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The Asymmetric Effects of Commodity Price Shocks in Emerging Economies☆

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Abstract

Commodity price fluctuations are a significant driver of business cycles in Emerging Economies (EMEs). While previous works have emphasized the link between commodity prices and financial conditions, none of them has explored empirically the potentially sign-dependent effects induced by commodity price shocks on domestic macro-financial conditions. Using a non-linear panel local projections model, we show that negative commodity price shocks induce stronger and faster effects on output and investment relative to positive shocks in EMEs. The trade balance improves after a negative shock due to the tightening of domestic financial conditions whereas it is unresponsive after a positive one. The response of financial conditions, both in terms of an increase in country spreads as well as in terms of a fall in net capital flows, is thus crucial in explaining the asymmetric responses. The faster and stronger spillover from faltering - rather than surging - commodity prices to the macro-financial conditions of commodity-exporting EMEs has important implications for the design of optimal policies in EMEs.

Keywords: commodity prices, capital flows, financial frictions, non-linear effects.

JEL Codes: F41, F44.

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1 Introduction

Commodity price shocks are a key driver of business cycles in emerging economies (henceforth, EMEs).[1] Consistently with a vast empirical literature, Figure 1 (left panel) shows a strong and positive correlation between the growth rates of output and the country-specific commodity export prices (often referred also as commodity terms of trade - CTOT) for a set of selected EMEs.[2]

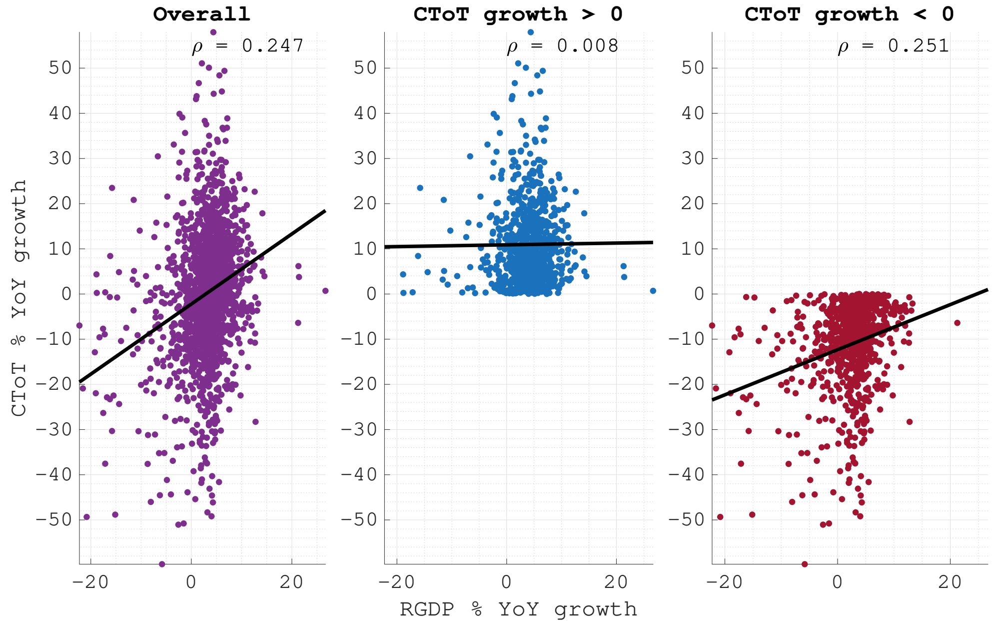
Previous works have usually analyzed the relationship between CTOTs and EMEs' business cycles within a linear framework. However, if these economies are subject to an external borrowing constraint that positively depends on commodity prices, then these shocks could induce a tightening in the external borrowing constraint. If the negative shock is strong enough, it may force the country to deleverage, inducing an improvement in the current account and a strong adjustment in macroeconomic variables. Thus, negative shocks may induce non-linear effects (see, for example, Bianchi, 2011). Figure 1 (middle-right panels) shows that, indeed, the correlation between output and CTOT annual growth rate is different depending on the sign of the latter. The middle panel, which conditions on positive values of CTOT growth, displays a slightly positive but not statistically significant correlation. On the contrary, the right panel, which conditions on negative values, presents a positive correlation that is statistically equal to the one presented in the left panel. In other words, the overall correlation between the variables is exclusively driven by negative growth rate of CTOT.

This paper estimates the sign-dependent effects of commodity price shocks on EMEs.

[1] See, for example, Shousha (2016), Fernández, Schmitt-Grohé, and Uribe (2017), Ben Zeev, Pappa, and Vicondoa (2017), Schmitt-Grohé and Uribe (2018), Drechsel and Tenreyro (2018), Fernández, Schmitt-Grohé, and Uribe (2020).

[2] We use the country-specific commodity price index computed by Gruss and Kebhaj (2019) deflated by the US Producer Price Index (PPIACO in FRED), which constitutes a proxy for global manufacturer prices. The commodity price index is computed using fixed weights calculated, similar to Shousha (2016) and Fernández, González, and Rodriguez (2018), as the ratio of country j's commodity i exports to total commodity exports over several decades. Using fixed weights ensures that the measure of commodity prices captures variations in commodity prices rather than supply responses due to those variations.

Figure 1 Correlation between Output and Commodity Prices



Note: Scatter plot of output and commodity prices (CTOT) annual growth rate at quarterly frequency. Each point in the graph represents the growth rate of output and commodity prices for one EME in one particular quarter. The first plot (Overall) considers all the changes in CTOT while the other two focus on positive (CTOT growth > 0*) and negative changes in CTOT (CTOT growth* < 0*). Variables are defined in Section 3.1. Countries included in the sample are detailed in Table A.1. Section 3.1 explains sample selection criteria and the definition of the variables used for the analysis.*

For this purpose, we use a non-linear local projections model in an unbalanced panel of commodity-exporting EMEs with quarterly data between 1994:Q1-2019:Q4. Restricting our analysis to small open economies allows us to assume that domestic macro-financial conditions do not affect global commodity prices. We delve into the asymmetric effects induced by CTOT shocks both on macroeconomic aggregates and on financial variables, including capital flows, to document the transmission channels.

Negative CTOT shocks induce stronger and more immediate effects on GDP and investment compared to positive shocks, whose transmission is more gradual. While the immediate response of the trade balance to positive shocks is not significant, negative shocks induce an improvement in the trade balance. Two main mechanisms could explain the differential response of macroeconomic aggregates to commodity price shocks within theoretical models. First, the deterioration of commodity prices may tighten the external borrowing constraint and force the country to deleverage, inducing an improvement in the current account. The shift in commodity prices can be regarded as a shift in the tradable endowment in theoretical models that have been used to analyze *Sudden Stops* (see, for example, Bianchi, 2011). Second, the differential response of macroeconomic variables to positive and negative CTOT shocks can be rationalized by the combination of downward wage rigidities and a fixed exchange rate regime. In this context, a negative price shock induces a fall in aggregate demand for tradable and non-tradable good. Considering that the nominal wage is rigid downwards and the country has a fixed exchange rate, real wages cannot fall and the shock induces an increase in unemployment (see, for example, Schmitt-Grohé and Uribe, 2016). If the fall in tradable demand is stronger than the decrease in tradable output, this shock may also induce an improvement in the trade balance. We assess the relevance of these two mechanisms in explaining the results. First, we document that country spreads increase and net capital flows fall on impact in response to negative shocks, which reflect tighter financial conditions for EMEs. Positive CTOT shocks do not induce a significant effect on these variables. Additionally, we explicitly show that negative CTOT shocks may trigger *Sudden Stop* episodes. Second, we show that countries with flexible and fixed exchange rate regimes display comparable impulse responses. Thus, our analysis suggests that the financial channel is the main mechanism in explaining the sign-dependent asymmetric response of EMEs to CTOT shocks.

Fluctuations in commodity prices are a relevant source of business cycle fluctuations in EMEs, accounting for up to half of business cycle fluctuations (see, for example Fernández, González, and Rodriguez, 2018; Ben Zeev, Pappa, and Vicondoa, 2017). Small open economy models that analyze the transmission of CTOT shocks typically assume that interest rate at which countries can borrow from international capital markets depends negatively on commodity prices (see, for example, Shousha, 2016; Drechsel and Tenreyro, 2018; Fernández, González, and Rodriguez, 2018). This specification is based on the empirical fact that the country spread declines (increases) when commodity prices increase (decline). In these models, the financial channel amplifies the effects of commodity price shocks on business cycles without inducing asymmetric effects. Another strand of the literature assumes that small open economies are subject to an *Occasionally Binding Borrowing Constraint* (henceforth, OBCs) which depends on capital or current income (see, for example, Mendoza, 2010; Bianchi, 2011). In this type of models, which have become popular to analyze *Sudden Stops*, a decline in tradable income induces a tightening of the external borrowing constraint which may force the country to deleverage, inducing non-linear effects. Consistent with these models, this paper documents that commodity price shocks induce sign-dependent macroeconomic effects whose heterogeneity is quantitatively sizable. These empirical facts have important implications for the design of optimal policies in these economies. Given that financial frictions drive the sign-dependent implications of CTOT, policies should counteract the amplification effects acting via financial channel.

Previous empirical works have analyzed different kinds of asymmetries on EMEs' business cycles in response to terms of trade shocks. Broda (2004) shows that changes in terms of trade induce stronger effects on countries with a fixed exchange rate regime. Edwards and Levy-Yeyati (2005) document that the response to changes in terms of trade depends on the exchange rate regime and the sign of the change. We differ from their analysis along several dimensions. First, while they estimate the effects of unconditional changes in broadly defined terms of trade (ToT), our definition of CTOT changes is conditional (and thus orthogonal to) on past values of CTOT itself and of other macro-financial variables. The latter definition is consistent with the concept of structural shocks in theoretical models and aligned with the latest empirical research on the topic. Second, we focus on business cycles dynamics and shed light on the role of the financial channel in determining the sign-dependent responses of EMEs to CTOT shocks. While we also consider the role of exchange rates in explaining the asymmetry, we document comparable responses of countries with flexible and fixed exchange rate regime. Third, rather than relying on traditional panel regression, we employ local projections methods that are specifically designed to estimate dynamic effects and allow us to study the response of domestic economic conditions at farther horizons to CTOT shocks.[3] Our findings echo and complement those in Ben Zeev (2019), who documents that global risk appetite shocks produce an asymmetry in EMEs' business cycles. In our analysis, we show that commodity price shocks are an additional source of the documented asymmetry that also are generated via financial frictions consistently with the interpretation in Ben Zeev (2019). Recently, Di Pace, Juvenal, and Petrella (2023) evaluate whether business cycles in a broad set of EMEs and low-income countries respond asymmetrically to a ToT shock on the export or import price index. They find that the former is twice as important as the latter in explaining business cycle dynamics in EMEs. This paper contributes to the literature by shedding light on CTOT shocks' asymmetric effects over EMEs' business cycles. We focus on the role of export price index, which according to Di Pace, Juvenal, and Petrella (2023) is the main component of the terms of trade to explain business cycle fluctuations. While our results confirm that commodity price shocks induce sign-dependent effects on EMEs' output, we also show that other relevant macroeconomic variables display significant asymmetric responses. We show that the asymmetric response of macroeconomic variables is tightly intertwined to the response of capital flows and country spreads. Conversely, nominal rigidities coupled with a fixed exchange rate regime do not explain the sign-dependent effects of CTOTs shocks.

The remainder of the paper is structured as follows. Section 2 presents the empirical specification and data used for documenting the main empirical facts. Section 3 documents the empirical findings of CTOT shocks on macroeconomic and financial variables. Section 4 presents several robustness exercises. Finally, Section 5 concludes.

[3] Additionally, our analysis covers more recent year, while their analysis stops in 2000.

2 Econometric Framework

In this section we describe the identification strategy of commodity price shocks and the baseline empirical specification that we use to estimate the effects of positive and negative CTOT shocks.

2.1 Identification Strategy

Previous works assume that shifts in the terms of trade or in commodity prices are completely exogenous with respect to the domestic economic conditions of small open economies (see, for example, Mendoza, 1995; Schmitt-Grohé and Uribe, 2018). Consequently, shocks are identified in a VAR model where ToT or CTOT only depend on its past values and, in some cases, also on lags of the BAA Corporate Spread or the US real interest rate (see, for example, Schmitt-Grohé and Uribe, 2018; Fernández, Schmitt-Grohé, and Uribe, 2017). We also define commodity price shocks as the changes in commodity prices that are orthogonal to past values of CTOT. Importantly, in Section 4 we deal with the feedback between commodity prices and global financial conditions (driven by monetary policy or global risk appetite), in line with Juvenal and Petrella (2023), and find consistent results with our baseline. However, we do not identify CTOT shocks by estimating an AR or VAR process since we want to allow for the possibility that positive and negative commodity price shocks display differences in persistence. The persistence of CTOT shocks is key for assessing its effects (see, for example, Mendoza, 1995). Thus, a one-step specification allows us: i) to obtain more precise estimates, ii) control for domestic macroeconomic conditions which may reflect future movements in CTOT (see Ben Zeev, Pappa, and Vicondoa, 2017), iii) to allow for differential persistence of positive and negative CTOT shocks.[4]

[4] Nonetheless, our results are robust to an alternative two-stage estimation procedure where CTOT shocks are identified in a separate step from an univariate $AR(4)$ process as typically done in the literature.

2.2 Empirical Specification

We estimate non-linear Local Projections (LP) to uncover the heterogeneous effects of positive and negative CTOT shocks on the outcome variables. This is done by regressing the difference of country j's outcome variable in quarterly frequency on the CTOTs, controlling for a broad set of lagged macro-financial variables.

Our baseline specification is:

$$y_{j,t+h} - y_{j,t-1} = I_{j,t}\left[\alpha^{p}_{h,j} + \tau^{p}_{h}T + \sum_{z=0}^{4}\phi^{p}_{h,z}\mathrm{CTOT}_{j,t-z} + \Gamma^{p}_{h}(L)y_{j,t-1} + \Xi^{p}_{h}(L)x_{j,t-1}\right] +$$
$$(1-I_{j,t})\left[\alpha^{n}_{h,j} + \tau^{n}_{h}T + \sum_{z=0}^{4}\phi^{n}_{h,z}\mathrm{CTOT}_{j,t-z} + \Gamma^{n}_{h}(L)y_{j,t-1} + \Xi^{n}_{h}(L)x_{j,t-1}\right] + u_{j,t+h}$$
$$\forall \quad 0 \leq h \leq 20 \quad (1)$$

where h corresponds to the projection horizon, j denotes a country, T is a linear time trend, $I_{j,t}$ represents an indicator function that takes the value of one when the CTOT quarterly growth rate is positive and zero when negative, $\Gamma(L)$ and $\Xi(L)$ are a polynomial in the lag operator L up to order 4, x_{t-1} is the set of control variables, $\alpha_{h,j}$ are country-specific fixed-effect, and $u_{j,t+h}$ is the error term clustered at the country level. All estimated coefficients are specific to the horizon h. Hence, $\phi^{p}_{h,0}$ and $\phi^{n}_{h,0}$ are the coefficients of interest, i.e. the dynamic effects or impulse response functions (IRFs), to positive (p) and negative (n) shocks, respectively. Notice that we are assuming that the coefficients are common across countries, i.e. we are computing a pooled estimator as it is standard in the literature (see, for example, Fernández, Schmitt-Grohé, and Uribe, 2017).[5]

[5] We prefer the LP estimation to the VAR modeling due to its flexibility to estimate non-linear state-dependent impulse responses. As Sekine and Tsuruga (2018) and Auerbach and Gorodnichenko (2013) highlight, using LP to compute IRFs has several advantages. First, they can be estimated using OLS for each horizon. This feature allows economizing on parameters by avoiding adding all analyzed outcome variables as controls to guarantee shock's exogeneity. At the same time, it is easier to include interaction terms to estimate non-linear sign-dependent specifications compared to other popular methodologies in applied macroeconomics e.g. an SVAR. Second, LP are robust to misspecification of the data generating process since they do not constraint IRFs' dynamics. Such a characteristic can lessen specification errors arising

The outcome variables we use to estimate Eq.(1) are output, investment, exports, imports, trade balance, real exchange rate, and the country-specific Emerging Markets Bond Index (henceforth, EMBI) as a proxy for country credit spread, plus capital flows. EMBI is an essential country-specific variable for our analysis since it allows us to explore the financial frictions channels (see Section 3.3). Those variables constitute the set x included as controls in Eq.(1). Macro variables are expressed in real terms. Other than EMBI, the rest of the variables are taken from the IMF International Financial Statistics database. Appendix A contains a detailed description of the data we use and its sources.

3 Empirical Evidence

This Section presents the estimated responses of EMEs to CTOT shocks. Section 3.1 describes the baseline data set of EMEs. Section 3.2 displays the estimated effects for EMEs using the specification (1). Section 3.3 assesses the role of the financial channel in explaining the estimated asymmetries. Finally, Section 3.6 compares the estimated effects with the ones obtained using a linear model.

3.1 Data

The data set is an unbalanced quarterly panel of commodity-exporting EMEs small-open economies between 1994:Q1-2019:Q4. The criteria we use to include a country in the data set are: (i) the country is a small open economy such that domestic macro-financial conditions cannot affect global commodity prices; (ii) the median share of commodity exports to total exports between 1990:Q1-2019:Q4 is higher than 10% and (iii) the country belongs to the JP Morgan Emerging Market Bond Index (EMBI) ; iv) the availability of capital flows

from the lag structure of regressions. All these advantages come with no costs in terms of characterization of EMEs' business cycles.

data.[6] In this way, we are able to study the effect of commodity price shocks on commodity exporting EMEs and investigate the relevance of the the financial channel as source of their asymmetric effects. Our final sample is unbalanced due to the data availability of each country and consists of 13 commodity-exporting EMEs: Argentina 2004:Q1-2019:Q4, Brazil 1996:Q1-2019:Q4, Bulgaria 1995:Q1-2014:Q1, Chile 1999:Q2-2019:Q4, Colombia 2005:Q1-2019:Q4, Indonesia 2004:Q2-2019:Q4, Malaysia 1999:Q1-2018:Q4, Mexico 1994:Q1-2019:Q4, Peru 1997:Q1-2017:Q1, Poland 2000:Q1-2019:Q4, Romania 2012:Q1-2019:Q4, South Africa 2010:Q1-2019:Q4, and Ukraine 2000:Q2-2019:Q4.

Commodity Export Price Index

The country-specific CTOT index is computed by Gruss and Kebhaj (2019) as:

$$CTOT_{j,t} = \frac{\sum_{i=1}^{n} \omega_{j,i} P_{t,i}}{PCPI_t} \tag{2}$$

The numerator on the right-hand side of Equation (2) corresponds to the commodity export price index from the Commodity Terms of Trade database computed by the International Monetary Fund.[7] This index is a fixed weighted price average of country j's main commodities exports. $P_{t,i}$ is equal to commodity i's price at time t and $\omega_{j,i}$ represents its weight. to those variations. The weights are calculated, similar to Shousha (2016) and Fernández, González, and Rodriguez (2018), as the ratio of country j's commodity i exports to total commodity exports over several decades. The denominator is the U.S. producer commodity price index from the U.S. Bureau of Labor Statistics. We use it as a proxy for global manufacturer prices.

All the series were downloaded from the Commodity Terms of Trade database, published

[6] We compute the shares using data from the World Development Indicator database published by the World Bank. Commodities exports are defined as the sum of agricultural, raw materials, fuels, and metals exports as a share of total exports.

[7] https://data.imf.org/commoditytermsoftrade

by the International Monetary Fund. The original series are available at monthly frequency, hence we compute the quarterly average.

3.2 Sign-Dependent Macroeconomic Effects

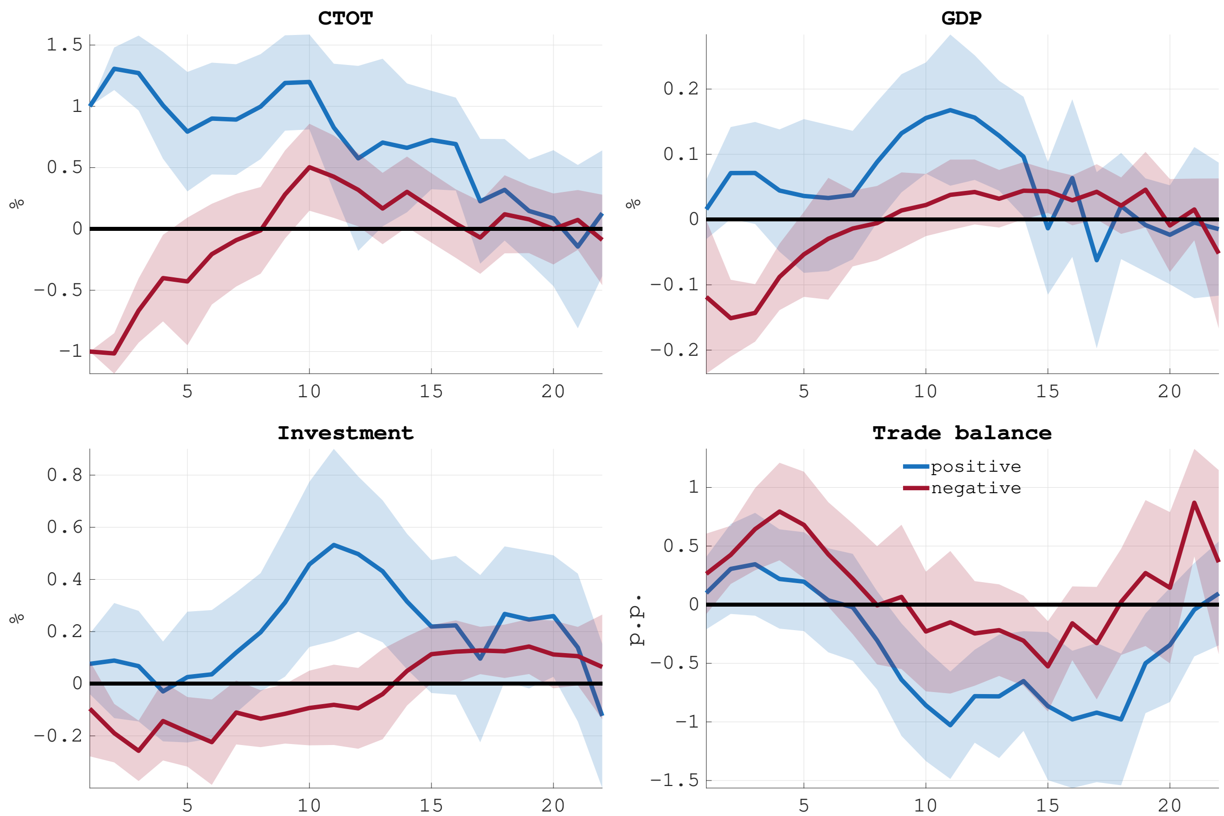
Prior to the sign-dependent estimation of the dynamic effects of CTOT shocks, we assess whether the distribution of positive and negative CTOT shocks are statistically different (reversing the sign of the latter). We apply the Kolmogorov-Smirnov test over the two sub-samples and cannot reject they are drawn from the same distribution (p-value = 0.7, KS-stat = 0.3). This result holds both for the CTOT growth rates, from the residuals from Eq.(4) that are implicitly the shocks employed in our analysis (and also for the residuals from an estimated AR(4) process of the CTOT).

Figure 2 reports the EMEs' estimated response to positive and negative CTOT shocks. The persistence of CTOT shocks is crucial to characterize their effects on EMEs' business cycles (see, for example, Mendoza, 1991). Positive CTOT shocks induce a more persistent response in CTOT compared to negative CTOT shocks. On the one hand, positive shocks induce an increase in CTOT which lasts more than 15 quarters. On the other hand, negative shocks seem dissipate after 5 quarters. This differential persistence may be related to the strong influence of the early 2000's commodity super cycle on our sample.[8]

Macroeconomic variables react stronger and faster in response to a negative CTOT shock. Real GDP falls by almost 0.2% two quarters after the shock but the effect dies out relatively quickly after 5 quarters. Conversely, the response of output to a positive shock is positive but more delayed, increasing only 2 years after the shock. Similarly, for investment a negative CTOT shock quickly impacts but dissipates rapidly, while positive CTOT shocks produce statistically significant effects only after 6 quarters and reach a peak

[8]Fernández, Schmitt-Grohé, and Uribe (2020) show that commodity supercycles' contribution in explaining aggregate economic activity at the country level is rather small compared to stationary world shocks. With this in mind, our results should still be valid regardless of the influence the latest commodity supercycle has on our sample.

Figure 2 Sign-Dependent IRFs to CTOT shocks - Macroeconomic Aggregates



Note: Estimated Sign-Dependent Impulse Response Functions (IRFs) of Commodity Terms of Trade (CTOT), GDP, Gross Fixed Capital Formation (Investment), and trade balance to output ratio computed using local projections defined in equation 1. Continuous blue (red) lines denote the median IRFs in response to a positive (negative) CTOT shock that induces a contemporaneous increase (decrease) of 1% in CTOT. Shaded areas denote 90% confidence bands based on Driscoll and Kraay standard errors. Horizon is in quarters.

after 10 quarters. Finally, the trade balance to output improves by almost 1 percentage point in response to a negative shock while it decreases after 2 years in response to the positive shock. These differential responses of macroeconomic variables are striking if we consider that positive shocks have a more persistent effect on CTOT. Small open economy models predict that more persistent shocks induce a stronger effect on consumption and investment on impact.

3.3 The Role of Financial Frictions and Capital Flows

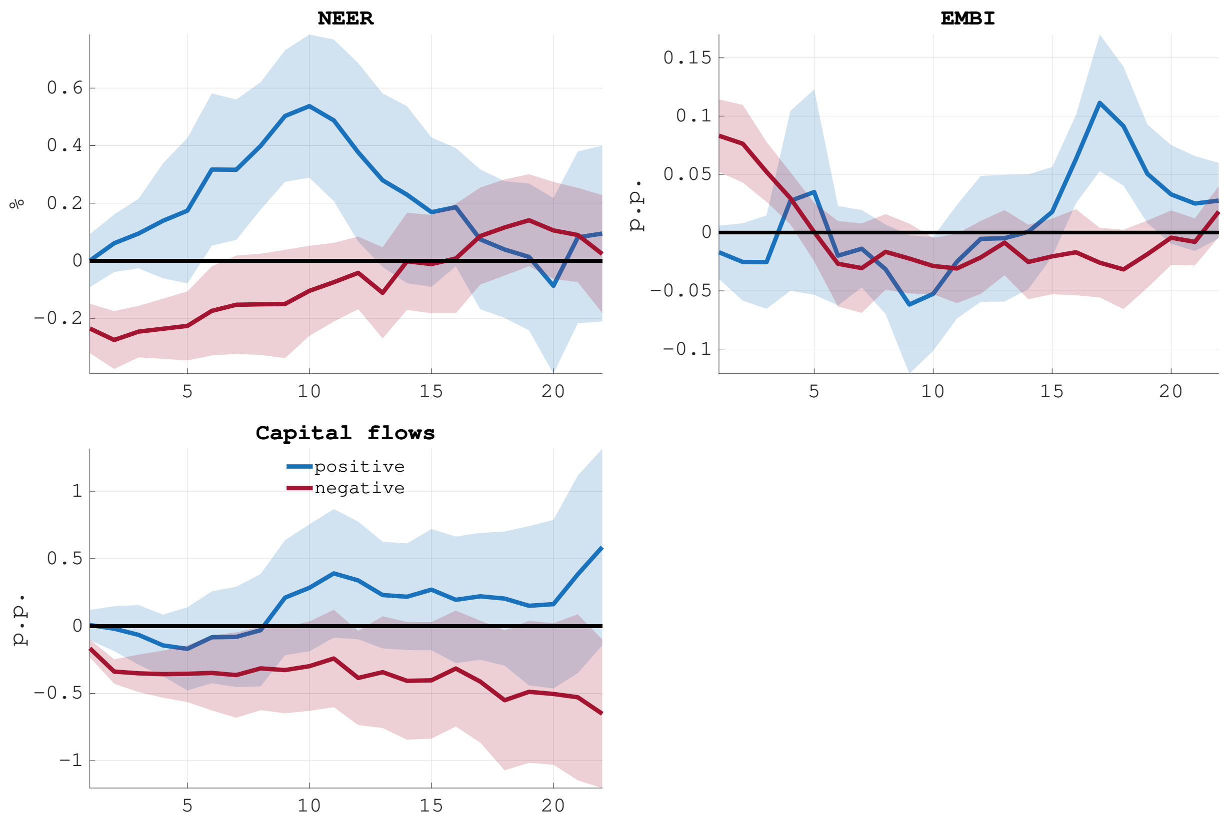
Financial frictions are important in explaining how commodity price shocks transmit into EMEs' business cycles (see, for example, Céspedes and Velasco, 2012; Shousha, 2016; Drechsel and Tenreyro, 2018; Fernández, González, and Rodriguez, 2018). Based on the negative relation between emerging economies' country credit spread and terms of trade (see for example, Hilscher and Nosbusch, 2010; Byrne, Fazio, and Fiess, 2013), previous works using small open economy models have assumed the country interest rate depends negatively on commodity prices (see, for example, Shousha, 2016; Drechsel and Tenreyro, 2018). This negative relation may reflect the fact that when commodity prices increase (decrease) the probability of default decreases (increases) since economies have less (more) incentives to default. In this framework, a negative CTOT shock that decreases the emerging economy's current income would also induce an increase in the country interest rate which reduces the incentives to issue debt. Considering this important interaction between commodity prices and the country interest rate, we estimate the non-linear effects of CTOT shocks on the sovereign spreads and on net capital flows to analyze in they are important to explain the asymmetric response of macroeconomic variables. Figure 3 displays the estimated IRFs.

EMBI spread spikes after a CTOT deterioration and capital inflows drop immediately and persistently, whereas after a positive shock both the EMBI and capital inflows do not react.[9] The sharp and persistent decline in net capital flows is explained by the stronger fall in gross capital inflows relative to gross capital outflows (see Figure B.2 included in the Appendix). Thus, the decrease in CTOT induces a significant tightening if the credit conditions which can be important to explain the estimated macroeconomic dynamics.

The fast and strong response of financial variables can be coupled with the differential response of macroeconomic variables. Mendoza (2010) develops a small open economy model with incomplete financial markets to explain *Sudden Stop* dynamics. The model

[9]EMBI displays a hike after about 17 quarters, likely reflecting the delayed macroeconomic response to a positive CTOT shock.

Figure 3 Sign-Dependent IRFs to CTOT shocks - Exchange Rate and Financial Channel



Note: Estimated Sign-Dependent Impulse Response Functions (IRFs) of nominal exchange rate (NEER), JP Morgan Emerging Market Bond Index (EMBI), and net capital flows to output ratio (Capital flows) computed using local projections defined in equation 1. Continuous blue (red) lines denote the median IRFs in response to a positive (negative) CTOT shock that induces a contemporaneous increase (decrease) of 1% in CTOT. Shaded areas denote 90% confidence bands based on Driscoll and Kraay standard errors. Horizon is in quarters.

incorporates a Fisherian endogenous collateral constraint that limits the amount of debt that the economy can issue to a fraction of the physical capital that is used as collateral. Bianchi (2011) develops a two-sector (tradable and non-tradable) small open economy model where the amount of debt is limited by tradable and non-tradable income. In this case, a negative shock induces a tightening of the borrowing constraint and a fall in consumption of tradable and non-tradable goods, generating a depreciation of the real exchange rate that further tightens the borrowing constraint. The estimated effects in response to a fall in CTOT are consistent with the effects described in this model. The sharp reduction in capital flows together with the increase in sovereign spread and the improvement in the trade balance to output ratio can be interpreted as a *Sudden Stop*. In fact, we also observe a strong and persistent depreciation of the nominal exchange rate (NEER in Figure 3) which is consistent with the real depreciation of the domestic currency.

3.4 Relationship with Sudden Stops

The decline in commodity prices induces a strong increase in the EMBI, a reversal in the trade balance-to-output ratio, and a decline in capital flows are consistent which are consistent with a *Sudden Stops*. In this section, we explore more in detail the link between negative commodity price shocks and *Sudden Stops*. First, we identify *Sudden Stop* episodes for the economies of our sample using the definition proposed by Calvo, Izquierdo, and Mejía (2008).[10] Table A.2 included in Appendix A.8 displays the *Sudden Stops* events identified in our sample. Then, we define a dummy variable ss that captures the beginning as a *Sudden Stop* episode. Finally, we model the probability of occurrence of a *Sudden Stop* as a function of positive and negative CTOT shocks using Eq.(3):

$$ss_{j,t} = \alpha + \beta CTOT^{p}_{j,t} + \gamma CTOT^{n}_{j,t} + \delta X_{j,t} + u_{j,t} \tag{3}$$

where $CTOT^{p}_{j,t}$ and $CTOT^{n}_{j,t}$ denote positive and negative CTOT shocks estimated as the residuals from an AR(4) of CTOT process (shocks) or the growth rates of CTOT relative to the previous period (growth). β and δ are the parameters of interest. $X_{j,t}$ denotes the set of controls the we employed in the LP analysis in Eq.(1).

[10] In particular, we compute the monthly proxy of capital flows as defined Calvo, Izquierdo, and Mejía (2008) and identify a *Sudden Stop* as periods when: i) there is at least one observation where the year-on-year decline in capital flows lies at least two standard deviations below its sample mean; this condition fulfills the 'unpredicted' prerequisite of a *Sudden Stop*, ii) the period of *Sudden Stop* phase ends when the annual change in capital flows surmounts one standard deviation below its sample mean. This commonly suggests persistence which is a common fact of *Sudden Stops*, iii) additionally, in order to ensure symmetry, the onset of a *Sudden Stop* phase is ascertained by the first time the annual change in capital flows drops one standard deviation below the mean. Both the first and second moments of the capital flow series are calculated each period using an expanding window with a minimum of 24 (months of) observations, which intends to capture the evolving behavior of the series. Table A.2 included in the Appendix displays the *Sudden Stop* events of the sample.

We estimate the equation using a Random Effect Logit (RE Logit) and also a Fixed-Effect Logit (FE Logit). Due to the specific nature of our dependent variable, which is a binary and quite sparse variable because it measures the beginning of a *Sudden Stop*, we do not aim at estimating dynamic effects but focus on the CTOT asymmetric influence on the probability of this type of crises only contemporaneously. Moreover, the response of capital flows display in Figure 3 shows that the impact of negative CTOT shocks materialize already in the first two quarters, suggesting that focusing on the static effects may already fully capture the dynamics at play.

The results are presented in Table 1. Negative shocks to CTOT increase the probability of occurrence of a *Sudden Stop* while positive shocks' influence is faint at best. Computing the average marginal effects associated with the estimated coefficients in Table 1 - column (1), our results indicate that a 1% increase in the absolute value CTOT, when the shock is negative, is associated with a surge in the probability of the occurrence of a *Sudden Stop* by 0.065 percentage points.[11] Referring to specification (3), when CTOT enters in actual growth rates, the estimated coefficients imply that a 1 percentage point increase, in modulus, in the negative growth in CTOT leads to a surge in the occurrence of a *Sudden Stop* equal to 0.055 percentage points contemporaneously (and 0.077 p.p. with a one quarter delay). This result is robust across the different specifications.

3.5 The Role of the Exchange Rate Regime

The asymmetric macroeconomic responses of EMEs' business cycles to CTOT shocks could alternatively arise from a combination of nominal frictions, in the form of downward wage rigidity, and fixed exchange rate regimes (see, for example, Schmitt-Grohé and Uribe, 2013, 2016). Under a freely floating exchange rate regime, a negative commodity price shock induces a depreciation of the local currency. Hence, real wage adjustment occurs through

[11] The unconditional probability of a *Sudden Stop* in our sample is 2.64%. Variables are re-expressed such that the estimated coefficients have a sign consistent with the local projections analysis.

Table 1 CTOT shocks and *Sudden Stops*

Dependent variable: Probability of a Sudden Stop				
	(1) RE Logit-shocks	(2) FE Logit-shocks	(3) RE Logit-growth	(4) FE Logit-growth
$CTOT_t$ positive	-5.162	-4.542	-3.307	-3.048
	(5.891)	(6.292)	(5.941)	(6.786)
$CTOT_{t-1}$ positive			-9.087*	-10.394*
			(5.495)	(6.201)
$CTOT_{t-2}$ positive			-7.863	-7.285
			(6.337)	(6.851)
$CTOT_{t-3}$ positive			4.822	6.886
			(4.974)	(8.410)
$CTOT_t$ negative	6.506**	5.932*	6.794**	6.529**
	(3.218)	(3.433)	(2.851)	(3.120)
$CTOT_{t-1}$ negative			9.584***	10.100**
			(3.621)	(4.147)
$CTOT_{t-2}$ negative			-1.988	-1.568
			(7.526)	(7.595)
$CTOT_{t-3}$ negative			-6.953	-8.585
			(7.475)	(11.468)
Macro-financial controls	✓	✓	✓	✓
Observations	874	757	874	757
Countries	13	10	13	10

Standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Note. The dependent variable is dummy that takes values 1 when a Sudden Stop episode start as defined by Calvo, Izquierdo, and Mejía (2008). In column (1) results are based on a random effect (RE) panel logit model and CTOT is defined as the residuals from a AR(4) process. In column (2) results are based on a fixed effect (FE) panel logit model and CTOT is defined as the residuals from a AR(4) process. In column (3) results are based on a RE panel logit model and CTOT enter in growth rates together with its own lags. In column (4) results are based on a FE panel logit model and CTOT enter in growth rates together with its own lags. All specification include the same macro-financial controls as eq.(1).

the exchange rate. Conversely, under a fixed exchange rate regime, the lack of currency depreciation and the rigidity of nominal wages prevents real wages from adjusting, leading to an increase in unemployment. The initial adverse effect on economic activity steaming from a negative CTOT gets amplified due to this mechanism. Such an amplification effect is not in place in the case of a positive CTOT shock as upward nominal wage movements are not restricted and real wages can adjust.[12]

In order to evaluate the role of exchange rates in explaining the asymmetric response of EMEs to CTOT shocks, we estimate Equation (1) separately for a subset of economies that have a flexible and fixed exchange rate. We classify countries following the exchange rate classification of Ilzetzki, Reinhart, and Rogoff (2019). In particular, we use their fine classification and define countries with currency boards or crawling peg regimes within a corridor smaller or equal than 2 percent as countries with fixed exchange rate regime (see Table A.3).[13]

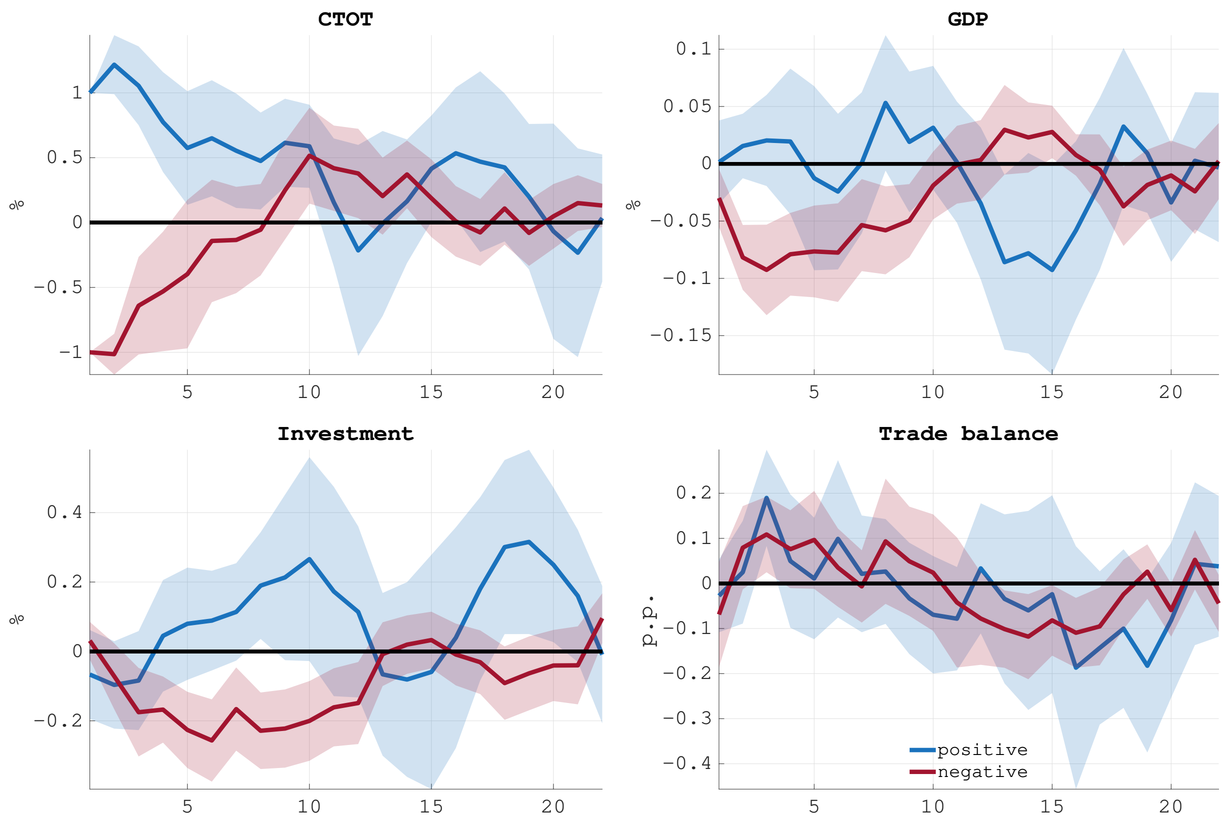
Figures 4-5 show the estimates for flexible exchange rate regimes. Figures B.3-B.4 report the estimates for fixed exchange rate regime.[14] The responses of macroeconomic and financial variables are not statistically different from the ones presented in Figures 2 and 3. These results confirms that the estimated asymmetry is not explained by countries that have a fixed exchange rate regime.

[12]In line with this exposition, Broda (2004) estimates the effects of terms of trade shocks on developing economies and finds that GDP and prices respond more to terms of trade shocks if they have a fixed exchange rate regime. Thus, countries with more flexible regimes insulate better the effects caused by this kind of shocks.

[13]This corresponds to all the countries that belong to categories from 1 to 8 in the classification. For our analysis, we consider the exchange rate regime of each period (i.e. we allow countries to shift regimes in our sample).

[14]Due to the limited sample size for countries with a fixed exchange rate regime in this estimation we truncate the local projection horizon to 15 quarters.

Figure 4 Sign-Dependent IRFs to CTOT shocks with flexible exchange rate regime - Macroeconomic Aggregates

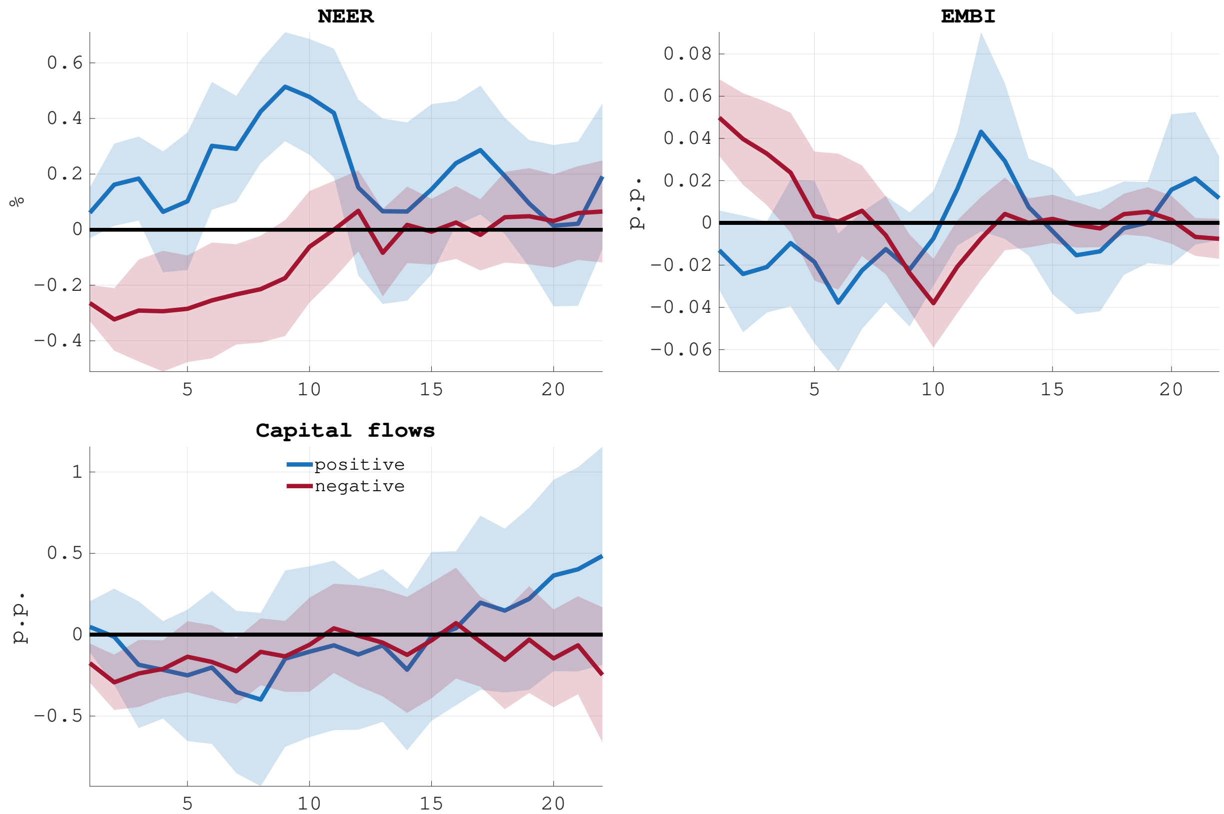


Note: Estimated Sign-Dependent Impulse Response Functions (IRFs) of Commodity Terms of Trade (CTOT), GDP, Gross Fixed Capital Formation (Investment), and trade balance to output ratio computed using local projections defined in equation 1. Continuous blue (red) lines denote the median IRFs in response to a positive (negative) CTOT shock that induces a contemporaneous increase (decrease) of 1% in CTOT. Shaded areas denote 90% confidence bands based on Driscoll and Kraay standard errors. Horizon is in quarters.

3.6 Comparison with the Estimated Linear Effects

Previous works have mostly estimated the effects of EMEs in response to CTOT shocks using linear models (see, for example, Shousha, 2016; Fernández, González, and Rodriguez, 2018; Ben Zeev, Pappa, and Vicondoa, 2017; Fernández, Schmitt-Grohé, and Uribe, 2017; Schmitt-Grohé and Uribe, 2018). In order to link our findings with those of previous works, we estimate the effects of a CTOT shock without distinguishing by the sign of the shock using the following specification:

Figure 5 Sign-Dependent IRFs to CTOT shocks with flexible exchange rate regime - Exchange Rate and Financial Channel



Note: Estimated Sign-Dependent Impulse Response Functions (IRFs) of Commodity Terms of Trade (CTOT), GDP, Gross Fixed Capital Formation (Investment), and trade balance to output ratio computed using local projections defined in equation 1. Continuous blue (red) lines denote the median IRFs in response to a positive (negative) CTOT shock that induces a contemporaneous increase (decrease) of 1% in CTOT. Shaded areas denote 90% confidence bands based on Driscoll and Kraay standard errors. Horizon is in quarters.

$$y_{j,t+h} - y_{j,t-1} = \tau_h T + \alpha_{h,j,t} + \sum_{z=0}^{4} \phi_h^z \text{CTOT}_{j,t-z} + \Gamma_h(L) y_{j,t-1} + \Xi_h(L) x_{j,t-1} + u_{j,t+h}$$

$$\forall \quad 0 \leq h \leq 20 \quad (4)$$

where the variables and controls are exactly the same as in Eq.(1). Figures 6 displays the estimated IRFs of macroeconomic and financial variables in response to a CTOT shock.

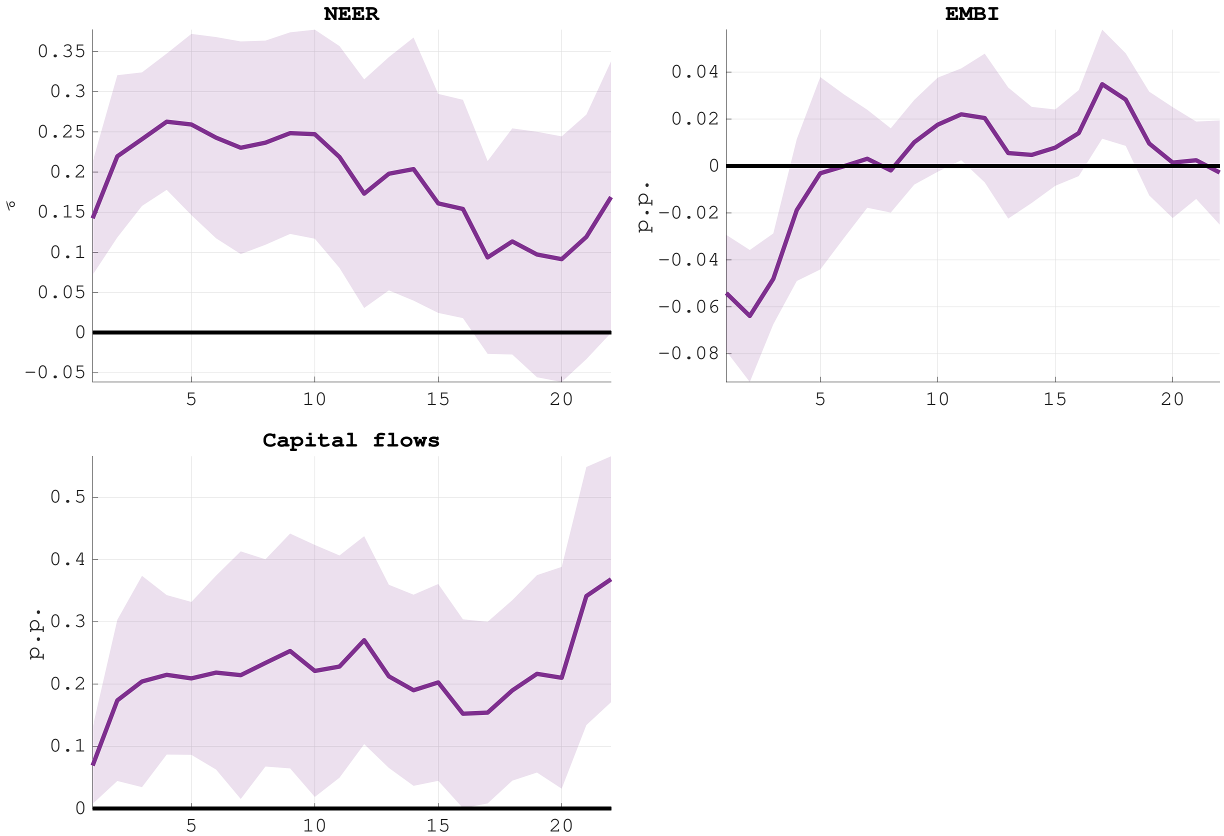
A positive CTOT shock induces an increase in output and investment and a deterioration of the trade balance-to-output ratio. The response of output and consumption is consistent with those of previous works (see, for example, Shousha, 2016; Ben Zeev, Pappa,

Figure 6 Linear IRFs to a CTOT shock - Macroeconomic Aggregates

Note: Estimated Linear Impulse Response Functions (IRFs) of Commodity Terms of Trade (CTOT), GDP, Gross Fixed Capital Formation (Investment), and trade balance to output ratio computed using local projections defined in equation 4. Continuous purple lines denote the median IRFs in response to a CTOT shock that induces a contemporaneous increase of 1% *in CTOT. Shaded areas denote 90% confidence bands based on Driscoll and Kraay standard errors. Horizon is in quarters.*

and Vicondoa, 2017; Fernández, Schmitt-Grohé, and Uribe, 2017; Drechsel and Tenreyro, 2018). The response of trade balance to output is consistent only with the one found by Drechsel and Tenreyro (2018) and not in line with a standard small open economy model (see, for example, Schmitt-Grohé and Uribe, 2018). This response can be explained by the fact that negative CTOT shocks induce an improvement in the trade balance-to-output ratio while positive CTOT shocks do not induce a significant effect on this variable during the first quarters. When we combine positive and negative shocks in a linear estimation, we find that trade balance to output deteriorates as a combination of the disaggregated effects. Thus, looking at the differential effects is crucial to better understand the response of this variable. Figure 7 displays the IRFs of the exchange rate and financial variables to CTOT shocks.

Figure 7 Linear IRFs to CTOT shocks - Exchange Rate and Financial Channel



Note: Estimated Linear Impulse Response Functions (IRFs) of nominal exchange rate (NEER), JP Morgan Emerging Market Bond Index (EMBI), and net capital flows to output ratio (Capital flows) computed using local projections defined in equation 4. Continuous purple lines denote the median IRFs in response to a CTOT shock that induces a contemporaneous increase of 1% in CTOT. Shaded areas denote 90% confidence bands based on Driscoll and Kraay standard errors. Horizon is in quarters.

In response to a positive CTOT shock, we observe an appreciation of the nominal exchange rate, a decrease in the EMBI, and an increase in capital inflows. Overall, the linear effects of CTOT shocks on EMEs are in line with previous works. However, for most of the variables, our results suggest that the linear effects typically described in the literature are mainly determined by negative CTOT shock, especially in the initial periods.

4 Robustness and Additional Results

In this section we consider alternative specification to assess the robustness of our findings. For ease of exposition, the impulse responses are included in Appendix B.3 and here we only summarize the exercises together with its main results.

4.1 Accounting for the Global Financial Conditions

Rey (2013) and Rey (2015) document that there is a strong comovement of asset prices worldwide which is labeled as the Global Financial Cycle (GFC). US monetary policy and the global risk appetite of investors are key drivers of the GFC (see, for example, Bruno and Shin, 2015, Avdjiev, Hardy, Kalemli-Özcan, and Servén, 2022, Miranda-Agrippino and Rey, 2020). Juvenal and Petrella (2023) document a strong interplay between commodity prices and the GFC. US monetary policy shocks and uncertainty shocks may drive CTOT and thus explain the differential response of EMEs to positive and negative CTOT shocks. To account for this possibility, we augment the specification of Equation (1) with the series of US monetary policy shocks computed by Jarociński and Karadi (2020) and uncertainty shocks computed by Piffer and Podstawski (2018) as controls. Figures B.5 and B.6 presented in the Appendix display the IRFs. The responses remain unaffected to controlling for these shocks which means that US monetary shocks and uncertainty shocks are not the divers of the asymmetric responses.

More in general, global financial conditions may be affecting the estimated effects since fluctuations in commodity prices may also reflect fluctuations in these conditions. To assess whether the previous findings are driven by financial conditions, we augment the specification of Eq.(1) with past values US BAA Corporate Spreads, the VIX index, and US dollar NEER. Figures B.7 and B.8 display the IRFs using this specification. The main conclusions remain unchanged.

4.2 Estimation by Sub-Groups

The baseline sample consists of EMEs that are commodity exporters from different regions. Considering that we are assuming that the response of EMEs is homogeneous, the estimated effects may be explained by some particular region. Considering that six economies belong to Latin America, we estimate the Eq.(1) using separately only the EMEs from our baseline sample that belong to Latin America and for those countries that belong to other regions.[15] The Latin American sample is very similar to the one used by Ben Zeev, Pappa, and Vicondoa (2017) who focused on estimating the effects of CTOT on Latin American economies. Figures B.9 and B.10 included in the Appendix display the IRFs for this set of countries. The main findings of the paper are robust to using focusing only on Latin American economies or only on non-Latam economies.

4.3 Estimation with Annual Data

Previous works have estimated the effects of CTOT shocks using annual data (see, for example, Fernández, Schmitt-Grohé, and Uribe, 2017; Schmitt-Grohé and Uribe, 2018; Drechsel and Tenreyro, 2018). The advantage of using annual data is that we can cover a longer time span for each country and consider more cycles. The disadvantages, relative to our baseline sample, are the lower number of available observations and the potential bias of temporal aggregation of macroeconomic and financial variables on the estimated effect. Moreover, EMBI series only starts in 1994 so we do not have an alternative index to proxy country spreads, which is a significant transmission channel for these shocks. In order to compare with previous works, we estimate our baseline specification with annual data for the same set of countries but with a longer time span.[16] Instead of using our baseline

[15]Our sample for Latam's estimation consists of: Argentina 2004:Q1-2019:Q4, Brazil 1996:Q1-2019:Q4, Chile 1999:Q2-2019:Q4, Colombia 2005:Q1-2019:Q4, Mexico 1994:Q1-2019:Q4, Peru 1997:Q1-2017:Q1.

[16]The estimation is based on an unbalanced panel that spans 1980-2019 for the following countries: Argentina, Brazil, Bulgaria, Chile, Indonesia, Latvia, Lithuania, Malaysia, Mexico, Poland, Romania, South Africa, Ukraine. The difference with respect to the quarterly sample is due to data availability.

measure of CTOT, we rely on the country-specific CTOT index computed by Di Pace, Juvenal, and Petrella (2023). Figures B.15 included in the Appendix displays the IRFs of output, capital flows and CTOT estimated using annual data. The main conclusions remain unchanged when we consider this specification.

4.4 Alternative Empirical Specifications

Specification in differences. Our baseline specification defines the dependent variables as cumulated differences while the lagged controls enter in levels. We employ this type of hybrid specification as often done in the literature (see, for example, Juvenal and Petrella, 2023) to obtain efficiency gains in the estimation. The baseline results are nonetheless robust if we specify Eq.(1) with the controls expressed in differences (see Figure B.11 included in the Appendix).

Shocks from a AR process. An alternative empirical specification to the one presented in Eq.(1) is a two-stage estimation procedure where CTOT shocks are identified in a first stage from an univariate $AR(4)$ process as typically done in the literature (see, for example, Schmitt-Grohé and Uribe, 2018). In this alternative, the identified CTOT shocks are then included in a second stage regression similar to Eq. (1) where CTOT and lagged values of CTOT are replaced by the contemporaneous series of CTOT shocks. We prefer the one step baseline specification because it allows to account for the potential heterogeneity in the persistence of positive relative negative shocks. Figure B.12 included in the Appendix displays the estimated IRFs computed with this alternative empirical specification. The main empirical findings are robust to this change in the empirical specification.

Specification of sign asymmetries. Our results are robust if we estimate sign-dependent effects as suggested in Barnichon, Debortoli, and Matthes (2022) and Tomas and Bruera (2024). The estimation of Eq.(5) yields IRFs that display a starker asymmetry compared to our baseline results.

$$y_{j,t+h} - y_{j,t-1} = \alpha_{h,j} + \tau_{h,t}T + \phi^{p}_{h,0} min(0, CTOT_{j,t}) + \phi^{n}_{h,0} max(0, CTOT_{j,t}) + \sum_{z=1}^{3} \phi^{n}_{h,z} \mathrm{CTOT}_{j,t-z} + \Gamma_h(L) y_{j,t-1} + \Xi_h(L) x_{j,t-1} + u_{j,t+h} \quad \forall \quad 0 \leq h \leq 20 \quad (5)$$

Results are reported in Figures B.14-B.13.

5 Conclusion

CTOT shocks are an important driver of business cycle conditions in EMEs. This paper shows that negative CTOT shocks induce stronger and faster effects on output and investment coupled with an improvement in the trade balance, a significant increase in country spread, and a drop in capital inflows. Thus, the response to a negative CTOT shock is consistent with a *Sudden Stop*. The exchange rate regime of EMEs does not explain the asymmetric response to both types of shocks. These results are consistent with an important role for non-linear financial frictions like the occasionally binding borrowing constraints that depend on tradable income (see, for example, Bianchi, 2011).

Policymakers should expect a faster and stronger spillover from faltering - rather than surging - commodity prices to the macro-financial conditions of commodity exporting EMEs. Taking into account the asymmetry documented in this paper is particularly important in light of the importance of commodity cycles in emerging economies. As the process of real fragmentation underway in the world economy and transition towards a low emission economy is likely to increase the volatility of commodity prices (Alvarez, Andaloussi, Maggi, Sollaci, Stuermer, and Topalova, 2023), shocks that lead commodity-exporting economy to hit the occasionally binding borrowing constraint they face are likely to become more and more frequent. Given that financial frictions drive the sign-dependent implications of CTOT, optimal policies should consider the importance of this transmission channel. For instance, fiscal rules related to commodity prices could allow exporters to accumulate a precautionary buffer during booms to smooth the impact of the busts (Eyraud, Gbohoui, and Medas, 2023). Analyzing the optimal design of macroeconomic policies and/or sovereign wealth funds to mitigate the asymmetric effects of CTOT shocks represents a promising area for future research.

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A Data Appendix

Our panel includes the following countries and samples.

Table A.1 Sample of Commodity-Exporting EMEs

1. Argentina (AR)	2004:Q1-2019:Q4	**7.** Malaysia (MY)	1999:Q1-2018:Q4
2. Brazil (BR)	1996:Q1-2019:Q4	**8.** Mexico (MX)	1994:Q1-2019:Q4
3. Bulgaria (BG)	1995:Q1-2014:Q1	**9.** Peru (PE)	1997:Q1-2017:Q1
4. Chile (CL)	1999:Q2-2019:Q4	**10.** Poland (PL)	2000:Q1-2019:Q4
5. Colombia (CO)	2005:Q1-2019:Q4	**11.** Romania (RO)	2012:Q1-2019:Q4
6. Indonesia (ID)	2004:Q2-2019:Q4	**12.** South Africa (ZA)	2010:Q1-2019:Q4
		13. Ukraine (UA)	2000:Q2-2019:Q4

Note: Selected EMEs that are considered in our baseline sample.

A.1 Output, Consumption, Investment, Exports, Imports, and the Trade Balance

- **Output:** local currency seasonally adjusted nominal GDP divided by the GDP deflator.

- **Consumption:** local currency seasonally adjusted nominal private sector consumption divided by the GDP deflator.

- **Investment:** local currency seasonally adjusted nominal gross fixed capital formation divided by the GDP deflator.

- **Exports:** local currency seasonally adjusted nominal exports of goods and services divided by the GDP deflator.

- **Imports:** local currency seasonally adjusted nominal imports of goods and services divided by the GDP deflator.

- **Trade Balance:** nominal exports minus nominal imports of goods and services as a share of nominal local currency GDP.

we downloaded all series from the International Financial Statistics database, published by the International Monetary Fund. Leaving out REER and the country credit spread, we seasonally adjust all variables. Series for Bolivia, Malaysia, Paraguay, Peru, and Ukraine are seasonally adjusted using ARIMA X12. Excluding the trade balance and EMBI, we apply logarithm towards all variables. At last, we extract the cyclical component from trending variables by estimating a quadratic-trend time polynomial[17]. We removing this long-term component from output, investment, consumption, exports, imports, and REER, whereas the remaining variables have no relevant trend.

A.2 Real Effective Exchange Rate

REER is CPI-based. we downloaded all series from the International Financial Statistics database, published by the International Monetary Fund. REER IFS' missing data for Argentina, Indonesia, Lithuania, and Peru was complemented with the Bank of International Settlements REER database. A higher (lower) REER means a currency appreciation (depreciation).

A.3 Emerging Markets Bond Index

we use EMBI Global published by J.P. Morgan as a proxy variable to measure EMEs' country credit spread. The original series is in daily frequency, hence we compute the quarterly average.

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[17]This is equivalent to estimate the following equation:

$$y_t = \alpha + \beta t + \gamma t^2 + \varepsilon_t$$

and take ε_t as the corresponding cyclical component of the series.

A.4 U.S. Corporate Bond Spread

we use the Baa corporate bond spread published by Moody's as an indicator to measure EMEs' global financial conditions. we downloaded the data from the FRED of Saint Louis. The original series is in daily frequency, hence we compute the quarterly average. we consider the series between 1990:Q1-2021:Q1.

A.5 Real Global GDP

we use the quarterly real global GDP to measure the state of the global economy. we downloaded the data from Oxford Economics through Datastream.

A.6 Current Account

The current account excludes exceptional financing. we seasonally adjust the original series using ARIMA X12. Then, as they are expressed in U.S. dollar values, we convert them to local currency values using the U.S. dollar nominal exchange rate. Finally, we compute the series as a share of nominal GDP. we downloaded all series from the International Financial Statistics database, published by the International Monetary Fund.

A.7 Net International Investment Position

The NIIP is computed as the difference between a country's international assets and liabilities. As series are expressed in U.S. dollar values, we convert them to local currency values using the U.S. dollar nominal exchange rate. we downloaded all series from the International Financial Statistics database, published by the International Monetary Fund.

A.8 Sudden Stop Events

Table A.2 displays the *Sudden Stops* episodes identified in our sample. As explained in the draft, we define periods of *Sudden Stops* following Calvo, Izquierdo, and Mejía (2008) as periods when: i) there is at least one observation where the year-on-year decline in capital flows lies at least two standard deviations below its sample mean; this condition fulfills the 'unpredicted' prerequisite of a *Sudden Stop*, ii) the period of *Sudden Stop* phase ends when the annual change in capital flows surmounts one standard deviation below its sample mean. This commonly suggests persistence which is a common fact of *Sudden Stops*, iii) additionally, in order to ensure symmetry, the onset of a *Sudden Stop* phase is ascertained by the first time the annual change in capital flows drops one standard deviation below the mean. Both the first and second moments of the capital flow series are calculated each period using an expanding window with a minimum of 24 (months of) observations.

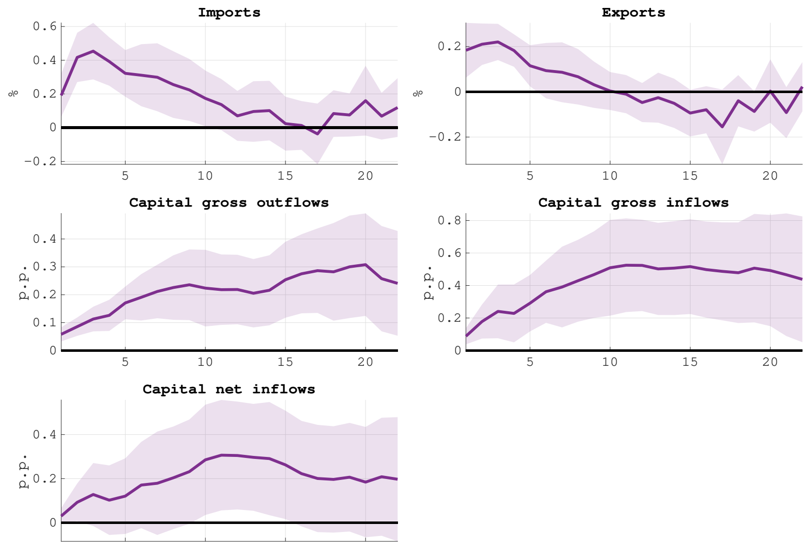
B Additional Empirical Results

B.1 Response of Additional Variables

B.2 Response under Fixed Exchange-Rates

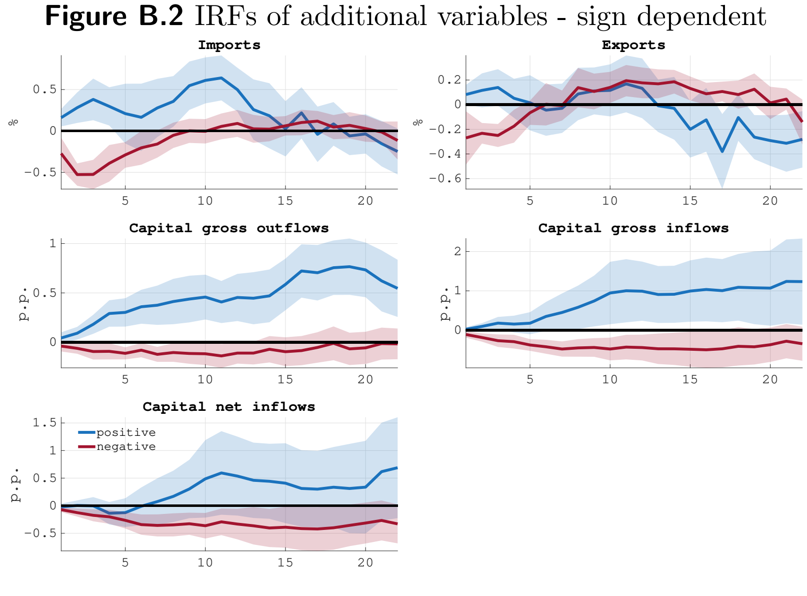
B.3 Alternative Specifications

Figure B.1 IRFs of additional variables - linear



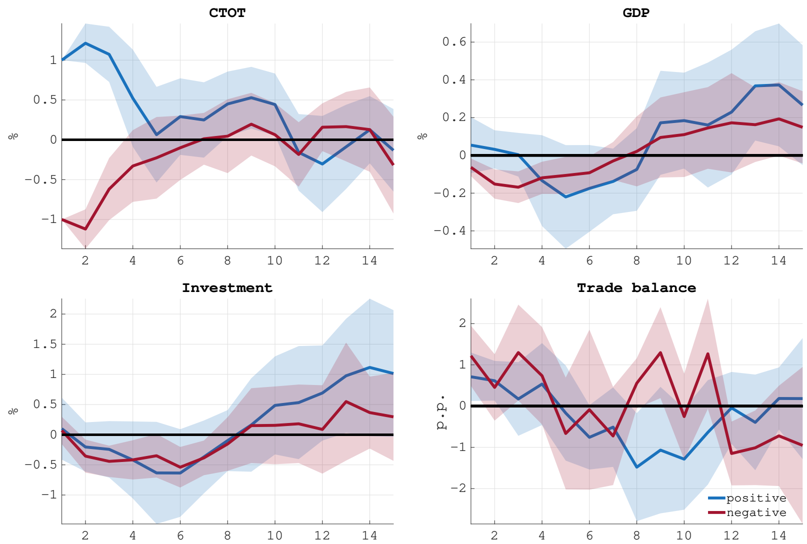
Note: Linear impulse response functions of exports, imports, gross capital outflows and inflows in response to a CTOT shock. The blue (red) line depicts a response conditional on a positive (negative) shock; the corresponding areas represents 90% confidence intervals. Horizon is in quarters.

Figure B.2 IRFs of additional variables - sign dependent



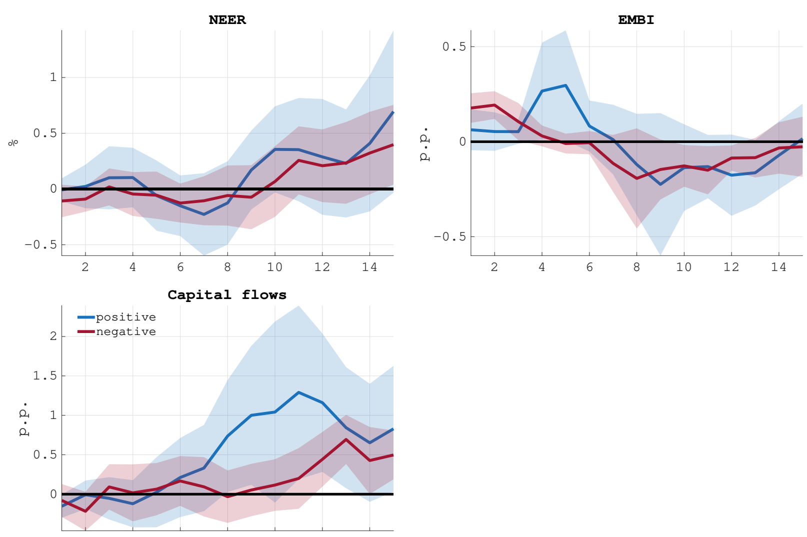
Note: Sign-dependent impulse response functions of exports, imports, gross capital outflows and inflows in response to a CTOT shock. The blue (red) line depicts a response conditional on a positive (negative) shock; the corresponding areas represents 90% confidence intervals. Horizon is in quarters.

Figure B.3 Sign-Dependent IRFs to CTOT shocks with fixed exchange rate regime - Macroeconomic Aggregates



Note: Estimated Sign-Dependent Impulse Response Functions (IRFs) of Commodity Terms of Trade (CTOT), GDP, Gross Fixed Capital Formation (Investment), and trade balance to output ratio computed using local projections defined in equation 1. Continuous blue (red) lines denote the median IRFs in response to a positive (negative) CTOT shock that induces a contemporaneous increase (decrease) of 1% in CTOT. Shaded areas denote 90% confidence bands based on Driscoll and Kraay standard errors. Horizon is in quarters.

Figure B.4 Sign-Dependent IRFs to CTOT shocks with fixed exchange rate regime - Exchange Rate and Financial Channel



Note: Estimated Sign-Dependent Impulse Response Functions (IRFs) defined in equation 1. Continuous blue (red) lines denote the median IRFs in response to a positive (negative) CTOT shock that induces a contemporaneous increase (decrease) of 1% in CTOT. Shaded areas denote 90% confidence bands based on Driscoll and Kraay standard errors. Horizon is in quarters.

Table A.2 List of Sudden Stop Episodes

Country	**Begins**	**Ends**
Argentina	2018m9	2020m8
Brazil	1999m1	1999m8
Brazil	2008m7	2009m7
Bulgaria	2005m6	2006m5
Bulgaria	2008m9	2009m9
Bulgaria	2021m8	2022m2
Chile	2006m8	2007m12
Chile	2020m5	2021m3
Chile	2022m5	2022m11
Indonesia	2008m6	2009m2
Indonesia	2011m9	2012m8
Indonesia	2021m7	2022m11
Malaysia	2005m11	2006m10
Malaysia	2008m9	2009m8
Mexico	2009m3	2009m12
Mexico	2015m6	2016m3
Mexico	2019m11	2021m7
Peru	2006m1	2006m7
Peru	2008m10	2009m10
Peru	2013m9	2014m10
Poland	1999m3	2000m9
Poland	2008m11	2009m9
Poland	2012m2	2012m8
Romania	2003m5	2004m3
Romania	2005m12	2006m9
Romania	2008m8	2009m8
Romania	2012m1	2012m8
South Africa	2010m8	2011m9
South Africa	2020m9	2021m10
Ukraine	2009m7	2010m8
Ukraine	2014m4	2015m9

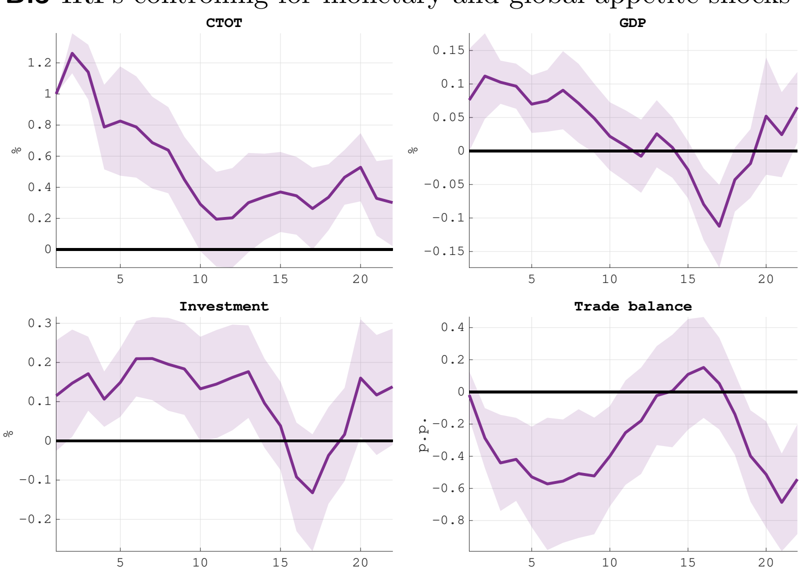
NOTE. NOTE. Episodes of Systemic *Sudden Stops* in our baseline sample. These episodes are defined following the definition of Calvo, Izquierdo, and Mejía (2008).

Table A.3 Time fixed regimes by country and time

Country	Begins	Ends
Argentina	1993q1	2001q4
Argentina	2003q1	2015q3
Brazil	1994q3	1998q4
Bulgaria	1997q1	2019q4
Indonesia	1993q1	1997q2
Indonesia	2007q3	2019q4
Malaysia	1993q1	1997q2
Malaysia	1998q4	2005q2
Mexico	1993q1	1994q4
Peru	1994q1	2002q4
Peru	2012q3	2019q4
Romania	2001q2	2004q2
Romania	2006q3	2019q4
Ukraine	1999q4	2013q4

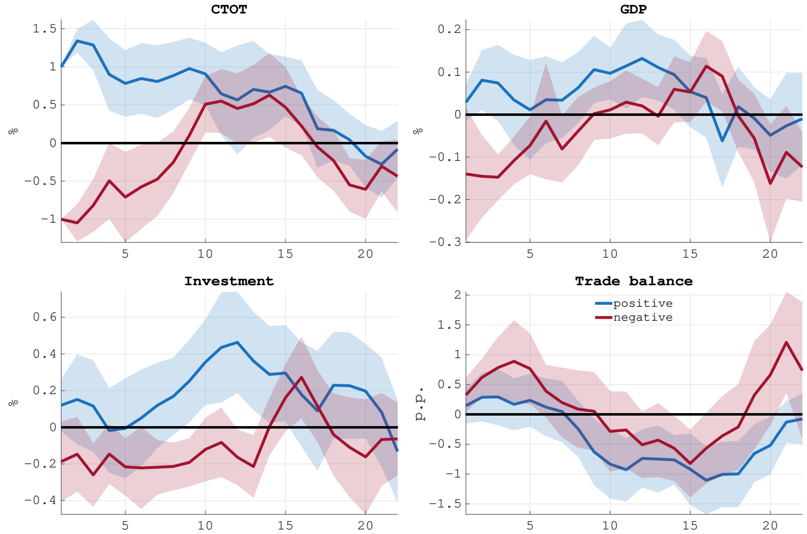
Note. Note. Periods of fixed exchange rate regime by country in our baseline sample. We classify countries following the exchange rate classification of Ilzetzki, Reinhart, and Rogoff (2019). In particular, we use their fine classification and define countries with currency boards or crawling peg regimes within a corridor smaller or equal than 2 percent as countries with fixed exchange rate regime.This corresponds to all the countries that belong to categories from 1 to 8 in the classification. For our analysis, we consider the exchange rate regime of each period (i.e. we allow countries to shift regimes in our sample).

Figure B.5 IRFs controlling for monetary and global appetite shocks - linear



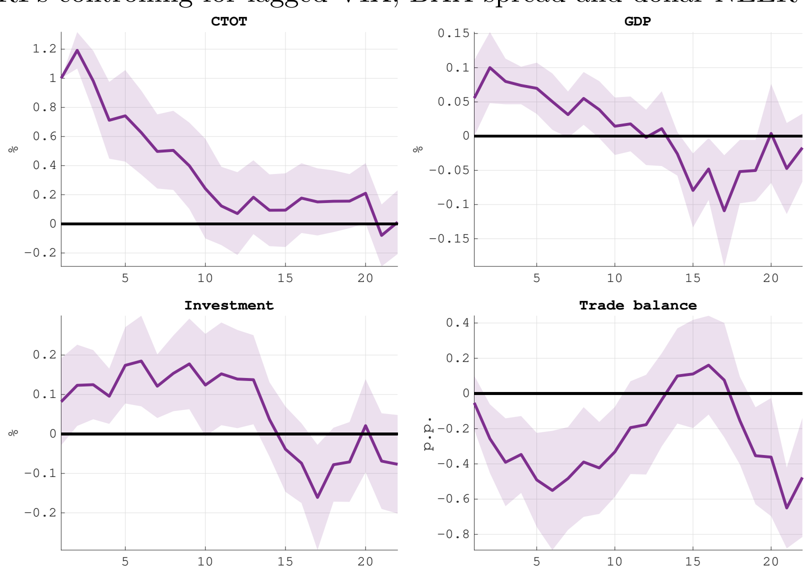
Note: Linear impulse response functions in response to a CTOT shock. The areas represent 90% confidence intervals. Horizon is in quarters.

Figure B.6 IRFs controlling for monetary and global appetite shocks - sign dependent



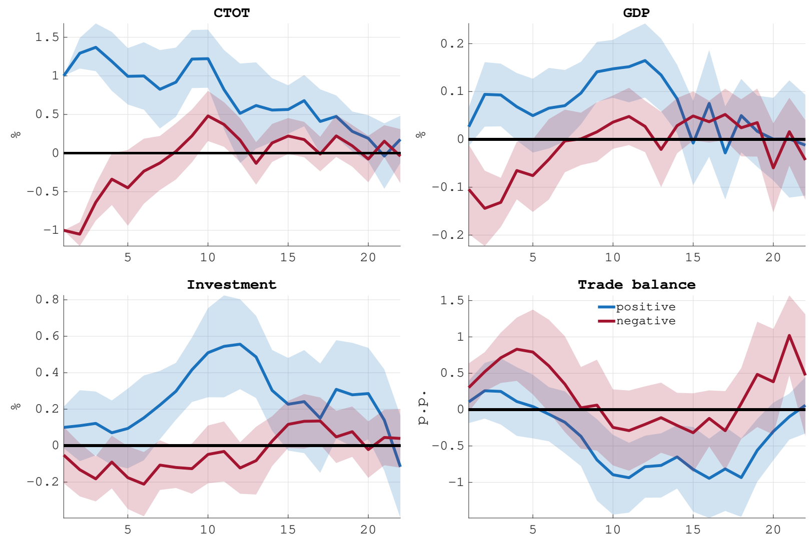
Note: Sign-dependent impulse response functions of in response to a CTOT shock. The blue (red) line depicts a response conditional on a positive (negative) shock; the corresponding areas represent 90% confidence intervals. Horizon is in quarters.

Figure B.7 IRFs controlling for lagged VIX, BAA spread and dollar NEER index - linear



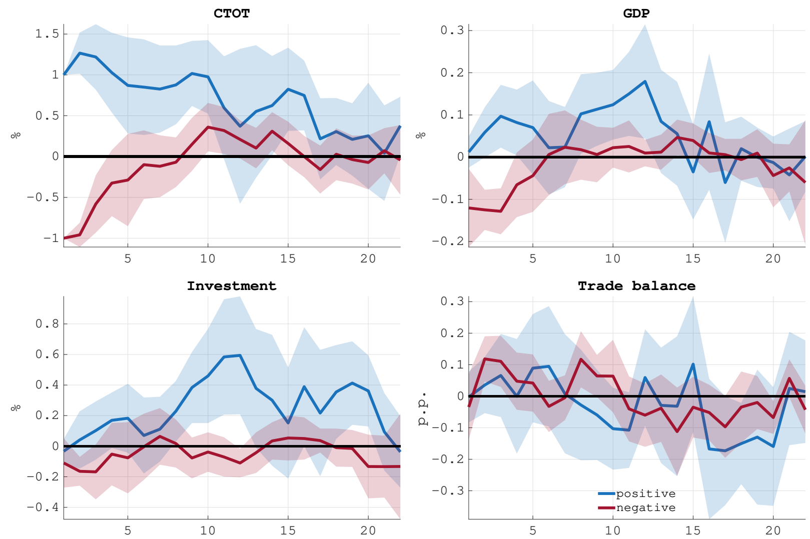
Note: Linear IRFs Horizon is in quarters.

Figure B.8 IRFs controlling for lagged VIX, BAA spread and dollar NEER index - sign dependent



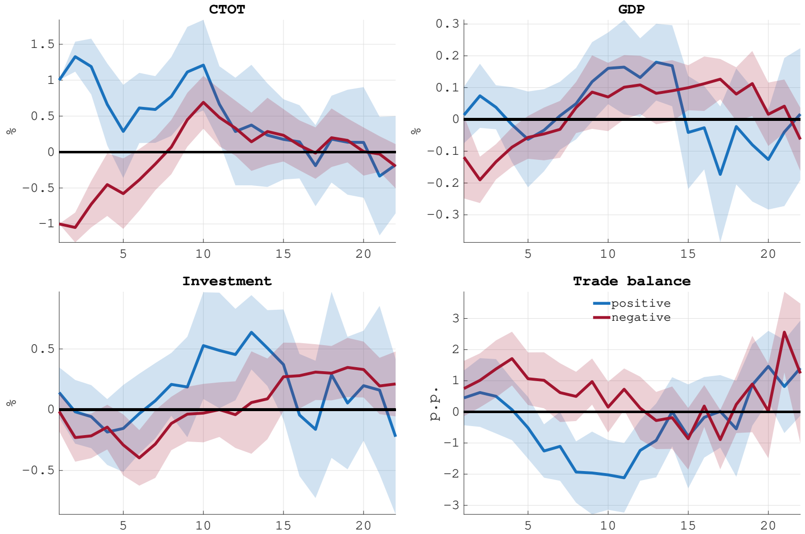
Note: The blue (red) line depicts a response conditional on a positive (negative) shock; the corresponding areas represents 90% confidence intervals. Horizon is in quarters.

Figure B.9 IRFs for Latam countries - sign dependent



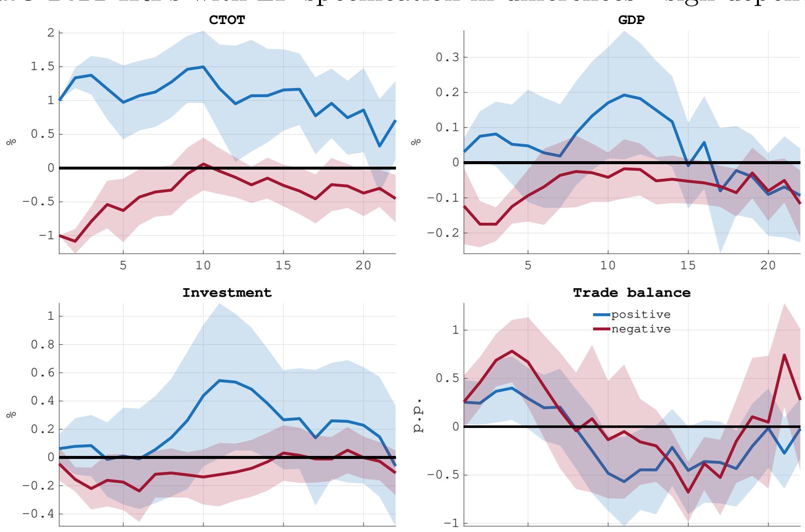
Note: The blue (red) line depicts a response conditional on a positive (negative) shock; the corresponding areas represents 90% confidence intervals. Horizon is in quarters.

Figure B.10 IRFs for non-Latam countries - sign dependent



Note: The blue (red) line depicts a response conditional on a positive (negative) shock; the corresponding areas represents 90% confidence intervals. Horizon is in quarters.

Figure B.11 IRFs with LP specification in differences - sign dependent

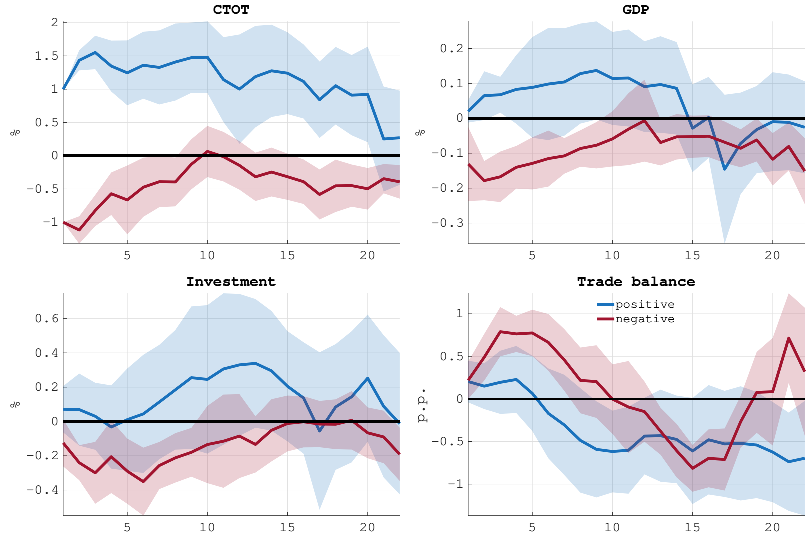


Note: The blue (red) line depicts a response conditional on a positive (negative) shock; the corresponding areas represents 90% confidence intervals. Horizon is in quarters.

Figure B.12 IRFs with LP specification in differences - sign dependent

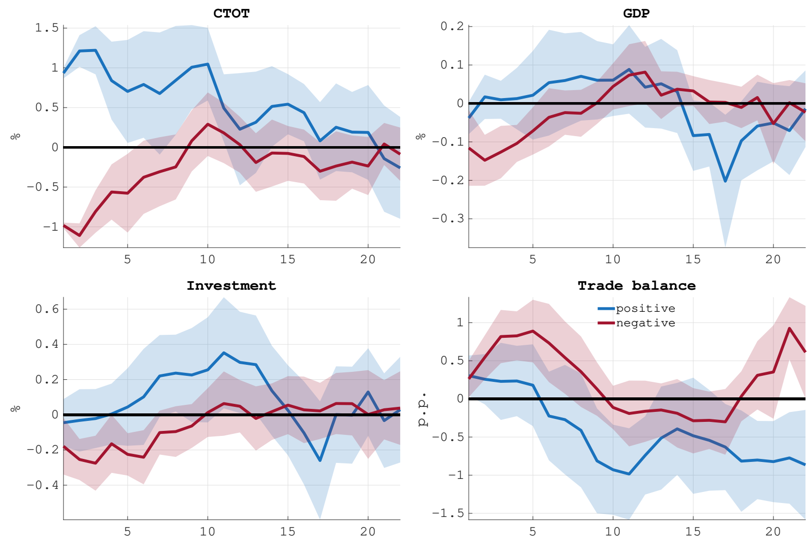
Note: The blue (red) line depicts a response conditional on a positive (negative) shock; the corresponding areas represents 90% confidence intervals. Horizon is in quarters.

Figure B.13 IRFs with LP specified as in Eq.(5) - CTOT in growth rates - sign dependent



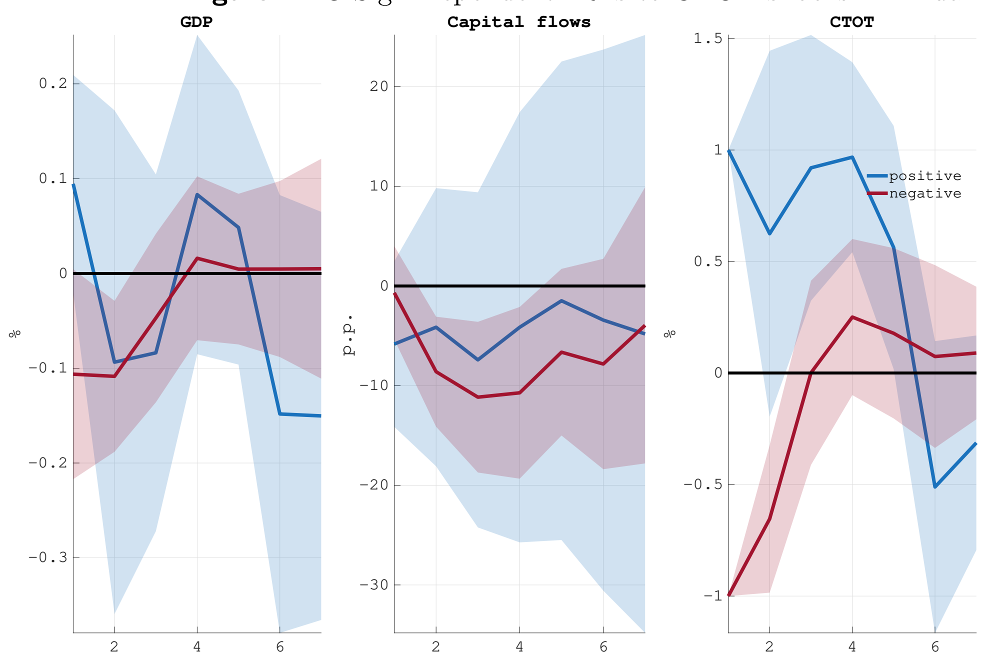
Note: The blue (red) line depicts a response conditional on a positive (negative) shock; the corresponding areas represents 90% confidence intervals. Horizon is in quarters.

Figure B.14 IRFs with LP specified as in Eq.(5) - CTOT shocks from AR process - sign dependent



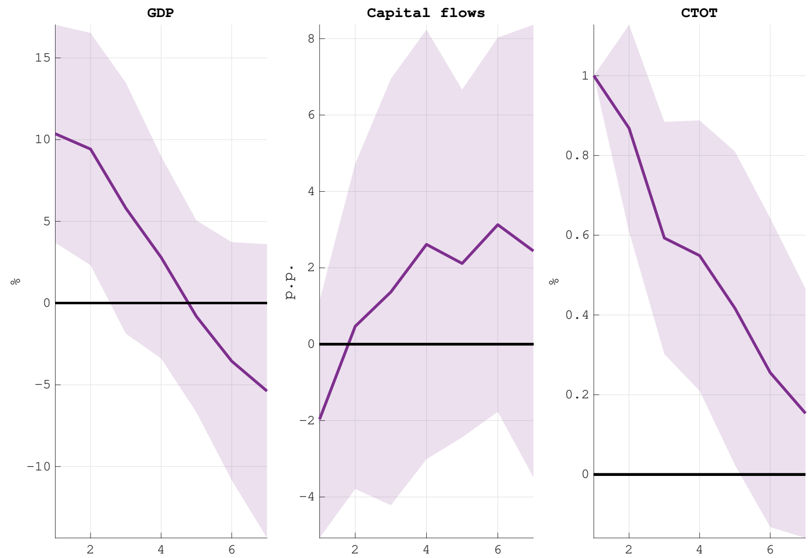
Note: The blue (red) line depicts a response conditional on a positive (negative) shock; the corresponding areas represents 90% confidence intervals. Horizon is in quarters.

Figure B.15 Sign Dependent IRFs to CTOT shocks - Annual Data



Note: Estimated Sign Dependent Impulse Response Functions (IRFs) of GDP (GDP), Net Capital Flows (Capital Flows), and Commodity Terms of Trade (CTOT) computed using local projections defined in equation 1 but estimated with annual data. Continuous purple lines denote the median IRFs in response to a CTOT shock that induces a contemporaneous increase of 1% in CTOT. Shaded areas denote 90% confidence bands based on Driscoll and Kraay standard errors. Horizon is in quarters.

Figure B.16 IRFs using annual CTOT - linear



Note: Linear impulse response functions of GDP, capital flows and CTOT in response to a CTOT shock.