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Collateral Damage: Dollar Strength and Emerging Markets' Growth

by Pablo Druck, Nicolas E. Magud, and Rodrigo Mariscal

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Collateral Damage: Dollar Strength and Emerging Markets' Growth[1]

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Abstract

We document that, historically, although stronger growth in the U.S. increases growth in emerging markets, U.S. dollar appreciation (depreciation) cycles—which are highly persistent—mitigate (amplify) the impact on real GDP growth in emerging markets. We argue that the main transmission channel of the latter is through an income effect: as the dollar appreciates, commodity prices fall; weaker commodity prices depress domestic demand via lower real income; real GDP in emerging markets decelerates; and vice versa. These effects hold despite any potential expenditure-switching effect resulting from the relative (to the U.S. dollar) currency depreciation of emerging market economies. We also show the negative effect on emerging markets' growth of U.S. interest rates beyond the effects of the U.S. real exchange rate and real GDP growth. *Therefore, at the time of writing, emerging markets' growth is expected to remain subdued reflecting, intera alia, the expected persistence of the strong dollar and the anticipated increased in the U.S. interest rates*.

JEL Classification Numbers: E23, E32, F31, F41, F44.

Keywords: Dollar appreciation cycles, growth in emerging markets.

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I. INTRODUCTION

We document, using data for 1970–2014, that during periods of U.S. dollar appreciation, real GDP growth in emerging markets slows down. Symmetrically, U.S. dollar depreciations are associated with growth in emerging markets. We argue that the role of the multilateral value of the dollar can be directly tied to these different growth patterns. The main transmission channel is through an income effect owing to the impact of the U.S. dollar on global commodity prices.[2] As the dollar appreciates, dollar commodity prices tend to fall. In turn, weaker commodity prices depress domestic demand via lower real (dollar) income. Thus, real GDP in emerging markets decelerates. Moreover, we show that these effects hold despite any potential expenditure-switching effect resulting from the relative currency depreciation of emerging market economies when the U.S. dollar appreciates. We also show that despite controlling for the effects of the U.S. real exchange rate appreciation and real GDP growth, an increase in the U.S. interest rate further reduces growth in emerging markets. All these effects are stronger in countries with more rigid exchange rate regimes. Finally, although net commodity exporters are affected the most, countries that rely on importing capital or inputs for domestic production will also be affected—though marginally less. Therefore, at the time of writing, emerging markets' growth is likely to remain subdued reflecting, in part, the expected persistence of the strong dollar and the anticipated increased in the U.S. interest rates.

Why the U.S. real effective exchange rate? For developing countries, this is essentially an exogenous variable. Moreover, since most international transactions are priced in U.S. dollars, including commodity prices, and the fact that emerging markets (excluding perhaps China) cannot affect much the weights in the multilateral exchange rate of the U.S., developments in the U.S. will affect emerging markets—and not vice versa. Further, the independence of U.S. macroeconomic policy with respect to less developed countries, suggests that the U.S. real exchange rate is likely to be more relevant and even more exogenous that the terms of trade. On the margin, for example, the latter could be affected by domestic policies in emerging markets such as trade restrictions, exchange rate policies, or even monetary and fiscal policies.[3]

To this end, and to put the exercise below in perspective, we first characterize U.S. dollar appreciation and depreciation medium-term cycles from a historical standpoint.[4] Specifically,

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[2] Although not necessarily the only transmission channel. Some countries are not net commodity exporters. For the latter, either other income effects (such as remittances and trade) could play a role. Many emerging markets might benefit from a stronger growth in the U.S. and for most emerging markets, monetary policy in U.S. impacts on the cost of international financing costs.

[3] See also the discussion in Calvo and others (1993, 1996) on the relevance of push over pull factors to emerging markets.

[4] Thus, we abstract from short-term changes in the U.S. dollar and economic activity driven by other sources.

we show the dynamics of the U.S. real effective exchange rate and growth in emerging markets. We use South America's real GDP growth as an example—results holding for other regions. We observe in Figure 1 that there have been appreciating and depreciating cycles of the U.S. dollar. We will identify these cycles and their persistence more precisely below. Broadly speaking, we observe the following "decade-dynamics:"

1970s: The Oil shocks and easy U.S. monetary policy. The 1970s was a period of dollar depreciation with an expansionary U.S. monetary policy through low real interest rates, the latter hovering around 2 percent. Economic activity in the U.S. went through two recessions and stagflation. South America's real GDP growth was strong (averaging over 6 percent), on the back of two oil shocks that resulted in higher commodity prices more generally.

1980s: The Volcker disinflation. Following high inflation in the U.S., the Federal Reserve tightened monetary policy in the early 1980s, with real interest rates reaching 8 percent. As a result, the dollar appreciated and commodity prices dropped as the U.S. economy went into recession. Growth in South America was mediocre at best (about 2½ percent)—the 1980s in fact let to be known as Latin America's lost decade. Moreover, higher U.S. rates spilled over into an abrupt increase in the cost of international financing, triggering some countries to default on their international debts.

1990s: Clinton's (protracted) expansion. During the 1990s, particularly following the 1993 U.S. recession, we witnessed a sustained period of strong growth in the U.S.—one of the longest periods of U.S. economic expansion in recent economic history. U.S. real interest rates were higher than in the 1970s, yet lower than those in the 1980s. Commodity prices were mostly weak during this decade. Real GDP growth in South America also depicted intermediate values (close to 3 percent). Yet, given the host of structural reforms implemented in the region in the early years of the decade, it is at least suggestive that growth has not been stellar.

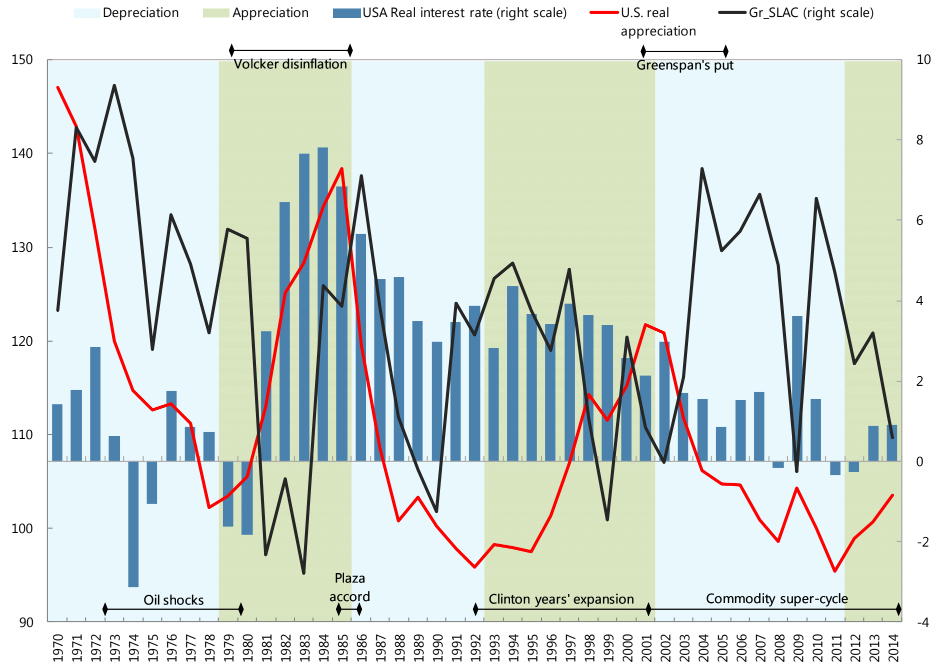
2000s: Greenspan's put and the resurgence of strong commodity prices. The 2000s came with low real interest rates (the so-called Greenspan's put), a depreciating dollar, and strong commodity prices on the back of strong external demand, particularly from China. South America's growth bloomed, growing about 4¼ percent—until the 2008–9 global financial crisis.

2010s: A strong dollar, again. More recently, the dollar has been appreciating, particularly since mid-2014. Commodity prices have weakened, and their prospects (at the time of writing) are to remain subdued into the medium term.[5] How would this environment fare for emerging markets? The simple "(hi)story" described above would suggest a period in which real GDP growth in emerging markets would be low. Economic activity in emerging markets

[5] In part, owing to an increase in oil supply. See Husain and others (2015).

in fact has been decelerating recently, for various reasons. Will the U.S. dollar be, again, one of those factors weighing on emerging market growth going forward?

Figure 1. A Historical Perspective of U.S. Real Exchange Rate Cycles



The latter is the question that we address in this paper. In fact, if history is an indication, the answer appears to be yes, at least based on the connection found between the dollar and weaker growth in emerging markets.[6] Given that U.S. dollar appreciation and depreciation cycles are highly persistent, subdued growth might hover around emerging markets in the short- to medium-term. To support this claim, after systematically identifying appreciation and depreciation cycles, we document some general stylized facts of these cycles. These stylized facts do suggest that in spite of strong U.S. growth boosting external demand for emerging markets, this effect will be mitigated by the strong dollar going forward. We then add more structure, by way of documenting these facts by using event analysis. We also study the possible channels of transmission. Finally, we support these stylized facts and event analysis by a few econometric exercises. We also develop a simple model to understand the mechanics of changes in U.S. real exchange rates on economic activity in EME, including the transmission channel. The latter is particular strong for commodity exporters. To a lesser extent, it is also relevant for countries that rely heavily on imports of capital and inputs to produce domestic goods.

[6] In fact, the U.S dollar appreciated about 13 percent between April 2014 and April 2015, while average emerging market and developing economies growth for 2015 has been revised down by over 1 percent. See 2015 IMF's *World Economic Outlook*.

Frenkel (1986) provides theoretical support that this transmission channel can operate, for example, through commodity prices. He shows that U.S. monetary easing—usually related to a more depreciated U.S. dollar—results in higher commodity prices, and vice versa. Dornbusch (1986) and Borensztein and Reinhart (1994) and Akram (2009) show that nominal and real commodity prices depend negatively on the U.S. real exchange rate. Zhang and others (2008) show that a stronger U.S. dollar lowers the real price of oil.

Engel and Hamilton (1990) have long ago documented the long swings in dollar values.[7] However, we are not aware of any systematic evidence of the link between the strength of the U.S. dollar and economic activity in emerging markets over the dollar cycle—less so of any study documenting the transmission channel. We try to bridge this gap in this paper.

The rest of the paper is organized as follows. The next section identifies U.S. dollar appreciation and depreciation cycles and then presents the stylized facts and the event analysis. Section III proposes a simple model to understand the dynamics of the stylized facts and the transmission channel, while Section IV tests these results econometrically. Section V concludes.

II. Stylized Facts

In this section we document some key stylized facts using annual data for 63 emerging market and developing economies spanning over the period 1970–2014.[8] We show some time series data as well as some event analysis. The main (exogenous) driving force is the appreciation/depreciation of the U.S. multilateral real exchange rate. In particular, we look into the impact of the U.S. real effective exchange rate on real GDP and domestic demand dynamics in emerging market economies. We identify these U.S. dollar appreciation and depreciation cycles using a Markov-switching regime change framework. We then use these identified cycles to highlight the stylized facts and the event analysis. Finally, we also use the identified cycles for the econometric exercise below.

A. Identifying U.S. Dollar Appreciating and Depreciating Cycles: Markov Switching

Given two states of nature (as has been commonly used in the exiting literature), that we label appreciation and depreciation, we proceed to estimate the transitions from one state to the other. Using annual data from *International Financial Statistics* (IMF) for the period 1970–2014, we estimate a simple Markov-switching model with two regimes:

$$\text{Regime 1: } \Delta\, reer_t = \mu_1 + \gamma I_{2009} + \varepsilon_t, \quad \varepsilon_t \sim N(0,\sigma^2)$$
$$\text{Regime 2: } \Delta\, reer_t = \mu_2 + \gamma I_{2009} + \varepsilon_t, \quad \varepsilon_t \sim N(0,\sigma^2)$$

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[7] For a recent update see Chinn's (2015) Econobrowser piece.

[8] See the annex for a list of countries.

We call Regime 1 "appreciation" and Regime 2 "depreciation." $\Delta\, reer_t$ stands for the growth rate of the real effective exchange rate of the U.S. (REER). $\mu_{1,2}$ is our parameter of interest and tells us the average growth rate of the REER in each regime—our hypothesis being that this coefficient is different in each regime and statistically significant. We include an impulse dummy for year 2009 to account for the global financial crisis, I_{2009}. The number of regimes is arbitrary but the transition periods are estimated by the model. Table 1 shows the results.

Table 1. U.S. Dollar Appreciation Cycles

	Left-hand varible		Right-hand variable		Sigma
			Mu	I (2009)	
Regime 1	Δ REER	Coeff.	3.17	9.48	3.54
(Appreciation)		t-stat	3.07	2.55	7.89
		p-value	0.00	0.02	0.00
Regime 2	Δ REER	Coeff.	-3.76	9.48	3.54
(Depreciation)		t-stat	-4.06	2.55	7.89
		p-value	0.00	0.02	0.00

Descriptive statistics for scaled residuals:
Normality test: Chi^2(2) = 5.5771 [0.0615]
ARCH 1-1 test: F(1,37) = 0.41741 [0.5222]
Portmanteau(6): Chi^2(6) = 10.635 [0.1003]

Regime 1	years	avg.prob.
1979 - 1985	7	0.909
1993 - 2001	9	0.896
2012 - 2014	3	0.897

Total: 19 years (42.22%) with average duration of 6.33 years.

Regime 2	years	avg.prob.
1970 - 1978	9	0.961
1986 - 1992	7	0.912
2002 - 2011	10	0.936

Total: 26 years (57.78%) with average duration of 8.67 years.

Transition probabilities

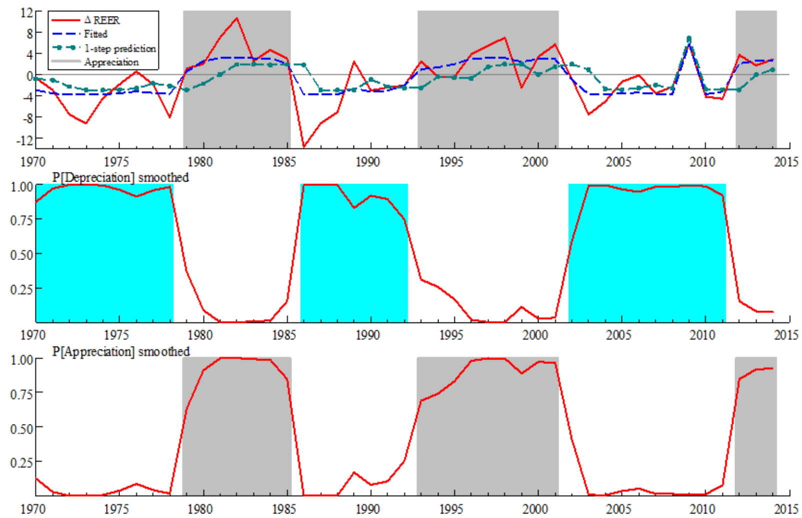
	Regime 1, (t)	Regime 2, (t)
Regime 1, (t+1)	0.833	0.124
Regime 2, (t+1)	0.167	0.876

It is worth highlighting the following from Table 1. First, note that there is a difference in the average growth rate and in the duration of the regimes. Real depreciation has been, on average, stronger and lasted longer than real appreciation. We estimate a real annual average appreciation of 3.2 percent per year with an average duration of over 6 years and a real average annual depreciation of 3.8 percent with an average duration of close to 9 years. This pattern captures the downward trend observed in the REER.[9] Second, and more important, these regimes are very persistent. Thus, periods of depreciation are more likely to be followed by depreciations and periods of appreciation by subsequent appreciations. In particular, we estimate that a period of real appreciation is 83 percent more likely to remain appreciating in the following period than to switch regimes. For real depreciation, the

[9] The Annex replicates the estimations in Table 1 excluding the current appreciation cycle, to assess if the shorter duration of appreciation cycles is driven by the ongoing event. In that exercise we find that appreciation cycles are shorter than depreciation cycles, but not as much as in Table 1. The average length is about 8 years. The average annual appreciation rate is 3.4 percent, and the average annual depreciation rate is 3.7 percent. The identification of past cycles holds.

probability of continuation of the state of nature is about 88 percent.[10] This finding has been interpreted in the literature as resulting from the transactions cost or tendency for traders to wait for sufficient large arbitrage opportunities.[11] Figure 2 shows the growth rate of the REER and the estimated regimes with the smoothed transition probabilities.

Figure 2. U.S. Effective Exchange Rates Appreciation/Depreciation Cycles and Transition Probabilities



The Markov switching regime estimation identifies the following appreciation and depreciation cycles of the U.S. dollar, summarized in Table 2. The analysis in the rest of the paper is based on these identified appreciation and depreciation cycles.[12]

Table 2. U.S. Appreciation and Depreciation Cycles

Depreciation Cycles	Appreciation Cycles
1970–1978	1979–1985
1986–1992	1996–2001
2002–2011	2012–2014

[10] The results from excluding the current appreciation cycle implies a slightly higher persistence of depreciation cycles (92 percent), and similar expected persistence for appreciation cycles (82 percent).

[11] See, for example, Taylor, and others (2001) and the references therein. Other explanations of real exchange rate persistence include, for example Rogoff (1996) and references therein.

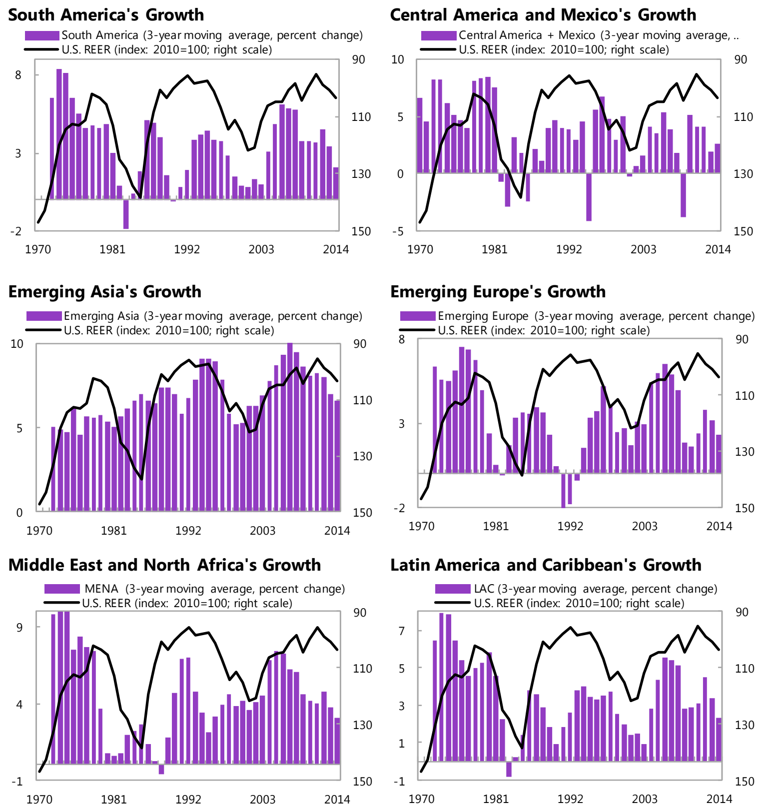
[12] The period 1992–1995 appears to be part of neither cycle. Thus, we have excluded it to avoid arbitrarily assigning to either the depreciation cycle ending in 1992 or the appreciation cycle starting in 1996.

B. Stylized Facts

Based on the appreciation and depreciation cycles of the U.S. dollar identified above, the first salient stylized fact is the strong co-movement between the U.S. dollar and economic activity in emerging market economies. Figure 3 shows the U.S. real effective exchange rate (REER) and real GDP growth in different emerging market regions. We look into Latin America, emerging Asia, emerging Europe, and the Middle East and North Africa regions. We further split Latin America into South America and Central America plus Mexico. The latter is relevant given the particularly different production structures, and the trade and financial links to the U.S. South American countries are mostly commodity exporters with limited exports to the U.S., while Central American economies and Mexico have tighter relations to the U.S., not only through trade but also via tourism and remittances' flows. Specifically, we observe the following stylized facts.

Stylized Fact I: Stronger U.S. dollar, lower emerging markets' growth. We observe that periods of U.S. dollar appreciation coincide with softer real GDP growth rates throughout emerging market regions (Figure 3). Symmetrically, a more depreciated U.S. dollar is associated with stronger economic activity in emerging markets. This stylized fact is especially strong for regions that are strong net commodity exporters. Specifically, across regions we observe a strong co-movement in Latin America (particularly for the net commodity exporters of South America), as well as for emerging Asia, and to a lesser extent countries in the Middle East and North Africa. The links appear to be somewhat weaker for emerging Europe.

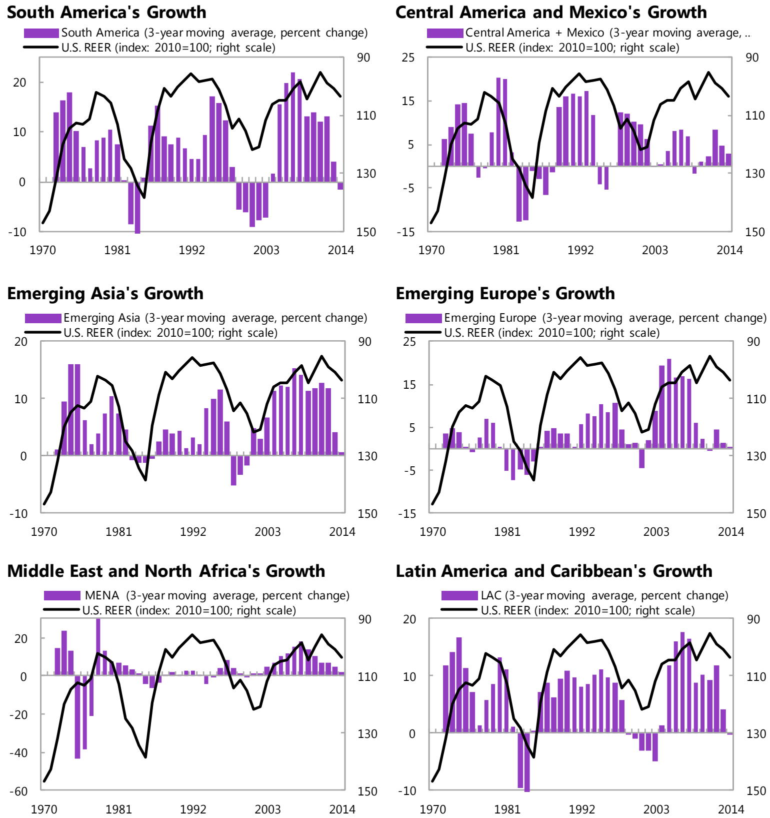
Figure 3. U.S. Dollar Strength and Real GDP Growth in Emerging Markets



Sources: IMF, *World Economic Outlook;* and IMF, *International Financial Statistics;* and IMF staff calculations.
Note: REER = Real Effective Exchange Rate. Increase = depreciation.

Stylized Fact II: Stronger U.S. dollar, softer real domestic demand growth. Figure 4 presents a similar picture as Figure 3, but using the growth rate of real domestic demand. It suggests that domestic demand is a strong driver of economic activity, beyond other factors that might impact on domestic demand. In turn, we show below that domestic demand seems to be affected by the purchasing power of the real exchange rate (an income effect). We argue that this is behind the transmission channel of the U.S. real exchange rate activity in emerging and developing countries. Notice that the impact on domestic demand appears to be weaker for MENA (more below), while stronger for Latin America (both Central America and Mexico and South America). Emerging Asia and emerging Europe seem to be in an intermediate range.

Figure 4. U.S. Dollar Strength and Real Domestic Demand Growth in Emerging Markets

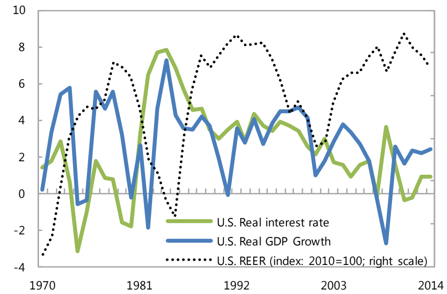


Sources: IMF, *World Economic Outlook;* and IMF, *International Financial Statistics;* and IMF staff calculations.
Note: REER = Real Effective Exchange Rate. Increase = depreciation.

Naturally, the stylized fact above poses the following question: what is the driving force behind the dollar appreciation? Are there higher interest rates or stronger growth in the U.S., or both? And, does it matter for economic activity in emerging market economies? These questions are relevant to understand the transmission channel resulting from the strength of the U.S. dollar. Presumably, robust economic activity growth in the U.S. (owing to underlying shocks, e.g., productivity, etc.) should increase external demand (directly, or indirectly through other countries) to emerging markets. However, higher U.S. interest rates would increase financial costs, reducing economic activity in emerging markets. These two channels are documented next.

Stylized Fact III: Higher U.S. interest rates, a more appreciated U.S. dollar. Figure 5 shows that periods of higher interest rates in the U.S. tend to occur alongside a stronger dollar, and vice versa. Higher interest rates in the U.S. would increase capital inflows to the U.S. searching for higher yields (especially given the reserve currency nature of the U.S. dollar), appreciating the currency. Lower interest rates, which increase the opportunity cost of financial investment, would tend to depreciate the U.S. dollar on the back of capital outflows. However, oftentimes, higher interest rates are also associated with stronger growth, though not always. The latter is captured in Stylized Fact IV.

Figure 5. U.S. Dollar Strength, Real GDP Growth, and Real Interest Rates



Sources: IMF, *World Economic Outlook*; and IMF, *International Financial Statistics;* and IMF staff calculations.
Note: REER = Real Effective Exchange Rate. Increase = depreciation.

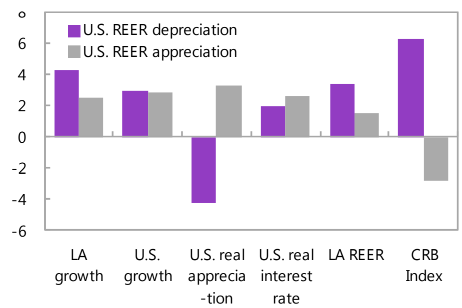
Stylized Fact IV: though not systematic, higher U.S. interest rates appear to be associated with stronger U.S. growth. Depending on the time period, we observe that there have been times of a tight interest rate-economic activity relationship. Stronger growth eventually generates demand-induced inflationary pressures when domestic demand closes the output gap. Lack of sufficient (or fast enough) supply response (i.e., excess demand) translates into higher prices. The latter triggers the Federal Reserve into tightening its monetary policy, which has been usually implemented by raising the Fed funds interest rate. To the extent that this interest rate increase spills over to wholesale and individual borrowing costs, it tends to mitigate inflationary pressures through slower economic activity growth—owing to the tighter credit conditions. In the event, as the U.S. economy grows faster, interest rates tend to increase to mitigate business cycle volatility and inflation dynamics, while anchoring inflation expectations. That said, however, there have been other periods in which the relation activity-interest rates weakened.

Based on the above stylized facts, we infer that the co-movement between U.S. dollar strength and EMs growth goes beyond the impact of U.S. interest rates and real GDP growth. In particular, faster U.S. growth benefits emerging markets' growth; but less less so when U.S. real interest rates increase and especially, when the dollar is stronger. However, to better gauge and compare the findings in the stylized facts above, we construct averages of several variables during the identified appreciation and depreciation cycles. Specifically, for each set of episodes of appreciation and depreciation of the U.S. dollar we compute the average of: the real GDP growth rate of emerging market regions, the real GDP growth of the U.S., the appreciation/depreciation throughout episodes, the U.S. real interest rate, the real effective exchange rate, and a commodity price index. This provides us with the average response in each of these variables during appreciation and depreciation cycles (as per Table 2), respectively.

Stylized Fact V: Stronger dollar, slower emerging market growth driven by weaker commodity prices. We observe in Figure 6 that, during episodes of appreciation and of depreciation of the U.S. dollar, average real GDP growth in the U.S. is about the same. Real interest rates, though slightly higher during appreciation periods, are not substantially different. However, growth rates of real GDP (in this case, without loss of generality, using

Latin America as an example) are much stronger when the U.S. dollar is more depreciated—thus weaker during periods of a stronger U.S. dollar. Real exchange rates in Latin America tend to be less appreciated when the dollar is stronger. Strikingly, along with weaker growth in Latin America, when the U.S. dollar is in an appreciating cycle, the price of commodities is weaker (and vice versa).

Figure 6. Appreciation and Depreciation Cycles



Sources: IMF, *World Economic Outlook;* and IMF, *International Financial Statistics;* and IMF staff calculations.
Note: CRB = Commodity Research Bureau (commodity price index). REER = Real Effective Exchange Rate. U.S. real interest rates are 10-year treasury rates deflated by observed annual inflation.
[1] Appreciation and depreciation cycles defined by peak-to-trough long-term trend changes in U.S. real effective exchange rate. Depreciation cyles: 1970-78, 1986-92, and 2002-11. Appreciation cycles: 1979-1985, 1996-2001, and 2011-13. Bars show average percent change per annum. See Druck and Magud 2015 for details.

Furthermore, we argue that an important channel for the income effect owing to a stronger U.S. dollar results from the "depreciation" of commodity prices with respect to the dollar.[13] A lower dollar purchasing power of commodity exports reduces a country's (dollar) real income. In turn, the economy being poorer, this would negatively affect domestic demand, and thus economic activity. Figure 7 shows such purchasing power, computed as follows.[14] Recall that the real effective exchange rate is essentially computed as the nominal exchange rate times the (export-share) weighted consumer price index of a country's trading partners, and divided by the domestic country's consumer price index. We re-compute the purchasing power of a country by the commodity terms of trade real effective exchange rate. Simply put, we replace each country's weighted consumer price indices by the (trade-weighted) commodity terms of trade of each country.[15] We observe that when commodity prices

[13] Think, for instance, of commodity prices as the price of any other asset. A stronger U.S. dollar implies that the dollar appreciates with respect to any other asset, including commodities. Thus, commodity producers receive less dollars per unit exported. For a theoretical example, see Frenkel (1986), documented in Akram (2009).

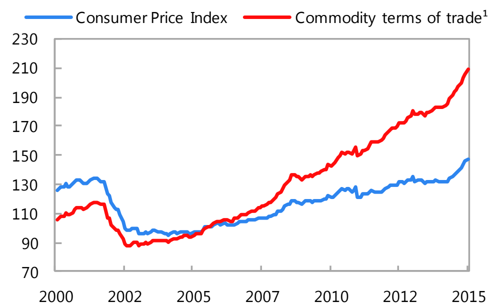
[14] Results for each individual country in this chart and for other emerging market economies are available from the authors upon request.

[15] Commodity terms of trade are from Gruss (2014). They are computed as the net commodity prices of a country, where the weights of each commodity come from that country's bilateral trading weights, taking into account the country-specific basket for exports and imports for each country.

increase, the commodity REER, which is a measure of the economy's purchasing power of goods and services, increased beyond the standard REER. Likewise, weaker commodity terms of trade result in lower purchasing power than the usual REER.

Figure 7. Purchasing Power of Commodity Real Exchange Rates

South America and Mexico: Real Effective Exchange Rates
(Index: 2005=100)



Sources: IMF, *Information Notice System;* and IMF staff calculations.
Note: South America = Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Mexico, Paraguay, Peru, Uruguay, and Venezuela.
[1] Calculated using net commodity terms of trade data based on Gruss 2014 (instead of domestic consumer price indices) for the partner countries.

C. Event Analysis

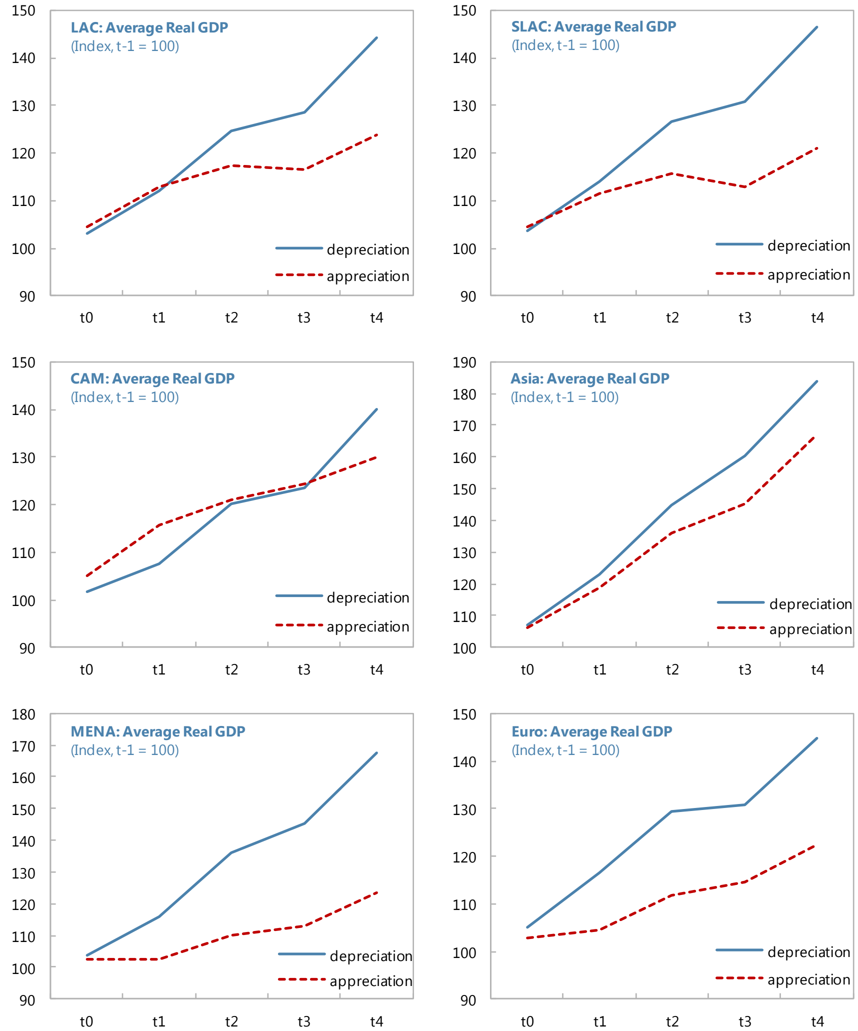
Next we add dynamics to the average depreciation and appreciation cycles, based on event analysis. For each of the identified cycles listed in Table 2 we do the following in order to construct the events. First, given that each event is not necessarily of the same period length, we discretize the length of each event. To this end, let us call period t_0 the first observation in any appreciation or depreciation cycle and (the real GDP) observation in the last year of the appreciation or depreciation cycle as t_4. Let us standardize real GDP in period t_{-1} equal to 100. Given the data for real GDP growth rates for each (PPP-weighted) real GDP, we reconstruct the indexed real GDP for each region. We discretize the time-space to compute the real GDP index at the half-life of each event, as well as at quarter-life and three-quarter-life. Last, we compute basic statistics across each set of appreciation and depreciation episodes at t_0, ¼, ½, and ¾ and t, respectively (which we label as t_0, t_1, t_2, t_3, and t_4, respectively). Figure 8 shows these indices for the average real GDP during appreciation and depreciation episodes.

We repeat this process using an index of real domestic demand. We present these event analysis in Figure 9.

Notice that except for Central America and Mexico, every other emerging market region shows that real GDP is lower during periods of U.S. dollar appreciation. We observe that this pattern holds for Latin America as an aggregate, and especially for South America. The latter is a strong commodity exporter—unlike Central America and Mexico. It also holds for emerging countries in the Middle East and North Africa Region (MENA), as well as for emerging Europe. Although to a lesser extent, it also true for emerging Asia. The effect is economically meaningful (we will assess its statistical significance below). The event analysis suggests that, on average, Latin America's slower growth results in real GDP being about 25 percent lower toward at end of the cycle during appreciation cycles than during depreciation cycles. South America's differences are of similar order of magnitude. They are even higher in MENA countries—about 50 percentage points, while lower in Emerging Asia, though still sizeable (at about 20 percentage points). There is not such a marked difference in Central America and Mexico—thus our claim in the introduction to split Latin America, as in here. Among the possible causes of these marked differences, the strong links via trade, tourism, and remittances appear to be relevant. The trade link operates through the external demand for goods. Tourism boosts external demand for services. And remittances transfer resources from the U.S. to Mexico, Central America, and the Caribbean. All these factors help increase domestic demand and income in the emerging and developing countries. Thus, they could offset any negative income effect owing to the stronger dollar. Countries with hard exchange rate pegs or outright dollarization are further synchronized with the U.S.' business cycle (e.g., Ecuador, El Salvador, and Panama). These features are considered in the model below. Depending on whether the net income effect dominates the expenditure-switching effect or not, a stronger U.S. dollar will be expansionary or contractionary for the EME—conditional on other factors, such as U.S. real GDP growth.

Moreover, this regional separation will also be exploited in the econometric exercise below, elaborating on how trade, remittances and tourism links affect the impact of dollar strength to economic activity in emerging markets. This will shed some light in the strength of the external demand vs. income effects in each region and (for Latin America) sub-regions.

Figure 8. Real GDP During U.S. Dollar Appreciation and Depreciation Cycles



Source: authors' calculations.

Figure 9 documents the strikingly different impact on domestic demand during U.S. dollar appreciation and depreciation cycles. Except for Central America and Mexico, all other regions and sub-regions experience much stronger real domestic demand growth when the U.S. dollar is more depreciated. In fact, in many of the regions domestic demand actually decreases or remains flat. We take this as a powerful indication of the negative impact of a stronger dollar on the purchasing power of domestic demand. In turn, this could suggest that it might be the case that the income effect actually dominates the (expenditure-switching) substitution effect in some cases.

Figure 9. Real Domestic Demand During U.S. Dollar Appreciation and Depreciation Cycles

Source: authors' calculations.

To sum up, we have documented that during periods of U.S. dollar appreciation, regardless of whether the stronger dollar results from monetary tightening and/or faster growth in the U.S., commodity prices are weaker, and emerging markets grow at a slower pace, especially domestic demand. We argue that behind these dynamics there is an income effect, in which commodity net exports' unit prices that lowers emerging countries' income soften domestic demand, and thus real GDP. In the next section, we present a simple model along these lines, which is then tested econometrically in the following section.

III. Theoretical Framework: A Sketch

In this section we present a simple theoretical model. We show that the impact of a change in the U.S. real exchange rate on domestic demand and on real GDP in a small open emerging market economy is ambiguous. The latter depends on the flexibility to substitute among consumption goods in the utility function for the response of domestic demand, while the supply of domestic goods hinges on the ability to substitute factors of production. This ambiguity, in turn, implies that in the end the actual impact of changes in the U.S. dollar strength is an empirical issue—that we tackle in the next section.

A. Supply Side

Suppose an economy that produces two goods: nontradable goods, *N*, and home tradable goods, *H*, in a perfect competition environment. Prices of each good, p^N and p^H, are taken as given. Thus, in equilibrium firms earn zero profits. Without loss of generality, assume an increasing and concave production function for nontradable goods, using labor (which is supplied inelastically) as the only input in production; namely:

$$y_t^N = g\left(L_t^N\right); \qquad g'(\bullet) > 0; \qquad g''(\bullet) < 0 \tag{1}$$

The production function of *H* goods uses labor and imports, *M*, to produce (which, for example, could be considered as either foreign capital or foreign inputs not available in the domestic economy,). It is given by:

$$y_t^H = f\left(L_t^H; M_t\right); \qquad f_L > 0; \qquad f_M > 0; \qquad f_{LL} < 0; \qquad f_{MM} < 0 \tag{2}$$

implying an increasing marginal product of each factor, at a decreasing rate. Owing to perfect competition and taking as given prices of goods and services and factors of production, optimally,

$$\frac{f_L}{f_M} = \frac{w}{p^M} \tag{3}$$

for the *H* good and $g_L = w$ in the *N* sector. The marginal rate of transformation equals factors' relative price. Thus, the price of *H* goods, p^H, is a function of the prices of the inputs which are the wage rate, *w*, and the price of imports, p^M:

$$p_t^H = \Gamma\left(w_t; p_t^M\right) \tag{4}$$

Likewise, for the nontradable goods production, p^N:

$$p_t^N = \Pi\left(w_t\right) \tag{5}$$

B. Domestic Demand

Regarding domestic demand, assume a standard well-behaved concave utility function, in which the representative agent derives utility from consuming nontradable goods, c^N, home goods, c^H, and imports, c^M. Labor income is the only source of income to the representative consumer. Thus, the agent's optimization problem is given by

$$\max_{c^N, c^H, c^M} \quad u\left(c^N; c^H; c^M\right) \tag{6}$$

subject to the budget constraint

$$wL = p^N c^N + p^H c^H + p^M c^M; \qquad L = L_N + L_H \tag{7}$$

In equilibrium, the marginal rate of substitution between each type of good needs to equal the relative price, namely

$$\frac{u_M}{u_N} = \frac{p_M}{p_N}; \qquad \frac{u_M}{u_H} = \frac{p_M}{p_H}; \qquad \frac{u_H}{u_N} = \frac{p_H}{p_N} \tag{8}$$

C. Market Clearing Conditions

Nontradable goods, by definition, exhaust production: $c^N = y^N$. Home goods can be either consumed by domestic residents, or exported. Given demand for export, *X*:

$$y^H = c^H + X \tag{9}$$

where the trade balance is $p^H X = p^M \left(c^M + M\right)$.

For inelastically supplied imports, M^S, the equilibrium implies $M^S = M + c^M$. The demand for exports is an increasing function of the purchasing power of the U.S., p^M/p^H, i.e., $X = X\left(p^M / p^H\right)$; with $X' > 0$.[16] Lastly, the price of tradable goods, p^H and p^M, are exogenously set in international markets.

D. Response to a U.S. Appreciation Shock

One easy way to represent a real appreciation of the U.S. dollar is given by an increase in the purchasing power of the U.S. dollar, which implies a lower relative price of U.S. imports (which are emerging markets exports, i.e. *H* goods). Thus, a higher p^M/p^H.

In other words, the external shock is given by a deterioration of the terms of trade for the emerging market economy. This represents a decrease in the purchasing power of home goods to acquire imports. Mirroring the change U.S. appreciation, this increase in the relative

[16] Other factors could affect export demand, such as foreign income. Thus, the model is conditional on those other potential factors.

price of emerging markets imports, p^M/p^H, can be represented by an increase in the price of imports ($\Delta p^M > 0$), holding the price of home goods constant ($\Delta p^H = 0$).

For the representative firm producing home goods, the degree of substitutability between its factors of production is key. If the production function is of the *Leontieff* type, with given constant proportions of factors of production (i.e., with no substitutability of factors of production), the change in relative prices between imports and home goods requires lower wages in equilibrium. In this case optimality condition (3) can be specified as:

$$p^H = a_{HL} w + a_{HM} p^M \tag{10}$$

Where a_{ij} is the contribution of factor j to produce good i. Given the change in relative prices $\Delta p^M > 0$, $\Delta p^H = 0$, then (10) can be expressed as

$0 = a_{HL} \Delta w + a_{HM} \Delta p^M$, which results in $\Delta w = -\frac{a_{HM}}{a_{HL}} \Delta p^M \Rightarrow \Delta w < 0$.

The above shows that for this specific production function, the constant coefficient implies that to be able to produce at the new exogenous price, when firms face higher prices for their imports, in equilibrium they need to pay lower wage rates. In fact, the constant coefficient technology implies that higher import prices reduce the demand for imports, which in turn requires a decrease in the demand for labor. The latter, in equilibrium, decreases wages. Therefore, this results in a negative income effect for consumers.

Having more flexibility in the production function in terms of combinations of imports and labor would reduce the use of imports and increase the use of labor along any isoquant. In the latter production function, however, for labor demand to increase, in equilibrium, wages need to decrease given the constant marginal rate of substitution, as shown in (3). Only in the limit, as $\lim_{M \to 0} f_L = \infty \Rightarrow \Delta w = 0$, which implies that as imports tend to zero the marginal product of imports tends towards infinity, wages remain constant.

For the consumer, the relative price change results in a change in the composition of her consumption basket. As the marginal utility of consuming imports increases with respect to the marginal utility of home and nontradable goods, the relative consumption of home and nontradable goods increase in terms of imports (see (8) above).

Moreover, the reduction in income (owing to the lower w) decreases the absolute consumption of all the consumption basket, regardless of the change in the composition of the latter. Given the market clearing condition for nontradable goods, the drop in demand for nontradable goods reduces the price of nontradable goods, $\Delta p^N < 0$, thus decreasing nontradable goods production.

The above, on the back of the fact that the price of home goods is held constant, implies a lower relative price of nontradable goods. In turn, the latter results in a higher rate of marginal utility for home goods relative to nontradable goods (8), thus an increase in c^N with respect to c^H. Overall, therefore, the effect of an appreciation of the U.S. real exchange rate results in a lower level of aggregate domestic consumption, with a change in the composition of consumption, the latter implying a relative increase in the consumption of nontradable goods with respect to imports and home tradable goods, while home tradable goods increase relative to imports:

$$\Delta c < 0 \text{, with } \Delta c_N > \Delta c_H = 0 > \Delta c_M \qquad (11)$$

In sum, the U.S. real appreciation lowers domestic demand. This income effect reduces output.[17] However, the impact of the terms of trade shock also increases external demand for home goods, i.e., exports increase. The latter, on the back of the increase in the demand for home and nontradable goods relative to imports (the change in the basket of consumption composition), is commonly referred to as the expenditure switching effect. In turn, the expenditure switching effect is likely to result in an improvement in the trade balance—, which is amplified by the negative income effect reducing imports' level. However, lower domestic demand is reduced as a consequence of the income effect. If the latter is large enough, despite the improvement in the trade balance, domestic demand and real GDP will be lower. In the end, however, the overall impact on domestic activity hinges on which of these two effects dominate.

In other words, if the income effect dominates the substitution effect in the case of factors of production being perfect complements (as in the Leontieff constant proportions production function), an appreciation of the U.S. real exchange rate results in lower domestic demand and output in the small open economy.

The above results also hold for a constant returns to scale Cobb-Douglas production function $(y^H = L^\alpha M^{1-\alpha})$. It can be easily shown that the impact of such a terms of trade shock $(\Delta p^M > 0, \Delta p^H = 0)$ has ambiguous effects on the production of home goods. Namely, given marginal product of labor and imports, $f_L = \frac{\alpha y^H}{L}$; $f_M = \frac{(1-\alpha) y^H}{M}$, and the optimality condition, then $M = \frac{(1-\alpha) wL}{\alpha p_M}$. Plugging the latter into the production function and taking the partial derivative with respect to p^M, after some manipulation, we obtain:

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[17] Notice that dollar remittances operate as a transfer, partially offsetting the negative income effect, and thus mitigating slower domestic demand growth as these transfers would stimulate consumption of all goods, including imports. Moreover, the appreciation of the U.S. dollar would tend, all else equal, to increase remittances.

$$\frac{\partial y^H}{\partial p_M} = \left(\frac{1-\alpha}{\alpha}\frac{w}{p_M}\right)^{1-\alpha}\left[-\frac{(1-\alpha)}{p_M} + \frac{\partial L}{\partial p_M}\right] \tag{12}$$

Given that $\partial L / \partial p_M > 0$, then $\frac{\partial y^H}{\partial p_M}$ is ambiguous. Moreover, the optimality condition for this production function implies $\frac{\alpha}{1-\alpha}\frac{M}{L} = \frac{w}{p_M}$. Plugging L from the latter into $\partial L / \partial p_M$ implies $\partial L / \partial p_M = \frac{\alpha}{1-\alpha}\frac{M}{w} > 0$.

These results still imply that the overall effect on domestic output is ambiguous.

In the case of a linear production function, with perfect substitutability of factors of production, corner solutions are feasible. If the production function is given by $y^H = aL + bM$, the marginal product of labor equals a and the marginal product of imports equals b. The marginal rate of substitution is $f_L/f_M=a/b$. Maximizing profits implies either producing using any combination of (M,L) if and only if $a/b=w/p_M$, or corner solutions with only M or only L as the factor of production. In either case, the level of production of home goods remains unaltered. To the extent that export increase in response to the terms of trade shock, overall output could increase.

Adding the financial account balance to trade balance, an increased interest rates (which also appreciates the U.S. dollar) would have an additional impact, reinforcing the above mentioned effects. Higher U.S. real interest rates would trigger capital flows from emerging markets to the U.S., depreciating EME's real exchange rates, i.e., a making nontradable goods cheaper (and imports more expensive not only with respect to nontradable goods, but also relative to home goods), amplifying the results presented above. Furthermore, adding a credit market in which firms borrow to invest amplifies the impact of capital flows. For instance, as the U.S. dollar appreciates on the back of capital inflows from emerging markets, the latter suffer a credit squeeze, which dampens economic activity. For the effects on credit and economic activity during capital inflow booms and capital flow reversals see Magud and others (2014) and Magud and Vesperoni (2015), respectively.

In the end, this is an empirical question. In the following section we test which predictions of the model hold in the data.

IV. ECONOMETRIC MODEL

A. Baseline Specification

To shed some light on the theoretical ambiguity presented above, in this section we present the main econometric exercise to test for the relevance of the U.S. real effective exchange rate in emerging market economies' growth. The baseline specification is the following:

$$y_t^i = \alpha + \beta X_t^{US} + \delta Z_t + \varepsilon_t^i \tag{12}$$

Where y_t^i denotes real GDP growth in country *i* during period *t*, α stands for a constant term, X_t^{US} represent the vector of main explanatory variables, and Z_t of the controls. ε_t^i represents a vector of error terms.

In turn, vector X_t^{US} includes the log change in U.S. real effective exchange rate (REER), the lagged U.S. real interest rate (RIR, proxied by the rate of return on 10-year U.S. treasury bonds deflated by observed inflation), and lagged U.S. real GDP growth. Namely,

$$X_t^{US} = \begin{bmatrix} REER_t^{US} \\ RIR_{t-1}^{US} \\ RGDPgr_{t-1}^{US} \end{bmatrix} \tag{13}$$

The baseline set of controls include the lagged real GDP per capita of each emerging market economy ($RGDPpc_{t-1}^i$) to factor in income differences across countries, the growth rate of China's real GDP to account for external demand from China—which has been particularly strong over the last decade— $RGDPgr_t^{CH}$, net capital inflows (KI_{t-1}^i) to control for the availability of international financing stimulating domestic economic activity (measured as the financial account balance in percent of GDP), and a measure of volatility, given by the standard deviation of the Standards and Poor's index (Vol_t^{US}).

$$Z_t = \begin{bmatrix} RGDPpc_{t-1}^i \\ RGDPgr_t^{CH} \\ KI_{t-1}^i \\ Vol_t^{US} \end{bmatrix} \tag{14}$$

In extended form, we estimate the following equation:

$$\begin{aligned} y_t^i = \alpha + \beta_1 REER_t^{US} + \beta_2 RIR_{t-1}^{US} + \beta_3 RGDPgr_{t-1}^{US} \\ + \delta_1 RGDPpc_{t-1}^i + \delta_2 RGDPgr_t^{CH} + \delta_3 KI_{t-1}^i + \delta_4 Vol_t^{US} \end{aligned} \tag{15}$$

The model is estimated in pooled panel regressions, with country fixed effects and robust standard errors, clustered by country. We run the model for each region separately. The data are from the International Monetary Fund's *World Economic Outlook*, *International Financial Statistics*, and *Information Notice System*. Interest rate data come from Saint Louise Federal Reserve Bank's *Federal Reserve Economic Data* (FRED). Volatility series are from *Bloomberg*.

B. Results

Tables 3–8 present the results of the baseline specification for different emerging market regions. The main striking result is the role of U.S. real exchange rate on EME's growth in most emerging market regions. Table 3 shows the results for Latin America (LAC). We observe the statistically strong economic significance throughout specifications, implying that when the U.S. dollar appreciates, all else equal, real GDP growth in LAC decreases. This result holds despite controlling for other important variables contributing to the appreciation of the U.S. dollar. Higher U.S. real interest rates reduce EME's economic activity—presumably through increasing financing costs. Stronger U.S. growth, directly or indirectly (through other countries) increasing external demand for emerging market economies, results in faster real GDP growth. All these effects are strongly statistically significant, as well as economically meaningful. Results hold when controlling for the level of income of each country, as per the lagged real GDP per capita. They also hold if not lagged; but endogenity issues might arise in latter case.[18]

Table 3. Baseline Regression: Real GDP Growth in Latin America

Panel LAC: real GDP growth rate (in percent)

	(1)	(2)	(3)	(4)	(5)	(6)
U.S. real effective exchange rate	-0.206***	-0.202***	-0.213***	-0.210***	-0.207***	-0.209***
	(0.025)	(0.025)	(0.026)	(0.026)	(0.026)	(0.026)
U.S. real interest rate (t-1)	-0.270***	-0.314***	-0.320***	-0.415***	-0.424***	-0.430***
	(0.087)	(0.091)	(0.096)	(0.114)	(0.116)	(0.116)
U.S. real GDP growth (t-1)		0.154**	0.218***	0.222***	0.221***	0.199***
		(0.064)	(0.059)	(0.059)	(0.061)	(0.061)
Ln real GDP per capita (t-1)			-0.082	-0.060	-0.057	-0.073
			(0.072)	(0.069)	(0.070)	(0.073)
China real GDP growth				0.147**	0.155***	0.153***
				(0.054)	(0.052)	(0.052)
Net capital inflows					-0.025	-0.028
					(0.026)	(0.027)
Volatility, S&P						-0.169***
						(0.049)
Constant	3.963***	3.641***	4.434***	3.086***	3.104***	5.091***
	(0.224)	(0.250)	(0.840)	(0.820)	(0.829)	(1.180)
Observations	946	946	865	865	858	858
Adjusted R2	0.0699	0.0739	0.0890	0.0979	0.0978	0.1056

Standard errors in parentheses.
+ p<0.15, * p<0.10, ** p<0.05, *** p<0.01.
Panel regression with country fixed-effects and robust standard errors.
Source: authors' calculations.

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[18] Each of the explanatory variables was added one at the time to verify their stand alone relevance. They did turn the other variable insignificant. To economize on space we do not show them in the tables in the paper, but they are available from the authors upon request.

Regarding the other controls, we note that a higher growth rate of China's real GDP increases LAC growth, while higher U.S. stock market volatility reduces real GDP growth in EME, presumably by increasing uncertainty. In regards to the economic significance of these results, we observe that, conditional on the positive effect of stronger U.S. growth, on average, a one percent real appreciation of the U.S. dollar reduces average real GDP growth in emerging markets by 0.2 percentage points.[19]

Intuitively, these results show that *beyond* the negative financial impact of higher U.S. real interest rates and the positive impulse from stronger U.S. growth, a more appreciated U.S. dollar tends to lower short-run real GDP growth in LAC—and vice versa. This points to the income effects suggested above, despite any positive expenditure-switching effect owing to the change in the valuation of the U.S. dollar. Moreover, given that commodity prices are priced in U.S. dollar, an appreciation of the dollar implies that it is appreciating against any other asset, including commodities.[20] Additionally, in relative terms, a stronger dollar is the mirror a weaker EME's currencies. As such, these results imply that the negative income effect of "receiving" fewer dollars per unit of commodity exports (as reflected in weaker terms of trade) offsets any potentially expansionary effects of a more depreciated currency. Additionally, as EME oftentimes export commodities but import other production inputs, including machinery and capital more generally, a more depreciated domestic currency translates into more expensive imports, which would lower domestic demand and economic activity.[21]

Table 4 shows that the above results hold for South America (SLAC), with even larger coefficients. This is not surprising given that this sub-region is mostly composed of net commodity exporters. It also holds for Central America and Mexico (CAM), though the effect of the U.S. real exchange rate is smaller in absolute terms (the coefficient is about half that of SLAC) and less statistically significant (Table 5). This would be consistent with the closer trade, remittances, and tourism links between CAM countries and the U.S., unlike SLAC economies.

[19] The econometric estimation results are consistent with recent dynamics. As mentioned in footnote 3, as the U.S. dollar appreciated about 13 percent between April 2014 and April 2015, average emerging market and developing economies growth for 2015 has been revised down by over 1 percent.

[20] See Frenkel (1986) for a theoretical model and Akram (2009) for empirical evidence.

[21] For a related perspective, see Diaz-Alejandro (1963).

Table 4. Baseline Regression: Real GDP Growth in South America

Panel SLAC: real GDP growth rate (in percent)	(1)	(2)	(3)	(4)	(5)	(6)
U.S. real effective exchange rate	-0.247***	-0.243***	-0.254***	-0.249***	-0.245***	-0.248***
	(0.028)	(0.027)	(0.029)	(0.029)	(0.031)	(0.031)
U.S. real interest rate (t-1)	-0.417***	-0.468***	-0.461***	-0.617***	-0.616***	-0.621***
	(0.098)	(0.101)	(0.094)	(0.103)	(0.103)	(0.102)
U.S. real GDP growth (t-1)		0.182*	0.240**	0.246**	0.250**	0.230**
		(0.096)	(0.085)	(0.085)	(0.086)	(0.088)
Ln real GDP per capita (t-1)			-0.101	-0.067	-0.065	-0.079
			(0.080)	(0.075)	(0.076)	(0.081)
China real GDP growth				0.246***	0.241***	0.237***
				(0.070)	(0.067)	(0.067)
Net capital inflows					-0.027	-0.035
					(0.051)	(0.052)
Volatility, S&P						-0.179**
						(0.079)
Constant	4.195***	3.814***	4.899***	2.634**	2.743**	4.872**
	(0.247)	(0.331)	(1.078)	(1.099)	(1.097)	(1.739)
Observations	516	516	489	489	489	489
Adjusted R2	0.1027	0.1071	0.1177	0.1395	0.1389	0.1452

Standard errors in parentheses.
+ p<0.15, * p<0.10, ** p<0.05, *** p<0.01.
Panel regression with country fixed-effects and robust standard errors.
Source: authors' calculations.

Table 6 presents the results for emerging Asia. For this region, we mostly do not find statistically significant effects, though the coefficient for U.S. REER is negative, and marginally significant (see column 6). Surprisingly, real GDP growth in China is not statistically significant. Part of the explanation behind this result lies in the sample period. Many Asian emerging market economies begun a strong growth process well before China's –which turn significant only towards the end of the 1990s. Results for emerging Europe (Table 7) are similar to those of LAC, but with smaller coefficients—as these economies rely relatively less in commodities than LAC. Surprisingly, for MENA countries (Table 8) we do not find a statistically significant REER coefficient, yet it is negative. The financial effect appears as dominant for this region. However, in oil exporting countries the effects of an appreciation of the U.S. dollar might be ambiguous. On the one hand, oil prices drop, triggering the negative income effect suggested above. On the other hand, however, the accumulated dollar-denominated "saved" funds appreciate in value. Thus the revaluation of the stock of accumulated wealth might compensate for the lower flow of dollars received owing to the lower oil prices. The overall income effect could thus be close to zero.

Table 5. Baseline Regression: Real GDP Growth in Central America and Mexico

Panel CAM: real GDP growth rate (in percent)

	(1)	(2)	(3)	(4)	(5)	(6)
U.S. real effective exchange rate	-0.131**	-0.127**	-0.127**	-0.125**	-0.119**	-0.121**
	(0.044)	(0.043)	(0.043)	(0.044)	(0.041)	(0.042)
U.S. real interest rate (t-1)	-0.249*	-0.296**	-0.337**	-0.401**	-0.423**	-0.427**
	(0.109)	(0.114)	(0.118)	(0.131)	(0.141)	(0.140)
U.S. real GDP growth (t-1)		0.165+	0.249**	0.252**	0.247**	0.220**
		(0.100)	(0.083)	(0.082)	(0.082)	(0.078)
Ln real GDP per capita (t-1)			0.216+	0.267*	0.243	0.188
			(0.132)	(0.130)	(0.151)	(0.165)
China real GDP growth				0.100+	0.129**	0.125*
				(0.059)	(0.051)	(0.053)
Net capital inflows					-0.019	-0.020+
					(0.013)	(0.011)
Volatility, S&P						-0.176**
						(0.052)
Constant	4.173***	3.829***	2.033*	0.823	0.873	3.271*
	(0.299)	(0.364)	(1.065)	(1.221)	(1.185)	(1.491)
Observations	344	344	290	290	283	283
Adjusted R2	0.0411	0.0455	0.0823	0.0859	0.0780	0.0903

Standard errors in parentheses.
+ p<0.15, * p<0.10, ** p<0.05, *** p<0.01.
Panel regression with country fixed-effects and robust standard errors.
Source: authors' calculations.

Table 6. Baseline Regression: Real GDP Growth in Emerging Asia

Panel DevAsia:real GDP growth rate (in percent)

	(1)	(2)	(3)	(4)	(5)	(6)
U.S. real effective exchange rate	-0.058	-0.059	-0.061	-0.061	-0.087+	-0.088+
	(0.047)	(0.048)	(0.052)	(0.052)	(0.053)	(0.053)
U.S. real interest rate (t-1)	0.042	0.054	0.015	-0.027	-0.099	-0.101
	(0.093)	(0.090)	(0.097)	(0.093)	(0.096)	(0.096)
U.S. real GDP growth (t-1)		-0.041	-0.035	-0.031	-0.033	-0.046
		(0.064)	(0.066)	(0.065)	(0.062)	(0.065)
Ln real GDP per capita (t-1)			-0.435**	-0.416**	-0.315**	-0.331**
			(0.166)	(0.166)	(0.128)	(0.129)
China real GDP growth				0.064	0.074	0.073
				(0.064)	(0.063)	(0.063)
Net capital inflows					0.079***	0.079***
					(0.017)	(0.017)
Volatility, S&P						-0.083
						(0.074)
Constant	4.628***	4.714***	8.313***	7.664***	6.818***	7.848***
	(0.217)	(0.284)	(1.362)	(1.518)	(1.258)	(1.495)
Observations	812	812	755	755	629	629
Adjusted R2	0.0028	0.0019	0.0209	0.0213	0.0588	0.0599

Standard errors in parentheses.
+ p<0.15, * p<0.10, ** p<0.05, *** p<0.01.
Panel regression with country fixed-effects and robust standard errors.
Source: authors' calculations.

Table 7. Baseline Regression: Real GDP Growth in Emerging Europe

Panel DevEuro: real GDP growth rate (in percent)						
	(1)	(2)	(3)	(4)	(5)	(6)
U.S. real effective exchange rate	-0.167**	-0.161**	-0.169**	-0.170**	-0.145**	-0.146**
	(0.058)	(0.059)	(0.055)	(0.055)	(0.052)	(0.053)
U.S. real interest rate (t-1)	-0.222+	-0.300*	-0.301*	-0.274*	-0.176	-0.173
	(0.127)	(0.151)	(0.145)	(0.138)	(0.112)	(0.117)
U.S. real GDP growth (t-1)		0.280*	0.297*	0.297*	0.342*	0.339*
		(0.124)	(0.128)	(0.128)	(0.143)	(0.153)
Ln real GDP per capita (t-1)			-0.122	-0.135	-0.190	-0.193
			(0.111)	(0.108)	(0.147)	(0.137)
China real GDP growth				-0.040	-0.010	-0.013
				(0.037)	(0.061)	(0.063)
Net capital inflows					0.040*	0.043+
					(0.018)	(0.023)
Volatility, S&P						-0.024
						(0.107)
Constant	3.301***	2.719***	4.020**	4.460***	4.078**	4.370***
	(0.309)	(0.242)	(1.087)	(1.021)	(1.288)	(1.079)
Observations	271	271	271	271	255	255
Adjusted R2	0.0287	0.0381	0.0392	0.0361	0.0304	0.0265

Standard errors in parentheses.
+ p<0.15, * p<0.10, ** p<0.05, *** p<0.01.
Panel regression with country fixed-effects and robust standard errors.
Source: authors' calculations.

Table 8. Baseline Regression: Real GDP Growth in MENA

Panel MENA: real GDP growth rate (in percent)						
	(1)	(2)	(3)	(4)	(5)	(6)
U.S. real effective exchange rate	-0.002	-0.002	-0.015	-0.015	0.033	0.030
	(0.074)	(0.074)	(0.072)	(0.071)	(0.067)	(0.066)
U.S. real interest rate (t-1)	-0.222	-0.226	-0.262	-0.221	-0.302*	-0.307*
	(0.256)	(0.262)	(0.260)	(0.186)	(0.170)	(0.172)
U.S. real GDP growth (t-1)		0.016	0.064	0.061	0.125	0.105
		(0.184)	(0.193)	(0.193)	(0.189)	(0.191)
Ln real GDP per capita (t-1)			-0.826**	-0.852**	-0.706+	-0.747+
			(0.292)	(0.360)	(0.463)	(0.482)
China real GDP growth				-0.062	-0.102	-0.100
				(0.270)	(0.261)	(0.260)
Net capital inflows					0.183***	0.182***
					(0.018)	(0.018)
Volatility, S&P						-0.159
						(0.118)
Constant	5.148***	5.115***	12.917***	13.626**	12.841*	14.902*
	(0.644)	(0.751)	(3.116)	(5.518)	(6.604)	(7.672)
Observations	645	645	645	645	633	633
Adjusted R2	-0.0006	-0.0021	0.0067	0.0054	0.1152	0.1149

Standard errors in parentheses.
+ p<0.15, * p<0.10, ** p<0.05, *** p<0.01.
Panel regression with country fixed-effects and robust standard errors.
Source: authors' calculations.

Tables 9–14 replicate the above specifications using real domestic demand growth as the left-hand side variable. The results in these tables underscore the domestic demand/income channel suggested above. We find that the coefficients on how domestic demand growth responds to changes in the U.S. REER are statistically and economically greater or equally significant as those in Tables 3–8 on real GDP growth. This is case in LAC (in both SLAC and CAM) and emerging Europe. Moreover, notice that for emerging Asia and for MENA countries domestic demand growth is negatively associated with the U.S. real exchange rate, but in this case it is also statistically significant—and strongly so. U.S. real interest rates reduce domestic demand growth in this region. These results are also consistent with Magud and Sosa (2015), who show that in emerging markets, investment at the firm level positively depends on commodity terms of trade—beyond expected future profitability, leverage, debt, etc.

Table 9. Baseline Regression: Real Domestic Demand Growth in Latin America

Panel LAC: real domestic demand growth rate (in percent)

	(1)	(2)	(3)	(4)	(5)	(6)
U.S. real effective exchange rate	-0.587***	-0.577***	-0.617***	-0.607***	-0.598***	-0.596***
	(0.132)	(0.131)	(0.146)	(0.146)	(0.145)	(0.146)
U.S. real interest rate (t-1)	-0.773***	-0.899***	-1.125***	-1.463***	-1.503***	-1.500***
	(0.214)	(0.235)	(0.221)	(0.265)	(0.262)	(0.261)
U.S. real GDP growth (t-1)		0.445*	0.639***	0.658***	0.663***	0.674***
		(0.227)	(0.216)	(0.216)	(0.220)	(0.221)
Ln real GDP per capita (t-1)			-0.242**	-0.162*	-0.154*	-0.147*
			(0.094)	(0.082)	(0.084)	(0.083)
China real GDP growth				0.531***	0.508***	0.509***
				(0.143)	(0.143)	(0.144)
Net capital inflows					-0.164***	-0.163***
					(0.057)	(0.057)
Volatility, S&P						0.085
						(0.165)
Constant	7.304***	6.374***	8.574***	3.683**	4.554**	3.556
	(0.544)	(0.662)	(1.517)	(1.702)	(1.728)	(2.718)
Observations	939	939	858	858	858	858
Adjusted R2	0.0245	0.0254	0.0599	0.0684	0.0722	0.0712

Standard errors in parentheses.
+ p<0.15, * p<0.10, ** p<0.05, *** p<0.01.
Panel regression with country fixed-effects and robust standard errors.
Source: authors' calculations.

Table 10. Baseline Regression: Real Domestic Demand Growth in South America

Panel SLAC: real domestic demand growth rate (in percent)

	(1)	(2)	(3)	(4)	(5)	(6)
U.S. real effective exchange rate	-0.813***	-0.798***	-0.875***	-0.861***	-0.837***	-0.837***
	(0.212)	(0.211)	(0.219)	(0.220)	(0.222)	(0.224)
U.S. real interest rate (t-1)	-1.254***	-1.427***	-1.528***	-1.964***	-1.953***	-1.952***
	(0.274)	(0.279)	(0.304)	(0.365)	(0.374)	(0.370)
U.S. real GDP growth (t-1)		0.611*	0.720**	0.736**	0.759**	0.761**
		(0.299)	(0.304)	(0.304)	(0.319)	(0.323)
Ln real GDP per capita (t-1)			-0.245**	-0.150*	-0.137+	-0.136+
			(0.091)	(0.078)	(0.083)	(0.084)
China real GDP growth				0.683***	0.648***	0.649***
				(0.190)	(0.189)	(0.192)
Net capital inflows					-0.189*	-0.188*
					(0.096)	(0.100)
Volatility, S&P						0.018
						(0.304)
Constant	8.427***	7.153***	9.986***	3.700+	4.463*	4.246
	(0.734)	(1.020)	(1.972)	(2.157)	(2.096)	(4.334)
Observations	516	516	489	489	489	489
Adjusted R2	0.0710	0.0740	0.0870	0.0975	0.0997	0.0978

Standard errors in parentheses.
+ p<0.15, * p<0.10, ** p<0.05, *** p<0.01.
Panel regression with country fixed-effects and robust standard errors.
Source: authors' calculations.

Table 11. Baseline Regression: Real Domestic Demand Growth in Central America and Mexico

Panel CAM: real domestic demand growth rate (in percent)

	(1)	(2)	(3)	(4)	(5)	(6)
U.S. real effective exchange rate	-0.290**	-0.287**	-0.237*	-0.228*	-0.228*	-0.227*
	(0.111)	(0.111)	(0.111)	(0.115)	(0.113)	(0.114)
U.S. real interest rate (t-1)	-0.178	-0.211	-0.640*	-0.918**	-1.020**	-1.018**
	(0.284)	(0.364)	(0.294)	(0.318)	(0.323)	(0.324)
U.S. real GDP growth (t-1)		0.119	0.498	0.515	0.526	0.536
		(0.411)	(0.372)	(0.370)	(0.358)	(0.350)
Ln real GDP per capita (t-1)			-1.052+	-0.837+	-0.880+	-0.861+
			(0.559)	(0.486)	(0.484)	(0.470)
China real GDP growth				0.449*	0.444*	0.445*
				(0.225)	(0.225)	(0.228)
Net capital inflows					-0.137+	-0.137+
					(0.078)	(0.079)
Volatility, S&P						0.060
						(0.113)
Constant	6.213***	5.964***	14.026**	8.667*	9.828*	9.008*
	(0.765)	(0.768)	(4.821)	(4.391)	(4.332)	(4.432)
Observations	337	337	283	283	283	283
Adjusted R2	-0.0026	-0.0055	0.0180	0.0250	0.0288	0.0254

Standard errors in parentheses.
+ p<0.15, * p<0.10, ** p<0.05, *** p<0.01.
Panel regression with country fixed-effects and robust standard errors.
Source: authors' calculations.

Table 12. Baseline Regression: Real Domestic Demand Growth in Emerging Asia

Panel DevAsia: real domestic demand growth rate (in percent)

	(1)	(2)	(3)	(4)	(5)	(6)
U.S. real effective exchange rate	-0.849***	-0.845***	-0.861***	-0.846***	-0.853***	-0.848***
	(0.155)	(0.155)	(0.159)	(0.158)	(0.190)	(0.191)
U.S. real interest rate (t-1)	-0.286	-0.352	-0.449	-1.177***	-0.964***	-0.952***
	(0.364)	(0.371)	(0.389)	(0.264)	(0.282)	(0.286)
U.S. real GDP growth (t-1)		0.231	0.268	0.329+	0.210	0.306
		(0.214)	(0.214)	(0.212)	(0.234)	(0.235)
Ln real GDP per capita (t-1)			-1.866**	-1.534*	-1.490*	-1.369+
			(0.776)	(0.803)	(0.821)	(0.798)
China real GDP growth				1.123***	1.184**	1.194**
				(0.362)	(0.435)	(0.438)
Net capital inflows					-0.025	-0.022
					(0.071)	(0.070)
Volatility, S&P						0.618**
						(0.239)
Constant	5.779***	5.303***	20.338***	9.051	8.388	0.680
	(0.912)	(1.009)	(6.809)	(9.362)	(10.176)	(10.870)
Observations	778	778	732	732	629	629
Adjusted R2	0.0558	0.0553	0.0733	0.1037	0.0939	0.0988

Standard errors in parentheses.
+ p<0.15, * p<0.10, ** p<0.05, *** p<0.01.
Panel regression with country fixed-effects and robust standard errors.
Source: authors' calculations.

Table 13. Baseline Regression: Real Domestic Demand Growth in Emerging Europe

Panel DevEuro: real domestic demand growth rate (in percent)						
	(1)	(2)	(3)	(4)	(5)	(6)
U.S. real effective exchange rate	-0.755**	-0.758**	-0.870***	-0.845***	-0.889***	-0.886***
	(0.208)	(0.209)	(0.190)	(0.193)	(0.220)	(0.214)
U.S. real interest rate (t-1)	0.436+	0.470	0.533	-0.292+	-0.840	-0.853
	(0.239)	(0.441)	(0.511)	(0.162)	(0.688)	(0.761)
U.S. real GDP growth (t-1)		-0.127	0.176	0.199	0.077	0.091
		(0.915)	(0.872)	(0.858)	(0.959)	(0.885)
Ln real GDP per capita (t-1)			-2.071**	-1.703**	-1.981**	-1.962**
			(0.754)	(0.596)	(0.782)	(0.754)
China real GDP growth				1.230	1.581	1.596
				(0.866)	(1.267)	(1.345)
Net capital inflows					-0.639	-0.654
					(0.692)	(0.767)
Volatility, S&P						0.125
						(0.725)
Constant	3.052***	3.321*	24.996**	11.629+	15.974**	14.426
	(0.556)	(1.579)	(8.372)	(6.617)	(5.514)	(11.367)
Observations	262	262	262	262	255	255
Adjusted R2	0.0180	0.0143	0.0623	0.0764	0.0958	0.0923

Standard errors in parentheses.
+ p<0.15, * p<0.10, ** p<0.05, *** p<0.01.
Panel regression with country fixed-effects and robust standard errors.
Source: authors' calculations.

Table 14. Baseline Regression: Real Domestic Demand Growth in MENA

Panel MENA: real domestic demand growth rate (in percent)						
	(1)	(2)	(3)	(4)	(5)	(6)
U.S. real effective exchange rate	-0.632**	-0.635**	-0.646**	-0.645**	-0.637**	-0.639**
	(0.264)	(0.267)	(0.265)	(0.262)	(0.258)	(0.260)
U.S. real interest rate (t-1)	-1.024	-0.983	-1.013	-1.088	-1.098	-1.104
	(1.411)	(1.300)	(1.294)	(1.642)	(1.643)	(1.650)
U.S. real GDP growth (t-1)		-0.147	-0.097	-0.092	-0.078	-0.099
		(0.553)	(0.556)	(0.542)	(0.539)	(0.555)
Ln real GDP per capita (t-1)			-0.911*	-0.866	-0.838	-0.880
			(0.508)	(0.622)	(0.633)	(0.611)
China real GDP growth				0.112	0.100	0.102
				(0.592)	(0.588)	(0.590)
Net capital inflows					0.032	0.031
					(0.035)	(0.035)
Volatility, S&P						-0.163
						(0.274)
Constant	8.439**	8.746*	17.315***	16.036**	15.912**	18.025**
	(3.462)	(4.416)	(5.035)	(6.414)	(6.460)	(6.587)
Observations	633	633	633	633	633	633
Adjusted R2	0.0051	0.0036	0.0028	0.0012	-0.0001	-0.0017

Standard errors in parentheses.
+ p<0.15, * p<0.10, ** p<0.05, *** p<0.01.
Panel regression with country fixed-effects and robust standard errors.
Source: authors' calculations.

Adding the exchange rate regime (Ilzeztky and others, 2012) or the degree of trade openness (measured by exports plus imports, in percent of GDP) does not change the results, Interestingly, when separating the effect of the U.S. real effective exchange rate on emerging market growth for economies with more rigid and more flexible exchange rate regime, the effect is statistically significant for both groups (Table 15).[22] Importantly, the absolute value of the coefficient is larger for countries with more rigid exchange rate regimes. This implies that, all else equal, a stronger dollar impacts more on economies with less exchange rate flexibility, and vice versa. Intuitively, in more rigid exchange rate regimes, the negative income effect owing to a stronger dollar experiences a weaker offsetting effect from the expenditure switching precisely because the of the more contained response of the real exchange rate—unless deflationary forces rapidly depreciate the domestic currency. In more flexible exchange rate regimes, the reaction of the nominal exchange rate enables a stronger expenditure-switching effect to counter-balance the negative income effect.

Table 15. Exchange Rate Rigidity

Panel : Real GDP growth rate (in percent)--full sample

	(1)	(2)	(3)	(4)	(5)	(6)
U.S. real effective exchange rate (Fixed reg.)	-0.171***	-0.171***	-0.175***	-0.174***	-0.183***	-0.183***
	(0.029)	(0.029)	(0.030)	(0.031)	(0.031)	(0.031)
U.S. real effective exchange rate (Floating reg.)	-0.151***	-0.147**	-0.136**	-0.136**	-0.138**	-0.141**
	(0.056)	(0.056)	(0.056)	(0.056)	(0.057)	(0.056)
U.S. real interest rate (t-1)	-0.085	-0.134+	-0.142*	-0.164**	-0.169**	-0.170**
	(0.081)	(0.081)	(0.083)	(0.077)	(0.079)	(0.078)
U.S. real GDP growth (t-1)		0.179***	0.205***	0.206***	0.251***	0.223***
		(0.064)	(0.068)	(0.067)	(0.065)	(0.065)
Ln real GDP per capita (t-1)			-0.112	-0.104	-0.124	-0.151
			(0.156)	(0.156)	(0.153)	(0.160)
China real GDP growth				0.036	-0.015	-0.022
				(0.064)	(0.057)	(0.057)
Net capital inflows					0.122***	0.123***
					(0.046)	(0.045)
Volatility, S&P						-0.157***
						(0.033)
Constant	4.394***	4.029***	4.950***	4.593***	4.548***	6.541***
	(0.189)	(0.245)	(1.303)	(1.458)	(1.466)	(1.648)
Observations	2558	2558	2461	2461	2377	2377
Adjusted R2	0.0197	0.0234	0.0244	0.0243	0.0875	0.0925

Standard errors in parentheses.
+ p<0.15, * p<0.10, ** p<0.05, *** p<0.01.
Panel regression with country fixed-effects and robust standard errors.
Source: authors' calculations.

Moreover, looking at the impact on domestic demand (Table 16), we notice that the negative effect of a stronger U.S. dollar is larger in more flexible exchange rate arrangements. A more flexible exchange rate regime enables more short-run adjustment to the negative income shock through the nominal exchange rate. The relatively less appreciated domestic currency (compared to a more rigid exchange rate regime) results in a relatively stronger income effect, thus affecting domestic demand more than in more rigid exchange rate arrangements, despite the overall larger expansionary effect on output reflected in Table 15.

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[22] We use the "coarse" exchange rate classification, removing observations classified as 5 and 6 ("free falling" and "dual market in which parallel market data is missing"), as these are noisy. We label as "fixed" exchange rate regime classifications 1 and 2 (which goes from "no separated legal tender" to "de facto crawling band narrower or equal to +/- 2 percent"), and flexible regimes for observations classified as 3 and 4 ("pre-announced crawling band wider than +/- 2 percent" to "free floating"). See Ilzetzky and others (2012) for details.

Table 16. Exchange Rate Regimes and Real Domestic Demand Growth

Panel All: Real domestic demand growth rate (in percent)

	(1)	(2)	(3)	(4)	(5)	(6)
U.S. real effective exchange rate (Fixed reg.)	-0.531***	-0.534***	-0.534***	-0.518***	-0.505***	-0.505***
	(0.095)	(0.095)	(0.099)	(0.095)	(0.095)	(0.095)
U.S. real effective exchange rate (Floating reg.)	-0.733***	-0.724***	-0.816***	-0.808***	-0.808***	-0.803***
	(0.160)	(0.161)	(0.163)	(0.160)	(0.161)	(0.162)
U.S. real interest rate (t-1)	-0.260	-0.371	-0.477	-0.741+	-0.739+	-0.739+
	(0.399)	(0.376)	(0.396)	(0.473)	(0.477)	(0.477)
U.S. real GDP growth (t-1)		0.404***	0.478***	0.497***	0.504***	0.546***
		(0.152)	(0.152)	(0.148)	(0.148)	(0.149)
Ln real GDP per capita (t-1)			-0.448+	-0.339	-0.316	-0.276
			(0.293)	(0.273)	(0.265)	(0.258)
China real GDP growth				0.443**	0.443**	0.452**
				(0.189)	(0.191)	(0.191)
Net capital inflows					-0.040*	-0.041*
					(0.021)	(0.022)
Volatility, S&P						0.233***
						(0.088)
Constant	6.472***	5.648***	9.338***	4.838*	4.826*	1.856
	(0.913)	(1.123)	(2.750)	(2.591)	(2.514)	(2.736)
Observations	2505	2505	2408	2408	2377	2377
Adjusted R2	0.0134	0.0141	0.0177	0.0200	0.0195	0.0198

Standard errors in parentheses

+ p<0.15, * p<0.10, ** p<0.05, *** p<0.01

Panel regression with country fixed-effects and robust std. errors.

Next, we explore the strength of the effects of U.S. dollar conditional on whether countries are net commodity exporters or net commodity importers (Table 17).[23] We observe that the negative statistically and economically significant impact of a stronger dollar holds for both sub-groups. As expected, however, the impact is economically larger in net commodity exporters—though not immensely so. The latter suggest that the commodity income effect transmission channel is important. It also suggests that the foreign capital and/or inputs channel, though to a lesser extent, is also relevant. Table 18 replicates the above exercise for real domestic demand growth. Results are similar.

[23] Source: World Bank, WITS. Products are grouped by stages of processing using the WITS HS Combined Nomenclature. A net commodity exporter is a country that has positive net exports (X-M) of raw materials and intermediate goods in a given year.

Table 17. Net Commodity Exporters and Real GDP Growth

Panel All: Real GDP growth rate (in percent)

	(1)	(2)	(3)	(4)	(5)	(6)
U.S. real effective exchange rate (net comm. exp.)	-0.135***	-0.132***	-0.149***	-0.148***	-0.138***	-0.139***
	(0.037)	(0.037)	(0.039)	(0.039)	(0.043)	(0.043)
U.S. real effective exchange rate (net comm. imp.)	-0.104***	-0.102***	-0.100***	-0.100***	-0.121***	-0.123***
	(0.026)	(0.026)	(0.028)	(0.028)	(0.026)	(0.026)
U.S. real interest rate (t-1)	-0.135*	-0.179**	-0.176**	-0.194***	-0.213***	-0.216***
	(0.069)	(0.070)	(0.074)	(0.065)	(0.069)	(0.069)
U.S. real GDP growth (t-1)		0.153***	0.176***	0.178***	0.219***	0.196***
		(0.050)	(0.053)	(0.053)	(0.055)	(0.055)
Ln real GDP per capita (t-1)			-0.152*	-0.147*	-0.148*	-0.165**
			(0.077)	(0.079)	(0.076)	(0.079)
China real GDP growth				0.028	0.006	0.004
				(0.064)	(0.066)	(0.066)
Net capital inflows					0.120***	0.121***
					(0.038)	(0.037)
Volatility, S&P						-0.150***
						(0.038)
Constant	4.242***	3.925***	5.297***	5.032***	4.759***	6.549***
	(0.172)	(0.204)	(0.730)	(1.042)	(1.086)	(1.328)
Observations	3413	3413	3218	3218	2946	2946
Adjusted R2	0.0101	0.0123	0.0156	0.0154	0.0656	0.0687

Standard errors in parentheses

+ p<0.15, * p<0.10, ** p<0.05, *** p<0.01

Panel regression with country fixed-effects and robust std. errors.

Table 18. Net Commodity Exporters and Real Domestic Demand Growth

Panel All: Real domestic demand growth rate (in percent)

	(1)	(2)	(3)	(4)	(5)	(6)
U.S. real effective exchange rate (net comm. exp.)	-0.683***	-0.677***	-0.750***	-0.739***	-0.745***	-0.744***
	(0.131)	(0.132)	(0.141)	(0.138)	(0.147)	(0.147)
U.S. real effective exchange rate (net comm. imp.)	-0.690***	-0.687***	-0.706***	-0.694***	-0.684***	-0.682***
	(0.085)	(0.085)	(0.090)	(0.089)	(0.094)	(0.094)
U.S. real interest rate (t-1)	-0.604*	-0.694**	-0.760**	-1.134***	-1.102***	-1.100***
	(0.306)	(0.289)	(0.312)	(0.364)	(0.388)	(0.389)
U.S. real GDP growth (t-1)		0.319*	0.366**	0.398**	0.399**	0.421**
		(0.162)	(0.164)	(0.161)	(0.170)	(0.173)
Ln real GDP per capita (t-1)			-0.556***	-0.449**	-0.433**	-0.417**
			(0.202)	(0.183)	(0.176)	(0.175)
China real GDP growth				0.589***	0.574***	0.576***
				(0.172)	(0.182)	(0.182)
Net capital inflows					-0.020	-0.020
					(0.029)	(0.029)
Volatility, S&P						0.139
						(0.106)
Constant	6.808***	6.150***	11.229***	5.650***	5.777***	4.118+
	(0.749)	(0.944)	(2.168)	(2.117)	(2.115)	(2.569)
Observations	3304	3304	3121	3121	2946	2946
Adjusted R2	0.0200	0.0204	0.0257	0.0300	0.0275	0.0274

Standard errors in parentheses

+ p<0.15, * p<0.10, ** p<0.05, *** p<0.01

Panel regression with country fixed-effects and robust std. errors.

Thus, we infer from these results that, conditional on the expansionary effect of stronger U.S. growth, the income effect of a stronger U.S. dollar transmission channel operates through domestic demand growth, offsetting the potential expansionary effect of a more depreciated currency.

C. Some Robustness Checks

We run a battery of robustness exercises to verify the strength of our results.[24] Among them, we have included the lagged real exchange rate of each emerging market country, to explore whether there was a direct expansionary or contractionary (expenditure-switching vs. income effect) link through it. However, it is not always statistically significant. It appears to have a stronger effect in domestic demand growth, both statistically and economically. All of the baseline results hold.

We also tested the model using 5-year averages, with a longer-term perspective. Again, we find the same results as with the baseline model.[25] As an alternative measure of volatility, we used the Chicago Board of Exchanges' VIX, obtaining results similar to the baseline. Additionally, we controlled for an index of (the log difference of) commodity terms of trade (see Gruss 2014). The latter was not always statistically significant. It was significant in all regions only if the U.S. real exchange rate was removed from the regression it, but not significant if both variables were included—the U.S. REER remaining statistically significant, however. The sign of the growth rate of commodity terms of trade was the expected: positive for regions with a large share of net commodity exporters (e.g., South America and MENA), and negative for those with mostly net commodity importer countries (e.g., Central America and Mexico).

To investigate some dynamics, we run the baseline model as rolling regressions. Using rolling-expanding regressions (adding one extra year at a time) for the full sample, we found that the negative coefficient on the U.S. real exchange rate on real GDP growth is quite stable over time—and almost flat since the late 1990s. The impact of U.S. real interest rates is systematically negative, and increasing in absolute value throughout our sample. The positive association between U.S. real GDP growth and economic activity in emerging markets is also systematically stable. Interestingly, the growth rate of China's real GDP growth becomes positively statistically significant only in the second half of the 1990s—not being significantly different from zero for earlier observations. When these regressions are run separately by region, results hold for most regions; they are particularly strong for LAC (and especially SLAC) and emerging Europe.[26]

Finally , we also verified that the baseline results hold if we add dummy variables for crises (e.g., the 1997–98 Asian crisis, the 1994–95 Mexican crisis, etc.), or if time effects are included, or if the robust standard errors are clustered by time. We also restricted the sample to start in 1999. Results hold, but the statistical significance of the impact of U.S. real exchange rate of real GDP growth diminishes. Although that might signal that stronger

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[24] All of these are available from the authors upon request, in order to economize on space.

[25] Recall that the main goal of the paper is to look at the impact of medium-term U.S. dollar appreciation/depreciation cycles in economic activity in emerging markets..

[26] Upon request from the authors, country-specific rolling regressions for LAC are available, as well as country-specific "betas" for the size of the U.S. real effective exchange rate on each country's real GDP growth.

policy frameworks help to reduce the sensitivity of emerging markets to external shocks, it can simply reflect the reduction in the sample size. We leave further analysis on the latter for future work.

V. Concluding Remarks

We have shown that, conditional of the positive effect of stronger U.S. growth, periods of a stronger U.S. dollar result in subdued growth in emerging markets—and vice versa. We have documented this byway of some stylized facts and event analysis, and tested for it econometrically—using a simple pooled panel approach. We argue that the tension between the income effect of a stronger dollar, which reduces the purchasing power of exports, particularly for commodity exporters, offsets any expansionary effect owing to a weaker domestic currency (via a standard expenditure switching effect). Moreover, we present a simple model that shows the potential ambiguity of a change in the strength of the dollar, highlighting the empirical nature of the question.

The U.S. dollar appears to be on an appreciating cycle since mid-2014. Based on our historical estimations, the probability of the dollar remaining appreciated in the short- and medium-term is high (above 80 percent). Moreover, this is in line with appreciating cycles in the U.S. dollar of about 68 years. In the circumstances, commodity prices are expected to remain weak. Together, all these effects point to slower domestic demand and real GDP growth in emerging markets than otherwise—across all regions.

Moreover, in the context of a lift-off in U.S. interest rates as the Federal Reserve is expected to start unwinding the extraordinary expansionary monetary policy implemented in recent years, if anything, the U.S. dollar is more likely to remain strong. Capital inflows to emerging markets are likely to moderate at best (even if no capital flow reversal take place), on the back of weaker commodity prices. Unfortunately, thus, the external front for these economies is not promising.

Strong U.S. growth is good for emerging markets, as external demand for the latter increase. Beyond that effect, a stronger U.S. dollar mitigates the expansionary effect of faster growth in the U.S., via an income effect. The latter, in turn, is particularly strong for commodity exporters and countries with more rigid exchange rate regimes. To a lesser extent, countries that rely on importing capital and intermediate inputs in production could also experience this offsetting income effect via domestic demand. Higher U.S. real interest rate further add to the mitigation/amplification effect through or the tighter/easier financial conditions that usually come along with a more appreciated dollar.

On a positive note, the times ahead look as a good opportunity to assess the strength of the policies and reforms implemented during good times in some emerging market economies. Countries with stronger fiscal frameworks, credible monetary policy, and flexible exchange rates should be better prepared to navigate through the less benign external conditions than those that have not. In the end, as the old saying goes, the test is in the pudding. Let us have a piece—whether we planned for it, or not.

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ANNEX

A.1. List of Countries

LAC	DevAsia	MENA
Argentina	Bangladesh	United Arab Emirates
Belize	Bhutan	Bahrain
Bolivia	Fiji	Algeria
Brazil	Indonesia	Egypt
Chile	India	Iran
Colombia	Lao P.D.R.	Jordan
Costa Rica	Sri Lanka	Kuwait
Dominican Republic	Maldives	Lebanon
Ecuador	Mongolia	Libya
Guatemala	Malaysia	Morocco
Guyana	Nepal	Oman
Honduras	Philippines	Qatar
Jamaica	Papua New Guinea	Saudi Arabia
Mexico	Solomon Islands	Sudan
Nicaragua	Thailand	Tunisia
Panama	Tonga	
Peru	Vietnam	**DevEuro**
Paraguay	Vanuatu	Albania
El Salvador	Samoa	Bulgaria
Suriname		Hungary
Uruguay		Montenegro, Rep. of
Venezuela		Poland
		Romania
		Turkey

A.2. U.S. Dollar Appreciation Cycles—Without Current Appreciation Cycle

	Left-hand varible		Right-hand variable		Sigma
			Mu	I (2009)	
Regime 1 (Appreciation)	Δ REER	Coeff.	3.43	9.49	3.60
		t-stat	2.98	2.55	8.24
		p-value	0.01	0.02	0.00
Regime 2 (Depreciation)	Δ REER	Coeff.	-3.74	9.49	3.60
		t-stat	-4.34	2.55	8.24
		p-value	0.00	0.02	0.00

Descriptive statistics for scaled residuals:
Normality test: Chi^2(2) = 4.3971 [0.1110]
ARCH 1-1 test: F(1,34) = 0.22521 [0.6381]
Portmanteau(6): Chi^2(6) = 10.302 [0.1125]

Regime 1	years	avg.prob.
1979 - 1985	7	0.898
1993 - 2001	9	0.875

Total: 16 years (38.10%) with average duration of 8.00 years.

Regime 2	years	avg.prob.
1970 - 1978	9	0.977
1986 - 1992	7	0.940
2002 - 2011	10	0.953

Total: 26 years (61.90%) with average duration of 8.67 years.

Transition probabilities

	Regime 1, (t)	Regime 2, (t)
Regime 1, (t+1)	0.827	0.173
Regime 2, (t+1)	0.083	0.917