The Asymmetric Effects of Commodity Price Shocks in Emerging Economies☆

Andrea Gazzani[†] Vicente Herrera[‡] Alejandro Vicondoa[§]

August 15, 2024

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 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. These empirical findings have important implications for the design of optimal policies in EMEs.

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

JEL Codes: F41, F44.

☆We thank Piergiorgio Alessandri, Regis Barnichon, Nadav Ben Zeev, Fabio Canova, Ambrogio Cesa-Bianchi, Fabrizio Ferriani, Lutz Kilian, David Kohn, Luciana Juvenal, Ivan Petrella, Morten Ravn, Marco Taboga, Javier Turén, Giovanni Veronese, Joaquin Vial, and seminar participants at the Bank of Italy, Birkbeck College, Pontificia Universidad Catolica de Chile, Queen Mary University, and Workshop in Empirical Macroeconomics 2024 for useful comments and suggestions. The views expressed in the paper are those of the authors only and do not involve the responsibility of the Bank of Italy.

[†]Bank of Italy. Email: andreagiovanni.gazzani@bancaditalia.it.

[‡]SQM and Pontificia Universidad Católica de Chile. Email: vgherrera@uc.cl.

[§]Instituto de Economía, Pontificia Universidad Católica de Chile. Email: alejandro.vicondoa@uc.cl.

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 mostly analyzed how plain fluctuations in terms of trade affect EMEs business cycle. However, recent contributions have undertaken a deeper characterization of the effects of different types of terms of trade shocks. Di Pace et al. (2023) show that EMEs and developing economies respond asymmetrically to changes in export and import prices; the former ones turn out to be more important than the latter. Juvenal and Petrella (2024) focus instead on the origins of commodity price fluctuations and show that their effect is heterogeneous depending on whether the underlying source is a commodity-specific shock or a global financial shock.[3]

This paper extends such a line of research by estimating the sign-dependent effects of commodity price shocks on EMEs. Figure 1 (middle and 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

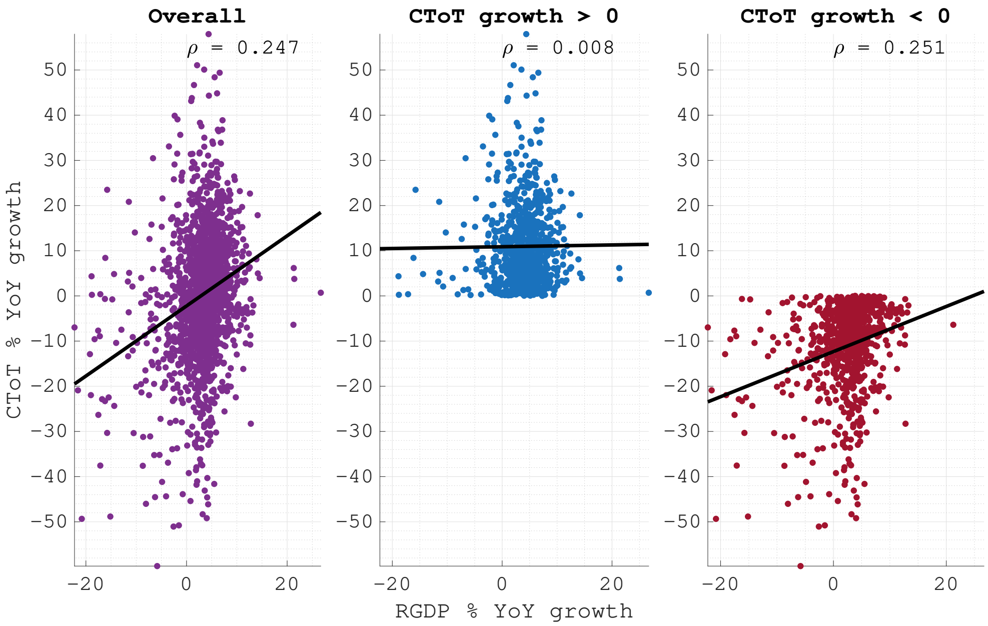
[1]See, for example, Shousha (2016); Ben Zeev et al. (2017); Schmitt-Grohé and Uribe (2018); Fernández et al. (2018); Drechsel and Tenreyro (2018); Fernández et al. (2023); Di Pace et al. (2023); Juvenal and Petrella (2024).

[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 et al. (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.

[3]Charnavoki and Dolado (2014) analyze the effects of different types of CTOT shocks in Canada, a small open Advanced Economy. They also find that the origin of the shock matters for understanding the effects.

is statistically equal to the one presented in the left panel. In other words, the overall (unconditional) correlation between these variables is exclusively driven by negative growth rate of CTOT.

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. Section 3.1 describes the countries included in the analysis, sample selection criteria, and the definition of the variables used for the analysis.*

To test for the potentially asymmetric effects of CTOT shocks, we estimate a non-linear local projections model using 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 ones, whose transmission is more gradual. While the immediate response of the trade balance-to-output ratio to positive shocks is not significant, negative shocks induce an improvement in this variable. There results are robust to three different identification strategies for CTOT shocks: *i)* in a plain baseline, we directly employ the fluctuations in CTOT; *ii)* in a first robustness exercise, we purge fluctuations in CTOT from the global financial (and real) cycles; iii) in a second robustness exercise, we identify CTOT shocks exploiting an instrument for commodity-specific shocks (Juvenal and Petrella, 2024).

Three main mechanisms could explain, in theory, the differential response of macroeconomic aggregates to commodity price shocks. 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 goods. 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. Third, the asymmetric response of macroeconomic variables could be explained by the pro-cyclicality of fiscal policy in EMEs (see, for example, Kaminsky et al., 2004).

We assess the relevance of these 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. We also exclude that the asymmetry generated by this financial channel is due to US monetary policy and uncertainty shocks, which are considered the main drivers of the Global Financial Cycle (Rey, 2013). Additionally, we show that negative CTOT shocks increase the probability of *Sudden Stop* episodes. Second, we show that countries with flexible and fixed exchange rate regimes display comparable impulse responses. Third, we show that the response of fiscal policy does not explain the asymmetric response of macroeconomic variables. Thus, our analysis suggests that the financial channel is the main driver of the sign-dependent asymmetric response of EMEs to CTOT shocks. Our empirical findings can inform the design of optimal policies in commodity-exporting EMEs (and developing countries).

Relationship with the literature. 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 et al., 2018; Ben Zeev et al., 2017; Di Pace et al., 2023). Previous works have used small open economy models to characterize the effects of CTOT shocks in EMEs (see, for example, Kohn et al., 2021). A strand of the literature assumes that the 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 et al., 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 type of models used to analyze CTOT shocks in EMEs and also for the design of optimal policies in these economies.

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.[4]

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 et al. (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

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

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 et al. (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.

Structure of the paper. 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 analyzes the role of financial frictions and exchange rate regime in explaining the asymmetric responses. Section 5 presents several robustness exercises. Finally, Section 6 concludes.

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 et al., 2017). We also define commodity price shocks as the changes in commodity prices that are orthogonal to past values of CTOT in our baseline specification. 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 et al., 2017), iii) to allow for differential persistence of positive and negative CTOT shocks.[5]

Juvenal and Petrella (2024) show that fluctuations in commodity prices may be due to CTOT shocks (source of business cycle fluctuations) and also to financial shocks (amplification). They exploit a series of events related to commodity markets as a source of exogenous variation in CTOT. In Section 3.4 we exploit the same set of events to estimate the asymmetric effects of CTOT shocks and we find consistent effects relative to our baseline specification.

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. Our specification follows Caravello and Martinez-Bruera (2024) who suggest using piece-wise linear methods, albeit shocks are not observed ex-ante in our analysis. As the sign asymmetry might be plagued by size non-linearity, we run a battery of tests suggested in Gonçalves et al. (2021) and Caravello and Martinez-Bruera (2024) that do not diagnostic a contamination of our results

[5]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.

by spurious factors.

The baseline non-linear local projection 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, $y_{j,t+h} - y_{j,t-1}$ denotes the cumulative change in the variable of interest h periods ahead, $I_{j,t}$ 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 et al., 2017).[6]

The outcome variables we use to estimate Eq.(1) are output, investment-to-output ratio, real exchange rate, net capital flows, and the country-specific J.P. Morgan Emerging

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

Markets Bond Index (henceforth, EMBI) as a proxy for country credit spread. EMBI is an essential country-specific variable for our analysis since it allows us to explore the financial frictions channels (see Section 4.1). This set of variables, denoted by x, is 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 global shocks and conditions in driving the results. Section 3.4 displays the estimated effects using the series of events proposed by Juvenal and Petrella (2024) as an IV. Finally, Section 3.5 presents the estimated linear effects and compares them with those of previous works.

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 J.P. Morgan Emerging Market Bond Index (EMBI); iv) the availability of capital flows data.[7] 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

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

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, Brazil, Bulgaria, Chile, Colombia, Indonesia, Malaysia, Mexico, Peru, Poland, Romania, South Africa, and Ukraine. Table A.1 presented in the Appendix displays the time span for each country included in our sample. Table A.2 presented in the Appendix describes the relevance of commodity exports out of total exports for each country together with the main commodities exported.

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.[8] This index is a fixed weighted price average $\omega_{j,i}$ of commodity i for country j's and $P_{t,i}$ is the commodity i's price at time t. The weights are calculated, similar to Shousha (2016) and Fernández et al. (2018), as the ratio of country j's commodity i exports to total commodity exports over several decades. The original series are available at monthly frequency, hence we compute the quarterly average. The denominator is the U.S. Producer Price index (PPIACO from FRED) computed by the U.S. Bureau of Labor Statistics, which we use as a proxy for global manufacturing prices.

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

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

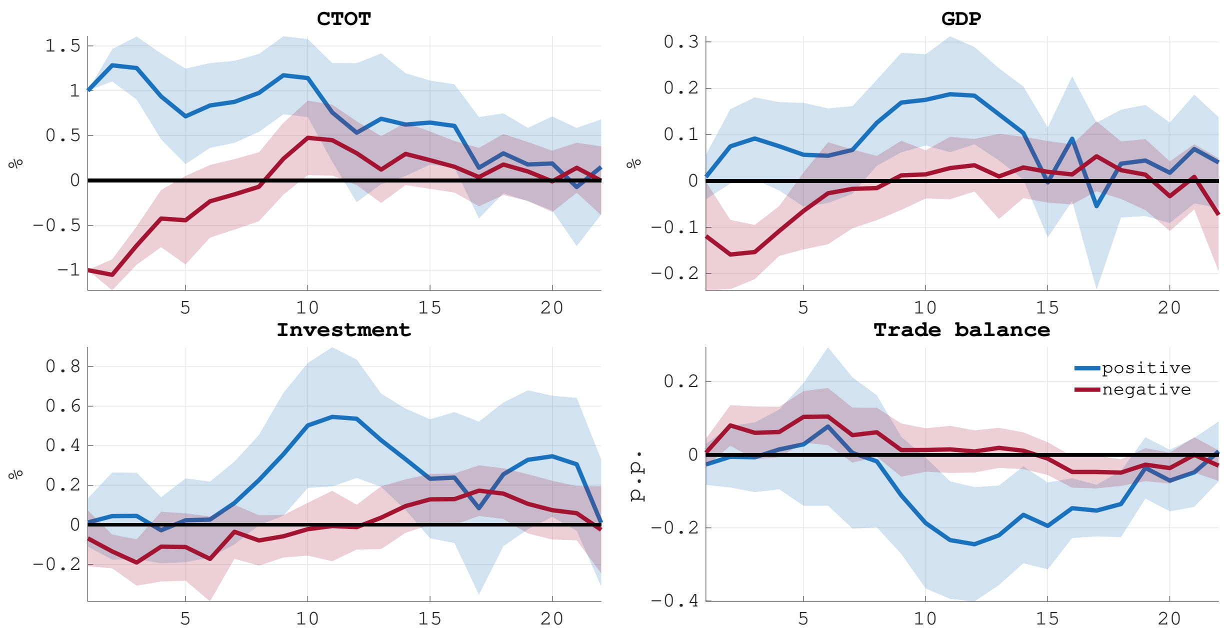
(reversing the sign of the latter). We apply both the Kolmogorov-Smirnov test over the two sub-samples and cannot reject they are drawn from the same distribution (p-value = 0.7, KS-stat = 0.3) and the triples test developed by Randles et al. (1980) that fail to reject the asymmetry (p-value = 0.4). This result holds both for the CTOT growth rates and also for the residuals from an estimated AR(4) process of the CTOT. Furthermore, in Section 5 we report two exercises that do not diagnostic a strong contamination of our asymmetric results by spurious factors such as the size asymmetries. In particular, we estimate size-asymmetric responses following Caravello and Martinez-Bruera (2024) that display a strong homogeneity and correct the LP estimates, as suggested by Gonçalves et al. (2021), obtaining very similar results to our baseline.

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 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.[9]

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 fast 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 after 10 quarters. Finally, the trade balance-to-output ratio improves by almost 1 percentage point

[9] Fernández et al. (2023) 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 (Trade balance) 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.

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 Accounting for Global Financial Conditions

The *Global Financial Cycle* (GFC) may potentially affect CTOT as documented in Juvenal and Petrella (2024). Rey (2013) and Rey (2015) describe the GFC as the comovement of asset prices worldwide. US monetary policy and the global risk appetite of investors are key drivers of the GFC (see, for example, Bruno and Shin, 2015; Avdjiev et al., 2022; Miranda-Agrippino and Rey, 2020).

In light of the potential relevance of the financial conditions in driving the asymmetric effect of CTOT (see Section 4.1), in this section we aim at ruling out that our findings are driven by an underlying financial shock. Specifically, following Juvenal and Petrella (2024), 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.6 and B.7 presented in the Appendix display the IRFs. The responses remain unaffected to controlling for these shocks, suggesting that US monetary shocks and uncertainty shocks are not the drivers of the asymmetric responses.

The main conclusions of our analysis remain unchanged if we estimate Eq.(1) with a CTOT series that is orthogonal to the VIX (Figures B.8 and B.9) or to the the global real cycle proxied by world trade (Figures B.10 and B.11).[10]

3.4 Instrumenting CTOT with Commodity Specific Shocks

Commodity prices comove with the Global Financial Cycle. Thus, the identified series of CTOT shocks may be mixing CTOT with other shocks that influence the financial cycle, different from US monetary or uncertainty shocks. Juvenal and Petrella (2024) identify major episodes specific to commodity markets and exploit them to build an instrument (IV) for commodity-specific shocks.

Although we cannot use their IV directly because our sample is at the quarterly frequency (instead of annual) and our CTOT measure is computed using fixed weights (instead of rolling weights), we build upon their narrative events to create a country-specific IV within our framework. We assume that the events that affected a commodity market in a given year affect that commodity for all quarters in that year. Following Juvenal and Petrella (2024), the IV takes the value of 1(-1) if the shock induces a positive (negative) effect on that commodity price. Then, we compute a country-specific IV using the weights

[10] The same conclusions hold if we orthogonalize CTOT by the VIX or world trade both in a preliminary stage and separaterly for each country or if we include these controls directly in the LP estimations.

from the CTOT series. Finally, we use these series as IVs in our non-linear LP setup.[11] Albeit the IV estimates are by construction less precise than those from a one-step procedure, we obtain an asymmetry in line with our baseline specification (Figures B.12-B.13 in the Appendix). If anything, the asymmetry is even amplified by the IV approach as positive CTOT shocks affect macroeconomic aggregates with more delay. Overall, the baseline results are robust to this alternative identification strategy.

3.5 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 et al., 2018; Ben Zeev et al., 2017; Fernández et al., 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:

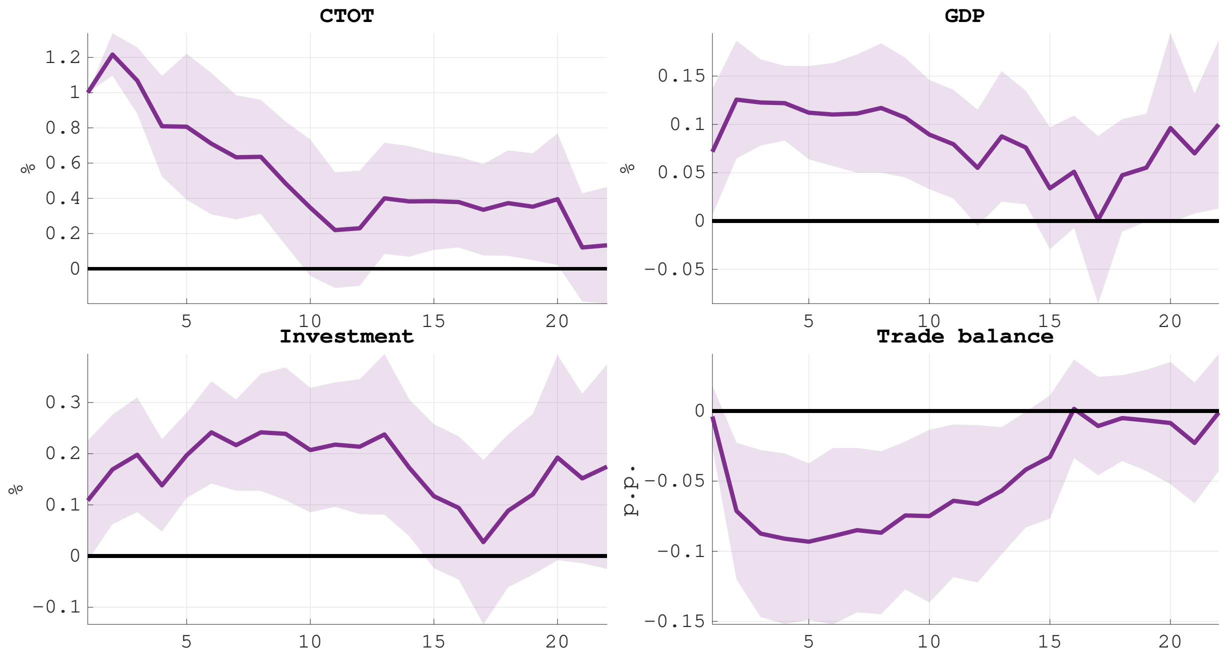
$$y_{j,t+h} - y_{j,t-1} = \tau_h T + \alpha_{h,j,t} + \sum_{z=0}^{4} \phi_h^z \mathrm{CTOT}_{j,t-z} + \Gamma_h(L) y_{j,t-1} + \Xi_h(L) x_{j,t-1} + u_{j,t+h} \quad \forall \quad 0 \leq h \leq 20 \quad (3)$$

where the variables and controls are exactly the same as in Eq.(1). Figures 3 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 et al., 2017; Fernández et al., 2017; Drechsel and Tenreyro, 2018). The response of trade balance-to-output ratio 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

[11] In particular, following Wooldridge (2010) we employ the IV that takes positive (negative) values for the CTOT growth rate that in the positive (negative) domain.

Figure 3 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 3. 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 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.

4 Understanding the Source of Asymmetry

This section explores the role of different propagation mechanisms that could explain the heterogeneous responses to positive and negative CTOT shocks. Section 4.1 assesses the role of the financial channel in explaining the estimated asymmetries. Section 4.2 explicitly analyzes the asymmetric relationship between CTOT and Sudden Stops. Section 4.3 and Section 4.4 considers two alternative source of asymmetry: the role of exchange rate regimes and the role of fiscal policy.

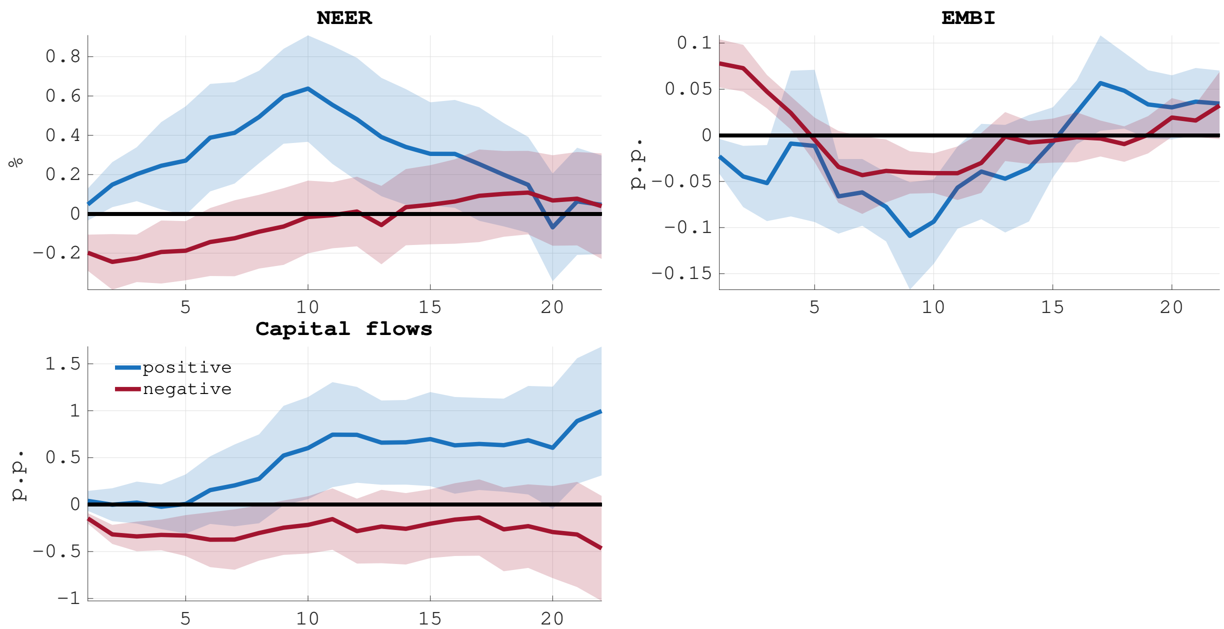
4.1 The Role of Financial Frictions and Capital Flows

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 et al., 2018). Based on the negative relation between emerging economies' country credit spread and the terms of trade (see for example, Hilscher and Nosbusch, 2010; Byrne et al., 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 assess if they are important in explaining the asymmetric response of macroeconomic variables. Figure 4 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 almost do not react.[12] 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.3 included in the Appendix). Thus, the decrease in CTOT induces a significant tightening if the credit

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

Figure 4 Sign-Dependent IRFs to CTOT shocks - Exchange Rate and Financial Channel



Note: Estimated Sign-Dependent Impulse Response Functions (IRFs) of nominal exchange rate (NEER), J.P. 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.

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 incorporates a Fisherian endogenous collateral constraint that limits the amount of debt that the economy can issue to a fraction of the physical capital held by the economy. 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 income 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 sharp reduction in capital flows coupled with the increase in sovereign spread and the improvement in the trade balance-to-output ratio in response to a fall in CTOT are consistent with the effects described in this model. We also observe a strong and persistent depreciation of the nominal exchange rate (NEER in Figure 4) which is consistent with the real depreciation of the domestic currency.

4.2 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 which are consistent, at least qualitatevely, with a *Sudden Stop*. 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 et al. (2008).[13] Table A.3 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 of a *Sudden Stop* episode. 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 displayed in Figure 4 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.

Finally, we model the probability of occurrence of a *Sudden Stop* as a function of positive

[13]In particular, we compute the monthly proxy of capital flows as defined Calvo et al. (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.3 included in the Appendix displays the *Sudden Stop* events of the sample.

Table 1 CTOT shocks and *Sudden Stops*

Dependent variable: Probability of a Sudden Stop			
	(1) LPM-FE	(2) Logit-FE	(3) Logit-RE
CTOT positive	0.119	2.159	2.064
	(0.148)	(6.944)	(6.260)
CTOT negative	-0.351***	-5.729*	-6.206**
	(0.119)	(3.088)	(2.978)
Constant	0.001		-5.443***
	(0.012)		(0.693)
Macro-financial controls	✓	✓	✓
Observations	925	808	925
Countries	13	10	13

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 et al. (2008). CTOT enters as the growth rates with its own lags as controls. In column (1), a linear probability model with FE is estimated by OLS. Columns (2) and (3) report the results from a logit model with FE and RE, respectively. All specification include the same macro-financial controls as eq.(1).

and negative CTOT shocks using Eq.(4):

$$ss_{j,t} = \alpha + \beta CTOT^{p}_{j,t} + \gamma CTOT^{n}_{j,t} + \delta X_{j,t} + u_{j,t} \tag{4}$$

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).

Table 1 report the results from a linear probability model (LPM), estimated with fixed effects by OLS, since we are interested in the average marginal effects (column 1). Column (2-3) display instead the estiamates from a logit with fixed and random effects, respectively. Additionally, Table B.1 reports similar results obtained when CTOT shocks are extracted from an AR(4) process.

The results indicate that negative shocks to CTOT increase the probability of occurrence of a *Sudden Stop* while the positive shocks' influence is faint and less precisely estimated. Both using CTOT as an AR(4) residuals or in growth rates suggest that negative CTOT shocks increase the probability of a Sudden Stop while positive shocks do not have any effect. Quantitatively, a 1% decline in CTOT leads to an increase in the probability of a *Sudden Stop* equal to about 0.3 percentage points.[14]

4.3 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 a fixed exchange rate regime (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 decreases through 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 stemming 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.In line with this exposition, Broda (2004) estimates the effects of terms of trade shocks on developing economies, without focusing on the sign of the shock. He 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.

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

[14]If we convert the estimates from the logit models in terms of the average marginal effects, we obtain an effect equal to 0.049 percentage points.

that have a flexible and fixed exchange rate. We classify countries following the exchange rate classification of Ilzetzki et al. (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.4 in the Appendix).[15] If the asymmetry is explained by the exchange rate regime, economies with flexible exchange rate will not display any asymmetry in response to CTOT shocks.

Figures 5-6 show the estimates for flexible exchange rate regimes. Figures B.4-B.5 included in the Appendix report the estimates for fixed exchange rate regime.[16] The responses of macroeconomic and financial variables under a flexible exchange rate regime are not statistically different from the ones presented in Figures 2 and 4. These results confirms that the estimated asymmetry is not explained by countries that have a fixed exchange rate regime.

4.4 The Role Fiscal of Policy

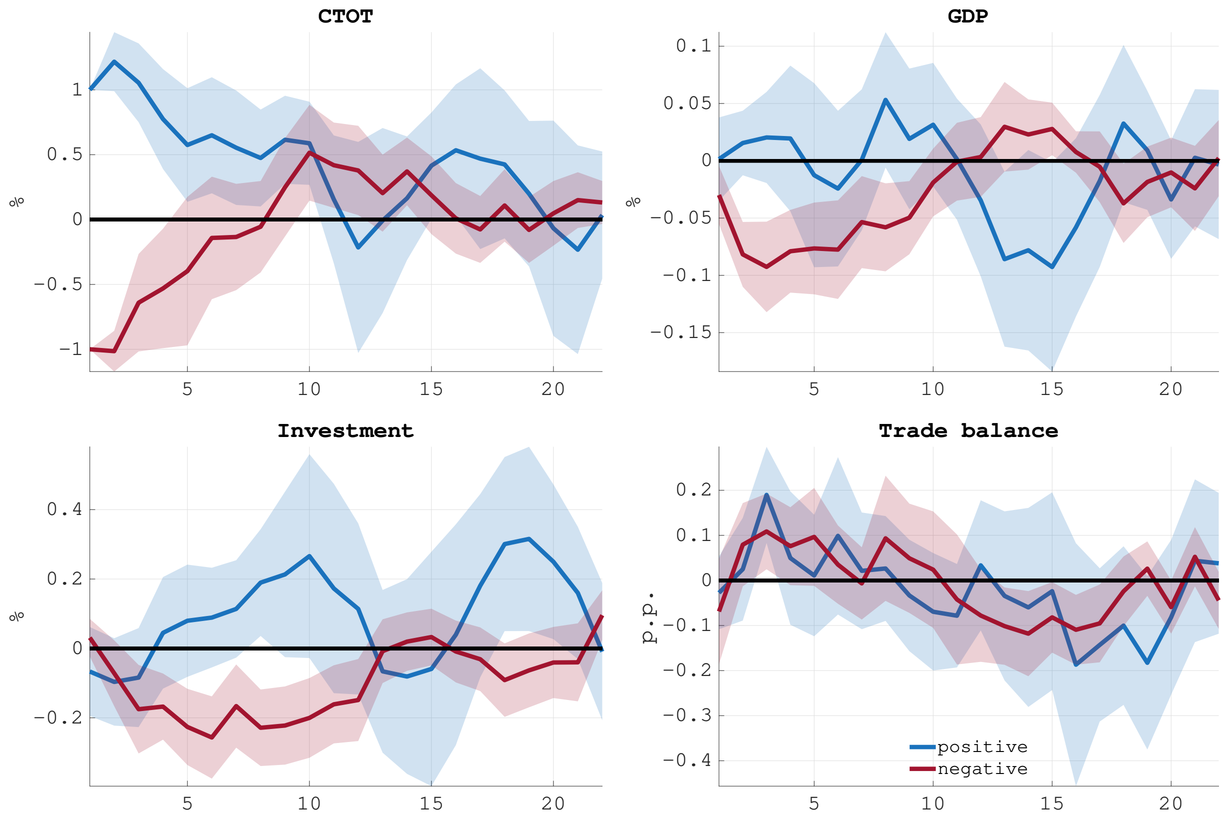
The asymmetric macroeconomic responses of EMEs' business cycles to CTOT shocks could also stem from the fiscal policy response that is typically regarded as pro-cyclical (see, for example, Kaminsky et al., 2004; Vegh and Vuletin, 2015). A pro-cyclical fiscal policy could amplify the recessionary effect of a negative CTOT shock and create or reinforce the asymmetry that we have documented. However, recently Di Pace et al. (2024) have documented that, within a linear framework, the pro-cyclicality of fiscal policy in EMEs (and developing economics) holds unconditionally but not in response to a CTOT shock. After a CTOT shock fiscal policy actually proves to be counter-cyclical.

In order to evaluate the role of fiscal policy in explaining the asymmetric response

[15] 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).

[16] 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.

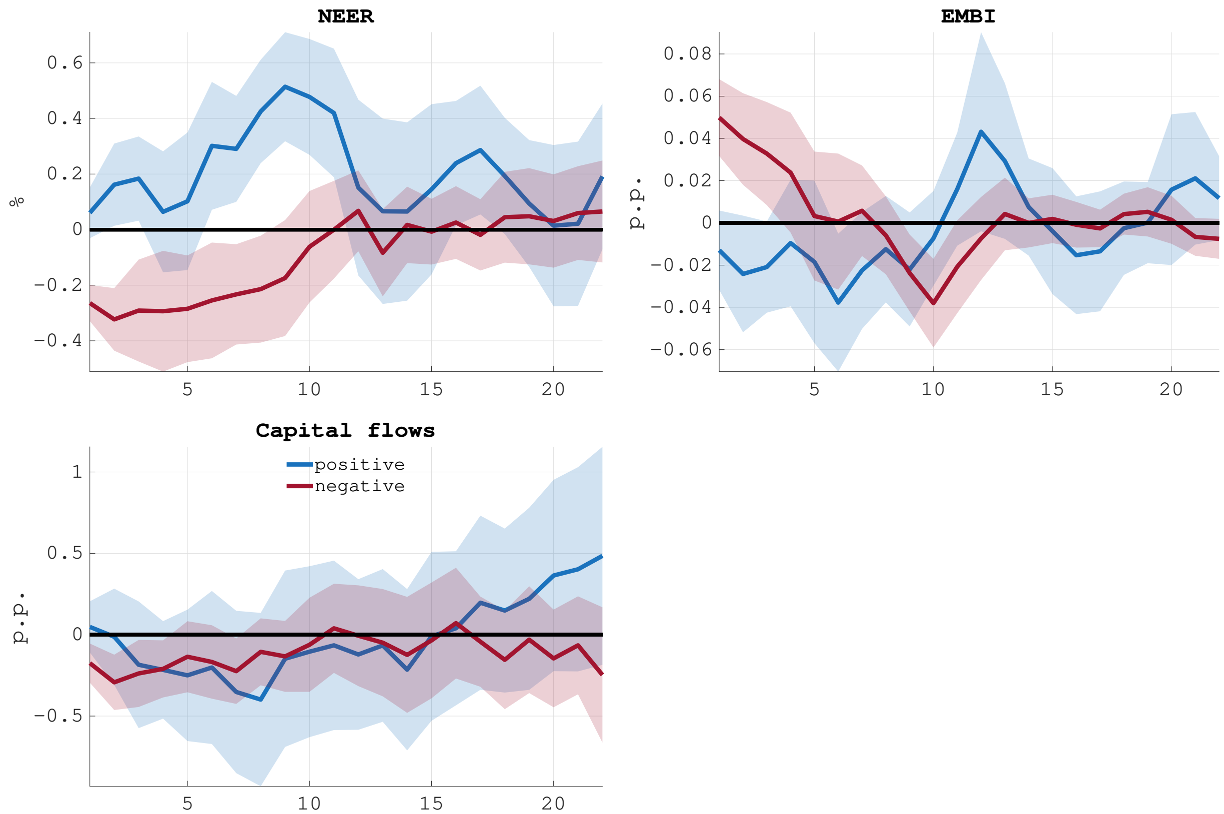
Figure 5 Sign-Dependent IRFs to CTOT shocks with flexible exchange rate regime - Macroeconomic Aggregates



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 (Trade balance) 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.

of EMEs to CTOT shocks, we estimate Equation (1) adding a fiscal deficit/GDP as a dependent variable and considering its lagged values as a control. Figures 7-8 show the response to a CTOT shock in this enlarged specification. The responses of macroeconomic and financial variables is very similar to the baseline, suggesting that fiscal policy is not the source of the asymmetry. Moreover, the response of fiscal deficit is consistent with the results in Di Pace et al. (2024) on the counter-cyclicality of fiscal policy after a CTOT shock (see also Figure B.14 included in the Appendix for the linear case; deficit improves after a CTOT shock).

Figure 6 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.

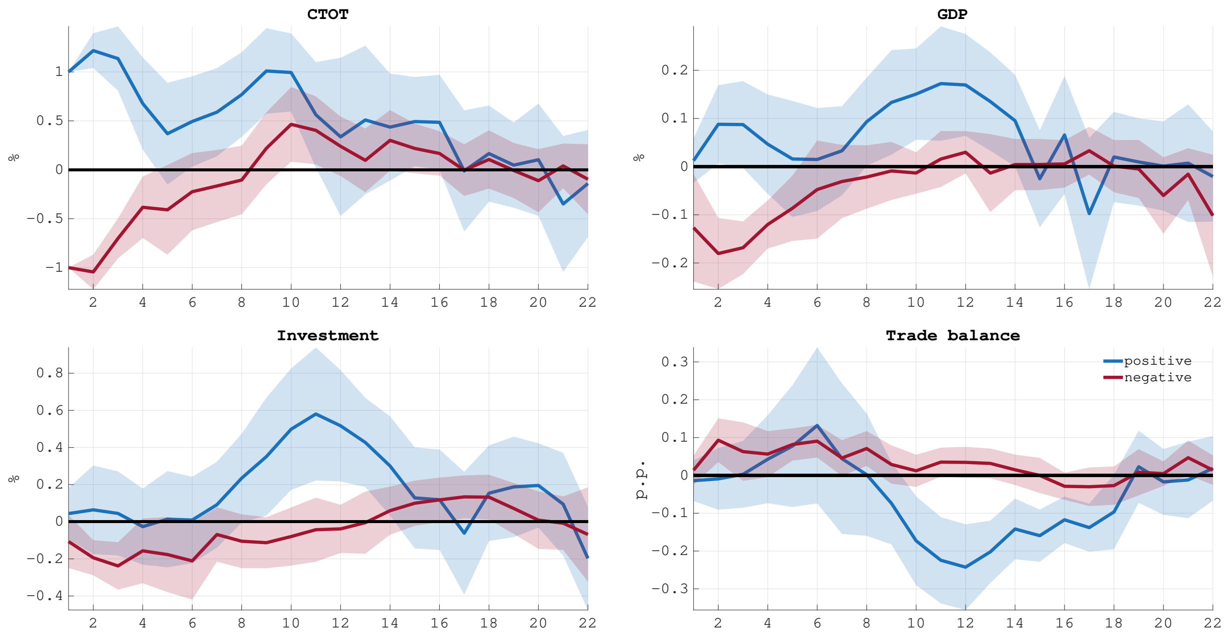
5 Robustness and Additional Results

In this section, we consider alternative specifications to assess the robustness of our findings. For ease of exposition, the impulse responses are included in Appendix B.5, and here we only summarize the exercises together with their main results.

5.1 Estimation Country by Country

Canova (2024) documents that if the units of a panel are dynamically heterogeneous, the local projection estimator is inconsistent. To investigate whether this issue may plague our

Figure 7 Sign-Dependent IRFs to CTOT shocks controlling for fiscal deficit - Macroeconomic aggregates

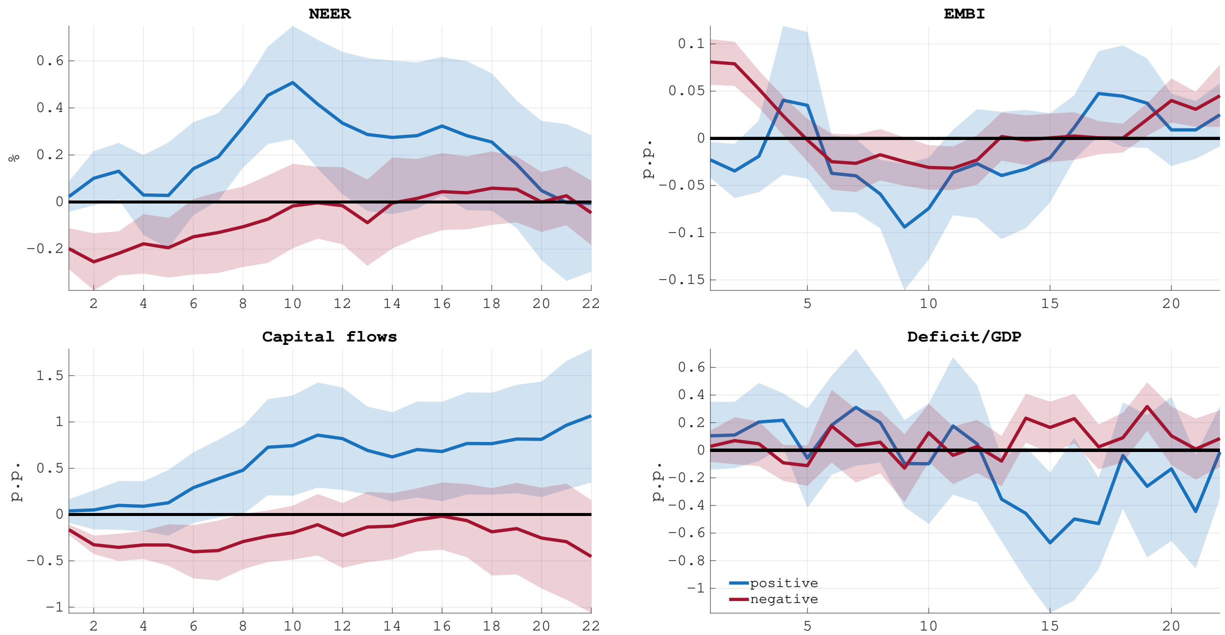


Note: Estimated Sign-Dependent Impulse Response Functions (IRFs) of Commodity Terms of Trade (CTOT), GDP, Gross Fixed Capital Formation (Investment), and trade balance to output ratio computed using local projections defined in equation 1. Continuous blue (red) lines denote the median IRFs in response 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.

results, we employ an average time series estimator (Pesaran, 2006; Canova, 2024). We estimate the local projection equation (1) separately for each country.[17] Then, we build a weighted average of the IRFs where the weights are proportional to the precision of the IRFs for each country as typically done in meta-analsyis (see, for example, Ben Zeev et al., 2017). Results reported in Figure B.15 and B.16 are qualitative similar to our baseline pooled estimator, thus suggesting that the countries are sufficiently homogeneous in a dynamic sense.

[17] We rely on a bivariate specification in this case that includes CTOT and the endogenous variable of interest.

Figure 8 Sign-Dependent IRFs to CTOT shocks controlling for fiscal deficit - Additional variables



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.

5.2 Estimation with Annual Data

Previous works have estimated the effects of CTOT shocks using annual data (see, for example, Fernández et al., 2017; Schmitt-Grohé and Uribe, 2018; Drechsel and Tenreyro, 2018; Di Pace et al., 2023). 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. 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. Instead of using our baseline measure of CTOT, we rely on the country-specific CTOT index computed by Di Pace et al. (2023). Figure B.25 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.

5.3 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, 2024) 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.19 included in the Appendix).

Shocks from an 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. This specification follows closely Barnichon et al. (2022) and Caravello and Martinez-Bruera (2024) as in this case shocks are assumed to be observed. Figure B.20 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.

Sign dependent regressors. We employ another alternative specification where only our regressor of interest (CTOT) enters as sign dependent, whereas the set of controls is common. Results from this specification, either with CTOT in growth rates (Figure B.23) or as an AR(4) process (Figure B.24) yield comparable results to the baseline.

Sign versus size asymmetry. Following Caravello and Martinez-Bruera (2024), we compute the size-asymmetric response of our variable of interest to large versus small CTOT shocks to gauge whether the sign asymmetry may be contaminated by the size of the shocks in the positive and negative domain. We define large shocks as the CTOT growth rates belonging to the first, second, nine and tenth quantile of their distribution. The remaining shocks are labeled as small. Results in Figure B.27-B.28 display a high degree of homogeneity suggesting that the evidence of size asymmetry is indeed mild. Figures B.29-B.30 display the same results using CTOT shocks as residuals from AR(4) processes that lead to similar conclusions.

Correction for LP estimation. The asymmetry in the response to CTOT shocks remains strong and similar to the baseline even if we apply the correction method for local projections proposed in Gonçalves et al. (2021) (Figures B.21-B.22). See Alessandri et al. (2023) for a detailed description of the procedure in a similar setup to ours.

6 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, at least qualitatively, with a *Sudden Stop*. The exchange rate regime and the fiscal response do 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 et al., 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 and sovereign wealth funds related to commodity prices could allow exporters to accumulate a precautionary buffer during booms to smooth the impact of the busts (Eyraud et al., 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.

References

Alessandri, P., Jordà, Ò., and Venditti, F. (2023). Decomposing the monetary policy multiplier. Federal Reserve Bank of San Francisco.

Alvarez, J., Andaloussi, M., Maggi, C., Sollaci, A., Stuermer, M., and Topalova, P. B. (2023). Geoeconomic fragmentation and commodity markets.

Auerbach, A. J. and Gorodnichenko, Y. (2013). Fiscal multipliers in recession and expansion. *University of Chicago Press*.

Avdjiev, S., Hardy, B., Kalemli-Özcan, Ş., and Servén, L. (2022). Gross capital flows by banks, corporates, and sovereigns. *Journal of the European Economic Association*, 20(5):2098–2135.

Barnichon, R., Debortoli, D., and Matthes, C. (2022). Understanding the size of the government spending multiplier: It's in the sign. *The Review of Economic Studies*, 89(1):87–117.

Ben Zeev, N. (2019). Asymmetric business cycles in emerging market economies.

Ben Zeev, N., Pappa, E., and Vicondoa, A. (2017). Emerging economies business cycles: The role of commodity terms of trade news. *Journal of International Economics*, 108:368–376.

Bianchi, J. (2011). Overborrowing and systemic externalities in the business cycle. *American Economic Review*, 101(7):3400–3426.

Broda, C. (2004). Terms of trade and exchange rate regimes in developing countries. *Journal of International Economics*, 63(1):31–58.

Bruno, V. and Shin, H. S. (2015). Cross-border banking and global liquidity. *The Review of Economic Studies*, 82(2):535–564.

Byrne, J. P., Fazio, G., and Fiess, N. (2013). Primary commodity prices: Co-movements, common factors and fundamentals. *Journal of Development Economics*, 101:16–26.

Calvo, G. A., Izquierdo, A., and Mejía, L.-F. (2008). Systemic sudden stops: The relevance of balance-sheet effects and financial integration. Working Paper 14026, National Bureau of Economic Research.

Canova, F. (2024). Should we trust cross-sectional multiplier estimates? *Journal of Applied Econometrics*, 39(4):589–606.

Caravello, T. E. and Martinez-Bruera, P. (2024). Disentangling sign and size non-linearities.

Céspedes, L. F. and Velasco, A. (2012). Macroeconomic performance during commodity price booms and busts. *IMF Economic Review*, 60(4):570–599.

Charnavoki, V. and Dolado, J. J. (2014). The effects of global shocks on small commodity-exporting economies: Lessons from canada. *American Economic Journal: Macroeconomics*, 6(2):207–37.

Di Pace, F., Juvenal, L., and Petrella, I. (2023). Terms-of-trade shocks are not all alike. *CEPR Discussion Paper No. DP14594*.

Di Pace, F., Juvenal, L., and Petrella, I. (2024). Commodity prices and fiscal (pro)cyclicality. *Mimeo*.

Drechsel, T. and Tenreyro, S. (2018). Commodity booms and busts in emerging economies. *Journal of International Economics*, 112:200–218.

Edwards, S. and Levy-Yeyati, E. (2005). Flexible exchange rates as shock absorbers. *European Economic Review*, 49(8):2079–2105.

Eyraud, L., Gbohoui, W., and Medas, P. A. (2023). A new fiscal framework for resource-rich countries.

Fernández, A., González, A., and Rodriguez, D. (2018). Sharing a ride on the commodities roller coaster: Common factors in business cycles of emerging economies. *Journal of International Economics*, 111:99–121.

Fernández, A., Schmitt-Grohé, S., and Uribe, M. (2017). World shocks, world prices, and business cycles: An empirical investigation. *Journal of International Economics*, 108:S2–S14.

Fernández, A., Schmitt-Grohé, S., and Uribe, M. (2023). Does the commodity super cycle matter? In Aguirre, A., Fernández, A., and Kalemli-Ozcan, S., editors, *Credibility of Emerging Markets, Foreign Investors Risk Perceptions, and Capital Flows*, pages 205–247. Central Bank of Chile.

Gonçalves, S., Herrera, A. M., Kilian, L., and Pesavento, E. (2021). Impulse response analysis for structural dynamic models with nonlinear regressors. *Journal of Econometrics*, 225(1):107–130. Themed Issue: Vector Autoregressions.

Gruss, B. and Kebhaj, S. (2019). Commodity terms of trade: A new database. *IMF*.

Hilscher, J. and Nosbusch, Y. (2010). Determinants of sovereign risk: Macroeconomic fundamentals and the pricing of sovereign debt. *Review of Finance*, 14(2):235–262.

Ilzetzki, E., Reinhart, C. M., and Rogoff, K. S. (2019). Exchange Arrangements Entering the Twenty-First Century: Which Anchor will Hold?*. *The Quarterly Journal of Economics*, 134(2):599–646.

Jarociński, M. and Karadi, P. (2020). Deconstructing monetary policy surprises—the role of information shocks. *American Economic Journal: Macroeconomics*, 12(2):1–43.

Juvenal, L. and Petrella, I. (2024). Unveiling the dance of commodity prices and the global financial cycle. *Journal of International Economics*, 150:103913.

Kaminsky, G. L., Reinhart, C. M., and Végh, C. A. (2004). When it rains, it pours: procyclical capital flows and macroeconomic policies. *NBER macroeconomics annual*, 19:11–53.

Kohn, D., Leibovici, F., and Tretvoll, H. (2021). Trade in commodities and business cycle volatility. *American Economic Journal: Macroeconomics*, 13(3):173–208.

Mendoza, E. G. (1991). Real business cycles in a small open economy. *The American Economic Review*, pages 797–818.

Mendoza, E. G. (1995). The terms of trade, the real exchange rate, and economic fluctuations. *International Economic Review*, pages 101–137.

Mendoza, E. G. (2010). Sudden stops, financial crises, and leverage. *American Economic Review*, 100(5):1941–66.

Miranda-Agrippino, S. and Rey, H. (2020). U.S. Monetary Policy and the Global Financial Cycle. *The Review of Economic Studies*, 87(6):2754–2776.

Pesaran, M. H. (2006). Estimation and inference in large heterogeneous panels with a multifactor error structure. *Econometrica*, 74(4):967–1012.

Piffer, M. and Podstawski, M. (2018). Identifying uncertainty shocks using the price of gold. *The Economic Journal*, 128(616):3266–3284.

Randles, R. H., Fligner, M. A., Policello, G. E., and Wolfe, D. A. (1980). An asymptotically distribution-free test for symmetry versus asymmetry. *Journal of the American Statistical Association*, 75(369):168–172.

Rey, H. (2013). Dilemma not trilemma: the global cycle and monetary policy independence. *Proceedings - Economic Policy Symposium - Jackson Hole*.

Rey, H. (2015). Dilemma not trilemma: The global financial cycle and monetary policy independence. Working Paper 21162, National Bureau of Economic Research.

Schmitt-Grohé, S. and Uribe, M. (2013). Downward nominal wage rigidity and the case for temporary inflation in the Eurozone. *Journal of Economic Perspectives*, 27(3):193–212.

Schmitt-Grohé, S. and Uribe, M. (2016). Downward nominal wage rigidity, currency pegs, and involuntary unemployment. *Journal of Political Economy*, 124(5):1466–1514.

Schmitt-Grohé, S. and Uribe, M. (2018). How important are terms of trade shocks? *International Economic Review*, 59:85–111.

Sekine, A. and Tsuruga, T. (2018). Effects of commodity price shocks on inflation: a cross-country analysis. *Oxford Economic Papers*, 70(4):1108–1135.

Shousha, S. (2016). Macroeconomic effects of commodity booms and busts: The role of financial frictions. *Unpublished manuscript*.

Vegh, C. A. and Vuletin, G. (2015). How is tax policy conducted over the business cycle? *American Economic Journal: Economic Policy*, 7(3):327–370.

Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data*. MIT press.

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: EMEs considered in our baseline sample.

Table A.2 displays the share of commodity exports to total exports for each of these economies together with the main commodities exported by these economies, expressed as a share of total commodity exports.

Table A.2 Main Commodities Exported by Each EME

Country	Commodity Exports	Main Commmodities (% of commodity exports)
Argentina	14%	Soybean Meal (17%), Crude Oil (13%), Wheat (9%), Corn (9%)
Brazil	23%	Iron ore (19%), Coffee (12%), Soybean Meal (10%), Crude Oil (10%)
Bulgaria	26%	Crude Oil (30%), Copper (24%), Lamb (7%), Wheat (5%)
Chile	61%	Copper (67%), Fish (8%), Soft Logs (7%), Fish Meal (5%)
Colombia	51%	Crude Oil (39%), Coffee (31%), Coal (13%), Bananas (6%)
Indonesia	38%	Crude Oil (34%), Natural Gas (20%), Coal (8%), Palm Oil (8%)
Malaysia	18%	Crude Oil (32%), Palm Oil (19%), Natural Gas (15%), Rubber (8%)
Mexico	13%	Crude Oil (76%), Copper (4%), Coffee (3%), Gold (3%)
Peru	49%	Copper (25%), Gold (15%), Crude Oil (13%), Zinc (11%)
Poland	11%	Coal (32%), Copper (18%), Crude Oil (8%), Beef (7%)
Romania	13%	Crude Oil (45%), Aluminium (12%), Iron Ore (6%), Hard Sandwood (5%)
Ukraine	16%	Iron ore (22%), Crude Oil (15%), Sunflower Oil (10%), Wheat (9%)
South Africa	34%	Coal (27%), Iron Ore (12%), Crude Oil (8%), Aluminium (8%)

Note: Main commodity exported by each EME in the baseline sample 1995:Q1-2019:Q4. The second column displays the average % of commodity exports relative to total exports for this sample. The third column displays the four main commodities exported by each economy in this sample together with the % of exports this commodity to total commodity exports (median over the 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[18]. We removing this

[18]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.

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.

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.3 displays the *Sudden Stops* episodes identified in our sample. As explained in the draft, we define periods of *Sudden Stops* following Calvo et al. (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.

Table A.3 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 et al. (2008).

B Additional Empirical Results

B.1 Responses of Additional Variables - Linear Specification

Figure B.1 displays the IRFs of the exchange rate and financial variables to CTOT shocks.

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

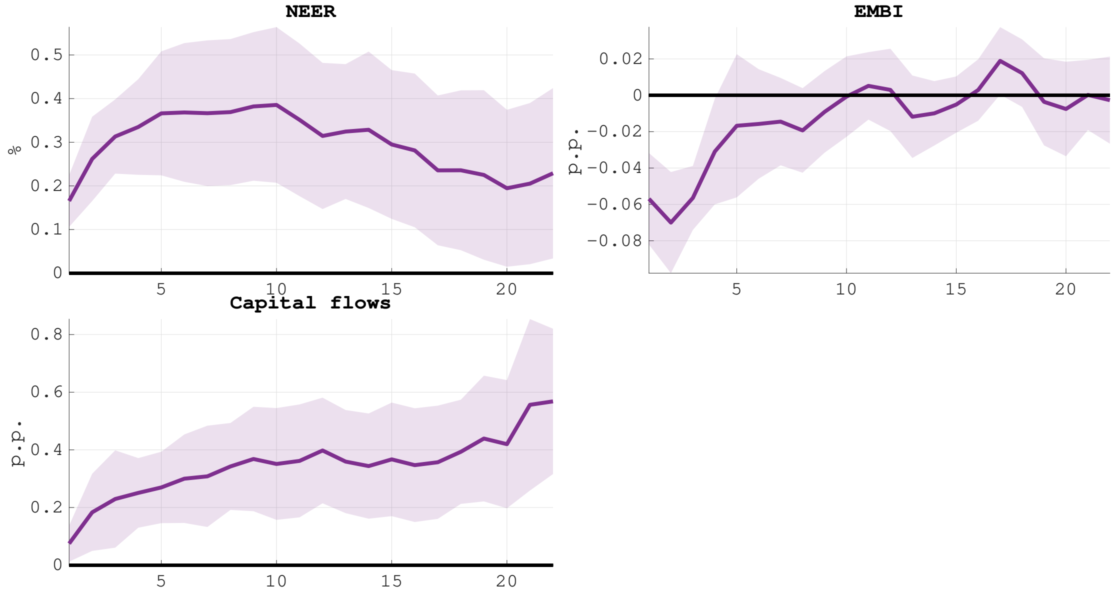
Table A.4 Time fixed regimes by country and time

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 et al. (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).

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.

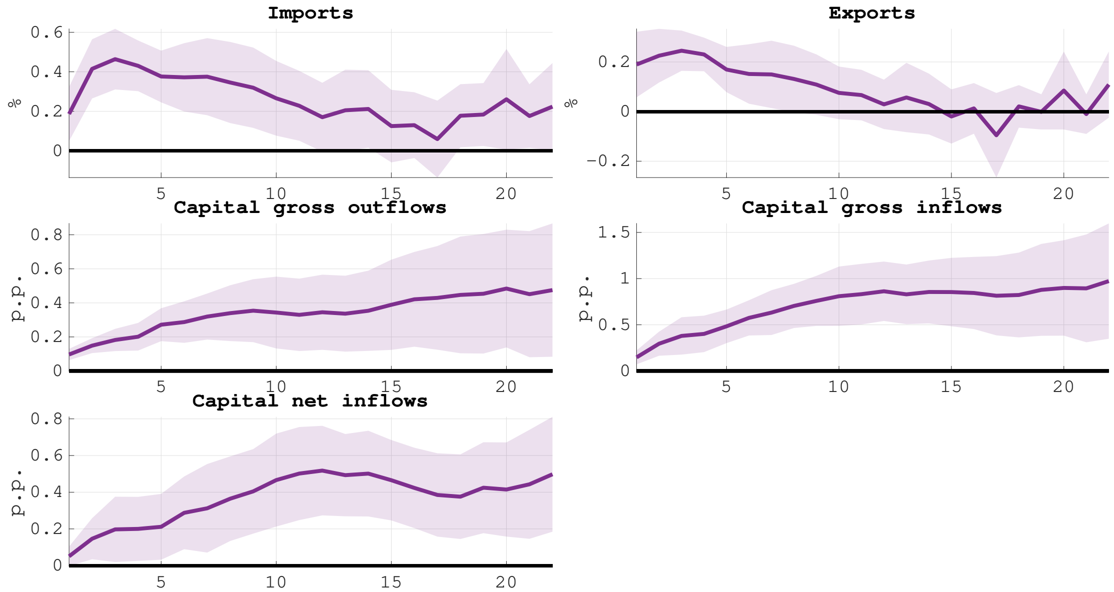
Figure B.1 Linear IRFs to CTOT shocks - Exchange Rate and Financial Channel



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 3. 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.

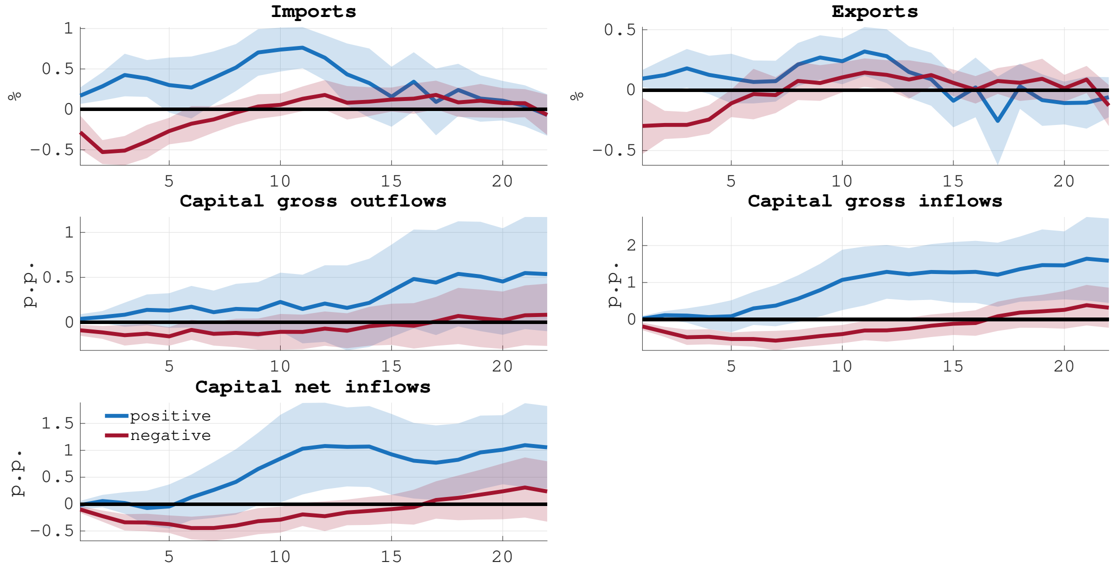
B.2 Response of Additional Variables

Figure B.2 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.3 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.

B.3 CTOT shocks from an AR(4) process and Sudden Stops

Table B.1 CTOT shocks and *Sudden Stops*

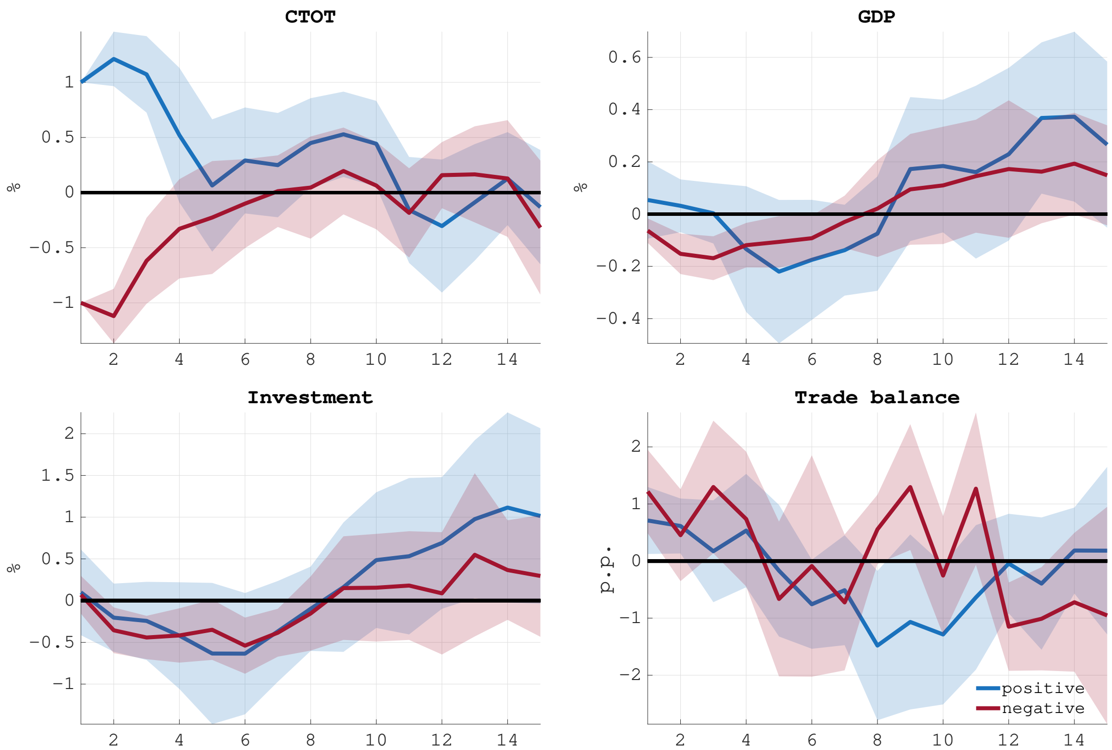
Dependent variable: Probability of a Sudden Stop			
	(1)	(2)	(3)
	LPM-FE	Logit-FE	Logit-RE
CTOT positive	0.170	4.723	5.033
	(0.156)	(6.338)	(5.884)
CTOT negative	-0.310**	-5.667*	-6.113**
	(0.127)	(3.439)	(3.405)
Constant	0.014		-5.064***
	(0.009)		(0.519)
Macro-financial controls	✓	✓	✓
Observations	925	808	925
Countries	13	10	13

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 et al. (2008). CTOT enters as the residuals from an AR(4) process. In column (1), a linear probability model with FE is estimated by OLS. Columns (2) and (3) report the results from a logit model with FE and RE, respectively. All specification include the same macro-financial controls as eq.(1).

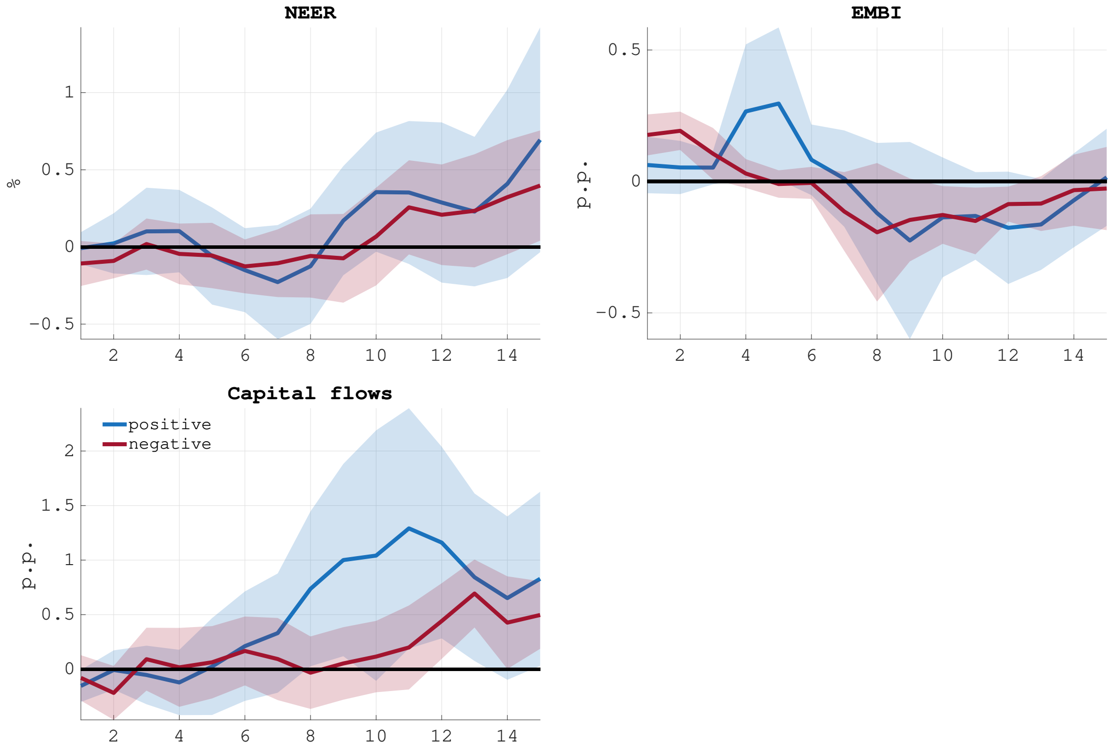
B.4 Response under Fixed Exchange-Rates

Figure B.4 Sign-Dependent IRFs to CTOT shocks with fixed exchange rate regime



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.

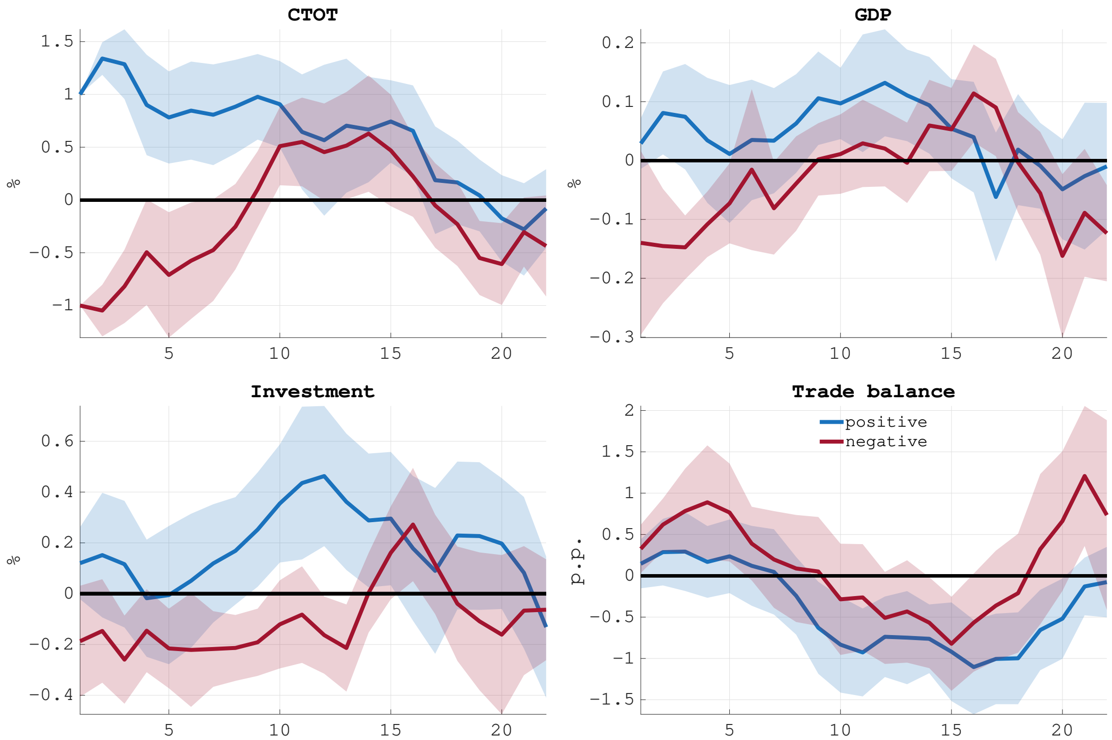
Figure B.5 Sign-Dependent IRFs to CTOT shocks with fixed exchange rate regime



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.

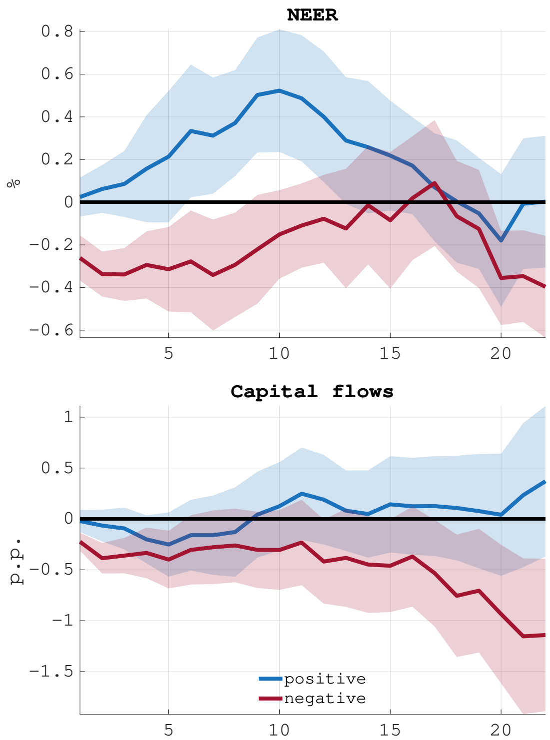
B.5 Alternative Specifications

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



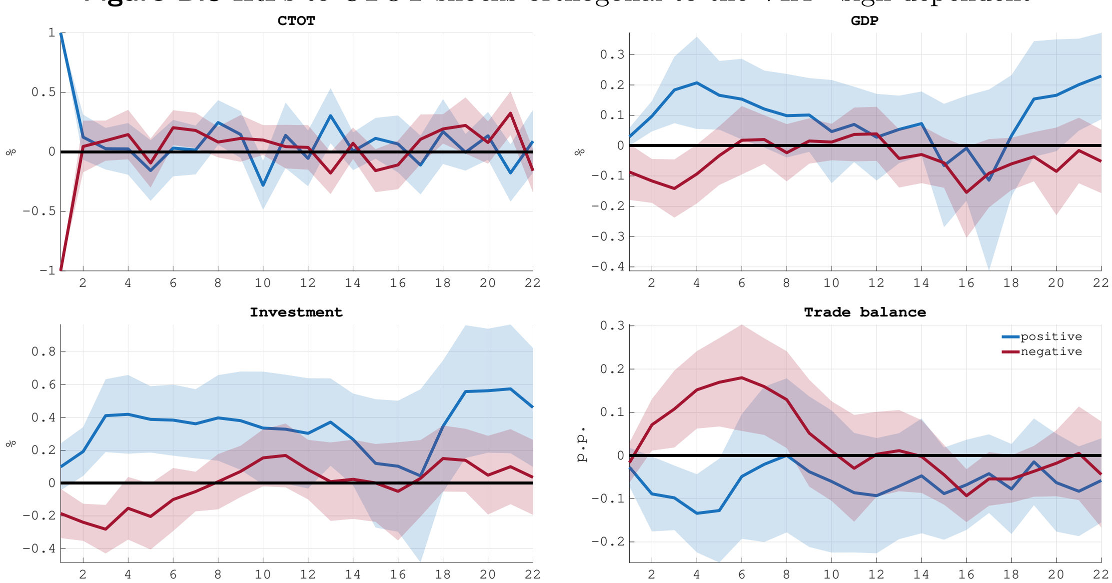
Note: Sign-dependent impulse response functions of in response to a CTOT shock. The blue (red) line depicts a response conditional on a positive (negative) shock; the corresponding areas represent 90% confidence intervals. Horizon is in quarters.

Figure B.7 IRFs controlling for monetary and global appetite shocks - sign dependent



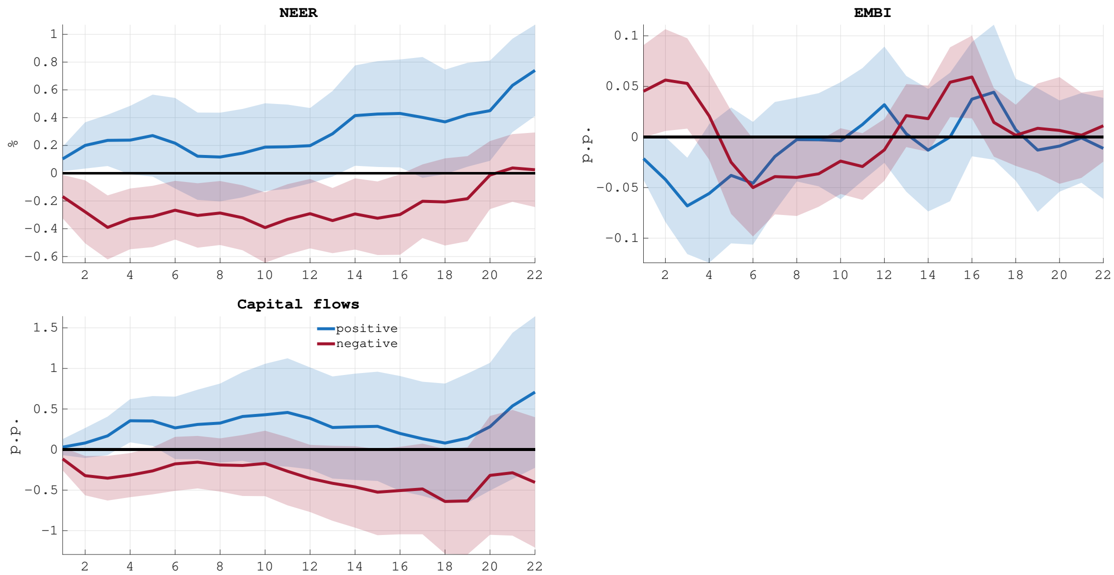
Note: Sign-dependent impulse response functions of in response to a CTOT shock. The blue (red) line depicts a response conditional on a positive (negative) shock; the corresponding areas represent 90% confidence intervals. Horizon is in quarters.

Figure B.8 IRFs to CTOT shocks orthogonal to the VIX - sign dependent



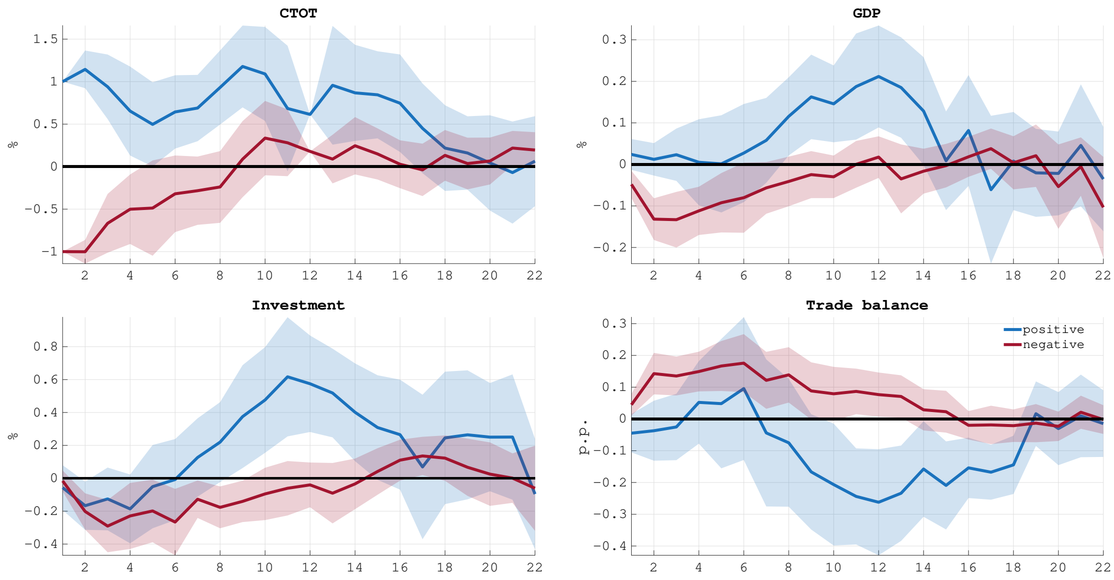
Note: The blue (red) line depicts a response conditional on a positive (negative) shock; the corresponding areas represents 90% confidence intervals. Horizon is in quarters.

Figure B.9 IRFs to CTOT shocks orthogonal to the VIX - sign dependent



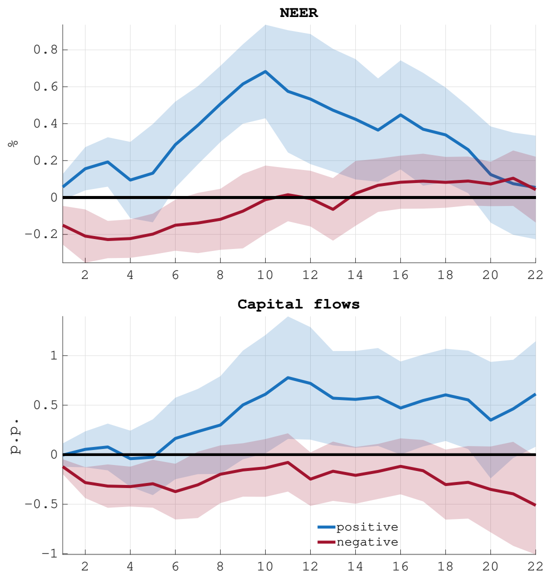
Note: The blue (red) line depicts a response conditional on a positive (negative) shock; the corresponding areas represents 90% confidence intervals. Horizon is in quarters.

Figure B.10 IRFs to CTOT shocks orthogonal to the world trade - sign dependent



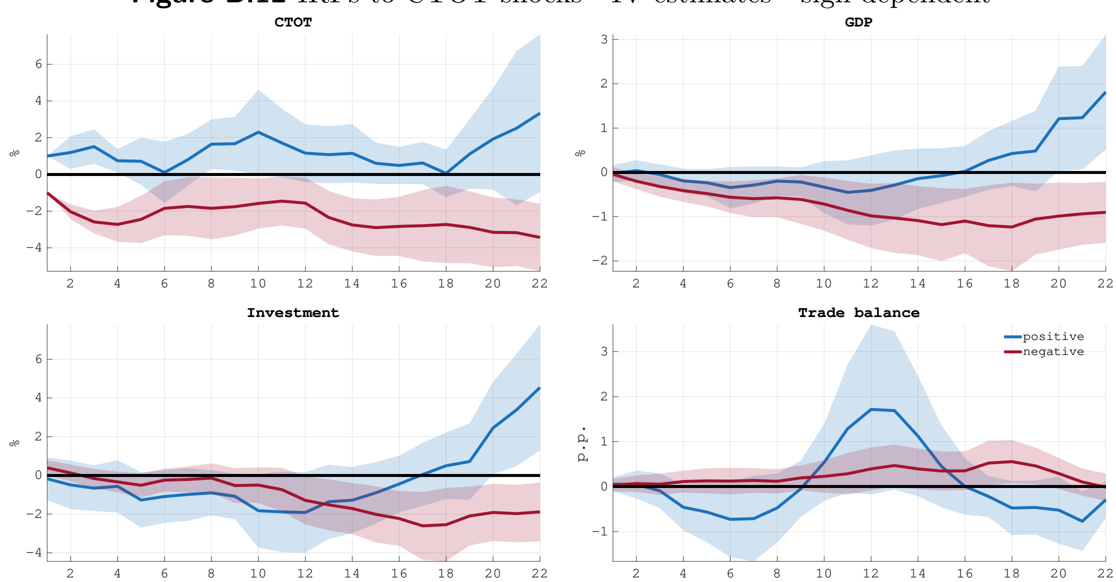
Note: The blue (red) line depicts a response conditional on a positive (negative) shock; the corresponding areas represents 90% confidence intervals. Horizon is in quarters.

Figure B.11 IRFs to CTOT shocks orthogonal to the world trade - sign dependent



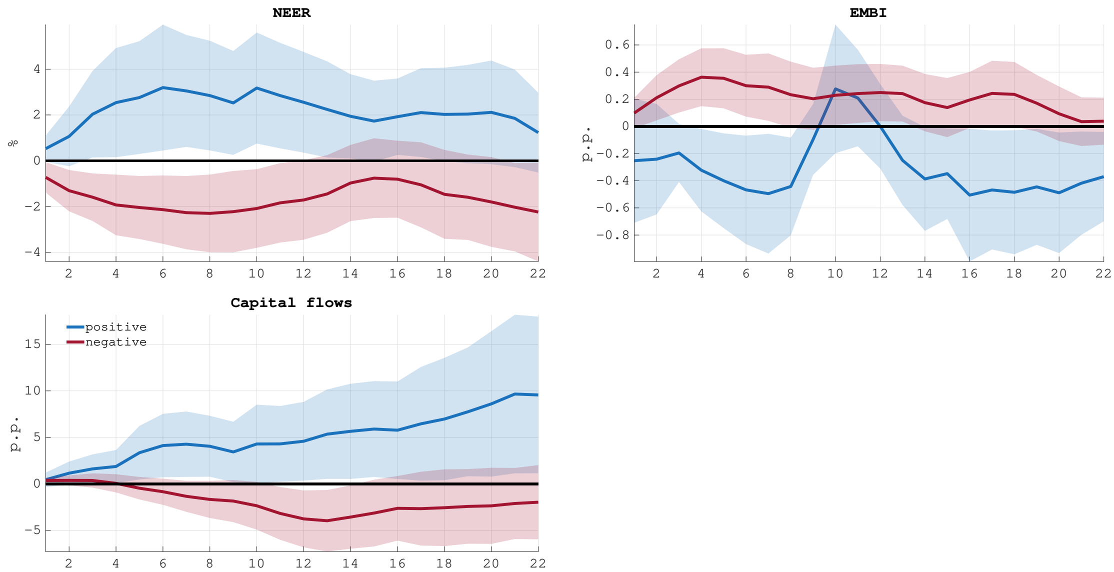
Note: The blue (red) line depicts a response conditional on a positive (negative) shock; the corresponding areas represents 90% confidence intervals. Horizon is in quarters.

Figure B.12 IRFs to CTOT shocks - IV estimates - sign dependent



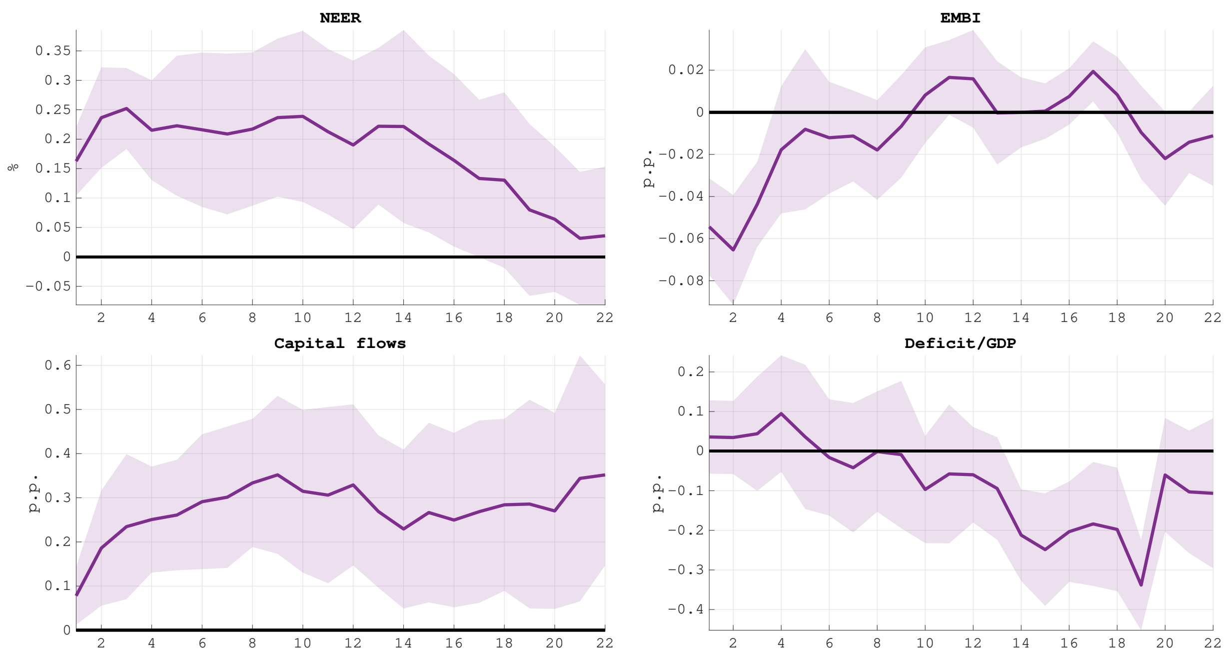
Note: The blue (red) line depicts a response conditional on a positive (negative) shock; the corresponding areas represents 90% confidence intervals. Horizon is in quarters.

Figure B.13 IRFs to CTOT shocks - IV estimates - sign dependent



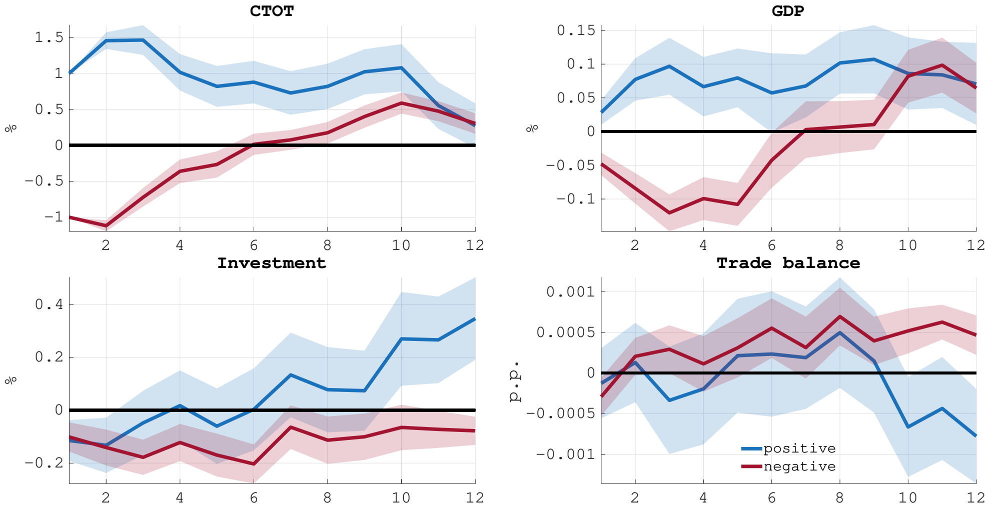
Note: The blue (red) line depicts a response conditional on a positive (negative) shock; the corresponding areas represents 90% confidence intervals. Horizon is in quarters.

Figure B.14 Sign-Dependent IRFs to CTOT shocks controlling for fiscal deficit - Additional variables



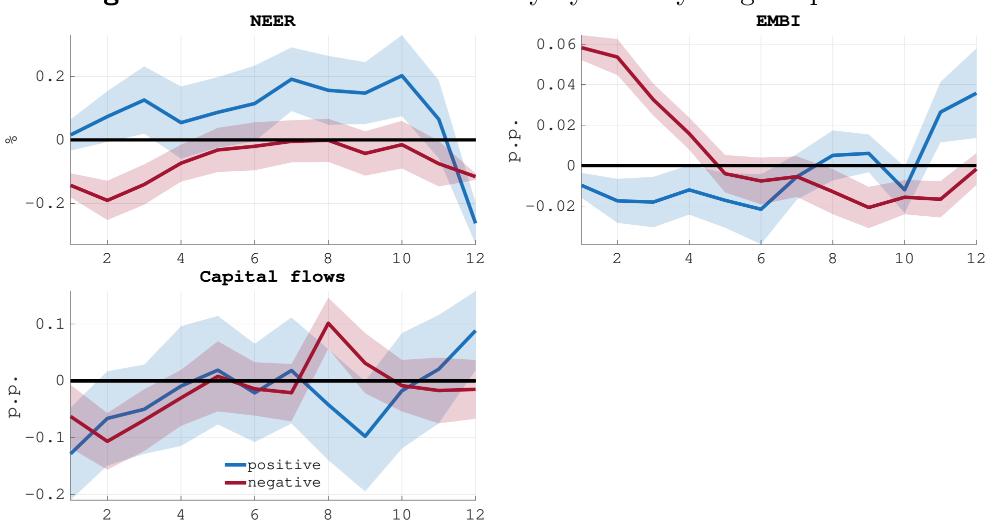
Note: Estimated Linear Impulse Response Functions (IRFs) of Commodity Terms of Trade (CTOT), GDP, Gross Fixed Capital Formation (Investment), and trade balance to output ratio computed using local projections. Shaded areas denote 90% confidence bands based on Driscoll and Kraay standard errors. Horizon is in quarters.

Figure B.15 IRFs to CTOT country by country - sign dependent



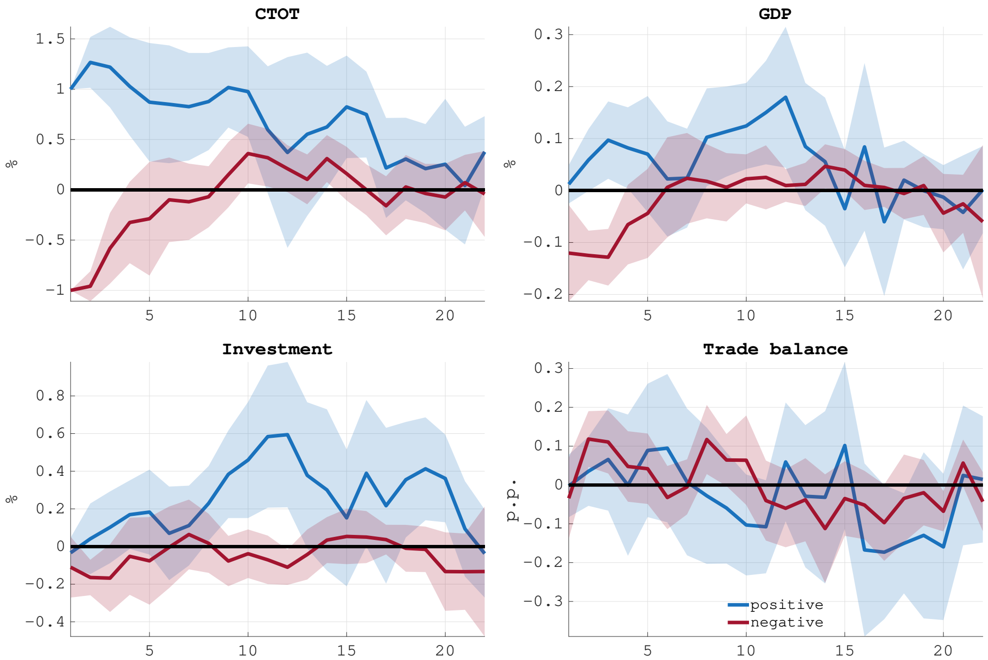
Note: The blue (red) line depicts a response conditional on a positive (negative) shock; the corresponding areas represents 90% confidence intervals. Horizon is in quarters.

Figure B.16 IRFs to CTOT country by country - sign dependent



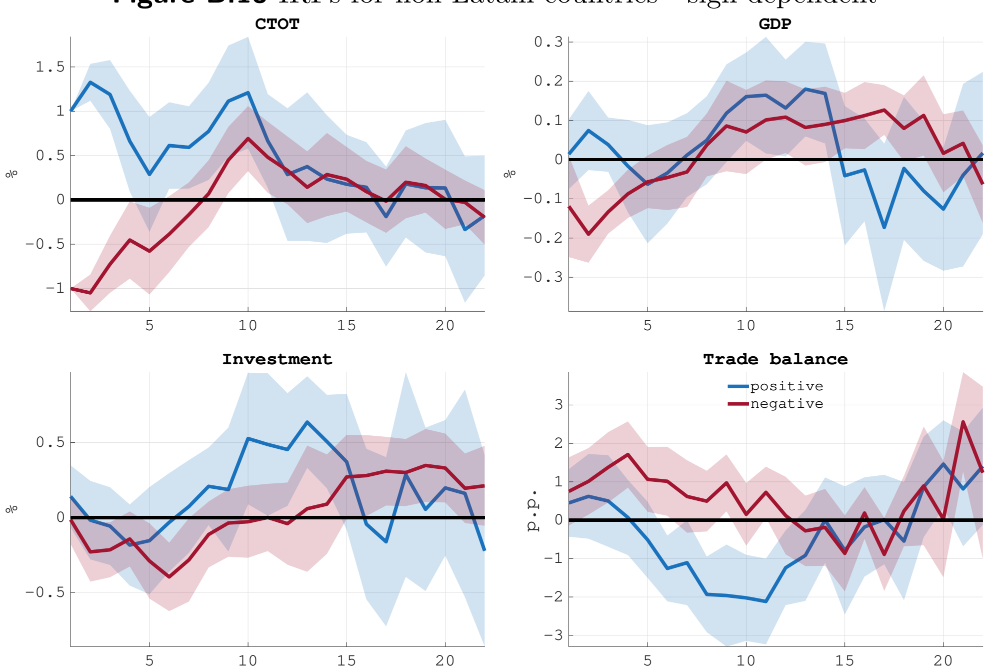
Note: The blue (red) line depicts a response conditional on a positive (negative) shock; the corresponding areas represents 90% confidence intervals. Horizon is in quarters.

Figure B.17 IRFs for Latam countries - sign dependent



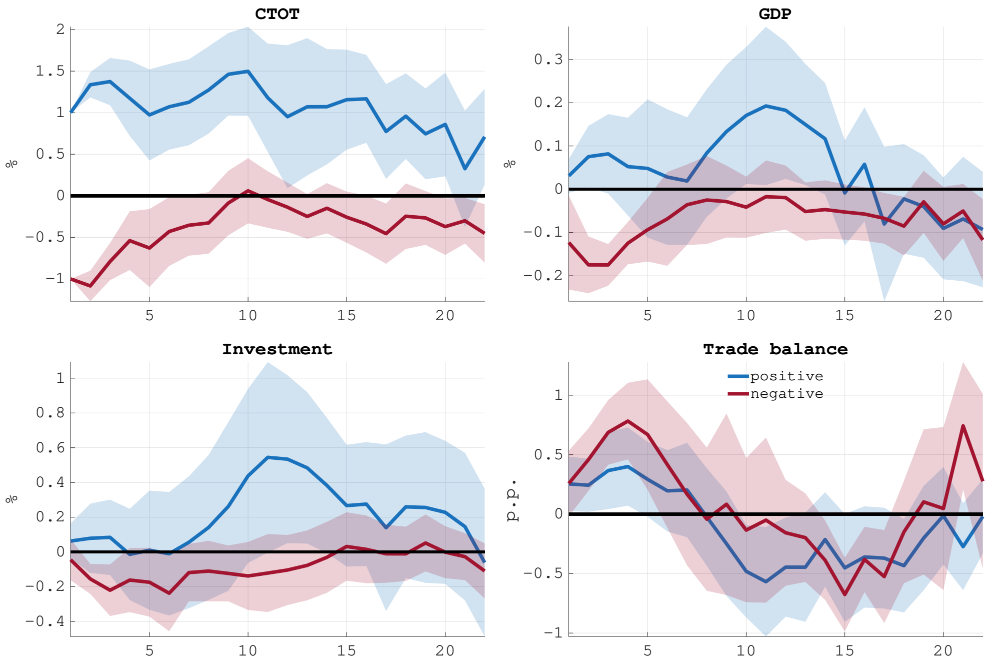
Note: The blue (red) line depicts a response conditional on a positive (negative) shock; the corresponding areas represents 90% confidence intervals. Horizon is in quarters.

Figure B.18 IRFs for non-Latam countries - sign dependent



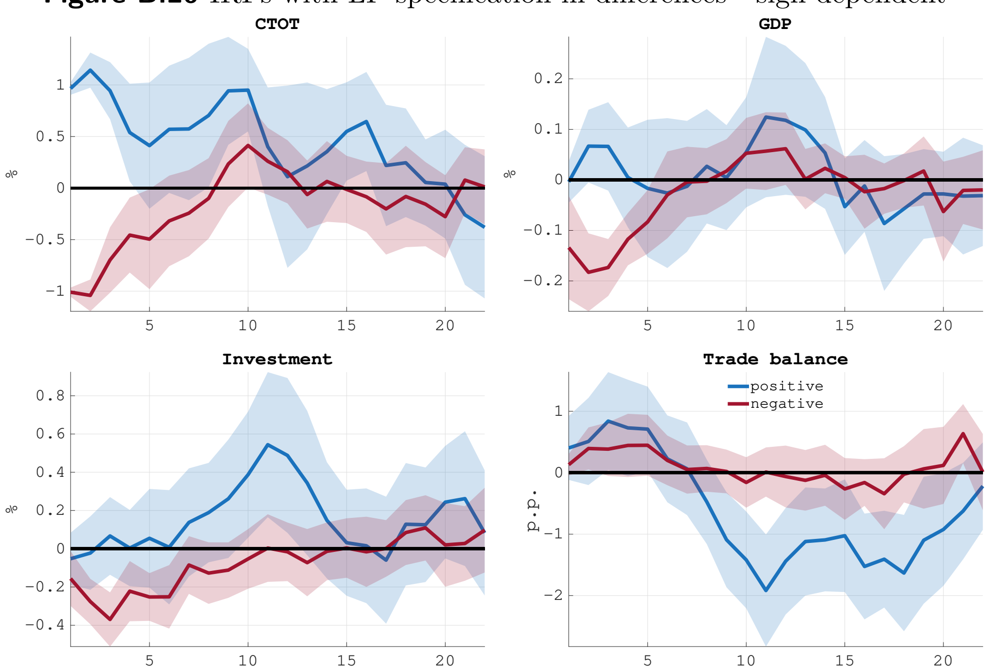
Note: The blue (red) line depicts a response conditional on a positive (negative) shock; the corresponding areas represents 90% confidence intervals. Horizon is in quarters.

Figure B.19 IRFs with LP specification in differences - sign dependent



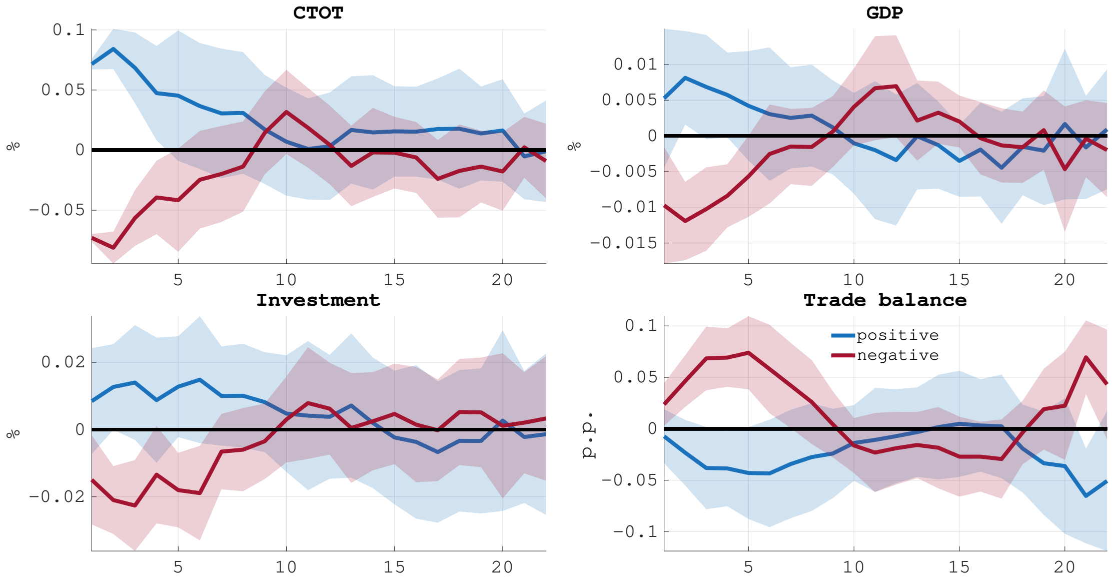
Note: The blue (red) line depicts a response conditional on a positive (negative) shock; the corresponding areas represents 90% confidence intervals. Horizon is in quarters.

Figure B.20 IRFs with LP specification in differences - sign dependent



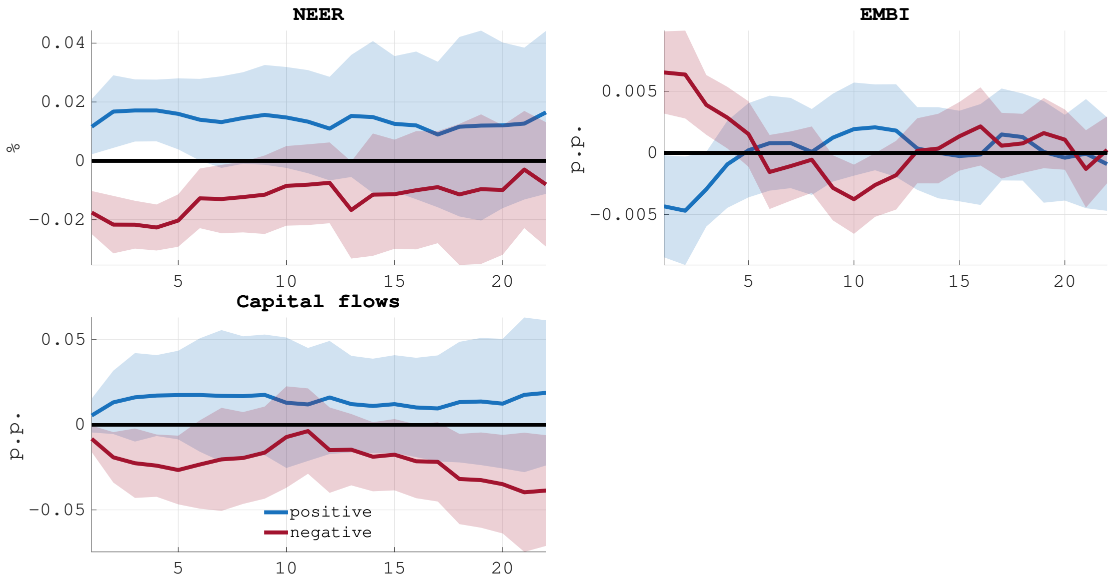
Note: The blue (red) line depicts a response conditional on a positive (negative) shock; the corresponding areas represents 90% confidence intervals. Horizon is in quarters.

Figure B.21 IRFs with LP under Gonçalves et al. (2021) correction - sign dependent



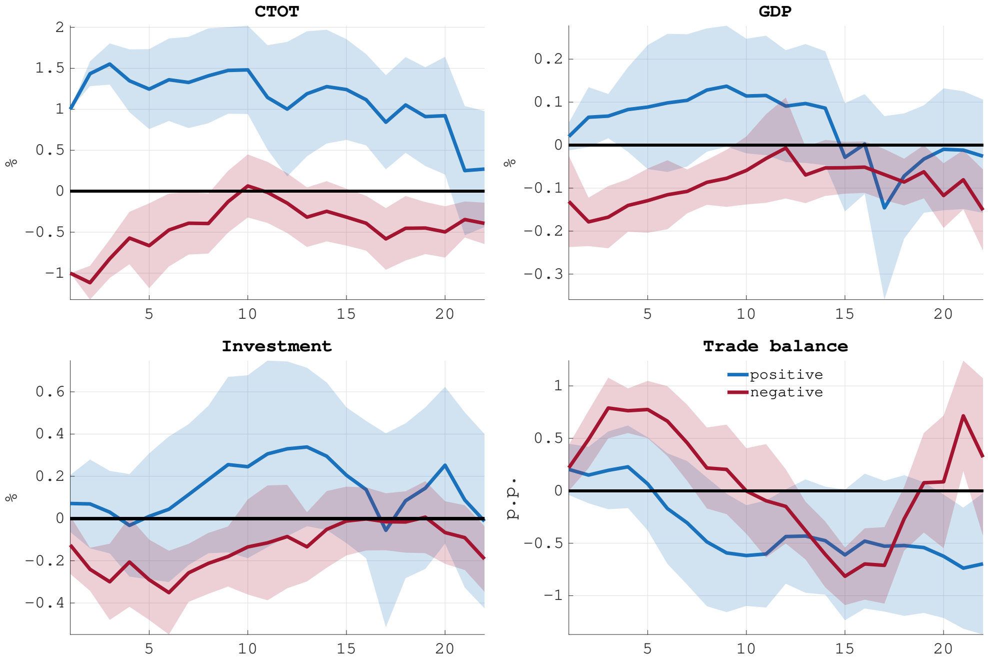
Note: The blue (red) line depicts a response conditional on a positive (negative) shock; the corresponding areas represents 90% confidence intervals. Horizon is in quarters.

Figure B.22 IRFs with LP under Gonçalves et al. (2021) correction - sign dependent



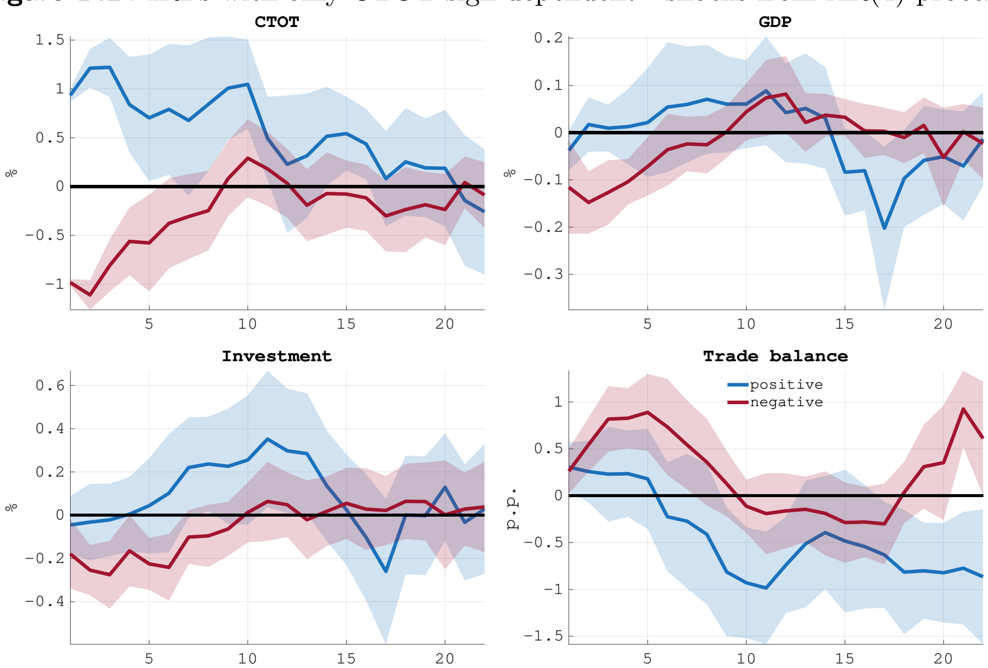
Note: The blue (red) line depicts a response conditional on a positive (negative) shock; the corresponding areas represents 90% confidence intervals. Horizon is in quarters.

Figure B.23 IRFs with only CTOT sign dependent - in growth rates



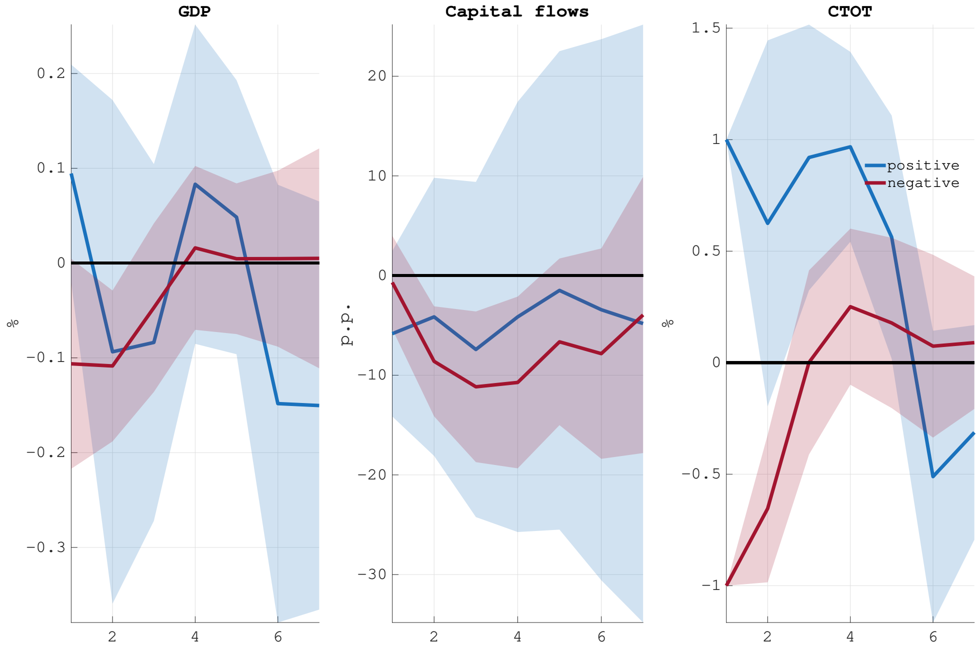
Note: The blue (red) line depicts a response conditional on a positive (negative) shock; the corresponding areas represents 90% confidence intervals. Horizon is in quarters.

Figure B.24 IRFs with only CTOT sign dependent - shocks from AR(4) process



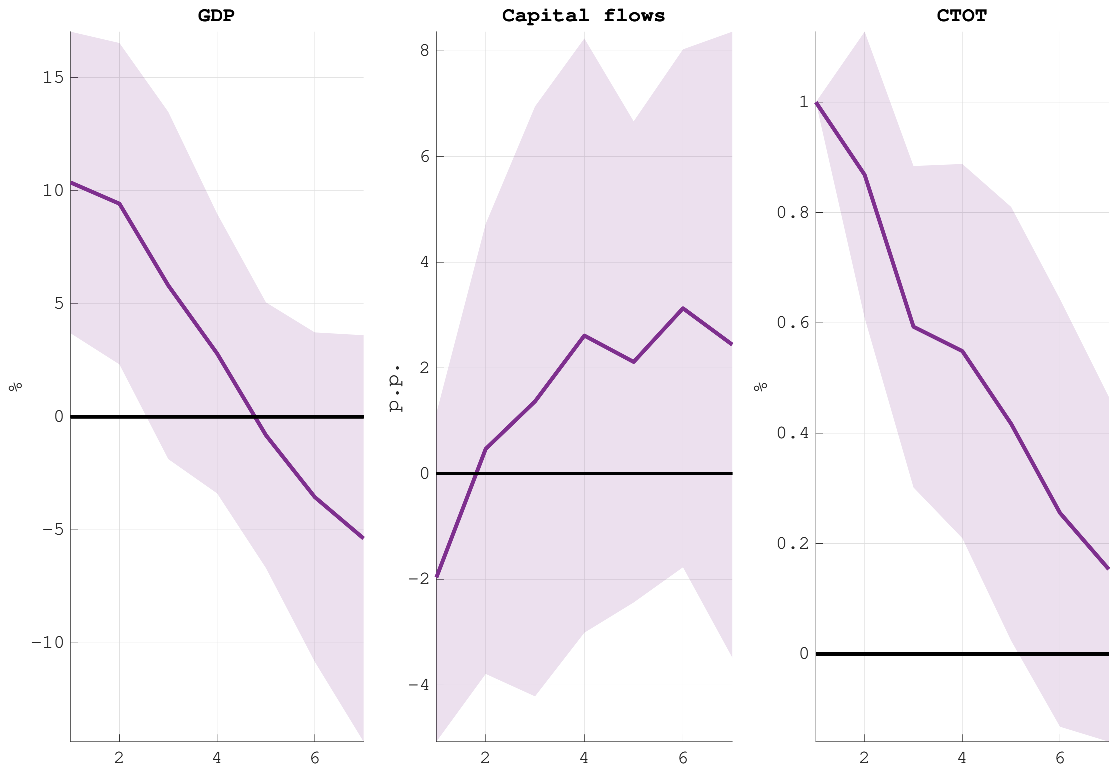
Note: The blue (red) line depicts a response conditional on a positive (negative) shock; the corresponding areas represents 90% confidence intervals. Horizon is in quarters.

Figure B.25 Sign Dependent IRFs to CTOT shocks - Annual Data



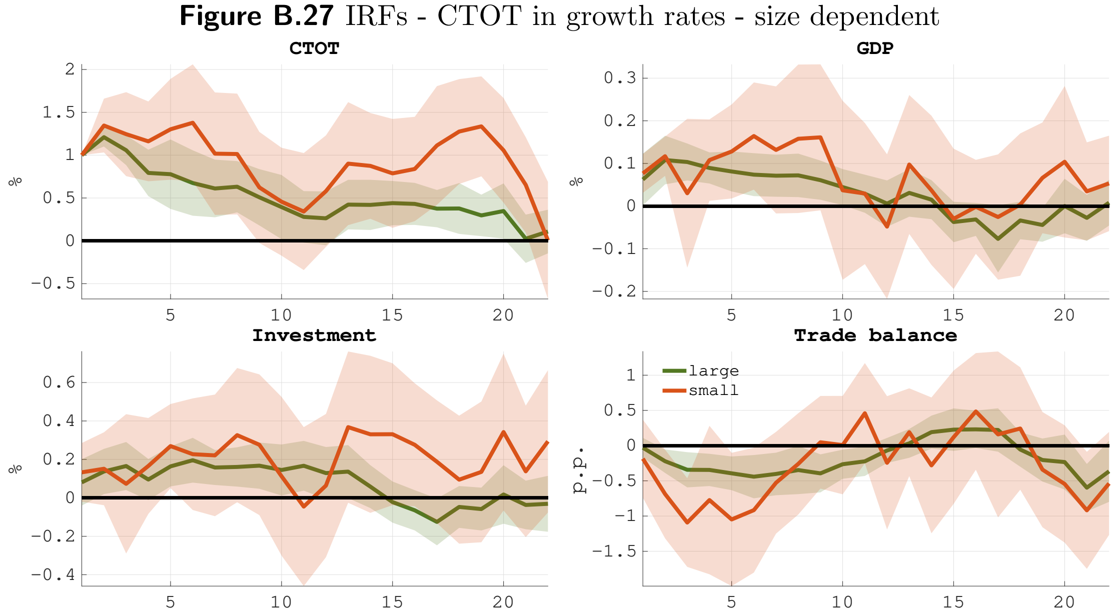
Note: Estimated Sign Dependent Impulse Response Functions (IRFs) of GDP (GDP), Net Capital Flows (Capital Flows), and Commodity Terms of Trade (CTOT) computed using local projections defined in equation 1 but estimated with annual data. Continuous purple lines denote the median IRFs in response to a 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.26 IRFs using annual CTOT - linear



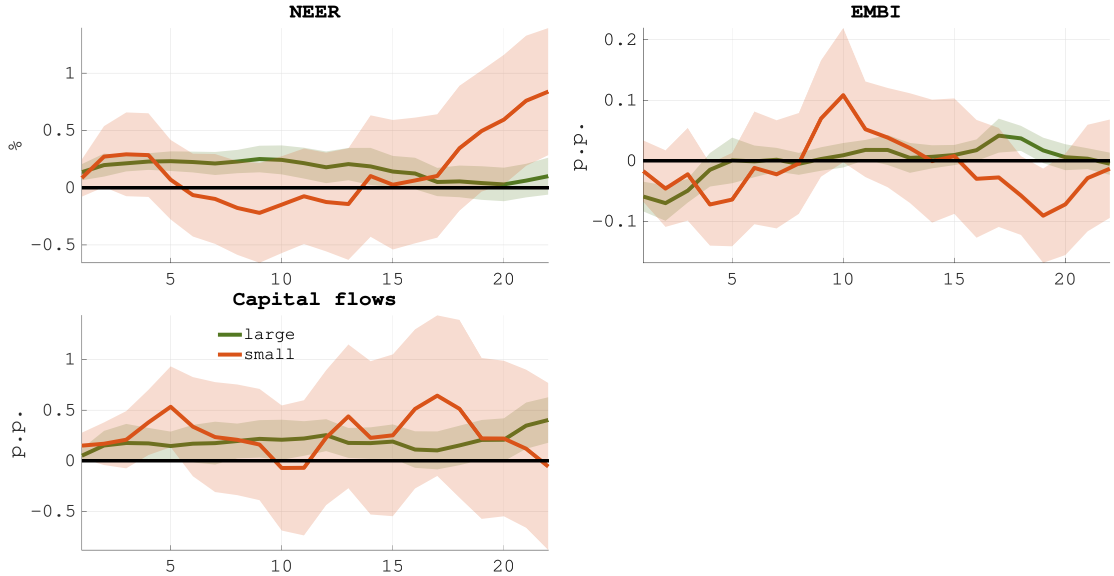
Note: Linear impulse response functions of GDP, capital flows and CTOT in response to a CTOT shock.

Figure B.27 IRFs - CTOT in growth rates - size dependent



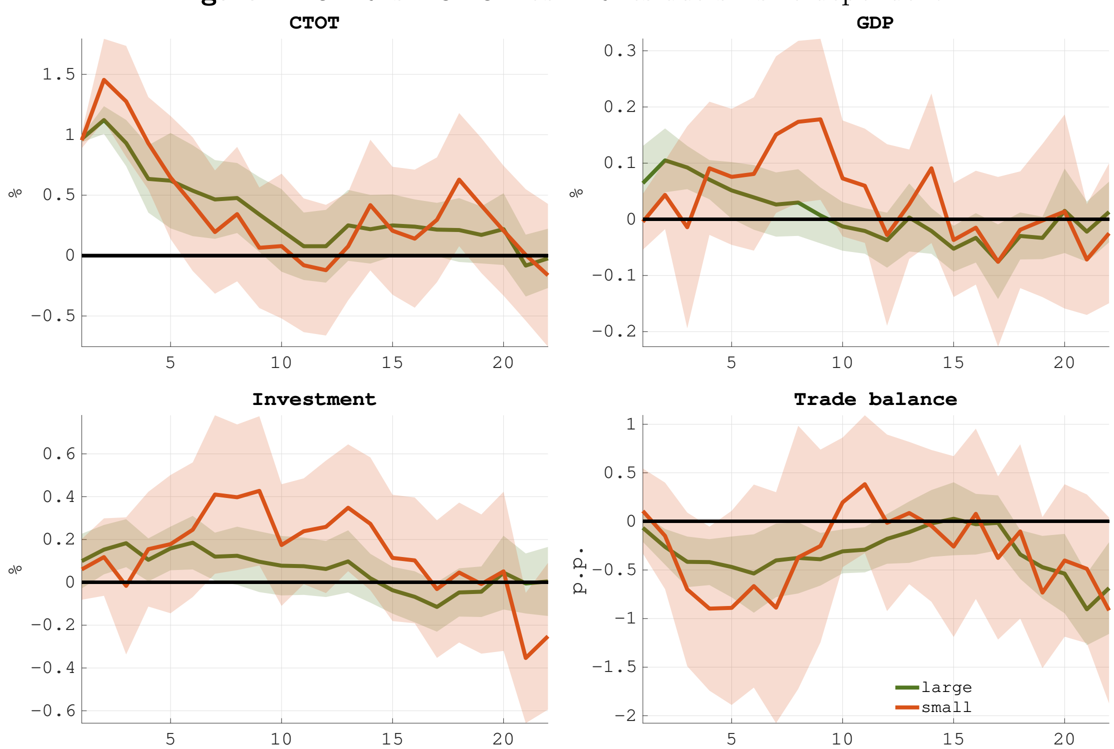
Note: The green (orange) line depicts a response conditional on a large (small) shock; the corresponding areas represents 90% confidence intervals. Horizon is in quarters.

Figure B.28 IRFs - CTOT in growth rates - size dependent



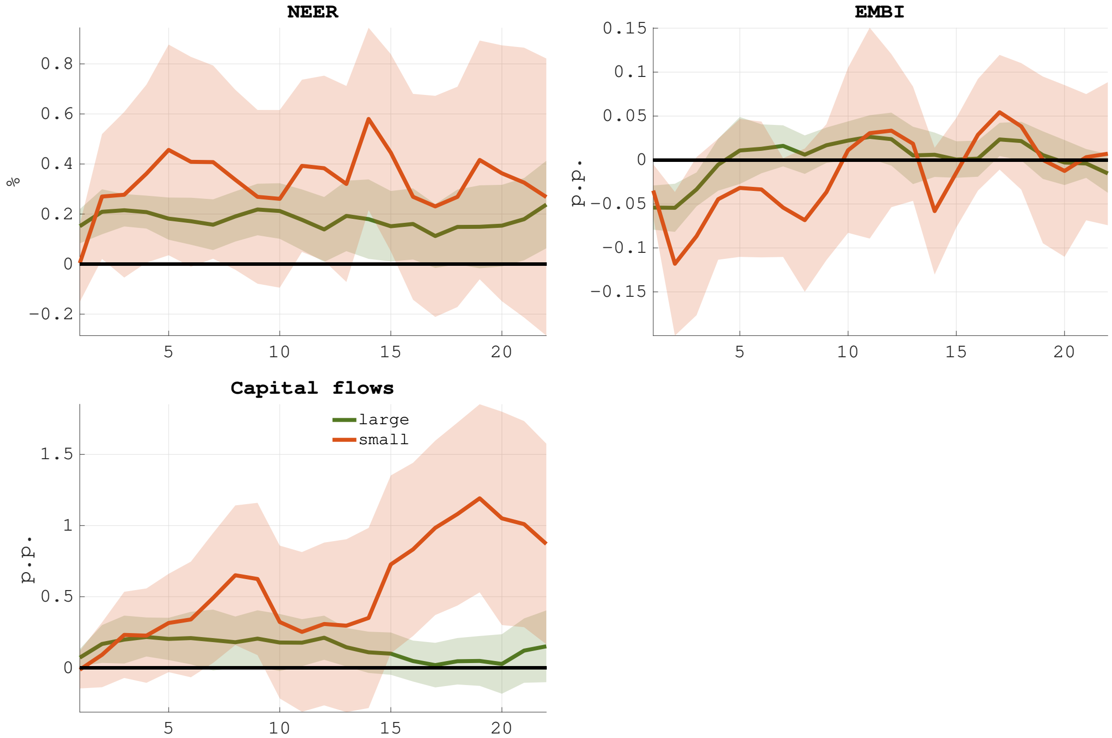
Note: The green (orange) line depicts a response conditional on a large (small) shock; the corresponding areas represents 90% confidence intervals. Horizon is in quarters.

Figure B.29 IRFs - CTOT as AR residuals - size dependent



Note: The green (orange) line depicts a response conditional on a large (small) shock; the corresponding areas represents 90% confidence intervals. Horizon is in quarters.

Figure B.30 IRFs - CTOT as AR residuals - size dependent



Note: The green (orange) line depicts a response conditional on a large (small) shock; the corresponding areas represents 90% confidence intervals. Horizon is in quarters.