Krugman (1999) and Cespedes, Chang, and Velasco (2004) show in theoretical models that if an economy has a large share of debt denominated in foreign currency, a weaker currency can lead to a deterioration in the balance sheets of domestic banks and firms and end up being contractionary. Kalemli-Ozcan, Kamil, and Villegas-Sanchez (2016) provide empirical evidence on this balance sheet channel, showing that in the presence of currency mismatches large depreciation events can lead to a persistent decline in output and investment. More recently, Bruno and Shin (2015), using a model where regional banks borrow in dollars from global banks to lend to local corporates, show that in the presence of currency mismatches there is a tight link between local currency appreciation and loosening of financial conditions. Caballero, Fernandez, and Park (2019) also document a considerable increase in foreign financing through bond issuance in EMEs since the early 2000s, which unveiled an additional transmission channel of dollar movements to economic activity in these economies. Finally, Avdjiev et al. (2019) provide empirical evidence of a "triangular" relationship between dollar movements, cross-border bank flows, and real investment in EMEs. Using both macro (country-level) and micro (firm-level) data, they show that a dollar appreciation leads to a fall in cross-border bank lending to EMEs and lower real investment. I contribute to this literature by evaluating empirically the effects of dollar movements in EMEs and showing that GDP, investment, and credit to the private sector contract after dollar appreciations, and more so in countries with higher dollar-denominated debt.

Finally, this paper is related to the literature that links monetary policy credibility, exchange rate pass-through, and the effects of currency depreciations in real activity. Several authors have found evidence of a lower exchange rate pass-through to consumer prices when countries have greater monetary policy credibility (see, for example Carriere-Swallow et al. (2016) and Ha, Stocker, and Yilmazkuday (2019)). I contribute to this literature by showing that the monetary policy credibility channel is also important to explain the contractionary effect of dollar appreciations on real

activity in EMEs, especially in countries with a long history of high inflation.

The remainder of the paper is organized as follows. Section 2 discusses in more detail the different transmission channels of exchange rate movements. Section 3 highlights the main stylized facts, describes the panel VAR specification, and presents and interprets the baseline results. Section 4 evaluates the importance of each of the different transmission channels. Section 5 presents several robustness checks. Section 6 concludes.

2 How Are Dollar Movements Transmitted to EMEs?

The literature that studies the transmission of exchange rate movements to real activity typically emphasizes the traditional trade channel (embodied in the seminal work of Mundell (1963) and Fleming (1962)) as the key determinant of the response of economies to currency movements. In this framework, a local currency depreciation is expansionary through its effects on net exports. Assuming prices are sticky in the currency of the producing country, a local currency depreciation leads to a decline in the price of exports and a rise in the price of imports, expanding the quantity exported and contracting the quantity imported, and thus leading to higher net exports. Moreover, the depreciation increases the demand for home goods through the change in relative prices, shifting consumers away from imported goods towards domestic ones and, consequently, leading to an output expansion.

However, there are some features in the current international trade system that weaken the effect of the traditional trade channel. First, there is ample evidence that most trade, especially in EMEs, is invoiced in dollars. This so-called dominant currency paradigm states that the prevalence of dollar invoicing in trade leads to export prices that are essentially denominated in dollars and, consequently, exchange rate movements against the dollar should have negligible effects on exports. Moreover, the dollar also affects credit conditions for working capital, as 80 percent of bank trade credit is denominated in dollars. These facts together could even lead to a contraction in exports after a dollar appreciation, strongly weakening the traditional

trade channel. Finally, as import prices are also predominantly denominated in dollars, dollar appreciations lead to greater contractions in import quantities. Figure 2 provides evidence on the prominence of dollar invoicing in global trade.

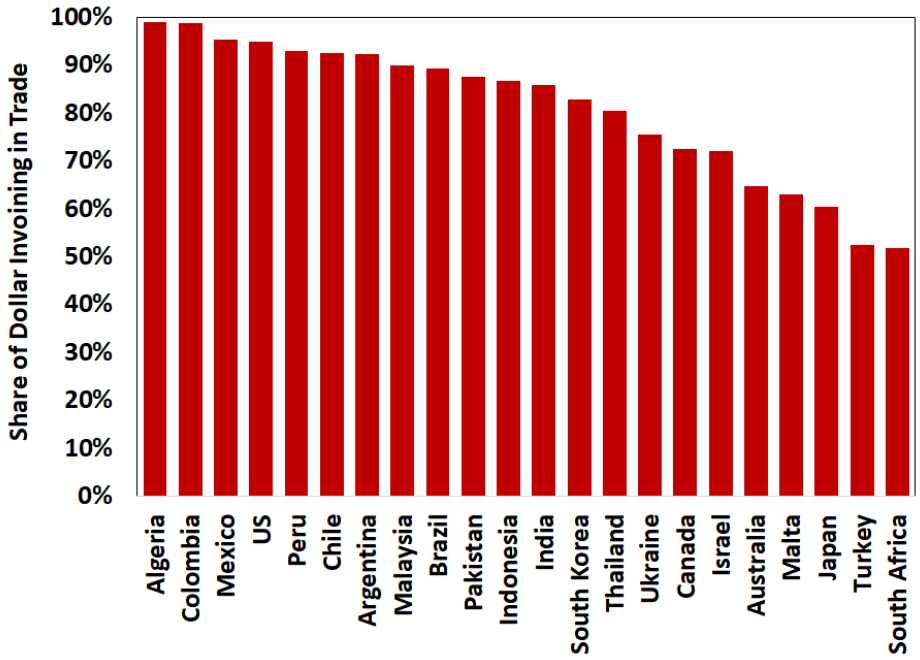

FIGURE 2: Dollar Dominance in Trade Invoicing

Source: National sources, Kamps (2006), Goldberg and Tille (2009), Gopinath (2016), Castellares (2017), Labbe (2018), and Giuliano and Luttini (2019).

Second, a higher integration into global value chains - higher import content of exports - dampens trade volume responses to exchange rate movements, as export and import volumes tend to move together. Moreover, in the presence of dominant currency pricing, this effect is amplified, as export prices and marginal costs also tend to move together. Thus, the correlation of export and import volumes should be higher the greater the import content of exports.

Moving to financial channels that can revert the effects of the traditional trade channel, let us first consider the balance channel channel. The literature on this channel argues that local currency depreciations in the presence of currency mismatches of assets and liabilities weaken balance sheets of domestic bank and firms, tightening financial conditions and contracting lending and real activity.[5] Figure 3

[5] Baskaya et al. (2017) provide evidence that EMEs' domestic banks, especially those with higher

illustrates the mechanism. When the local currency depreciates, the net worth of the domestic bank or firm decreases from n_t to n_{t+1}. This reduction happens because the foreign-currency value of local assets contracts (from $S_t * d_t$ to $S_{t+1} * d_t$, with d being the local currency value of assets and S being the exchange rate) relative to liabilities (d_t^{*B} in dollars). This decrease in net worth leads to a contraction in credit extension from foreign lenders and the need for a further contraction in assets.

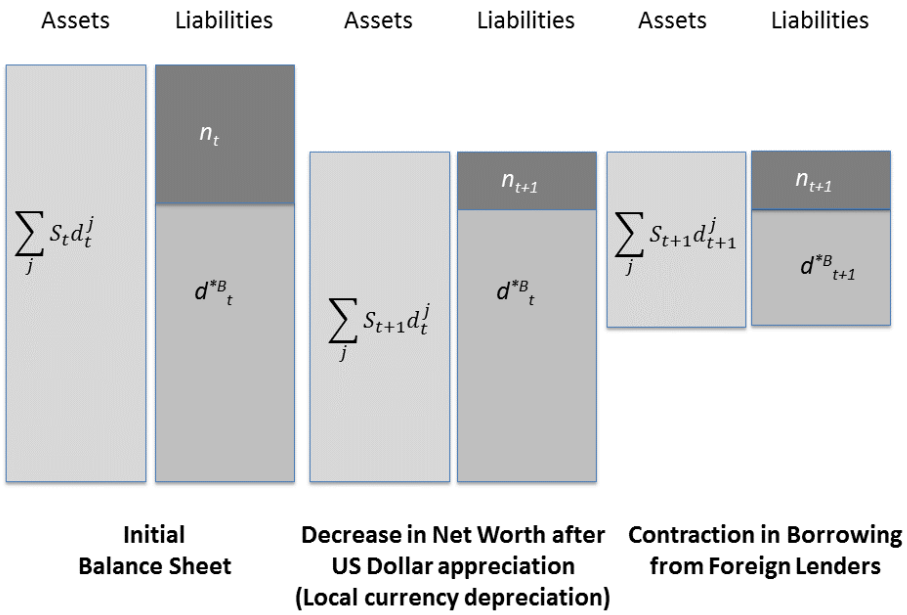

FIGURE 3: Balance Sheet Channel

This channel operates through both the demand and supply in the dollar global credit market. On the demand side, borrowers that are heavily indebted in dollars see a deterioration of their balance sheets and decrease their propensity to consume and invest. On the supply side, local banks that draw on cross-border bank lending to lend to local borrowers are affected by local currency depreciations, as it increases the effective credit risk faced by banks, given the presence of currency mismatches. Consequently, episodes of appreciation of the dollar are associated with deleverag-

non-core financing, extend more credit during periods of high capital inflows, using as a funding source the international capital market. Additionally, Kalemli-Ozcan, Liu, and Shim (2018) show that firms with a higher volume of foreign exchange debt before the exchange rate appreciates increase their leverage (and consequently risk taking) relatively more after the appreciation, supporting the balance sheet channel.

ing of global banks and an overall tightening of global financial conditions.[6] As Figure 4 shows, the broad real dollar is inversely related to dollar-denominated cross-border bank lending to non-U.S. residents and international dollar bonds issued by EMEs non-financial corporations, consistent with this mechanism.[7] This feedback loop reinforces the contractionary effects of dollar appreciations, leading to a contraction in GDP, investment, and credit and an increase in risk spreads. This contraction should be stronger the higher the exposure of private sector liabilities to the dollar, ie, the higher the share of dollar credit in the total credit to the private sector in the country.

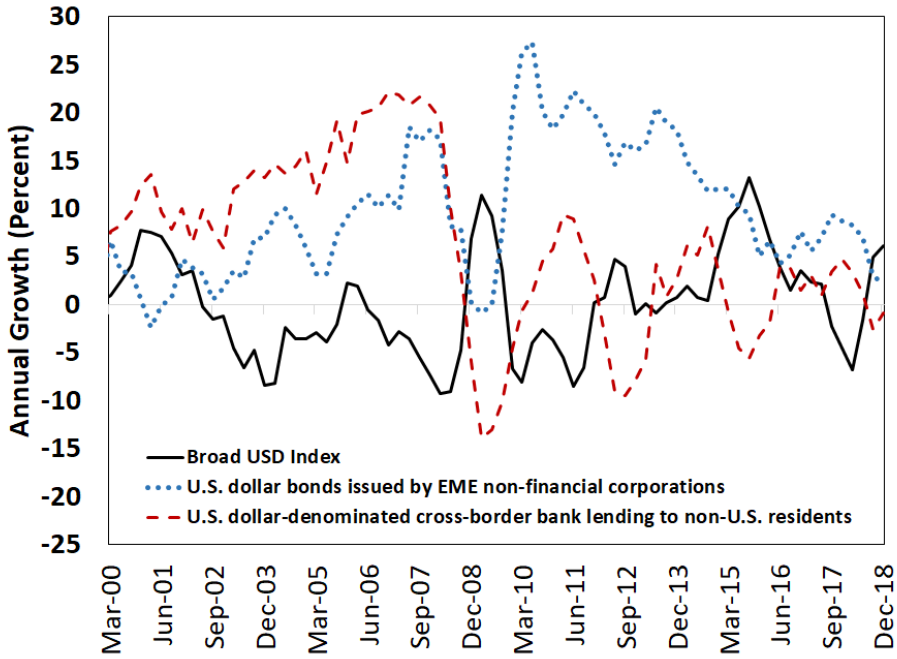

FIGURE 4: Broad Dollar and Dollar Loans and Bonds
Source: BIS locational banking statistics and FRED.

Finally, monetary policy credibility and the anchoring of inflation expectations affect the extent to which relative price shocks have secondary effects. Countries with less anchored inflation expectations could have a higher exchange rate pass-through to consumer prices and consequently need to tighten monetary policy after

[6] Bruno and Shin (2015) formulate a model with this interaction between global and local banks and the tight link between dollar movements and global financial conditions. They also show using a panel study of 46 countries that the predictions of the model are supported by the data.

[7] Shin (2018) provides similar evidence.

a local currency depreciation. Indeed, Ha, Stocker, and Yilmazkuday (2019) show that, although the exchange rate pass-through can vary considerably depending on the nature of the shocks, exchange rate pass-through is significantly lower in countries that adopt inflation targeting and have higher central bank independence. The tightening in monetary policy could more than offset the expansionary effects stemming from the traditional trade channel and also lead to contractions in real activity after local currency depreciations, especially for EMEs with very low credibility and higher rates of inflation.

3 Empirical Model and Results

I first estimate a structural panel VAR for thirteen emerging market economies (EMEs) to evaluate the effects of dollar shocks.

3.1 Data and Panel VAR Specification

My empirical model takes the form of a first-order VAR:

$$Ay_{i,t} = \eta_i + \sum_{k=1}^{p} B_k y_{i,t-k} + \epsilon_{i,t} \tag{1}$$

where η_i is a country fixed effect, i denotes countries, t denotes time period, and

$y_{i,t} = [yf_{i,t}, yh_{i,t}]$
$yf_{i,t} = [gdp_t^{US}, r_t^{US}, vix_t, reer_t^{US}]$, $yh_{i,t} = [gdp_{i,t}, inv_{i,t}, exp_{i,t}, imp_{i,t}, crt_{i,t}, r_{i,t}, reer_{i,t}]$

gdp_t^{US} denotes the U.S. GDP, r_t^{US} denotes the U.S. 2-year real interest rate, vix_t denotes the index of the implied volatility in S&P500 stock index option prices from the Chicago Board Options Exchange (CBOE), $reer_t^{US}$ denotes the broad trade-weighted U.S. real exchange rate, $gdp_{i,t}$ denotes real gross domestic product, $inv_{i,t}$ denotes real gross fixed capital formation, $exp_{i,t}$ denotes real exports, $imp_{i,t}$ denotes real imports, $crt_{i,t}$ denotes real credit volume to the non-financial private sector, $r_{i,t}$ denotes the country-specific interest rate, and $reer_{i,t}$ denotes the real exchange rate. All variables

are log deviations from a log-linear and a log-quadratic trend with the exception of U.S. GDP, VIX, interest rates, and exchange rates which are deviations from a linear trend. I also remove the sample mean after detrending for each variable separately.

I estimate the panel VAR for thirteen EMEs - Argentina, Brazil, Chile, Colombia, Indonesia, Korea, Malaysia, Mexico, Peru, Philippines, South Africa, Thailand, and Turkey - using quarterly data from 1996 to 2018. The countries selected have well-developed financial markets and at least 15 years of data. The data sources are listed in the Appendix.

Table 1 shows business cycle statistics for sample countries, averaging over country-specific moments. As mentioned earlier, Figure 1 shows that real activity variables (GDP and investment) are strongly negatively correlated with the dollar. More surprisingly, even exports are slightly negatively correlated with the dollar - the correlation coefficients with the broad real dollar are shown in the third column of Table 1. Also, consistent with previous work, the country interest rate is countercyclical in EMEs (column 2 in Table 1). Finally, the country interest rate has a positive co-movement with the dollar in EMEs.

TABLE I
SUMMARY STATISTICS FOR DETRENDED VARIABLES

	σ_X	$\rho(X_t, BroadUSD_t)$	$\rho(X_t, Y_t)$
Y	0.03	-0.80	1.00
I	0.11	-0.81	0.98
Exp	0.04	-0.36	0.62
Imp	0.09	-0.77	0.95
Crt	0.07	-0.36	0.46
R	0.02	0.80	-0.81
REER	0.06	-0.74	0.83

Note: The data are the simple average of the indicators for Argentina, Brazil, Chile, Colombia, Indonesia, Korea, Malaysia, Mexico, Peru, Philippines, South Africa, Thailand, and Turkey. The data sources are listed in the Appendix. The data are sampled quarterly from 1996:Q1 to 2018:Q4. The columns labeled Y, I, Exp, Imp, Crt, R, and REER refer, respectively, to detrended GDP, investment, real exports, real imports, real credit, country real interest rate, and real effective exchange rate. σ_X represents the standard deviation of each variable, $\rho(X_t, BroadUSD_t)$ represents the correlation of each variable with the broad real dollar, and $\rho(X_t, Y_t)$ represents the correlation of each variable with detrended output.

I identify the panel VAR by a simple recursive structure, imposing that the matrix A is lower triangular in equation (1), with the variables ordered in the same order presented in $y_{i,t}$. This means that the dollar can have contemporaneous and lagged effects on EME variables, but affects other U.S. variables only with a lag. The idea is to isolate dollar shocks that are independent of contemporaneous movements in U.S. GDP, U.S. 2-year real interest rate, and the VIX.[8]

I use the least square dummy variable (LSDV) estimator to estimate the panel VAR for each group. As $T >>> N$, the LSDV strategy is preferred to Generalized Methods of Moments (GMM) estimators as it has better finite sample properties and efficiency, especially if the degree of cross-section to time series variation is large. Also, with a large T, Nickel (1981) critique regarding the bias of the LSDV estimator is less important. I use the Akaike Information Criteria (AIC) to select the lag length and get p = 2 as optimal. I calculate the error bands using bootstrap methods.

3.2 Baseline Results

Figure 5 shows the impulse response functions for a 10% positive shock to the dollar on the variables in the model. Dollar appreciations lead to contractions in GDP, investment, and real credit as well as, an increase in sovereign risk in EMEs, contrary to the conventional textbook notion that a depreciation of the currency is expansionary through its effect on net exports. The results are generally statistically significant and the contraction in investment and real credit to the private sector is particularly strong, consistent with the results obtained by Avdjiev et al. (2019). Moreover, we see a negligible effect and even an initial small contraction in exports, consistent with the interaction between the 'dominant currency paradigm' and the working capital channel of trade fluctuations. Finally, imports experience a strong contraction.

To understand the contribution of each shock for different variables, I perform a variance decomposition of the forecast errors. Table 2 shows the results. According to my estimates, innovations in the dollar are responsible for about 21% of move-

[8] I use the 2-year real interest rate to control also for changes in expectations about future monetary policy, not only its current stance.

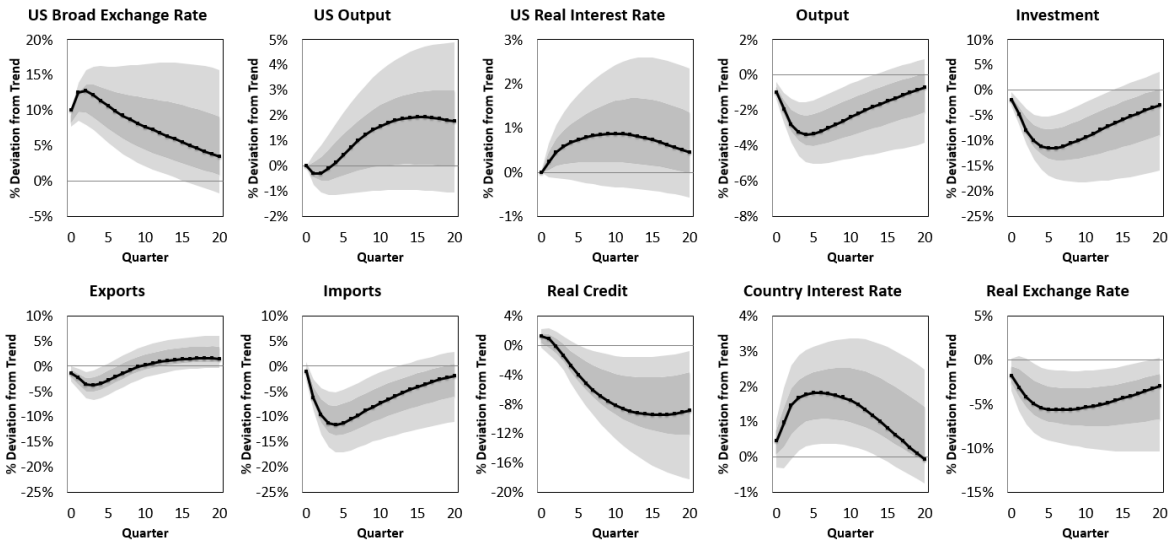

FIGURE 5: Impulse response to a 10% dollar shock.

Note: Marked black lines show point estimates of impulse responses respectively for the baseline panel VAR; and 68% and 95% confidence bands are depicted with dark-gray and light-gray shaded areas, respectively. Bootstrap confidence bands are based on 100,000 repetitions.

ments in GDP and investment in EMEs. For credit to the non-financial private sector, dollar innovations are responsible for around 29% of fluctuations in EMEs. Moreover, the share of the variance of forecast errors explained by dollar innovations for imports is around 20%, while for exports it is much smaller, around 8%, again consistent with the dominant currency paradigm, which predicts that dollar movements should have negligible effects on exports. Finally, for the country interest rate the share of the variance of forecast errors explained by dollar innovations is small, around 10%.

4 Evaluating the Importance of the Channels

To examine the importance of the different channels, I first construct indices that measure the exposure of countries to each channel. Then, I split the countries into two groups, one with relatively high and other with relatively low exposure to each of the channels.

TABLE II
VARIANCE DECOMPOSITION OF DETRENDED VARIABLES: PERCENT OF VARIATION EXPLAINED BY BROAD DOLLAR SHOCKS

Forecast horizon h	Y	I	Exp	Imp	Crt	R	REER
1	4%	2%	1%	3%	0%	1%	1%
4	12%	10%	5%	11%	1%	3%	3%
8	18%	17%	5%	17%	6%	6%	6%
12	20%	20%	5%	19%	13%	7%	8%
24	21%	21%	7%	20%	27%	8%	11%
60	21%	21%	8%	20%	29%	10%	11%

Note: The columns labeled Y, I, Exp, Imp, Crt, R and REER refer, respectively, to detrended GDP, investment, real exports, real imports, real credit, country real interest rate and real effective exchange rate.

4.1 Construction of the Exposure Indices

I follow Iacoviello and Navarro (2019) and construct each exposure index in three steps. First, I standardize the exposure variable by subtracting its mean and dividing by its variance to make all exposure variables comparable. Denote the standardize variable by v_{it}^k, where k refers to one of the four mechanisms in question. Then, I construct a logistic transformation of the standardized measure getting $l_{it}^k = \frac{exp(v_{it}^k)}{1+v_{it}^k}$ to map the exposure variables in the unit interval to make them comparable among each other.

The exposure variables for each channel are:

(i) Global value chain integration: import content of exports;

(ii) Dominant currency channel: share of exports invoiced in dollars;

(iii) Balance sheet channel: share of credit to the non-financial private sector denominated in dollars;

(iv) Monetary policy credibility: average inflation rate.

Figure 6 presents the indices constructed. The detailed data sources are listed in the Appendix.

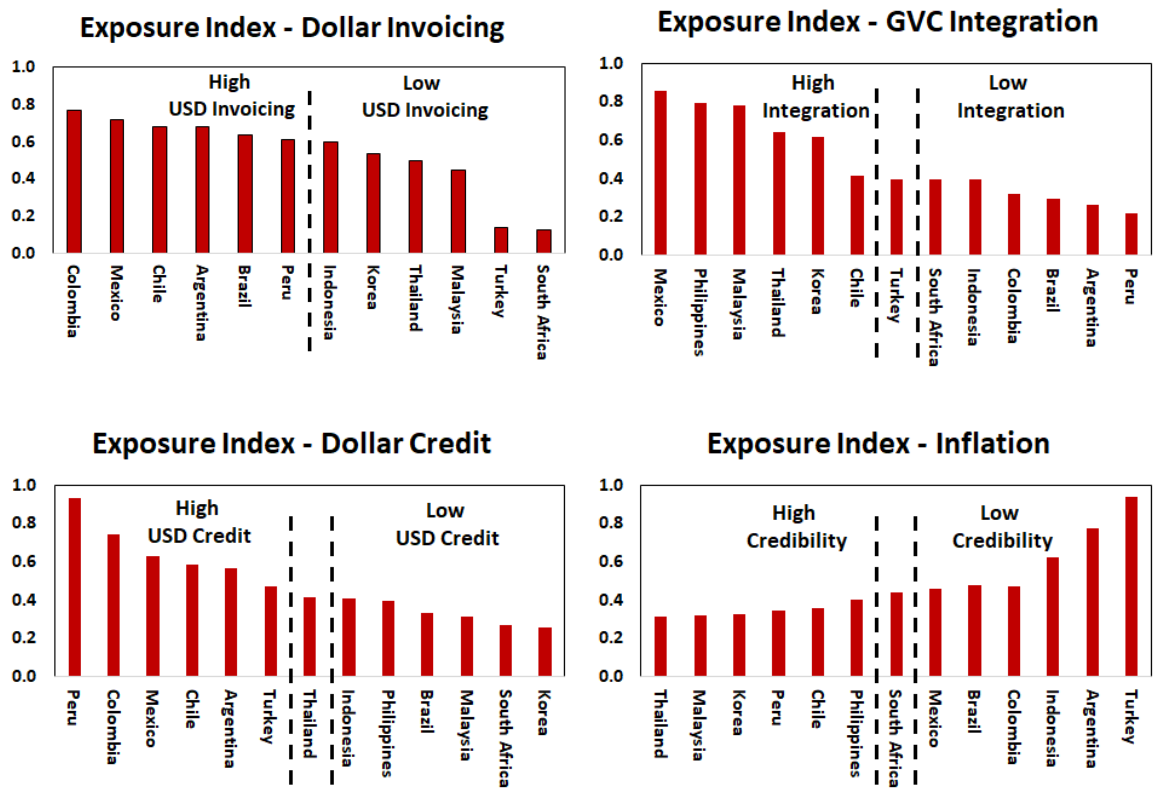

FIGURE 6: Exposure Indices

Source: Author's calculations based on national sources, BIS, Kamps (2006), Goldberg and Tille (2009), Gopinath (2016), Castellares (2017), Labbe (2018), and Giuliano and Luttini (2019).

4.2 Subgroup Analysis

I evaluate the effects of each channel by doing a subgroup analysis, using the split the sample in "relatively high" and "relatively low" exposure groups constructed in section 4.1.

Figure 7 shows the results for the dominant currency channel. Countries with higher dollar trade invoicing have a greater contraction on imports, as expected. Moreover, both export responses are muted and even initially negative, supporting the interaction between the dominant currency paradigm and the working capital channel of trade fluctuations proposed by Bruno, Kim, and Shin (2018).[9]

Figure 8 shows the results for the global value chain integration intensity. The

[9]The low discrepancy of export responses between the two groups might be related to the fact that apart from South Africa and Turkey, all the remaining countries in my sample have a share of over 80% of trade invoiced in dollars, which makes it harder to differentiate between both groups.

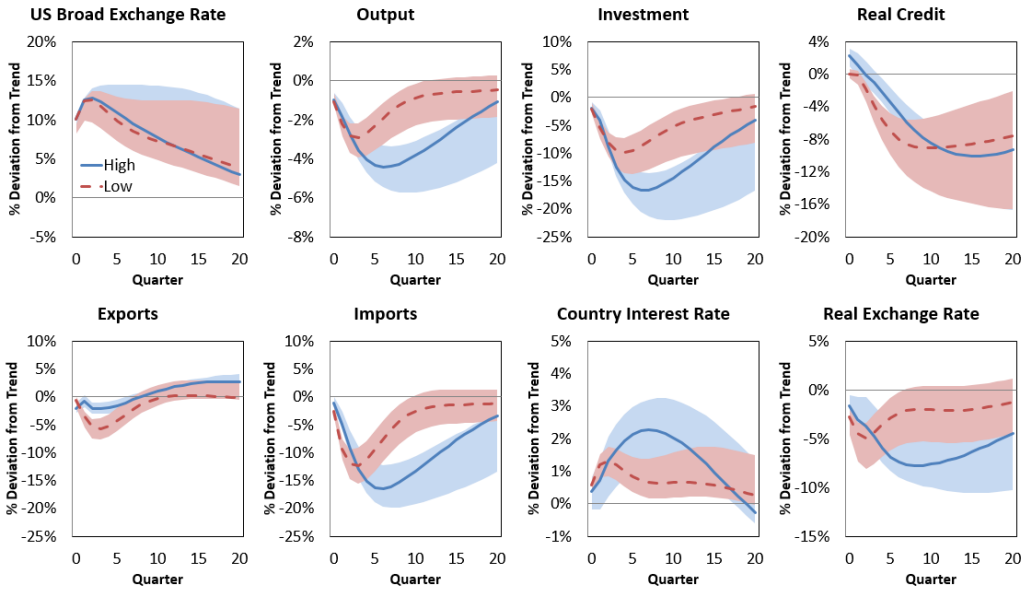

FIGURE 7: Dominant Currency Channel - Impulse response to a 10% dollar shock.
Note: Solid blue and dashed red lines show point estimates of impulse responses respectively for the group with relatively high exposure and that with relatively low exposure; light-blue and light-red shaded areas represent 68% (1 standard deviation) confidence bands for each group. Bootstrap confidence bands are based on 100,000 repetitions.

effects on imports are significantly smaller for countries that have a higher global value chain integration, i.e., a higher import content on exports. These results are consistent with a higher co-movement of exports and imports in countries with high integration into international supply chains, which mitigates the expansionary effect of the traditional channel.

For all subgroups shown thus far, the effects of dollar appreciations on EME GDP, investment, and real credit are negative, with a more pronounced contraction in countries with lower global value chain integration and higher dollar trade invoicing.[10] Thus, I move now to the other two channels, balance sheet vulnerabilities and lack of monetary policy credibility, which can revert the effects predicted by the traditional trade channel.

Figure 9 shows the results for the balance sheet channel. Again, both groups

[10]It is important to note that countries with lower global value chain integration and higher dollar trade invoicing are also mostly major commodity exporters, which usually suffer additional negative effects from dollar appreciations due to the negative effect from such an appreciation on commodity prices (see Cheng and Xiong (2014) for more details on the financialization of commodity markets and the relationship between commodity prices and the dollar).

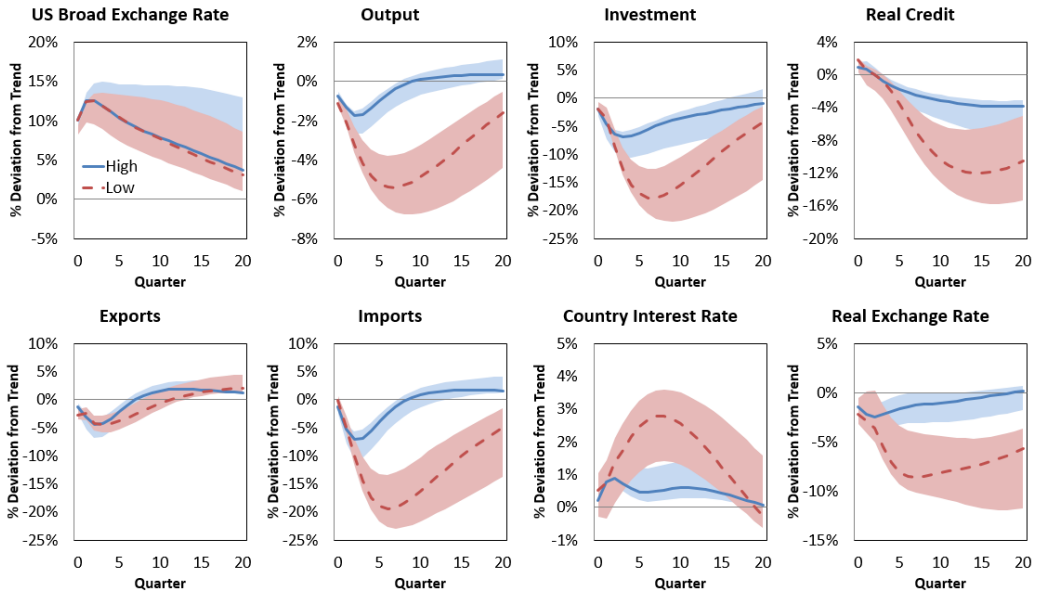

FIGURE 8: Global Value Chain Integration Channel - Impulse response to a 10% dollar shock.
Note: Solid blue and dashed red lines show point estimates of impulse responses respectively for the group with relatively high exposure and that with relatively low exposure; light-blue and light-red shaded areas represent 68% (1 standard deviation) confidence bands for each group. Bootstrap confidence bands are based on 100,000 repetitions.

have a contraction in GDP, investment, and real credit and an increase in sovereign spreads. Moreover, countries with a higher share of dollar credit in total credit to the private sector experience greater contractions in GDP, investment, imports, and credit than those with a lower share.[11] These results are consistent with adverse balance sheet effects being important in the transmission of dollar movements to EMEs.

Finally, Figure 10 shows the results for the monetary policy credibility channel. Countries with persistently higher inflation also experience greater contractions in GDP, investment, imports, and real credit and a much more pronounced increase in country spreads. These results indicate that lack of monetary policy credibility is also a relevant distinguishing factor in the transmission of dollar movements to EMEs.

[11]The greater contraction on imports could be related to the high share of imported capital goods on EME investment, as shown by Eaton and Kortum (2001).

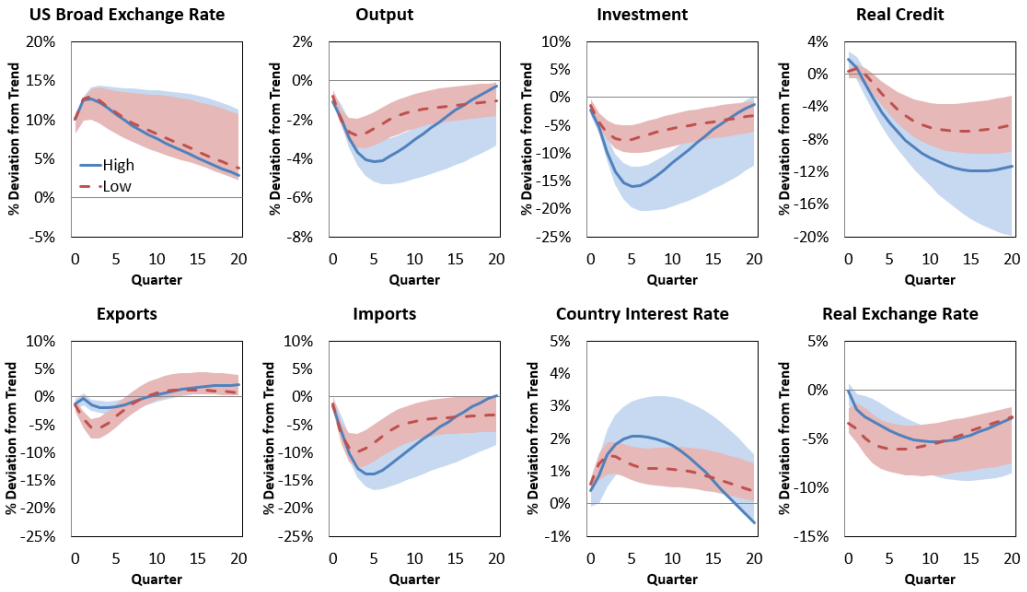

FIGURE 9: Balance Sheet Channel - Impulse response to a 10% dollar shock.
Note: Solid blue and dashed red lines show point estimates of impulse responses respectively for the group with relatively high exposure and that with relatively low exposure; light-blue and light-red shaded areas represent 68% (1 standard deviation) confidence bands for each group. Bootstrap confidence bands are based on 100,000 repetitions.

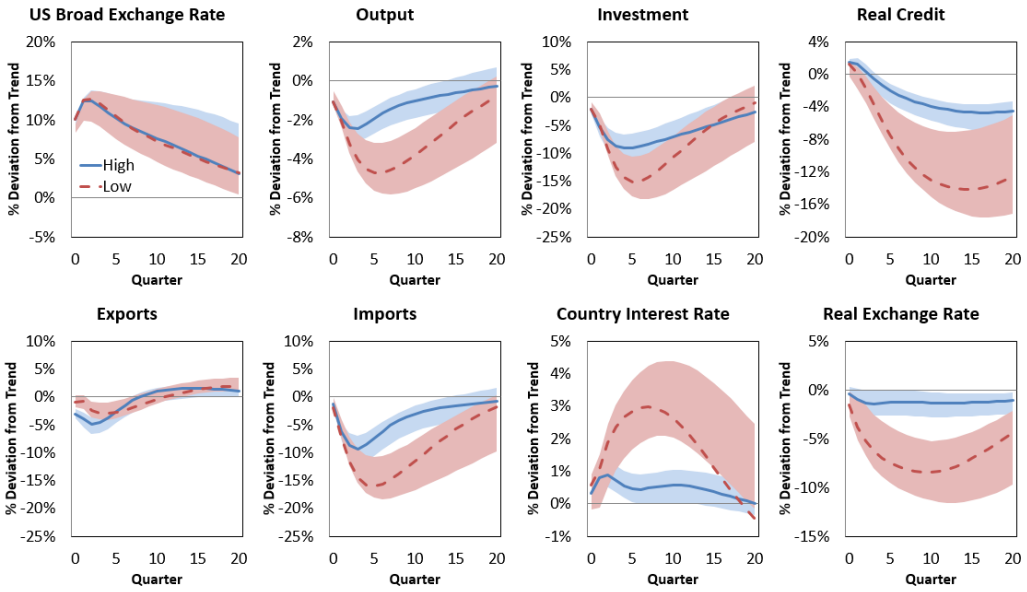

FIGURE 10: Monetary Policy Credibility Channel - Impulse response to a 10% dollar shock.
Note: Solid blue and dashed red lines show point estimates of impulse responses respectively for the group with relatively high exposure and that with relatively low exposure; light-blue and light-red shaded areas represent 68% (1 standard deviation) confidence bands for each group. Bootstrap confidence bands are based on 100,000 repetitions.

Altogether, the subgroup analysis indicates that all the channels emphasized in the recent literature that weaken or reverse the traditional trade channel - high dollar trade invoicing, integration into international supply chains, balance sheet vulnerabilities, and the lack of monetary policy credibility - are important for the transmission of dollar movements to EMEs. However, it is important to note that the subgroup analysis only separates one characteristic at a time and thus cannot speak to the relative importance of the different channels in a nested model.

5 Robustness Analysis

Robustness analysis confirm that the results hold under a host of alternative specifications which include (i) allowing contemporary effects of EMEs' real variables on the dollar and only lagged effects of the dollar on them and checking also the effects of EME output shocks on the dollar to evaluate the possibility of reverse causality; (ii) estimating the model only for the pre Global Financial Crisis period; (iii) including commodity prices in the panel VAR, having both contemporaneous and lagged effects or only lagged effects on the dollar; and (iv) estimating individual VARs for each EME. I describe below each robustness exercise, while the figures are shown in the appendix.

5.1 EME Feedback Effects on the Dollar

I reestimate the panel VAR allowing now for contemporary effects of EMEs' real variables - output and investment - on the dollar to check any potential feedback effects stemming from EMEs to the dollar. First, I check if the results of broad dollar shocks are different if EME variables are put before the broad dollar in the causal ordering. The impulse responses for all variables are almost identical, with just a smaller effect in the short run on EME GDP and investment as the initial impact is zero by construction (Figure B.1). However, both impulse responses end up mostly at the same level of the baseline estimation. Second, I also check if there is any sig-

nificant effect of EMEs' output shocks on the dollar. Confirming the results obtained for the dollar shock, EMEs' GDP shocks have a negligible effect on the dollar (Figure B.2).

5.2 Pre-Global Financial Crisis (GFC) Analysis

Lilley et al. (2019) document a correlation between changes in U.S. foreign bond holdings and the dollar that emerges since the GFC. Also, several proxies for global risk factors start to co-move strongly with the dollar and changes in U.S. foreign bond holdings around 2007, suggesting that risk plays a key role in this finding.[12] I thus check the robustness of my findings, estimating the model only up to the pre-GFC period, when this co-movement is not present.[13] Although the results for the U.S. GDP and U.S. real interest rate reverse, the results for EME variables all go in the same direction as in the baseline scenario, although they are quantitatively smaller for EME GDP, investment, imports, and real credit (Figure B.3). These results also indicate that even when the sources of dollar movements are different, dollar appreciations are contractionary for EMEs.

5.3 Commodity Price Effects on the Dollar

The subgroup analysis indicated that commodity exporters experience greater contractions after dollar appreciations, hinting that the connection between commodity prices and the dollar could be important to explain the contractionary effects of dollar appreciations, due to the negative relation between commodity prices and the dollar. I check that by including commodity prices in the panel VAR. The impulse responses are very similar to the baseline estimation, irrespective of whether we put the dollar before commodity prices in the causal ordering (Figure B.4) or the reverse (Figure B.5).

[12] I thank Stephanie Curcuru and Friederike Niepmann for pointing out this fact and suggesting this robustness exercise.

[13] I exclude Indonesia from the sample for this analysis because the country's sample would be too short.

5.4 Country-specific VARs

I estimate country-specific VARs to explore the cross-section of countries and evaluate the relation between the long-run effects on real activity and trade variables and the exposure indices. Broadly, the results are very similar to the subgroup analysis.[14] For dollar invoicing, we see, again, a stronger contraction in imports with higher dollar invoicing. For global value chain integration, a higher integration means again a smaller contraction of imports. Moreover, countries with a higher share of dollar credit and lower monetary policy credibility experience greater contractions in output, investment, and imports. Finally, exports are, again, broadly insensitive to dollar movements, regardless of country characteristics.

6 Conclusion

This paper evaluates the effects of dollar movements on emerging market economies. First, I estimate a panel VAR and show that dollar appreciations lead to contractions in GDP, investment and credit to the private sector and an increase in sovereign risk in EMEs. Moreover, a subgroup analysis shows that these results are true regardless of how we divide the countries, although the magnitudes vary across groups with different characteristics. These results suggest that the channels emphasized in the recent literature that weaken or reverse the traditional trade channel (high dollar invoicing, integration of supply chains, adverse balance sheet effects, and lack of monetary policy credibility) should be given greater attention.

The quantitatively small role of the trade channel and predominance of financial channels is coherent with previous works such as Bruno and Shin (2015). More recently, Hofmann, Shim, and Shin (2017) and Avdjiev et al. (2019) show that currency appreciations against the dollar lead to easier financial conditions, compressing sovereign bond spreads, and increasing dollar-denominated cross-border bank flows, which then lead to higher real investment. My results are consistent with these findings and show that there is also an interaction between financial vulner-

[14] Results for each individual country are available upon request.

abilities and the international trade system.[15] A more complete modeling of the interactions between these two channels is a promising avenue of work.

It is important to note that the results in this paper do not suggest that EMEs are better off with fixed or heavily managed currencies. Fixing or managing exchange rates have other negative effects, such as the loss of monetary autonomy and a higher risk of a balance of payment crisis due to volatile capital flows. In fact, Kalemli-Ozcan (2019) shows that free-floating EMEs are much more insulated from international risk spillovers than EMEs with managed floats. Thus, although I find fewer benefits from flexible exchange rates, these results do not change the fact that EMEs are still better off with flexible rather than fixed or managed exchange rates. A more clear policy implication stemming from this work would be to emphasize the need for improved institutions to lower countries' financial vulnerabilities such as better monetary policy implementation and possibly the use of macroprudential measures to limit "excessive" borrowing in foreign currency.

One important caveat is that this empirical model is agnostic about the exact sources of dollar movements. Although we likely can agree that EME developments themselves are not the major factor behind movements in the dollar, dollar movements related, say, to changing expectations about U.S. growth prospects, or fiscal policy changes, or monetary policy shifts may have different effects on EMEs, as emphasized in other works.[16]

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[15] Gopinath and Stein (2018) provide a unified explanation for the emergence of a dominant currency in both trade and financial dimension, emphasizing the strategic complementarity between the role of the dollar as unit of account and safe store of value and reinforcing the contractionary effects of dollar appreciations in EMEs.

[16] For the different spillover effects of U.S. monetary policy in emerging markets and advanced economies and its relation with global risk perceptions and EMEs vulnerabilities, see, for example, Kalemli-Ozcan (2019) and Iacoviello and Navarro (2019).

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A Data

The data set includes quarterly data for Argentina, Brazil, Chile, Colombia, Indonesia, Korea, Malaysia, Mexico, Peru, Philippines, South Africa, Thailand, Turkey, and the United States. The sample periods vary across countries. They are: Argentina, Brazil, Mexico, Philippines, South Africa and United States, 1996:Q1-2018:Q4; Turkey, 1996:Q2-2018:Q3; Malaysia, 1996:Q4-2018:Q3; Colombia and Peru, 1997:Q1-2018:Q3; Korea and Thailand, 1998:Q1-2018:Q3; Chile, 1999:Q2-2018:Q3; and Indonesia, 2004Q2-2018Q3.

U.S. Real GDP, U.S. Real Interest Rate, VIX, and Broad U.S. Dollar: all the data are from FRED. The U.S. real interest rate is measured by the interest rate on the 2-year U.S. Treasury bond minus a measure of U.S. expected inflation.

Real GDP, Real Investment, Real Exports, and Real Imports: all the data are from national accounts, deflated by each own deflator and seasonally adjusted using ARIMA X-12.

Real Credit: obtained by dividing nominal credit to the non-financial private sector by the CPI and seasonally adjusted using ARIMA X-12. For Argentina, Brazil, Chile, Indonesia, Korea, Malaysia, Mexico, South Africa, Thailand, and Turkey, nominal credit to the non-financial sector is obtained from the BIS at http://www.bis.org/statistics/totcredit.htm. For Colombia, Peru, and Philippines, nominal credit to the non-financial sector is obtained from each country's central bank. CPI is obtained from national statistical agencies.

Real Interest Rate: the country specific interest rate in the international financial markets, R, is measured as the sum of J. P. Morgan's EMBI+ sovereign spread and the U.S. real interest rate. EMBI+ is a composite index of different dollar-denominated bonds on four markets: Brady bonds, Eurobonds, U.S. dollar local markets, and

loans. The spreads are computed as an arithmetic, market-capitalization-weighted average of bond spreads over the U.S. Treasury bonds of comparable duration.

Real Exchange Rates: obtained from the BIS effective exchange rate indices database, particularly the quarterly average of the broad indices. Real EERs are calculated as geometric weighted averages of bilateral exchange rates adjusted by relative consumer prices. The weighting pattern is time-varying, and the most recent weights are based on trade in the 2008-10 period (see broad and narrow weights in http://www.bis.org/statistics/eer.htm). An increase in the index indicates an appreciation.

Import Content of Exports: I use the VAX ratio, which represents the value-added ratio in international trade, defined as the domestic value-added in gross exports divided by total gross exports, obtained from Johnson and Noguera (2012) and Johnson and Noguera (2017).

Share of Dollar in Trade Invoicing: for Brazil, Indonesia, Korea, Thailand, and Turkey, I obtain data from national sources. For Malaysia and South Africa, I obtain the data from Kamps (2006). For Argentina and Colombia, I obtain the data from Gopinath (2016). For Chile, I obtain the data from Labbe (2018) and Giuliano and Luttini (2019). For Peru, I obtain the data from Castellares (2017). For Mexico, the shares are proxied by data provided by the Bank of Thailand for trade flows between Mexico and Thailand.

Share of Credit to Non-Financial Private Sector Denominated in Dollars: obtained by dividing nominal credit to non-financial private sector denominated in dollars divided by total nominal credit to the non-financial private sector. For the credit denominated in dollars, I obtain the data for Argentina, Brazil, Chile, Indonesia, Korea, Malaysia, Mexico, South Africa, Thailand, and Turkey from the BIS Global Liquidity Indicators. For Colombia, Peru, and Philippines, nominal credit to

the non-financial sector denominated in dollars is obtained from each country's central bank. Total nominal credit to the non-financial private sector is obtained from the same sources used in the construction of real credit.

Inflation: all the data are from national statistical agencies.

B Robustness Analysis

B.1 EMEs Feedback Effects on the Dollar

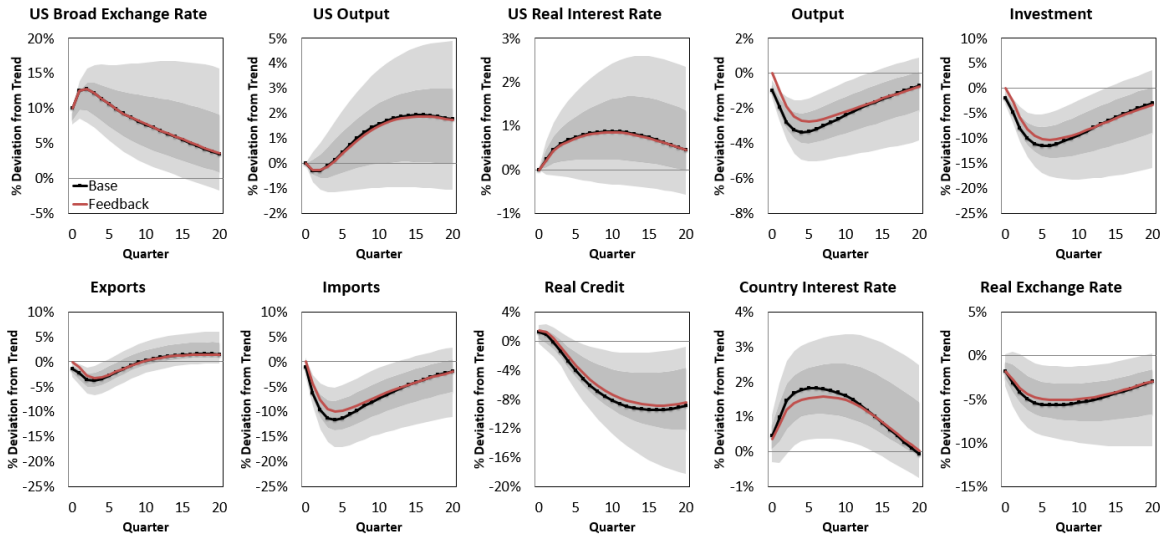

FIGURE B.1: Impulse response to a 10% dollar shock - Allowing Feedback Effects from EMEs. Note: Marked black and solid red lines show point estimates of impulse responses, respectively, for the baseline panel VAR and the panel VAR allowing for contemporary effects of EME real variables - output and investment - on the dollar; 68% and 95% confidence bands are depicted with dark-gray and light-gray shaded areas, respectively. Bootstrap confidence bands are based on 100,000 repetitions.

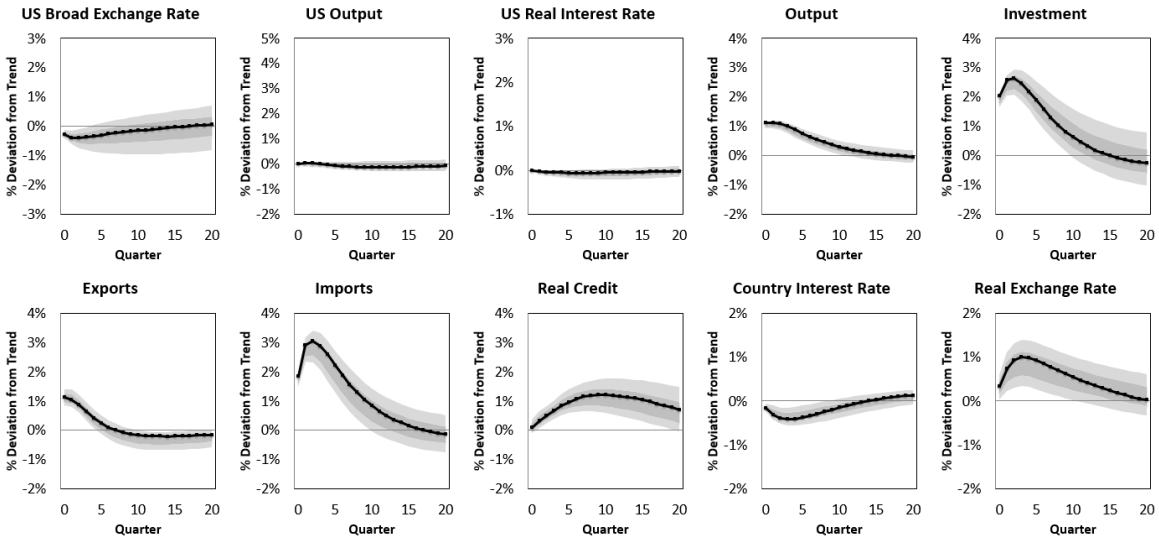

FIGURE B.2: Impulse response to a 1% EME GDP shock.

Note: Marked black lines show point estimates of impulse responses for the panel VAR allowing for contemporary effects of EME real variables - output and investment - on the dollar; 68% and 95% confidence bands are depicted with dark-gray and light-gray shaded areas, respectively. Bootstrap confidence bands are based on 100,000 repetitions.

B.2 Pre-Global Financial Crisis Analysis

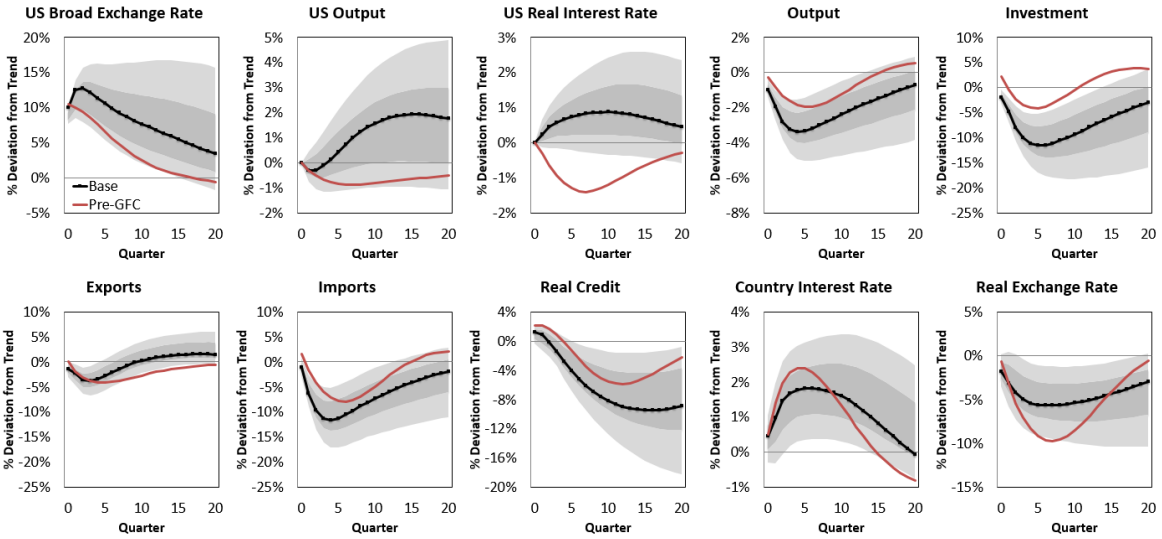

FIGURE B.3: Impulse response to a 10% dollar shock - Pre-GFC period.

Note: Marked black and solid red lines show point estimates of impulse responses, respectively, for the baseline panel VAR and the panel VAR estimated only for the pre-global financial crisis period; 68% and 95% confidence bands are depicted with dark-gray and light-gray shaded areas, respectively. Bootstrap confidence bands are based on 100,000 repetitions.

B.3 Commodity Price Effects on the Dollar

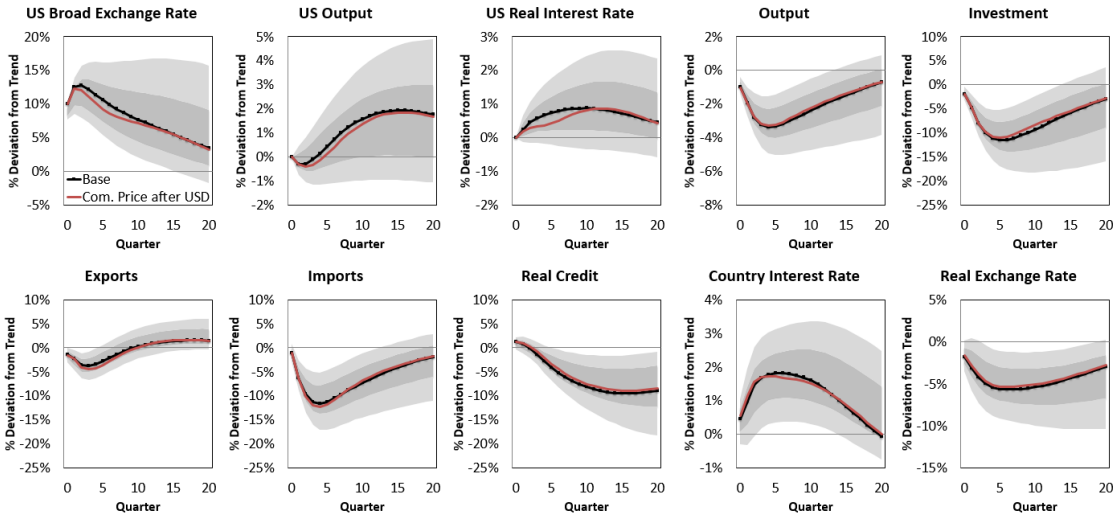

FIGURE B.4: Impulse response to a 10% dollar shock - Commodity Prices After the Dollar.
Note: Marked black and solid red lines show point estimates of impulse responses, respectively, for the baseline panel VAR and the panel VAR including commodity prices with the dollar before commodity prices in the causal ordering; 68% and 95% confidence bands are depicted with dark-gray and light-gray shaded areas, respectively. Bootstrap confidence bands are based on 100,000 repetitions.

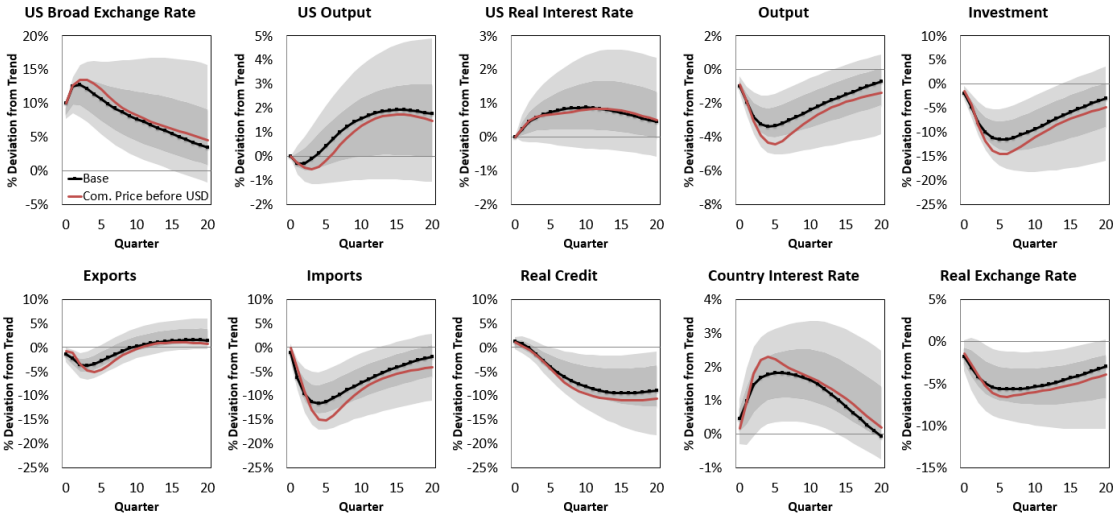

FIGURE B.5: Impulse response to a 10% dollar shock - Commodity Prices Before the Dollar.
Note: Marked black and solid red lines show point estimates of impulse responses, respectively, for the baseline panel VAR and the panel VAR including commodity prices with commodity prices before the dollar in the causal ordering; 68% and 95% confidence bands are depicted with dark-gray and light-gray shaded areas, respectively. Bootstrap confidence bands are based on 100,000 repetitions.