CIP Deviations, Commodity Markets Shocks, and the Role of Macroprudential Policy *

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June 11, 2026

Abstract

We study Covered Interest Parity (CIP) deviations across advanced and emerging economies in the post-crisis period, using LIBOR and commercial paper data and a panel of 30 countries between 2008 and 2021. Our analysis exploits a lag-augmented local projection setup that recovers the direct effect of macroprudential policy actions, the direct effect of identified commodity-market shocks, and their interaction. We document that the deviations are large, persistent, and heterogeneous along several dimensions: by stage of economic development, by exposure to commodity markets, and by the type of regulatory instrument used. A macroprudential tightening pushes deviations further from zero by 1–2 basis points in advanced economies and by up to 10 in emerging markets, with the response concentrated among non-exporters and varying in size across capital, asset, and liquidity-based instruments. Identified commodity shocks generate equally heterogeneous responses across country groups, consistent with safe-haven, terms-of-trade, and FX-liquidity channels. Interactions between regulation and commodity shocks are present but only partial, reflecting that prudential policies can simultaneously curtail intermediation capacity and shield domestic markets from external disturbances. Our findings point to a trade-off between domestic resilience and arbitrage efficiency that varies with the country group and the specific tool deployed.

JEL Codes: F31, F38, F42, G18, Q43

Keywords: Covered Interest Parity, Macroprudential Policy, Commodity Shocks, International Capital Flows, Emerging Markets

*We thank the comments and feedback provided by Dongwon Lee. Additionally, we are grateful to the editor, Peter G. Szilagyi, and the anonymous reviewers for their insightful comments and suggestions. Julian Fernandez acknowledges the financial support provided by Pontificia Universidad Javeriana through its research grant, which made this work possible. All remaining errors are of our own.

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1 Introduction

The covered interest parity (CIP) condition has long served as a cornerstone of international finance theory, positing that arbitrage should eliminate systematic differences in money-market rates across currencies. The 2007–08 financial crisis disrupted this condition, leading to persistent and economically significant CIP deviations that challenge one of the assumptions underlying standard models (Du and Schreger, 2016; Du, Tepper, and Verdelhan, 2018). Post-crisis research has established that regulatory constraints contribute to these deviations (Ivashina, Scharfstein, and Stein, 2015; Du, Hébert, and Huber, 2022; Augustin, Chernov, Schmid, and Song, 2024), that the subprime experience led to heightened dollar demand, capital reallocation, and elevated interest rate differentials (Caballero, Farhi, and Gourinchas, 2008; Ready, Roussanov, and Ward, 2017a,b), and that macroprudential policies generate sizable international spillovers whose effectiveness depends on the nature of global financial shocks (Buch and Goldberg, 2017; Avdjiev et al., 2017; Hansen and Morales, 2021; Claessens et al., 2023). At the same time, a similar account of the cross-country heterogeneity of these effects, and the dimensions along which it varies, remains in order.

The deviations themselves vary along several meaningful dimensions. Mean and volatility patterns differ between advanced and emerging economies, with the latter exhibiting deviations that are larger in absolute terms and substantially more volatile, and within each group the dynamics also depend on the country's exposure to commodity markets, as commodity-currency carry trades generate positive risk-adjusted returns during periods of elevated funding costs (Bakshi and Panayotov, 2013; Ready et al., 2017b), and commodity-currency comovements constitute a priced risk factor (Byrne et al., 2019). Commodity-market shocks, in turn, affect the deviations through several channels, including safe-haven demand for the dollar (Cerutti et al., 2021; Avdjiev et al., 2019), terms-of-trade and currency-appreciation forces in exporter economies (Ready et al., 2017b), and FX-swap liquidity provision by commodity-currency producers (Iida et al., 2018). On the other hand, the macroprudential stance can modify these dynamics by tightening the constraints faced by financial intermediaries through effects that can vary by level of economic development and the specific type of policy instrument adjusted (Ahnert, Forbes, Friedrich, and Reinhardt, 2021; Chari, Dilts-Stedman, and Forbes, 2022; Kwak and Granados, 2025).

In light of these observations, our paper asks three questions. First, how does a macroprudential tightening reshape CIP deviations across countries with different levels of financial development, different exposures to commodity markets, and under different prudential instruments? Second, how do identified commodity-market shocks transmit to the deviations across these same dimensions? Third, do the two interact in a way that materially modifies the deviations' response? Our setup leverages identified demand and supply-driven commodity-market shocks together with detailed cross-country information on the macroprudential stance, embedded in a lag-augmented local projection framework that recovers the direct effect of regulation, the direct effect of the shocks, and their interaction simultaneously.

Our empirical strategy is grounded in various contributions from recent literature. To start, we leverage externally identified commodity-market shocks from Baumeister and Hamilton (2019), Baumeister and Guérin (2021), Känzig (2021), and Baumeister (2023), which allow us to distinguish supply and demand-side innovations.[1] We then source detailed cross-country information on macroprudential policy stances from Alam, Alter, Eiseman, Gelos, Kang, Narita, Nier, and Wang (2024), capturing the scope of post-crisis regulatory changes through indicators for a varied menu of individual policy tools. Following Cerutti and Zhou (2023), we construct high-frequency CIP deviations using LIBOR-based measures for advanced economies and commercial-paper-based measures for emerging markets, which we subsequently aggregate to match the policy and shocks timing, enabling us to proceed with the estimation of the deviation responses.

Our findings can be organized into three blocks. To start, macroprudential tightenings push CIP deviations further from zero in a heterogeneous fashion that reflects three economically meaningful dimensions. By stage of development, a one-unit tightening generates a deviation that is 1–2 basis points more negative for advanced economies and up to 10 basis points more negative for emerging markets in our 2008–2021 quarterly panel, with the latter response masked by the higher volatility of emerging economies' deviations but visible once policy subtypes are considered separately. By exposure to commodity markets, the regulatory effect concentrates among non-exporters, as commodity revenues compress deviations in exporting countries through FX-swap liquidity provision and currency appreciation, dampening the regulatory amplification channel (Iida et al.,

[1] Chari, Dilts Stedman, and Lundblad (2020) and Chari, Dilts-Stedman, and Forbes (2022) suggest focusing on shocks, as the macroprudentially relevant effects arise from extreme events rather than median responses.

2018; Ready et al., 2017b). By the type of instrument, capital and liquidity-based interventions yield more visibly negative effects on the deviations than asset-based ones, suggesting that the intermediation-friction channel is the most active source of post-crisis basis widening. These estimates complement existing evidence on the role of post-crisis regulation in sustaining arbitrage opportunities (Du and Schreger, 2016; Du et al., 2022) and on leakage effects from prudential measures (Ahnert, Forbes, Friedrich, and Reinhardt, 2021).[2]

Second, identified commodity-market shocks are themselves drivers of CIP deviations, with responses that vary with the nature of the shock and the type of country. Demand-side oil shocks generate a 2–4 basis points increase in CIP deviations in advanced economies, persisting for up to eight quarters, consistent with flight-to-quality dynamics that raise USD safe-asset demand. The broader real commodity prices factor initially moves deviations in the opposite direction before converging to the same sign at longer horizons. For emerging markets, the same shocks decrease deviations by 5 to 10 basis points, magnifying them in absolute terms, consistent with appreciation forces in commodity-exporting currencies. Supply-side shocks generate a persistent decline in deviations of approximately 5 basis points in advanced economies through forward-premium dynamics, while in emerging markets the initial response is positive before turning negative at longer horizons, an outcome consistent with a weakened USD safe-haven appeal and spot rates overshooting forward rates. We further document that the deviation responses differ between commodity exporters and non-exporters, and find that supply and demand shocks lead to similar responses as those in emerging economies for both groups, reflecting the greater volatility of emerging markets' deviations, while activity and inventories shocks generate responses that differ by exporter status. In particular, inventory shocks would reflect the more salient differences between exporters and non-exporters, which relate to the diverging way in which oil market supply pressures are reflected in each type of economy.

Third, we find evidence of interactions between macroprudential policy and commodity shocks, but their magnitude is modest relative to the direct effects discussed above. For demand shocks, tighter policies act as partial stabilizers, primarily through shifts in the mean response for advanced economies and through wider confidence intervals in emerging markets, often rendering

[2]Country-specific evidence includes Fabiani, Piñeros, Peydró, and Soto (2022) for Colombia and Cheung and Herrala (2014), Lin, Chen, and Qian (2022), and Balding, Gregoriou, Tarzia, and Zhang (2024) for China.

responses statistically insignificant at certain horizons. For supply shocks and other commodity innovations, macroprudential policies primarily increase uncertainty rather than materially altering the point estimates. The reading of these interactions is non-trivial, since prudential policies can simultaneously curtail intermediation capacity—raising the deviations by construction—and shield domestic markets from global disturbances, which works against full insulation. We therefore present the interaction estimates as supporting evidence on the joint behavior of regulation and commodity markets rather than as a first-order policy effect. By contrast, for global activity shocks the interactions are stronger in emerging economies, consistent with their heightened sensitivity to global financial conditions (Claessens, Ghosh, and Mihet, 2013; Bergant and Forbes, 2023).

Our paper contributes to several strands of the literature. To start, we extend the empirical evidence on post-crisis CIP deviations (Du, Tepper, and Verdelhan, 2018; Cerutti, Obstfeld, and Zhou, 2021; Cerutti and Zhou, 2023) by characterizing their behavior across a richer set of country groups, namely by stage of economic development, by exposure to commodity markets, and by the specific instrument used in the regulatory response. Furthermore, we connect this body of work to the literature on commodity-currency premia (Bakshi and Panayotov, 2013; Ready et al., 2017b; Byrne et al., 2019) and on the macroeconomic transmission of identified commodity shocks (Baumeister and Hamilton, 2019; Känzig, 2021; Baumeister, 2023), showing that the deviations are responsive to the latter but with magnitudes and signs that vary across country groups. Finally, we add to the evidence on the international effects of macroprudential interventions (Ahnert, Forbes, Friedrich, and Reinhardt, 2021; Claessens, Ghosh, and Mihet, 2013; Bergant and Forbes, 2023; Forbes, 2021), by documenting that regulatory tightenings affect deviations directly and through potential interactions with other economically meaningful developments.

The remainder of the paper proceeds as follows. Section 2 presents the data. Section 3 outlines our identification strategy and empirical methodology. Section 4 presents our main findings, organized around the heterogeneity of regulatory and shock effects. Section 6 provides robustness checks, and Section 7 concludes.

2 Data Description

Our initial analysis is based on daily data on CIP deviations. Then, we move to the estimation of a model at the quarterly frequency that includes other fundamentals (available at lower frequencies). The data we consider is described below.

2.1 CIP deviations

We construct the Covered Interest Parity (CIP) Deviations of advanced and emerging countries against the United States Dollar (USD) following the papers of Du, Tepper, and Verdelhan (2018), Du and Schreger (2022), and Cerutti and Zhou (2023) as[3]

$$\lambda_{t,t+n} = i^{USD}_{t,t+n} - i^{*}_{t,t+n} - f_{t,t+n} + s_t, \tag{1}$$

where $\lambda_{t,t+n}$ is the CIP deviation of the currency against the dollar in basis terms, $i^{USD}_{t,t+n}$ is the dollar funding interest rate, i^* is the foreign country rate, $f_{t,t+n}$ is the forward rate between the period t and the n-periods ahead, and s_t is the spot rate, expressed in foreign currency units per US Dollar. The right-hand-side of equation (1) compares the returns of domestic funding in dollars (i^{USD}) and the effective return rate from a comparable alternative investment in a foreign economy, which implies an associated currency conversion to foreign currency at t and back to US dollars n periods later, where the future conversion is pre-negotiated with a forward contract ($i^*_{t,t+n} + f_{t,t+n} - s_t$). The latter rate of return is called a synthetic dollar investment, as it is equivalent to acquiring an FX dollar swap in the dollar rate, which, if priced correctly, and in the absence of frictions, should yield a similar return to the domestic alternative such that the parity holds without deviations, consistent with the absence of arbitrage opportunities in equilibrium ($\lambda_{t,t+n} = 0$).[4] In practice, however, the deviation can differ from zero, with a negative value indicating that the effective foreign rate is higher than the dollar, and the contrary if the deviation (or basis as it is known) is positive.

[3]It should be noted that in this definition the US is implied as the home or domestic economy and the other country as the foreign one.

[4]Rime et al. (2022) use the FX swap data directly rather than the calculation of the synthetic to approximate the higher use of these instruments rather than the outright forward. FX swaps are typically more liquid than outright forwards, but as we use Emerging Markets, this will introduce potential market segmentation problems.

We follow the literature on exchange rates and classify the countries into two categories: advanced (AE) and emerging market economies (EM). We use the middle rates on spot, forward, and interest rates that come from two sources, Bloomberg and Refinitiv.[5] We will focus only on a low maturity tenor of 3 months to avoid liquidity problems characteristic of higher terms and to ensure as much comparability with the previous literature as possible. As advanced, we use the Australian Dollar (AUD), Canadian Dollar (CAD), Swiss Franc (CHF), Danish Krone (DKK), Euro (EUR), British Pound (GBP), Japanese Yen (JPY), Norwegian Krone (NOK), New Zealand Dollar (NZD), and the Swedish Krona (SEK). We show our calculation of the CIP deviations for these economies in Figure 1, where we can see that these deviations are typically negative, with the DKK being the lowest, but with some exceptions, notably NZD, and the AUD, which can display positive deviations. The focus on the post-crisis 2007 is based on the findings of Du et al. (2018), Cerutti, Obstfeld, and Zhou (2021), and Du and Schreger (2022) that show that CIP held statistically in the pre-crisis period. Another event that brought higher deviations was the dash-for-cash of March 2020, which generated momentarily higher deviations that went back to their previous trend.

Figure 1: CIP deviations of Developed Currencies 2007-2024

[5]In Table 3 of Appendix A, we present the tickers of each of the considered exchanges and interest rates for the thirty countries considered.

For the emerging economies, we use the same twenty countries as in Cerutti and Zhou (2023), namely the Brazilian Real (BRL), Chilean Peso (CLP), Chinese Yuan (CNY), Colombian Peso (COP), Czech Koruna (CZK), Hungarian Forint (HUF), Indonesian Rupiah (IDR), Israeli Sheqel (ILS), Indian Rupee (INR), South Korean Won (KRW), Mexican Peso (MXN), Malaysian Ringgit (MYR), Peruvian Sol (PEN), Philippine Peso (PHP), Polish Zloty (PLN), Russian Ruble (RUB), Thai Baht (THB), Turkish Lira (TRY), Taiwan Dollar (TWD), and the South African Rand (ZAR). A relevant consideration for emerging economies is that the benchmark measure of interest rates, the Libor rate, is not the best baseline because of their relatively high exposure to default risk. Therefore, for this group of countries, we instead opt for a measure of deviations based on the A2/P2 non-commercial paper interest rate as in Cerutti and Zhou (2023), which accounts more comprehensively for the presence of high risk premia.[6] At the same time, for defining the domestic returns in all cases ($i^{USD}_{t,t+n}$), we take a conservative approach to avoid potential measurement issues, and use the average between the 90-day rate of Bloomberg (DCPD090Y Index) and the one in Refinitiv (FRCP23M) instead of the US Libor rate directly. The computed deviations for these countries are shown in Figure 2.[7]

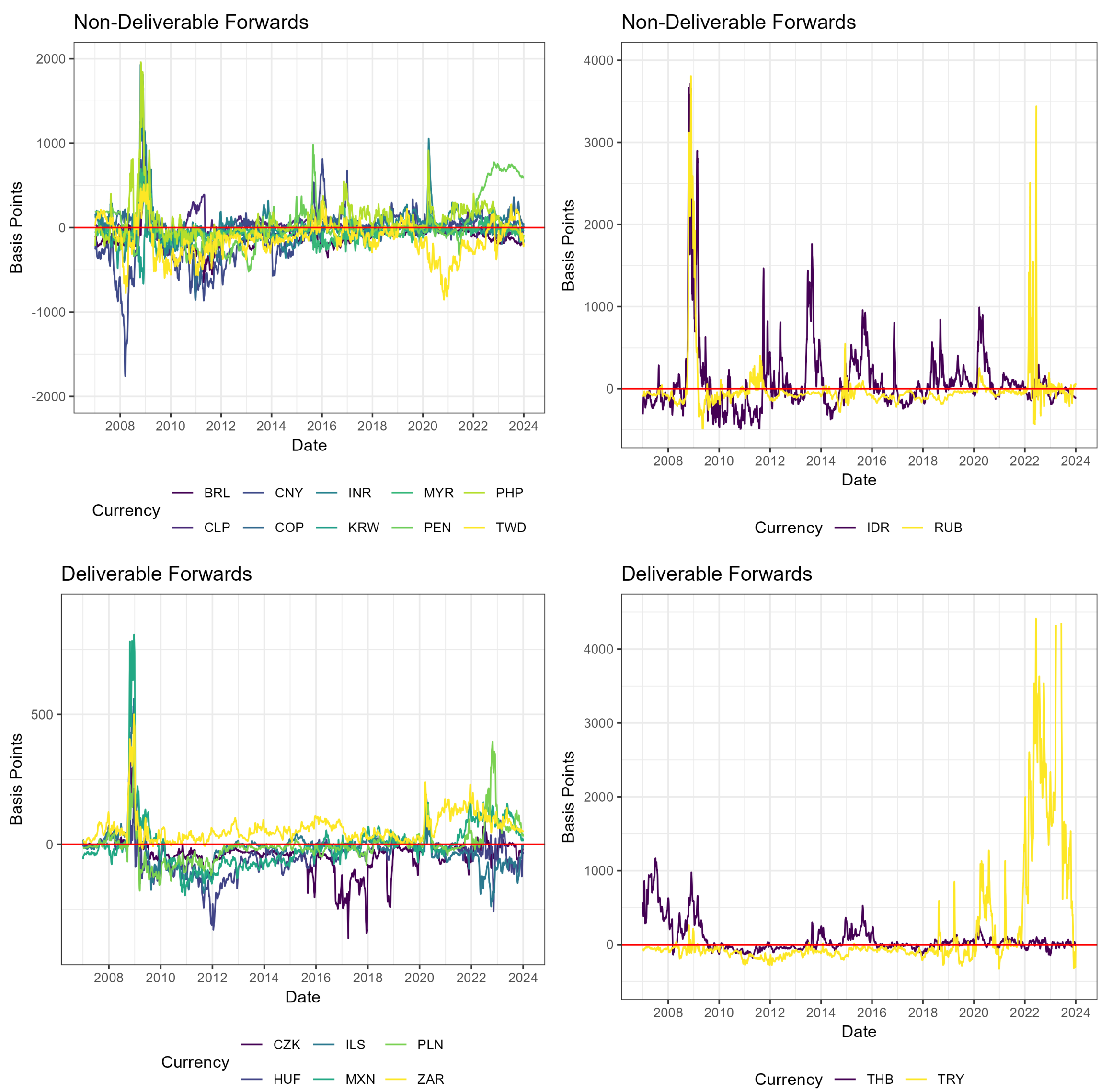
There are multiple channels through which commodity shocks can affect CIP deviations. The first is the risk-premium and interest-rate-differential channel. Based on Ready, Roussanov, and Ward (2017b), commodity-producing countries are partially insulated from shocks, whereas other countries are more sensitive to them. This lower exposure creates higher risk premia in commodity-producing countries' markets and, in turn, larger interest rate differentials and carry trade positions. Higher interest rates appreciate the currency and widen the forward discount, thereby reducing the CIP premium. The second channel, the safe-haven channel, as described in Avdjiev, Bruno, Koch, and Shin (2019) and Cerutti, Obstfeld, and Zhou (2021), suggests that safe-haven economies experience increased capital inflows, which reduce the forward premium, while the currencies of other advanced economies depreciate. As such, CIP deviations widen for safe-haven currencies and become even more negative. Emerging-market currencies experience offsetting capital-flow effects,

[6]We still carried out the estimation for the Libor rates as a robustness exercise.

[7]An additional characteristic of emerging economies is the existence of segmentation in the market, where two types of forwards are traded: Non-Deliverable Forwards (NDF) and Deliverable Forwards (DF). We present in Figure 2 the two types of Deviations generated by these types of forwards, where we can see that the average DF has a lower volatility and deviation compared to the case of NDF. Four outlier countries, two by type, are the Indonesian Rupiah and the Russian Ruble, as well as the Thai Baht and the Turkish Lira.

whereby higher commodity-price revenues appreciate the currency, and the forward premium in turn rises, which implies a decline in CIP deviations. Finally, a third channel is the FX market liquidity channel as in Iida, Kimura, and Sudo (2018). In this channel, commodity-currency producers use surplus income to finance demand for FX swaps and dollar funding more generally. Greater liquidity reduces the forward premium and, in turn, lowers CIP deviations. Conversely, shocks that reduce oil prices, such as supply shocks, create liquidity shortages in these instruments, which widen the premium.

Figure 2: CIP deviations of Emerging Currencies



Macroprudential effects, in turn, operate through related but distinct mechanisms. Most regulations put pressure on financial intermediaries. Their effects are well documented in the intermediary asset-pricing literature, including He and Krishnamurthy (2013), He, Kelly, and Manela (2017), Du, Hébert, and Huber (2022), and Du and Schreger (2022). These constraints raise intermediation costs, increase the cost of hedging instruments, and therefore increase the risk premium charged. This limits arbitrage and increases the persistence of deviations. Macroprudential policies, as explained by Ahnert et al. (2021), translate into changes in risk allocation across sectors, shifting risk from the banking sector to the corporate sector, which has greater exchange-rate risk and lower levels of hedging. Finally, Bergant et al. (2024) provides evidence that macroprudential policies may dampen the effects of global shocks, as regulation decreases exposure to external volatility arising from financial or monetary shocks.

Country groupings and benchmark-rate comparability Beyond the conventional AE/EM partition described above, we also exploit a complementary classification of the countries in our sample by their commodity-market exposure. Following Lee (2023), we define as commodity exporters those economies whose commodity exports exceed 50% of total exports. In our panel, this group comprises Australia, Brazil, Chile, Colombia, Indonesia, Norway, New Zealand, Peru, and Russia, and the remaining countries form the non-exporters group. This split cuts across the AE/EM partition and provides a natural source of heterogeneity in how commodity-market dynamics transmit to the deviations, which we exploit explicitly in Section 4.

We use LIBOR offshore rates for advanced economies and A2/P2 commercial-paper rates for emerging markets, following Cerutti and Zhou (2023). The benchmark-rate may introduce conflicts due to comparability between both, but this choice is motivated by the limited representativeness of LIBOR for the actual cost of dollar funding in EM jurisdictions, where institutions face tighter funding constraints and are subject to higher credit and liquidity premia not reflected in interbank reference rates. It is worth noting that the interest rate spread is the primary driver of both CIP and UIP deviations, with the national rate serving as the key reference for each country; this holds under both benchmark choices and is consistent with the findings of Kalemli-Özcan and Varela (2021). We also construct alternative CIP deviations based on a bid-ask adjusted version, which embeds the round-trip transaction cost of the synthetic FX swap directly into the dependent variable.[8]

2.2 Other variables

To analyze the effect of other variables on the CIP deviations, we construct a quarterly dataset with 30 economies for the period 2008-2024. We consider earlier years (starting in 2000) for robustness analyses, but perform our main estimates starting after the Global Financial Crisis due to the notion that the breakdown of the CIP deviations started with the post-crisis regulatory changes (Du, Tepper, and Verdelhan, 2018; Bacchetta, Davis, and van Wincoop, 2023). Our sample includes emerging (EM) and advanced (AE) economies. For our target variable, the CIP deviations, we compute the quarterly average of the daily data described before. Our panel also includes a macroprudential policy stance variable obtained from the Integrated Macroprudential Policy Database (iMAPP) from the IMF and Alam, Alter, Eiseman, Gelos, Kang, Narita, Nier, and Wang (2024).[9] From this source, we obtain the policy stance indicators for 17 policy tools, which we discuss in more detail in the next subsection.

At the same time, we consider a set of commodity market-related shocks identified and made available in recent studies (see Table 1). The shocks will span different types of innovations, including prices, quantity, inventories, expectations, and news, among others. We classify them into broader categories, namely supply and demand, whenever possible, with only one exception that recovers both types of effects. It is important to note that some shocks are refined functions of other ones, or may be obtained within the same model structure (e.g., the BSVAR-derived shocks). This latter group also includes a global economic activity shock that, even if not related directly to commodity markets, consists of the output shock from the SVAR that considers output and commodity variables in its vector of variables. Similarly, an example of the former case is the news shock, which consists of a surprise shock after removing the effect of other fundamentals (in an IV setup).

[8] We report additional results for this measure in Appendix D.6. Country-specific tickers and sources are listed in Appendix A

[9] This variable is reported with a greater lag (up to 2021 as of the time of our estimations), slightly shortening our final sample in the later years.

Table 1: Commodity markets shocks considered

Shock	Description	Source	Type
Real Commodity Prices Factor	Principal component of set of commodity prices	Baumeister and Guérin (2021)	Demand
1-month oil price surprise	Percent deviations of oil expectations from realized price	Baumeister (2023)	Demand
Pure oil price expectation	Filters out Pure expectation component from 1-month oil surprise after removing the effect of fundamental shocks	Baumeister (2023)	Demand
Oil supply	Shock from the BSVAR equation associated to oil quantities	Baumeister and Hamilton (2019)	Supply
Oil consumption	Shock from the BSVAR equation associated to oil prices	Baumeister and Hamilton (2019)	Demand
Inventories shock	Shock from the BSVAR equation associated with inventories. Inventories are defined as the excess production of oil (supply minus demand)	Baumeister and Hamilton (2019)	Both supply and demand
Oil supply news	Oil futures surprise measure with additional filtering to retain news component only	Känzig (2021)	Supply

The diversity of sources and identification strategies underlying the shocks in Table 1 also accounts against a common global confounding concern. Commodity shocks may interact with other global forces, such as monetary policy spillovers or the Global Dollar Cycle discussed by Obstfeld and Zhou (2023), and could in principle appear as different disturbances if their identification is contaminated by the same underlying factor. Nevertheless, the shocks are drawn from methodologically different frameworks: the supply, consumption-demand, and inventory shocks come from the BSVAR identification of Baumeister and Hamilton (2019), which exploits prior information on short-run price and quantity elasticities, while the oil supply news shock is constructed via the narrative-based IV strategy of Känzig (2021), using futures price surprises around OPEC announcements that are further filtered to retain only the news component. The orthogonality of these identification schemes to one another is by design, making it unlikely that a single global factor drives all of them simultaneously. Precisely because some shocks share demand-side or supply-side origins, finding similar responses across shocks of the same type provides internal consistency rather than evidence of contamination; in this sense, the comovement of same-type shocks reinforces the robustness of the estimated effects rather than undermining it.

Table 2: Correlation CIP Deviations and Oil Shocks

	Oil Supply	Oil Consumption Demand	Oil Inventory Demand	1-Month Oil	Pure Price Oil	Oil Supply News
AUD	0.19	-0.20	-0.02	-0.17	0.04	-0.30
CAD	0.09	-0.08	0.03	-0.12	-0.08	-0.14
CHF	0.10	-0.13	0.00	-0.11	0.02	-0.19
DKK	0.10	-0.05	0.03	-0.04	0.03	-0.11
EUR	0.15	-0.14	0.03	-0.11	0.03	-0.22
GBP	0.05	-0.06	-0.06	-0.05	0.02	-0.17
JPY	0.16	-0.11	0.03	-0.11	0.01	-0.24
NOK	0.09	-0.12	-0.00	-0.06	0.06	-0.16
NZD	0.11	-0.16	-0.13	-0.10	0.12	-0.14
SEK	0.12	-0.12	-0.03	-0.10	0.03	-0.17
BRL	0.01	-0.09	-0.02	-0.07	0.05	-0.08
CLP	-0.06	-0.03	-0.09	-0.03	0.03	-0.03
CNY	-0.07	-0.00	-0.19	-0.07	-0.04	-0.03
COP	-0.04	-0.05	0.11	0.05	0.10	0.02
CZK	-0.02	0.02	-0.08	0.01	-0.01	-0.07
HUF	-0.05	0.03	0.05	0.06	0.01	0.13
IDR	0.04	-0.01	-0.00	-0.05	-0.06	-0.08
ILS	-0.09	0.03	-0.09	0.03	0.01	0.01
INR	0.02	-0.12	-0.04	-0.04	0.10	-0.14
KRW	-0.06	0.09	-0.05	0.03	-0.06	0.16
MXN	0.11	-0.12	-0.03	-0.07	0.10	-0.28
MYR	-0.00	0.06	0.11	0.06	0.01	0.12
PEN	0.07	-0.02	-0.23	-0.09	0.00	-0.05
PHP	0.04	-0.13	-0.08	-0.07	0.08	-0.22
PLN	0.08	-0.06	-0.02	-0.04	0.05	-0.15
RUB	-0.01	-0.06	0.08	-0.00	0.05	-0.07
THB	0.02	0.05	-0.04	0.03	0.02	0.02
TRY	0.03	-0.02	-0.05	-0.03	0.02	-0.07
TWD	-0.18	0.10	0.01	0.13	-0.02	0.12
ZAR	-0.13	0.05	-0.11	0.18	0.19	-0.07

Notes: The table shows the correlation of each of the currencies against the oil shocks. Cells are color-coded by sign and magnitude: blue indicates positive correlations, red indicates negative correlations.

As a first exploration, we display the correlation of the calculated CIP deviations with the commodity market shocks in Table 2. From these figures we can already gauge systematic differences in the comovement between CIP deviations and oil market shocks across advanced and emerging market currencies that align with the aforementioned patterns. Advanced economy currencies consistently exhibit negative correlations with demand-driven oil shocks, particularly oil consumption demand (ranging from -0.05 to -0.20), in line with the finding of Lustig, Roussanov, and Verdelhan (2014) that currency risk premia vary countercyclically with global risk factors. This pattern is most pronounced for commodity-exporting currencies such as the Australian dollar (-0.20), Canadian dollar (-0.08), and Norwegian krone (-0.12), which aligns with the fact that commodity currencies systematically benefit from positive demand shocks through improved terms of trade as discussed by Ready, Roussanov, and Ward (2017b). At the same time, the modest positive correlations with oil supply shocks (0.05 to 0.19) align with Kilian (2009) where supply-driven price increases benefit commodity exporters differently than demand-driven increases, and finally, we see uniformly negative correlations with oil supply news (-0.11 to -0.30), a result that resembles the findings of Känzig (2021), where positive supply news reduces oil prices, weakening commodity currencies through reduced scarcity rents. Noticeably, the sign patterns from the oil supply news are very different from the supply shocks, highlighting the relevance of analyzing subcomponents of the shocks themselves if feasible.

The correlation patterns for emerging market currencies display substantially greater heterogeneity and weaker magnitudes, consistent with the global dollar funding constraints documented by Du, Tepper, and Verdelhan (2018) and Avdjiev, Bruno, Koch, and Shin (2019). Unlike the systematic responses observed for advanced economies, emerging market currencies show mixed correlations with oil demand shocks, with some currencies, such as the Korean won (0.09) and Malaysian ringgit (0.06), exhibiting positive correlations, while others, such as the Indian rupee (-0.12) and Mexican peso (-0.12), maintain negative correlations. This heterogeneity reflects Ready (2018)'s observation that oil price transmission varies significantly across countries depending on their economic structure and financial development. Notably, several emerging market currencies exhibit positive correlations with oil supply news, particularly the Korean won (0.16), Hungarian forint (0.13), Malaysian ringgit (0.12), and Taiwan dollar (0.12), contrasting sharply with advanced economies. This divergent pattern is consistent with the argument by Du and Schreger (2022) that emerging markets are more sensitive to global risk sentiment due to constrained access to dollar funding markets. The weaker correlations with fundamental oil shocks but stronger sensitivity to news-based measures suggest that emerging market CIP deviations are more driven by financial market frictions and sentiment than by underlying commodity market fundamentals, as predicted by the global dollar funding literature.

On the other hand, we consider various economic controls. A first group will be country-specific variables such as GDP growth, CPI inflation, exchange rate depreciation (vis-à-vis the US dollar), and monetary policy rates. We also consider global variables (common to all countries in the panel) such as VIX, and the first principal component of the real GDP growth of three major economies (US, EU, Japan), consistent with the standard in the empirical international finance literature (e.g. Aizenman and Binici, 2016; Coman and Lloyd, 2022, among others), and in addition, based on our explorations of the daily data, we include a broad USD index, and a market leverage ratio variables as described below.[10]

Additional global controls based on daily data comovements We also verify the high-frequency comovement of the deviations with a set of daily financial data described in Appendix A.4. The variables that showed a stronger co-movement with the daily deviations are the market leverage and the U.S. dollar index. We are including them as additional controls in our baseline specification, as these may capture global developments that may be absorbed by the country-specific dynamics of the deviations if omitted. We note, however, that as part of our robustness checks, we verify an alternative model without these additional variables.[11]

Leverage We account for the effects of intermediary leverage by following He, Kelly, and Manela (2017), Du, Hébert, and Huber (2022), and Cerutti and Zhou (2023), which show the importance of intermediaries in potentially driving global markets-wide effects on CIP deviations. We measure intermediary leverage using the capital ratio of primary FX dealers. The capital ratio is defined as the ratio of market equity to total assets (market equity plus book value of debt):

$$\eta_{i,t} = \frac{\text{Market Equity}_{i,t}}{\text{Market Equity}_{i,t} + \text{Book Debt}_{i,t}},$$

where $\text{Market Equity}_{i,t}$ is the product of the share price and the total shares outstanding, and $\text{Book Debt}_{i,t}$ is the total assets minus the common equity. We aggregate the capital ratio with equal weights to create a single market measure. Following He, Kelly, and Manela (2017), we invert the capital ratio and square it to approximate intermediary risk as in He and Krishnamurthy (2012), yielding $Lev^2_{i,t} = 1/\eta^2_{i,t}$, which captures the non-linear effect of increasing leverage. We take the square root of this measure and include it as a control in our panel specification.

[10]It should be noted that using time effects in our specification is not feasible as we are interested in the effect of shocks that are common to all countries in the panel. With this in mind, we incorporate a comprehensive set of global controls.

[11]We show the list of variables and associated correlations with the CIP deviations in each country in our sample in Figure 17 and Tables 7 and 8 Appendix A.4.

USD Index We also include the trade-weighted U.S. dollar index as an additional control variable. This measure captures common movements in the dollar that affect all bilateral exchange rates in our sample, thereby accounting for valuation dynamics that the CIP specification itself may not fully isolate. Since CIP deviations are defined bilaterally against the dollar, including a broad dollar index helps control for global dollar strength effects that country-specific deviation dynamics could otherwise absorb.

Other variables We also consider other controls in robustness exercises, such as the capital inflows to GDP, credit to GDP (to domestic deposit institutions), and a principal component of the policy rates of some major economies (corrected by the presence of a zero lower bound by using shadow rates). In many of these cases, the source of the data is the IMF-IFS database. Some of these variables are ultimately excluded from the sample as they lacked significance (in the presence of the other controls and main variables).[12]

Finally, we adjusted the monetary policy variables for some countries to account for the presence of dates with a binding zero-lower bound (ZLB). For these cases, we replace the rate at ZLB dates with the shadow rates, reported by Wu and Xia (2016) for the US, EU, and UK, and by Krippner (2013) for Japan. It should be noted, nonetheless, that in more recent years, these economies are no longer at the zero lower bound, and thus, by the end of the sample, the shadow rates take on the same values as the original rates.

2.3 Macroprudential Policy Stance Variable

We obtain a macroprudential policy stance measure from the Integrated Macroprudential Policy Database (iMAPP), as reported by the IMF, based on Alam, Alter, Eiseman, Gelos, Kang, Narita, Nier, and Wang (2024). The data consists of policy indicators for 17 instruments (shown in Table 11 in the Appendix B). For each tool and period, an indicator is calculated according to the policy

[12] Given that some of the control variables are obtained from the IMF-IFS, we amend missing data whenever possible with information from other sources such as the BIS Statistics warehouse and the Macro-financial dataset of Monnet and Puy (2019), who provide IMF-IFS consistent series for a large number of economies. The full list of variables in the quarterly dataset (included in the baseline and considered in other exercises) can be found in Table 10 in Appendix B.

change observed:

$$MaPP^j_{i,t} = \begin{cases} 1 & \text{if tightened} \\ 0 & \text{if unchanged} \\ -1 & \text{if loosened} \end{cases},$$

for instruments $j = \{1, 2, 3, \cdots, 17\}$ and country i.

We aggregate the indices through the available instruments and obtain the indicator of the average policy stance of each economy i at time t as: $MaPP_{i,t} = \sum_{j=1}^{17} MaPP^j_{i,t}$. This indicator will take values between -17 and 17 at each date, depending on the individual changes in each instrument. In that sense, and similar to the case of Fernández, Rebucci, and Uribe (2015) for capital controls, this net tightening indicator can be interpreted as a measure of the overall macroprudential stance of an economy, with higher values indicating a stricter regulatory stance.

Now, although this measure accounts for the stance, it is still given in terms of policy changes, which implies that a policy stance adjustment (e.g., a tightening) would be reflected only for one period in the indicator, and future values of the variable may fail to capture the posture of the prudential regulators. Because of that, a common practice in the literature (e.g. Richter, Schularick, and Shim, 2019; Coman and Lloyd, 2022) consists of using a rolling sum of this indicator. We do that as well and use the four-quarter rolling sum, meaning that in each period our policy index accounts for the annual macroprudential policy stance (current and previous three quarters).[13] Additionally, we will focus on the change in the annual policy stances in our estimations, as it could be argued that the annual indexes for some countries may be non-stationary for our sample period —for example, if a country has repeatedly tightened its toolkit after the GFC.

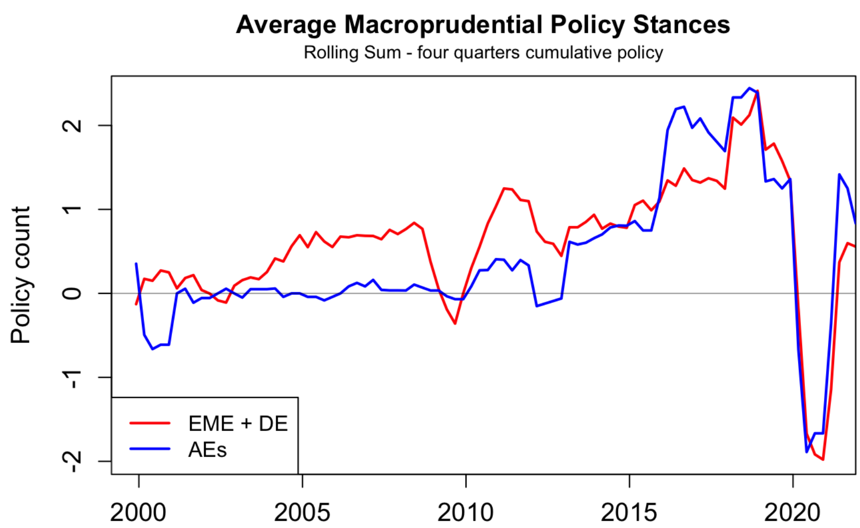
This database is relatively recent and offers a key advantage: it distinguishes between types of policy tightenings rather than relying solely on dummy indicators of regulatory use.[14] The index varies substantially across countries. However, when aggregated by country type (advanced and emerging economies), more regular patterns emerge as shown in Figure 3, where we can see that during normal times, the index averages around 1, with occasional peaks near 2; this implies

[13]The resulting policy indexes for each country are shown in Figure 20 in Appendix C.

[14]Other comprehensive macroprudential policy databases exist, such as the Macroprudential Policies Evaluation Database (MaPPED) produced by the ECB, as reported in Budnik and Kleibl (2018), which covers the full lifecycle of prudential interventions across the European Union.

regulators apply one to two prudential tightenings in any given year. At the same time, the stances can lower markedly during crises. These patterns are consistent with the policy-space-building hypothesis described in Bergant and Forbes (2023). On the other hand, the regulatory patterns can vary by type of instrument. We illustrate on this dimension in Appendix C where we show summary statistics for different components of the prudential toolkit.[15]

Figure 3: Average Macroprudential Policy Stance by Country Type



Note: The plot presents the average macroprudential policy stance, measured as the 4-quarter rolling sum of the macroprudential policy indicator, for advanced economies (AE) and emerging market economies plus developing economies (EM and DE) over the sample period. The average is taken as the sum of policy indexes by total number of countries of each type implementing prudential interventions in each period, as reported by Alam, Alter, Eiseman, Gelos, Kang, Narita, Nier, and Wang (2024).

These policies can also potentially comove across countries, due to shared global economic conditions or potential regulatory spillovers (Granados, 2024). The potential interlinkages between macroprudential policies can lead to interactions where global banks may seek to circumvent stricter regulations in one country by shifting activities to jurisdictions with looser frameworks. This phenomenon has been explored in works like Tripathy (2020) and Aiyar, Calomiris, and Wieladek (2014), which highlight the challenges regulators face in an interconnected financial

[15]Specific examples of tightenings (marked as +1 in the index) include: (i) Singapore, January 2016: "MAS has implemented the CCB requirement for banks from Jan 1, 2016, in line with Basel III timeline"; (ii) Belgium, April 2018: "The new macroprudential measure to impose higher risk weights for Belgian residential real estate exposures on banks became effective...". Examples of loosenings (marked as -1) include: (i) Brazil, September 2020: "The risk weight for loans to small-and medium-sized enterprises was reduced from 100% to 85%"; (ii) Denmark, June 2020: "To maximize the capacity of banks to lend and support households and businesses in recovery from the COVID-19 crisis, certain capital relief measures were adopted...".

system. These patterns are also visible in Figure 3, with emerging economies implementing higher levels of prudential regulations prior to the crisis, which arguably, as indicated by Forbes (2021) and Bergant and Forbes (2023), provided them with greater scope for managing the financial crisis, and arguably prompted other types of countries to adopt similar measures in the following years, leading to more pronounced policy movements during the pandemic downturn.

3 Empirical Strategy

Our empirical setup follows a lag-augmented local projection (LP) approach along the lines of Coman and Lloyd (2022) or Richter, Schularick, and Shim (2019) that builds on the projection method of Jordà (2005). The method is increasingly applied in empirical studies, as it is relatively robust to misspecification compared to traditional VAR methods (Haug and Smith, 2012; Montiel-Olea and Plagborg-Moller, 2021). As explained below, we can recover the dynamic effect of macroprudential policies and of commodity market-related shocks on the CIP deviations, as well as their potential interactions, from specific coefficients in our specification.

Identification We leverage the availability of several identified commodity market-related shocks and thus include them directly in our setup. These shocks are related to different features of the commodity markets, although a majority of them focus especially on the oil markets. A summarized description of the shocks is included in the Table 1. We note that we broadly include demand-side and supply-side shocks. However, we also consider a few other shocks whose type is somewhat less delimited. At the same time, the macroprudential stances that we include—based on 17 individual instruments—can be considered relatively slowly moving with respect to the deviations, and thus would largely consist of lagged policy actions, which allows for an inclusion in the model without major endogeneity concerns. However, for good measure, we include the policies in an explicit lagged format, further mitigating any potential endogeneity issues.[16]

[16]We also conduct a placebo test by considering a model with regulation leads to verify that markets are not anticipating prudential policies that would render them endogenous. This exercise is reported in the robustness tests.

3.1 Specification

For our baseline LP estimation, we set up a panel regression for a measure of the CIP deviations as a function of contemporaneous and lagged regressors and controls. There are two main variables of interest, one is the lagged change in the (cumulated) macroprudential policy stances, and the other is the commodity-market shock, which we incorporate by estimating the model for each of the shocks in Table 1 (as well as an activity shock). We include an interaction between the shock and the lagged macroprudential policy changes, along similar lines as Coman and Lloyd (2022). Such an interaction informs whether the effect of the shocks is altered in any way by the presence of macroprudential policy tightening interventions. Our estimation setup also accounts for other standard control variables, as well as for the presence of fixed country effects.

The estimation is set in terms of CIP deviation changes, that is, it inquires on how higher or lower the deviation in local (US) to foreign returns (adjusted by the implied Forward rate depreciation) will be after the onset of the shocks and policy changes for several horizons (quarters) $h = 0, 1, \cdots, H(= 12)$:[17]

$$\begin{aligned} \text{CIPdev}_{i,t+h} - \text{CIPdev}_{i,t-1} = \alpha^{(h)} + \beta_1^{(h)}\text{shock}_t + \beta_2^{(h)}\Delta MaP_{i,t-1} + \beta_3^{(h)}(\text{shock}_t \times \Delta MaP_{i,t-1}) \\ + \sum_{k=0}^{4}\gamma^{(h)}X_{i,t-k} + \sum_{k=0}^{4}\phi^{(h)}Z_{t-k} + FE_i^h + \epsilon_{i,t+h}, \end{aligned} \tag{2}$$

where t and h denote quarter and horizon.

$X_{i,t-k}$ represents a set of controls (contemporaneous and lagged) that include individual controls, namely, the real GDP growth, CPI inflation, changes in the monetary policy rate, exchange rate depreciation (vis-a-vis the US Dollar), the capital inflows to GDP, [18] as well as four lags of the other explanatory variables (shocks and prudential policy stance) and the dependent variable. Z_{t-k} is a set of global controls that include the change in the VIX, a principal component of the GDP growth of a selection of advanced economies (US, UK, Japan), the market leverage, and a trade-weighted USD index. The global controls are included because of the fact that we are interested in the effect

[17] It has been documented that the response recovered in this format is analogous to one using a local projections setup in levels, however, the "long-difference" format is still preferred as it reports better bias and confidence interval coverage properties in finite samples. For details, see Piger and Stockwell (2025).

[18] This variable is measured as a smoothed flow along the lines of Forbes and Warnock (2012) and Cavallo, Izquierdo, and León (2017).

of global commodity shocks that are common to several countries, which makes the inclusion of time effects unfeasible.

Our specification recovers three estimands of interest. The first is the direct effect of a macroprudential tightening on the deviations ($\beta_2^{(h)}$), capturing how regulation alone reshapes the basis. The second is the direct effect of an identified commodity-market shock ($\beta_1^{(h)}$), measuring how commodity-market disturbances transmit to the deviations independently of the regulatory stance. The third is the combined effect of the shock in the presence of a regulatory change ($\beta_1^{(h)} + \beta_3^{(h)}$), informing whether the policy modifies the shock pass-through. We obtain these three sets of estimates for several horizons in each specification and use them to build the associated impulse responses reported as results.

Two further considerations on identification merit discussion. To start, although our use of lagged macroprudential variables alleviates contemporaneous endogeneity concerns, it does not eliminate them, as regulators may anticipate or react to the same financial-market conditions that drive the deviations. We address this in two ways. First, we control for a substantial set of country-specific and global financial conditions that may comove with both the policy stance and the deviations, including the VIX, a global activity factor, the trade-weighted USD index, an intermediary leverage measure, country-level monetary stance, and capital inflows. A second concern relates to common global shocks. The inclusion of time fixed effects is incompatible with our specification, as the commodity-market shocks we use are common to all countries in the panel and would be absorbed by the time effect, leaving the shock coefficient unidentified. We therefore include the global controls listed above as a partial substitute, capturing the bulk of common-shock variation that would otherwise confound the country-level responses, and conduct a time fixed effects alternative estimation and compare the subset of results that remain feasible —relative to our baseline with global commodity shocks— as part of our robustness checks.

4 Results

We present the impulse response functions (IRFs) of CIP deviations after macroprudential tightenings and after a set of commodity market shocks. We first show the effect of changes in the prudential policy stance across different country groupings. Then we turn to analyzing the effect of commodity market-related shocks on the deviations. The responses are reported as the additional fluctuation in the CIP deviation for 12 quarters after the onset of a shock and are given in basis points.

For interpretability, it is important to note that our LP specification trades off the smoothness and volatility of the estimates in favor of lower bias. Ultimately, that is the dilemma for a practitioner in opting for these models as opposed to VAR models of a similar order. At the same time, it is useful to keep in mind that in either type of setup (LP or VAR), we should put more weight in the horizons that are closer to our lag-order (Montiel-Olea, Plagborg-Møller, Qian, and Wolf, 2025; Baumeister, 2025). Remembering this is relevant, in particular for LPs, as their higher variance property makes them depict volatile and jagged confidence intervals, and at later horizons, the response of interest may even switch signs relative to the initial periods.

4.1 Heterogeneity in CIP deviations: stylized facts

Before turning to the impulse responses, we organize the discussion around the heterogeneity of the deviations themselves. The summary statistics in Table 4 of Appendix A reveal pronounced cross-country differences both in the mean and in the volatility of the deviations. Advanced-economy currencies exhibit mean deviations between -28 and $+3$ basis points and standard deviations between 12 and 72 basis points, whereas emerging-market currencies cover a much wider range, with means as extreme as -150 basis points (BRL) and $+135$ basis points (TRY) and standard deviations routinely above 100 basis points. This pattern is consistent with the additional frictions that characterize EM dollar funding conditions (e.g., Cerutti and Zhou, 2023), and motivates a separate treatment of the two groups in the estimation that follows.

This country classification is standard in the literature; however, as suggested by our descriptive analysis of the deviations, including a hierarchical clustering of countries in our sample (Figure **??** in Appendix A), the country clusters for the deviations do not map cleanly into the AE-EM classification, indicating a rich cross-country variation in other dimensions. The correlation matrix between the deviations and a battery of financial controls, reported in Figure 17 (Appendix A.4), reinforces this reading by documenting that the comovement of the deviations with global financial variables differs systematically across countries. With this in mind, we also explore the responses of the deviations on two more dimensions, first by exporter and non-exporter status following the classification of Lee (2023) introduced in Section 2, and second, by type of regulatory instrument, where we isolate the effect of specific types of policy instrument changes, namely, capital, asset prices, and liquidity and FX related interventions.

These observations frame the rest of this and next section. We next characterize the direct effect of macroprudential policy on the deviations across the AE/EM, exporter/non-exporter, and instrument-type partitions; we then examine the direct response of the deviations to identified commodity-market shocks. Finally, we discuss the potential for interaction effects between policy interventions and commodity shocks.

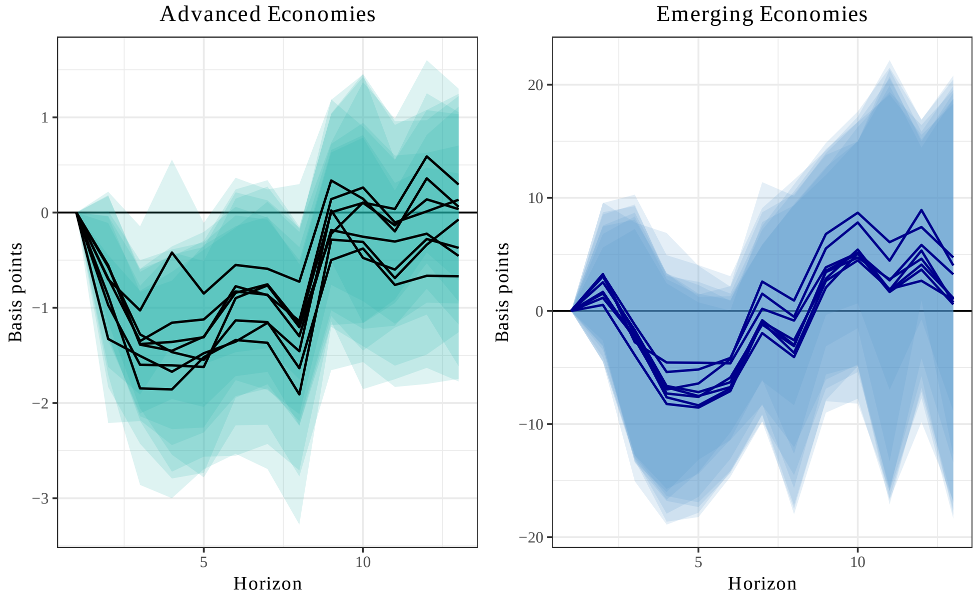
4.2 Direct effects of macroprudential policy on CIP deviations

To begin, we consider the isolated effect of a macroprudential tightening. In principle, policy interventions are expected to yield larger departures from zero in CIP deviations, as tighter regulations prevent the parity from becoming binding. The effects are given by $\beta_2^{(h)}$ in our specification in equation (2). We explore these effects across three dimensions: by stage of economic development, by commodity trade exposure —or incidence of commodity markets (exporter, non-exporter)— and by the specific type of instrument or intervention deployed.

4.2.1 Heterogeneity by stage of economic development

Figure 4 reports the IRF of the CIP deviation to a macroprudential tightening for advanced (AE) and emerging economies (EM). Each panel shows the response in estimations of equation (2) for specifications where the shocks in Table 1 are included individually in the model. The shaded areas are the 95% confidence intervals. A first salient result is that, regardless of the specific shock included, the effect of regulation on the CIP deviations is robustly negative for advanced economies. For emerging economies, the point estimates are also negative, but the volatility of the deviations dominates, rendering the response largely insignificant.

Figure 4: LP IRFs to a Macroprudential Policy Tightening



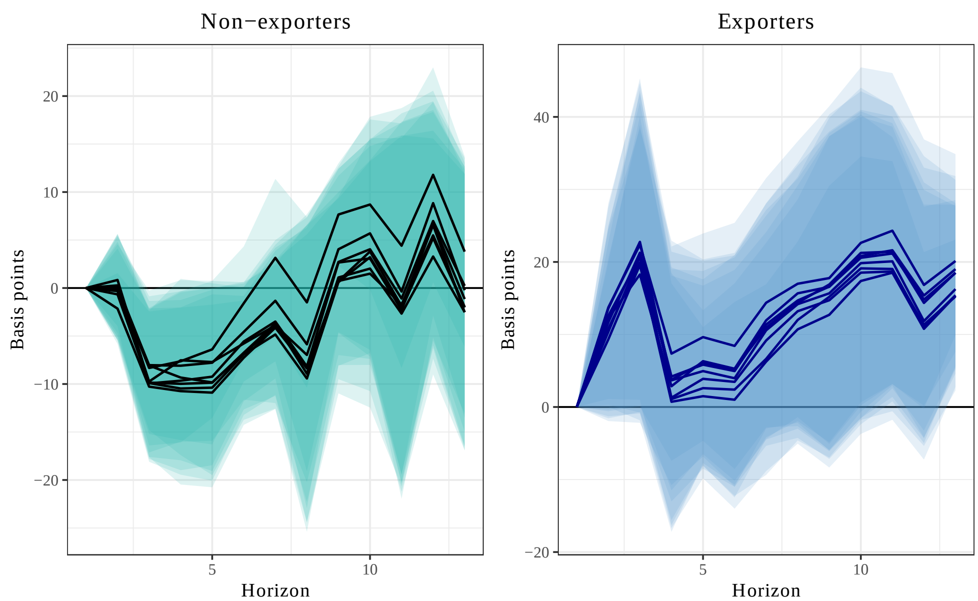
Note: These plots depict the IRF of the CIP deviations in our baseline specification to a macroprudential policy tightening for specifications with different commodity-market-related shocks as listed in Table 1. For each shock, the IRF and 95% confidence intervals are plotted.

The magnitude of the effect varies markedly with the country group. In advanced economies, the regulatory impact ranges from -1 to -2 basis points and is estimated with comparatively narrow confidence intervals. Emerging markets display point estimates of larger absolute magnitude—in the order of -5 to -10 basis points but with much wider confidence intervals that reflect the higher volatility of EM deviations documented in Section 4.1. Regulatory changes also take effect more quickly in advanced economies, with statistically significant impacts observed within the first year, while emerging markets exhibit stronger but slower responses, taking an additional one to two quarters to materialize. Given the systematic negativity of the deviations documented in Section 2, both responses indicate that macroprudential regulation amplifies departures from covered interest parity by pushing the deviations further from zero, in line with the post-crisis evidence in Du and Schreger (2022) and Avdjiev et al. (2019). At the same time, a quick reading of this first set of effects in emerging economies may lead to deeming their responses as irrelevant. However, this could also be an effect of substantial volatility and heterogeneity in this country group, which is the point we make by exploring additional country and policy categories as shown next.

4.2.2 Heterogeneity by exposure to commodity markets

Continuing our exploration across different country types, we report in Figure 5 the CIP deviations responses to macroprudential policies for commodity exporters and non-exporters as defined in Section 2. For non-exporters, the response is statistically significant and negative, of about -10 basis points on average, in line with the baseline AE/EM results. For commodity exporters, by contrast, the response is small, surprisingly positive, although insignificant.

Figure 5: LP IRFs to a Macroprudential Tightening - Commodity Exporters vs. Non-Exporters



Note: IRF of the CIP deviations to a macroprudential policy tightening for specifications with different commodity-market-related shocks as listed in Table 1, estimated separately for commodity exporters and non-exporters. The exporters group is defined as in Lee (2023) (commodity exports exceeding 50% of total exports). The list of exporters in our sample is: Australia, Brazil, Chile, Colombia, Indonesia, Norway, New Zealand, Peru, and Russia. For each shock, the IRF and 95% confidence intervals are plotted.

The asymmetry reflects how commodity revenue flows interact with the distortive effects on intermediation from stricter macroprudential policies. In commodity-producing countries, persistent terms-of-trade gains from commodity exports translate into higher average interest rates and currency appreciation during booms (Ready et al., 2017b), while the FX-swap-market liquidity from these revenues compresses the deviations independently of the regulatory stance (Iida et al., 2018). In non-exporter economies, by contrast, the deviations are more directly governed by intermediation frictions, with limited balance-sheet capacity for arbitrage that becomes further constrained when the regulatory stance tightens (Du, Tepper, and Verdelhan, 2018; Avdjiev, Bruno, Koch, and Shin, 2019; Du, Hébert, and Huber, 2022). The cross-section of the regulatory effect therefore reflects, in part, the same heterogeneity in commodity exposure that was referred to in Section 4.1.

4.2.3 Heterogeneity by type of macroprudential instrument

As a final economically relevant category, we consider the types of interventions within the policy toolkit. Aggregating the macroprudential stance across the 17 individual tools in our index masks substantial heterogeneity in the way each instrument transmits to the deviations. Therefore, a natural follow-up exercise is to consider subcategories of prudential policies as feasible, while acknowledging the increase in uncertainty and limited power due to the information loss from discarding (other tools') policy interventions. Figures 6 and 7 disaggregate the policy stance by tool category, distinguishing capital-related, asset-related, and liquidity and FX-related interventions. For the sake of clarity—given the opening in the policy dimension and as a robustness check—we focus, in this case, on a version of the model that abstracts from commodity shocks.[19] The categorization follows Cabral et al. (2019), BIS (2012), and Cerutti, Claessens, and Laeven (2017), and the components of each subaggregate are detailed in Appendix C.

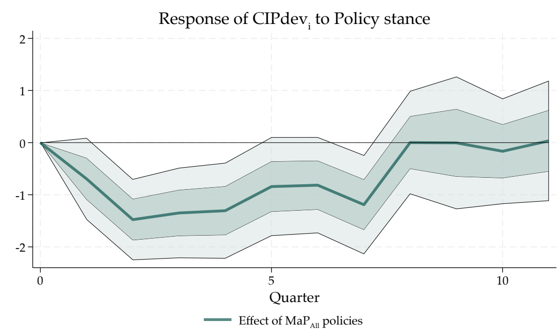
Three patterns are visible. To start, capital-related interventions (Panel b of both figures) produce a clearly negative effect on the deviations in both country groups, consistent with their direct bearing on the balance-sheet capacity of intermediaries that price FX swaps and forwards. In addition, liquidity and FX-related tools (Panel d) generate an even more pronounced negative effect in emerging economies, where exposure to dollar-funding stress and FX-position limits is more binding—this effect is significant, dispelling the potential interpretation that policy is not relevant for this country group if we would only focus on the aggregate toolkit. Finally, asset-related tools (Panel c) operate through a partly different channel, as several of these instruments target borrower-side leverage and credit growth, with smaller and less precisely estimated effects on the deviations. The all-tools index in Panel (a) reflects the net of these effects and matches the AE response in Figure 4; for emerging markets, the dominance of liquidity and FX-related tightenings yields a slightly significant overall response that is partly masked once asset-related interventions

[19] We report the estimation equation for this case (equation (4)) and additional responses in Appendix D.3. On the other hand, analogous results for the baseline model are shown in Appendix D.5.

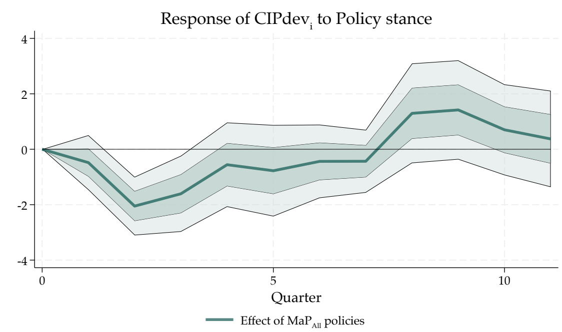
are added back into the all-tools index. As an implication, a complete description of the extent to which the prudential regulations amplify the deviations requires a look that discriminates by the type of instrument at hand. Nonetheless, we emphasize again that a tool-specific answer is only complementary to the one for the whole stance index, given the trade-off between a narrower policy-target delimitation of specific tools and the richer statistical information underlying the estimations that encompass all types of interventions.

Figure 6: LP-IRFs to policy tightenings by instrument type - Advanced Economies

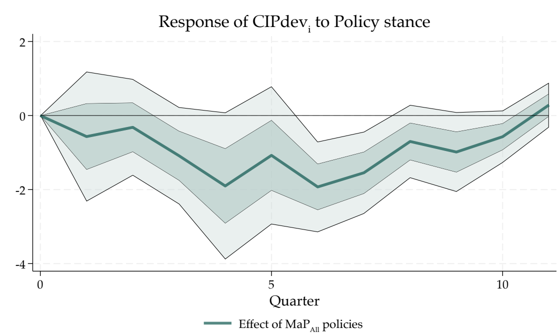
Panel (a): All tools



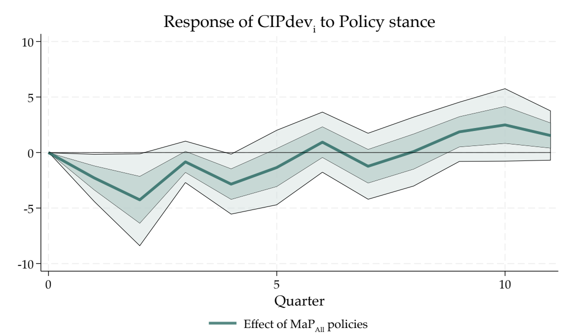
Panel (b): Capital-related tools



Panel (c): Asset-related tools



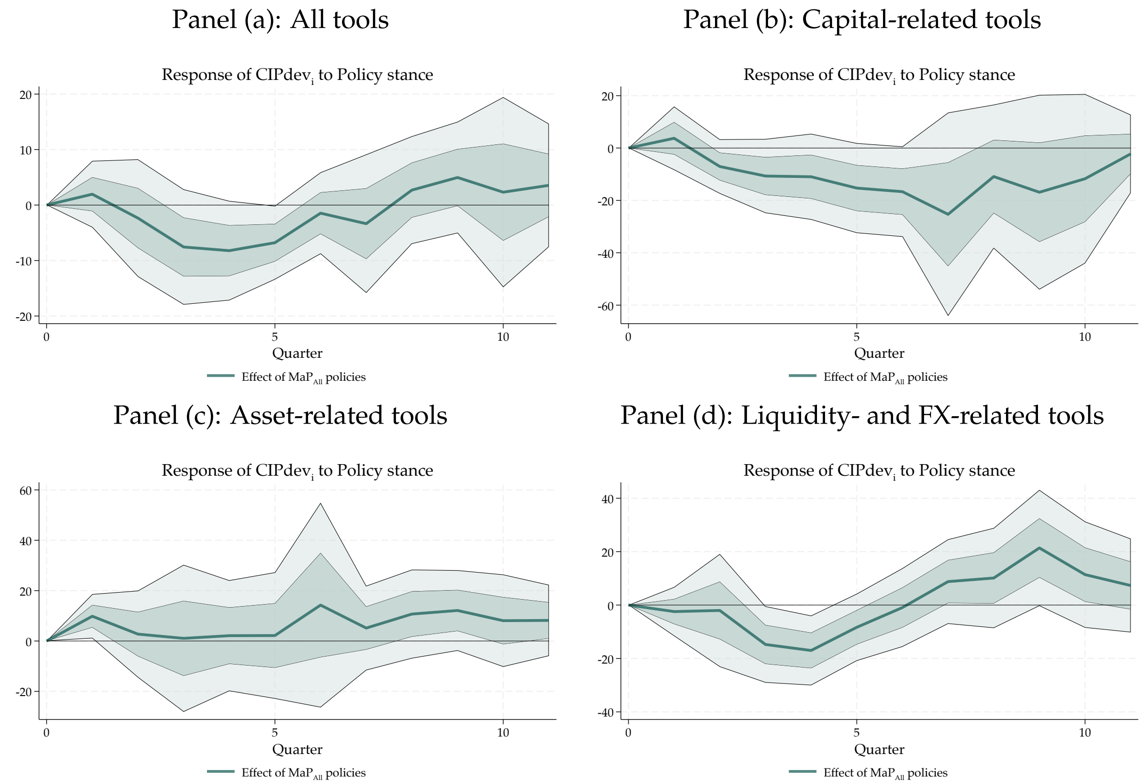
Panel (d): Liquidity- and FX-related tools



Note: Each plot depicts the IRF of the CIP deviation in advanced economies after a unit increase in the policy stance index. The policy index in Panel (a) is the all-tools index used in the baseline; Panels (b)–(d) report indexes that aggregate only the indicated subcategory of the toolkit, defined as in Appendix C. The confidence intervals have 68% and 95% coverage in all cases.

We also obtain these effects for non-exporters and exporters and report them in Figures 24 and 25 in the Appendix D.3. Non-exporter economies display a negative, deviation-augmenting effect, as in the other country groupings, reflecting the expected decrease in market liquidity that follows stricter prudential stances. The scale of the negative effect is lower, reflecting the fact that non-exporter countries are largely composed of advanced economies with more developed financial markets. The clear significance of these responses also aligns with such an interpretation.

Figure 7: LP-IRFs to policy tightenings by instrument type - Emerging Economies



Note: Each plot depicts the IRF of the CIP deviation in emerging economies after a unit increase in the policy stance index. The policy index in Panel (a) is the all-tools index used in the baseline; Panels (b)–(d) report indexes that aggregate only the indicated subcategory of the toolkit, defined as in Appendix C. The confidence intervals have 68% and 95% coverage in all cases.

On the other hand, the effects for exporter countries are positive, which contrasts with all categories. Here the intuition is reversed: For exporter countries with abundant inflows in dollars that need to be backed by domestic currency, the banks rely more extensively on swap instruments, such intermediation would imply an increased volatility in the forward markets and a greater volatility of the deviations. In this situation, lower banking intermediation will reduce demand for swap instruments, thereby mitigating deviations. This effect co-exists with the standard liquidity effect for other instruments that is documented for the other country groupings, and ultimately would lead to a positive, but barely significant, response for exporters. This result highlights the non-trivial heterogeneity in CIP deviation responses we are alluding to with our estimations.

Effects by type of policy stance change Another important exploration relates to determining whether the type of policy intervention adjustment is a relevant source of heterogeneity in the deviations' responses. We can analyze that by evaluating the effects only for policy tightenings, and for an index of policy loosenings. The tightenings work in a similar fashion to our baseline prudential stance indexes, but considering only changes that render the instruments more stringent (e.g., higher capital requirements, or lower Loan-to-Value ratios). The loosenings index, on the other hand, will be recorded as dummy variables increasing across the toolkit when there is a policy relaxation. In that regard, for the latter group, we expect effects with the contrary signs as for the tightenings and other indexes so far —i.e., a looser policy and higher loosening index would imply weaker deviations and positive IRFs precisely for the contrary reasoning we have used until now to explain the effect of net prudential stances or tightening policies.

The responses for all country types are shown in Figure 26 in Appendix D.3. In this case, the direction of the effects is the expected one in all cases. First, the tightenings effects are mirrored by the responses after loosenings. Second, exporter countries display the opposite effect for both types of interventions relative to the other groups due to their particular dynamics in swap markets—given their oil-exporting revenues. At the same time, aside from exporter countries, prudential tightenings seem to have stronger effects than those of loosenings in the deviations. This is also expected, given the experience following the prudential regulatory adjustments at the onset of the GFC and their associated CIP deviation dynamics.

Having documented the direct effect of regulation across these three dimensions of heterogeneity, we now turn to the second source of variation in our setup: the response of deviations to identified commodity-market shocks.

4.3 Direct effects of commodity-market shocks on CIP deviations

We turn to the direct effect of identified commodity-market shocks on the deviations, which our specification recovers as $\beta_1^{(h)}$. We examine a diverse set of shocks and group them into three broad categories: demand-side, supply-side, and other shocks. These shocks are obtained from Baumeister and Guérin (2021), Baumeister (2023), Baumeister and Hamilton (2019), and Känzig (2021), as reported in Table 1, and are meant to capture distinct drivers of oil-market dynamics and their transmission to financial markets.[20] For each shock, we report the IRF of the deviations under the baseline specification in equation (2).

A priori, we expect these shocks to have diverging effects on different types of countries. For example, for advanced economies, the commodities are typically production inputs and thus downward forces on their prices may lead to economic improvements that are reflected in the deviations. However, for emerging economies, which are typically commodity exporters, the same shocks may have the opposite effect. More concretely, the demand shocks may lead to higher deviations in advanced economies, as the interest rate differentials may remain unchanged (vis-à-vis the US, another developed economy), but a spot depreciation may ensue. For emerging markets, we could expect the opposite; they have an appreciation pressure given they produce commodities (and their productive sector benefits from the shock), and in addition, their domestic rates may increase. The intuition on supply shocks is similar: a stronger supply of commodities may lower advanced economies's costs and lead to domestic appreciation via higher growth prospects, which end up lowering the deviations. For emerging economies, the effect is a bit more nuanced—better supply conditions may increase their returns, and on the exchange rate side, appreciation forces may be observed given their commodity-producer status; these effects are consistent with lower deviations, however, lower commodity prices may also lead to lower terms of trade and thus depreciation pressures in the short run. At the same time, given that the advanced versus emerging categories don't exactly map onto the exporters versus non-exporters groups, we also provide responses to the shocks for these alternative country groups, where similar broad interpretations would hold. As we will see, these interpretations are consistent with our local projection estimates, but the latter are more informative as they depict the dynamic effects over time.

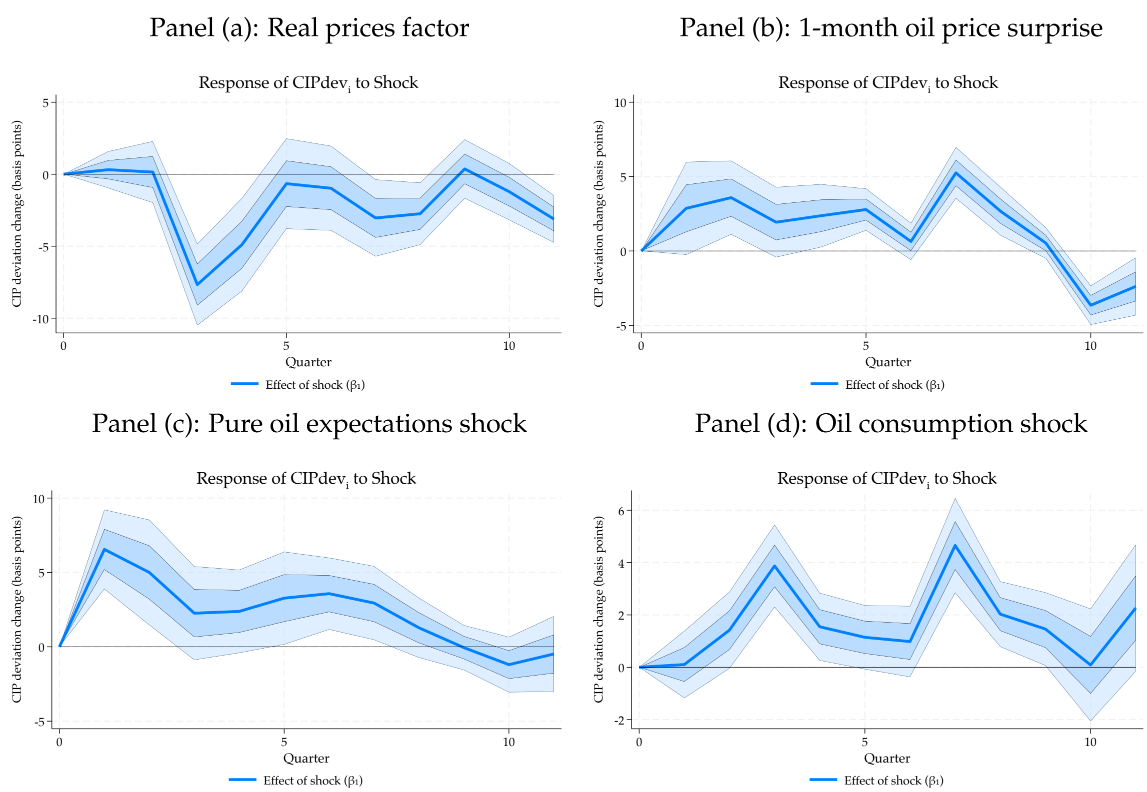
The results for estimations of equation (2) for each demand-side shock and the subsample of advanced economies are reported in Figure 8. Positive demand shocks are typically associated with increases in CIP deviations, as reflected by the three shocks in this group reflecting oil demand improvements (1-month oil price surprises, oil expectations, and oil consumption). A plausible interpretation for a positive response relates to flight-to-quality mechanisms, consistent with the safe-haven literature documented by Cerutti, Obstfeld, and Zhou (2021). These shocks—typically

[20]The shocks are reported in different units in their original sources. To facilitate interpretations, we standardize them prior to computing the local projections.

favoring emerging markets—can simultaneously increase effective market risk, leading to heightened demand for U.S. safe assets. This causes advanced-economy currencies to depreciate and generates a decrease in the forward premium term in the CIP deviation (an absolute-value decrease in the non-interest-rate-differential component of equation (1)), which drives the deviation upwards. Similarly, at medium horizons, investors price in higher expected U.S. yields, maintaining the elevated deviation through carry-trade dynamics.

As for the remaining shock (the commodity-prices factor), the effects are instead negative. In this case, a contrary effect is consistent with the expectation of interest rate hikes in advanced economies in the presence of the shock—an effect that overcomes the aforementioned safe-haven channel for this particular shock, possibly because it is the only shock not tightly related to oil markets and is instead based on a larger set of commodity prices.

Figure 8: LP-IRFs to demand shocks - Advanced Economies

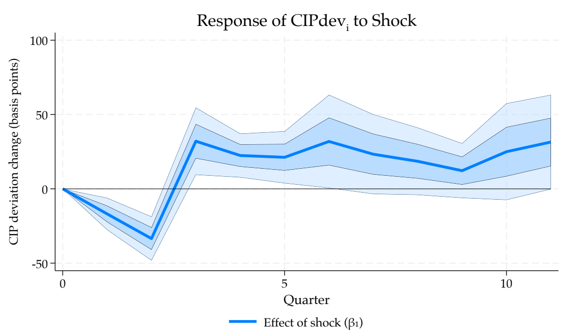


Note: Each plot depicts the IRF of the CIP deviation after a different commodity-related shock. The confidence intervals reported have a 68% and 95% confidence coverage.

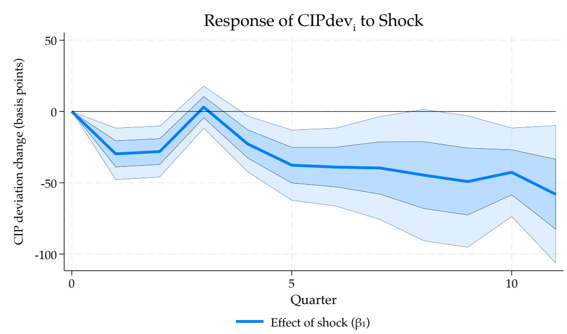
The effect of demand-side shocks in emerging economies is reported in Figure 9. For these countries, the responses are negative in most cases. Noticeably, besides having the expected sign, we can see the responses depict the reverse sign to those for advanced economies in all cases. These can be rationalized as the result of appreciation pressures on EM currencies—many of which are issued by commodity exporters—which lower the risk premium when the spot rate overshoots. At later horizons, the effect is sustained by the prospect of increased capital inflows and currency demand, driven by expectations of higher returns. Notably, the expectation shock still generates an initial positive effect, consistent with a potential risk-on effect increasing demand for safe assets. However, appreciation effects appear more relevant at later horizons, rendering the mean effect negative. Responses for emerging markets are subject to greater uncertainty than those for advanced economies, reflecting the substantially higher volatility of their observed deviations.

Figure 9: LP-IRFs to demand shocks - Emerging Economies

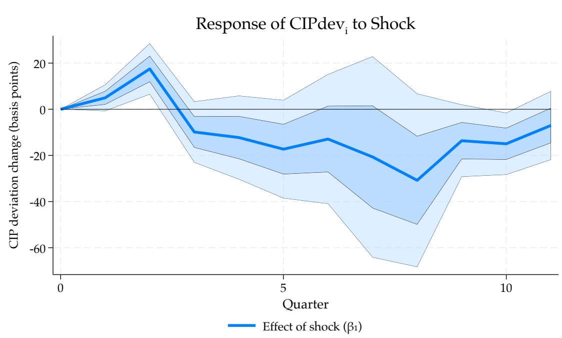
Panel (a): Real prices factor



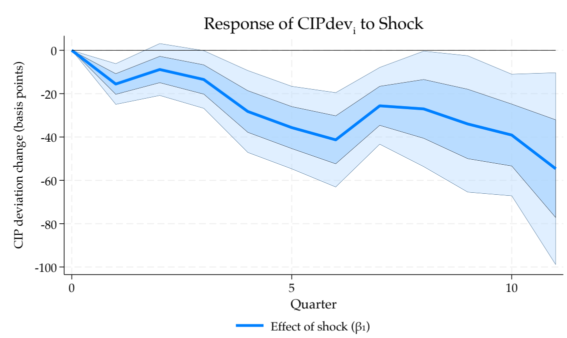
Panel (b): 1-month oil price surprise



Panel (c): Pure oil expectations shock



Panel (d): Oil consumption shock

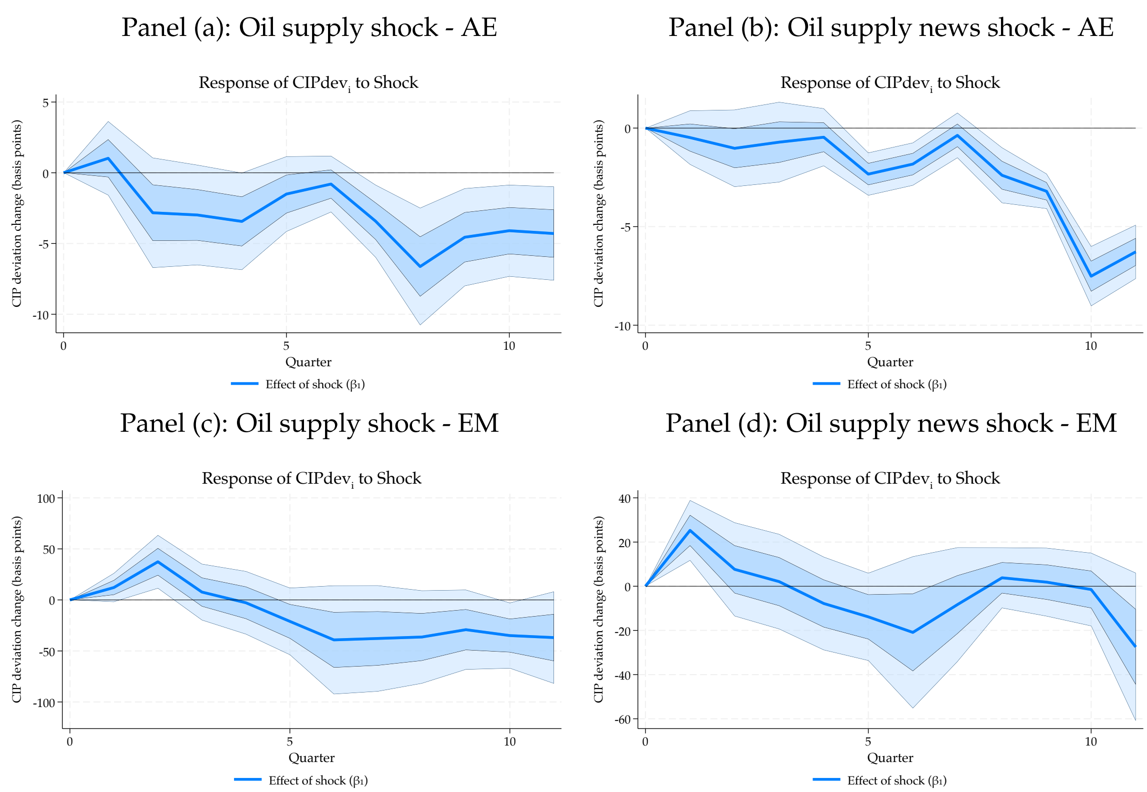


Note: Each plot depicts the IRF of the CIP deviation after a different commodity-related shock. The confidence intervals reported have a 68% and 95% confidence coverage.

A second group of relevant shocks comprises supply-side innovations. We examine two such shocks: the SVAR-identified oil-supply shock and an oil-supply-news shock constructed as a filtered measure of futures surprises. Figure 10 presents the impulse responses of CIP deviations for advanced and emerging economies, respectively.

In advanced economies, both supply shocks generate a persistent negative response in CIP deviations of approximately -5 basis points. The responses become significant in the medium and later horizons. The mechanism operates via the forward-premium: improved oil-supply conditions are generally positive for global markets and reduce the USD's safe-haven appeal, consistent with the currency adjustment patterns documented in oil-market studies such as Lizardo and Mollick (2010). This leads AE currencies to appreciate (both spot and forward rates decline), with the spot rate overshooting the forward rate ($|\Delta s| > |\Delta f|$). As a result, the forward premium $(f - s)$ rises, thereby lowering the deviation. This mechanism is supported by sticky-price models (e.g., Chari, Kehoe, and McGrattan, 2002; Steinsson, 2008), in which exchange rates overreact and adjust slowly, potentially generating the forward premium puzzle behavior described in Bansal and Dahlquist (2000).

Figure 10: LP-IRFs to supply shocks - Advanced and Emerging economies



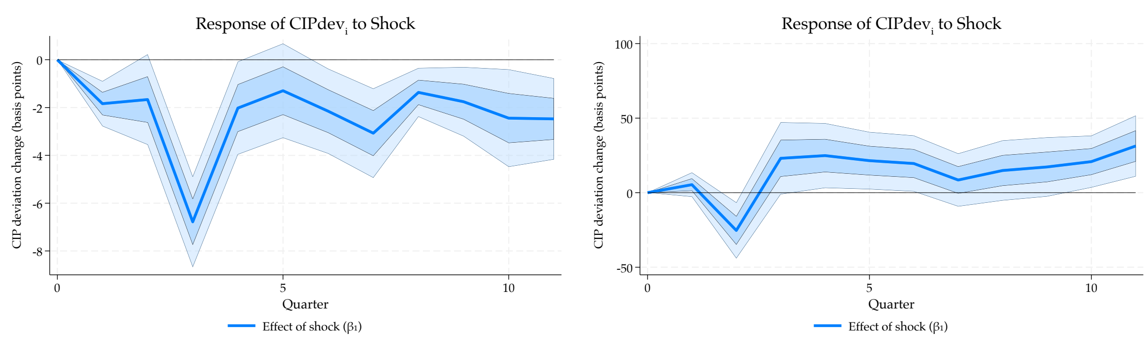
Note: Each plot depicts the IRF of the CIP deviation after a different commodity-related shock. The confidence intervals reported have a 68% and 95% confidence coverage.

In emerging economies, the same supply shocks and appreciation forces are at work. However, the initial response to CIP deviations is positive. This reflects a decline in EM funding premia (i.e., lower risk premia) that drives the forward rate down more sharply than the spot rate ($|\Delta f| > |\Delta s|$), reducing the forward premium $(f - s)$ and thereby increasing the deviations. At longer horizons, the response turns negative, as in AE countries, but the overall effect is non-significant given the greater uncertainty in the EM data.

Other shocks As a final set of shocks, we consider an oil-inventories-related shock that potentially reflects both supply and demand components of the oil market, along with a global activity shock. The latter is not a standard TFP shock; rather, it is derived from the same BSVAR model used to identify the commodity-related demand and supply shocks analyzed earlier (Baumeister and Hamilton, 2019). In this sense, the activity shock is linked to GDP dynamics but is identified within a framework designed to isolate commodity-market features.

Figure 11: LP-IRFs to inventories shocks

Panel (a): Advanced Economies Panel (b): Emerging Economies

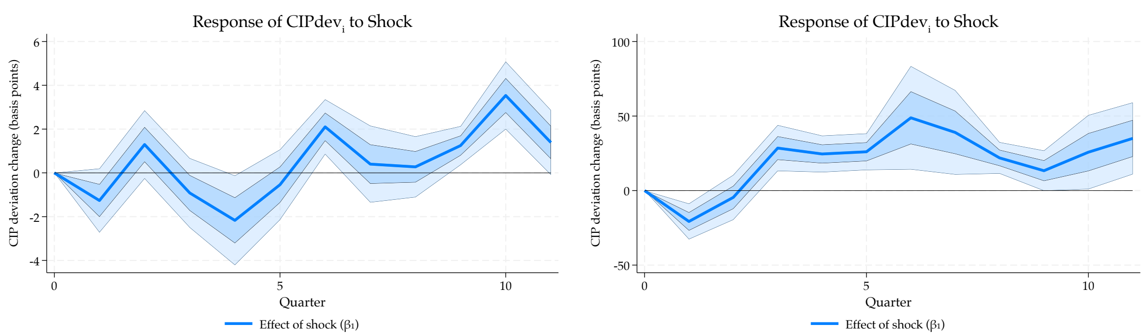


Note: Each plot depicts the IRF of the CIP deviation after a different commodity-related shock. The confidence intervals reported have a 68% and 95% confidence coverage.

The responses to the inventories shock for both country groups are shown in Figure 11. In advanced economies, the shock induces a statistically significant decline in CIP deviations of roughly -7 basis points in the third quarter, with effects persisting for several periods. As before, this response can be explained by forward-premium dynamics: higher inventories reduce the USD's safe-haven appeal, leading to an appreciation of AE currencies relative to the USD. This mechanism is consistent with Cerutti et al. (2021), who show that safe-haven currency movements (including the Swiss franc and Japanese yen) explain almost half of the variation in CIP deviations during risk-off episodes. With the spot rate overshooting the forward rate, the forward premium rises, thereby lowering the CIP deviation. In contrast, in emerging economies, the shock yields positive responses across medium-term horizons. This differential response is consistent with Cerutti and Zhou (2023), who document that EM CIP deviations exhibit fundamentally different dynamics due to market segmentation.

Figure 12: LP-IRFs to activity shocks

Panel (a): Advanced Economies　　　　Panel (b): Emerging Economies



Note: Each plot depicts the IRF of the CIP deviation after a different commodity-related shock. The confidence intervals reported have a 68% and 95% confidence coverage.

Finally, the responses to global activity shocks are shown in Figure 12. These results serve partly as a robustness check, as they are not directly related to commodity-market developments, yet remain consistent with the commodity-shock findings since they are identified within the same econometric framework. These effects are best interpreted jointly for both country groups. During a global boom, there is a risk-on reallocation of capital flows from advanced economies (AEs and the U.S.) toward emerging-market (EM) countries, a pattern consistent with the results in Bergant et al. (2024) alluded to above. In this scenario, AEs can also depreciate against the dollar, as the latter is purchased to acquire EM currencies and assets. As a result, in AEs the forward premium falls and CIP deviations rise, while the reverse occurs in EMs. The negative effect is reversed at longer horizons for emerging economies, possibly reflecting a correction in the forward premium and interest differentials as the shock dissipates.

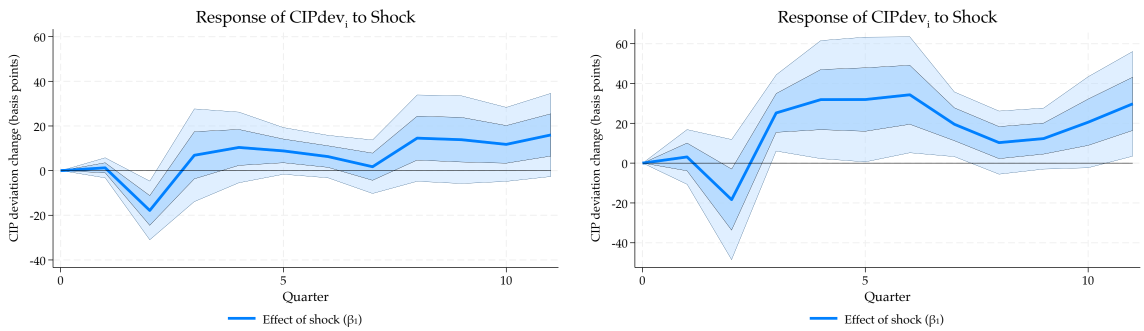
Heterogeneity by exposure to commodity markets As this exercise centers on commodity-related shocks, it is natural to ask whether responses differ between commodity exporters and non-exporters, beyond the advanced-versus-emerging split. The corresponding estimates are reported in Figures 27 through 29 in Appendix D.4. Overall, supply and demand shocks generate response patterns similar to those for emerging economies, but with lower implied volatility. This reflects the composition of these groups, each of which combines advanced and emerging economies, and where the higher volatility of emerging-economy deviations is diluted in the aggregate. For activity shocks, non-exporters resemble the advanced-economy response, whereas exporters track the emerging-economy pattern more closely. As noted above, these differences are consistent with the imperfect overlap across the country classifications used in the analysis.

There is, however, a meaningful difference regarding the responses to inventory shocks, where countries differ saliently by their exporting status relative to the advanced and emerging economies. The responses for this shock are shown in Figure 13. The results reveal a sharp asymmetry between the two groups. In non-exporter economies, a positive inventory shock induces a statistically significant decline in CIP deviations at medium-term horizons. The mechanism operates through the safe-haven channel: higher inventories signal reduced oil market stress, dampening demand for USD-denominated safe assets. The resulting depreciation of the dollar spot exceeds the adjustment in the forward rate, and the forward premium rises, thereby lowering the CIP deviation. This is consistent with Cerutti et al. (2021), who document that safe-haven currency dynamics account for a substantial share of the deviations' variation during risk-off episodes. In contrast, in exporter economies, the same shocks generate an increase in the CIP deviations. In this case, the dominant channel is real. Higher inventories signal weaker future commodity revenues and terms of trade, generating capital outflows pressure and a spot depreciation against the dollar. As with non-exporters, the spot moves more than the forward rate, but in the opposite direction, increasing the CIP deviation. This result reinforces a broad finding of our analysis: CIP deviations in commodity-exporting economies are governed by terms-of-trade and income effects rather than the financial arbitrage frictions dominating in every other country group.

Figure 13: LP-IRFs to inventory shocks - Non-exporter and exporter economies

Panel (a): Inventory shock - Non-exporters

Panel (b): Oil supply news shock - Exporters



Note: Each plot depicts the IRF of the CIP deviation after a different commodity-related shock. The confidence intervals reported have a 68% and 95% confidence coverage.

5 Suggestive evidence on policy-shock interactions

The heterogeneity in direct effects documented in Section 4 is the main focus of our analysis. We now turn to a follow-up question of interest: whether the regulatory stance materially modifies the pass-through of identified commodity shocks to the deviations. This is captured by the interaction coefficient $\beta_3^{(h)}$ in our specification. We present this evidence as supporting rather than primary, both because the estimates are somewhat noisier and quantitatively modest relative to the direct effects and because the underlying mechanism is potentially ambiguous, as discussed below.

The indirect effect of regulation is shaped by two opposing forces. On one side, stricter prudential regulations push the deviations further from zero by restricting arbitrage, as documented in Section 4. On the other, prudential policies can dampen the pass-through of global disturbances to domestic markets by reducing the exposure of intermediaries to external volatility (Bergant et al., 2024). The two channels can work against each other, and the nature of the shock—global-risk versus terms-of-trade versus FX-liquidity—determines which channel dominates at each horizon. The implication is that interactions can plausibly amplify rather than mitigate the deviation response in some specifications, and that full insulation from external disturbances cannot be expected from prudential interventions alone.

We report the effects with interactions for supply and demand shocks in the presence of prudential tightening and loosening interventions in Appendix D (Figures 30-35). These figures include direct-effect responses of the shocks as previously but overlay a dashed line with the joint shock-plus-policy effect ($\beta_1^{(h)} + \beta_3^{(h)}$) and the associated confidence intervals. For a more complete exposition we focus on the interactions with different type of policy changes (tightening, loosenings) but similar results hold for models with a single policy stance index as in the baseline.

Some patterns stand out. To start, the interaction effects are clearer for advanced economies. In emerging economies, the greater relative volatility of the responses is dominant: the interaction tends to widen the confidence intervals rather than to shift the mean response, often rendering effects insignificant at horizons where the direct shock response was significant. A second salient result is that loosening interventions deliver stronger interaction effects than tightenings, which suggests that the amplifying effect of stringent regulations on the deviations is of first order, while the insulation they provide against global shocks is of second order—loosening the toolkit in the presence of shocks generates lower deviations, as expected under a more lenient regulatory environment. This reading should not be taken as evidence that the insulation channel is irrelevant, as it may still produce unintended effects or alter policy effectiveness for instruments with specific targets. Consistent with this view, the interactions verified in estimations with policy subtypes (Figure 36) are more relevant for asset-based instruments in advanced economies and for liquidity- and FX-related tools in emerging economies, mirroring the direct-effect heterogeneity by instrument type documented in the subsection 4.2.3.

Taken together, these patterns indicate that prudential regulations interact with commodity shocks in a way that is consistent with the heterogeneity of direct effects rather than orthogonal to it: the same instruments that bear most strongly on the deviations also exhibit the clearest interaction with external disturbances.

6 Robustness Checks

We conduct a range of robustness exercises to assess the stability of our baseline findings and specification. We list some of these exercises in this section.[21]

Alternative shocks: We assess US monetary shocks as a robustness check, since they represent a

[21] A subset of robustness exercises is reported in Appendix D. Additional results are available upon request.

distinct global financial condition tightening orthogonal to commodity markets. Using instrumental variables with monetary surprises from Jarociński and Karadi (2020), we find that monetary shocks generate positive CIP deviations in both economy groups (see Figure 42 in the Appendix D), consistent with tighter US financial conditions. Crucially, unlike commodity shocks, monetary innovations exhibit no interaction at all with macroprudential tightenings.

Exclusion of global financial controls: We consider alternative specifications with a more parsimonious set of controls. Specifically, we estimate a model that includes only the VIX and a measure of global economic growth as controls, which represents a simpler yet comparable specification to those used in other studies. This version excludes the USD index and the leverage measure that we identified as relevant in the daily data analysis. The point estimates remain largely similar; however, our baseline specification yields tighter confidence intervals.

Inclusion of additional controls: We test a number of additional controls, including net capital flows, credit-to-GDP ratios, and a global rates variable (principal component of policy rates in major economies). The results are similar to those of the baseline, and the additional variables are broadly not significant given the other regressors. We opt for abstracting from these variables in our baseline to avoid the associated information loss from missing observations. Similarly, we test the inclusion of US monetary policy surprises as an additional control. The results remain analogous.

Different lags and specifications: As alternative exercises, we tested changes in the lag structure of the model and changes in the panel specification. Estimations with additional lags yield similar responses in the first half of the IRF horizon but reduce significance in later periods. The inclusion of fewer lags delivers analogous results, although with stronger significance for additional horizons. For example, Figure 23 in Appendix D reports the direct effects of prudential tightenings in a model with three lags, showing an effect similar to that reported in Section 4. We also consider a version of the model with no global controls but time effects and verify that comparable results—namely the policy effects that are based on country-specific stances—remain similar.

Alternative policy indicators: We estimate versions of the model with no smoothing of the policy index, or with smoothing over a longer horizon (6 lags). The direct effect of regulation on the deviations is analogous to the baseline, with magnitudes and significance patterns that closely track those in Section 4. Similarly, we test setups with a contemporaneous policy index (instead of only lags); the direct effects remain similar for most shocks, but the reading of the interaction term becomes harder due to reverse-causality concerns, which is why we retain a lagged index in our baseline.

Anticipation of Policy Effects: We estimate the deviations' responses to policy with lead policies as a placebo test. Given our identification assumption, we should find smaller or non-significant anticipation effects in response to policy changes. We execute this test by computing the responses to policy in a model with a four-periods lead of the policy stance index —the lead order should be relatively high, given that the policy index contains lagged policy information by construction. The results are in line with our assumptions, and the effects are non-significant for all country groupings. We perform similar tests for other lead orders.

Other exercises: As a final set of checks, we recomputed the deviations using the Libor-OIS (overnight index swap) spread. The resulting deviations are very similar to those in our baseline (which uses Bloomberg-Refinitiv data), although the OIS-based series are not available for a sizable number of countries in our sample. Similarly, we computed a version of the deviations with a bid-ask spread adjustment, which embeds the transaction-cost adjustment directly into the dependent variable; the results for these estimations are in line with the baseline as well. Finally, we also estimate the model on a number of individual currencies; the results are analogous, with uncertainty that widens as expected due to the severe sample reduction.

7 Conclusions

CIP deviations across advanced and emerging economies in the post-crisis period are large, persistent, and heterogeneous along several dimensions of economic relevance. Our analysis combines identified commodity-market shocks with detailed cross-country information on the macroprudential stance in a lag-augmented local projection framework, and recovers a variety of quantities of interest: the effect of changes in the macroprudential stances on the deviations, the effect of a commodity-market shock, and their joint effect.

Our findings indicate that macroprudential tightenings push CIP deviations further from zero in a way that reflects three economically meaningful dimensions of heterogeneity. By stage of development, the response is on the order of -1 to -2 basis points in advanced economies and up to -10 basis points in emerging markets, with the latter response masked by the higher volatility of EM deviations but visible once the toolkit is decomposed. By exposure to commodity markets, the effect concentrates among non-exporters and is surprisingly reversed for commodity-exporting economies, where revenues from commodity sales provide FX-swap-market liquidity that compresses the deviations. By type of instrument, capital and liquidity-based interventions yield the most visibly negative effects. At the same time, identified commodity-market shocks also generate heterogeneous responses on the deviations. Demand-side shocks raise deviations in advanced economies through safe-haven dollar flows and reduce them in emerging markets through commodity-currency appreciation; supply-side shocks generate persistent declines in advanced economies through forward-premium dynamics and an initial reversal in emerging markets that turns negative at longer horizons. The same dimensions of heterogeneity that shape the regulatory effect—development stage and commodity exposure—also inform on the cross-country variation in the shock responses.

Our results point to a trade-off between domestic resilience and arbitrage efficiency that is shaped by the country group and by the regulatory instrument. Post-crisis macroprudential reforms strengthen domestic resilience but raise barriers to cross-border arbitrage, contributing to persistent CIP violations of an order that is non-trivial. Moreover, the effect on the deviations is not uniform across the toolkit: capital and liquidity-based instruments carry the highest cost in terms of basis widening, while asset-based instruments may be less distortive of cross-border arbitrage. Finally, the asymmetry between tightening and loosening interventions, with the latter producing more pronounced mitigation but only available to economies that built policy space through prior tightenings (Bergant and Forbes, 2023), suggests that the cyclical use of the prudential toolkit should account for the cumulative position of the regulatory stance.

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A Additional information data sources

In this appendix, we describe the sources of information for the deviations, and for other variables we explore at the daily frequency. We also provide the results on the clustering of the deviations and the comovement of these with covariates available at a high frequency (daily).

A.1 CIP deviations data

For the construction of the CIP deviations with Onshore and Offshore data for Developed and emerging markets, we use mid-price data from Bloomberg and Refinitiv to match the Benchmark rates, using Libor rates, and government bonds as presented in Table 3. We focus on the short maturities in 3-month Libor and Government Bonds and contrast them with the Libor and Treasury rates of the US market. As a reference, we use the government bonds from Du and Schreger (2016) and Du et al. (2018), the Libor rates in Du et al. (2018), and the data from emerging markets used in Cerutti and Zhou (2023). We annualize the data and adjust it by the maturity of the forward rates. For the case of Korea and Malaysia, where the source is Refinitiv, we assume that the days to maturity are the same for Offshore and Onshore.

In Table 4 we present the summary statistics of the calculated CIP deviations for emerging and developed economies. We can see the clear heterogeneity between advanced and emerging economies, which have CIP deviations that motivates our separate estimation strategy. Advanced economy currencies exhibit mean deviations typically between -30 and $+5$ basis points, with standard deviations ranging from 12 to 72 basis points. Most AE currencies carry a negative mean, consistent with the post-GFC pattern documented by Du et al. (2018) whereby the synthetic dollar return systematically exceeds the direct dollar return. The two exceptions are the Australian dollar (AUD) and the New Zealand dollar (NZD), whose positive mean deviations reflect historically higher policy rates and commodity-currency dynamics in these economies, as discussed in Ready et al. (2017a).

Table 3: Data Tickers

Currency	Spot	Forward Rates: Offshore	Forward Rates: Onshore	Libor	Government Rates: 3 Months	Government Rates: 10 Years
AUD	AUD Curncy	AUD3M Curncy		ADBB3M Curncy	C1273M Index	C12710Y Index
CAD	CAD Curncy	CAD3M Curncy		CDOR03 Index	C1013M Index	C10110Y Index
CHF	CHF Curncy	CHF3M Curncy		SFO003M Index *ECSWF3M* (after January 2020)	C2563M Index	C25610Y Index
DKK	DKK Curncy	DKK3M Curncy		CIB003M Index	C2673M Index	C26710Y Index
EUR	EUR Curncy	EUR3M Curncy		EUR003M Index	C9103M Index	C91010Y Index
GBP	GBP Curncy	GBP3M Curncy		BP0003M Index	C1103M Index	C11010Y Index
JPY	JPY Curncy	JPY3M Curncy		JY0003M Index	C1053M Index	C10510Y Index
NOK	NOK Curncy	NOK3M Curncy		NIBOR3M Index	C2663M Index	C26610Y Index
NZD	NZD Curncy	NZD3M Curncy		NDBB3M Curncy	C2503M Index	C25010Y Index
SEK	SEK Curncy	SEK3M Curncy		STIB3M Index	C2593M Index	C25910Y Index
USD				US0003M Index	C0823M Index	C08210Y Index
			Emerging			
BRL	BRL Curncy	BCN3M Curncy	BC03M Curncy	PREDI90 Index BRDPR3M (after June 2020)	I39303M Index	I39310Y Index
CLP	CLP Curncy	CHN3M Curncy	CHO3M Curncy	CHSWPC Curncy	C9903M Index	C99010Y Index
CNY	CNY Curncy	CCN3M Curncy	CC03M Curncy	SHIF3M Index	C0203M Index	C02010Y Index
COP	COP Curncy	CLN3M Curncy	CLO3M Curncy	DTF RATE Index	C4773M Index	C47710Y Index
CZK	CZK Curncy	CZK3M Curncy		PRIB03M Index	C4803M Index	C48010Y Index
HUF	HUF Curncy	HUF3M Curncy		BUBOR03M Index	C1143M Index	C11410Y Index
IDR	IDR Curncy	IHN3M Curncy	IHO3M Curncy	JIIN3M Index	C1323M Index	C13210Y Index
ILS	ILS Curncy	ILS3M Curncy		TELBOR03 Index	I32503M Index	I32510Y Index
INR	INR Curncy	IRN3M Curncy	IRO3M Curncy	*INROS3M*	F12303M Index	F12310Y Index
KRW	KRW Curncy	*KRW3M=*	KW03M Curncy	KRBO3M Index	C2323M Index	C23210Y Index
MXN	MXN Curncy	MXN3M Curncy		*MXTIIE3M=RR*	C4763M Index	C47610Y Index
MYR	MYR Curncy	MRN3M Curncy	*MYR3M=MY*	KLIB3M Index	C1283M Index	C12810Y Index
PEN	PEN Curncy	PSN3M Curncy		PRBOPR3 Index	C9953M Index	C99510Y Index
PHP	PHP Curncy	PPN3M Curncy *PHP3MNDF=* (after 11/4/2016)	PPO3M Curncy	PREF3MO Index	PDSR3MO Index	PDSR10Y Index
PLN	PLN Curncy	PLN3M Curncy		WIBR3M Index	C1193M Index	C11910Y Index
RUB	RUB Curncy	RUB3M Curncy		MOSKP3 Index *RBDEP3M* (after 01/01/2022)	C4963M Index	C49610Y Index
THB	THB Curncy	THB3M Curncy	TBO3M Curncy	BOFX3M Index	C1223M Index	C12210Y Index
TRY	TRY Curncy	TRY3M Curncy		TRLIB3M Index *TLOREFR* (after 01/01/2022)	C9653M Index	C96510Y Index
TWD	TWD Curncy	NTN3M Curncy	NTO3M Curncy	TAIBOR3M Index	C1263M Index	C12610Y Index
ZAR	ZAR Curncy	ZAR3M Curncy		JIBAR3M Index	C2623M Index	C2623M Index

Notes: Most of the tickers included are from Bloomberg. Italics reference data only available in Refinitiv (Datastream). As in Cerutti and Zhou (2023), the only countries that have offshore and onshore forwards markets are emerging markets.

Table 4: Summary Statistics for CIP Deviations

Currency	Mean	Median	St. Dev	Min	Max
AUD	3.46	1.94	12.09	-116.00	124.47
CAD	-11.96	-6.98	17.06	-137.19	46.18
CHF	-9.43	-1.37	18.27	-224.05	75.98
DKK	-28.41	-17.57	39.84	-571.84	285.78
EUR	-14.50	-6.51	23.89	-252.55	66.90
GBP	-10.04	-7.40	15.26	-219.79	39.99
JPY	-12.34	-6.74	17.39	-222.83	66.80
NOK	-11.58	-9.49	72.22	-1249.86	2259.55
NZD	2.67	1.58	17.19	-276.47	129.38
SEK	-12.62	-10.04	57.85	-1128.40	1793.62
BRL	-149.18	-107.44	339.53	-4360.65	1328.81
CLP	12.61	12.41	97.85	-379.08	574.16
CNY	-90.35	-9.32	333.79	-2047.84	1692.15
COP	-15.07	-9.90	170.70	-898.74	1274.61
CZK	-79.53	-21.30	232.30	-3061.84	448.92
HUF	-3.61	-10.24	115.57	-351.24	753.61
IDR	73.43	-11.77	486.29	-674.27	8658.41
ILS	-16.88	-12.99	70.96	-255.44	587.52
INR	45.54	17.57	254.62	-553.43	3865.14
KRW	-54.86	-35.83	76.07	-749.32	93.14
MXN	-2.40	-12.70	95.07	-206.67	894.44
MYR	-47.39	-59.84	124.99	-783.45	971.68
PEN	51.04	-8.06	253.73	-591.63	1453.98
PHP	78.46	24.31	219.84	-577.34	2750.63
PLN	-1.13	-6.43	61.77	-310.02	430.01
RUB	-5.37	-59.58	397.64	-2213.90	7561.54
THB	66.14	18.95	184.78	-221.02	1276.78
TRY	134.54	-88.01	855.50	-758.40	7372.75
TWD	-132.99	-117.44	209.20	-980.61	623.25
ZAR	52.08	42.42	52.70	-121.26	532.87

A.2 Offshore and Onshore Deviations in EM

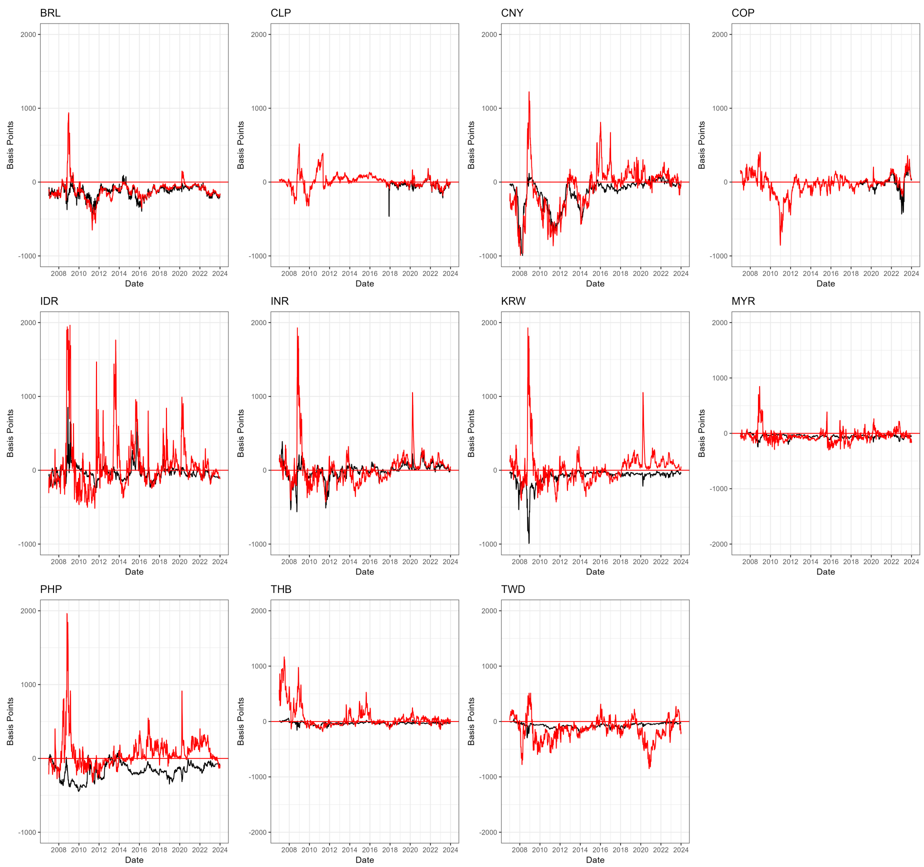


Figure 14: CIP deviations of Emerging Currencies

For the case of a binding parity, we can rearrange the right-hand side of Equation (1) to compare the two main components of the deviations:

$$i^*_{t,t+n} - i^{USD}_{t,t+n} = f_{t,t+n} - s_t, \tag{3}$$

where the equality tells us that in equilibrium —and in the absence of deviations— any variation of the interest rates should be matched by an equivalent variation in the difference between forward and spot rates. Kalemli-Özcan and Varela (2021) carries a similar comparison for the case of Uncovered Interest Parity (UIP) deviations and shows that they are driven mainly by fluctuations in the interest differential. In a similar spirit, we present the correlation between the CIP deviations and each of the involved interest rates in tables 5 and 6. The predominantly negative correlations between CIP deviations and domestic interest rates across developed markets, ranging from -0.37 for AUD and GBP to near-zero for JPY (-0.02), show that most deviations from CIP are consistent with movements in their own (national) rate rather than with fluctuations in the US returns.

Table 5: Correlation between CIP deviations and interest rates for Developed Markets

	Offshore	
Currency	Own Rate	US Rate
AUD	-0.37	0.15
CAD	-0.32	0.14
CHF	-0.14	0.08
DKK	-0.17	0.08
EUR	-0.16	0.19
GBP	-0.37	0.25
JPY	-0.02	0.11
NOK	-0.15	0.04
NZD	-0.07	0.09
SEK	-0.09	0.03

Table 6: Correlation between CIP deviations and interest rates for Emerging Markets

	Offshore			Offshore	
Currency	Own.Rate	US.Rate	Currency	Own.Rate	US.Rate
BRL	-0.23	0	MXN	-0.34	-0.02
CLP	-0.27	0.04	MYR	-0.01	0.02
CNY	-0.04	0.07	PEN	-0.17	0.05
COP	-0.13	0.02	PHP	-0.18	-0.02
CZK	-0.9	-0.01	PLN	-0.28	0
HUF	-0.16	0.01	RUB	-0.01	-0.01
IDR	-0.05	0.02	THB	-0.03	0.03
ILS	-0.1	0.01	TRY	-0.09	0
INR	-0.05	0.02	TWD	-0.04	0.02
KRW	-0.06	-0.09	ZAR	-0.25	0.01

The differential correlation patterns between developed and emerging market currencies reveal the heterogeneous nature of CIP deviations across different currency groups. The emerging market results demonstrate substantially weaker negative correlations with their local (own) rates, with several currencies (MYR, RUB, CNY, TWD) showing correlations near zero, while others like CZK exhibit a higher negative correlation of -0.90. This heterogeneity reflects the additional frictions and risk factors that characterize emerging market dollar funding conditions, including heightened sensitivity to global risk appetite and more pronounced regulatory and institutional constraints that affect arbitrage capital.

A.3 Hierarchical clustering of the deviations

Figures 15 and 16 report hierarchical clustering and principal component analysis of the 30 currencies in our sample based on the joint behavior of their CIP deviations. The clustering in Panels (a) and (b) of Figure 15 is performed on the standardized series of quarterly deviations using Euclidean distance and Ward linkage, with the same tree structure colored alternatively by commodity-exposure status and by development status. Panels (a) and (b) in 16 project the same standardized deviations onto their first two Principal Components (PC), which together account for 45.0% of total variation (PC1: 31.2%; PC2: 13.8%), and overlay 95% concentration ellipses for each group under the same two classifications.

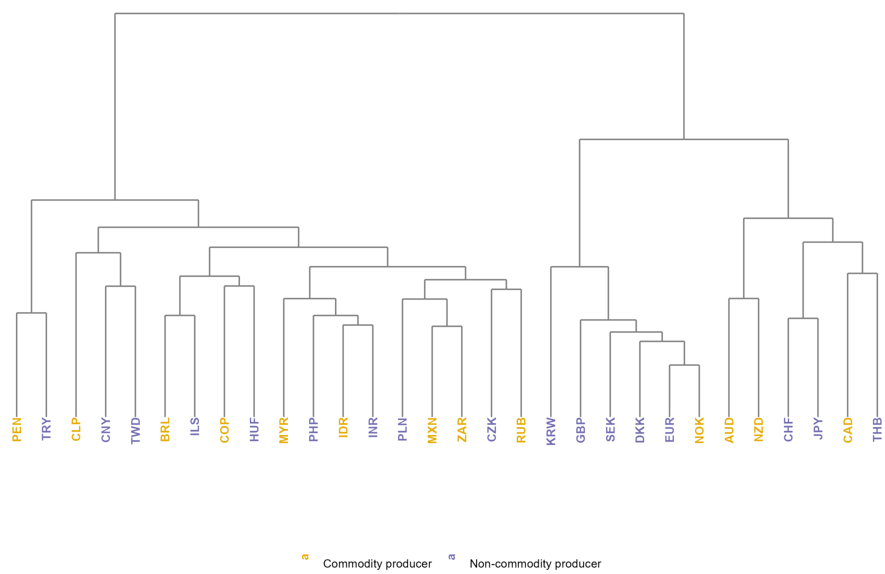
Comparing the two classifications, the development-status partition provides a cleaner characterization of the cross-sectional variation in CIP deviations than the commodity-exposure partition. In Panel (b) of Figure 16, the AE and EM concentration ellipses are well-separated along the first PC, with most advanced economies occupying negative values and most emerging markets occupying positive values, and the two main branches of the associated dendrogram map closely onto the AE/EM divide. By contrast, the commodity-producer and non-producer ellipses overlap substantially across the full range of both PCs, and commodity producers are interleaved throughout both branches of the dendrogram, indicating that commodity-exposure status does not organize the cross-section of deviations as coherently as development status does.

That said, the AE/EM partition is itself imperfect. Commodity-currency pairs from the AE group, such as AUD and NZD, fall within or close to the EM concentration ellipse and branch with EM currencies in the dendrogram, while THB, an emerging-market currency, clusters with advanced economies. The PCA ellipses overlap in the central region of Panel (b) of Figure 16 further confirms that a non-trivial share of AE and EM deviations share common dynamics. The commodity-exposure dimension therefore captures residual variation that the AE/EM split leaves unexplained, making the two classifications complementary rather than redundant.

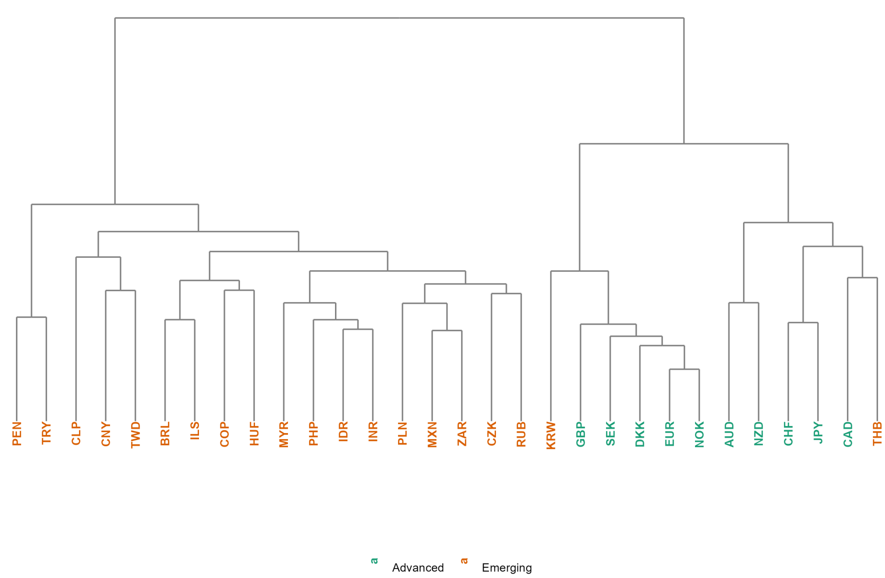
Taken together, the figures support the reading in Section 4.1 that development status is the primary dimension along which CIP deviations vary cross-sectionally, while commodity exposure provides a secondary but economically meaningful source of heterogeneity.

Figure 15: Hierarchical clustering of the CIP deviations across country classifications

Panel (a): Dendrogram — commodity exposure



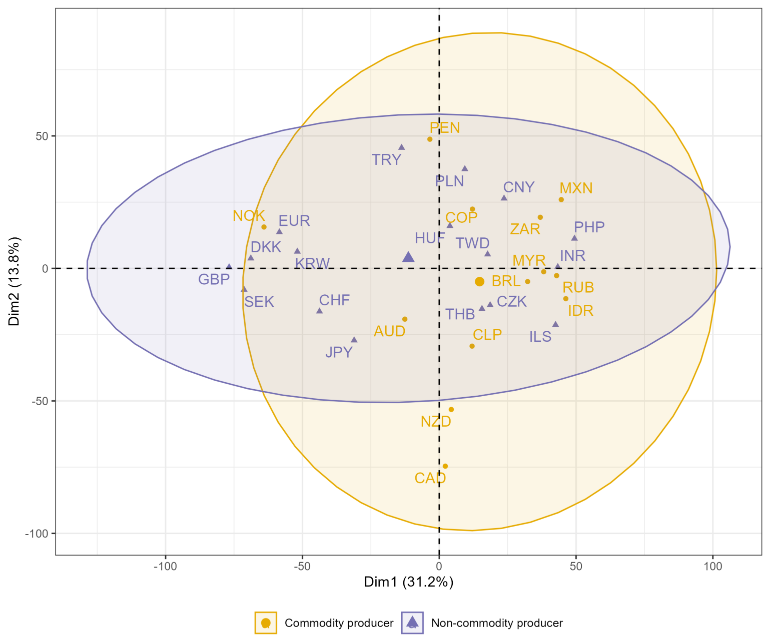
Panel (b): Dendrogram — development status



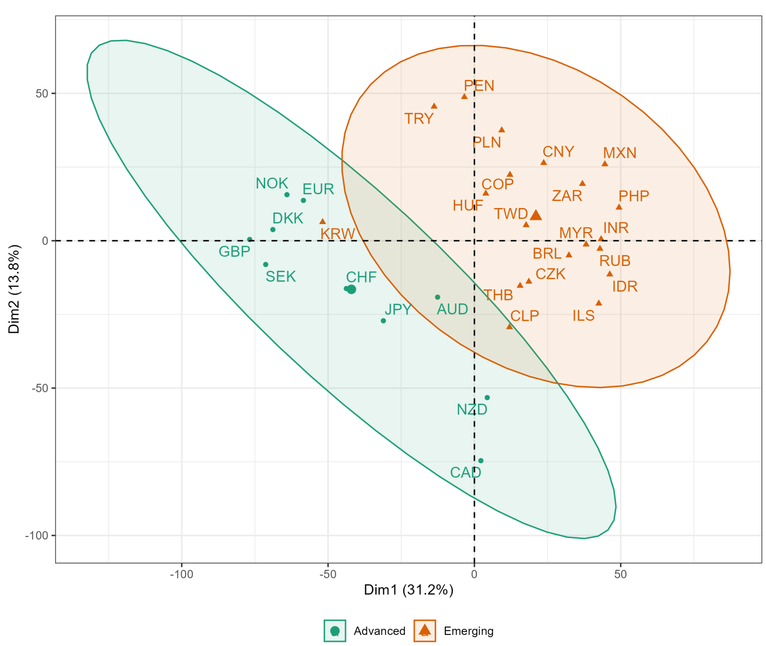
Note: Panels (a) and (b) report hierarchical clustering of the 30 currencies in our sample, computed on the standardized quarterly CIP deviations using Ward linkage and Euclidean distance. In panel (a) currencies are colored by commodity-exposure status: gold denotes commodity producers and purple denote non-commodity producers, following the classification of Lee (2023).

Figure 16: Principal component analysis of CIP deviations across country classifications

Panel (a): PCA biplot — commodity exposure



Panel (b): PCA biplot — development status



Note: Panels (a) and (b) report the first two principal components of the same standardized deviations, which together account for 31.2% and 13.8% of total variation respectively; 95% concentration ellipses are drawn for each group. In panel (a) currencies are colored by commodity-exposure status: gold circles denote commodity producers and purple triangles denote non-commodity producers, following the classification of Lee (2023). In panel (b) currencies are colored by development status: green circles denote advanced economies and orange triangles denote emerging markets.

A.4 Explanatory Variables and comovement with CIP deviations at daily frequency

Table 7 presents the variables used in a daily frequency exploratory analysis with their respective Bloomberg Tickers. The Volatility indices VIX and VXO capture the uncertainty in the stock market that is a source of dispersion in the prices and capital flows, the US Dollar Indices capture the fluctuations of the dollar rather than specific variations of individual exchange rates, the TED spread measure the overall liquidity of the market, the Futures of the Federal Funds and the West Texas Intermediate (WTI), the Baltic Dry Index to measure trade transportation costs, the corporate 1 minus 5 year index to measure corporate credit risk, and the Standard and Poor's indices to account for changes in the asset market of our reference economy.

Table 7: Data Tickers

Name	Bloomberg Ticker
CBOE S&P 100 Volatility Index (VXO)	VXO Index
CBOE S&P 500 Volatility Index (VIX)	VXVWA Index
Trade-Weighted U.S. Dollar Index	USTWBGD Index
U.S. Dollar Index	DXY Curncy
TED Spread	BASPTDSP Index
Federal Funds Futures (3rd Month)	FF3 Comdty
Federal Funds Futures (4th Month)	FF4 Comdty
WTI Crude Oil Futures (3rd Month)	CL3 Comdty
WTI Crude Oil Futures (4th Month)	CL4 Comdty
Baltic Dry Index	BDIY Index
Bloomberg U.S. Corporate BBB 1–5 Year Index	CSI BBB Index
S&P 500 Index	SPX Index
S&P 100 Index	OEX Index

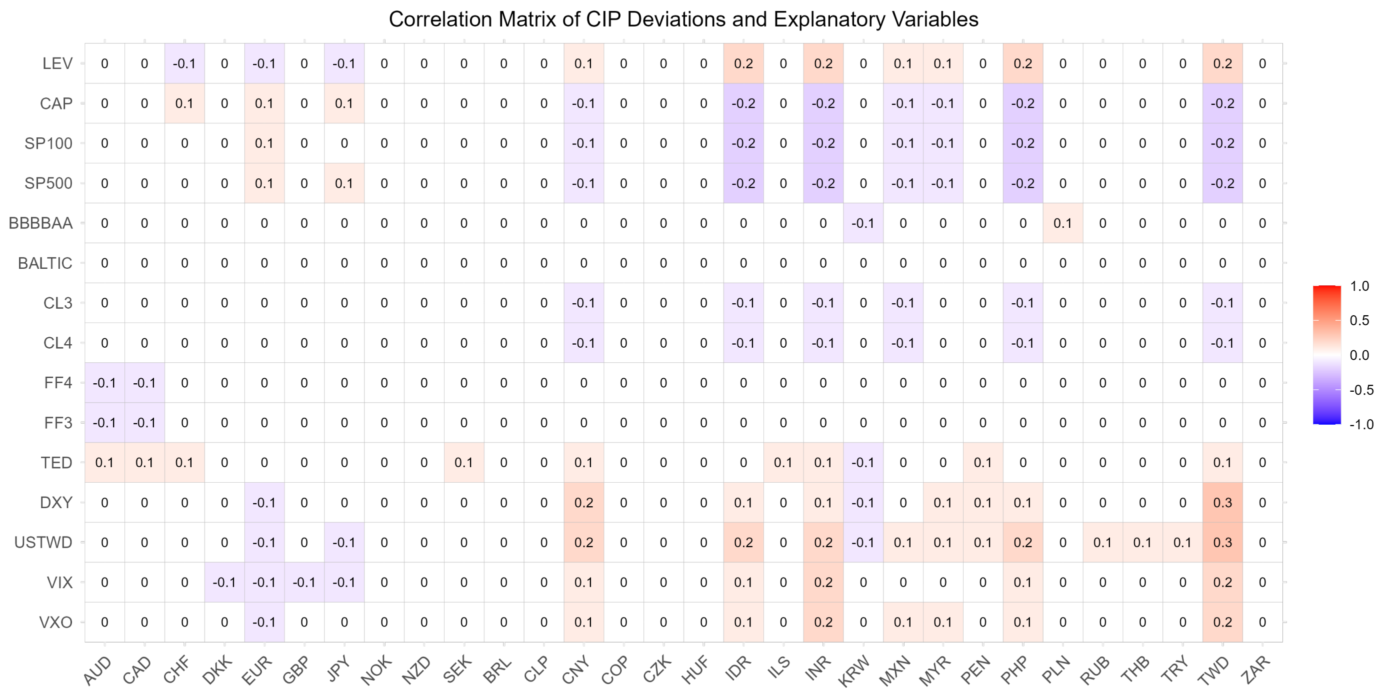


Figure 17: Correlation Matrix (whole sample)

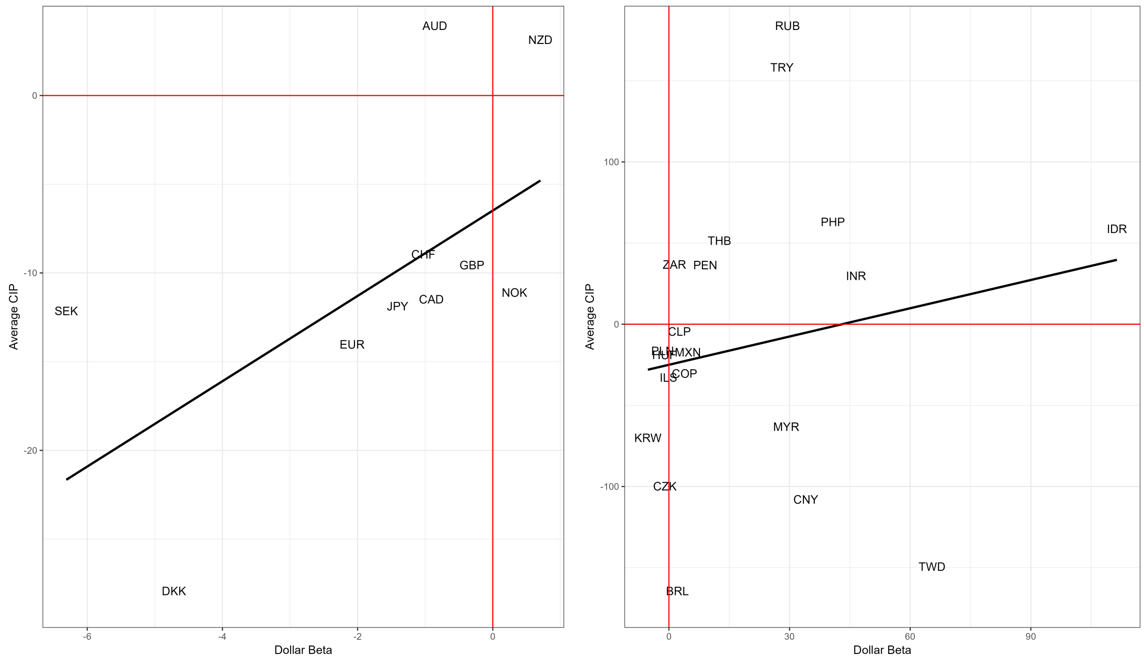
Table 8: Descriptive Statistics on the Dependent Variables.

	VXO	VIX	USTWD	DXY	TED	FF3	FF4	CL4	CL3	BALTIC	BBBBAA	SP500	SP100	CAP	LEV
Observations	12724	7178	12724	12724	8705	12724	12724	12724	12724	12724	8074	12724	12724	12635	12635
Minimum	-0.38	-0.41	-0.03	-0.03	-80.66	-0.47	-0.40	-0.28	-0.34	-0.19	-0.56	-0.13	-0.12	-0.47	-0.92
Maximum	0.76	0.98	0.02	0.03	83.62	0.52	0.52	0.19	0.24	0.20	0.52	0.11	0.11	0.46	0.94
Mean	-0.00	0.00	0.00	0.00	-0.00	0.00	0.00	0.00	0.00	-0.00	-0.00	0.00	0.00	-0.00	0.00
Median	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Variance	0.00	0.00	0.00	0.00	13.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
St. Dev	0.06	0.06	0.00	0.00	3.67	0.03	0.03	0.02	0.02	0.02	0.03	0.01	0.01	0.02	0.03
Skewness	0.90	1.54	0.14	-0.06	0.81	-0.17	0.28	-1.20	-1.35	0.49	0.42	-0.45	-0.36	-1.37	1.37
Excess Kurtosis	10.39	15.93	7.55	4.02	142.66	62.51	42.25	24.28	32.76	14.32	63.65	16.77	15.22	128.03	128.03
Unit Root Tests															
ADF	-8.36	-6.71	-1.59	-1.96	-4.92	-2.27	-2.18	-1.90	-1.96	-2.95	-1.46	2.31	2.69	-2.26	-5.68
PP	-7.76	-6.37	-1.63	-1.96	-5.07	-2.24	-2.16	-1.87	-1.92	-2.80	-1.66	2.34	2.74	-2.15	-5.13
Crt. Val.	-2.86	-2.86	-2.86	-2.86	-2.86	-2.86	-2.86	-2.86	-2.86	-2.86	-2.86	-2.86	-2.86	-2.86	-2.86

Notes: The table presents the descriptive statistics of the explanatory variables used in the model. The Unit Root tests used are the Augmented Dickey-Fuller (ADF) and Phillips and Perron Tests (PP), which share the same null hypothesis that the series has a Unit Root. The second and third panels correspond to the test statistics and critical values for each of the tests under a 95% confidence level. Both the ADF and the PP share the same critical values. Excess Kurtosis is the kurtosis level above a normal distribution (mesokurtic) of three.

A.5 USD index and CIP Deviations

Figure 18: Average CIP and USD Beta for Developed and Emerging Economies Post-2007



Notes: The plots present the relationship between the average CIP deviation and the beta coefficient from the regression of the CIP deviation on the trade-weighted US dollar index. The left panel corresponds to developed economies, while the right panel corresponds to emerging economies.

Figure 18 shows a scatterplot between the average CIP and the beta on a simple regression against the USD trade-weighted index. Although exploratory, we see that advanced economies exhibit lower betas relative to the index, consistent with the limited-dollar-funding condition patterns—vis-a-vis the EM— documented in developed countries in Du et al. (2018). At the same time, the figures illustrate how the dispersion of both measures is substantially larger in EM.

A.6 Calculation of market leverage

To estimate a measure of Intermediaries' Leverage in FX markets, we followed He, Kelly, and Manela (2017) and Cerutti and Zhou (2023). We use the same intermediaries as in the latter, to guarantee replicability. We take Euromoney's annual FX survey of 2022 as a reference, and select the top participants and exclude the non-bank firms that span from January 1990 to December 2024. In Table 9, we present the name, country of the main headquarters, and Bloomberg Ticker.

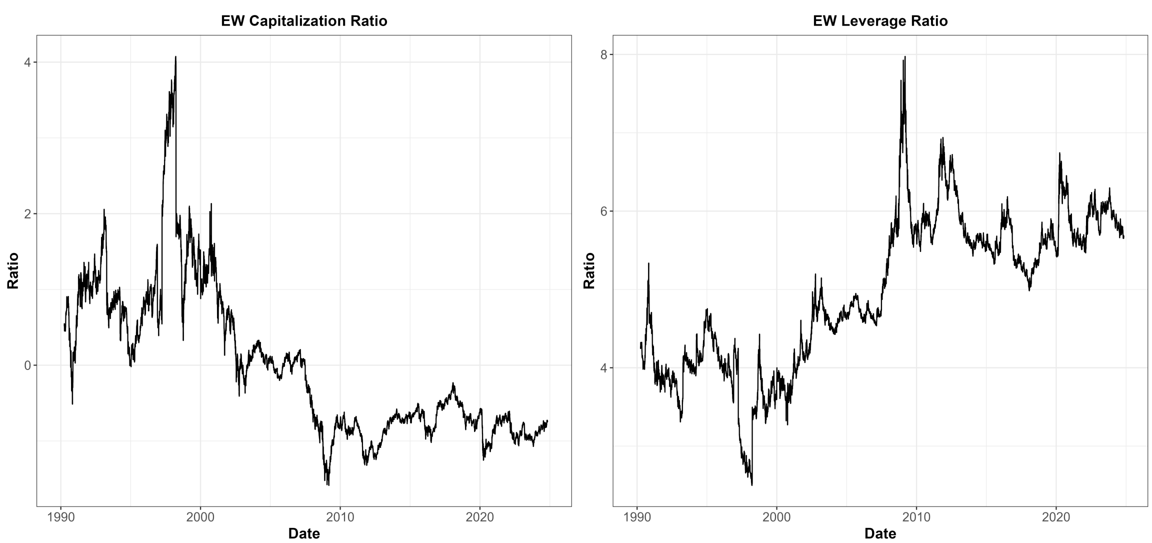
For the calculation of the leverage, we used the mid price (PX_MID) and the Shares Outstanding (BS_SH_OUT) for the calculation of the market equity, as well as the Total Common Equity (TOT_COMMON_EQY) and Total Assets (BS_TOT_ASSET) for the Book Debt. In Figure 19, we plot both measures (capital ratio and leverage level).

Table 9: Main FX World Intermediaries

Name	Country	Bloomberg Ticker
BNP Paribas SA	France	BNP FP Equity
Barclays PLC	United Kingdom	BARC LN Equity
Bank of America Corporation	United States	BAC US Equity
Citigroup Inc.	United States	C US Equity
Credit Suisse Group AG	Switzerland	CSGN SW Equity
Deutsche Bank AG	Germany	DBK GR Equity
The Goldman Sachs Group, Inc.	United States	GS US Equity
HSBC Holdings plc	United Kingdom	HSBA LN Equity
JP Morgan Chase & Co.	United States	JPM US Equity
Morgan Stanley	United States	MS US Equity
Société Générale SA	France	GLE FP Equity
Standard Chartered PLC	United Kingdom	STAN LN Equity
State Street Corporation	United States	STT US Equity
UBS Group AG	Switzerland	UBSG SW Equity

Notes: The table uses the information from Bloomberg based on the intermediaries used in Cerutti and Zhou (2023) and the Euromoney FX Survey 2022.

Figure 19: Standardized Intermediary Capitalization and Leverage Ratio under different weights



B Data Sources for baseline quarterly panel

Table 10: Variables included in the quarterly panel dataset

Name	**Description**	**Source**
CIP Deviations		
CIP Deviations AE	Offshore interest rate differential plus differential between the log of the forward rate and the log of the spot rate (as in equation 1)	Bloomberg and Refinitiv (see Table 3)
CIP Deviations EM	Commercial paper (A2/P2) interest rate differential plus differential between the log of the forward rate and the log of the spot rate (as in equation 1)	Bloomberg and Refinitiv (see Table 3)
Main variables of interest		
Commodity shocks	Identified shocks related to features of international oil and commodity markets	Previous studies as described in Table 1
Macroprudential policy index	Aggregate of macroprudential tightenings and loosenings across 17 policy instruments (shown in Table 11	IMF-integrated Macroprudential Policies Database (iMaPP)
Control variables		
GDP growth	Non-seasonally adjusted GDP and interpolations from missing data	IMF-IFS, Monnet and Puy (2019), Central Banks, and Statistical agencies.
Inflation	Consumer Price Index annual growth. Missing index data is interpolated from other sources.	IMF-IFS, Monnet and Puy (2019), Central Banks, and Statistical agencies.
Monetary policy rate	Short-term policy rate with replacement for shadow rates in selected countries for the period with zero lower bound; for the US, EU, UK, obtained from Wu and Xia (2016), for JP obtained from Krippner (2013).	IMF-IFS, BIS Statistics warehouse, and individual central banks' data.
Nominal Depreciation	Nominal Exchange rate annual depreciation (price of 1 USD in terms of local currency, average of period)	IMF-IFS
Capital inflows	Capital inflows to GDP, quarterly smoothed variable as in Forbes and Warnock (2012)	IMF-IFS
VIX	Chicago Board Options Exchange S&P500 Volatility Index	FRED
Global growth	Principal component of real output growth from selected countries (US, GB, EU, JP)	—
US Monetary Policy Rates	Effective Federal Funds Rate	FRED
US Monetary Surprises (shocks)	Surprises based on the 3-month ahead Federal Funds Rate	Jarociński and Karadi (2020)

Table 11: Macroprudential policy instruments considered in the policy stance variable

Countercyclical Capital Buffer	Conservation Cap. Buffer	Capital Requirements
Limits to Leverage	Loan Loss Provision	Limits to Credit Growth
Loan Restrictions	Limits on Foreign Currency Lending	Debt Service to Income Ratio
Loan-to-Value Ratio (LTV)	Taxes	Liquidity Requirements
Loan-to-Deposit Ratio	Limits on FX positions	Reserve Requirements
SIFI (Too-big-to-fail institutions)	Other (e.g., stress testing, structural measures)	

C Additional information about the macroprudential policy stance

Here, we include additional information about the policy index data. The table below presents descriptive statistics for the macroprudential policy stance variable and its components by country sample. The columns indicate the type of instruments considered. "All tools" includes all the tools (17 instruments) in the prudential toolkit. The other columns include subaggregates of the toolkit to account for broad types of policies. These categories include instruments as follows:

- Capital: Countercyclical Capital Buffer, Conservation Capital Buffer, Capital Requirements, SIFI (large banks' specific regulations).
- Assets: Limits on Credit Growth, Loan Restrictions, Loan-to-Value Ratio (LTV), Debt Service to Income Ratio, Tax-based tools.
- Liquidity and FX: Liquidity Requirements, Limits on Loan-to-Deposit Ratio, Limits on FX positions, Limits on Foreign Currency Lending, Reserve Requirements.
- Borrower: Loan-to-Value, Debt Service to Income Ratio.
- Lenders: Rest of the toolkit not included in "Borrower" (15 instruments).
- Tightenings: Index increasing by one (+1) with any instrument tightening (in the toolkit).
- Loosenings: Index increasing by one (+1) with any instrument loosening.

The first categorization, between capital, asset-side, and liquidity and FX instruments, is obtained from Cabral et al. (2019) and the BIS (2012). The second split of the toolkit, between borrowers and lenders, follows from Cerutti et al. (2017). And finally, the indexes that consider only tightenings or loosenings span the full prudential toolkit (17 instruments).

Table 12: Macroprudential policy instruments considered in the policy stance variable

Sample (2008-2021)	Statistic	Total	Capital	Assets	Limits	Borrower	Leverage	Times	Loans
All Countries	mean	1.31	0.57	0.32	0.32	0.12	1.21	2.16	0.83
	median	1.00	0.00	0.00	0.00	0.00	1.00	2.00	0.00
	sd	2.69	1.41	1.12	1.43	0.72	2.48	2.18	1.69
	min	-13.00	-7.00	-4.00	-7.00	-3.00	-13.00	0.00	0.00
	max	14.00	7.00	8.00	10.00	4.00	13.00	15.00	13.00
Advanced Economies	mean	1.33	0.57	0.44	0.25	0.21	1.17	1.78	0.40
	median	1.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00
	sd	2.16	1.40	1.02	0.67	0.62	1.99	1.91	1.22
	min	-7.00	-5.00	-2.00	-2.00	-1.00	-7.00	0.00	0.00
	max	10.00	5.00	5.00	3.00	3.00	9.00	10.00	8.00
Emerging Markets	mean	1.31	0.57	0.26	0.36	0.08	1.23	2.34	1.03
	median	1.00	0.00	0.00	0.00	0.00	1.00	2.00	0.00
	sd	2.93	1.42	1.17	1.68	0.76	2.68	2.28	1.83
	min	-13.00	-7.00	-4.00	-7.00	-3.00	-13.00	0.00	0.00
	max	14.00	7.00	8.00	10.00	4.00	13.00	15.00	13.00

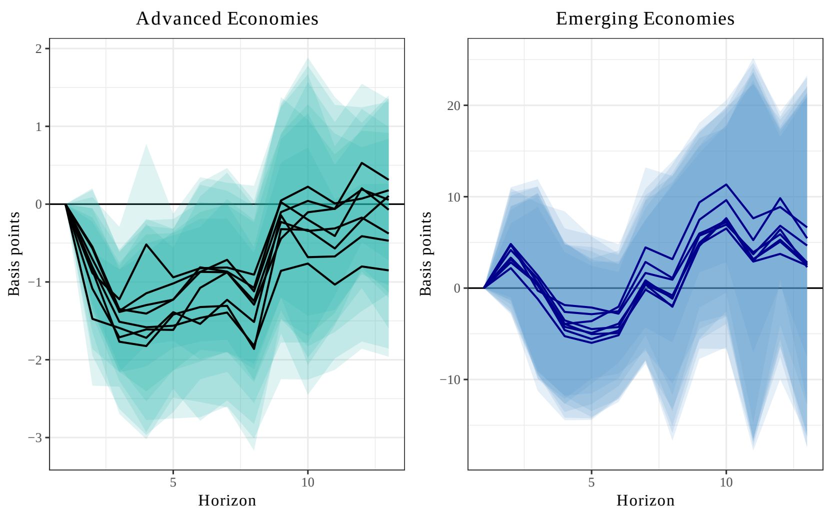
Notes: The table presents descriptive statistics for the macroprudential policy stance variable and its components by country sample. The columns indicate the type of instruments considered in the index. All tools include all the tools (17 instruments) in the prudential toolkit. The other columns include subaggregates of the toolkit to account for broad types of policies. Data Source: iMAAP-IMF.

Figure 20: Macroprudential Policy Stances (4-quarter window sum of interventions - all tools)

D Other panel estimation results

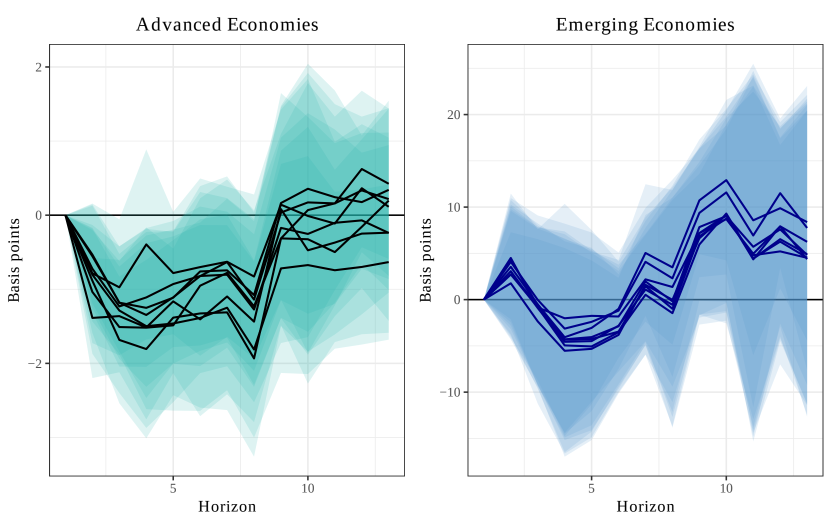
D.1 The effect of Macroprudential Policy Tightening on Interest Rate Differentials and Exchange Rate Premium

Figure 21: LP IRFs to a Macroprudential Policy Tightening to the (negative) Forward Premium



Note: These plots depict the IRF of the exchange rate premium in Equation (1) in our baseline specification to a macroprudential policy tightening (increase in the stance index) for specifications with different commodity-market-related shocks as listed in Table 1. For each shock, the IRF and 95% confidence intervals are plotted.

Figure 22: LP IRFs to a Macroprudential Policy Tightening to the Interest Rate Differential



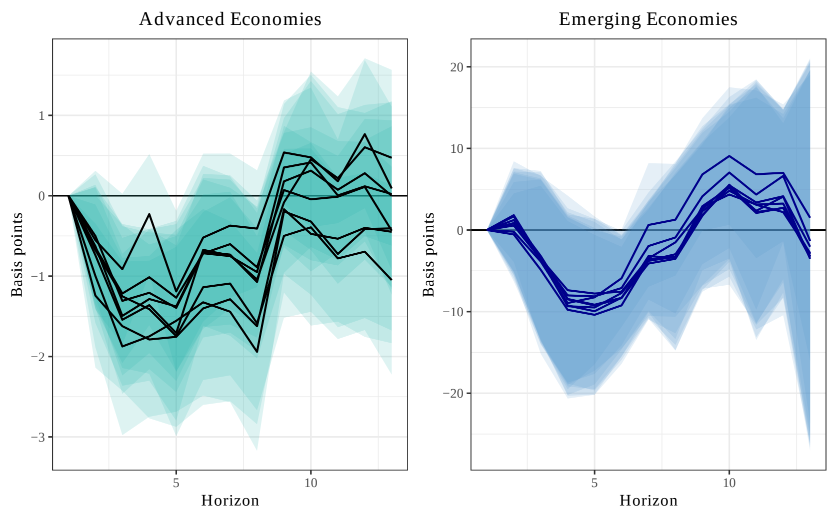
Note: These plots depict the IRF of the interest rate premium in Equation (1) in our baseline specification to a macroprudential policy tightening (increase in the stance index) for specifications with different commodity-market-related shocks as listed in Table 1. For each shock, the IRF and 95% confidence intervals are plotted.

We plot the IRFs of the model only for the Forward Premium ($f_{t,t+n} - s_t$) and the Interest Rate differentials ($i^{USD}_{t,t+n} - i^{*}_{t,t+n}$) in Figures 21 and 22. From them, we can see that the effects are rather similar for both of the CIP deviation responses in Figure 4.

D.2 Robustness: lag-structure variant for the regulation IRF

For comparison with the baseline specification, Figure 23 reports the IRF of the CIP deviations to a macroprudential tightening for an alternative model with three lags of the regressors and the dependent variable, instead of the four lags used in the baseline. The responses are similar to the four-lag results in Figure 4, with somewhat tighter confidence intervals at later horizons.

Figure 23: LP IRFs to a Macroprudential Policy Tightening - model with three lags



Note: These plots depict the IRF of the CIP deviations in a specification with three lags of the regressors and the dependent variable, to a macroprudential policy tightening (increase in the stance index). The IRF is reported for each of the commodity-market shock specifications listed in Table 1. The IRF and 95% confidence intervals are plotted.

D.3 Local projections for models without shocks

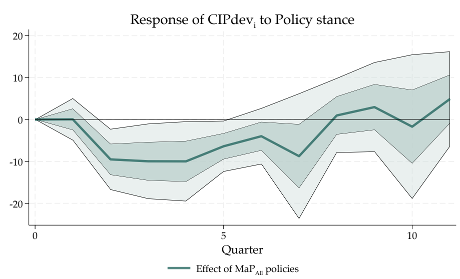
The instrument-type breakdown reported in Section 4.2.3 (Figures 6 and 7) is estimated from a regulation-only specification that abstracts from the commodity-market shocks and their interactions with the macroprudential stance. The estimation equation is

$$\mathrm{CIPdev}_{i,t+h} - \mathrm{CIPdev}_{i,t-1} = \alpha^{(h)} + \phi^{(h)} \Delta MaP_{i,t-1} + \sum_{k=0}^{4} \gamma^{(h)} X_{i,t-k} + \sum_{k=0}^{4} \phi^{(h)} Z_{t-k} + FE_i^h + \epsilon_{i,t+h}, \tag{4}$$

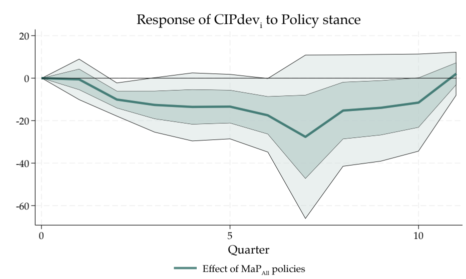
where all variables are as in the baseline specification, but without the commodity-market-related shocks and their interactions with the macroprudential policy stance. The figures referenced above plot the implied IRFs for advanced and emerging economies separately, with the instrument-type aggregations defined in Appendix C. At the same time, we report below similar figures for non-exporter and exporter countries (Figures 24 and 25).

Figure 24: LP-IRFs to policy tightenings by instrument type - Non-Exporter Economies

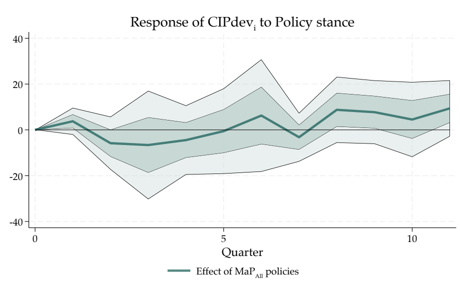
Panel (a): All tools



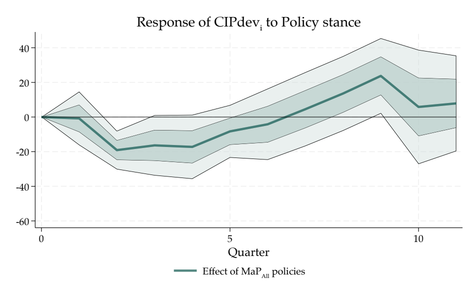
Panel (b): Capital-related tools



Panel (c): Asset-related tools

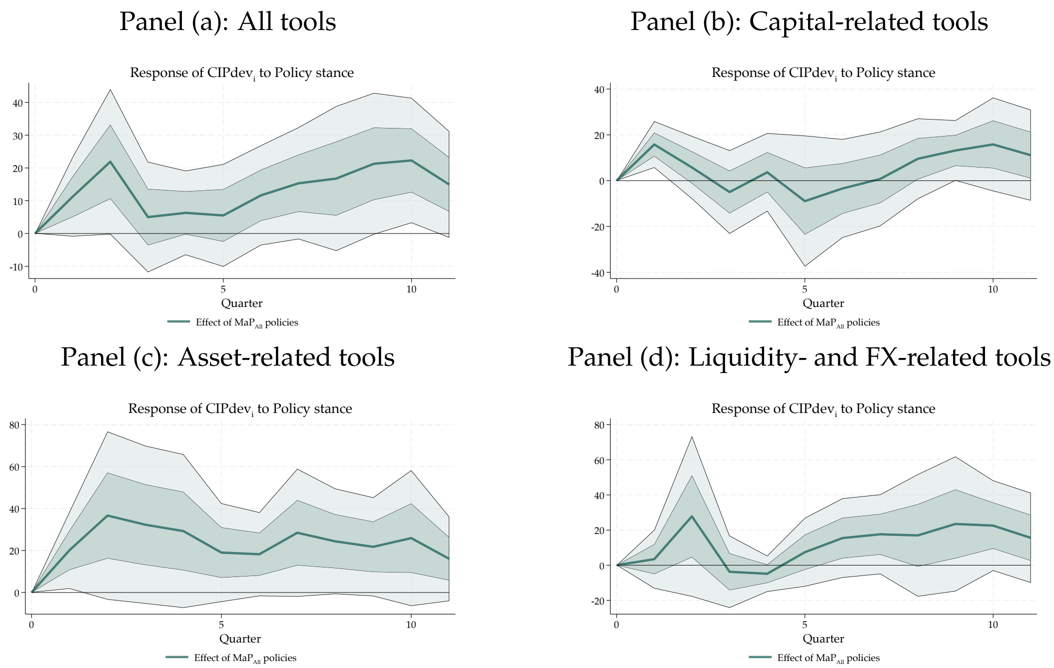


Panel (d): Liquidity- and FX-related tools



Note: Each plot depicts the IRF of the CIP deviation in non-exporters (of commodities) economies after a unit increase in the policy stance index. The policy index in Panel (a) is the all-tools index used in the baseline; Panels (b)–(d) report indexes that aggregate only the indicated subcategory of the toolkit, defined as in Appendix C. The confidence intervals have 68% and 95% coverage in all cases.

Figure 25: LP-IRFs to policy tightenings by instrument type - Exporter Economies

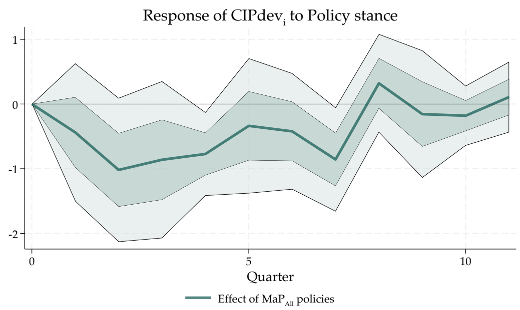


Note: Each plot depicts the IRF of the CIP deviation in commodity exporters after a unit increase in the policy stance index. The policy index in Panel (a) is the all-tools index used in the baseline; Panels (b)–(d) report indexes that aggregate only the indicated subcategory of the toolkit, defined as in Appendix C. The confidence intervals have 68% and 95% coverage in all cases.

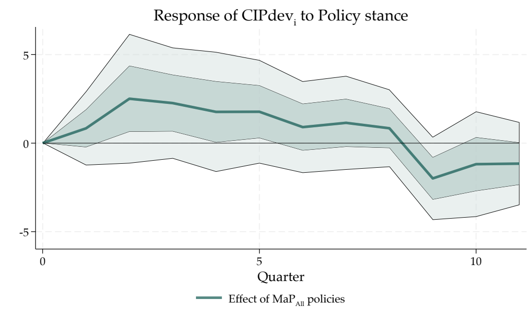
On the other hand, below in Figure 26 we also report the policy responses from this model in equation (4) for estimations with policy indexes that only capture prudential tightenings and loosenings. The figure includes the responses for all the country groups considered.

Figure 26: LP-IRFs to macroprudential policies by type of stance change

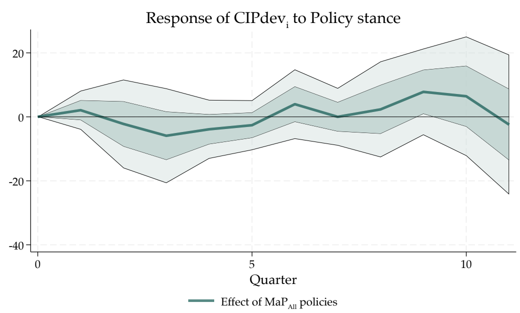
Panel (a): Tightenings only - AE



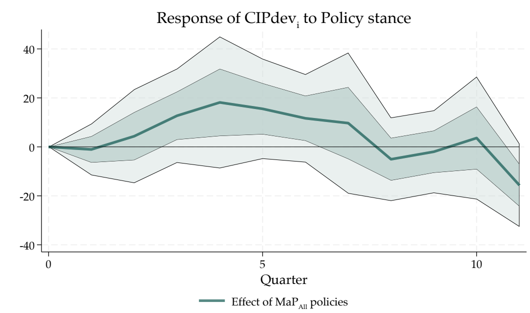
Panel (b): Loosenings - AE



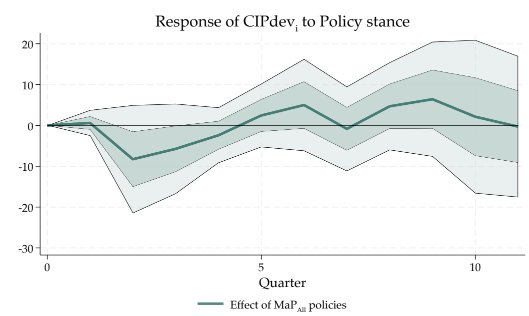
Panel (c): Tightenings only - EM



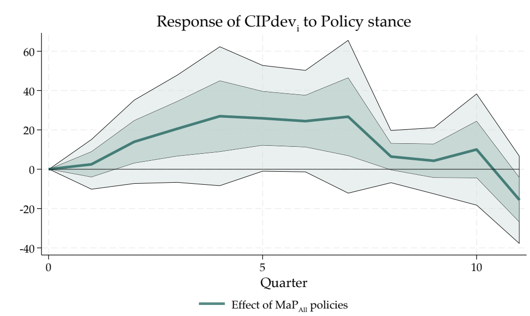
Panel (d): Loosenings - EM



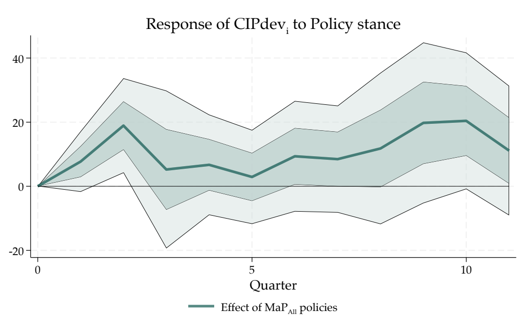
Panel (e): Tightenings only - Non-Exporters



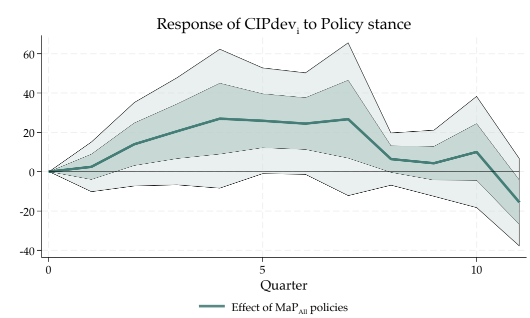
Panel (f): Loosenings - Non-Exporters



Panel (g): Tightenings only - Exporters



Panel (h): Loosenings - Exporters

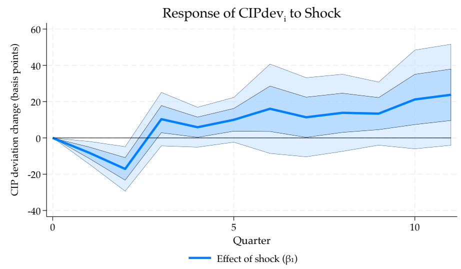


Note: Each plot depicts the IRF of the CIP deviation in a country category after a type of change in the stance index for all tools, with the (only) tightenings in the first column and an index of policy loosenings in the right column. We include details on the policy index by stance in Appendix C. The confidence intervals have 68% and 95% coverage in all cases.

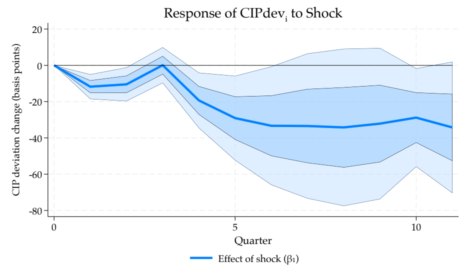
D.4 Additional estimation results for non-exporters and exporters of commodities

Figure 27: LP-IRFs to demand shocks - Non-exporter economies

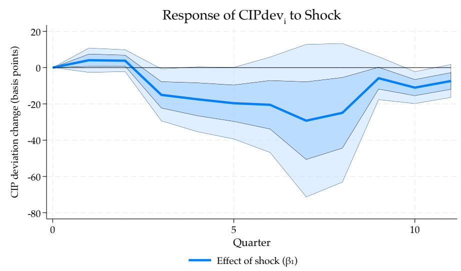
Panel (a): Real prices factor



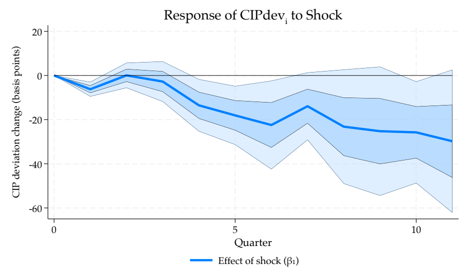
Panel (b): 1-month oil price surprise



Panel (c): Pure oil expectations shock



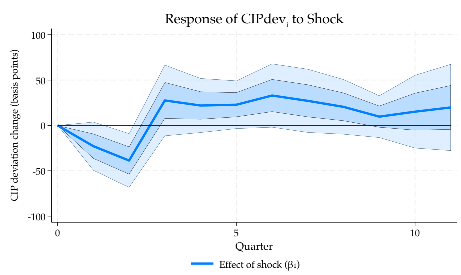
Panel (d): Oil consumption shock



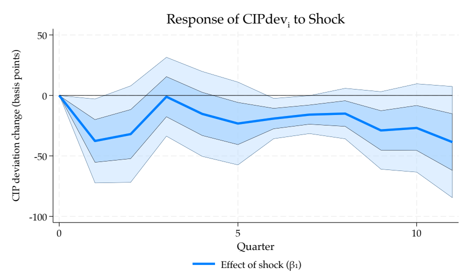
Note: Each plot depicts the IRF of the CIP deviation after a different commodity-related shock. The confidence intervals reported have a 68% and 95% confidence coverage.

Figure 28: LP-IRFs to demand shocks - Exporter economies

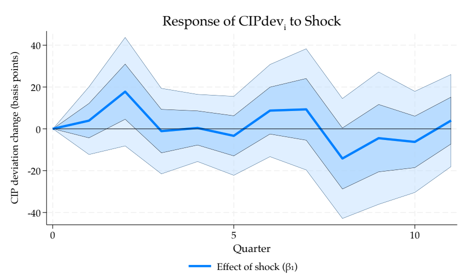
Panel (a): Real prices factor



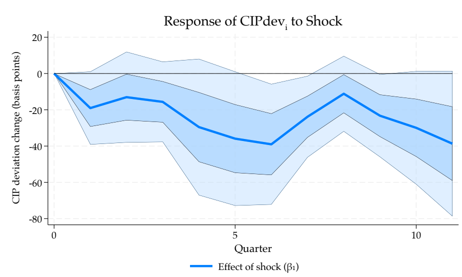
Panel (b): 1-month oil price surprise



Panel (c): Pure oil expectations shock



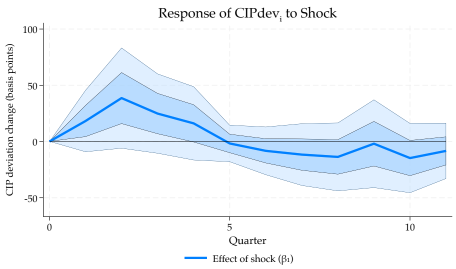
Panel (d): Oil consumption shock



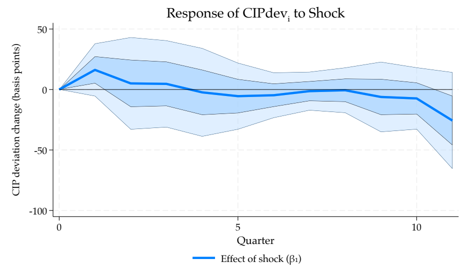
Note: Each plot depicts the IRF of the CIP deviation after a different commodity-related shock. The confidence intervals reported have a 68% and 95% confidence coverage.

Figure 29: LP-IRFs to supply shocks - Non-exporter and exporter economies

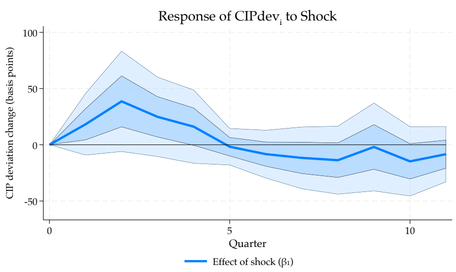
Panel (a): Oil supply shock - Non-exporters



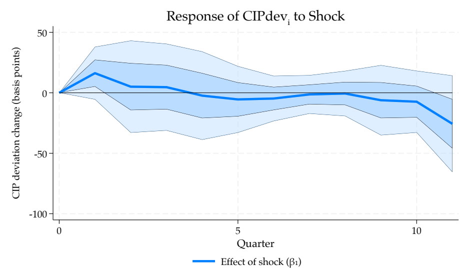
Panel (b): Oil supply news shock - Non-exporters



Panel (c): Oil supply shock - Exporters



Panel (d): Oil supply news shock - Exporters

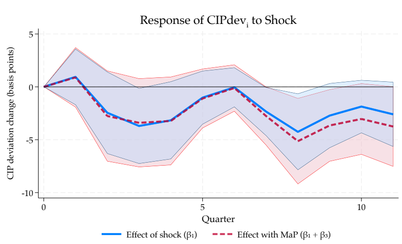


Note: Each plot depicts the IRF of the CIP deviation after a different commodity-related shock. The confidence intervals reported have a 68% and 95% confidence coverage.

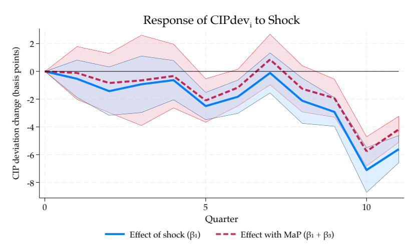
D.5 Alternative results with policy interactions

Figure 30: LP-IRFs to supply shocks with policy tightening-only and loosening indexes - Advanced Economies

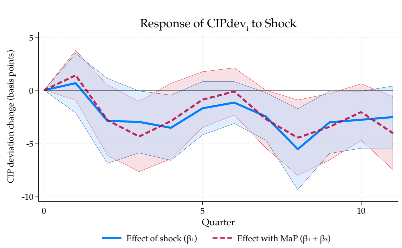
Panel (a): Prudential tightenings - Supply



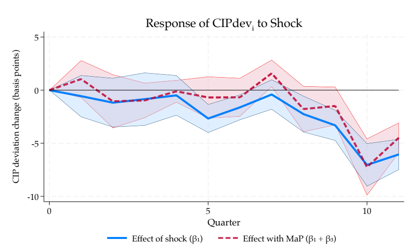
Panel (b): Prudential tightenings - Supply News



Panel (c): Prudential loosenings - Supply



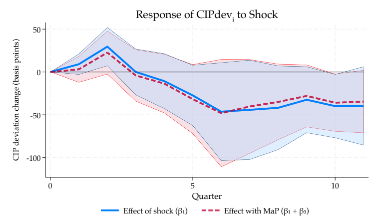
Panel (d): Prudential loosenings - Supply News



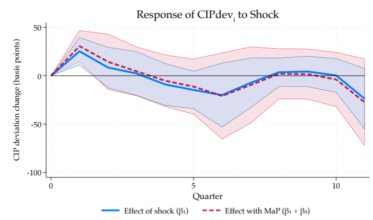
Note: Each plot depicts the IRF of the CIP deviation after a type of supply-side commodity shock. In blue, the main IRF is plotted, and in red (dashed), the shock effect in the presence of an increase in the macroprudential stance is shown (joint effect with interaction). Panels (a) and (b) show the effect for an index that records prudential tightenings only. Panels (c) and (d) show the responses to an increase in an index recording only policy loosenings (+1 implies a looser policy stance). The policy indexes are described in Appendix C. The confidence intervals have a 95% coverage.

Figure 31: LP-IRFs to supply shocks with policy tightening-only and loosening indexes - Emerging Economies

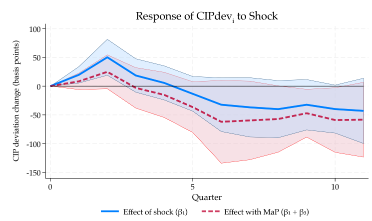
Panel (a): Prudential tightenings - Supply



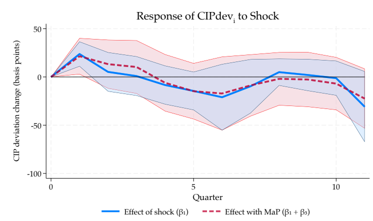
Panel (b): Prudential tightenings - Supply News



Panel (c): Prudential loosenings - Supply



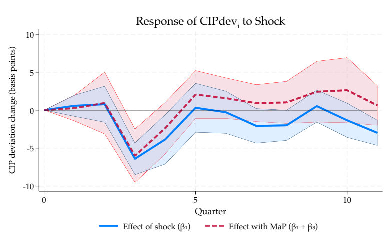
Panel (d): Prudential loosenings - Supply News



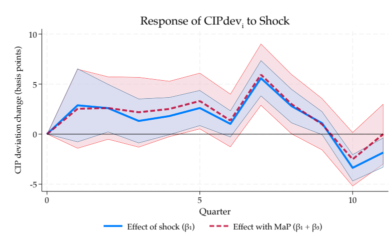
Note: Each plot depicts the IRF of the CIP deviation after a type of supply-side commodity shock. In blue, the main IRF is plotted, and in red (dashed), the shock effect in the presence of an increase in the macroprudential stance is shown (joint effect with interaction). Panels (a) and (b) show the effect for an index that records prudential tightenings only. Panels (c) and (d) show the responses to an increase in an index recording only policy loosenings (+1 implies a looser policy stance). The policy indexes are described in Appendix C. The confidence intervals have a 95% coverage.

Figure 32: LP-IRFs to Demand Shocks in Advanced Economies: Policy tightening-only index

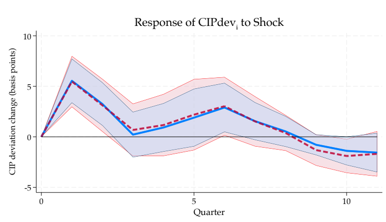
Panel (a): Real prices factor



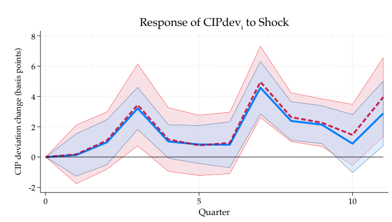
Panel (b): 1-month oil price surprise



Panel (c): Pure oil expectations shock



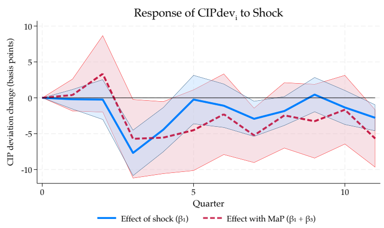
Panel (d): Oil consumption shock



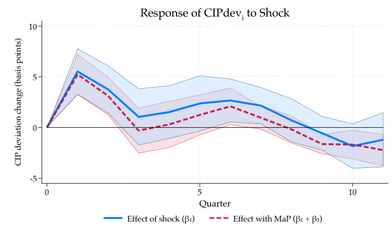
Note: Each plot depicts the IRF of the CIP deviation after a type of demand-side commodity shock for a model with a policy index that only considers tightenings. In blue, the main IRF is plotted, and in red (dashed), the shock effect in the presence of an increase in the macroprudential stance is shown (joint effect with interaction). The policy indexes are described in Appendix C. The confidence intervals have a 95% coverage.

Figure 33: LP-IRFs to Demand Shocks in Advanced Economies: Policy loosening index

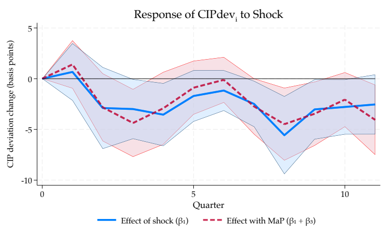
Panel (a): Real prices factor



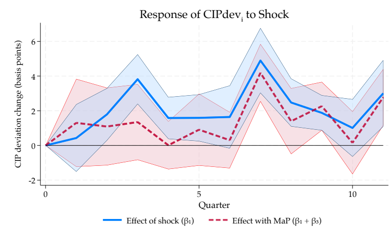
Panel (b): 1-month oil price surprise



Panel (c): Pure oil expectations shock



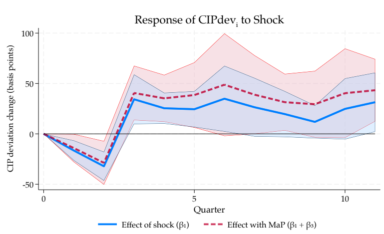
Panel (d): Oil consumption shock



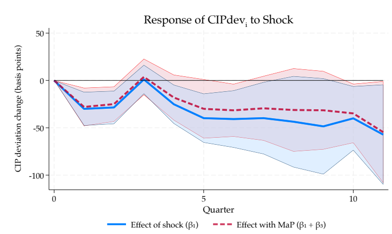
Note: Each plot depicts the IRF of the CIP deviation after a type of demand-side commodity shock for a model with a policy index that only considers loosenings. In blue, the main IRF is plotted, and in red (dashed), the shock effect in the presence of an increase in the macroprudential stance is shown (joint effect with interaction, +1 in the index implies a looser policy stance). The policy indexes are described in Appendix C. The confidence intervals have a 95% coverage.

Figure 34: LP-IRFs to Demand Shocks in Emerging Economies: Policy tightening-only index

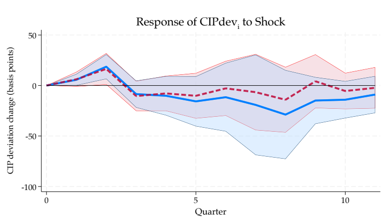
Panel (a): Real prices factor



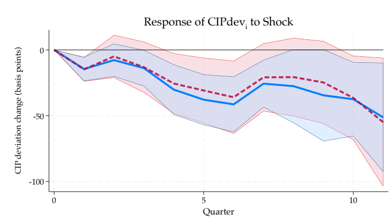
Panel (b): 1-month oil price surprise



Panel (c): Pure oil expectations shock

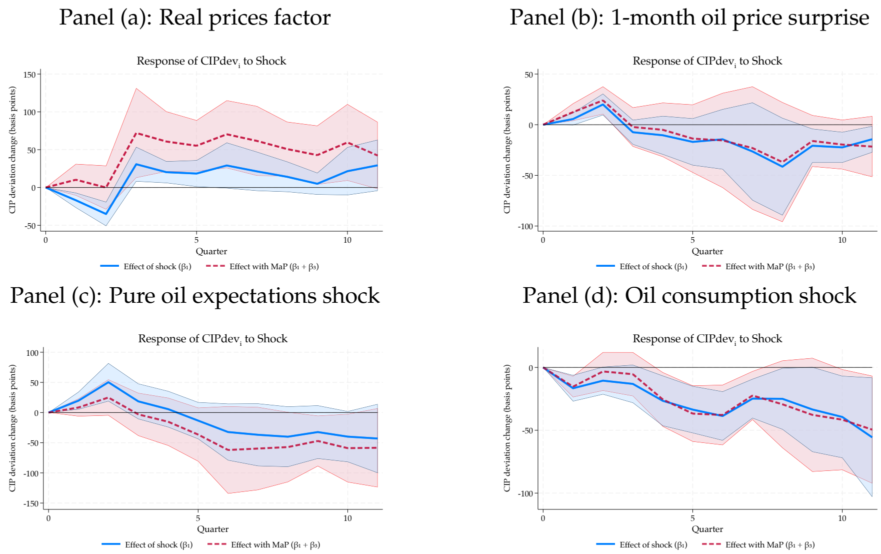


Panel (d): Oil consumption shock



Note: Each plot depicts the IRF of the CIP deviation after a type of demand-side commodity shock for a model with a policy index that only considers tightenings. In blue, the main IRF is plotted, and in red (dashed), the shock effect in the presence of an increase in the macroprudential stance is shown (joint effect with interaction). The policy indexes are described in Appendix C. The confidence intervals have a 95% coverage.

Figure 35: LP-IRFs to Demand Shocks in Emerging Economies: Policy loosening index

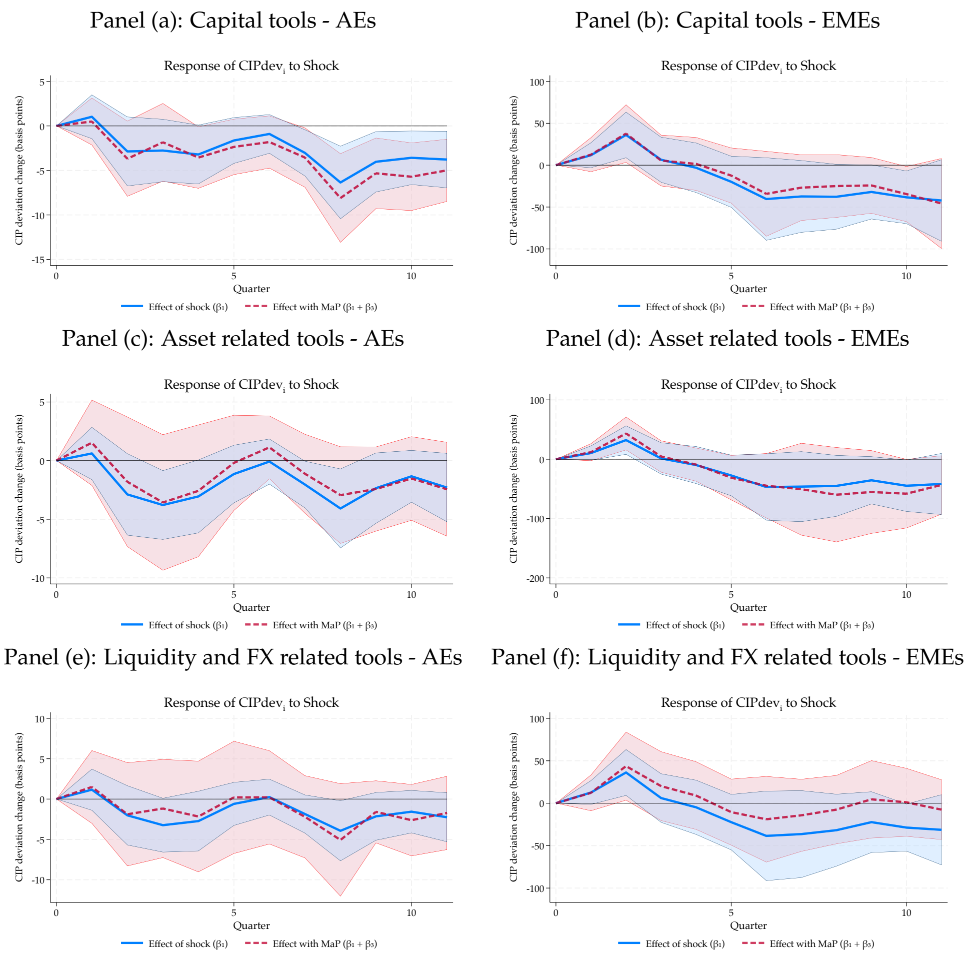


Note: Each plot depicts the IRF of the CIP deviation after a type of demand-side commodity shock for a model with a policy index that only considers loosenings. In blue, the main IRF is plotted, and in red (dashed), the shock effect in the presence of an increase in the macroprudential stance is shown (joint effect with interaction, +1 in the index implies a looser policy stance). The policy indexes are described in Appendix C. The confidence intervals have a 95% coverage.

Selected estimation results for subtypes of macroprudential policy tools The figure 36 shows the CIP deviation responses for specifications where the policy stance variable is constructed using only a subset of the macroprudential toolkit. The subtypes considered are capital-related tools, asset-related tools, and liquidity and FX-related tools. The figure reports the responses for a model with supply-side commodity-market-related shocks; the results for other shocks are also analogous to the baseline.[22]

[22]The results for other shocks are available upon request.

Figure 36: LP-IRFs to policy subtypes tightenings for Advanced (AEs) and Emerging Economies (EMEs)



Note: Each plot depicts the IRF of the CIP deviation after a unit increase in the policy stance index. Each row corresponds to a different policy tool type. Types are defined as a subaggregation of the instruments of the toolkit as described in Appendix C. The confidence intervals have a 95% coverage.

D.6 Transaction-cost-adjusted CIP deviations

We re-estimate our baseline specification using a transaction-cost-adjusted measure of the CIP deviations. Our baseline uses midpoint forward and spot rates, the standard convention in the CIP literature (e.g., Du et al., 2018; Cerutti et al., 2021; Rime et al., 2022; Cerutti and Zhou, 2023), which provides the cleanest measure of the theoretical deviation by abstracting from transaction costs. An arbitrageur attempting to exploit a negative basis, however, faces asymmetric pricing: she must sell the foreign currency forward at the *bid* forward rate and buy spot dollars at the *ask* spot rate. The relevant no-arbitrage condition therefore tightens relative to the midpoint, and the transaction-cost-adjusted deviation is

$$\lambda^{TC}_{t,t+n} = i^{USD}_{t,t+n} - i^{*}_{t,t+n} - f^{bid}_{t,t+n} + s^{ask}_{t}, \tag{5}$$

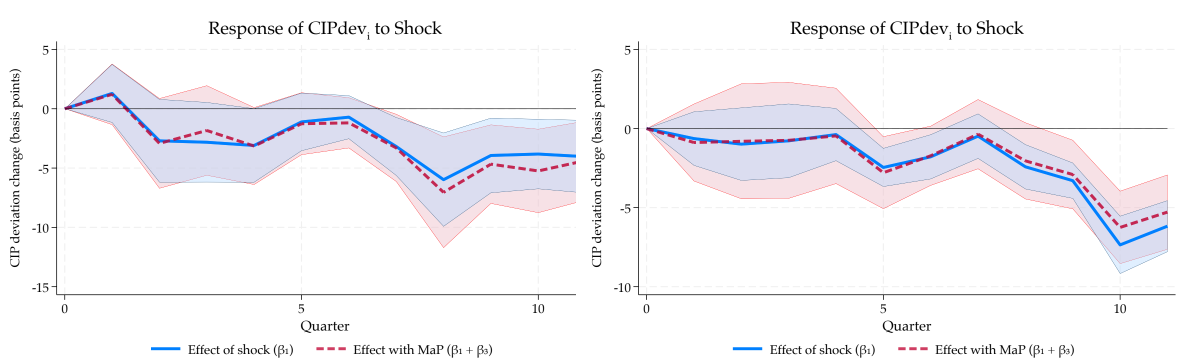
where $f^{bid}_{t,t+n}$ is the bid forward rate and s^{ask}_{t} is the ask spot rate. Since $f^{bid} \leq f^{mid}$ and $s^{ask} \geq s^{mid}$, we have $\lambda^{TC} \leq \lambda$ by construction: the adjusted measure is weakly more negative than the midpoint one, shrinking the effective deviation by the full round-trip transaction cost of the synthetic FX swap. Deviations that remain beyond zero after this adjustment cannot be profitably arbitraged regardless of regulatory or shock-driven forces, and any estimated effects that survive in this measure are therefore economically significant in the strict sense that they exceed the transaction-cost band.

Figures 39–38 replicate the baseline impulse responses from Figures 8–10 using this adjusted measure. The results are virtually identical to the midpoint-based baseline for both demand and supply shocks across advanced and emerging economies, confirming that the estimated effects operate beyond the transaction-cost arbitrage band rather than within it. This finding echoes the intermediary asset-pricing literature (Du et al., 2018; He et al., 2017; Du et al., 2022), emphasizing that post-crisis deviations persist precisely because balance-sheet constraints prevent arbitrageurs from exploiting them even when they exceed transaction costs.

Figure 37: LP-IRFs to supply shocks and interactions with policy - Advanced Economies (transaction-cost-adjusted)

Panel (a): Oil supply shock

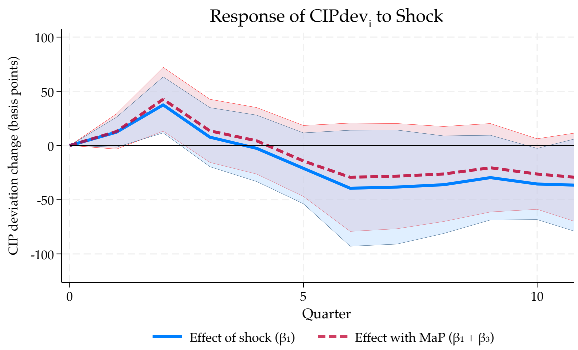
Panel (b): Oil supply news shock



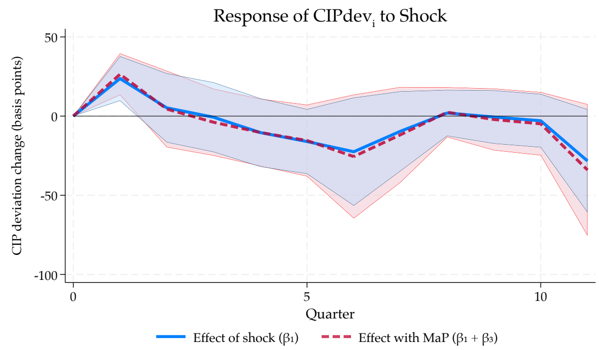
Note: Each plot depicts the IRF of the transaction-cost-adjusted CIP deviation after a different commodity-related shock. In blue, the main IRF is plotted, and in red (dashed), the shock effect in the presence of macroprudential policy tightening (effect with interaction). The confidence intervals have a 95% coverage in all cases.

Figure 38: LP-IRFs to supply shocks and interactions with policy - Emerging Economies (transaction-cost-adjusted)

Panel (a): Oil supply shock



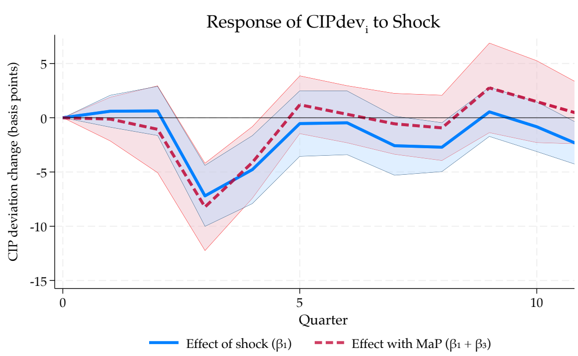
Panel (b): Oil supply news shock



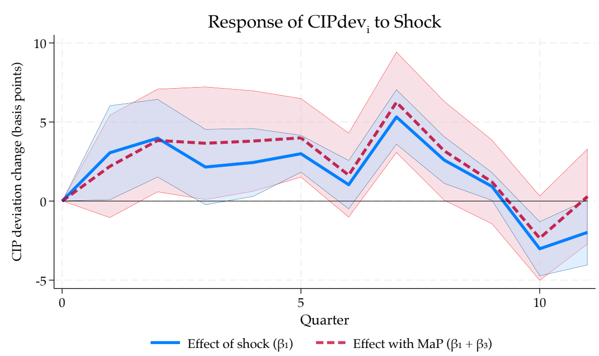
Note: Each plot depicts the IRF of the transaction-cost-adjusted CIP deviation after a different commodity-related shock. In blue, the main IRF is plotted, and in red (dashed), the shock effect in the presence of macroprudential policy tightenings (effect with interaction). The confidence intervals have a 95% coverage in all cases.

Figure 39: LP-IRFs to demand shocks and interactions with policy - Advanced Economies (transaction-cost-adjusted)

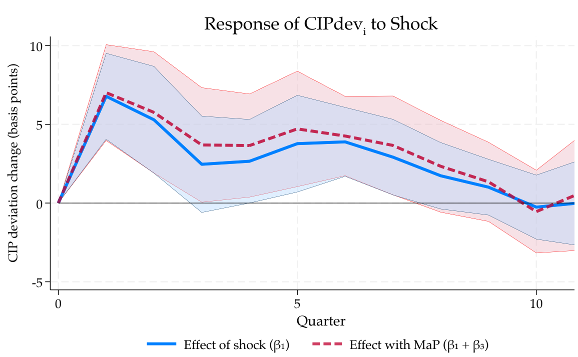
Panel (a): Real prices factor



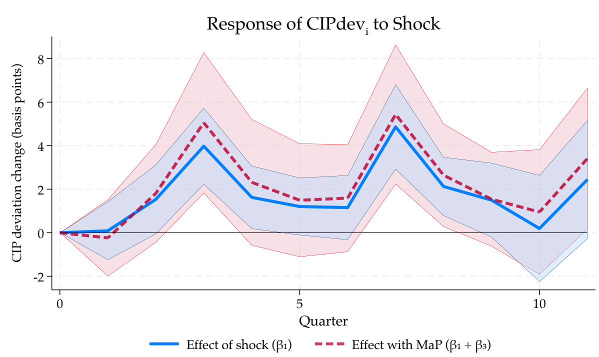
Panel (b): 1-month oil price surprise



Panel (c): Pure oil expectations shock

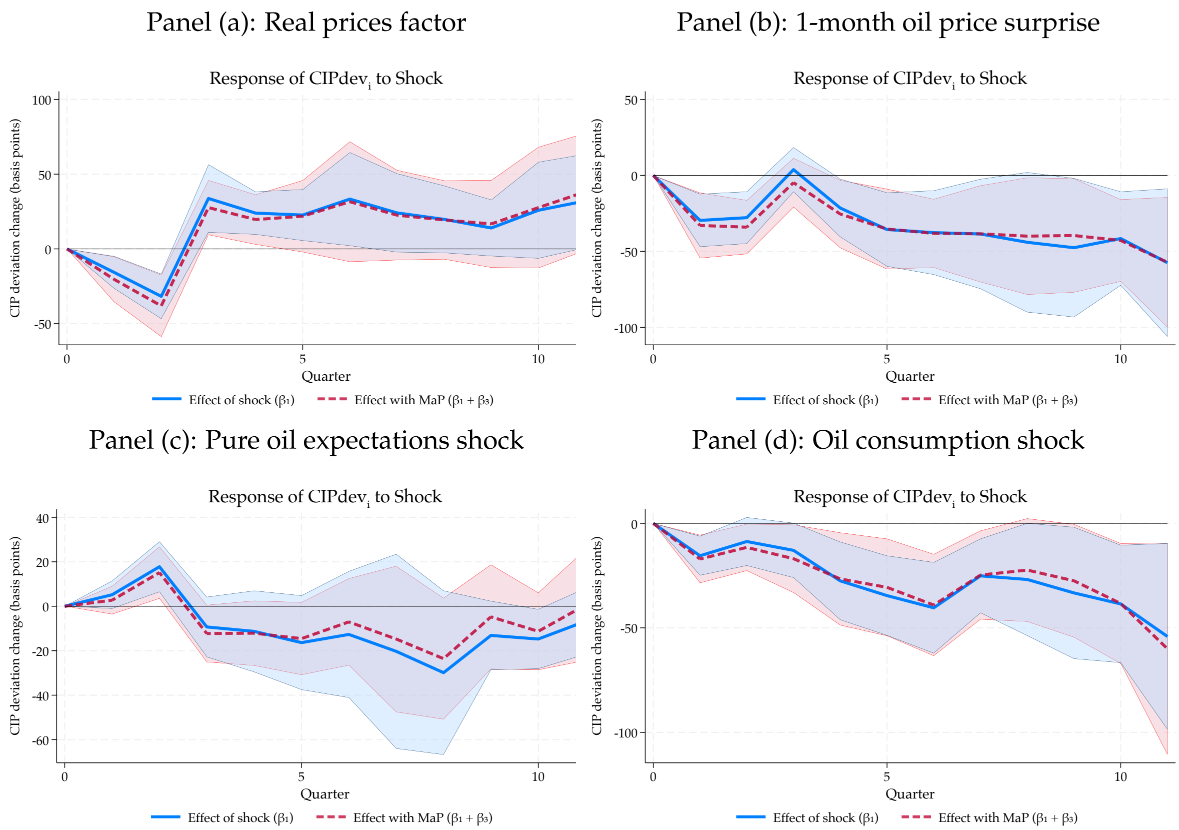


Panel (d): Oil consumption shock



Note: Each plot depicts the IRF of the transaction-cost-adjusted CIP deviation after a different commodity-related shock. In blue, the main IRF is plotted, and in red (dashed), the shock effect in the presence of a macroprudential policy tightening (effect with interaction). The confidence intervals have a 95% coverage in all cases.

Figure 40: LP-IRFs to demand shocks and interactions with policy - Emerging Economies (transaction-cost-adjusted)



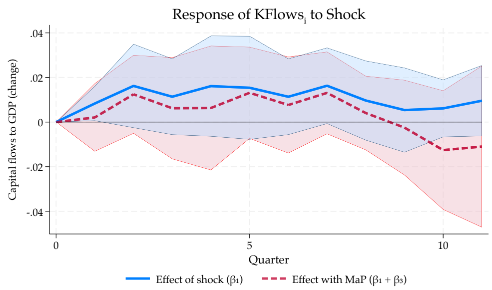
Note: Each plot depicts the IRF of the transaction-cost-adjusted CIP deviation after a different commodity-related shock. In blue, the main IRF is plotted, and in red (dashed), the shock effect in the presence of a macroprudential policy tightening (effect with interaction). The confidence intervals have a 95% coverage in all cases.

D.7 Selected estimation results of models with capital inflows as dependent variable

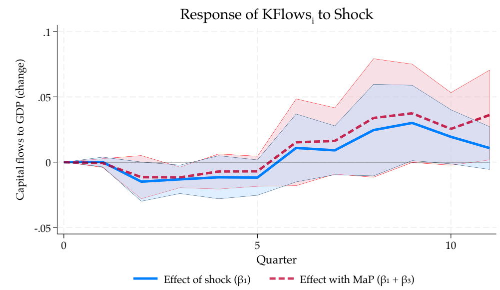
Here we show a selection of the estimation results for an alternative version of the model where the dependent variable is a type of gross capital inflows (as in Forbes and Warnock, 2012). In these versions of the model, the CIP deviation is removed from the set of controls. The coefficient responses depicted are, as in our baseline results, the main effect of the commodity market shock, and the joint effect with an interaction between the shock and the macroprudential policy stance.

Figure 41: LP-IRFs to demand shocks and interactions with policy - Emerging Economies

Panel (a): IRF of total inflows to real prices shock

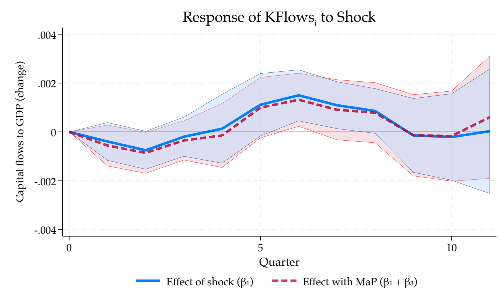


Panel (b): IRF of total inflows to supply shock



Panel (c): IRF of riskiest inflows to real prices shock

Panel (d): IRF of riskiest inflows to supply shock

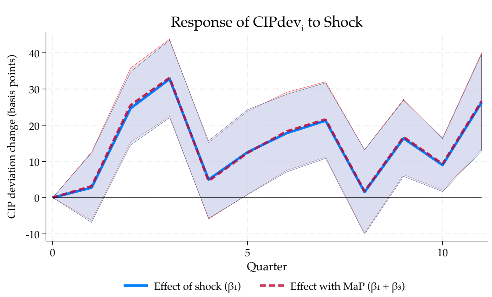


Note: Each plot depicts the IRF of the capital inflow after a different commodity-related shock. For the Advanced Economies the inflows considered are the total gross inflows; for emerging countries the flows considered are the riskiest flows category: portfolio equity flows. In blue, the main IRF is plotted, and in red and dashed, the effect is the shock effect in the presence of a macroprudential policy tightening (effect with interaction). The confidence intervals have a 95% coverage in all cases.

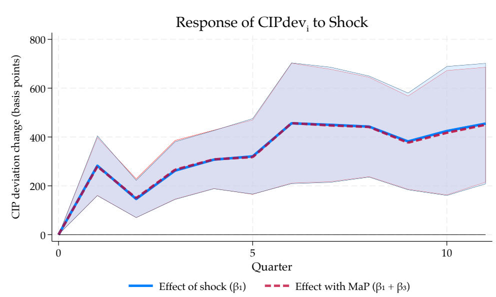
D.8 Other robustness estimations

Figure 42: LP-IRFs to US monetary shocks and interactions with policy

Panel (a): Advanced Economies



Panel (b): Emerging Economies



Note: Each plot depicts the IRF of the CIP deviation after a U.S. monetary shock. The shock series is obtained from Jarociński and Karadi (2020). In blue, the main IRF is plotted, and in red and dashed, the effect is the shock effect in the presence of macroprudential policy tightenings (effect with interaction). The confidence intervals have a 95% coverage in all cases.