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Demand for Safe Assets and Spillovers from the Global Dollar Cycle

Cian Allen, Rudolfs Bems, Lukas Boer, and Racha Moussa

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Prepared by Cian Allen, Rudolfs Bems, Lukas Boer, and Racha Moussa*

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ABSTRACT: US dollar appreciations can inflict sizable negative cross-border spillovers. We investigate such spillovers from flight-to-safety shocks and the accompanying "global dollar cycle". Results show that negative real sector spillovers from US dollar appreciations fall disproportionately on emerging markets. In contrast, effects on advanced economies are small and short-lived. Emerging market commodity exporters historically experienced larger negative spillovers than commodity importers, reflecting a strong negative link between the US dollar and commodity prices. In terms of policies, more anchored inflation expectations can mitigate the initial negative spillovers while more flexible exchange rates can speed up the subsequent economic recovery.

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Author's E-Mail Address:	callen@imf.org, rbems@imf.org, lboer@imf.org, rmoussa@imf.org

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1 Introduction

During the post–Bretton Woods era of flexible exchange rates, the US dollar has followed pronounced decade-long swings. The most recent sharp US dollar appreciation in 2021–22 is part of these oscillations. An extensive literature has studied determinants of US dollar fluctuations, including contributions from established macroeconomic factors and policies, albeit recognizing their limited explanatory power (see, for example, Dornbusch, 1976; Frenkel, 1976; Rogoff and Obstfeld, 1996; Engel and West, 2005; Gourinchas and Rey, 2007; Engel and Wu, 2024). More recent research has focused on the close association between the US dollar and global financial conditions, with appreciations accompanied by tightening financing constraints (see, for example, Rey, 2013; Miranda-Agrippino and Rey, 2022).

Policymakers and market participants scrutinize US dollar cycles closely because of potential negative cross-border spillovers and ensuing policy challenges, especially in emerging markets (EMs). A large literature has highlighted the impact of global financial cycles on economic activity and policy trade-offs and studied the channels of transmission (see, for example, Rey, 2013; Bruno and Shin, 2015; Kalemli-Özcan, 2019; Kalemli-Özcan and Unsal, 2024).

This paper studies spillovers from US dollar cycles, focusing on fluctuations originating from global 'flight-to-safety' shocks. The first part identifies shocks [indirectly] from uncovered interest parity (UIP) deviations between the US dollar and other major advanced economy currencies, which are attributed to global financial market factors, such as fluctuations in global risk appetite, the convenience yield of safe US dollar assets and/or constraints of global financial intermediaries. We simultaneously control for other potential contributors to UIP deviations, including monetary policy developments and broader US financial conditions. In other words, we use UIP deviations in advanced economies as an instrument for fluctuations in the global dollar cycle and exclude further potential underlying factors.

The second part of the paper examines whether there are systematic cross-border spillovers from the identified 'flight-to-safety' shocks and the resulting dollar cycle. We examine differences in spillovers across countries and study sources of the heterogeneity, including the role that policies play in mitigating spillovers.

The paper estimates cross-border spillovers with a state-dependent local projections (LP) methodology, building on Obstfeld and Zhou (2022). Estimated impulse responses are allowed to vary based on countries' policies and structural characteristics, which can shed light on the trade and financial channels of transmission. Given the lagged nature of spillovers, both short- and longer-term responses for variables of interest are examined. To benchmark the findings, EMs are contrasted with smaller advanced economies.

We find that global financial factors, as captured by the UIP deviations in advanced economies, are an important determinant of the US dollar cycle. The resulting US dollar appreciations inflict sizable negative spillovers on EMs while several country characteristics and policies can mitigate these spillovers. More specifically, negative spillovers from US dollar appreciations fall disproportionately on EMs when compared with smaller advanced economies. Impacts on EMs are large in economic terms; a 1 percent US dollar appreciation decreases output by 0.2 percent during the first year, and the negative effect dissipates only after 10 quarters. In contrast, the negative effects in advanced economies are considerably smaller in size and short-lived, peaking after two quarters and fully dissipating after four quarters.

Among structural characteristics, the paper finds commodity export dependence to be an important contributor to spillovers from US dollar appreciations. Within the EM sample, commodity exporters exhibit larger negative spillovers owing to a deterioration in their terms of trade, reflecting a strong negative link between commodity prices and the US dollar, in which most commodities are invoiced (Boz et al., 2022). The ensuing economic adjustment has contrasting implications for external balances: current account (CA) surpluses for commodity importers, in contrast to a broad balance for commodity exporters.

Policies can mitigate negative spillovers to EMs from US dollar appreciations. First, in line with Obstfeld and Zhou (2022), the paper finds that monetary policy credibility facilitates accommodative policy responses to a US dollar appreciation, including through lower policy rates and real effective exchange rate (REER) depreciations. The result is a shallower initial negative spillover. Moreover, there is evidence that more anchored inflation expectations allow economies to use the CA to smooth out the impact of the negative shock. Second, a more flexible exchange rates systematically speeds up medium-term economic recovery. Following comparable initial negative output spillovers, EMs with more flexible exchange rates exhibit a sizable economic boom three years after the shock. The paper further examines the roles of trade openness, exposure to US dollar liabilities and foreign exchange reserve buffers in mitigating spillovers. Results show that more open EMs exhibit less negative spillovers, while US dollar liabilities have only a marginal impact, after controlling for commodity exposures. Countries with a larger stock of reserve assets intervene systematically in the initial quarters after the shock, but do not exhibit systematic short-run real sector or exchange rate impacts from the intervention.

This paper's identification strategy leans on the macro modeling literature that studies the role of risk premium shocks and, more recently, has emphasized the role of UIP deviations in driving exchange rate fluctuations (Itskhoki and Mukhin, 2021; Eichenbaum et al., 2021; Kekre and Lenel, 2024). Focusing on advanced economies, these papers examine how global financial factors, via UIP deviations, drive US dollar fluctuations. Building on these insights, we empirically measure UIP deviations for advanced economies vis-à-vis the US and estimate spillovers through the accompanying global dollar cycle to EMs.

Our paper is closely linked to a recent strand of literature that puts the US dollar at the center of global financial market booms and busts, which can generate economic spillovers (see Druck et al., 2018; Shin, 2020; Shousha, 2022; Akinci et al., 2023; Obstfeld and Zhou, 2022; Fukui et al., 2023; Jiang et al., 2023; Müller et al., 2023; Niepmann and Schmidt-Eisenlohr, 2023). In particular, Obstfeld and Zhou (2022) link the "global dollar cycle" to large negative spillovers to economic activity in EMs, through both financial and trade channels. Relative to this literature, the main contribution of our paper is the focus on spillovers from global 'flight-to-safety' shocks, identified from UIP deviations between the US dollar and other advanced economies. Our identified shocks drive the global dollar cycle and generate spillovers to EMs. Further, we emphasize the central role of commodities in spillovers and contrast spillovers to EMs and smaller advanced economies.

Another strand of related literature analyzes spillovers from US monetary policy (see Dedola et al., 2017; Kalemli-Özcan and Unsal, 2024; Di Giovanni and Rogers, 2024). Our paper complements such studies, identifying and estimating alternative sources and channels of global spillovers.

Finally, our findings on the role of policies in mitigating spillovers add to a growing literature on this topic. Using alternative methodologies, previous studies have shown that both exchange rate flexibility and inflation targeting can mitigate spillovers from global financial market shocks (Eichenbaum et al., 2021; Obstfeld and Zhou, 2022; Hegarty et al., 2024). Relative to these studies, we focus on the importance of net commodity export exposure, when interpreting the role of other policies and structural characteristics, such as exposure to US dollar liabilities, US dollar invoicing or global value chain participation, for cross-border spillovers.

The rest of the paper is structured as follows: Section 2 characterizes the US dollar cycle and the accompanying UIP deviations. Section 3 presents the empirical estimation framework and data. Section 4 reports the empirical results and Section 5 concludes.

2 The Global Dollar Cycle and UIP Deviations

This section measures 'flight-to-safety' shocks, linking them to US dollar fluctuations. We first briefly present the well-established swings in the US dollar. Next, we derive and discuss sources of UIP deviations for major advanced economy currencies—our proxy for the shocks. Finally, we link the UIP deviations to the US dollar cycle and compare the relationship with other indicators of global financial forces.

US dollar fluctuations are captured with the FED's trade-weighted Nominal Advanced Foreign Economies U.S. Dollar Index[1] (henceforth USD index), as this index is plausibly more exogenous for a study of spillovers to emerging markets.[2] Three decades-long cycles in the USD index since the 1980s are evidenced in Figure 1, including the most recent appreciation during 2021-2022. A similar cyclical pattern emerges for broader specifications of the USD index.

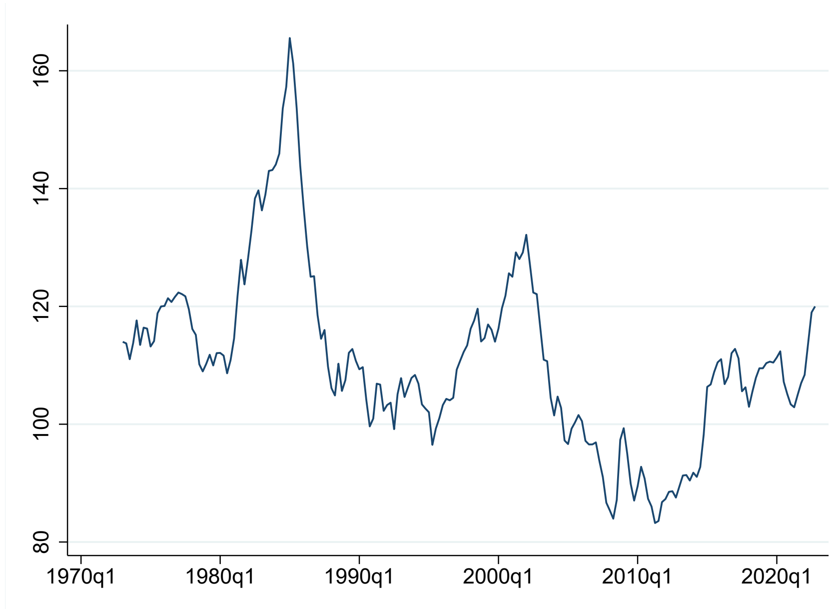
Conventional macroeconomic factors explain some of the cyclical pattern. The literature finds that a tightening of measured domestic financial conditions is associated with a US dollar appreciation, as is an increase in the policy rate differential in the US with respect to that in other advanced economies, while a fall in the external balance is associated with a US dollar depreciation (see Obstfeld and Zhou, 2022; Gourinchas and Rey, 2007; Engel and Wu, 2024). However, such factors explain a limited share of US dollar fluctuations.

We instead study global financial market forces as the source of shocks that trigger US dollar fluctuations. With the rise of financial globalization, the literature has focused on the role of such factors in driving and magnifying exchange rate fluctuations, as captured by, for example, the portfolio-balance approach to capital flows and exchange rates (see, for example, Gabaix and Maggiori, 2015) and renewed

[1] The index includes seven economies: Australia, Canada, Japan, Sweden, Switzerland, United Kingdom and the euro area.

[2] The paper defines exchange rates, including bilateral, nominal effective, and real effective, in terms of foreign currency per US dollar, so that an increase represents an appreciation of the US dollar and a depreciation of the foreign currency (or a basket of currencies, in the case of an effective exchange rate).

Figure 1: Nominal USD Trade-Weighted Index Against Advanced Foreign Economies



Note: 100=January 2006. Series retrieved from Haver Analytics, based on the Nominal Advanced Foreign Economies US Dollar Index from FRED, using goods and services trade weights. Values before 2006 are constructed with services trade data estimates from the Federal Reserve Board. Index constructed as the trade-weighted average against the currencies of seven major advanced economies: Australia, Canada, the euro area, Japan, Sweden, Switzerland, and the United Kingdom.

interest in the exchange rate disconnect puzzle (Itskhoki and Mukhin, 2021). The literature also emphasizes the unique role of the US dollar in global financial markets, linked to safe-haven and liquidity considerations (see, for example, Jiang et al., 2021, 2023).[3]

2.1 Constructing a Measure of UIP Deviations

A notable empirical challenge for studying the role of financial markets is that the underlying financial shocks that have an impact on the US dollar are not directly observable. We address this issue by interpreting the shocks through a prism of UIP deviations. More specifically, to indirectly measure the relevant "flight-to-safety' shocks, we define UIP deviations for a currency pair $j/\$$ as residuals, $\lambda_t^{j/\$}$, from the classic UIP condition. This condition states that, assuming risk neutrality, full arbitrage and rational expectations, investment returns in the currency of country j, $i_t^{j,k}$, at time t and horizon k, should equal corresponding returns in the US dollar, $i_t^{\$,k}$, after adjusting for the expected change in the bilateral nominal exchange rate,

$$\lambda_t^{j/\$,k} = ln(1 + i_t^{j,k}) - ln(1 + i_t^{\$,k}) - (ln(E(S_{t+k}^{j/\$})) - ln(S_t^{j/\$})), \quad (1)$$

[3]Financial markets can also be a key transmission channel through which conventional macroeconomic shocks and policies (such as monetary tightening) affect the exchange rate (see, for example, Miranda-Agrippino and Rey, 2022; Kalemli-Özcan, 2019). Our empirical specification will control for such considerations.

where nominal spot exchange rate, $S_t^{j/\$}$, and expected exchange rate at horizon k, $E(S_{t+k}^{j/\$})$, are expressed in local currency j units per US dollar, so that an increase represents a US dollar appreciation. If $\lambda_t^{j/\$,k}$ equals zero, the UIP condition holds, while $\lambda_t^{j/\$,k} > 0$ implies positive excess returns for the foreign currency over the US dollar.

To construct the relevant aggregate index of UIP deviations, based on equation (1), we focus on major advanced economies included in the Nominal Advanced Foreign Economies U.S. Dollar Index. We use Consensus Economics monthly surveys of exchange rate forecasts by professionals, which cover the 1999Q1-2023Q4 sample of the quarterly macro data used in our spillover analysis.[4] To limit concerns about subjectivity in exchange rate forecasts, horizon k is set at two years.[5] Comparable results for shorter 1-year and 3-months horizons are reported in Annex A. Risk-free interest rates are measured with 2-year government bond yields. To arrive at a quarterly index of UIP deviations that matches our macro data for estimating spillovers, monthly UIP deviations for the individual currencies vis-à-vis the US dollar are aggregated into quarterly averages, and then further aggregated into an index,

$$\lambda_t^{AE} = \sum_j \omega^j \lambda_t^{j/\$}, \tag{2}$$

where USD index weights are used for ω^j. One advantage of this aggregated UIP measure is that it can be directly compared to the USD index.

2.2 Results

Results reveal two key findings. First, the constructed aggregate measure of UIP exhibits persistent deviations from zero (see panel (a) in Figure 2). The swings center on the parity (i.e., UIP holding), with a mean quarterly deviation of mere 0.005.[6] This contrasts with comparable emerging market UIP deviations which are large and positive, capturing compensation for excess risk (see Kalemli-Özcan and Varela, 2021). Second, measured UIP deviations are strongly positively correlated with the USD index. An appreciation (depreciation) of the USD index is associated with excess returns in other major AE currencies (the US dollar), as measured by UIP deviations. The level correlation is 0.86, present in both pre-GFC (1999-2007: 0.85) and post-GFC (2010-2022: 0.82) sub-samples. The correlation is equally strong when computed for quarterly changes (0.80), reported in panel (b) in Figure 2.

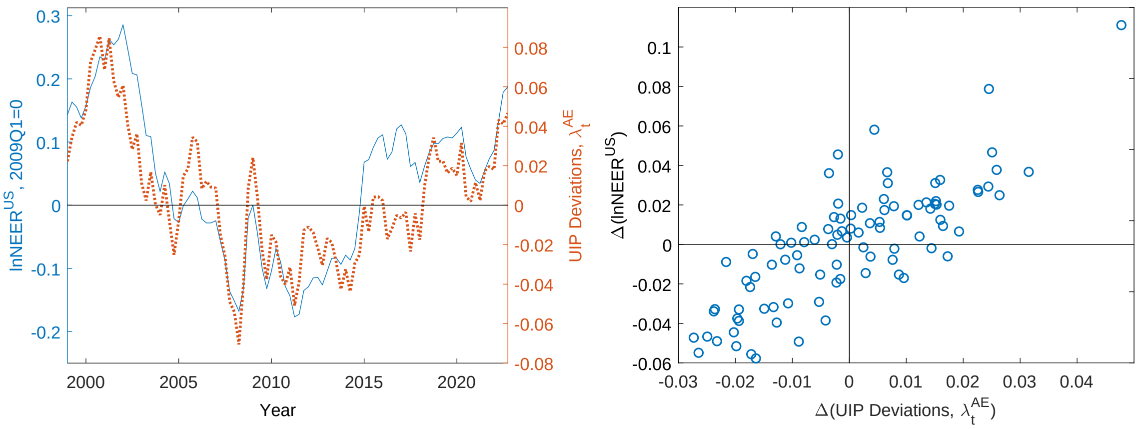
These aggregate findings broadly hold across the underlying individual AE currencies (see Table 1). Correlations of UIP deviations with bilateral US dollar exchange rates are in the 0.66-0.87 range. Country-level correlations remain high against the USD index or our aggregated measure of UIP deviations, λ_t^{AE}. A notable exception is the Japanese yen, which exhibits weaker correlations with the

[4] These surveys have been used by various studies in international finance (see, e.g., De Marco et al., 2021, Kalemli-Özcan and Varela, 2021.

[5] Kremens et al., 2023 find that for major advanced economy currencies Consensus Economics 2-year exchange rate forecasts are broadly consistent with realized exchange rates, while at horizons below one year there is a valid concern about subjective expectations.

[6] This mean deviation, $(1/N)\sum_t \lambda_t^{AE} = 0.005$, can be compared to an absolute average quarterly mean deviation of $(1/N)\sum_t |\lambda_t^{AE}| = 0.026$

Figure 2: USD Index and UIP Deviations with Major Advanced Economy Currencies



(a) In Levels

(b) In First-Difference

Note: NEER is Fed's Nominal Advanced Foreign Economies Dollar Index. UIP deviations is a weighted average of the US dollar UIP deviations against currencies of the 7 advanced economies included in the Fed's Nominal Advanced Foreign Economies Dollar Index (Australia, Canada, Japan, the Euro Area, Sweden, Switzerland and the UK), where bilateral UIP deviations are based on 2-year risk-free interest rates and Consensus Economics' 2-year exchange rate forecasts.

aggregated variables.[7]

How should one interpret the systematic residuals from the parity in equations (1) and (2) and their relationship to the US dollar? If UIP held, i.e. $\lambda_t^{AE} = 0$, as is the case in standard macro models, the global dollar cycle would show no correlation with UIP deviations. Even when UIP does not hold, US dollar fluctuations need not be systematically related to UIP deviations. Risk premium considerations could be one underlying driver of the correlation. When risk appetite falls, the US dollar appreciates, as it is a relatively safe asset. But reduced risk appetite is expected to be temporary, bringing about an increase in risk premia for currency j, which in turn generates (i) positive excess returns for currency j over the US dollar and (ii) the positive correlation between UIP deviations and the USD index. Global financial intermediaries could also be contributing. When faced with higher demand for US dollars, intermediaries demand a higher expected return for supplying dollars.[8] Ultimate sources of financial-market-driven US dollar fluctuations remain an active area of research, beyond the scope of the current study.

The USD index and the UIP deviations exhibit significantly weaker correlations with other commonly examined financial market indicators (see Table 2). The global financial cycle, emphasized by Rey (2013), Bruno and Shin (2015) and Miranda-Agrippino and Rey (2022), is measured as the global common factor

[7]In Annex A we show that this discrepancy for the Japanese yen is driven by the pre-GFC sample, while in the post-GFC data results for the yen are in line with other major AE currencies.

[8]In line with these interpretations, in Annex A a statistical decomposition of UIP deviations for our weighted AE measure, λ_t^{AE}, into contributions from (i) interest rate differentials and (ii) expected exchange rate changes reveals that most movements in UIP deviations are associated with the expected rate of exchange rate depreciation; that is, US dollar appreciations coincide with expected dollar depreciations, while cross-border interest rate differentials vary relatively less.

Table 1: Correlations of Individual Country UIP Deviations $\lambda_t^{j/\$}$ with

	LC/USD	USD index	λ_t^{AE}
GBP	0.66	0.45	0.63
SWK	0.80	0.78	0.91
CHF	0.82	0.66	0.85
CAD	0.81	0.82	0.74
JPY	0.66	0.28	0.40
EUR	0.84	0.78	0.95
AUD	0.87	0.82	0.87
AE Index Average		0.86	1.00

Note: $\lambda_t^{j/\$}$ is the UIP deviation as defined in the text. LC/USD denotes local currency per US dollar. USD index denotes the US dollar index against advanced economies. λ_t^{AE} is derived by calculating individual UIP deviations against the US dollar for each of the 7 advanced economy currencies included in the US dollar index and constructing a weighted average of these deviations using the US dollar index weights. The average weights for AEs in the index are: AUD 2.7, CAD 30.4, JPY 14.3, SWK 1.3, CHF 4.5, GBP 10.6, EUR 36 percent.

estimated from a worldwide cross-section of risky asset prices, covering equity, bonds, and commodities (Miranda-Agrippino et al., 2020). Tightening of financial conditions, as captured by a downswing in the global financial cycle, tends to be accompanied by an appreciation of the global dollar index. However, the correlation (at −0.39) is significantly weaker than the relation between the USD index and UIP deviations. Level-wise correlations with the global financial cycle strengthen significantly if the 2008-10 GFC period is excluded from the sample, but in terms of quarterly differences, the correlation remains significantly below that of USD index and UIP deviations, even when the GFC period is excluded.[9] The Chicago Board Options Exchange Volatility (VIX) Index—a measure of US stock price volatility and one of the components of the global financial cycle—has been explored by the literature (di Giovanni et al., 2021; Obstfeld et al., 2019) as an indicator of global risk sentiment. However, with correlations of around 0.2, the VIX does not correlate significantly with the USD index or UIP deviations for the period of our investigation.[10] Finally, we note that a global commodity price index exhibits negative correlation (−0.56) with the USD index and UIP deviations. We will further explore this link in the discussion of the empirical findings.

Overall, while the other commonly studied measures of global financial conditions exhibit the expected qualitative relationship with our preferred indicator, the correlation in levels and first differences is considerably stronger and more robust between the USD index and UIP deviations.

[9]See Table A4 in Annex A for further details.

[10]The VIX exhibits a strong (0.73) correlation with the USD index only during the pre-GFC sub-period (see Annex A for details).

Table 2: Correlation of USD Index, UIP Deviations and Other Measures of Global Financial Conditions

Variable	USD Index	UIP Deviations	Global Financial Cycle	VIX	Commodity Price Index
USD Index	1.00				
UIP Deviations	**0.86**	1.00			
Global Financial Cycle	−0.39	−0.25	1.00		
VIX	0.16	0.25	−0.42	1.00	
Commodity Price Index	−0.55	−0.56	0.05	−0.18	1.00

Note: Quarterly correlations in levels over 1999:Q1–2022:Q4 depending on data availability. Global financial cycle (GFC) variable from Miranda-Agrippino et al. (2020) ends in 2019:Q2.

3 Empirical Analysis

3.1 Data and Empirical Framework

Building on Obstfeld and Zhou (2022), our main empirical analysis uses a local projections framework (Jordà 2005) to examine the impact of US dollar fluctuations on real, external sector, and financial variables for a broad sample of countries subject to the availability of quarterly data. Our sample consists of 15 advanced and 19 emerging market economies. We retain advanced economies with a weight in the trade-weighted US dollar index vis-à-vis major advanced economies of less than 4 percent in 2023 to increase the size of the advanced economy sample.[11,12] The sample period covers 1999-2023 at the quarterly frequency, with some variation based on the availability of data for different dependent variables.

We aim to identify changes in the US dollar due to shifts in global risk sentiment and flight-to-safety that can be reasonably considered unrelated to emerging markets. To do this, we take the following three steps. First, to limit the feedback from the sample countries to the US dollar, we use a trade-weighted US dollar index against currencies of major advanced economies as the main regressor of interest and exclude countries with a weight in the index greater than 4 percent in 2020 from the sample. Second, we control for the various established global variables, covering US policy rates and their differences with those of other advanced economies, US financial conditions, and an economic activity factor for the sample of spillover countries. Third, we use an instrumental variable approach whereby changes to the trade-weighted nominal US dollar index against a set of advanced economies are instrumented with UIP deviations for our set of advanced economies, λ_t^{AE}. This instrument displays strong relevance in first stage regressions, with very high F-statistics.[13] Taken together, these steps help us to isolate the US dollar

[11] These countries are Australia, Austria, Belgium, Finland, Greece, The Netherlands, Portugal, Spain, and Sweden. The paper's main findings regarding spillovers are robust to dropping from the sample all economies included in the US dollar index. Table B reports details on data sources.

[12] 36 economies are used in the local projection sample. Advanced economies: Australia, Austria, Belgium, Czech Republic, Denmark, Finland, Greece, Israel, Korea, Netherlands, New Zealand, Norway, Portugal, Spain, and Sweden. Emerging markets: Argentina, Brazil, Chile, China, Colombia, Hungary, India, Indonesia, Malaysia, Mexico, Pakistan, Peru, Philippines, Poland, Romania, Russia, South Africa, Thailand, and Türkiye.

[13] Table C1 shows the first-stage regression results of the endogenous variable, the trade-weighted nominal US dollar in-

fluctuations that can be attributed to shifts in financial factors that are unrelated to other macroeconomic factors such as monetary policy or changes in productivity.

As a starting point, similarly to Ramey and Zubairy (2018), we use panel local projections with instrumental variables (LP-IV) and estimate the following equation:

$$y_{i,t+h} - y_{i,t-1} \quad = \quad \mu_{i,h} + \beta_h \hat{\Delta s}_t + \gamma_h' \Delta z_t + \sum_{l=1}^{p} \delta_{h,l}' \Delta w_{i,t-l} + \varepsilon_{i,t+h}, \text{ for } h = 0, 1, ..., H, \tag{3}$$

where the dependent variable, y, is the cumulative change in the variable of interest over the t-1 to t+h horizon, with h extending to 12 quarters. $\hat{\Delta s}_t$ are changes in the US dollar index that are instrumented with the change in UIP deviations constructed earlier, i.e., λ_t^{AE}. We include country-horizon fixed effects, $\mu_{i,h}$, to allow for country-specific trends that vary with the horizon. Δz_t is a set of global factors mentioned above, and includes: (i) the US effective federal funds rate (the shadow rate is used at the zero lower bound), (ii) the policy rate differential between the US and the weighted rate for the countries in the US dollar index against advanced foreign economies (using the same weights), (iii) the Chicago Fed's Adjusted National Financial Conditions Index, and (iv) a common factor for economic activity. In addition to these global controls, the specification includes a set of lagged country-specific controls, Δw, — namely GDP growth, the policy rate, and the bilateral exchange rate against the US dollar—as well as lags of the global control variables, the change in the US dollar index, and the dependent variable. Consistent with previous papers using quarterly data, p is set to 4. We use heteroskedasticity-robust standard errors.

To study how our results differ across country groups and to measure the differential impact of country characteristics and policies, we use a state-dependent local projection specification, building on Ramey and Zubairy (2018) and Cloyne et al. (2023). Here, the effect of the (instrumented) US dollar appreciation is allowed to differ based on predetermined characteristics for the sample economies. For binary state dependence, the estimation specification is

$$\begin{aligned} y_{i,t+h} - y_{i,t-1} = I_{i,t-1}[\mu_{A,i,h} + \beta_{A,h} \hat{\Delta s}_t + \gamma_{A,h}' \Delta z_t + \sum_{l=1}^{p} \delta_{A,h,l}' \Delta w_{i,t-l}] \\ + (1 - I_{i,t-1})[\mu_{B,i,h} + \beta_{B,h} \hat{\Delta s}_t + \gamma_{B,h}' \Delta z_t + \sum_{l=1}^{p} \delta_{B,h,l}' \Delta w_{i,t-l}] + \varepsilon_{i,t+h} \end{aligned} \tag{4}$$

where $I_{(i,t-1)}$ is a binary time-varying indicator for an aspect of heterogeneity. For example, the results in the next section are estimated for I_i indicating whether an economy is advanced or emerging. $I_{(i,t-1)}$ can also indicate policy and structural features, such as managed or free-floating exchange rate.[14]

When the characteristic or policy variable capturing the state is continuous, the estimation specification is

dex against a set of advanced economies on the instrument with and without controls. The F-stats clearly indicate a strong instrument.

[14] For policies and structural features that do not vary across time, the indicator is I_i.

$$
\begin{aligned}
y_{i,t+h} - y_{i,t-1} = \mu_{i,h} + \beta_{A,h}\hat{\Delta s}_t + \gamma'_{A,h}\Delta z_t + \sum_{l=1}^{p} \delta'_{A,h,l}\Delta w_{i,t-l} \\
+ \mathbf{V_{i,t-1}}[\beta_{B,h}\hat{\Delta s}_t + \gamma'_{B,h}\Delta z_t + \sum_{l=1}^{p} \delta'_{B,h,l}\Delta w_{i,t-l}] + \varepsilon_{i,t+h}
\end{aligned}
\tag{5}
$$

where $\mathbf{V_{i,t-1}}$ is a vector of demeaned country-specific characteristics, which can be time-varying.[15] As we will be primarily interested in explaining the differential impact between smaller advanced and emerging market economies, this state-dependent empirical framework will be our primary focus. In cases where there are important interactions among country characteristics and policies, $\mathbf{V_{i,t-1}}$ can accommodate simultaneous dependence on multiple characteristics.

4 Results

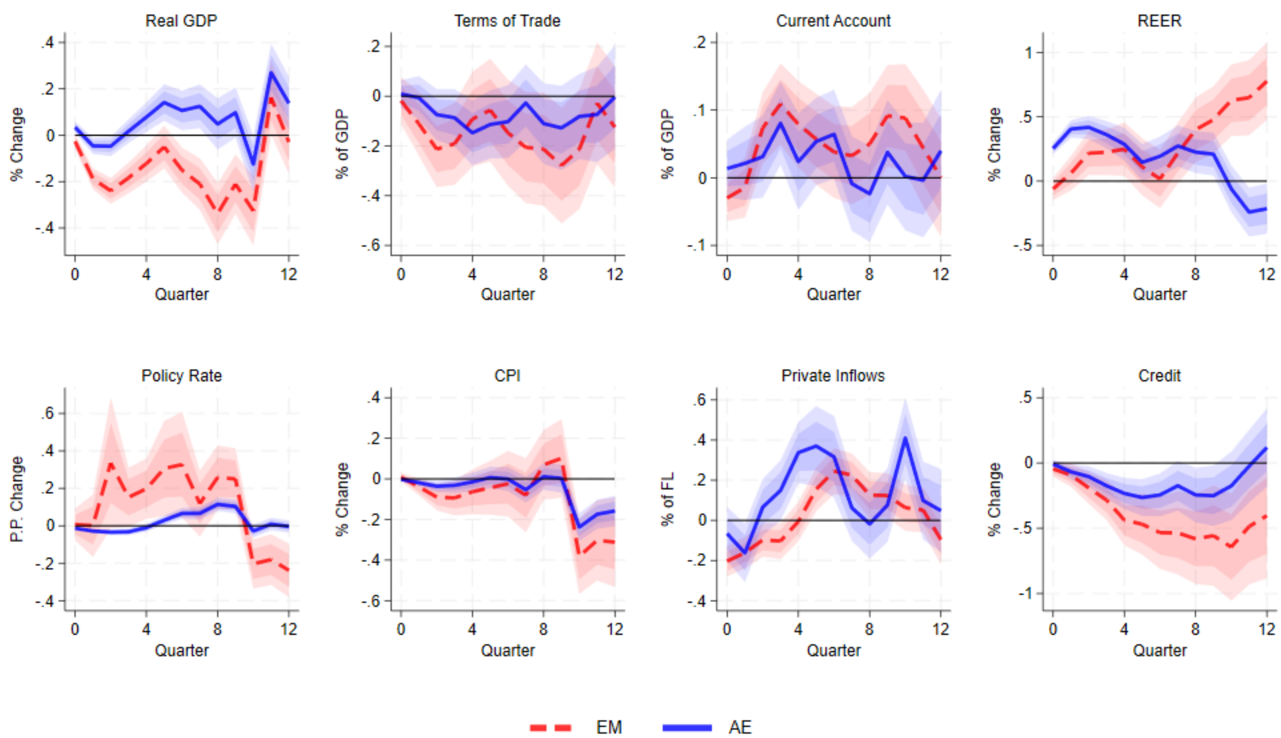
4.1 Spillovers to Advanced and Emerging Market Economies

US dollar appreciations affect emerging markets more adversely than advanced economies, with the former experiencing deeper and longer-lasting contractions (Figure 3). An appreciation of the US dollar index by 1 percentage points is associated with a decline in real output by 0.22 percent in emerging markets and 0.05 percent in advanced economies 2 quarters after the initial appreciation. Output in advanced economies recovers 3 quarters after the appreciation, while emerging market output remains depressed until 10 quarters out. The estimated large negative real spillovers for emerging markets confirm the findings in Obstfeld and Zhou (2022) and are consistent with results of several other recent studies, including Druck et al. (2018), Shousha (2022), and Fukui et al. (2023).

Figure 3 Panel (4) shows exchange rate responses to US dollar appreciations. An immediate exchange rate depreciation facilitates external sector adjustment in advanced economies. For this country group, the REER remains depreciated for eight quarters, allowing the expenditure switching channel to contribute to the external sector adjustment. Subsequent analysis of the role of exchange rate flexibility further highlights the benefits stemming from the shock-absorbing role that the exchange rate plays in response to US dollar appreciations. By contrast, in emerging markets the REER does not respond to a US dollar appreciation on impact, consistent with well-documented fear of floating for this country group and depreciates only gradually over subsequent quarters. In the absence of an exchange rate adjustment, income compression plays an outsized role, driving a large fall in imports (not shown). The response of terms of trade also contributes to the diverging output responses, as emerging markets as a group experience a deterioration during the first year. In response to US dollar appreciations, the current account, as a share of GDP, increases in both emerging markets and smaller advanced economies. The impact is sizable in economic terms: a 1 percent appreciation in the US dollar increases the current account after five quarters by about 0.1 percent of GDP in emerging markets and advanced economies.

[15] For policies and structural features that do not vary across time, the indicator is $\mathbf{V_i}$.

Figure 3: Spillovers from a US Dollar Appreciation: AE versus EM



Note: This figure plots the impulse responses for a 1% appreciation in the nominal US dollar AE Index with 90% and 68% confidence bands reported. Full sample of countries.

Financial transmission channels magnify the adverse spillovers in emerging markets. Contemporaneously with the US dollar appreciation, private capital inflows to emerging markets decline.[16] In terms of domestic financial conditions and policies, in advanced economies US dollar appreciations are initially associated with accommodative monetary policy, mitigating negative spillovers. Accordingly, the decline in domestic credit is shallow. In contrast, policy rate responses in emerging markets reveal a systematic and long lasting tightening, accompanied by a significant negative effect on CPI during the initial quarters. Domestic credit declines persistently, extending beyond the 12-quarter horizon.[17] These findings are broadly consistent with an extensive literature that has focused on financial transmission channels of global financial shocks to emerging markets (see, for example, Gourinchas (2018); di Giovanni et al. (2021); Kearns and Patel (2016)).

[16]The responses of private capital inflows tend to decrease on impact and recover after 4 quarters, albeit while displaying high volatility. Given the large differences in the magnitude of the inflows between advanced economies and emerging markets, we divide inflows by the lagged stock of portfolio liabilities. Using GDP does not change the qualitative results.

[17]Stock prices also decline by more in emerging markets than in advanced economies.

4.2 Policy Regimes and Structural Characteristics in Emerging Markets

To investigate why emerging markets experience larger negative spillovers than advanced economies, this section analyzes how US dollar appreciations differentially affect economies based on their policies and structural characteristics. The set of examined factors is motivated by the commonly studied policies at countries' disposal and structural characteristics that interact with US dollar fluctuations, including monetary and exchange rate regimes, commodity dependence as well as trade openness and exposures to the US dollar (see Table B8). For each factor considered, the analysis estimates state-dependent responses based on either a sample split into two contrasting subgroups, mirroring the estimation procedure for AEs and EMs (see equation (4)) or the country value of the factor (see equation (5)). To avoid US dollar fluctuations—our shock variable—impacting the country characteristics, we specify factors capturing policies and characteristics as country-specific averages over the sample period.[18]

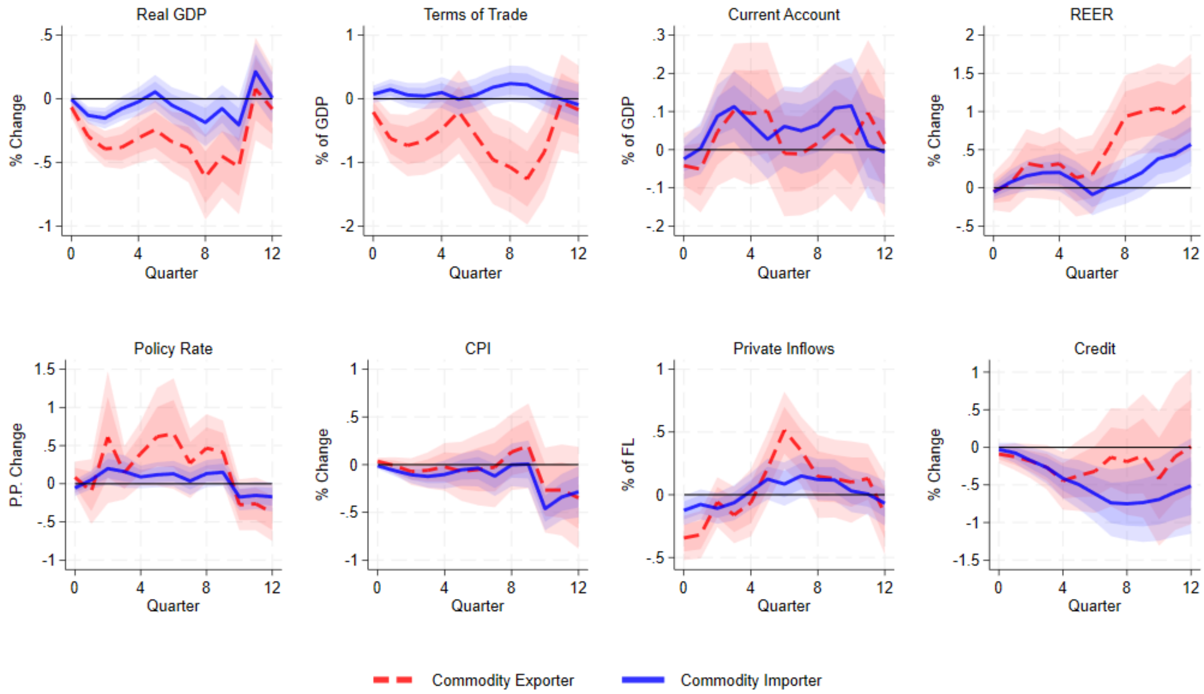
Identifying contributions to spillovers from individual country characteristics presents several challenges. First, the examined characteristics are closely correlated with the split of the sample between emerging market and advanced economies (see Figure B3 for more details). The issue is most striking for the extent of monetary policy anchoring, where all of the less anchored countries are found among emerging markets. Hence, any identification of this characteristic's contribution to spillovers requires limiting the sample to emerging markets. This issue is a concern for the other examined characteristics as well, except commodity dependence, which is more evenly distributed within the two country groups.

Second, many of the country characteristics are closely correlated with one another, complicating the identification of individual impacts on spillovers (see Table B5). An instructive example is the relation between exchange rate regimes and the extent of US dollar invoicing (see table B6); countries with floating exchange rate regimes disproportionately exhibit low shares of US dollar invoicing, while countries with less flexible exchange rate regimes exhibit high shares of US dollar invoicing. This issue is also pervasive for commodity dependence. Categorization results reveal that commodity-exporting countries are disproportionately associated with higher US dollar liabilities, lower GVC participation and higher share of US dollar invoicing of exports (see Figure B4). These relationships hold in the full sample as well as within EMs and AEs. Commodity exporters in EMs also tend to have less flexible exchange rates regimes and lower trade openness.

To address these identification challenges, we limit our analysis to heterogeneity within EMs. We start by examining commodity dependence as a key exogenous structural feature, motivated by the fact that most characteristics are endogenous, collinear, or both, which complicates identification. In contrast, commodity dependence is slow moving over the study's time frame and should arguably not respond to policies and other structural features. Next, we present results for monetary policy anchoring, as this feature is least correlated with commodity exporting status (see top left panel in Figure B4) and does not exhibit significant correlations with other country characteristics (see Table B5). We separately report

[18]This is a concern for all considered factors except the exchange rate regime, where a country's grouping into "free float" and "other" categories is allowed to vary over time.

Figure 4: Spillovers from a US Dollar Appreciation: Commodity Importer versus Exporter



Note: Emerging market sample only. This figure plots the impulse responses for a 1% appreciation in the nominal US dollar AE Index with 90% and 68% confidence bands reported. Commodity importer and exporter responses report results at the 10th and 90th percentile of net commodity export range, with corresponding values reported in Table B7.

results differentiating across exchange rate regimes given the centrality of exchange rate adjustments in response to external shocks. The effect of the exchange rate regime is estimated conditional on commodity dependence, though exchange rate flexibility is highly correlated with other country characteristics (see, e.g., table B6), complicating the interpretation. Finally, we examine the role of other country characteristics, conditional on commodity dependence, relating our findings with comparable results in the literature.

4.2.1 Commodity Dependence

In response to US dollar appreciations, commodity exporters exhibit larger negative spillovers owing to concurrent deteriorations in their terms of trade (Figure 4 panel 1 and 2). The magnitude of the terms-of-trade deterioration is sizable, with a 1 percent US dollar appreciation decreasing the terms of trade by 0.7 percent after three quarters. On the flip side, commodity importers' terms of trade remain broadly unaffected. These contrasting terms-of-trade responses drive the difference in spillovers between the commodity-exporting and commodity-importing emerging market economies.[19]

Notably, there is no evidence that the REER depreciates disproportionately for commodity exporters to compensate for the fall in the price of commodity exports, consistent with fear of floating.[20] The results also reveal no evidence for accommodative monetary policy in commodity exporters, which tighten monetary policy significantly from the 3rd quarter onward. Overall, the strong negative link between the US dollar and commodity prices is an important cross-border transmission channel for the negative spillovers.

For commodity importers, the small but positive terms of trade response contributes to the less negative spillovers from a US dollar appreciation. The decline in output is shallower, with the eventual REER depreciation further buffering the spillovers from the negative shock.

We can leverage the more evenly balanced distribution fo commodity dependence in EM and AE samples, to gain further insights on the role of commodity dependence from the AE sample (see Figure C1). Despite a sizable negative terms of trade response for commodity exporters in AEs—comparable to that of EMs—their output is not affected more negatively than for commodity importing AEs. This difference with emerging market commodity exporters can partly be explained with policies. AE commodity exporters exhibit more anchored inflation expectations. Accordingly, after the US dollar appreciation and the accompanying fall in commodity prices, AE commodity exporters allow their REER to depreciate significantly more than commodity importers' (see panel 4 in Figure C1). This stands in stark contrast with no significant REER adjustment for commodity exporting in EMs (see panel 4 in Figure 4). AE commodity exporters also pursue more accommodative monetary policy than AE commodity importers.

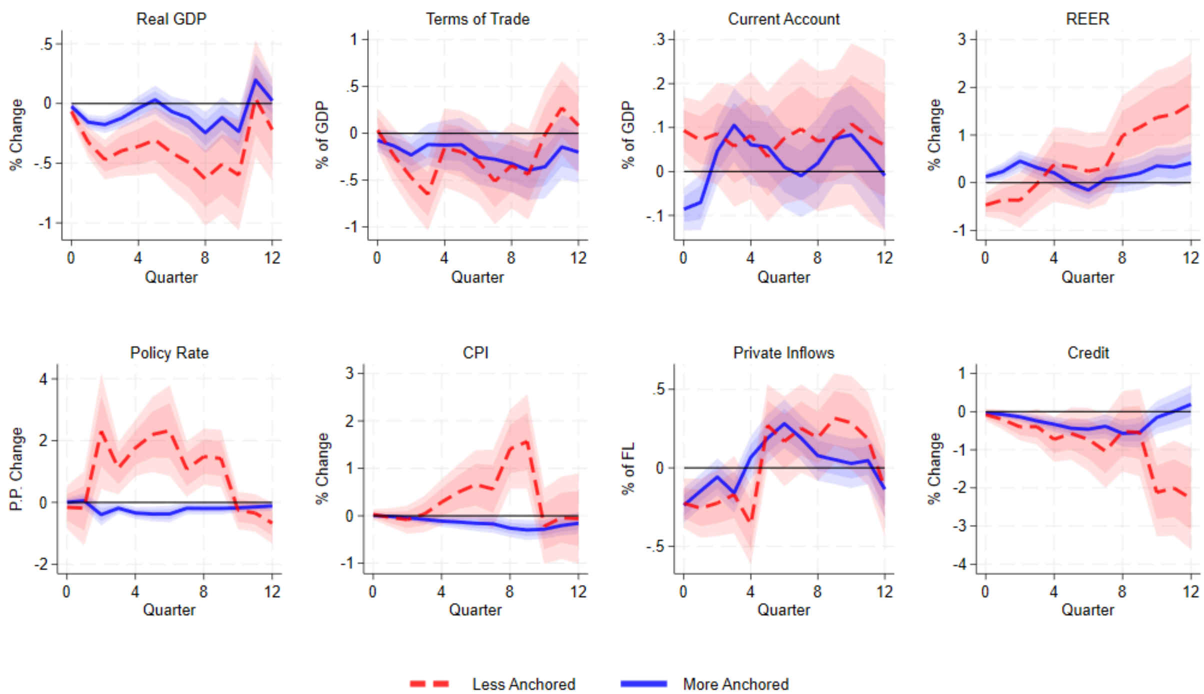
4.2.2 Monetary Policy Credibility

Monetary policy anchoring mitigates negative spillovers from US dollar appreciations by facilitating accommodative policy responses. Emerging markets with more anchored inflation expectations exhibit a shallower initial decline in output. The difference between emerging markets with more and those with less anchored inflation expectations is statistically significant (see Figure 5). When inflation expectations are anchored, the REER depreciates on impact, and the policy rate becomes more accommodative. Credibility of monetary policy limits imported inflation (see Bems et al, 2021) and thus creates room for these policy adjustments. Further, countries with more anchored inflation expectations smooth the temporary drop in output by decreasing current account balances (see Figure 5, Panel 3). In contrast, policy rates increase in emerging markets with less anchored monetary policy, and the REER appreciates on impact,

[19] The strong link between the US dollar appreciation and the terms of trade deterioration for net commodity exporters is consistent with the negative correlation between the USD index and commodity prices in Table 2. Furthermore, commodity prices are highly sensitive to US dollar changes. Obstfeld (2022) reports a coefficient of -2.45 (standard error of 0.42, $R^2 = 0.15$) for a simple OLS regression of oil price changes in dollar appreciations. Annex D puts forward a model to rationalize the link between the US dollar and commodity prices via a global demand channel.

[20] The same holds for the bilateral exchange rate against the US dollar (not shown).

Figure 5: Spillovers from a US Dollar Appreciation: Monetary Policy Credibility



Note: Emerging market sample only. This figure plots the impulse responses for a 1% appreciation in the nominal US dollar AE Index with 90% and 68% confidence bands reported. Responses for more anchored and less anchored report results at the 10th and 90th percentile of the anchoring index range, with corresponding values reported in Table B7.

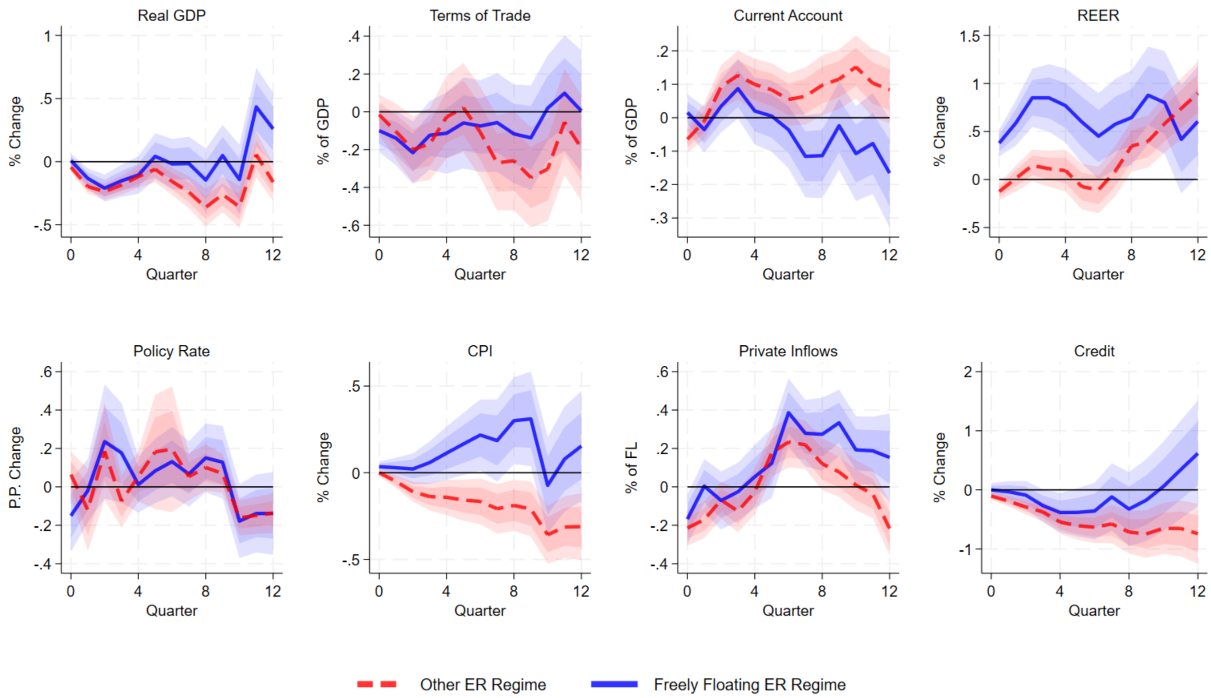
thereby contributing to larger negative spillovers.[21]

4.2.3 Exchange Rate Flexibility

In support of the shock-absorbing properties of flexible exchange rates, emerging markets with freely floating exchange rate regimes exhibit systematically faster recoveries in output than emerging markets with less flexible exchange rates (see Figure 6), with statistically significant differences by the end of the estimation horizon. The REER in countries with freely floating exchange rate regimes depreciates sizably on impact and remains depreciated into the medium term. Through REER depreciation, emerging markets with freely floating exchange rate regimes avoid the deflationary impact of the US dollar appreciation. In contrast, the REER in countries with other exchange rate regimes does not depreciate during the first two years and there is a persistent deflationary impulse on CPI. In the medium term, credit declines in countries with other exchange rate regimes whereas it recovers in countries with freely floating exchange rate regimes. Medium term private capital inflows also outperform under the freely

[21] Controlling for commodity dependence does not affect these findings, as terms of trade do not respond differently for emerging markets with more and those with less anchored monetary policy (see Figure 5, Panel 2).

Figure 6: Spillovers from a US Dollar Appreciation: Exchange Rate Regime



Note: Emerging market sample only. Estimation controls for commodity dependency as an additional country characteristic. This figure plots the impulse responses for a 1% appreciation in the nominal US dollar AE Index with 90% and 68% confidence bands reported.

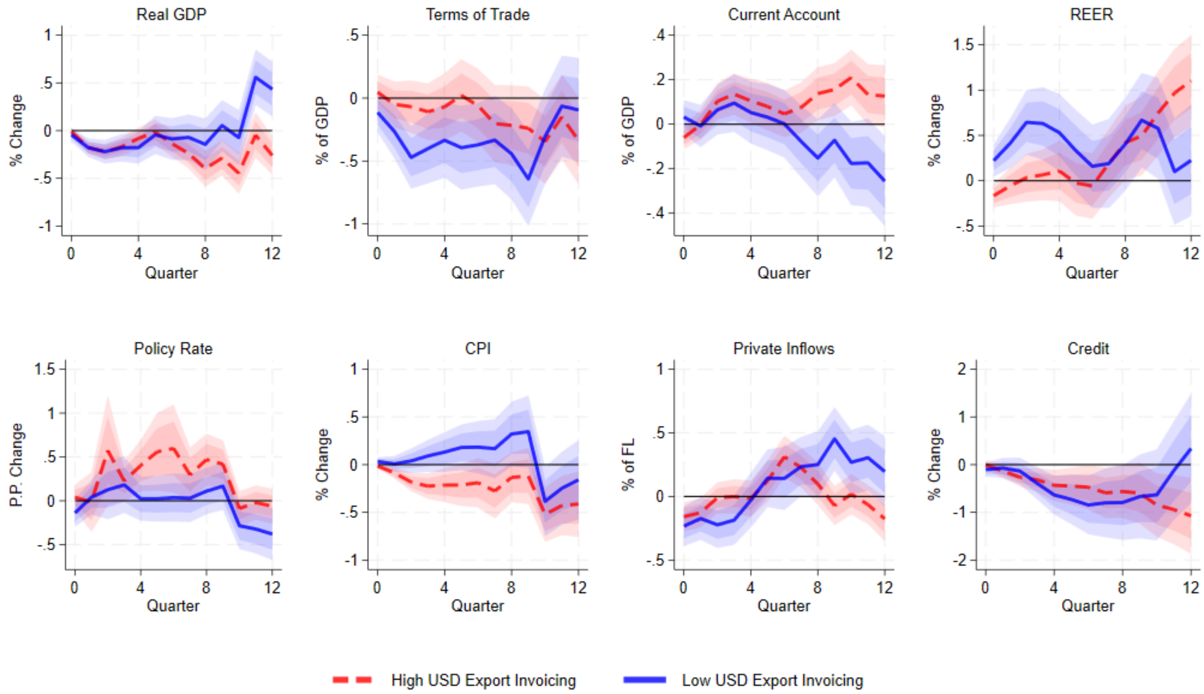
floating regime. The current account tends to increase with less flexible regimes, whereas it decreases as output recovers in countries with freely floating exchange rate regimes.

It is important to note in interpreting these charts, that exchange rate regimes are highly correlated with the share of exports invoiced in US dollars—a correlation of -0.9 systematically relates freely floating regimes with lower US dollar share in export invoicing. As a result, findings for the role of US dollar invoicing are very similar to those of the exchange rate regime (see Figure 7). A lower share of US dollar invoicing in exports speeds up the output recovery in the medium term, facilitated by REER depreciation, while emerging markets with a high US dollar invoicing share tighten monetary policy, exhibit a significant initial deflationary impulse for CPI and their REER does not depreciate during the initial 8 quarters. Responses for the current account, private inflows and credit also mimic those in Figure 6.

Both country characteristics—exchange rate regime and USD export invoicing share— highlight benefits of exchange rate flexibility in mitigating negative spillovers from US dollar shocks.[22] However,

[22]Because exchange rate regime and US dollar export invoicing both vary systematically with commodity dependence, Figures 6 and 7 control for commodity dependece as an additional country characteristic. Findings for the exchange rate regime and US dollar invoicing remain unchanged if commodity dependence is not controlled for (see C2 and C3).

Figure 7: Spillovers from a US Dollar Appreciation: US Dollar Export Invoicing



Note: Emerging market sample only. Estimation controls for commodity dependency as an additional country characteristic. This figure plots the impulse responses for a 1% appreciation in the nominal US dollar AE Index with 90% and 68% confidence bands reported. Responses for low and high USD export invoicing report results for the 10th and 90th percentile of the USD export invoicing shares, with corresponding values reported in Table B7.

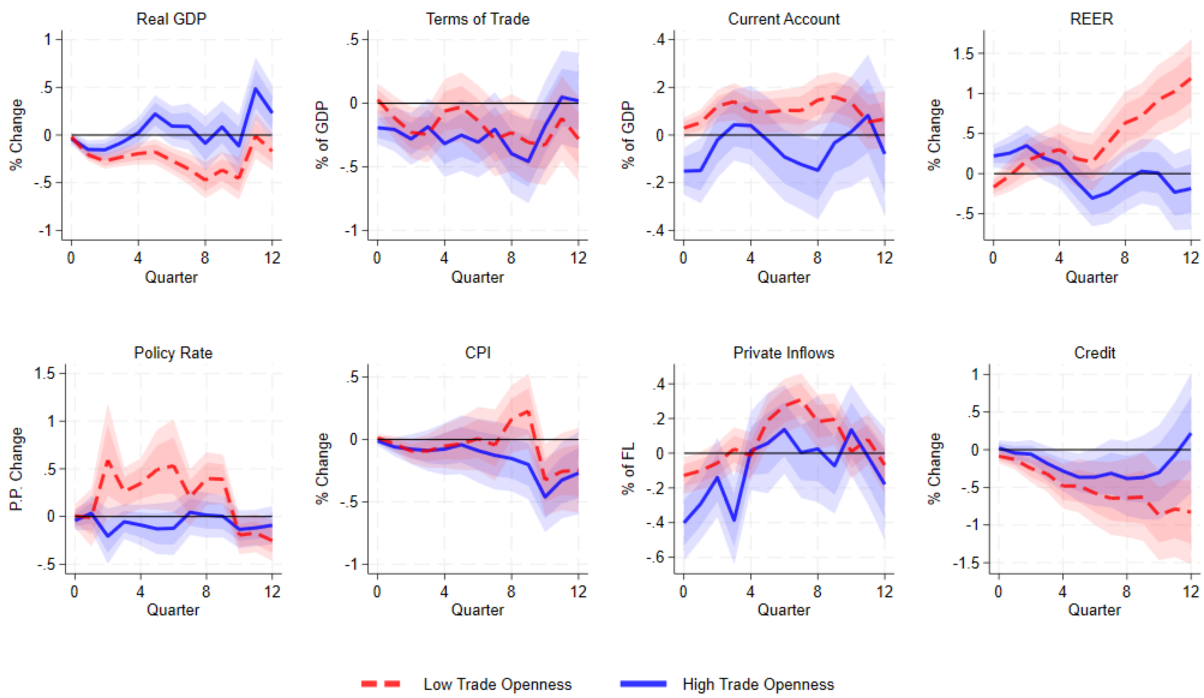
collinearity does not allow us to differentiate the impact of the two.

4.2.4 Other Characteristics

The focus above on commodity dependence, monetary policy credibility, and exchange rate flexibility is motivated by concerns about identification of conditional impulse responses to US dollar fluctuations among the sample countries of this paper, which examines aggregate data. It should not be interpreted as evidence that other policies or structural features do not affect spillovers from US dollar fluctuations to emerging markets. In what follows, we examine other factors while controlling for commodity dependence.

Trade Openness In emerging markets with high trade openness negative output spillovers from US dollar appreciations are shallower and limited to initial three quarters, resembling impacts for advanced economies (see Figure 8). For such emerging markets, REER depreciates on impact and there is sizable initial decrease in the current account balance, smoothing the impact of the negative output spillover. In contrast, emerging markets with low trade openness see a protracted fall in output, extending to 10 quarters, accompanied by a significant monetary tightening and and initial REER appreciation.

Figure 8: Spillovers from a US Dollar Appreciation: Trade Openness



Note: Emerging market sample only. Estimation controls for commodity dependency as an additional country characteristic. This figure plots the impulse responses for a 1% appreciation in the nominal US dollar AE Index with 90% and 68% confidence bands reported. Responses for low and high trade openness report results for the 10th and 90th percentile of the trade openness measure, with corresponding values reported in Table B7.

One concrete factor contributing to trade openness is global value chain (GVC) participation, simultaneously expanding country's gross imports and exports. Not surprisingly, GVC participation and trade openness in our sample emerging markets are highly positively correlated (+0.9), with estimated impulse responses that are very similar for high/low trade openness and high/low GVC participation (see Figure C4).

US Dollar Liability Exposure In line with the dollar currency mismatch channel (see (Jiang et al., 2023)) countries with more US dollar denominated foreign liabilities tend to be systematically hit harder by US dollar appreciations (see Section (a) in Figure C5). However, bulk of the significant negative output response stems from the more exposed countries being commodity exporters simultaneously hit by the terms of trade decline. Once the role of commodity dependence is controlled for, the output response for emerging markets with higher US dollar liability exposure is only marginally more negative than for less exposed EMs (see Section (b) in Figure C5). REER in highly exposed emerging markets appreciate on impact, as monetary policy is tightened. In contrast, emerging markets with low US dollar exposure depreciate REER in the short run and mitigate the negative output spillovers by decreasing policy rates.

Among other examined policies and structural features, countries with a higher stock of reserve assets are estimated to systematically intervene to buffer the ER movement (Figure C6), but they do not seem to have significantly different short-run exchange rate or GDP responses to the shock (Figure C7).

4.3 Robustness

In this section, we summarize additional sensitivity analysis for our baseline results. Overall, our results are robust to various changes in the specification.

In addition to the global controls in equation (4), we control for several monetary policy shocks, one at a time: Bauer and Swanson (2023) monetary policy surprises that are orthogonal to available information; Jarociński and Karadi (2020) monetary policy and central bank information effect shock series; Bu et al. (2021) monetary policy shocks; Gürkaynak et al. (2005) target and path series of monetary policy surprises and Nakamura and Steinsson (2018) monetary policy shocks as updated by Acosta (2023). Including these shocks does not change our baseline results. We separately control for oil supply shocks from Baumeister and Hamilton (2019), with similar results, as output declines in emerging market economies by more than in advanced economies (see Figure C8).

Our main results hold when we drop fixed exchange rate regimes from our sample allaying concerns that these observations were driving the results for EMs.[23] Figure C9 shows the results for EMs versus AEs and for EMs differentiated by exchange rate regimes. Restricting the sample to the pre-COVID19 period yields stronger rebound in output one year after the shock (Figure C10), but output response differences between EMs and AEs remain.[24]

Several modifications to equation (3) were estimated to examine the robustness of the impulse responses: removing global controls increases the magnitude of the decline in output for both advanced and emerging economies, reflecting that these global controls explain some of the impact from a US dollar appreciation on growth. It remains that advanced economies experience a shallower contraction in output that is shorter lived.

Finally, removing all the advanced economies that are included in the US dollar trade weighted index against advanced economies does not have a major impact on point estimates, although error bands expectantly increase with the smaller sample. The countries excluded from the sample are Australia, Austria, Belgium, Finland, Greece, Netherlands, Portugal, Spain, and Sweden.

5 Conclusion

Negative spillovers from US dollar appreciations are more pronounced in emerging market economies, with larger declines in output that are longer lived compared with those in advanced economies. A depreciation in the REER facilitates adjustment in advanced economies. Consistent with fear of floating, the REER does not adjust on impact in emerging markets and depreciates only gradually. Financial

[23] Ilzetzki et al. (2019) coarse classification 1 is dropped from the sample.
[24] The sample ends in 2019Q4.

channels contribute to the adverse spillovers in emerging markets through reduced capital inflows, and a decline in domestic credit.

Commodity export exposure magnifies spillovers from a US dollar appreciation. Given the historically negative relationship between commodity prices and the US dollar index, a US dollar appreciation is accompanied by deteriorating terms of trade for commodity exporters. In the absence of a real exchange rate depreciation that could buffer both shocks, emerging market commodity exporters exhibit more negative output spillovers.

Policies can mitigate negative spillovers from US dollar appreciation to emerging markets. More anchored inflation expectations mitigate the negative effect on real output through accommodative policy responses, as the real exchange rate depreciates and policy rates decrease. A more flexible exchange rate systematically speeds up economic recovery.

Beyond the policy advice for emerging markets to manage the spillovers from the global dollar cycle, an analysis of multilateral policy that could affect the global dollar cycle would require a deeper understanding of UIP deviations, which this paper has uncovered as a key driver of the global dollar cycle. UIP deviations can be attributed to the market-wide risk appetite and variations in the risk premia demanded by global financial intermediaries, which in turn reflect intermediary frictions, including spillover from financial regulation in other segments of the financial system. One indirect contribution of the paper is to bring attention to these issues that warrant further research.

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A Additional Results for UIP Deviations and the US Dollar Cycle

This annex reports data sources and construction details for UIP deviations. Also included are expanded findings and robustness results.

A.1 Data Sources and Construction Details

Table B8 reports data sources for variables used in the construction of UIP deviations. We implement the UIP calculation in equation (1) for the specific date on which Consensus Economics exchange rate forecast survey is published each month by selecting interest rates and spot exchange rates for the corresponding day.

For Switzerland and Sweden, where forecasts are reported for the local currency against the euro, we convert the forecast to local currency against the $ by using the corresponding euro/$ forecast. When calculating UIP deviations for euro/$, relevant interest rates are proxied with interest rates for Germany.

For interest rate data, we examine three separate types: (i) money market rates, (ii) deposit rates and (iii) yields on government's local currency borrowing. We find that for a given horizon, measured UIP deviations are very similar across the different type of interest rates. For example, at the 1-year horizon, where the three types of rates are available for all sample countries, correlations between aggregated measures of UIP deviations, constructed using money market rates, deposit rates or government yields exceed 0.99. Results reported in the paper are based on local currency government bond yields.

A.2 Extended Results and Robustness Analysis

This section reports (i) UIP deviations for shorter 3-months and 1-year investment horizons, (ii) individual currency pairs' UIP correlations with the US dollar exchange rate, USD index and an aggregated measure of UIP deviaitons in first differences, as well as for pre- and post-GFC periods, (iii) decomposition results for UIP deviations into 'interest rate differential' and 'exchange rate adjustment' components and (iv) further details on correlations of the USD index and UIP deviations with other measures of global financial conditions.

A.2.1 UIP deviation results for 1-year and 3-months horizons

Results for UIP deviations at the 1-year horizon are broadly similar to the 2-year horizon. UIP deviations are centered around zero, with a mean deviation of 0.002, while the mean of absolute value of deviations (at 0.020) is 23% smaller than for the 2-year horizon (at 0.026). UIP deviations are strongly correlated with the USD index (see panel (a) in Figure A1) and this correlation is broad based across the underlying individual AE currencies (see Table A1). Notably, the Japaneses yen, as well as the British pound, show weaker correlations.

Results for the 3-months horizon contrast starkly with the 1-year and 2-year horizons. While the deviations are still centered around zero (at -0.005), they are 56% smaller than for the 2-year horizon.

Table A1: Correlations of Individual Country 1-Year UIP Deviations, $\lambda_t^{j/\$}$, with

Currency	LC/USD	USD index	λ_t^{AE}
GBP	0.27	0.46	0.75
SWK	0.59	0.66	0.87
CHF	0.82	0.56	0.85
CAD	0.67	0.67	0.74
JPY	0.40	0.10	0.31
EUR	0.71	0.65	0.95
AUD	0.70	0.62	0.87
AE Index Average	–	0.69	1.00

Note: $\lambda_t^{j/\$}$ is the UIP deviation as defined in the text. LC/USD denotes local currency per US dollar. USD index denotes the US dollar index against advanced economies. λ_t^{AE} is derived by calculating individual UIP deviations against the US dollar for each of the 7 advanced economy currencies included in the US dollar index and constructing a weighted average of these deviations using the US dollar index weights.

UIP deviations at the 3-months horizon do not show a significant correlation with the USD index (see panel (b) in Figure A1 and Table A2). The aggregated measure of UIP deviations has a correlation of 0.18 with the USD index and the underlying individual currency correlations are in the -0.38 to 0.57 range.

Table A2: Correlations of Individual Country 3-Months UIP Deviations, ($\lambda_t^{j/\$}$), with

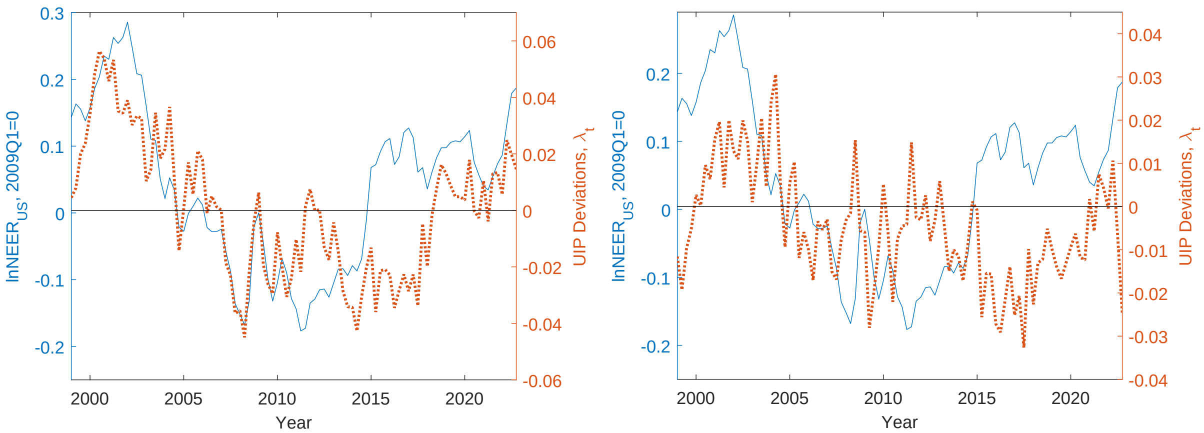
Currency	LC/USD	USD index	λ_t^{AE}
GBP	-0.38	0.21	0.81
SWK	0.06	0.18	0.86
CHF	0.58	0.22	0.77
CAD	0.27	0.28	0.74
JPY	-0.16	-0.34	0.21
EUR	0.32	0.29	0.89
AUD	0.20	0.12	0.82
AE Index Average	–	0.18	1.00

Note: $\lambda_t^{j/\$}$ is the UIP deviation as defined in the text. LC/USD denotes local currency per US dollar. USD index denotes the US dollar index against advanced economies. λ_t^{AE} is derived by calculating individual UIP deviations against the US dollar for each of the 7 advanced economy currencies included in the US dollar index and constructing a weighted average of these deviations using the US dollar index weights.

A.2.2 Additional correlations of individual country UIP deviations, $\lambda_t^{j,/\$}$, with the US dollar

Table A3 elaborates on results in Table 1 by reporting comparable correlations in first differences. Findings are similar for the two specifications, including the weaker correlation for the yen/US dollar UIP deviations with the USD index and the aggregated measure of UIP deviations. A further breakdown of correlations—in levels as well as in first differences—into pre- and post-GFC periods reveals similar strong correlations for the two sub-periods. In the level specification, the lower correlation for the

Figure A1: USD Index and UIP Deviations for Shorter Horizons



(a) 1-Year Horizon (b) 3-Months Horizon

Note: NEER is Fed's Nominal Advanced Foreign Economies Dollar Index. UIP deviations is a weighted average of the US dollar UIP deviations against currencies of the 7 advanced economies included in the Fed's Nominal Advanced Foreign Economies Dollar Index (Australia, Canada, Japan, the Euro Area, Sweden, Switzerland and the UK), where bilateral UIP deviations are based on 1-year risk-free interest rates in panel (a) and 3-months risk-free interst rates in panel (b) and Consensus Economics exchange rate forecasts for the corresponding horizon.

Japanese yen (i.e., 2nd and 3rd columns in Table 1) is driven entirely by the pre-GFC sample period, while in the first difference specification, the lower correlation for Japanese yen is present in both pre- and post-GFC data.[1]

A.2.3 A decomposition of UIP deviations

To further examine sources of deviations in the aggregate UIP index, the residual from the parity, λ_t^{AE}, can be statistically decomposed into changes in the interest differential between the yields on comparable assets and an expected exchange rate adjustment. More formally, substituting equation (1) into equation (2), we have

$$\lambda_t^{AE,k} = \sum_j \omega^j [ln(1+i_t^{j,k}) - ln(1+i_t^{\$,k})] + \sum_j \omega^j [ln(S_t^{j/\$}) - ln(E(S_{t+k}^{j/\$}))], \tag{A.1}$$

where the first summation on the right-hand side captures the weighted average interest rate differential and the second term is the weighted average expected exchange rate adjustment.

Results of the decomposition, reported in Figure A2, reveal that the bulk of UIP deviations are related to the expected exchange rate adjustment and not to interest rate differentials, which have been relatively subdued and less volatile for advanced economies over the last 20 years. Findings are similar, when the decomposition is performed at the level of individual major AE currencies.

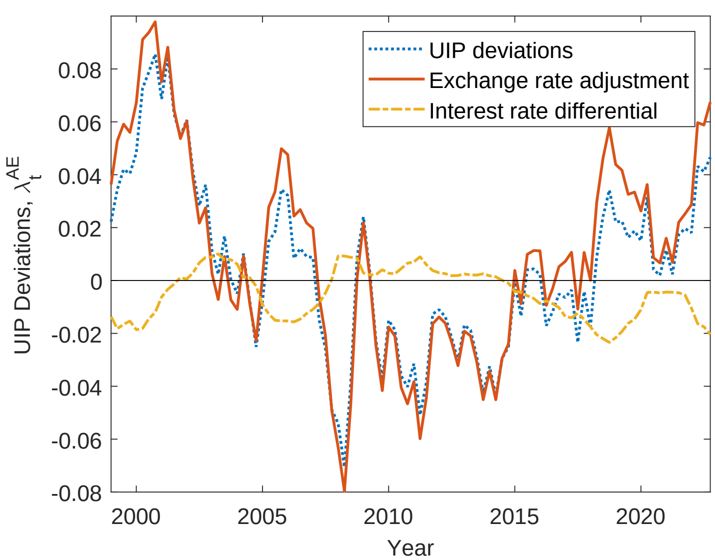
[1]These results are not included, but available from authors upon request.

Table A3: Correlations of Individual Country 2-Year UIP Deviations in First Differences, $\Delta(\lambda_t^{j/\$})$, with

Currency	LC/USD	USD index	λ_t^{AE}
GBP	0.66	0.52	0.67
SWK	0.76	0.64	0.79
CHF	0.80	0.52	0.76
CAD	0.85	0.64	0.70
JPY	0.68	0.22	0.34
EUR	0.77	0.67	0.89
AUD	0.84	0.71	0.71
AE Index Avearage	–	0.80	1.00

Note: $\lambda_t^{j/\$}$ is the UIP deviation as defined in the text. LC/USD denotes local currency per US dollar. USD index denotes the US dollar index against advanced economies. λ_t^{AE} is derived by calculating individual UIP deviations against the US dollar for each of the 7 advanced economy currencies included in the US dollar index and constructing a weighted average of these deviations using the US dollar index weights.

Figure A2: Decomposing the UIP Premium with Major Advanced Economy Currencies



Note: UIP deviations is a weighted average of the US dollar UIP deviations against currencies of the 7 advanced economies included in the Fed's Nominal Advanced Foreign Economies Dollar Index (Australia, Canada, Japan, the Euro Area, Sweden, Switzerland and the UK), where bilateral UIP deviations are based on 2-year risk-free interest rates and Consensus Economics' 2-year exchange rate forecasts. 'Exchange rate adjustment' and 'Interest rate differential' are defined in equation (A.1).

A.2.4 Correlations between the USD index and measures of global financial conditions

Table A4 reports extended correlation results for USD index, UIP deviations and other measures of global financial market conditions, including full-sample correlations in levels and first differences as well as their breakdown into pre/post-GFC periods. The World Uncertainty Index (WUI) (Ahir et al., 2022) is examined as an additional measure, not reported in Table 2.

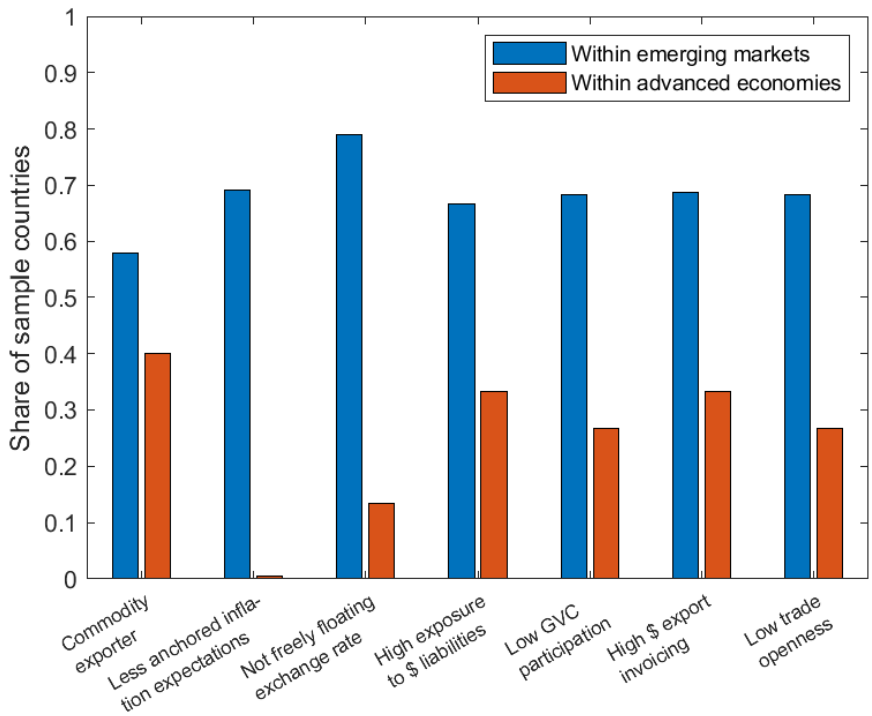
The correlation between the USD index and UIP deviations is robustly strong across the specification. For level correlations, several other measures (i.e., Global Financial Cycle, VIX, commodity price cycle) exhibit strong correlations with the USD index during the pre-GFC period. For the Global Financial Cycle, the level-wise correlation with the USD index is strong both in pre- and post-GFC data, but not for the full sample with the GFC period (i.e., 2008-2010) included. When measured in first differences, correlations with the USD index are weak for all of the considered alternative measures (except UIP deviations).

Table A4: Correlation of USD Index, UIP Deviations and Other Measures of Global Financial Conditions

Variable	USD Index	UIP Deviations	Global Financial Cycle	VIX	World Uncertainty Index	Commodity Price Index
			(a) Levels			
USD Index	1.00					
UIP Deviations	**0.86**	1.00				
Global Financial Cycle	-0.39	-0.25	1.00			
VIX	0.16	0.25	-0.42	1.00		
World Uncertainty Index	0.14	0.00	-0.47	0.00	1.00	
Commodity Price Index	-0.55	-0.56	0.05	-0.18	0.27	1.00
			(b) First differences			
USD Index	1.00					
UIP Deviations	**0.80**	1.00				
Global Financial Cycle	-0.56	-0.49	1.00			
VIX	0.35	0.28	**-0.76**	1.00		
World Uncertainty Index	0.12	0.01	-0.09	-0.08	1.00	
Commodity Price Index	-0.59	-0.43	**0.70**	-0.40	-0.04	1.00
			(c) Levels, pre-GFC			
USD Index	1.00					
UIP Deviations	**0.85**	1.00				
Global Financial Cycle	**-0.85**	-0.54	1.00			
VIX	**0.73**	0.44	**-0.72**	1.00		
World Uncertainty Index	0.24	-0.05	-0.39	0.30	1.00	
Commodity Price Index	**-0.92**	**-0.77**	**0.89**	-0.61	-0.11	1.00
			(d) Levels, post-GFC			
USD Index	1.00					
UIP Deviations	**0.80**	1.00				
Global Financial Cycle	**-0.79**	-0.83	1.00			
VIX	0.09	0.40	-0.04	1.00		
World Uncertainty Index	0.34	0.41	-0.46	0.11	1.00	
Commodity Price Index	-0.32	-0.03	**0.81**	0.22	-0.32	1.00
			(e) First differences, pre-GFC			
USD Index	1.00					
UIP Deviations	**0.80**	1.00				
Global Financial Cycle	-0.15	0.03	1.00			
VIX	-0.09	-0.19	-0.65	1.00		
World Uncertainty Index	0.04	-0.15	-0.07	-0.17	1.00	
Commodity Price Index	-0.41	-0.27	0.13	0.26	-0.17	1.00
			(f) First differences, post-GFC			
USD Index	1.00					
UIP Deviations	**0.71**	1.00				
Global Financial Cycle	-0.38	-0.41	1.00			
VIX	0.18	0.23	**-0.79**	1.00		
World Uncertainty Index	0.19	0.09	-0.10	-0.03	1.00	
Commodity Price Index	-0.50	-0.28	0.54	-0.18	0.00	1.00

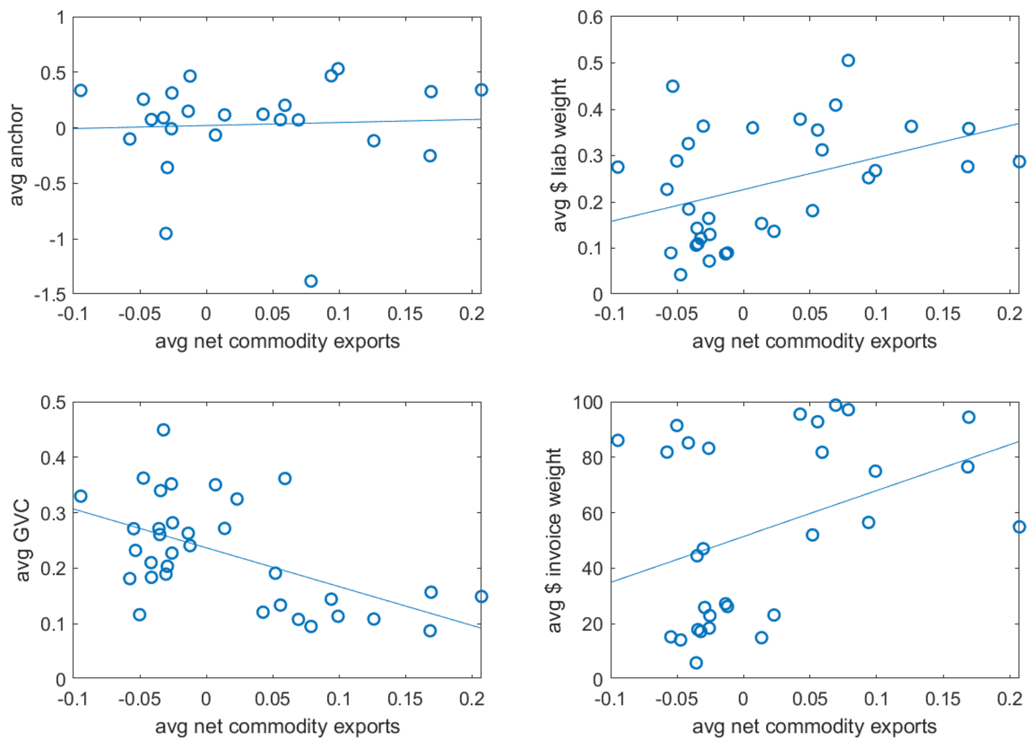
B Data

Figure B3: Distribution of Country Characteristics



Note: For each country characteristic, this chart shows the share of AEs and EMs with a value above/below the full sample mean, where above/below varies by the characteristic. "Commodity exporter" reports the share of AEs and EMs with net commodity exports above the full sample mean; "Less anchored inflation expectations" reports the share below the mean; "High exposure to US dollar liabilities" reports the share above the mean; "Low GVC participation" reports the share below the mean; "High US dollar export invoicing" reports the share above the mean; "Low trade openness" reports the share below the mean. Advanced economies exclude countries with weights in the US dollar index that are larger than 4 percent in 2020: Canada, France, Germany, Ireland, Italy, Japan, Switzerland, and the United Kingdom. Countries that are not freely floating but are anchored to a currency other than the US dollar, that is freely floating against the US dollar, are classified as freely floating.

Figure B4: Comparison of Net Commodity Exports with Other Characteristics



Note: Charts plot countries' average net commodity exports, as a share of GDP, against four other country characteristics: (i) average degree of inflation anchoring, (ii) average weight of the US dollar in foreign liabilities, (iii) average global value chain participation and (iv) the average weight of US dollar invoicing for exports.

Table B5: Correlation of Country Characteristics for Emerging Markets

Country characteristic	Commodity dependence	Monetary policy credibility	Exchange rate regime	US dollar liability exposure	Global value chain participation	US dollar export invoicing
Commodity dependence	1					
Monetary policy credibility	0.26	1				
Exchange rate regime	-0.28	-0.21	1			
US dollar liability exposure	0.48	-0.19	-0.57	1		
Global value chain participation	-0.40	0.17	0.19	-0.36	1	
US dollar export invoicing	0.37	0.35	-0.95	0.81	-0.31	1
Trade openness	-0.20	0.13	0.26	-0.51	0.94	-0.40

Note: For variable definitions see Table B8. Pairwise outliers dropped using Cook's distance measure, with a cutoff at 5 times the mean distance.

Table B6: Exchange Rate Regime and Trade Invoicing

	US dollar export invoicing share below average	**US dollar export invoicing share above average**
Other exchange rate regime		ARG; CHL; COL; ISR; IDN; IND; KOR; MYS; PAK; PHL; RUS; THA
Freely floating exchange rate regime	AUT; BEL; CZE; DNK; ESP; FIN; GRC; HUN; NLD; NOR; POL; PRT; ROU; SWE; TUR; ZAF	AUS; BRA; NZL

Table B7: Policies and Structural Features in EMs: Percentiles and Country Averages

Characteristic	Min	Max	Mean	10th Pct	25th Pct	Median	75th Pct	90th Pct
Net Commodity Exports	−.06	0.17	0.03	−.05	−.03	0.01	0.07	0.17
MP Credibility	−1.38	0.33	−.13	−.95	−.18	0.03	0.11	0.20
Trade Openness	26.39	157.57	65.35	28.21	43.10	52.41	72.21	150.80
USD Export Invoicing	17.21	98.76	70.85	25.85	47.02	81.85	94.43	97.12
GVC Participation	0.09	0.45	0.20	0.10	0.12	0.18	0.26	0.36
USD Liab. to Total Liab.	0.09	0.51	0.30	0.12	0.18	0.33	0.36	0.45
FX Reserves	0.05	0.37	0.18	0.09	0.11	0.16	0.23	0.36

Note: The average of a characteristic over time is calculated for each country. See Table B8 for data sources.

Table B8: Data Sources

Indicator	**Sources**
*Nominal US Dollar Trade-Weighted Index**	Retrieved from Haver Analytics based on the Nominal Advanced Foreign Economies US Dollar Index from Federal Reserve Economic Data (FRED), using goods and services trade weights. Values before 2006 are constructed with services trade data estimates from the Federal Reserve Board.
Exchange Rates and Interest Rates	
Bilateral Exchange Rates	Haver Analytics
Real Effective Exchange Rates	International Monetary Fund, Information Notice System (INS)
Shadow Rate (average of advanced economies) 1/	Haver Analytics; Federal Reserve Board, Krippner (2015), De Rezende (2023)
Policy Rate* 2/	Bank for International Settlements (BIS) Central Bank Policy Rates; Haver Analytics; International Monetary Fund, International Financial Statistics (IFS).
Effective Federal Funds Rate* 3/	Federal Reserve Board, Wu-Xia Shadow Federal Funds Rate (Wu and Xia, 2016), Haver Analytics
Exchange Rate Adjustment 4/	Consensus Economics; Haver Analytics
Interest Rate Differential 5/	Refinitiv Datastream
Macro Aggregates and External Variables	
Real Gross Domestic Product (SA)	Haver Analytics
Current Account Balance (SA)	Haver Analytics
Economic Activity Factor 6/	Haver Analytics; IMF staff estimates
Private and Public Inflows 7/	Avdjiev and others (2022)
Domestic Credit	Bank for International Settlements (BIS), Credit to the Non-Financial Sector
Foreign Exchange Intervention	Adler et al. (2024)
Prices and Financial Variables	
Adjusted National Financial Conditions index (ANFCI)*	Federal Reserve Economic Data (FRED)
Terms of Trade 8/	International Monetary Fund, International Financial Statistics (IFS); Haver Analytics; Refinitiv Datastream

Continued on next page

Table B8 – continued from previous page

Indicator	Sources
Consumer Price Index (SA) 9/	Haver Analytics; International Monetary Fund, World Economic Outlook (WEO)
Uncovered Interest Parity (UIP) Deviation 10/	Consensus Economics; Refinitiv Datastream; Haver Analytics; Federal Reserve Board; IMF staff estimates
Global Financial Cycle	Miranda-Agrippino, Nenova, and Rey (2020)
Chicago Board Options Exchange Volatility Index (VIX)	Federal Reserve Economic Data (FRED)
Policies and Structural Features	
Emerging Market Economy Dummy	International Monetary Fund, World Economic Outlook (WEO)
Commodity Trade Balance 11/	United Nations Statistics Division, UN Comtrade.
Monetary Policy Credibility	Bems et al. (2021)
Exchange Rate Regime 12/	Ilzetzki et al. (2019); International Monetary Fund, The Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER, 2020, 2021, 2022)
Trade Openness	International Monetary Fund, World Economic Outlook (WEO)
Share of Exports Invoiced in US dollars	Boz et al. (2022)
Global Value Chain Participation	The Organization for Economic Cooperation and Development (OECD), Trade in Value Added (TiVA)
Share of External Liabilities in US dollars 13/	Allen et al. (2023)
Foreign Exchange Reserves	External Wealth of Nations Database Milesi-Ferretti (2024) based on Lane and Milesi-Ferretti (2018)

Note: SA: variables from GDS are seasonally adjusted using X-12, other variables are adjusted using X-13.* indicates monthly data converted to quarterly by averaging.1/ Calculated with shadow short rate point estimates of Australia, Canada, Euro Area, Japan, Switzerland, United Kingdom from Haver, with the merchandise weights from Federal Reserve Board. 2/ To fill missing data for Turkiye, Peru, Indonesia, Korea, Thailand, and Romania IFS data are used. For Pakistan, the reverse repo policy rate is used from Haver Analytics. Missing observations for Vietnam are patched with the refinancing rate from Haver Analytics. 3/ The shadow rate is used when the lower bound of the effective fed funds rate is zero. 4/ Calculated as the expected US dollar depreciation. 5/ Denotes the advanced economies deposit rate minus US deposit rate. 6/ The economic activity factor is constructed with the log of real GDP of 42 economies using a static factor model. 7/ Private inflows are the sum of portfolio debt and other investment debt inflow of banks (except central bank) and corporates; public inflows are the sum of portfolio debt inflow and other investment debt inflow of general government and the central bank. 8/ Terms of trade are calculated by export price index over import price index except for Colombia, Russia, Romania, Turkiye, India, Malaysia, Thailand and Denmark data from Haver. Indexes for Greece, Spain, Chile, China, Israel, Argentina and Peru are seasonally adjusted from the source. 9/ Data for Malaysia from WEO. 10/ UIP deviations are based on exchange rate forecasts from Consensus Economics, deposit rates from Refinitiv Datastream. Individual UIP deviations are aggregated with the merchandise weights from Federal Reserve Board. 11/ Commodity trade balance is the sum of the trade balance in: aluminum, banana, barley, beef, coal, cocoa, coffee, copper, cotton, fish meal, groundnuts, gold, sawnwood, hides, iron ore, meat, lead, maize, natural gas, nickel, crude oil, olive oil, orange, palm oil, pork, meat, rice, rubber, salmon, shrimp, soybean meal, softwood, soybean oil, soybeans, sugar, sunflower oil, tea, tin, uranium, wheat, wool and zinc. Annual values are assumed to remain constant across quarters. Data for 2022 extended through 2023. For Russia and Romania data for 2021 extended through 2023. Data for Turkiye in 2000 missing and filled with data for 1999. Data for Hungary missing for 2003 and filled with data for 2002. 12/ Monthly coarse classification data are aggregated to quarterly data by taking the maximum values. We denote freely floating as 4, and other exchange rate regimes as 1, 2, and 3, and drop 5 and 6. Classification into freely floating and other exchange rate regimes is extended through 2023 guided by the IMF Annual Report on Exchange Arrangements and Exchange Restrictions 2020, 2021, 2022. 13/ Annual values are assumed to remain constant across quarters. Data for 2020 extended through 2023.

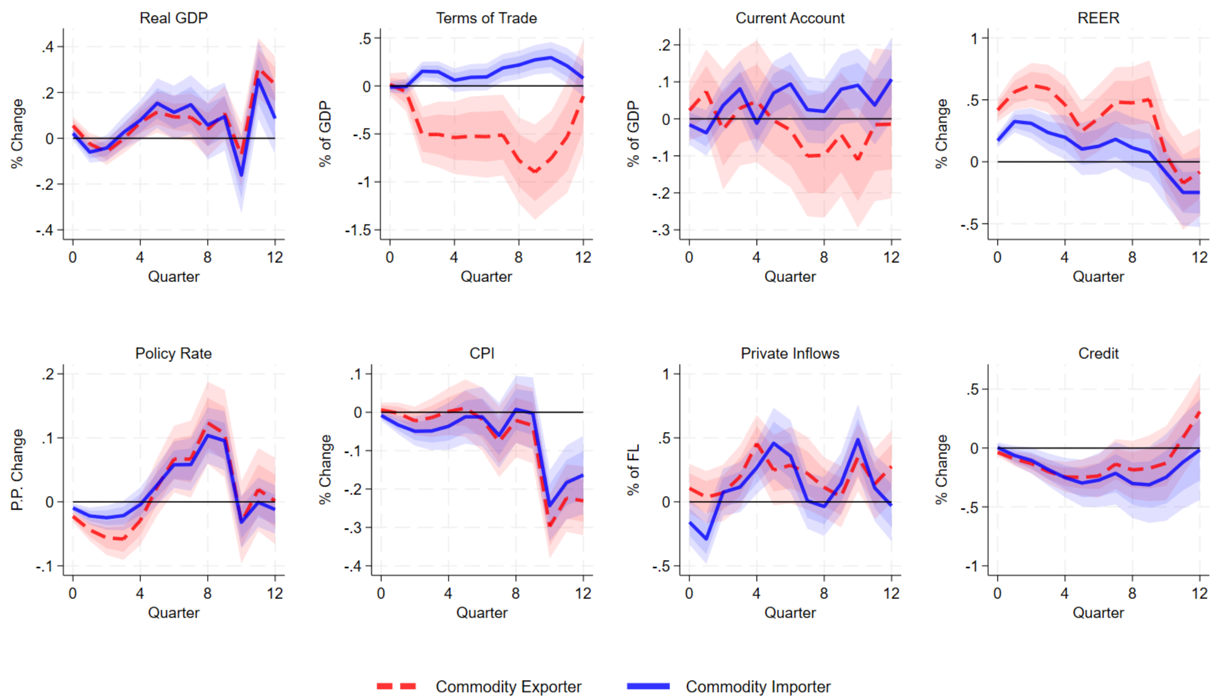
C Additional Results

Table C1: First-Stage Regression of Changes in the US Dollar index on the instrument

	Emerging Markets			Advanced Economies		
	Min.	Median	Max.	Min.	Median	Max.
IV Coefficient	2.05***	2.28***	2.42***	2.22***	2.30***	2.40***
F-statistic	65.35	159.66	254.70	118.90	164.68	194.81
Observations	77	95	95	95	95	95

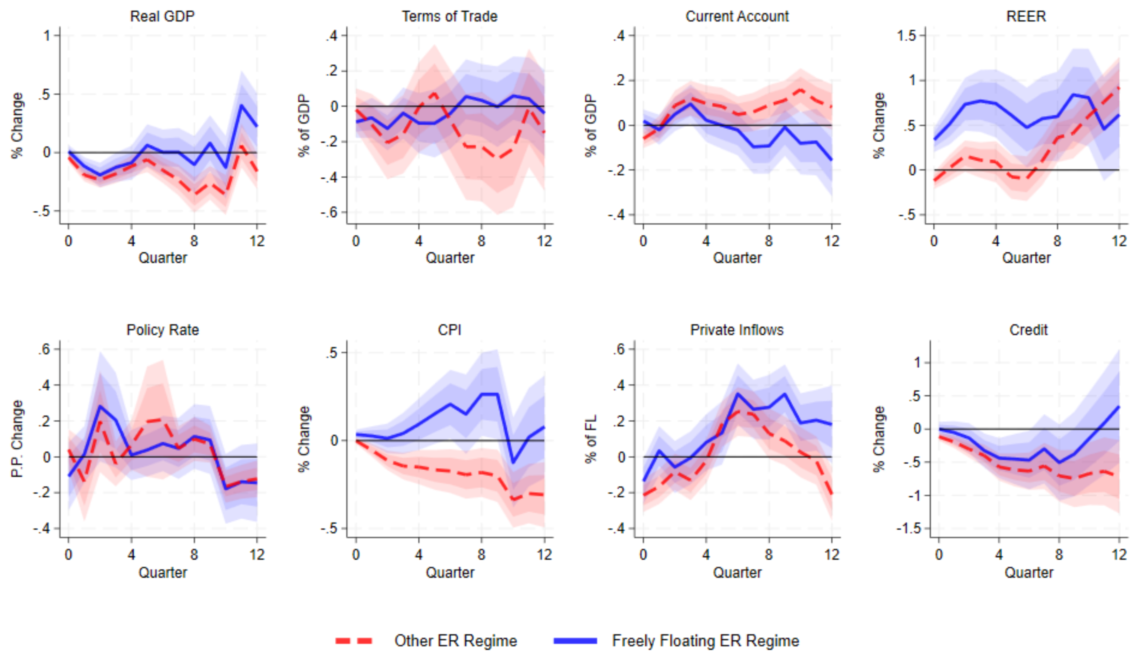
Note: This table reports the first-stage regression of changes in the US dollar index on UIP deviations with controls from equation (3). The specification without characteristics is run for each country separately at $h = 0$. The minimum, median and maximum Kleibergen-Paap Wald F-statistics are reported. Coefficients on the instrument are significant for all countries at the 1 percent level. The sample size for some countries is limited by the availability of the policy rate. *** p<0.01, ** p<0.05, * p<0.1.

Figure C1: Spillovers from a US Dollar Appreciation: AE Commodity Importer versus Exporter



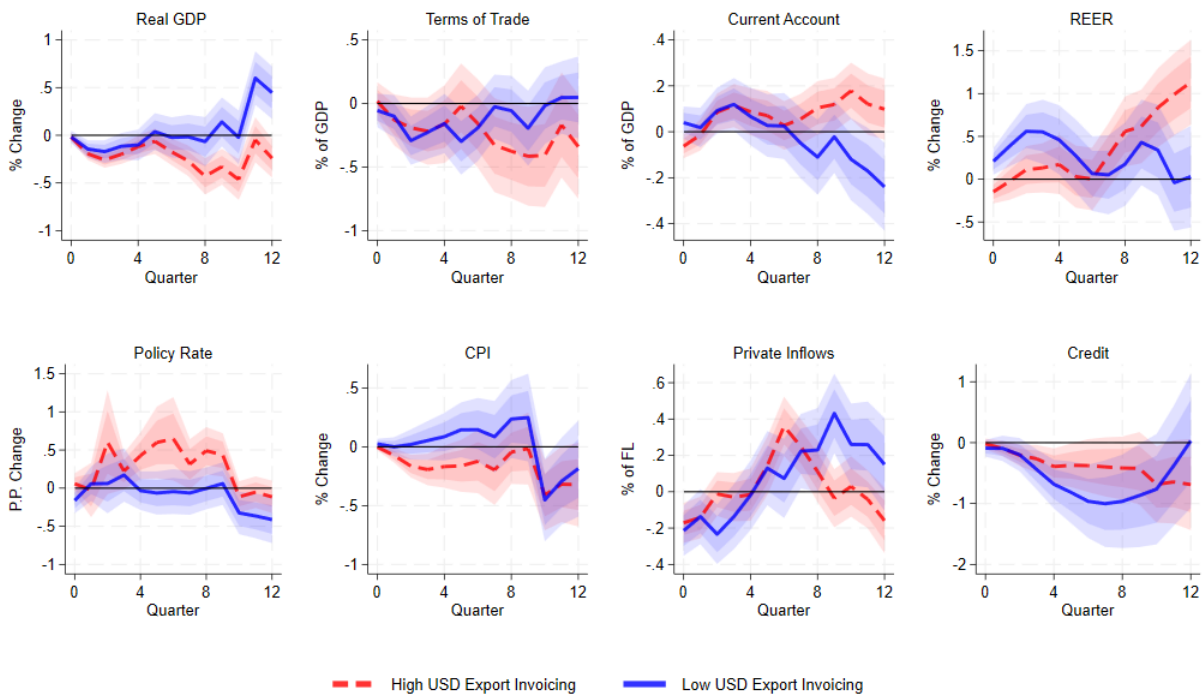
Note: Advanced economies sample only. This figure plots the impulse responses for a 1% appreciation in the nominal US dollar AE Index with 90% and 68% confidence bands reported. Commodity importer and exporter responses report results at the 10th and 90th percentile of net commodity export/import range, which correspondingly represent net commodity imports of 5 percent of GDP and net commodity exports of 10 percent of GDP.

Figure C2: Spillovers from a US Dollar Appreciation: Exchange Rate Regime



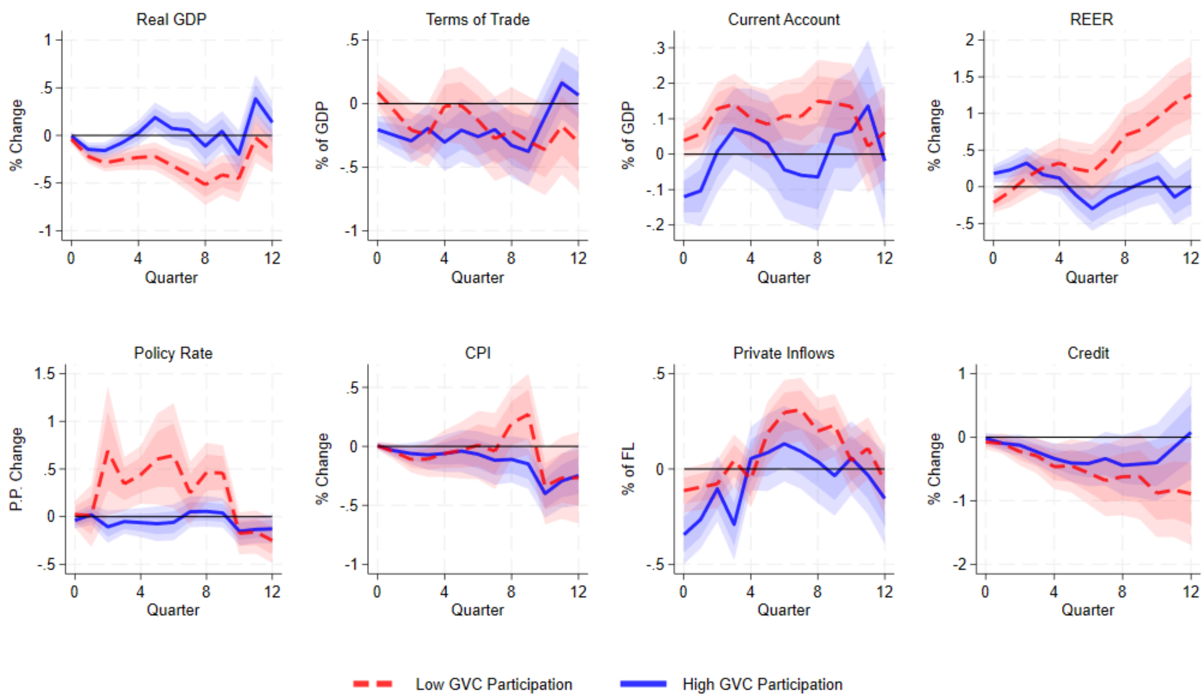
Note: Emerging market sample only. This figure plots the impulse responses for a 1% appreciation in the nominal US dollar AE Index with 90% and 68% confidence bands reported.

Figure C3: Spillovers from a US Dollar Appreciation: US Dollar Export Invoicing



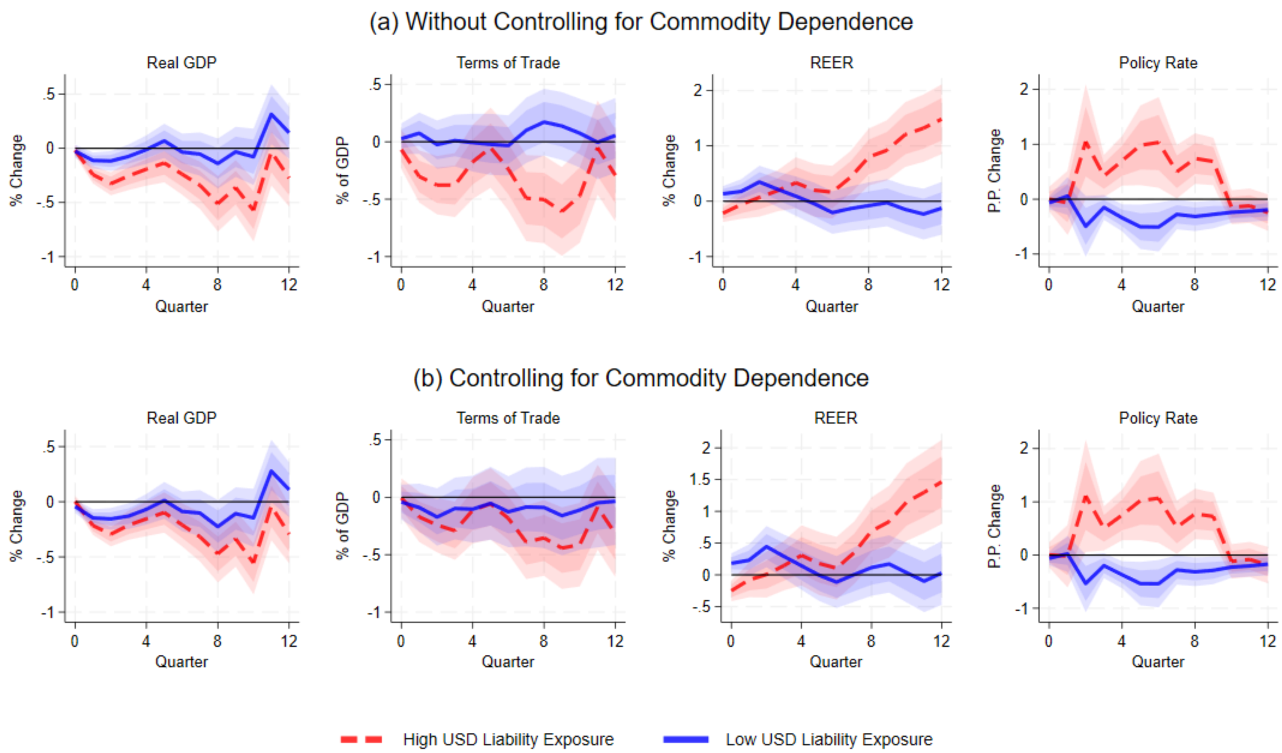
Note: Emerging market sample only. This figure plots the impulse responses for a 1% appreciation in the nominal US dollar AE Index with 90% and 68% confidence bands reported. Responses for low and high USD export invoicing report results for the 10th and 90th percentile of the USD export invoicing shares, with corresponding values reported in Table B7.

Figure C4: Spillovers from a US Dollar Appreciation: GVC Participation



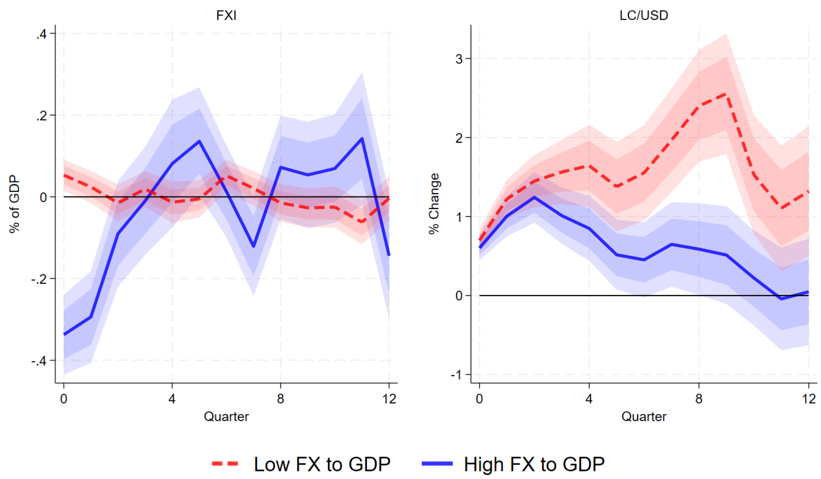
Note: Emerging market sample only. Estimation controls for commodity dependency as an additional country characteristic. This figure plots the impulse responses for a 1% appreciation in the nominal US dollar AE Index with 90% and 68% confidence bands reported. Responses for low and high GVC participation report results for the 10th and 90th percentile of the GVC participation measure, with corresponding values reported in Table B7.

Figure C5: Spillovers from a US Dollar Appreciation: USD liabilities



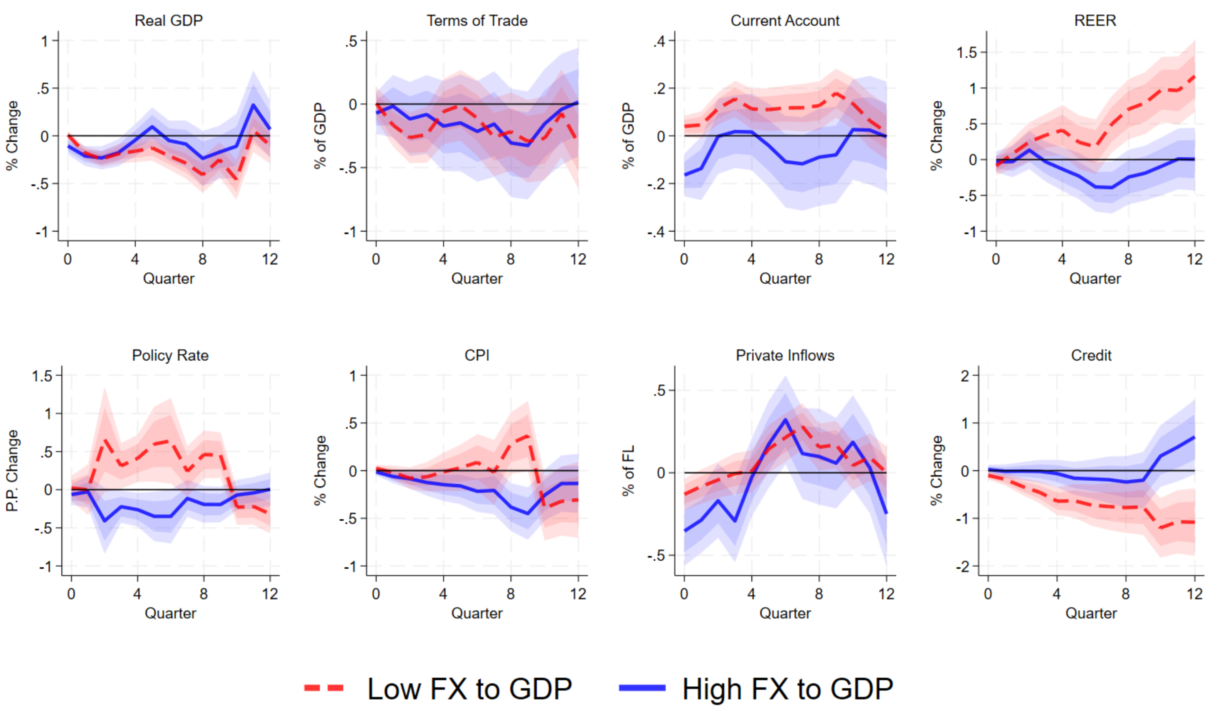
Note: Emerging market sample only. This figure plots the impulse responses for a 1% appreciation in the nominal US dollar AE Index with 90% and 68% confidence bands reported. Responses for low and high US dollar liability exposure report results for the 10th and 90th percentile of the weight of US dollar liabilities in total external liabilities, with corresponding values reported in Table B7.

Figure C6: Response of FXI and Bilateral US Dollar Exchange Rate to US Dollar Appreciation: Reserve Holdings



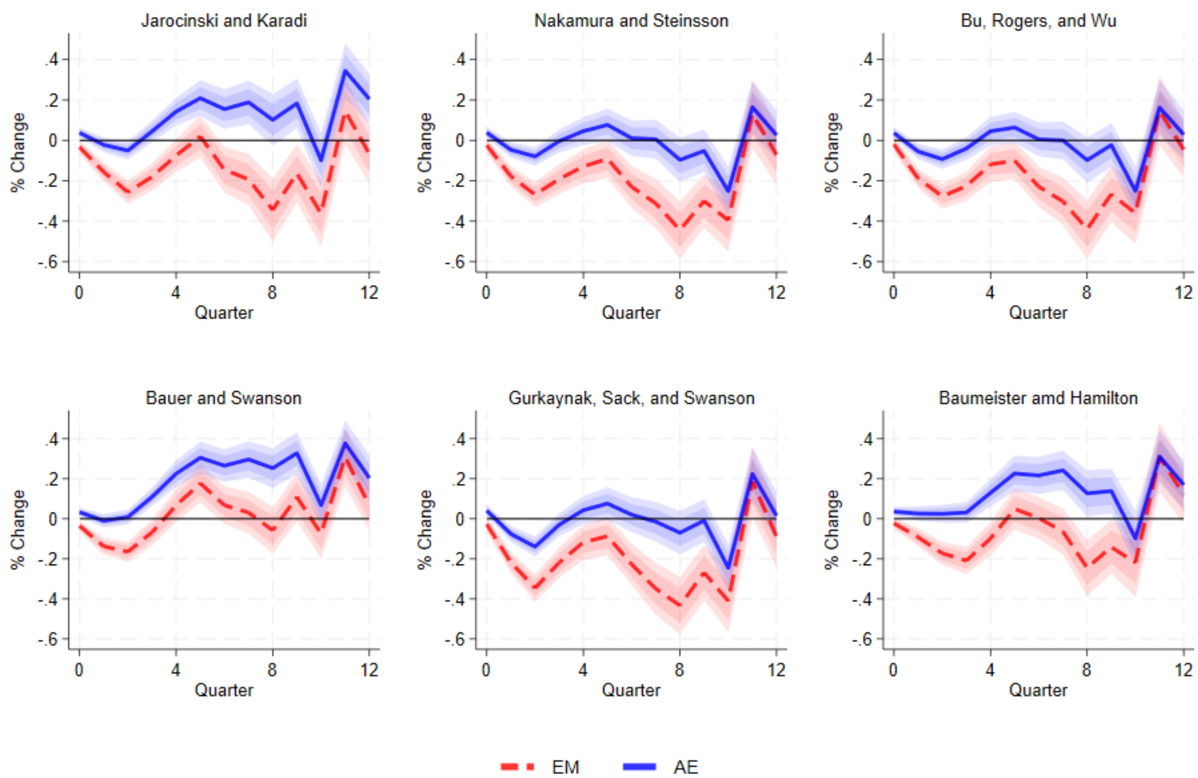
Note: Emerging market sample only. This figure plots the impulse responses for a 1% appreciation in the nominal US dollar AE Index with 90% and 68% confidence bands reported.

Figure C7: Spillovers from a US Dollar Appreciation: Reserve Holdings



Note: Emerging market sample only. This figure plots the impulse responses for a 1% appreciation in the nominal US dollar AE Index with 90% and 68% confidence bands reported. Responses for low and high US dollar liability exposure report results for the 10th and 90th percentile of the weight of US dollar liabilities in total external liabilities, with corresponding values reported in Table B7.

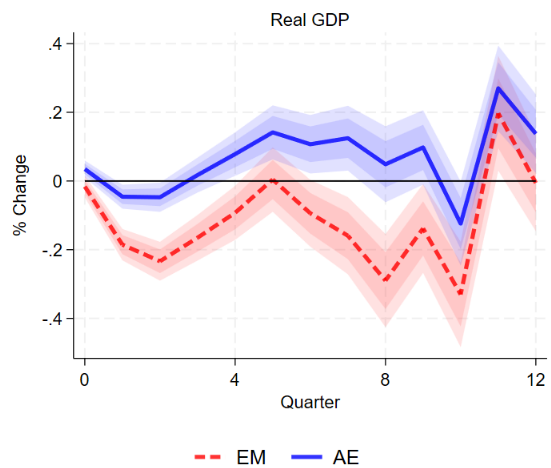
Figure C8: Controlling for Other Shocks



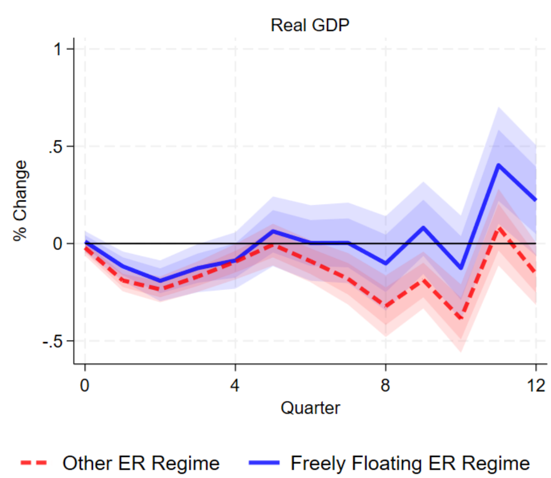
Note: This figure plots the impulse responses for a 1% appreciation in the nominal US dollar AE Index with 90% and 68% confidence bands reported. Shocks are from: Jarociński and Karadi (2020); Nakamura and Steinsson (2018) and Gürkaynak et al. (2005) as updated by Acosta (2023); Bu et al. (2021); Bauer and Swanson (2023); and Baumeister and Hamilton (2019).

Figure C9: Impact of Removing Countries with Fixed Exchange Rates from the Sample

(a) Output Response in EMs versus AEs

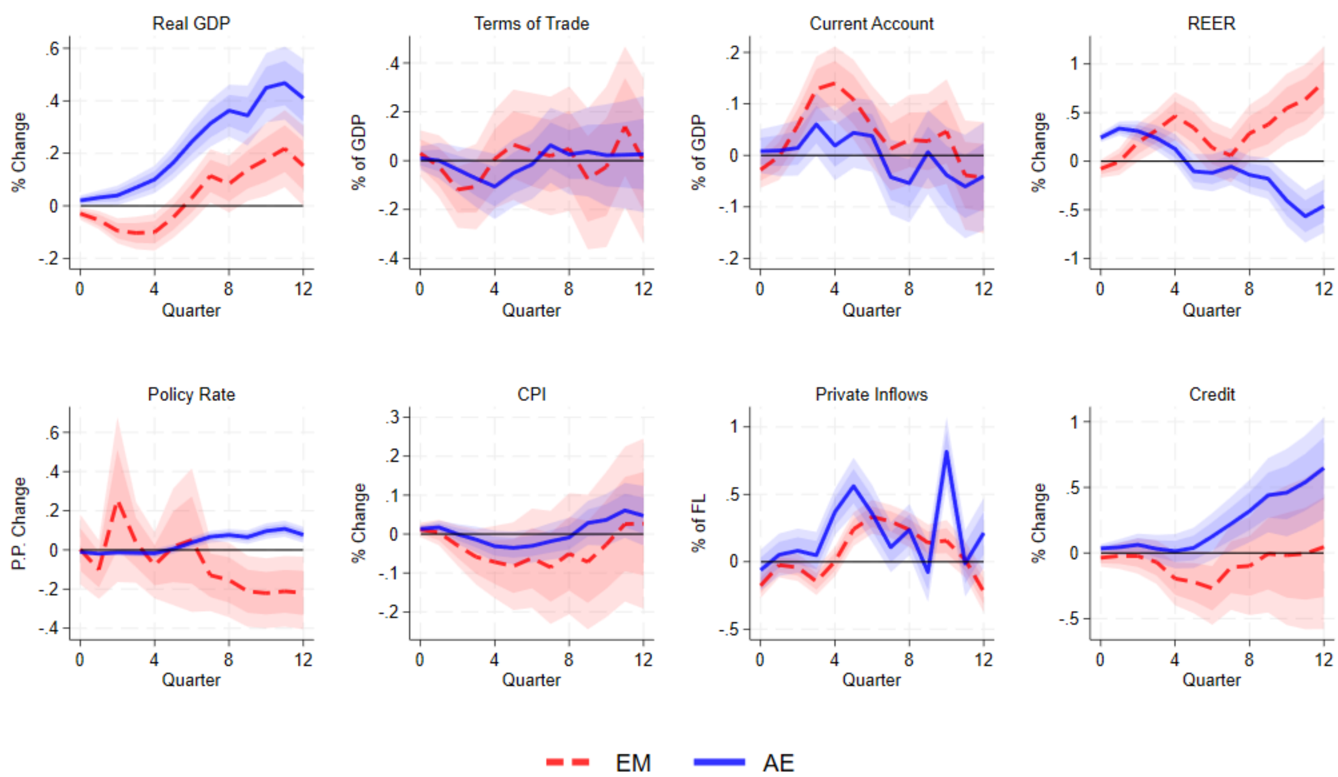


(b) Output Response in EMs by Exchange Rate Regime



Note: Sample excludes the coarse classification 1 from Ilzetzki et al. (2019). Panel (b) plots results for the emerging market sample only. Impulse responses are for a 1% appreciation in the nominal US dollar AE Index. 90% and 68% confidence bands are reported.

Figure C10: Impact of Excluding COVID-19 Period: EMs versus AEs



Note: Sample ends in 2019q4. This figure plots the impulse responses for a 1% appreciation in the nominal US dollar AE Index with 90% and 68% confidence bands reported.

D Model Simulations: Flexible System of Global Models

This annex uses a global general equilibrium model to examine how a change in global risk premiums, modeled as UIP shocks, may be driving the negative relationship between the US dollar and commodity prices, while simultaneously generating spillovers to EMs and other advanced economies. By isolating a specific shock, the model can illuminate the main channels that drive the paper's empirically estimated spillovers.

D.1 Model Description

The Flexible System of Global Models (FSGM) (Andrle et al., 2015) is a semistructural multiregion general equilibrium model of the global economy. The framework combines both micro-founded and reduced-form formulations of various economic sectors. The analysis presented in this annex uses the G20MOD module of FSGM, which includes every G20 economy.[2]

The model features essential to our analysis are:

- *Monetary authorities and interest rates*: An interest rate reaction function represents the behavior of monetary authorities. The standard form is an inflation-forecast-based rule operating under a flexible exchange rate, with a higher weight on exchange rate deviations for emerging markets, consistent with fear of floating. The long-term (10-year) interest rate is based on the expectations theory of the term structure, plus a term premium. Interest rates on consumption, investment, government debt, and net foreign assets are weighted averages of the 1- and 10-year interest rates, reflecting their differing term structures and allowing for a meaningful role of the term premium.
- *UIP*: Deviations from UIP in the model are based on risk premiums.[3] Different borrowers (households, firms, government) in the model face varying interest rates depending on their time horizons and risk profiles. The UIP condition holds in the short term only for the sovereign, and only if the sovereign risk premium is set to zero. However, the calibrated model has a nonzero exogenous sovereign risk premium and a term premium on long-term bonds. More generally, a UIP equation holds when all risk premiums are accounted for. The model includes an endogenous corporate risk premium, which depends on the business cycle and on commodity prices. The sovereign risk premium affects all interest rates in the model, while the corporate risk premium affects only those for the private sector. Risk premiums vary across private sector borrowers because shocks affect the cost of financing differently or can apply to different borrowers.

[2] Details of the model can be pursued in Andrle et al. (2015).

[3] At the normative level, there are two distinct approaches for modeling UIP deviations, with differing implications for policy, one based on risk premiums and the other on intermediary frictions. The former approach builds on nondiversifiable risk or reduced appetite for risk but does not feature price distortions. By contrast, the latter approach is based on market distortions, as intermediaries require rents to absorb risk (see, for example, Gabaix and Maggiori (2015)), with a potential role for policy. The semistructural FSGM does not feature financial intermediaries, so that UIP deviations are a proxy for risk premiums.

- *Commodity exposure*: Data-driven calibration makes the FSGM particularly well suited to examining the differential impacts of economic disturbances on commodity exporters and importers. The FSGM incorporates three types of commodities: oil, food, and metals, and their associated prices. The model is calibrated using countries' commodities production, consumption, and trade. Commodities are priced in the dominant currency: the US dollar.

- *External sector*: Foreign and domestic economic activity and the exchange rate determine exports and imports, with producer pricing assumed. Investment decisions of firms, saving decisions of households, and fiscal policy determine the current account and implied net-foreign-asset positions.

D.2 Simulation Setup and Model Results

The analysis of the global dollar cycle documents its strong association with UIP deviations, suggesting that economic disturbances driving UIP deviations contribute to the cycle. This annex takes the UIP deviations as the primitive exogenous shock in the FSGM and studies their implications for cross-border spillovers and key global variables, drawing parallels with the paper's empirical findings. There are different ways to introduce UIP deviations into the model. The one that most closely links to the empirical findings is a global (excluding the United States) disturbance to sovereign spreads, so that the direct effect of the disturbance is an increase in financing costs for firms and households.[4]

Figure D1 plots impulse responses for key variables of interest to this global persistent 1 percentage point shock to the sovereign premium, reported in panel 1. To facilitate comparison with the empirical findings, results for the G20 economies distinguish between an aggregated region of advanced economies, excluding the United States, and an aggregated region of emerging markets, with some results further distinguishing between emerging market commodity exporters and importers.

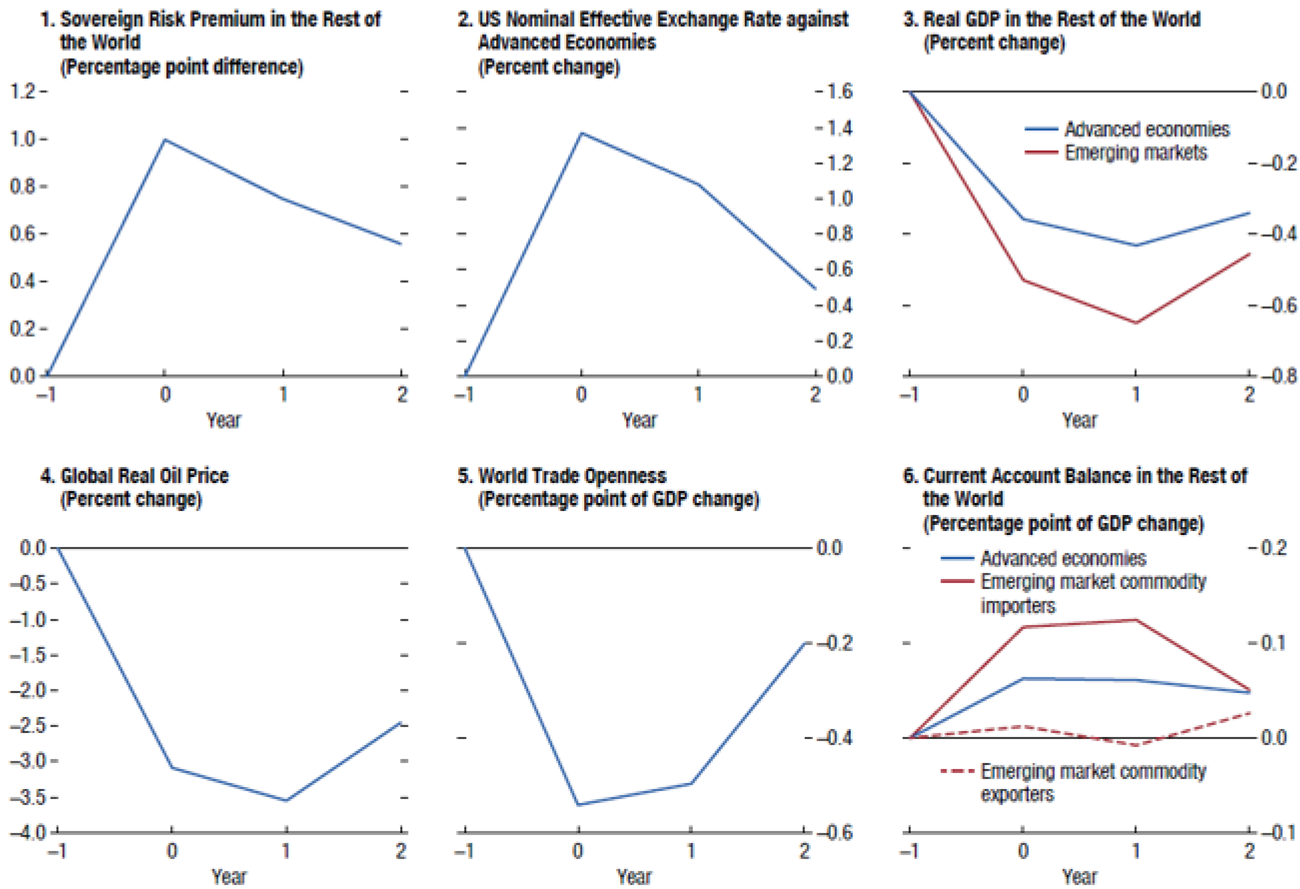
One of the direct effects of the sovereign premium shock is a US dollar appreciation. The shock increases the demand for US dollars by reducing risk-free returns on foreign bonds (short-term interest rates do not immediately change, and the risk premium increases) and creating an incentive to invest in US bonds absent changes in the policy rate (Figure D1, panel 2).[5] Another direct effect is an increase in financing costs, which leads to a reduction in domestic consumption, through the channel of intertemporal substitution, as it becomes more costly to borrow to smooth out consumption. The increase in financial costs also lowers investment, and the combined result is a fall in output in the rest of the world (see Figure D1, panel 3).[6] Thus, the modeled global risk premium shock generates the empirically observed negative real spillover, linking US dollar appreciations with falling foreign economic activity. The

[4]Consistent with empirical literature (Kalemli-Özcan and Varela, 2021), FSGM simulations show that exchange rate adjustment contributes more to UIP deviations in advanced economies than in emerging markets; as in the latter country group, the examined global risk premium shock endogenously triggers other mechanisms that increase the cost of capital, including through lower commodity prices tightening financing conditions.

[5]To facilitate comparison with the empirical findings, the figure reports US dollar index against currencies of other advanced economies, but the US dollar appreciation is broad based. Central banks in advanced economies react to the increase in financing cost by easing policy rates, which contributes to a further US dollar appreciation.

[6]Fiscal automatic stabilizers are allowed to operate and partially cushion the negative effects on activity.

Figure D1: Impulse Responses to a Global Risk Premium Shock in the Flexible System of Global Models



Note: Emerging market commodity importers include China, India, South Africa, and Türkiye; emerging market commodity exporters include Argentina, Brazil, Indonesia, Mexico, Russia, and Saudi Arabia; emerging markets include both of these country groups; advanced economies exclude the United States. In panel 2, an increase equals an appreciation.

fall is larger in emerging markets mainly because of their more limited exchange rate flexibility.

Model simulations also generate a strong negative link between US dollar and commodity prices through the demand channel. As global demand declines, the demand for commodities is depressed and the real price of commodities falls (Figure D1, panel 4). For the simulated shock, a 1 percent appreciation in the US dollar is associated with a 2.3 percent decline in commodity prices at a one-year horizon. The more than proportional fall in the commodity price is magnified by the higher commodity intensity in the rest of the world, compared to the United States, and the pricing of commodities in terms of the appreciating US dollar. [7]

As countries invest less, there is a large worldwide drop in imports due to the high import propensity of investment goods. The combined effect of less trade in both commodities and investment goods

[7]The model decomposition of the quantitative results shows that the US dollar pricing channel accounts for about 10 percent of the overall fall in the commodity price after one year.

lowers global trade openness (Figure D1, panel 5).

The commodity-induced terms-of-trade adjustment benefits commodity importers. As their import values temporarily fall, real income increases and households increase saving to smooth out consumption, representing an income effect. A substitution effect also operates, whereby the temporary fall in commodity prices, by lowering the consumption-based real interest rate households face, increases contemporaneous consumption, reducing saving. In the model calibration these two effects broadly offset one another, and the fall in investment is the main driver of the current account increase (Figure D1, panel 6). For commodity exporters, two opposing forces are at work. On the one hand, the rise in the cost of capital and resultant fall in investment increase the current account. On the other hand, falling commodity prices make commodity exporters temporarily worse off, as their export values decrease. This effect is buffered by reduced saving, which decreases the current account. In the model simulation, the investment response and the saving response broadly offset one another, leaving the current account unchanged. Overall, consistent with the empirical findings, the current account increases only in commodity-importing countries, more so in emerging market commodity importers because of the larger fall in investment.

It is worth stressing that the model omits several potentially important factors. One relates to additional financial vulnerabilities stemming from balance sheet mismatches and a more nuanced modeling of the degree of central bank credibility, both of which are not captured by FSGM, and could potentially magnify the negative spillovers. Another important caveat relates to the modeling of spillovers. In some models (Georgiadis et al., 2023), emerging market economies are directly exposed to a fraction of the shock imposed to the sovereign risk premium in an advanced economy. In the FSGM, this spillover is captured by an exogenous shock to financial conditions, representing a shortcut for incorporating financial spillovers not directly modeled but believed to be present in global risk-off episodes.

PUBLICATIONS

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