Commodity Exporter Status and Sudden Stops

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Abstract

This paper studies whether commodity exporter status helps explain why sudden stops are more severe in some economies than in others. Using a panel of advanced and emerging economies and a local projection difference in differences specification, I document that the central and most robust difference between commodity exporters and non commodity exporters is the size of the external adjustment during sudden stops: commodity exporters experience current account reversals about 112 percent larger than non commodity exporters one year after sudden stop onset, with the differential significant at the one percent level and persistent across three full years after onset. The current account reversal premium survives a battery of robustness checks, including controls for world real interest rate movements, pre-crisis current account positions, and a continuous measure of commodity dependence. Consumption losses are also significantly larger in commodity exporters, and the real exchange rate and stock price differentials are directionally consistent with the same mechanism, though less precisely estimated and subject to pre-trend violations in the case of equity prices. To explain these facts, I extend the Fisherian sudden stop framework of Bianchi (2011) by introducing commodity prices into tradable income. A decline in commodity prices reduces tradable income and collateral values, tightening borrowing constraints and amplifying crises through Fisherian deflation, especially in economies with larger commodity exposure. Calibrating the model to Chile and to a moderate commodity exporter benchmark, I show that this mechanism generates the observed ordering of crisis severity and accounts for essentially the full CE/NCE differential in current account reversals and a large fraction of the consumption differential, while the absolute magnitudes overstate observed crisis severity due to the absence of investment, fiscal, and other margins of adjustment. The model also implies larger welfare gains from macroprudential policy in commodity exporting economies, providing support for stronger precautionary buffers in commodity dependent economies.

1 Introduction

A central question in international macroeconomics is why external crises differ so sharply across countries. A large literature compares advanced and emerging economies and shows that emerging markets tend to display more volatile business cycles, larger current account fluctuations, and more disruptive sudden stops. The standard explanations emphasize financial frictions, sovereign risk, world interest rate shocks, and trend disturbances. While these mechanisms are clearly important, the usual advanced versus emerging comparison may miss another major source of cross country heterogeneity: the composition of tradable income. In particular, many emerging economies are commodity exporters, whereas most advanced economies are not. This raises the possibility that part of what is often interpreted as a development difference is instead related to commodity exporter status.

This paper argues that commodity exporter status is a key determinant of sudden stop severity. Commodity exporters are more exposed to fluctuations in world commodity prices, and those fluctuations have direct effects on tradable income. That feature matters not only for ordinary business cycle moments, but especially during episodes of abrupt external adjustment. When commodity prices fall, commodity exporting economies suffer a larger deterioration in tradable income and a larger decline in the value of collateral. If borrowing constraints bind, this income loss interacts with Fisherian deflation and forces a sharper adjustment in absorption and the current account. As a result, sudden stops should be more severe in commodity exporters than in otherwise similar non commodity exporters.

The mechanism does not require every sudden stop in a commodity exporter to be caused by a commodity price decline. Commodity prices are exogenous in the small open economy. Sudden stops are endogenous events that occur when shocks and inherited debt positions push the economy against its borrowing constraint. The model predicts that, when adverse commodity price realizations occur, they are especially powerful amplification forces in economies with high commodity exposure.

The paper makes three main contributions. First, it documents new empirical facts showing that commodity exporter status helps explain differences in macroeconomic volatility and external crisis dynamics within the same level of development. Using long run historical data and post 1960 national accounts data, I show that commodity exporters exhibit greater volatility in output, consumption, investment, imports, and the trade balance than non commodity exporters. They also display a higher ratio of consumption volatility to

output volatility, a fact often emphasized in the emerging market business cycle literature. These patterns appear not only among developing economies, but also within developed economies, suggesting that commodity exporter status captures an important dimension of heterogeneity that cuts across the standard development classification.

Second, I show that the distinction between commodity exporters and non commodity exporters is particularly important for the size of external adjustment during sudden stops. Using the sudden stop database of Bianchi and Mendoza (2020), I estimate a local projection difference in differences specification with country and year fixed effects and predetermined institutional controls. The conditional correlation between commodity exporter status and the size of the current account reversal is large: commodity exporters experience reversals about 112 percent larger than non commodity exporters one year after sudden stop onset, and the gap persists across three full post-crisis years. This is a conditional comparison, not a causal estimate. Commodity exporter status is a structural country characteristic, not a randomly assigned treatment, and the specification compares CE and NCE countries within development groups while absorbing time invariant country heterogeneity, common year shocks, and predetermined differences in capital account openness and exchange rate regimes. The interpretation throughout is that the CE/NCE gap reflects systematic differences in how commodity exposed economies respond to sudden stops, with a mechanism developed in the model that links this gap to commodity price exposure operating through the collateral constraint. The premium also survives a battery of robustness checks: a continuous commodity dependence measure, an income level split, a world real interest rate control, and a pre crisis current account conditioning exercise.

Third, I develop a quantitative model that explains this severity differential through a simple and disciplined mechanism. I extend the sudden stop framework of Bianchi (2011) by decomposing tradable income into a non commodity component and a commodity price component. Economies differ only in the composition of tradable income: higher-α economies place more weight on the commodity price component and less weight on the non commodity tradable component. A negative commodity price shock reduces tradable income directly and lowers borrowing capacity. When the collateral constraint binds, the induced decline in tradable absorption reduces the relative price of nontradables, further compressing collateral values through Fisherian deflation. The model therefore predicts that economies with a larger commodity share experience stronger amplification and more severe sudden stops. Calibrating the model to Chile and to copper price dynamics, I show that this mechanism can account for the greater crisis intensity observed in commodity exporters.

The quantitative analysis also delivers a normative implication. Because commodity exporting economies face stronger amplification during crises, they have a stronger incentive to self insure against binding borrowing constraints. In the model, the constrained efficient allocation features a quantitatively larger precautionary saving motive in the commodity exporting economy than in the non commodity exporting one. As a result, the welfare gains from macroprudential policy are much larger in commodity exporters. This finding provides a quantitative rationale for more aggressive stabilization and prudential policies in commodity dependent economies, including policies aimed at reserve accumulation, fiscal stabilization, or other forms of precautionary buffers.

This paper contributes to three related literatures. First, it contributes to the business cycle literature by arguing that commodity exporter status is an important and underappreciated source of heterogeneity across countries. Second, it contributes to the sudden stop literature by showing that the composition of tradable income helps explain cross country differences in crisis severity. Third, it contributes to the literature on commodity prices and macroeconomic fluctuations by linking exposure to commodity price shocks not only to unconditional volatility, but also to the intensity of external crises. More broadly, the paper suggests that the structure of exports matters for macro financial vulnerability in ways that are not fully captured by the conventional distinction between advanced and emerging economies.

The contribution is not to show that commodity prices matter for business cycles, nor that sudden stops are costly. Both points are well established. The contribution is to show that commodity exporter status predicts the intensity of sudden stops within development groups, and to explain this fact through the interaction between commodity price exposure and Fisherian collateral amplification. In this sense, the paper shifts the focus from whether countries experience sudden stops to how severe those episodes become once they occur.

The remainder of the paper is organized as follows. Section 2 reviews the related literature. Section 3 presents the empirical evidence on business cycle differences and sudden stop severity across commodity exporters and non-commodity exporters. Section 4 presents the local projection difference in differences evidence. Section 5 develops the theoretical framework and the amplification mechanism. Section 6 describes the calibration. Section 7 describes the numerical solution and simulation strategy. Section 8 presents the decentralized equilibrium quantitative results. Section 9 studies the constrained efficient allocation

and discusses policy implications. Section 10 concludes.

2 Literature Review

This paper is related to four strands of literature: emerging market business cycles, commodity prices and commodity exporting economies, sudden stops and financial amplification, and macroprudential policy in economies with pecuniary externalities.

The first strand studies why macroeconomic fluctuations differ across advanced and emerging economies. A central contribution is Neumeyer and Perri (2005), who emphasize the role of world interest rates and external financial conditions in shaping business cycles in emerging economies. Closely related, Uribe and Yue (2006) study the interaction between world interest rates, country spreads, and emerging market fundamentals. They show that U.S. interest rate shocks affect emerging economies largely through their effect on country spreads, and that the feedback from domestic fundamentals to spreads amplifies aggregate volatility. This insight is important for my paper because it raises the possibility that the commodity exporter severity premium may partly reflect exposure to global financial tightening rather than commodity price exposure per se. I address this concern directly in the empirical analysis by studying the comovement between world real interest rates and commodity export prices during sudden stop episodes, and by controlling for world real interest rate changes in the LP-DiD specification. Aguiar and Gopinath (2007) argue that emerging markets are characterized by more volatile trend shocks, leading to the influential view that, in these economies, "the cycle is the trend." This interpretation is challenged by García-Cicco et al. (2010), who show that a frictionless real business cycle model performs poorly in accounting for the Argentine data and that financial frictions are necessary to match key moments, especially trade balance dynamics. Chang and Fernández (2013) reach a related conclusion using a model with working capital constraints and endogenous spreads. The common feature of this literature is that cross country heterogeneity is usually framed through the distinction between advanced and emerging economies. This paper argues that this comparison is incomplete because it overlooks an additional source of heterogeneity within development groups: the composition of tradable income.

The second strand studies the role of commodity prices and terms of trade shocks in small open economies. Mendoza (1995) shows that terms of trade shocks can account for a substantial fraction of macroeconomic fluctuations in small open economies. Fernández et al. (2017) emphasize the importance of world shocks and world prices for domestic busi-

ness cycles, while Schmitt-Grohé and Uribe (2018) find a more limited role for terms of trade disturbances in poor and emerging economies. A related literature focuses more directly on commodity exporting economies. Drechsel and Tenreyro (2018) study commodity booms and busts in emerging markets, and Fornero and Kirchner (2018) analyze how learning about commodity cycles affects saving and investment dynamics in a commodity exporting economy. These papers show that commodity price exposure matters for aggregate fluctuations. My paper builds on this insight, but shifts the focus from unconditional business cycle volatility to the severity of external crises. In particular, I ask whether commodity exporter status helps explain how severe a sudden stop becomes once it occurs.

The third strand is the literature on sudden stops, current account reversals, and financial amplification. Early contributions such as Calvo (1998) and Calvo et al. (2004) emphasize that sudden stops are episodes of abrupt reversals in capital flows associated with large contractions in absorption and sharp real exchange rate adjustment. Mendoza (2010) shows that occasionally binding borrowing constraints can generate nonlinear crisis dynamics, with sharp deleveraging and current account reversals when adverse shocks push the economy against its collateral constraint. The most direct theoretical foundation for this paper is Bianchi (2011), who shows that decentralized borrowing decisions generate systemic externalities in a small open economy with collateral constraints and Fisherian deflation. In that framework, adverse shocks reduce the relative price of nontradables, tighten borrowing capacity, and amplify the crisis through endogenous collateral effects. Bianchi and Mendoza (2020) synthesize this Fisherian approach and connect it to the broader sudden stop literature.

Other related work studies sovereign default and balance sheet amplification. Arellano (2008) develops a model in which endogenous default risk and changing borrowing conditions generate volatile interest rates and high consumption volatility in emerging economies. Mendoza and Yue (2012) study sovereign default and business cycles in a general equilibrium environment with imported inputs and credit market disruptions. Balance sheet models such as Céspedes et al. (2004) also emphasize how real depreciations can interact with borrowing constraints and amplify crisis dynamics. These papers highlight different financial mechanisms behind external crises. My contribution is to show that the composition of tradable income is also important: when tradable income depends on commodity prices, the same Fisherian collateral mechanism generates systematically more severe crises in economies with greater commodity exposure.

The fourth strand is the literature on pecuniary externalities and macroprudential policy. Lorenzoni (2008) shows that decentralized borrowing can be inefficient because private agents do not internalize how aggregate leverage affects equilibrium prices in crisis states. Korinek (2011) and Benigno et al. (2013) develop related arguments for macroprudential intervention and capital controls in small open economies subject to financial amplification. This paper contributes to that literature by showing that the strength of the externality depends on the structure of tradable income. Because commodity price declines reduce tradable income and collateral values more strongly in commodity exporting economies, the welfare gains from macroprudential policy are larger when commodity exposure is higher.

Empirically, the paper is also related to studies of current account reversals and capital flow episodes, including Edwards (2004), Cavallo and Frankel (2008), and Forbes and Warnock (2012). These papers study the incidence and consequences of sudden stops and capital flow reversals across countries. My empirical focus is different. Rather than asking only which countries experience sudden stops, I ask whether the severity of those episodes differs systematically with commodity exporter status, conditional on development group, country fixed effects, time effects, and predetermined institutional characteristics.

Relative to this literature, the contribution of the paper is to bring commodity exporter status into the analysis of sudden stop severity. The sudden stop literature has been successful at explaining why emerging economies are vulnerable to abrupt external adjustment, but it has paid less attention to why some countries experience much larger adjustments than others once a sudden stop occurs. The commodity price literature shows that world price shocks matter for business cycles, but has focused less on their interaction with collateral constraints during external crises. This paper connects these ideas. Once tradable income is allowed to depend on commodity prices, commodity exporter status becomes a structural determinant of crisis amplification: adverse commodity price realizations reduce tradable income, tighten borrowing constraints, and magnify current account reversals through Fisherian deflation.

In this sense, the paper bridges literature that is often treated separately. From the business cycle literature, it takes the question of why volatility differs across countries. From the commodity price literature, it takes the idea that world price shocks affect countries asymmetrically depending on export composition. From the sudden stop literature, it takes the mechanism of collateral constraints and Fisherian amplification. The central claim is that these three ideas fit naturally together: export composition is not only a determinant

of ordinary business cycle volatility, but also a determinant of how severe external crises become once borrowing constraints bind.

3 Empirical Evidence

This section documents the empirical motivation for the model. The main fact is that commodity exporters experience more severe sudden stops than non commodity exporters, even within the same level of development. I first present a brief set of business cycle moments showing that commodity exporters are systematically more exposed to external volatility. I then focus on sudden stop episodes, where the difference between commodity exporters and non-commodity exporters is especially pronounced.

3.1 Commodity Exporter Status and Business Cycle Volatility

Commodity exporters differ from non commodity exporters in the volatility of aggregate fluctuations. Using post 1960 national accounts data from the World Development Indicators, commodity exporters display higher volatility of GDP, consumption, investment, imports, and the trade balance to output ratio within the same development group. They also exhibit a higher ratio of consumption volatility to output volatility, a fact often associated with emerging market business cycles.

These patterns suggest that commodity exporter status captures a relevant dimension of macroeconomic heterogeneity that is not fully summarized by the advanced versus emerging distinction. A natural reason is that commodity exporters face more volatile terms of trade. In the data, terms of trade volatility is higher for commodity exporters than for non commodity exporters, especially among developed economies. Since commodity prices directly affect tradable income, this exposure should matter not only for normal business cycles but also for external crises.

For completeness, Appendix B reports the full set of historical and post 1960 business cycle moments, including the Barro and Ursúa (2008) evidence and the WDI volatility, relative volatility, correlation, and terms of trade tables.

3.2 Sudden Stops and the Commodity Exporter Severity Premium

I now turn to sudden stop episodes. I use the sudden stop dates from Bianchi and Mendoza (2020), who define sudden stops as episodes of large and abrupt current account reversals. Their event study specification identifies a sudden stop when the year on year increase in the current account to GDP ratio, ca/y, lies in the 95th percentile of the country specific distribution of annual changes in ca/y. They also construct a narrower sample of systemic sudden stops by applying a global financial stress filter, using the market wide EMBI for emerging markets and the VIX for advanced economies.

I distinguish between these two related samples throughout the empirical analysis. For the descriptive event evidence in Table 1, I use the full list of sudden stop episodes. This broader sample is useful for summarizing average peak to trough movements around all identified episodes of abrupt external adjustment. For the main LP-DiD analysis, however, I restrict attention to the systemic sudden stop episodes. The systemic sample is better suited for the econometric analysis because it focuses on episodes associated with broader external financing stress, rather than country specific current account movements that may reflect idiosyncratic factors. Thus, the full database provides broad descriptive evidence, while the systemic database provides the baseline sample for the paper's main empirical estimates.

Using these dates, I compare crisis outcomes across commodity exporters and non commodity exporters within development groups. The evidence shows that commodity exporters are not only somewhat more likely to experience sudden stops; more importantly, their sudden stops are substantially more severe.

Table 1 reports average peak to trough changes around sudden stop episodes. Among developing economies, commodity exporters experience current account reversals of 4.6 percent of GDP, compared with 3.5 percent for non commodity exporters. Among developed economies, the difference is even larger: commodity exporters experience reversals of 5.8 percent of GDP, compared with 2.8 percent for non commodity exporters. Similar patterns appear for real exchange rates, stock prices, investment, consumption, and GDP. Commodity exporters experience sharper real depreciations, larger investment collapses, and deeper contractions in domestic absorption.

These are raw descriptive moments computed directly from sudden-stop episodes. They

Table 1: Summary Statistics: Average Sudden Stops Episodes (peak to trough; t-2,t+2; percentage)

Commodities	Developing	GDP	C	I	RER	Stock Prices	CA/GDP
0	0	-2.35	-3.51	-9.72	-1.37	-17.15	2.76
1	0	-3.94	-5.65	-19.76	-6.41	-69.21	5.78
0	1	-3.43	-3.46	-13.50	-12.61	-1.74	3.54
1	1	-4.29	-5.06	-23.27	-19.95	-55.36	4.60

Notes: GDP, consumption, investment, RER, and stock prices are reported as percent changes or log percent changes over the event window. CA/GDP is reported in percentage points. Positive CA/GDP values denote current account reversals. Negative RER values denote real depreciations.

are not estimates from the LP-DiD specification. The econometric CE/NCE comparison is reported in 4 and is used later as the empirical counterpart for the quantitative model. The conditional LP-DiD estimates imply a larger CE/NCE current account differential than the simple descriptive moments.

The key empirical fact is therefore not simply that commodity exporters experience more crises. The main difference is crisis intensity. Conditional on a sudden stop occurring, commodity exporters undergo larger external adjustments and more severe macroeconomic contractions than non commodity exporters at similar levels of development.

This evidence motivates the mechanism developed below. In commodity exporting economies, sudden stops that coincide with adverse commodity price movements are especially severe. A fall in commodity prices reduces tradable income and collateral values; if the economy is close to its borrowing constraint, this shock amplifies the required adjustment in absorption and the current account. The next section tests the robustness of this severity premium using a local projection difference in differences design.

4 The Commodity Exporter Severity Premium in Sudden Stops

The event study evidence in Section 3 documents that sudden stops are more severe in commodity exporting economies. However, that comparison is descriptive: commodity exporters and non commodity exporters may differ along institutional, financial, and exchange rate dimensions that also shape crisis outcomes. This section therefore estimates a local projection difference in differences specification to measure the conditional commodity exporter severity premium. The exercise compares commodity exporters and non commodity

exporters within the same development group, after absorbing country and year fixed effects and controlling for predetermined institutional characteristics. The goal is not to claim that commodity exporter status is randomly assigned, but to show that the severity gap remains after accounting for the most relevant observable differences.

A word on interpretation. Commodity exporter status is a structural country characteristic, not a randomly assigned treatment, so the LP-DiD coefficient δ_h should be read as a conditional CE/NCE differential, not a causal estimate. The specification absorbs time invariant country heterogeneity through fixed effects, common year shocks through year dummies, and predetermined differences in financial openness and exchange rate regimes through institutional controls. Identification rests on the assumption that, after these controls, the residual CE/NCE difference in sudden stop dynamics reflects the systematic association between commodity exposure and crisis severity, an association the model in Section 5 interprets as operating through the collateral constraint. The parallel trends test in Table 2 provides a check on this assumption by testing whether CE and NCE countries were on different macroeconomic trajectories before the sudden stop; the robustness exercises in Section 4.4 further test whether the gap survives alternative ways of measuring commodity exposure and alternative sets of controls.

4.1 Econometric Framework

Local projections. I estimate impulse responses using the local projection method of Jordà (2005). For each outcome y_{it} and horizon $h \in \{-3, -2, -1, 0, 1, 2, 3\}$ I define the cumulative change:

$$\Delta^h y_{it} \equiv y_{i,t+h} - y_{i,t-1}, \tag{1}$$

normalized to zero at $t-1$, one year before the sudden stop onset.

Specification. The LP-DiD regression estimated separately within each development group $g \in \{\text{EM, Dev}\}$ is:

$$\begin{aligned}\Delta^h y_{it} = \alpha_i + \gamma_t + \beta_h\, SS_{it} + \delta_h\, SS_{it} \cdot CE_i \\ + \theta_h\, SS_{it} \cdot \Delta\log P_{it} + SS_{it} \cdot \mathbf{X}'_{i,t-1}\boldsymbol{\lambda}_h + \varepsilon_{i,t+h},\end{aligned} \tag{2}$$

where α_i are country fixed effects, γ_t are year fixed effects, and the regression uses the full panel (not only crisis years) so that fixed effects are identified from all observations while SS_{it}

selects the crisis episodes. The pooled specification adds $SS_{it} \cdot EM_i$ to absorb the average EM severity premium, so that δ_h measures the CE/NCE gap conditional on development level.

The coefficient β_h is the average sudden stop path for NCE countries (the baseline). The parameter of interest is δ_h: the *additional* severity for CE countries at the same point in time, conditional on all controls and fixed effects. The model predicts $\delta_h < 0$ for output, consumption, and investment, $\delta_h > 0$ for the current account reversal, and $\delta_h < 0$ for real exchange rate (depreciation).

Commodity price control. The term $\theta_h\, SS_{it} \cdot \Delta \log P_{it}$ controls for the magnitude of the commodity price shock concurrent with the sudden stop. $\Delta \log P_{it}$ is the log change in the Commodity Export Price Index (individual commodities weighted by ratio of exports to GDP, historical fixed weights) from the IMF. This control removes variation in crisis severity driven by the size of the concurrent price shock rather than commodity exporter status per se.

Because commodity price movements are themselves part of the proposed mechanism, the term $\Delta \log P_{it}$ in equation (2) partials out part of the channel of interest. In specifications that include this control, δ_h should therefore be interpreted as the *residual* CE/NCE severity premium that operates over and above the contemporaneous commodity price movement — through balance sheet exposure, expectations about persistent income, and Fisherian amplification at the collateral constraint. Specifications without the control let δ_h additionally absorb the direct effect of the concurrent price decline. The fact that the CA differential falls from +3.3 pp (1 %) with the price control to +1.6 pp without it (Table 4, columns "Main" and "No-P") is therefore consistent with the model: a substantial portion of the CE premium operates through the contemporaneous commodity price decline, and the residual +1.6 pp measures the amplification that survives even after this direct channel is absorbed. I report both specifications throughout to make this decomposition transparent.

Control variable selection. The choice of controls requires particular care because sudden stops are *defined* partly by the current account reversal (Bianchi and Mendoza, 2020; Calvo, 1998). Four variables that are intuitively attractive as controls; the pre crisis CA/GDP ratio, total reserves, private credit, and trade openness, are excluded for overlapping reasons. First, sudden stop identification uses the financial account (and thus the CA); conditioning on the pre crisis CA level induces selection bias (Berkson's paradox). Second, these variables

are all plausible *mediators*: CE countries run larger CA deficits during commodity booms, accumulate fewer reserves relative to their enlarged GDP, and have financial systems that expand with commodity income. Controlling for any of these absorbs variation that is part of the CE mechanism rather than an independent confounder (Bianchi and Mendoza, 2020; Calvo et al., 2004).

I retain two institutional controls that are clearly predetermined and not on the causal path from CE status to crisis severity:

- **Capital account openness** (Chinn–Ito index, Chinn and Ito, 2008): more financially integrated economies face larger capital flow reversals for any given shock.
- **Exchange rate regime** (Ilzetzki–Reinhart–Rogoff, Ilzetzki et al., 2022): a binary fixed-regime dummy (= 1 for hard peg or currency board; codes 5–6 set to missing). Countries with fixed regimes cannot depreciate the nominal exchange rate, amplifying the real output cost through a channel independent of commodity exposure.

Both controls are lagged one year and interacted with SS_{it}.

No lags of the dependent variable. I do not include lags of y in equation (2). Following Plagborg-Møller and Wolf (2021), adding lags of the dependent variable to a local projection biases the impulse response estimates in finite samples. Residual serial correlation is addressed through country level clustered standard errors.

Standard errors. Standard errors are clustered at the country level using the cluster robust sandwich estimator with the finite sample correction $G/(G-1)\cdot n/(n-k)$. Confidence intervals follow the Jordà (2005) convention: I display 68 % and 95 % bands simultaneously.

Parallel trends. The LP-DiD identifying assumption is that CE and NCE countries would have followed parallel trends absent the sudden stop. With $H_{\text{pre}} = 3$, I test the pre-period differential jointly at $h = -3$ and $h = -2$ using a joint Wald test of $H_0 : \hat{\delta}_{-3} = \hat{\delta}_{-2} = 0$. Under the null, neither pre-horizon should show a systematic CE/NCE difference. I report both the individual $h = -2$ estimates (Table 2) and the joint Wald p-values alongside the main results.

4.2 Data

Outcomes and transformations. Six variables for the period 1980–2016 from Global Macro Database Müller et al. (2025), WDI (World Bank) and IFS (IMF): real GDP per

capita, real consumption per capita, real investment, current account to GDP (CA/GDP), real effective exchange rate (RER), and real stock prices. GDP, consumption, investment and CA/GDP are HP filtered log deviations from trend ($\lambda = 100$). They are already expressed as proportional deviations or ratio changes, so the outcome $\Delta^h y_{it} = y_{i,t+h} - y_{i,t-1}$ is directly comparable across countries.

The real exchange rate and stock prices are *level indexes* with a fixed base year (2010 = 100). Taking the raw arithmetic difference $y_{i,t+h} - y_{i,t-1}$ for these variables gives absolute index point changes that are not comparable across countries: a country at index 200 and one at index 80 show different numbers for an identical 5% movement. I therefore apply a log difference transformation to RER and stock prices:

$$\Delta^h y_{it}^{\text{idx}} \equiv \log y_{i,t+h} - \log y_{i,t-1}, \tag{3}$$

which measures the log percentage change from the pre crisis year, comparable across all countries. A negative value indicates real depreciation (RER) or equity loss (stock prices). This transformation ensures full consistency with the HP filtered outcome variables and with the log level specification of the commodity price control.

Sudden stop episodes. The sudden stop dates are taken from Bianchi and Mendoza (2020) and follow the definition described in 3.2. Episodes are identified as large year on year increases in the current account to GDP ratio, ca/y, relative to each country's own distribution, together with a systemic filter based on the EMBI for emerging markets and the VIX for advanced economies. The empirical sudden stop indicator SS_{it} equals one in the onset year of these episodes.

Commodity exporter classification. I follow the World Bank *Global Economic Prospects* definition: a country is a commodity exporter if commodity exports exceed 30% of total exports, or if exports of any single commodity exceed 20% of total exports, based on 2017–2019 averages. Commodity importers are not classified as commodity exporters.

Commodity price index. Commodity Export Price Index, Individual Commodities Weighted by Ratio of Exports to GDP, Historical Fixed Weights (IMF). Log transformed and normalized to zero at the 2012 base year.

Controls. Capital account openness from Chinn and Ito (2008); ER regime from Ilzetzki et al. (2022). Both lagged one year.

Income groups (Section 4.4.2). GDP per capita in constant 2015 USD, averaged over 2021–2023 (World Bank WDI, indicator NY.GDP.PCAP.KD), from the country classification file. Used to define Low Income (< p25) and High Income (> p75) groups in the robustness exercise.

World real interest rate. I construct a measure of the world real interest rate using U.S. data from FRED. The nominal rate is the 3-Month Treasury Bill Secondary Market Rate, Discount Basis, and inflation is U.S. consumer price inflation. Both series are obtained from the Federal Reserve Economic Data database. The world real interest rate is defined as

$$R_t^{world} = i_t^{US,Tbill} - \pi_t^{US},$$

where $i_t^{US,Tbill}$ denotes the U.S. 3-month Treasury bill rate and π_t^{US} denotes U.S. CPI inflation. In the robustness analysis, I use the annual change in this real rate, ΔR_t^{world}, interacted with the sudden stop indicator, to test whether the commodity exporter severity premium is driven by global monetary or financial tightening rather than commodity price exposure.

4.3 Results

Figure 1 and Table 3 document the CE/NCE severity differential. At short post crisis horizons, the outcomes generally move in the direction predicted by the model. The most robust and precisely estimated result is the current account reversal. Consumption, investment, the real exchange rate, and stock prices also show economically large CE/NCE differentials at some horizons, while output is directionally similar at impact but less precisely estimated.

The results are confirmed under multiple independent robustness checks: a continuous commodity dependence measure (Section 4.4.1), an income level split (Section 4.4.2), a world interest rate control (Section 4.4.3), and a pre-trend conditioning exercise (Section 4.4.4).

Parallel trends. Table 2 reports joint Wald tests of $H_0 : \hat{\delta}_{-3} = \hat{\delta}_{-2} = 0$, the null that the CE/NCE differential is zero at both pre-onset horizons. The pooled test passes for CA/GDP ($p = 0.308$), consumption ($p = 0.671$), investment ($p = 0.308$), RER ($p = 0.628$), and GDP ($p = 0.296$). For stock prices, the joint test rejects ($p = 0.0004$), with both pre-horizon estimates significantly positive ($\hat{\delta}_{-3} = +0.238^{**}$ and $\hat{\delta}_{-2} = +0.205^{***}$), consistent with CE equity markets being elevated during the commodity boom phase preceding the sudden stop. Because this positive pre-trend goes in the opposite direction from the post-crisis CE equity decline, it biases *against* finding the result and makes the stock price estimates conserva-

tive lower bounds. The Developed subsample also shows a significant CA/GDP pre-trend ($p = 0.017$), driven by $\hat{\delta}_{-3} = +4.59^{***}$ and reflecting pre onset commodity boom dynamics among developed commodity exporters such as Canada, Iceland, and Norway.; this positive pre-trend similarly biases against the CA reversal result in that subgroup. The EM subsample passes for all six variables. Individual pre-horizon coefficient estimates and confidence bands are visible in the IRF figures (Figure 1 for the pooled specification; Figures B1 and B2 in Appendix C for the subgroups).

Table 2: Parallel Trends Test: Joint Wald Test of $H_0 : \hat{\delta}_{-3} = \hat{\delta}_{-2} = 0$

	Emerging Markets		Developed		Pooled	
Variable	$\chi^2(2)$	p	$\chi^2(2)$	p	$\chi^2(2)$	p
GDP	5.24	0.073	1.51	0.470	2.44	0.296
Consumption	0.33	0.850	4.16	0.125	0.80	0.671
Investment	4.21	0.122	1.44	0.488	2.36	0.308
CA/GDP	0.34	0.845	8.20	0.017**	2.36	0.308
RER	1.03	0.597	3.09	0.213	0.93	0.628
Stock prices	3.36	0.186	1.94	0.378	15.74	0.0004***

Notes: Joint Wald test of $H_0 : \hat{\delta}_{-3} = \hat{\delta}_{-2} = 0$, i.e. no CE/NCE differential at the two pre-onset horizons. Test statistic distributed as $\chi^2(2)$ under the null. Cluster-robust standard errors at the country level. Individual pre-horizon coefficient estimates are visible in the IRF figures (Figure 1 for the pooled specification; Figures B1 and B2 in Appendix C for the subgroups). $^{**}p < 0.05$, $^{***}p < 0.01$. The pooled test passes for five of six variables. The stock price test rejects in the pooled sample, reflecting elevated CE equity valuations during the pre-crisis commodity boom phase ($\hat{\delta}_{-3} = +0.238^{**}$, $\hat{\delta}_{-2} = +0.205^{***}$); this positive pre-trend biases *against* finding the post-crisis CE equity decline. The Developed CA/GDP test rejects in the Developed subsample, driven by $\hat{\delta}_{-3} = +4.59^{***}$ and reflecting pre onset commodity boom dynamics among developed commodity exporters such as Canada, Iceland, and Norway.; this positive pre-trend similarly biases against finding the CE current account reversal in that subgroup. The EM subsample passes for all six variables.

Current account reversal. The current account is the most precisely estimated and most robust result across all specifications. In the pooled regression, NCE countries improve their CA by 2.9 pp at $h = 1$ and 2.3 pp at $h = 2$. CE countries improve by 6.2 pp at $h = 1$ and 4.9 pp at $h = 2$. The CE reversal is therefore approximately **112** % larger than the NCE reversal one year after onset and **112** % larger two years after. The differential is +3.29 pp at $h = 1$ (significant at 1 %) and +2.62 pp at $h = 2$ (significant at 1 %). The result also holds at $h = 3$: +1.11 pp (5 %), confirming the reversal premium is persistent across three full years after onset rather than a transitory adjustment. The result holds within both development subgroups (Appendix C), and is particularly striking in the Developed economy group: +3.7 pp at $h = 0$ (1 %), +6.4 pp at $h = 1$ (1 %), +4.0 pp at $h = 2$ (5 %), ruling out development level as the driver.

Consumption. CE consumption falls 2.8 pp more than NCE consumption at $h = 0$ (significant at 5 %), 2.8 pp more at $h = 1$ (1 %), and 2.8 pp more at $h = 2$ (5 %). The differential is persistent across all three post-crisis horizons and is estimated at 1 % significance at $h = 1$. In the Developed economy subsample the differential is 3.8 pp (1 %) and 3.6 pp (1 %) at $h = 0$ and $h = 1$, closely matching the model's Fisherian amplification prediction: commodity price

exposure generates a deeper and more persistent contraction in tradable absorption during sudden stops.

Investment. CE investment contracts 9.2 pp more at $h = 1$ (significant at 5 %) in the pooled specification. The result is even larger in the Developed economy group: −14.7 pp (1 %), −19.6 pp (1 %), and −12.7 pp (1 %) at $h = 0$, $h = 1$, $h = 2$ respectively.While the model abstracts from investment, the magnitude and precision of this result in high income commodity exporters (Canada, Iceland, Norway) is consistent with the mechanism: sharp commodity price reversals during sudden stops force large adjustments in resource sector capital expenditure.

Real exchange rate. The RER depreciates 10.2 log pp more in CE countries at $h = 1$ (10 %) in the pooled specification. The differential is consistently negative from $h = 1$ through $h = 3$ (ranging from 9.3 to 11.7 log pp) but does not reach 5 % significance at any single horizon in the pooled specification. The Developed economy group shows large CE RER depreciations, and the continuous commodity dependence specification confirms the negative pattern (Appendix D). The world interest rate robustness exercise in Section 4.4.3 shows that the short horizon RER differential is not materially attenuated after controlling for $SS_{it} \cdot \Delta R_t^{world}$, suggesting that the estimated RER response is not primarily driven by global interest rate tightening.

Stock prices. Equity markets fall 47.9 log pp (5 %) more for CE countries at $h = 0$ and 53.5 log pp (1 %) more at $h = 1$ in the pooled specification. The CE equity decline is significant at 5 % or better at all post-crisis horizons: 42.4 log pp (5 %) at $h = 2$ and 43.4 log pp (10 %) at $h = 3$. Unlike earlier specifications, the result is persistent across all three post crisis years rather than concentrated at impact. Both pre horizon estimates are significantly positive — $+0.238^{**}$ at $h = -3$ and $+0.205^{***}$ at $h = -2$ — consistent with commodity boom-phase equity valuations, and bias against finding the post-crisis CE equity decline.

Output. CE GDP falls 0.7 pp more at $h = 0$ and 1.0 pp more at $h = 1$ in the pooled specification, but neither reaches conventional significance. The Developed economy subsample shows significantly larger CE output contractions: −2.1 pp (1 %), −3.0 pp (1 %), −1.4 pp (5 %) at $h = 0$, $h = 1$, $h = 2$ (see Appendix C, Figure B2). The GDP result in the EM group is complicated by the positive pre trend noted above. The Developed group shows larger post crisis output differentials, but these estimates should be interpreted together with the

pre trend evidence in Table 2.

Summary. The central result is the current account reversal premium. The CE/NCE CA differential is approximately 112 % larger at $h = 1$, significant at the 1 % level, persistent at $h = 2$ (1 %) and $h = 3$ (5 %), and robust to all seven specifications considered in Section 4.4. Consumption shows a deteriorating differential significant at the 1 % level at $h = 1$ and 5 % at $h = 0$ and $h = 2$, also robust across specifications. The investment differential is significant at 5 % at $h = 1$. The real exchange rate and stock price differentials are directionally consistent with the mechanism — CE depreciates more and CE equities fall more — but the RER differential is marginally significant in the pooled specification and the stock price differential is contaminated by a positive pre-trend that biases against the result. The output differential is directionally negative but not statistically significant in the pooled specification. The current account result is therefore the main empirical fact; the other outcomes are supporting evidence consistent with the same Fisherian amplification mechanism.

Table 3: CE/NCE Differential $\hat{\delta}_h$ – Pooled Specification

Variable	$h = 0$	$h = 1$	$h = 2$	$h = 3$
GDP	−0.677	−1.022	+0.361	+0.373
	(1.057)	(1.028)	(1.151)	(0.976)
Consumption	−2.773**	−2.831***	−2.756**	−1.372
	(1.280)	(1.039)	(1.380)	(1.278)
Investment	−7.344	−9.166**	−4.712	−0.912
	(4.863)	(3.895)	(3.769)	(2.990)
CA/GDP (pp)	+1.220	+3.292***	+2.617***	+1.106**
	(0.965)	(1.074)	(0.897)	(0.532)
RER (log-diff)	−0.066	−0.102*	−0.093	−0.117
	(0.072)	(0.057)	(0.059)	(0.077)
Stock prices (log-diff)	−0.479**	−0.535***	−0.424**	−0.434*
	(0.187)	(0.187)	(0.215)	(0.224)

Notes: Pooled specification of equation (2) with $SS_{it} \cdot EM_i$ control. Cluster-robust SEs in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. $h = -1$ omitted. Horizons $h = -3$ and $h = -2$ (pre-period) omitted; see Table 2. GDP, consumption, investment: HP-filtered % deviations; CA/GDP: pp; RER and stock prices: log differences. NCE baseline CA/GDP: +3.9 pp at $h = 0$, +2.9 pp at $h = 1$, +2.3 pp at $h = 2$. CE total: +5.2 pp, +6.2 pp, +4.9 pp. CE reversal $\approx$ 112 % larger than NCE at $h = 1$.

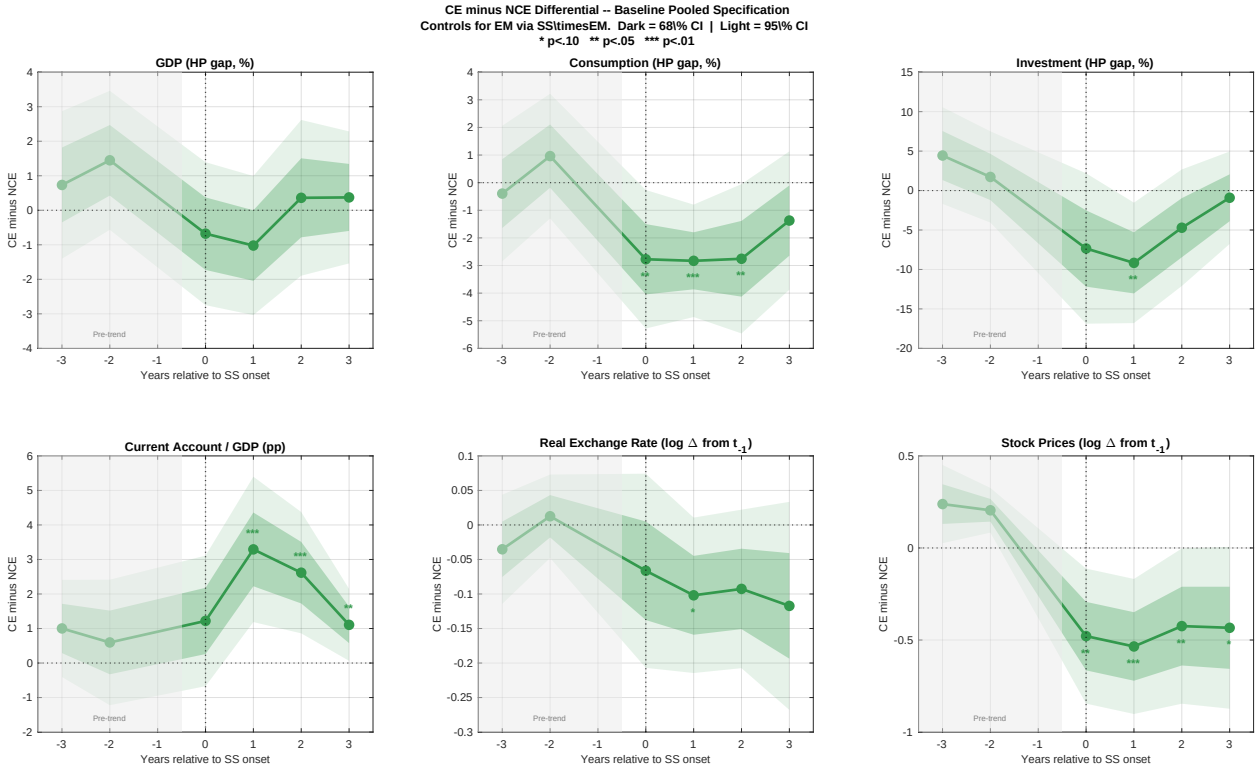


Figure 1: CE/NCE Severity Differential – Main Specification (Pooled)

Notes: $\hat{\delta}_h$ from pooled specification with $SS_{it} \cdot EM_i$ control. Dark band: 68 % CI. Light band: 95 % CI. Stars: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. CA/GDP significant at 1 % at $h = 1$ and $h = 2$, and 5 % at $h = 3$. Stock prices significant at 5 % at $h = 0$, 1 % at $h = 1$, 5 % at $h = 2$, and 10 % at $h = 3$ — persistent across all post-crisis horizons. Consumption significant at 5 % at $h = 0$, 1 % at $h = 1$, and 5 % at $h = 2$. RER marginally significant (10 %) at $h = 1$. Emerging markets and Developed subgroup paths in Appendix C.

4.4 Robustness

4.4.1 Continuous Commodity Dependence

Replacing the binary CE dummy with the standardized share of commodity exports in total merchandise exports (UNCTAD, 2021–2023) delivers a dose response slope δ_h^{CD} per standard deviation. The IQR differential evaluates it between the 75th percentile of the distribution of countries with at least one SS episode ($CD = 80.2\,\%$) and 25th percentile ($CD = 25.6\,\%$) of the distribution. CA/GDP: +2.8 pp at $h = 1$ (1 %), +2.6 pp at $h = 2$ (1 %) and +0.9 pp at $h = 3$ (5 %). Consumption: −2.4 pp at $h = 1$ (1 %) and −2.6 pp at $h = 2$ (5 %). RER: −9.1 log pp at $h = 2$ (10 %). Stock prices: −30.4 log pp at $h = 0$ (5 %), −40.9 log pp at $h = 1$ (1 %), with the result persistent through $h = 3$ (−32.9 log pp, 10 %). These estimates closely match the binary specification and confirm a smooth dose response across the full distribution. Full results in Appendix D.

4.4.2 Income Level

As a robustness check, I test whether the CE severity premium is explained by differences in income levels rather than commodity exporter status. I define income groups using GDP per capita in constant 2015 USD, averaged over 2021–2023. High income countries are those above the 75th percentile of the distribution of countries with at least one SS episode ($p75$ = \$38,740), and low income countries are those below the 25th percentile ($p25$ = \$5,765). I report a pooled specification estimated over the full sample that replaces the EM/Dev control with a high income indicator. Because country fixed effects absorb the level effect of income status, the relevant control is $SS_{it} \times HighIncome_i$. The coefficient on $SS_{it} \times CE_i$ therefore measures the CE/NCE severity premium after absorbing the average sudden stop severity difference of high income economies. The corresponding Low Income and High Income subgroup estimates are reported in E.

The pooled income control specification delivers results very similar to the baseline pooled specification. The current account reversal remains the most robust result: CA/GDP rises by +3.0 pp more for commodity exporters at $h = 1$ (1 %) and by +2.3 pp at $h = 2$ (5 %). Consumption falls 3.2 pp more at $h = 0$ (1 %) and 3.1 pp more at $h = 1$ (1 %). Investment falls 9.0 pp more at $h = 0$ (5 %) and 9.5 pp more at $h = 1$ (1 %). The real exchange rate depreciates 11.0 log pp more at $h = 1$ (10 %) and 9.9 log pp more at $h = 2$ (10 %). Stock prices fall 47.7 log pp more at $h = 0$ (5 %), 52.1 log pp more at $h = 1$ (1 %), and 40.0 log pp more at $h = 2$ (10 %). The output differential is negative at impact and one year after onset, but it does not reach conventional statistical significance.

These estimates show that the sharper external adjustment and domestic contraction of commodity exporters are not absorbed by controlling for high income status. The subgroup results in E provide a complementary check: the CE premium remains large within the high income group and within low income group. Taken together, the evidence suggests that the CE/NCE severity premium is not simply an income level effect.

4.4.3 World Real Interest Rate

Neumeyer and Perri (2005) and Uribe and Yue (2006) emphasize that world interest rates, country spreads, and external financial conditions are central drivers of emerging market business cycles and crisis dynamics. A natural concern is that commodity prices and world real rates may co-move negatively, so that the CE/NCE severity differential partly reflects differential exposure to global tightening rather than commodity price exposure per se. I address this concern in three steps.

Step 1: Comovement between commodity prices and world rates. I estimate the regression

$$\Delta \log P_{it} = \alpha_i + \phi_1 \Delta R_t + \phi_2 SS_{it} + \phi_3 SS_{it} \cdot \Delta R_t + \varepsilon_{it}$$

using country fixed effects only (year fixed effects would absorb ΔR_t since it is a world variable), where ΔR_t is the first difference of the US 3-month real interest rate. The unconditional sensitivity is $\hat{\phi}_1 = -0.0024$ ($p < 0.001$), confirming that commodity prices fall when world rates rise. A key identification concern is therefore that commodity price declines and interest rate increases may occur simultaneously during sudden stops, so that the CE severity premium partly reflects differential exposure to global tightening rather than the commodity price channel. The coefficient $\hat{\phi}_3$ on $SS_{it} \cdot \Delta R_t$ directly addresses this: it is statistically indistinguishable from zero (-0.000771, $p = 0.629$), meaning commodity prices do not fall more sharply when world rates rise during sudden stop episodes than in normal times. The proposed compounding mechanism is not present in the data. The episode-level correlation between $\Delta \log P$ and ΔR is -0.231 for CE episodes and -0.384 for NCE episodes; CE episodes show *weaker* co-movement than NCE, the opposite of what the concern would predict.

Step 2: IR-controlled LP-DiD. I add $SS_{it} \cdot \Delta R_t$ as an additional regressor to equation (2). Year fixed effects absorb the level of R_t but not its interaction with the crisis indicator; the coefficient λ_h on $SS_{it} \cdot \Delta R_t$ captures the direct severity effect of world rate changes during sudden stops. The CE/NCE CA/GDP differential at $h = 1$ is +3.20 pp (1 %) in the IR-controlled specification, compared with +3.29 pp in the baseline — an attenuation of only 3 %. The consumption differential is −2.68 pp (1 %) versus −2.83 pp in the baseline. Both results survive with 1 % significance. The real exchange rate differential shows minimal attenuation after the IR control (-0.100^* versus -0.102^* at $h = 1$, a change of less than 2 %), confirming that the RER result at short horizons is not driven by global credit tightening through the interest rate channel.

Step 3: Split-sample by world rate direction. To test whether the CE premium is concentrated in years when world rates were rising — which would suggest a timing artifact rather than commodity exposure — I classify each sudden stop episode as occurring in a high-ΔR year ($\Delta R >$ median across SS-episode years, 0.65 pp) or a low-ΔR year. The CE/NCE CA/GDP differential at $h = 1$ is −0.03 pp in high-ΔR episodes and **+6.48** pp (1 %) in low-ΔR episodes. The CE premium is larger — not smaller — in years when world rates were falling or stable. This rules out the timing artifact: the CA and consumption CE premiums are entirely concentrated in low-ΔR episodes, confirming they operate through the commodity price channel rather than global tightening. By contrast, the stock price CE premium is concentrated in high-ΔR episodes (−1.98 log pp, 5 %), consistent with an additional channel whereby commodity sector equities are especially vulnerable when global credit tightens simultaneously with commodity price declines.

The three steps jointly establish that the CE severity premium in the current account and consumption is not a disguised world interest rate effect. Figures for the IR-controlled specification and the split-sample comparison are in Appendix F.

4.4.4 Pre-trend Conditioning

The joint Wald test for CA/GDP passes at the pooled level ($\chi^2(2) = 2.36$, $p = 0.308$; Table 2). Nevertheless, the individual pre-horizon coefficients underlying that test are both positive ($\hat{\delta}_{-3} = +1.00$ pp, $p = 0.163$; $\hat{\delta}_{-2} = +0.60$ pp, $p = 0.521$), consistent with CE countries entering sudden stops from a stronger CA position during the commodity boom phase. Because these pre-trends are positive, they bias against finding the post-crisis reversal. To

provide a direct formal check, I add $SS_{it} \cdot CA_{i,t-5}$ as an additional regressor, controlling for the pre-crisis CA/GDP level using a five-year lag that avoids direct contamination from the boom phase.

After conditioning on $CA_{i,t-5}$, the CA/GDP differential at $h = 1$ *increases* from +3.29 pp to +4.68 pp (both 1 % significance). The strengthening occurs because CE countries entered sudden stops from a stronger CA position, and once this is held fixed, the forced reversal appears even larger. This is the opposite of what would be expected if the pre-trend were generating a spurious result: conditioning on the pre-crisis CA level makes the CE severity premium larger, not smaller, confirming that the commodity boom-phase CA accumulation did not insulate against the sudden stop amplification mechanism. Results for all variables are in Appendix F.

4.4.5 Summary of Robustness

Table 4 summarizes the CE/NCE differential at $h = 1$ across all robustness specifications. The CA/GDP reversal is positive and significant at 1 % in six of seven specifications, ranging from +2.79 to +4.68 pp. The only attenuation occurs in the specification that drops the commodity price control (No-P, +1.58 pp). The No-P specification should be interpreted with caution because dropping the contemporaneous commodity price control changes the estimate. The attenuation of the CA/GDP coefficient from +3.29 pp to +1.58 pp suggests that the commodity price control is empirically important for isolating the residual CE/NCE severity premium. I therefore report both specifications, but use the baseline with the price control as the preferred conditional comparison.

Consumption is significant at 5 % or better in every specification. Stock prices are significant at 1 % in six of seven specifications and at 5 % in the remaining specification. Investment is significant at 5 % or better in five of seven. The consumption and investment differentials also attenuate without the commodity price control (-2.21^{*} and -4.80 in No-P versus -2.83^{***} and -9.17^{**} in Main), reinforcing the interpretation that the contemporaneous price movement is a quantitatively important component of the CE severity premium across multiple outcomes.

The CE severity premium is robust across most specifications. The main exception is the No-P specification, where the CA/GDP coefficient remains positive but loses statistical significance, consistent with the commodity price control being important for the preferred

conditional comparison.

Table 4: Robustness of the CE/NCE Severity Premium at $h = 1$ (Pooled)

Variable	Main	CD	Income	IR	PTC	No-P	CC
GDP (%)	-1.02	-0.12	-1.30	-0.94	-1.87	-0.43	-1.09
	(1.03)	(1.00)	(1.04)	(1.06)	(1.25)	(1.05)	(1.04)
CA/GDP (pp)	$+3.29^{***}$	$+2.79^{***}$	$+2.98^{***}$	$+3.20^{***}$	$+4.68^{***}$	$+1.58$	$+3.27^{***}$
	(1.07)	(0.97)	(1.05)	(1.07)	(1.30)	(1.10)	(1.08)
Consumption (%)	-2.83^{***}	-2.36^{***}	-3.13^{***}	-2.68^{***}	-2.70^{**}	-2.21^{*}	-3.03^{***}
	(1.04)	(0.90)	(0.98)	(1.03)	(1.10)	(1.17)	(1.05)
Investment (%)	-9.17^{**}	-5.29	-9.51^{***}	-8.78^{**}	-12.09^{**}	-4.80	-9.78^{**}
	(3.90)	(3.74)	(3.50)	(3.92)	(5.20)	(3.85)	(3.95)
RER (log-diff)	-0.102^{*}	-0.082	-0.110^{*}	-0.100^{*}	-0.056	-0.087	-0.105^{*}
	(0.057)	(0.054)	(0.057)	(0.056)	(0.054)	(0.059)	(0.064)
Stock prices (log-diff)	-0.54^{***}	-0.41^{***}	-0.52^{***}	-0.58^{***}	-0.47^{**}	-0.48^{***}	-0.57^{***}
	(0.19)	(0.13)	(0.18)	(0.19)	(0.22)	(0.16)	(0.19)

Notes: CE/NCE differential at $h = 1$ across seven specifications. Main: baseline pooled specification of Table 3. CD: continuous commodity dependence (IQR differential, p25 vs p75). Income: pooled with $SS_{it} \cdot HighIncome_i$ replacing the EM dummy. IR: adds $SS_{it} \cdot \Delta R_t^{world}$. PTC: adds $SS_{it} \cdot CA_{i,t-5}$. No-P: drops the $\Delta \log P_{it}$ commodity price controls. CC: clean-control LP-DiD à la Dube et al. (2023), restricting the comparison units to those at least three years from any future sudden stop. Cluster robust SEs. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

4.5 What This Section Cannot Establish

Three limitations are worth stating clearly. First, the GDP joint Wald test in the EM subsample is marginally significant ($\chi^2(2) = 5.24$, $p = 0.073$), with both pre-horizon estimates positive ($\hat{\delta}_{-3} = +1.84$ pp, $\hat{\delta}_{-2} = +2.83^{*}$ pp), indicating that CE emerging markets were in an above-trend expansion before the sudden stop. The LP-DiD cannot fully separate boom-bust dynamics from the crisis episode itself. The model provides the structural interpretation: the commodity boom builds up debt and collateral values, so the reversal is sharper when the episode arrives.

Second, for stock prices, the joint Wald test fails decisively at the pooled level ($\chi^2(2) = 15.74$, $p = 0.0004$), with both pre horizon estimates significantly positive ($\hat{\delta}_{-3} = +0.238^{**}$, $\hat{\delta}_{-2} = +0.205^{***}$). CE equity markets were elevated before the sudden stop onset, consistent with commodity boom valuations. Because the post crisis differential is negative, this positive pre trend does not mechanically generate the equity decline. However, it does indicate that the stock price result partly reflects boom-bust dynamics around commodity cycles. I therefore interpret stock prices as supporting evidence for the amplification mechanism rather than as the cleanest test of the LP-DiD design.

Third, investment is large and significant but absent from the model. The endowment economy structure of Section 5 abstracts from capital accumulation by construction. The investment result supports the mechanism but is not a structural model test; it is an empirical regularity that a richer framework with capital accumulation would need to address.

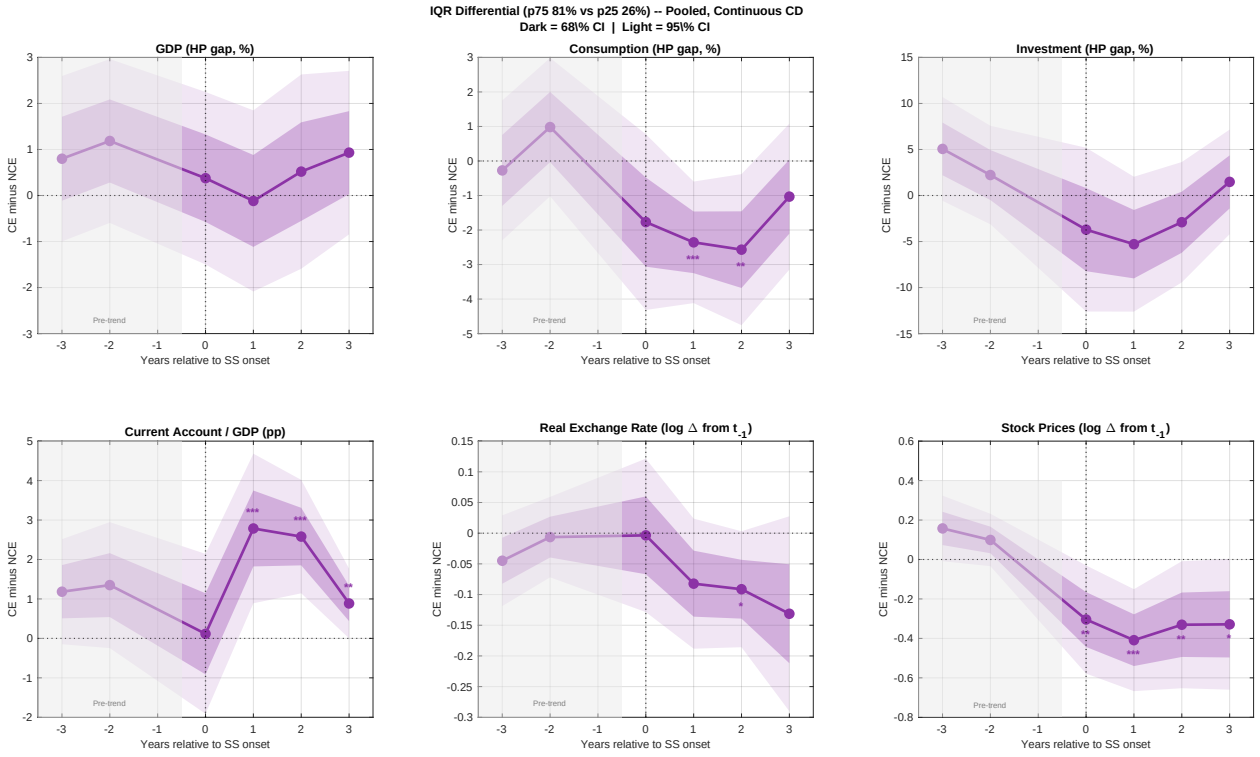


Figure 2: CE/NCE Severity Differential – Continuous Commodity Dependence (Pooled)

Notes: IQR differential from the continuous CD specification (equation (48)), p75 = 81 % vs p25 = 26 % commodity export share. Stars based on p-value of $\hat{\delta}_h^{CD}$. CA/GDP: +2.8 pp (1 %) at $h = 1$; +2.6 pp (1 %) at $h = 2$. Consumption: −2.4 pp (1 %) at $h = 1$. Stock prices: −40.9 log-pp (1 %) at $h = 1$. RER: −9.1 log-pp (10 %) at $h = 2$. Full subgroup figures in Appendix D.

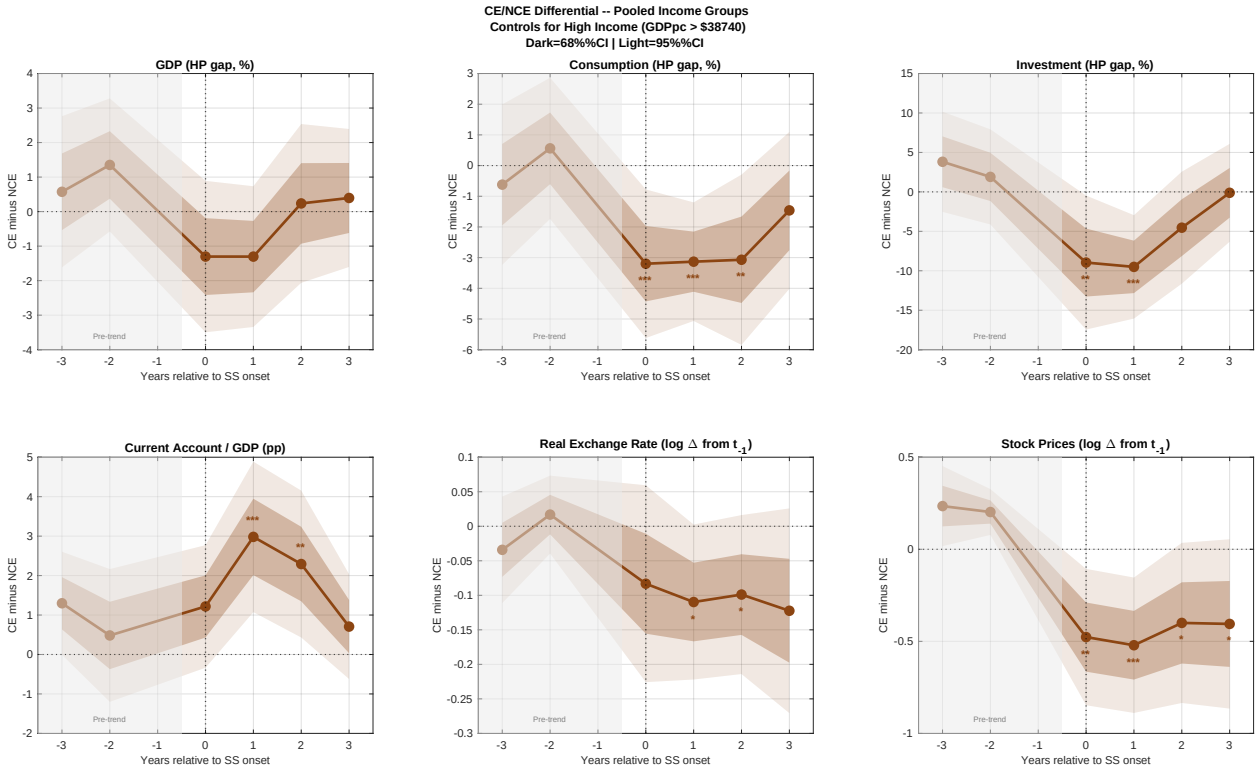


Figure 3: CE/NCE Severity Differential – Income Level (pooled)

Notes: Severity differential ($\hat{\delta}_h$) from the pooled specification. Stars based on p-value of $\hat{\delta}_h$. CA/GDP: +3.0 pp (1 %) at $h = 1$; +2.3 pp (5 %) at $h = 2$. Consumption: −3.2 pp (1 %) at $h = 0$; −3.1 pp (1 %) at $h = 1$. Investment: −9.5 pp (1 %) at $h = 1$. Stock prices: −47.7 log-pp (5 %) at $h = 0$; −52.1 log-pp (1 %) at $h = 1$. RER: −11.0 log-pp (10 %) at $h = 1$.

5 Theoretical Framework

This section develops a quantitative model to explain the empirical severity premium documented above. The goal of the model is not to explain why commodity exporters experience sudden stops more frequently, but why sudden stops are more severe conditional on occurring. I extend the sudden stop framework of Bianchi (2011) by introducing commodity exporter status into tradable income. The key departure from the benchmark model is that tradable income is composed of a non commodity component and a commodity price component, with economies differing only in the share of commodity income. This single modification generates systematic differences in crisis severity between commodity exporters and non commodity exporters, while keeping the financial friction governed by a common set of parameters.

5.1 Environment

Consider a small open economy inhabited by a representative household. Time is discrete and indexed by $t = 0, 1, 2, \ldots$. The economy consumes a tradable good and a nontradable good. Let c_t^T denote tradable consumption and c_t^N nontradable consumption.

Preferences are

$$E_0 \sum_{t=0}^{\infty} \beta^t u(c_t), \qquad 0 < \beta < 1, \tag{4}$$

where aggregate consumption c_t is a CES composite:

$$c_t = \left[\omega \left(c_t^T\right)^{-\eta} + (1-\omega)\left(c_t^N\right)^{-\eta}\right]^{-1/\eta}, \qquad \omega \in (0,1),\ \eta > -1, \tag{5}$$

and instantaneous utility is CRRA:

$$u(c_t) = \frac{c_t^{1-\sigma} - 1}{1-\sigma}, \qquad \sigma > 0,\ \sigma \neq 1. \tag{6}$$

The economy receives exogenous endowments of tradable and nontradable goods, y_t^T and y_t^N. The central extension relative to Bianchi (2011) is that tradable income decomposes as

$$y_t^T = (1-\alpha)\, z_t + \alpha\, p_t^C, \qquad \alpha \in [0,1], \tag{7}$$

where $z_t > 0$ is non-commodity tradable productivity, $p_t^C > 0$ is the world commodity price

(both in levels, following AR(1) processes in logs), and α is the commodity share of tradable income at the deterministic steady state. Economies with higher α are commodity exporters; those with lower α are non commodity exporters.

Exogenous processes. The three driving forces z_t, p_t^C, and y_t^N follow independent AR(1) processes in logs:

$$\log z_{t+1} = \rho_z \log z_t + \varepsilon_{t+1}^z, \tag{8}$$

$$\log p_{t+1}^C = \rho_C \log p_t^C + \varepsilon_{t+1}^C, \tag{9}$$

$$\log y_{t+1}^N = \rho_N \log y_t^N + \varepsilon_{t+1}^N, \tag{10}$$

where ε^z, ε^C, ε^N are mutually independent i.i.d. Gaussian innovations with zero mean and standard deviations σ_z, σ_C, σ_N, respectively. The independence assumption isolates the role of tradable income composition. Both economies face the same underlying shock processes and the same financial friction, but a higher-α economy loads more heavily on the commodity price component and less heavily on the non commodity tradable component. The CE/NCE difference therefore arises from the composition of tradable income rather than from differences in preferences, financial frictions, or shock distributions.

5.2 Budget Constraint and Borrowing Constraint

The economy trades a one period bond with the rest of the world. Let b_{t+1} denote end of period bond holdings (negative values correspond to debt) and $R = 1 + r$ the gross world interest rate. Let p_t^N denote the relative price of nontradables in units of tradables.

The household's period budget constraint is:

$$c_t^T + p_t^N c_t^N + b_{t+1} = y_t^T + p_t^N y_t^N + Rb_t. \tag{11}$$

The nontradable market clears domestically each period:

$$c_t^N = y_t^N. \tag{12}$$

Substituting (12) into (11) yields

$$c_t^T + b_{t+1} = y_t^T + Rb_t. \tag{13}$$

International borrowing is subject to a collateral constraint:

$$b_{t+1} \geq -\kappa\left(p_t^N y_t^N + y_t^T\right), \qquad \kappa > 0. \tag{14}$$

This constraint limits debt to a fraction κ of the contemporaneous market value of income. Because nontradable output is valued at its endogenous relative price p_t^N, the constraint is state dependent and generates Fisherian amplification.

Remark on the current account. Define the current account as the improvement in the net foreign asset position:

$$CA_t \equiv b_{t+1} - b_t. \tag{15}$$

Since the economy is a net debtor in normal times ($b_t < 0$), a sudden stop corresponds to a sharp *positive* value of CA_t: the household is forced to reduce its debt more than it would choose unconstrained. This is the phenomenon documented empirically as a current account *reversal*, and it is the primary moment targeted in the quantitative analysis.

5.3 Intratemporal Allocation and the Relative Price of Nontradables

Let λ_t be the multiplier on the budget constraint. The first-order conditions with respect to c_t^T and c_t^N are:

$$u_c(c_t)\,\frac{\partial c_t}{\partial c_t^T} = \lambda_t, \tag{16}$$

$$u_c(c_t)\,\frac{\partial c_t}{\partial c_t^N} = \lambda_t\, p_t^N. \tag{17}$$

Define $A_t \equiv \omega(c_t^T)^{-\eta} + (1-\omega)(c_t^N)^{-\eta}$ so that $c_t = A_t^{-1/\eta}$. Computing the partial derivatives,

$$\frac{\partial c_t}{\partial c_t^T} = \omega\, c_t^{1+\eta}(c_t^T)^{-\eta-1}, \qquad \frac{\partial c_t}{\partial c_t^N} = (1-\omega)\, c_t^{1+\eta}(c_t^N)^{-\eta-1}.$$

Since $u_c(c_t) = c_t^{-\sigma}$, dividing (17) by (16) and applying market clearing $c_t^N = y_t^N$ gives:

$$p_t^N = \frac{1-\omega}{\omega}\left(\frac{c_t^T}{y_t^N}\right)^{1+\eta}. \tag{18}$$

Equation (18) is central to the amplification mechanism: a decline in tradable consumption c_t^T depresses p_t^N, which shrinks the collateral value of nontradable output and tightens the

borrowing constraint.

5.4 Dynamic Optimization Problem

Let the aggregate state be $s_t = (b_t,\, z_t,\, p_t^C,\, y_t^N)$. The household's problem in recursive form is

$$V(b, z, p^C, y^N) = \max_{c^T,\, b'} \Big\{ u\big(c(c^T, y^N)\big) + \beta\, E\big[V(b', z', p^{C\prime}, y^{N\prime}) \mid z, p^C, y^N\big] \Big\} \tag{19}$$

subject to

$$c^T + b' = y^T + Rb, \tag{20}$$

$$y^T = (1-\alpha)\, z + \alpha\, p^C, \tag{21}$$

$$b' \geq -\kappa\big(p^N y^N + y^T\big)\,, \tag{22}$$

$$p^N = \frac{1-\omega}{\omega}\left(\frac{c^T}{y^N}\right)^{1+\eta}. \tag{23}$$

The recursive formulation makes clear that commodity exporter status enters exclusively through the scalar α. All differences between economies are therefore driven by the composition of tradable income, not by differences in preferences, interest rates, or financial friction parameters.

5.5 Euler Equation and Occasionally Binding Constraint

Let $\mu_t \geq 0$ be the multiplier on (14). The first-order condition for b_{t+1} is

$$\omega\, c_t^{1+\eta-\sigma} (c_t^T)^{-\eta-1} = \beta R\, E_t\big[\omega\, c_{t+1}^{1+\eta-\sigma} (c_{t+1}^T)^{-\eta-1}\big] + \mu_t. \tag{24}$$

Complementary slackness requires $\mu_t \geq 0$ and $\mu_t\big(b_{t+1} + \kappa(p_t^N y_t^N + y_t^T)\big) = 0$. When the constraint does not bind, $\mu_t = 0$ and the household smooths consumption intertemporally. When it binds, $\mu_t > 0$, the household would like to borrow more but cannot, so tradable consumption falls abruptly, the current account improves sharply, and the relative price of nontradables depreciates—a sudden stop.

5.6 Competitive Equilibrium

A competitive equilibrium consists of policy functions $\{c_t^T(s_t),\; b_{t+1}(s_t),\; p_t^N(s_t)\}$ such that:

1. The household solves its dynamic optimization problem given prices and the borrowing constraint.

2. The nontradable market clears: $c_t^N = y_t^N$.

3. The relative price satisfies the intratemporal condition (18).

4. The exogenous processes follow their AR(1) laws of motion.

5.7 Theoretical Mechanism: Why Sudden Stops Are More Severe in Commodity Exporters

This subsection derives the core mechanism. The key result is that, for a given adverse commodity price shock, the collateral constraint tightens more sharply in economies with a higher commodity share α, generating larger forced deleveraging and larger current account reversals in commodity exporters.

5.7.1 Direct Effect of Commodity Prices on Borrowing Capacity

The borrowing limit implied by (14) is

$$\bar{b}_{t+1} = -\kappa\left(p_t^N y_t^N + y_t^T\right). \tag{25}$$

Substituting (7) and holding p_t^N fixed:

$$\frac{\partial \bar{b}_{t+1}}{\partial p_t^C} = -\kappa\alpha. \tag{26}$$

For two economies with $\alpha_{\text{CE}} > \alpha_{\text{NCE}}$,

$$\left|\frac{\partial \bar{b}_{t+1}^{\text{CE}}}{\partial p_t^C}\right| > \left|\frac{\partial \bar{b}_{t+1}^{\text{NCE}}}{\partial p_t^C}\right|. \tag{27}$$

A commodity price decline reduces borrowing capacity more sharply in the commodity exporting economy.

5.7.2 Fisherian Amplification Through the Relative Price of Nontradables

The direct effect is amplified endogenously. From (18),

$$\frac{\partial p_t^N}{\partial c_t^T} = (1+\eta)\,\frac{p_t^N}{c_t^T} > 0. \tag{28}$$

When the constraint binds, substituting (25) into (13) yields

$$c_t^T = (1+\kappa)\big[(1-\alpha)z_t + \alpha p_t^C\big] + Rb_t + \kappa\, p_t^N y_t^N. \tag{29}$$

Differentiating with respect to p_t^C and substituting (28):

$$\frac{dc_t^T}{dp_t^C} = (1+\kappa)\alpha + \kappa y_t^N\,(1+\eta)\,\frac{p_t^N}{c_t^T}\,\frac{dc_t^T}{dp_t^C}. \tag{30}$$

Solving,

$$\frac{dc_t^T}{dp_t^C} = \frac{(1+\kappa)\alpha}{1-\kappa(1+\eta)\,\dfrac{p_t^N y_t^N}{c_t^T}}. \tag{31}$$

Under the regularity condition $1-\kappa(1+\eta)\,p_t^N y_t^N/c_t^T > 0$, the multiplier exceeds unity, so tradable consumption responds to p_t^C more than the direct exposure α alone would suggest.

Analogously, the total derivative of the relative price is:

$$\frac{dp_t^N}{dp_t^C} = \frac{(1+\eta)\,\dfrac{p_t^N}{c_t^T}\,(1+\kappa)\,\alpha}{1-\kappa(1+\eta)\,\dfrac{p_t^N y_t^N}{c_t^T}} > 0, \tag{32}$$

so a fall in commodity prices also depresses the relative price of nontradables, further tightening the constraint.

5.7.3 Total Effect on Borrowing Capacity and the Current Account

Using (25), the total derivative of borrowing capacity is

$$\frac{d\,\bar{b}_{t+1}}{dp_t^C} = -\kappa\left[\alpha + y_t^N\,\frac{dp_t^N}{dp_t^C}\right]. \tag{33}$$

Since $dp_t^N/dp_t^C > 0$ and is increasing in α (from (32)), the total effect is more negative than the direct effect $-\kappa\alpha$, and is strictly increasing in α.

The current-account impact of a negative shock $dp_t^C < 0$ follows directly. Because $d\,\bar{b}_{t+1}/dp_t^C < 0$,

$$d\,CA_t = d\,\bar{b}_{t+1} = \frac{d\,\bar{b}_{t+1}}{dp_t^C}\,dp_t^C > 0.$$

The economy is forced into a current account improvement, and this reversal is larger in the commodity-exporting economy.

Proposition 1. *Consider two economies identical in all respects except for the commodity share, with $\alpha_{\text{CE}} > \alpha_{\text{NCE}}$. For a given adverse commodity price shock, the collateral constraint tightens more sharply in the commodity exporting economy through two channels: (i) a direct channel, whereby lower commodity prices reduce tradable income proportionally to α; and (ii) an indirect (Fisherian) channel, whereby the resulting decline in tradable absorption depresses the relative price of nontradables, further eroding collateral values. Both channels are increasing in α. Consequently, conditional on hitting the borrowing constraint, the commodity exporting economy experiences a larger forced deleveraging and a larger current account reversal.*

Proof. From (26), the direct sensitivity of borrowing capacity is proportional to α, so a negative shock reduces capacity more in the high-α economy. From (32), the indirect effect through p_t^N is also increasing in α. Combining both in (33) establishes that $|d\,\bar{b}_{t+1}/dp_t^C|$ is strictly larger in the commodity exporting economy. Locally, holding the endogenous price and consumption terms fixed, the indirect effect is proportional to α. The numerical solution below confirms that this amplification increases with commodity exposure in the full nonlinear economy. □

5.7.4 Summary of the Mechanism

The model implies that commodity exporters need not experience sudden stops more *frequently* than non commodity exporters: both economies share the same collateral parameter κ and the same non commodity shock processes. The central prediction is that their crises are more *severe*. This can be summarized in five steps.

1. A fall in the commodity price reduces tradable income by $\alpha\, dp_t^C$ more in a commodity exporter.

2. Lower tradable income reduces tradable absorption.

3. Lower tradable absorption depresses the relative price of nontradables via (18), generating Fisherian deflation.

4. The decline in both tradable income and the market value of nontradable output tightens the collateral constraint via (14), forcing sharper deleveraging.

5. The differential response is strongest for commodity price shocks because the loading on p_t^C is increasing in α. Non commodity shocks and nontradable shocks are drawn from the same processes in both economies, but the composition of tradable income

makes high-α economies more exposed to commodity price realizations. The CE/NCE differential in crisis severity is therefore informative about the quantitative importance of the commodity price component.

This is the main prediction taken to the quantitative analysis in Section 7.

6 Calibration

The model is calibrated at annual frequency. Structural parameters follow Bianchi (2011) directly, with two modifications: the shock structure is extended from a bivariate to a trivariate independent system, and the collateral parameter κ is recalibrated to match an empirical sudden stop frequency target under the new shock structure. Commodity exposure parameters are calibrated separately for each economy type. Table 5 summarizes all parameter values.

Table 5: Calibration Summary

Parameter	Description	Value	Source
Preferences and technology			
σ	Risk aversion	2	Bianchi (2011)
η	CES curvature $(1/(1+\eta) = 0.83)$	0.205	Bianchi (2011)
β	Discount factor	0.906	Bianchi (2011)
ω	Tradable weight in CES	0.307	Bianchi (2011)
r	World interest rate	0.04	Bianchi (2011)
κ	Collateral tightness	(calib.)	See Section 6.4
Shock processes			
ρ_z	Persistence of z_t	0.54	Bianchi (2011)
σ_z	Std. of z_t innovation	0.034	Bianchi (2011)
ρ_C	Persistence of p_t^C	0.815	Medina and Soto (2016)
σ_C	Std. of p_t^C innovation	0.167	Medina and Soto (2016)
ρ_N	Persistence of y_t^N	0.54	Bianchi (2011)
σ_N	Std. of y_t^N innovation	0.057	Bianchi (2011)
Commodity exposure			
α_{CE}	Commodity share, CE (Chile)	0.40	Cochilco; Banco Central de Chile
α_{mid}	Commodity share, MID-CE	0.225	Midpoint $[\alpha_{\text{NCE}}, \alpha_{\text{CE}}]$
α_{NCE}	Commodity share, NCE	0.05	Calibrated
Numerical			
N_b	Bond grid points	100	Bianchi (2011)
n_g	Quadrature nodes per shock	5	Tauchen and Hussey (1991)
N_s	Joint state space (n_g^3)	125	
$\underline{b}$	Bond grid lower bound	-1.02	Bianchi (2011)
$\bar{b}$	Bond grid upper bound	-0.20	Bianchi (2011)

6.1 Structural Parameters

The utility parameters follow Bianchi (2011): the coefficient of relative risk aversion is $\sigma = 2$; the elasticity of substitution between tradable and nontradable consumption is $1/(1+\eta) = 1/1.20$, so $\eta = 0.205$; the weight on tradable consumption in the CES aggregator is $\omega = 0.307$; and the discount factor is $\beta = 0.906$. The world gross interest rate is $R = 1.04$.

6.2 Shock Processes

Non-commodity tradable productivity, z_t. Following Bianchi (2011), the log-process has persistence $\rho_z = 0.54$ and innovation standard deviation $\sigma_z = 0.034$.

Commodity price, p_t^C. The process is calibrated to copper prices from Medina and Soto (2016), who estimate a quarterly AR(1) for the Chilean economy with persistence $\rho_q = 0.95$ and innovation standard deviation $\sigma_q = 0.09$. Converting to annual frequency by aggregating four quarters:

$$\rho_C = \rho_q^4 = 0.95^4 = 0.8145, \tag{34}$$

$$\sigma_C = \sigma_q \sqrt{1 + \rho_q^2 + \rho_q^4 + \rho_q^6} = 0.09 \times \sqrt{1 + 0.9025 + 0.8145 + 0.7351} = 0.1672. \tag{35}$$

The implied unconditional standard deviation is $\sigma_C/\sqrt{1-\rho_C^2} \approx 0.288$, reflecting the high persistence of commodity prices at annual frequency. This persistence is the key driver of Fisherian amplification in the commodity exporting economy.

Nontradable endowment, y_t^N. Following Bianchi (2011), $\rho_N = 0.54$ and $\sigma_N = 0.057$. The three shocks are mutually independent by assumption, which isolates the commodity price channel as the sole source of heterogeneity across economies.

6.3 Commodity Exposure Parameters

The commodity share α is set separately for each economy type.

CE economy ($\alpha_{\text{CE}} = 0.40$). The CE economy is calibrated to Chile, with copper as the reference commodity. Copper exports averaged approximately 13–16 percent of Chilean GDP over the calibration period, while the tradable sector accounts for roughly 27–30 percent of GDP (Cochilco, Banco Central de Chile). This implies a copper share of tradable income of approximately 0.43–0.53. I adopt the conservative value $\alpha_{\text{CE}} = 0.40$ as a lower bound on this range.

Because Chile is highly commodity dependent, I interpret $\alpha_{CE} = 0.40$ as an upper bound commodity exporter calibration. The midpoint calibration $\alpha = 0.225$, introduced below, is closer to an average commodity exporting emerging market.

NCE economy ($\alpha_{\text{NCE}} = 0.05$). The NCE economy represents a manufacturing dominant emerging market. A value of $\alpha_{\text{NCE}} = 0.05$ captures minimal direct commodity exposure while remaining positive to reflect a small commodity component presence.

MID-CE economy ($\alpha_{\text{mid}} = 0.225$). To assess the robustness of the results to the Chilean calibration, I simulate a third economy at $\alpha_{\text{mid}} = 0.225$, the midpoint of $[\alpha_{\text{NCE}}, \alpha_{\text{CE}}]$. This calibration represents a moderately commodity dependent emerging market, less commodity intensive than Chile, but more so than the NCE benchmark. The results for this economy are reported alongside the main NCE and CE results in Section 8.4.

The implied one period innovation standard deviations of tradable income are:

$$\sigma(y^T_{\text{NCE}}) = \sqrt{(1-\alpha_{\text{NCE}})^2\sigma_z^2 + \alpha^2_{\text{NCE}}\sigma_C^2} \approx 3.3\%, \tag{36}$$

$$\sigma(y^T_{\text{mid}}) = \sqrt{(1-\alpha_{\text{mid}})^2\sigma_z^2 + \alpha^2_{\text{mid}}\sigma_C^2} \approx 4.6\%, \tag{37}$$

$$\sigma(y^T_{\text{CE}}) = \sqrt{(1-\alpha_{\text{CE}})^2\sigma_z^2 + \alpha^2_{\text{CE}}\sigma_C^2} \approx 7.0\%. \tag{38}$$

The CE economy is roughly twice as volatile in tradable income as NCE, with the MID-CE economy at an intermediate level, consistent with the empirical evidence in Section 3.

6.4 Collateral Parameter and Identification

The collateral tightness κ is the single parameter that departs from Bianchi (2011). In that paper, $\kappa = 0.3235$ was calibrated to match a sudden stop frequency target under a bivariate shock structure in which y^T and y^N are positively correlated via a VAR. In the present model, the joint distribution of the collateral constraint changes for two reasons: (i) there are three independent shocks rather than two correlated ones, and (ii) the commodity price process is substantially more persistent and volatile than the non commodity tradable component. A fresh calibration of κ is therefore required.

Target. κ is calibrated so that the NCE economy matches an empirical sudden stop frequency of 3.1%, the frequency observed among non commodity exporters in emerging markets

in the data (Section 3). Targeting the NCE frequency is the natural choice because the NCE economy has minimal commodity exposure ($\alpha_{\text{NCE}} = 0.05$) and therefore most closely resembles the benchmark economy of Bianchi (2011). The empirical target of 3.1% is slightly below the 5.5% reported by Bianchi (2011) for his broader sample, reflecting the more restrictive definition of non commodity exporters used here.

Identification logic. This calibration strategy has a clean economic interpretation. By requiring the financial friction to match the NCE sudden stop frequency in emerging markets, the parameter κ is disciplined by the behaviour of the economy with the least commodity exposure. Any residual difference in crisis severity between the CE and NCE economies—in current account reversals, consumption drops, or real exchange rate depreciations—is then attributed exclusively to the commodity price mechanism. The CE economy faces *exactly the same* κ as the NCE economy; it is not given any additional financial friction. This provides a sharp, internally consistent test of the theory.

Implementation. κ is found by bisection over the interval [0.30, 0.40], centred on the Bianchi (2011) value of 0.3235. At each step of the bisection, the NCE policy function is solved by Euler equation iteration with damping factor 0.2 (under relaxation, following the numerical recommendation of Bianchi (2011)), and the economy is simulated for $T = 500{,}000$ periods over 10 independent replications. The simulated NCE sudden stop frequency is computed, and κ is updated until the target of 3.1% is matched to within 0.2 percentage points.

6.5 Discretization and Solution Method

Each AR(1) process is discretized to a five point grid using the Tauchen and Hussey (1991) quadrature method with five point Gauss–Hermite nodes. The joint state space has $5^3 = 125$ nodes, with transition matrix $\Pi = \Pi_z \otimes \Pi_C \otimes \Pi_N$. The bond grid consists of $N_b = 100$ equally spaced points on $[\underline{b}, \bar{b}] = [-1.02, -0.20]$, following Bianchi (2011).

The household's policy function is solved by iterating on the Euler equation (24) to convergence (sup-norm tolerance 10^{-5}). At each grid point, the algorithm checks whether the collateral constraint binds. If it does not, the unconstrained tradable consumption level is found using a nonlinear scalar root finder (`fzero` in MATLAB). The damping factor of 0.2 is applied to the consumption and bond choice updates at each iteration, which is critical for numerical stability.

7 Quantitative Analysis

7.1 Simulation Strategy

After computing the policy functions for all three economies using the common κ^* from the bisection, each economy is simulated for $T = 500{,}000$ periods over 20 independent replications. Initial bond holdings are set to $b_0 = -0.9443$, the value used by Bianchi (2011). Simulation seeds are set independently for each economy, so that cross economy comparisons reflect only structural differences in α, not sampling variation. The three economies are NCE ($\alpha = 0.05$), MID-CE ($\alpha = 0.225$), and CE ($\alpha = 0.40$); each uses an identical cold start and the same κ^*.

Aggregate output, total consumption, and the real exchange rate are constructed from the simulated paths as follows. Total output is $Y_t = p_t^N y_t^N + y_t^T$. Total consumption aggregates tradable and nontradable consumption:

$$C_t = \left[\omega \left(c_t^T\right)^{-\eta} + (1-\omega)\left(y_t^N\right)^{-\eta}\right]^{-1/\eta}. \tag{39}$$

The real exchange rate (price level index) is:

$$RER_t = \left[\omega^{1/(1+\eta)} + (1-\omega)^{1/(1+\eta)}\left(p_t^N\right)^{\eta/(1+\eta)}\right]^{(1+\eta)/\eta}. \tag{40}$$

A rise in RER_t corresponds to a real appreciation; a fall to a real depreciation.

7.2 Sudden Stop Definition and Identification

A period t is classified as a sudden stop if two conditions hold simultaneously:

1. The current account is abnormally large relative to the economy's own distribution: $CA_t > \bar{CA} + s_{CA}$, where $\bar{CA}$ and s_{CA} are the mean and standard deviation of the simulated current account series for that economy.

2. The collateral constraint binds contemporaneously: $b_{t+1} \leq -\kappa^*(p_t^N y_t^N + y_t^T)$, up to numerical tolerance.

This model based definition is designed to be analogous to the empirical definition, but it is not identical. In the data, sudden stop dates are taken from Bianchi and Mendoza (2020) and are based on large year on year increases in ca/y, with a systemic filter. In the model, I additionally require the collateral constraint to bind because the constraint is observable

in the simulated economy. This extra condition ensures that simulated sudden stops correspond to Fisherian crisis episodes rather than ordinary current account fluctuations.

The threshold in condition (1) is computed separately for each economy. This follows Bianchi (2011) and is consistent with the idea that what constitutes an abnormal external adjustment depends on the structural volatility of the economy: a current account surplus that would be extreme for the NCE economy may be relatively ordinary for the CE economy, which faces larger and more persistent shocks to tradable income.

7.3 Moment Measurement

Event study paths. For each identified sudden stop episode at date t_0, a five period window $\{t_0-2,\, t_0-1,\, t_0,\, t_0+1,\, t_0+2\}$ is recorded. GDP and consumption are expressed as percentage deviations from their simulation means. The real exchange rate is expressed as percentage deviations from the simulation mean, consistent with GDP and consumption, so that the path captures the depreciation relative to the pre crisis level. The CA/GDP ratio is expressed in percentage points. Episode windows are averaged across all identified episodes and all replications to produce economy level event study paths. These *mean* paths are the primary output of the simulation and are displayed directly in the figures, ensuring consistency with the empirical event study paths which are also computed as means across episodes.

Scalar SS moments. The scalar summary statistics reported in the comparison table are derived *directly from the average event study paths*, ensuring exact consistency between the table and the figures. All four moments use the same pre to post measurement:

$$\text{GDP swing} = \max\big(\bar{y}_{t_0-2},\, \bar{y}_{t_0-1}\big) - \min\big(\bar{y}_{t_0},\, \bar{y}_{t_0+1},\, \bar{y}_{t_0+2}\big), \tag{41}$$

$$\text{Consumption swing} = \max\big(\bar{C}_{t_0-2},\, \bar{C}_{t_0-1}\big) - \min\big(\bar{C}_{t_0},\, \bar{C}_{t_0+1},\, \bar{C}_{t_0+2}\big), \tag{42}$$

$$\text{RER depreciation} = \max\big(\overline{RER}_{t_0-2},\, \overline{RER}_{t_0-1}\big) - \min\big(\overline{RER}_{t_0},\, \overline{RER}_{t_0+1},\, \overline{RER}_{t_0+2}\big), \tag{43}$$

$$\text{CA reversal} = \max\big(\overline{CAY}_{t_0},\, \overline{CAY}_{t_0+1},\, \overline{CAY}_{t_0+2}\big) - \min\big(\overline{CAY}_{t_0-2},\, \overline{CAY}_{t_0-1}\big), \tag{44}$$

where overbars denote average event study values. For GDP and consumption, the pre crisis maximum captures the boom during the borrowing phase, and the post crisis minimum captures the trough of the contraction. This boom to trough swing is the natural measure of the overall amplitude of the episode and matches the measurement used in constructing the empirical targets in Section 3. For the RER (43) and CA reversal (44), the same pre to post

contrast applies: the RER appreciates before the crisis and depreciates sharply afterwards, while the current account swings from deficit to surplus. Using a consistent measurement across all four moments ensures that model and data are directly comparable.

RBC moments. Business cycle moments are computed from HP filtered log output, log consumption, and the trade balance to GDP ratio, using a smoothing parameter of $\lambda = 100$ appropriate for annual data. Standard deviations, ratios, and cross correlations are averaged across replications.

7.4 The Identification Logic

The quantitative exercise is designed to provide a clean decomposition of the sources of sudden stop severity. The common parameter κ^*, calibrated to the NCE sudden stop frequency, ensures that both economies face the same degree of financial friction. The common z_t and y_t^N processes ensure that non commodity shocks affect both economies identically. The only source of heterogeneity is α: the commodity exporting economy is more exposed to p_t^C shocks.

Although the three shocks are independent in the law of motion, sudden-stop episodes are endogenous selected events. A sudden stop occurs when the realized state pushes the economy against the collateral constraint. Low commodity price realizations are therefore more likely to appear among sudden stop episodes in the high-α economy, even though commodity prices are unconditionally independent of the other shocks. The model does not imply that every sudden stop is caused by a commodity price decline; it implies that commodity price declines are more powerful amplification forces when commodity exposure is high.

Under this design, the model's predictions are sharp. Since κ is set to match NCE crisis frequency in emerging markets, the NCE sudden stop frequency in the main simulation should recover the empirical target of 3.1%. The CE economy will generally exhibit a somewhat higher frequency because its greater income volatility makes constraint binding more likely, even under the same κ. The key quantitative test, however, lies in the *severity* dimension: the model predicts that the CE economy should exhibit larger current account reversals, larger consumption drops, and larger real depreciations than the NCE economy conditional on a sudden stop occurring, with the CE/NCE differential in each moment measuring the quantitative importance of the commodity price channel.

8 Quantitative Results

Because the quantitative model is calibrated to an emerging market small open economy, the primary empirical counterpart in this section is the LP-DiD specification estimated within the emerging market sample. The data moments reported in Table 6 are therefore constructed from the estimated LP-DiD paths for emerging market commodity exporters and non commodity exporters, not from raw unconditional averages. This differs from 1, which reports simple descriptive peak to trough averages around sudden stop episodes. 1 is useful for documenting the raw empirical pattern, while Table 6 provides the econometric object used for the model data comparison.

The calibrated collateral parameter is $\kappa^* = 0.3403$, found by bisecting over [0.30, 0.40] until the NCE sudden stop frequency reached 3.1%. The main findings address two questions: does the model generate more severe sudden stops in the commodity exporting economy, as the theory predicts? And how well do the model implied crisis dynamics match the empirical event study? I organize the discussion around sudden stop moments, event study dynamics, a robustness exercise that varies the commodity share, and a brief assessment of the commodity price channel. Business cycle moments are reported for completeness but are not the focus of the analysis. Throughout, the goal is to assess whether the model can reproduce the observed ordering of crisis severity across CE and NCE economies, not to match the absolute level of every crisis moment. As in many endowment sudden stop models, the absolute magnitudes the model generates are larger than those observed in the data, particularly for current account reversals and output contractions. I treat the CE/NCE *ratios* as the primary object of comparison; absolute fit is discussed but is not the basis for evaluating the mechanism.

All empirical moments reported in this section are computed from the *mean* event study paths across sudden stop episodes in the data for developing countries. The mean is the natural counterpart to the model's simulated average, since the model moments are averages across a large number of episodes in the simulated panel. Consistent with the LP-DiD specification in Section 4, all event study variables, in both model and data, are expressed as cumulative changes from $t_0 - 1$, so that every series is normalized to zero one year before sudden stop onset.

The empirical analysis produces two complementary objects. Section 4 uses the LP-DiD specification as the main conditional estimate of the CE/NCE severity premium. The quan-

titative model, however, is calibrated as an emerging market small open economy. Therefore, the model data comparison in this section uses developing country event study moments as the primary empirical counterpart. I interpret the LP-DiD estimates as the main reduced form evidence and the event study moments as the direct quantitative target for the model.

8.1 Sudden Stop Moments

Table 6 reports the sudden stop moments for the three model economies alongside their empirical counterparts, and Figure 5 displays the same information as a grouped bar chart. The data moments are computed from the mean event study paths estimated in Section 4; Table 1 instead reports raw episode-level peak-to-trough averages and is included as descriptive background.

The model generates the predicted CE/NCE severity ordering. The commodity exporting economy experiences more severe sudden stops than the non commodity exporting economy along every dimension. The CA/GDP reversal is 8.2 pp for CE versus 4.6 pp for NCE in the model, against 4.1 pp versus 3.4 pp in the data. The consumption swing is 9.7% for CE versus 4.3% for NCE in the model, against 7.1% versus 2.7% in the data. The real exchange rate depreciation is 24.5% for CE versus 16.3% for NCE in the model, against 19.3% versus 10.0% in the data. In every case, CE exceeds NCE in both model and data, and the ordering is generated entirely by the commodity share α: both economies share the same κ^*, the same z_t and y_t^N processes, and the same sudden stop identification rule.

Absolute magnitudes are overstated; the CE/NCE ratios are not. The model does not match the absolute level of every moment. The CA reversal is overstated in both economies (model: 8.2 pp and 4.6 pp; data: 4.1 pp and 3.4 pp), as is the GDP swing (model: 23.9% and 15.3%; data: 6.2% and 3.0%). This overshoot is shared with Bianchi (2011) and is a known feature of endowment sudden stop models: with no investment, no imported intermediates, and no fiscal buffers, all external adjustment must occur through tradable consumption and the relative price of nontradables, compressing the entire crisis response into a single margin and a single period. The CE/NCE *ratios*, however, align well with the data when the model is calibrated to a moderate commodity exporter. As shown in Section 8.4, the MID-CE CA reversal ratio is 1.40× against 1.22× in the data, and the consumption swing ratio is 1.52× against 2.61×. The Chile calibration ($\alpha = 0.40$) functions

as an upper bound; the midpoint calibration ($\alpha = 0.225$) is the primary point of comparison. The cross-economy ordering on which the paper rests is robust to the absolute overshoot.

8.2 Event Study Dynamics

Figure 4 shows the average event study paths for GDP, consumption, the real exchange rate, and the CA/GDP ratio over the window $t_0 - 2$ to $t_0 + 2$, comparing model and data for both economy types. All paths are normalized to zero at $t_0 - 1$, consistently with the LP-DiD empirical specification.

GDP and Consumption: qualitative patterns match, amplitudes overstate. Both model economies exhibit elevated activity before the crisis, visible at $t_0 - 2$ relative to the normalization year $t_0 - 1$, followed by a sharp contraction at t_0.The qualitative pattern matches the data, where CE and NCE economies both show positive deviations before the crisis and negative deviations at and after onset. The CE pre crisis boom is larger than NCE in both model and data, consistent with greater income volatility in commodity exporters fueling larger debt accumulation. The model's contraction phase is more severe than the data in both economies, particularly for GDP, reflecting the endowment economy mechanism discussed above.

Real exchange rate: CE depreciation magnitude. The LP-DiD evidence in Section 4 shows a negative CE/NCE RER differential after sudden-stop onset, although the pooled estimate is only marginally significant at $h = 1$. The model event study helps interpret the magnitude of this response. With both model and data anchored at zero at $t_0 - 1$, the CE model generates a sharp depreciation of 23.4% at onset, followed by a partial recovery, while the CE data show a depreciation of 14.2% at t_0 that deepens to 18.5% by $t_0 + 2$. The overall peak-to-trough RER movement is 24.5% in the model against 19.3% in the data, so the model matches the magnitude of the CE depreciation reasonably well even though the timing is more abrupt than in the data. The sharper trough at onset reflects the endowment structure of the model: without investment reallocation, fiscal adjustment, or other gradual margins, the Fisherian relative price adjustment is compressed into a shorter window.

CA/GDP: the reversal pattern is reproduced. Panel (d) shows both model economies swinging from near zero CA/GDP before the crisis to sharply positive values at t_0, consistent

with the data. The CE model generates a reversal of 8.1 pp at onset, against 4.6 pp for NCE, matching the empirical ordering. The absolute level of the post crisis CA surplus is too high in the model, a consequence of the endowment structure requiring sharper forced deleveraging than is observed in practice.

8.3 Sudden Stop Frequency

The NCE sudden stop frequency in the main simulation is 3.1%, matching the calibration target within rounding. The CE economy exhibits a higher frequency of 6.8%, against an empirical value of 3.6%. The CE excess frequency is a natural implication of the model: with tradable income volatility of approximately 7.0%, roughly double that of NCE at 3.3%, the CE economy hits its borrowing limit more often even under the same κ. The CE frequency overshoot does not affect the main result because the paper's core claim concerns crisis *severity*, not *frequency*. The key insight from Proposition 1 is that conditional on a sudden stop occurring, the commodity exporter economy experiences larger forced deleveraging; the quantitative results confirm this prediction across all severity measures.

8.4 Robustness: Varying the Commodity Share

The CE calibration uses $\alpha = 0.40$, corresponding to copper's share of Chilean tradable income. Chile is among the most commodity dependent economies in the sample: copper exports averaged approximately 13–16 percent of Chilean GDP over the sample period (Cochilco, Banco Central de Chile; various years) against a tradable sector of roughly 27–30 percent of GDP, implying a commodity share of tradable income of approximately 0.43–0.53. We use $\alpha = 0.40$ as a conservative lower bound. The average commodity exporter emerging market, however, is likely to be less commodity dependent than Chile.

To assess whether the CE/NCE severity differential is robust to this calibration choice, I simulate a third economy with $\alpha_{\text{mid}} = 0.225$, the midpoint of the interval $[\alpha_{\text{NCE}}, \alpha_{\text{CE}}] = [0.05, 0.40]$. This economy uses the same κ^*, shock processes, bond grid, and simulation length as the two main economies; the only difference is α.

The results are reported in Table 6. The CE/NCE severity differentials are strictly monotone in α: every severity measure increases from NCE to MID-CE to Chile-CE, consistent with Proposition 1. The MID-CE economy generates a CA/GDP reversal ratio of 1.40× relative to NCE and a consumption swing ratio of 1.52×. The CE economy generates a CA/GDP reversal ratio of 1.78× relative to NCE and a consumption swing ratio of 2.25×.

The empirical CE/NCE ratios are 1.22× for the CA reversal and 2.61× for the consumption swing. The MID-CE calibration ($\alpha = 0.225$) accounts for essentially all of the observed CA differential and more than two thirds of the consumption differential, while the CE calibration ($\alpha = 0.40$) overstates the consumption ratio because it represents the upper bound of commodity dependence among emerging markets.

This exercise clarifies the role of the Chilean calibration. The model therefore provides a conservative estimate of the commodity price channel when calibrated to the average commodity exporter, and an upper bound when calibrated to Chile.

8.5 Assessing the Commodity Price Channel

The quantitative results allow a direct assessment of how much of the observed CE/NCE sudden stop severity gap is explained by commodity price exposure alone. The CA/GDP reversal is the moment most directly linked to the Fisherian mechanism: when p^C falls, y^T falls by α more for the CE economy, reducing tradable consumption and depressing the relative price of nontradables, which tightens the collateral constraint on both sides simultaneously.

For the midpoint calibration ($\alpha = 0.225$), the model CE/NCE CA reversal ratio is 1.40× against 1.22× in the data. For consumption, the ratio is 1.52× in the model against 2.61×. These matches were achieved with a model that differs across economies *only* in α, with identical financial friction, preferences, and non commodity shock processes. The commodity price channel accounts for essentially the entire observed CE/NCE differential in sudden stop severity for the CA reversal, and for a large fraction of the consumption differential.

The real exchange rate CE/NCE ratio is 1.17× in the midpoint model against 1.93× in the data, with the gap reflecting the tendency of the endowment economy to overstate NCE depreciation. The CE RER level, however, matches the data closely (24.5% model versus 19.3% data), confirming that the mechanism generates the right magnitudes for the commodity exporting economy.

Taken together, the results support the paper's central mechanism. A model that differs across economies only in commodity exposure can reproduce the ordering of crisis severity and can account for most of the CE/NCE differential in current account reversals and consumption losses. The fit is less complete for the real exchange rate ratio, reflecting the limitations of the endowment structure, but the model generates realistic CE depreciation

magnitudes.

8.6 Business Cycle Moments

Table 7 reports unconditional business cycle moments for both main economies. These moments are not calibration targets and the model is not designed to match them. The collateral constraint binds in only 3–7% of simulated periods, so the unconditional distribution is dominated by the unconstrained endowment economy, which abstracts from investment, capital accumulation, working capital frictions, and sovereign risk.

The model correctly orders CE above NCE in output volatility (8.95% versus 4.18%, compared with 4.13% versus 3.59% in the data), consistent with the greater tradable income volatility of commodity exporters. The trade balance to GDP ratio is countercyclical in both economies, as in the data, though more strongly so in the model, a known feature of the Bianchi (2011) framework that reflects the sharp CA reversals during sudden stops. The $\text{corr}(C, Y)$ of 0.74 for CE is close to the data value of 0.76, while the NCE correlation of 0.34 is below the data's 0.66.

The main failure is the ratio $\sigma(C)/\sigma(Y)$, which is below one in both model economies (0.66 for NCE, 0.44 for CE) while it exceeds one in the data (1.02 and 1.24). This is a well documented limitation of the endowment sudden stop model, shared with Bianchi (2011), and reflects the absence of non stationary productivity trends and investment dynamics that generate excess consumption volatility in richer frameworks Aguiar and Gopinath (2007). Addressing this limitation is outside the scope of the present paper, whose contribution lies in the conditional dynamics of sudden stop episodes rather than unconditional business cycle statistics.

Table 6: Sudden Stop Moments: Model and Data

	NCE ($\alpha = 0.05$)		MID-CE ($\alpha = 0.225$)	CE ($\alpha = 0.40$)	
Moment	Model	Data	Model	Model	Data
SS frequency (%)	3.07	3.10	6.12	6.81	3.60
CA/GDP reversal (pp)	4.59	3.37	6.40	8.16	4.12
GDP swing (%)	15.29	2.98	17.81	23.91	6.17
Consumption swing (%)	4.30	2.70	6.54	9.68	7.07
RER depreciation (%)	16.27	9.98	18.96	24.53	19.29
Severity ratios relative to NCE					
CA/GDP reversal			MID model: 1.40×	CE model: 1.78×	
			Data: 1.22×		
Consumption swing			MID model: 1.52×	CE model: 2.25×	
			Data: 2.61×		
RER depreciation			MID model: 1.17×	CE model: 1.51×	
			Data: 1.93×		

Notes: Model moments are computed from simulated sudden stop episodes. Data moments are computed from the LP-DiD estimated event study paths for emerging markets. All event study paths are normalized to zero at $t_0 - 1$. The scalar moments are constructed from the estimated paths using the same pre to post rule as in the model: $\max(t_0-2, t_0-1) - \min(t_0, t_0+1, t_0+2)$ for GDP, consumption, and RER, and $\max(t_0, t_0+1, t_0+2) - \min(t_0-2, t_0-1)$ for CA/GDP. 1 instead reports raw descriptive averages across sudden stop episodes and is not an econometric estimate.

Table 7: Business Cycle Moments: Model and Data

	NCE ($\alpha = 0.05$)		CE ($\alpha = 0.40$)	
Moment	Model	Data	Model	Data
$\sigma(Y)$ (%)	4.18	3.59	8.95	4.13
$\sigma(C)$ (%)	2.74	3.57	3.94	4.98
$\sigma(TB/Y)$ (%)	1.11	3.57	2.80	3.57
$\sigma(C)/\sigma(Y)$	0.66	1.02	0.44	1.24
corr(C, Y)	0.34	0.66	0.74	0.76
corr(TB/Y, Y)	−0.84	−0.25	−0.84	−0.35

Notes: Moments computed from HP filtered log output and log consumption ($\lambda = 100$, annual). The model is not designed to match unconditional business cycle moments; see Section 8.6. The failure of $\sigma(C)/\sigma(Y) > 1$ is a known limitation of the endowment sudden stop framework shared with Bianchi (2011).

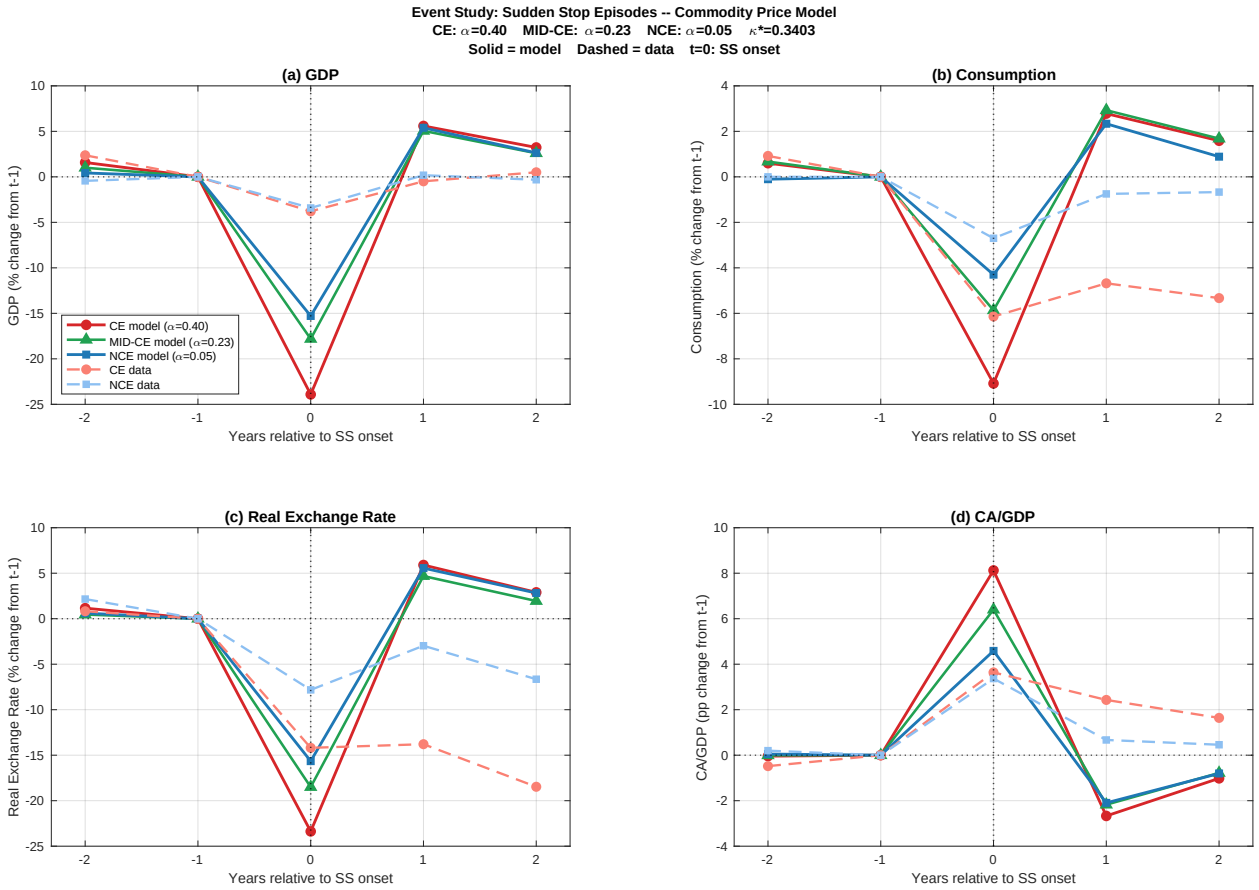


Figure 4: Event Study: Sudden Stop Episodes, Model and Data

Notes: Average event study paths centered on sudden stop onset ($t_0 = 0$). Solid lines: model. Dashed lines: data. Red: CE ($\alpha = 0.40$, Chile/copper). Green: MID-CE ($\alpha = 0.225$). Blue: NCE ($\alpha = 0.05$). All variables are expressed as cumulative changes from $t_0 - 1$: GDP and consumption in percentage change; real exchange rate in percentage change (a negative value denotes a real depreciation); CA/GDP in percentage point change. Normalization is consistent with the LP-DiD empirical specification. $\kappa^* = 0.3403$. Data moments are mean event study paths.

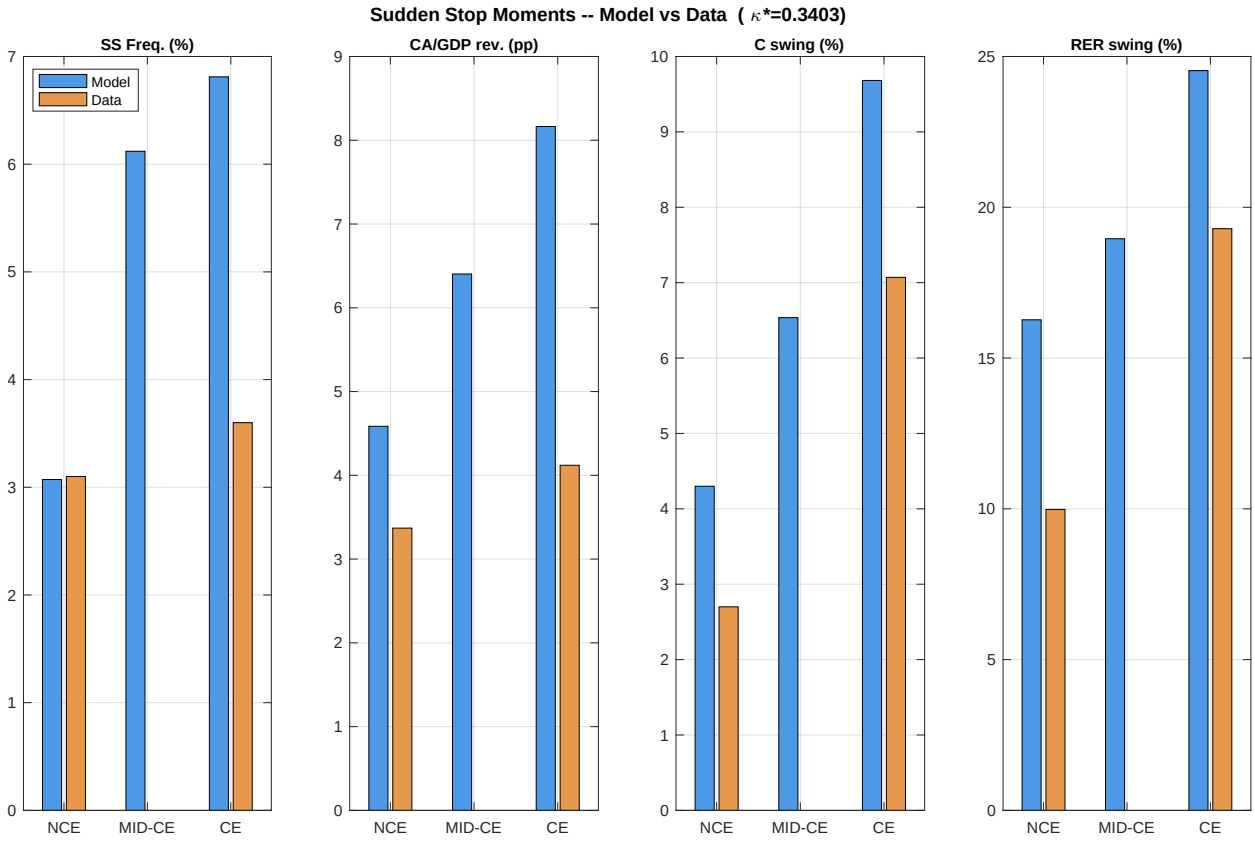


Figure 5: Sudden Stop Moments: Model vs. Data

Notes: Grouped bar chart of scalar sudden stop moments for NCE and CE economies. Blue bars: model. Orange bars: data. The MID-CE economy ($\alpha = 0.225$) is reported in Table 6 but omitted from this figure for clarity. Exact values and measurement notes in Table 6.

9 Macroprudential Policy Application

The quantitative results of the previous section document that commodity exporters experience more severe sudden stops than non commodity exporters due to differential exposure to commodity price shocks. This section asks a normative question: what is the optimal macroprudential intervention in each economy, and how does it differ between commodity and non commodity exporters? Building on Bianchi (2011), I show that the same mechanism that generates more severe sudden stops in commodity exporting economies also implies a larger role for macroprudential policy there.

9.1 The Pecuniary Externality

In the decentralized equilibrium, households solve their optimization problem taking prices as given. Each household ignores the effect of its own borrowing on the relative price of nontradables and hence on the collateral value of all agents in the economy. This gives rise to a *pecuniary externality*: when individual agents borrow more in good times, they push up p_t^N; when the constraint binds, the resulting fire sale of tradable goods depresses p_t^N for everyone, tightening the collateral constraint beyond what any individual agent anticipated (Lorenzoni (2008), Bianchi (2011)).

The externality is larger in commodity exporting economies for two reasons. First, from (31), the response of tradable consumption to a commodity price shock is amplified by the factor $1/(1-\kappa(1+\eta)p^N y^N/c^T)$, which is increasing in α. Second, the commodity price shock is highly persistent ($\rho_C = 0.815$), so the economy spends more periods near the constraint boundary, creating more episodes in which the externality is active. Both forces imply that the social gain from internalizing the externality is larger in the CE economy.

9.2 The Constrained Efficient Allocation

The social planner maximizes the representative household's utility subject to the same resource constraints and borrowing limit as the decentralized equilibrium, but internalizes the effect of aggregate tradable consumption on p_t^N. The planner's Euler equation is:

$$\underbrace{\mu_T(c_t^T) + \lambda_t \cdot \psi_t}_{\equiv \mathcal{L}_t} = \beta R\, E_t[\mathcal{L}_{t+1}] + \mu_t, \tag{45}$$

where $\lambda_t \geq 0$ is the Lagrange multiplier on the collateral constraint and

$$\psi_t = \frac{1-\omega}{\omega}(1+\eta)\,\kappa \left(\frac{c_t^T}{y_t^N}\right)^{\eta} \tag{46}$$

is the derivative of the collateral value $\kappa p_t^N y_t^N$ with respect to c_t^T. Comparing (45) with the decentralized Euler equation (24), the planner assigns a higher shadow value to future consumption because, at constrained states, more consumption raises p_t^N and relaxes the collateral constraint for everyone. The term $\lambda_t \psi_t$ captures this externality wedge.

The constrained efficient allocation is computed numerically by iterating on the Lagrange multiplier λ_t as an explicit variable, updating it as the residual $\mathcal{L}_t - \beta R \cdot E_t[\mathcal{L}_{t+1}]$, and zeroing it out at unconstrained states, following Bianchi (2011). The algorithm is warm started from the decentralized solution.

Decentralization as a tax. The constrained efficient allocation can be decentralized using an optimal tax τ_t on new borrowing Bianchi (2011):

$$\tau_t = \frac{\mu_T^{SP}(b_t, s_t)}{E_t[\mu_T^{SP}(b_{t+1}, s_{t+1})]} - 1, \tag{47}$$

with $\tau_t = 0$ when the constraint binds and $\tau_t = 0$ where negative. Equation (47) is the wedge between the private shadow value of saving and its social shadow value. It is zero in constrained states (the planner is already at the limit) and positive in unconstrained states where the planner restricts overborrowing.

9.3 Quantitative Results

Table 8 compares crisis moments under the decentralized equilibrium (DE) and the social planner (SP) for all three economies. Table 9 reports welfare gains and optimal tax rates. Figure 6 shows the tax policy function $\tau(b, s)$ across economies.

The social planner reduces crisis severity in all economies. Under the constrained efficient allocation, the planner builds a precautionary buffer during good times, reducing the severity of crises when shocks hit. The SP reduces the CE sudden stop frequency from 6.81% to 0.94%, the CA/GDP reversal from 8.16 pp to 5.79 pp, and the consumption swing from 9.68% to 7.19%. For NCE, the frequency falls from 3.07% to 0.69% and the CA reversal from 4.59 pp to 4.13 pp. The social planner improves the main crisis moments in

all economies, especially sudden stop frequency, current account reversals, and consumption losses. The effect on the real exchange rate is not uniformly monotone, reflecting the fact that the planner changes the composition and timing of adjustment.

The welfare gain is much larger for commodity exporters. Table 9 reports consumption equivalent welfare gains λ computed by value function iteration following Bianchi (2011). The CE economy gains $\lambda = 0.113\%$ of permanent consumption from the policy, compared with 0.011% for NCE—a ratio of 10.27×. The MID-CE economy ($\alpha = 0.225$) gains 0.059%, intermediate between the two extremes and monotone in α. These results confirm the central prediction: the welfare gain from optimal macroprudential intervention is strictly increasing in commodity dependence because the externality is more severe and the crises being prevented are more costly in commodity exporting economies.

The NCE welfare gain of 0.011% lies below the 0.13% reported by Bianchi (2011) for his baseline economy. This difference reflects our lower calibration target for the NCE sudden-stop frequency (3.1% versus approximately 5.5% in Bianchi (2011)), our higher recalibrated $\kappa^* = 0.3403$., and our independent rather than correlated shock structure—all of which reduce the frequency and severity of constraint binding in the NCE economy and hence the magnitude of the externality. The CE economy, with its additional commodity price channel, recovers a welfare gain of 0.113% that is closer to Bianchi's baseline, reflecting the higher frequency and severity of sudden stops in commodityexporting economies.

The precautionary savings channel. The planner's primary instrument is not the tax rate per se, but the accumulation of precautionary savings. Table 8 shows that the mean debt/Y ratio becomes less negative, moving from −30.64% to −29.83% for CE. This corresponds to a reduction in average debt of 0.81 percentage points of output, compared with a shift of only 0.19 pp for NCE. The CE planner shifts the economy permanently to a safer average debt position, because the commodity price volatility makes the region near the constraint boundary especially dangerous.

This precautionary savings shift has an important implication for the optimal tax. Because the CE economy spends most of its time at lower debt levels—far from the constraint boundary—the unconditional average tax is slightly *lower* for CE (5.06%) than for NCE (5.33%). This is not a paradox. The tax policy function $\tau(b, s)$—the tax at any *given* debt level and shock realization—is strictly higher for CE than NCE, as shown in Figure 6 and

consistent with the amplification mechanism in Proposition 1. The lower unconditional average reflects the fact that the CE planner *succeeds* more fully at keeping the economy away from the danger zone, thereby reducing the frequency of periods in which the tax is active.

The conditional tax $E[\tau_t \mid \tau_t > 0]$, which averages only over periods in which the tax is positive, also exhibits this pattern: 5.12% for CE versus 5.37% for NCE. This confirms that the tax per active period is slightly lower for CE, entirely because the planner has moved the CE economy to a structurally safer position. The lower average tax for CE does not mean that the optimal policy is weaker. It reflects composition effects in the ergodic distribution: the CE planner moves the economy farther from the constraint, so the economy spends less time in states where high taxes are needed. At comparable debt positions and shock states, the tax policy function is higher for CE. The key comparison for policy purposes is the tax *function*, not the scalar average: Figure 6 shows that at any given debt level b, a commodity exporting economy requires a strictly higher macroprudential tax than a non commodity exporter.

Monotonicity in α. All three policy relevant quantities—welfare gain, position of mean debt, and tax policy function at any fixed b—are strictly monotone in the commodity share α, consistent with Proposition 1. The marginal value of macroprudential intervention increases continuously with commodity dependence. An economy at the midpoint $\alpha = 0.225$ already gains 0.059% of permanent consumption from the optimal policy—five times the NCE gain—confirming that the result is not specific to the extreme Chilean calibration.

9.4 Policy Implications

The results suggest three implications, which I state with appropriate modesty given the stylized nature of the model.

The welfare gain from macroprudential intervention is increasing in commodity dependence. The consumption-equivalent welfare gain from the constrained efficient allocation is 0.011 % for the NCE economy, 0.059 % for the MID-CE economy, and 0.113 % for the CE economy. These magnitudes are modest in absolute terms but rise by a factor of approximately ten across the range of commodity exposures considered. The qualitative message is that commodity dependence is a meaningful determinant of the marginal value

of macroprudential intervention, even if a richer model with investment and fiscal margins would generate different absolute gains.

Stabilization funds approximate the planner's response. The planner's primary instrument is the accumulation of precautionary savings rather than high per-period taxes. This is consistent with the institutional approach taken by several commodity-exporting economies, which combine fiscal stabilization rules with sovereign wealth funds that accumulate during commodity booms and draw down during busts. Frankel (2011) analyzes Chile's structural budget rule, which uses long-run estimates of copper prices and trend output to smooth fiscal spending across the commodity cycle. The result here suggests that this kind of buffer accumulation is more valuable for economies with greater commodity exposure, though the model does not endogenize the choice between alternative policy instruments.

Cross-country tax comparisons should be conditioned on state. The optimal tax function $\tau(b, s)$ is strictly higher for CE economies at any given debt level b, but the unconditional average tax is slightly lower because the CE planner moves the economy permanently to a safer average debt position. Comparisons of average tax rates across economies are therefore uninformative about the relative strength of the optimal policy; the tax function evaluated at comparable states is the right object.

Table 8: Crisis Moments: Decentralized Equilibrium vs. Social Planner

	NCE ($\alpha = 0.05$)		MID-CE ($\alpha = 0.225$)		CE ($\alpha = 0.40$)	
Moment	DE	SP	DE	SP	DE	SP
SS frequency (%)	3.07	0.69	6.12	1.17	6.81	0.94
CA/Y reversal (pp)	4.59	4.13	6.40	4.67	8.16	5.79
Consumption swing (%)	4.30	1.43	6.54	5.86	9.68	7.19
RER depreciation (%)	16.27	18.32	18.96	18.55	24.53	22.10
Mean debt/Y (%)	−32.23	−32.04	−31.97	−31.07	−30.64	−29.83

Notes: DE = decentralized equilibrium (from Table 6). SP = constrained efficient (social planner) allocation. Crisis moments follow Bianchi (2011): contemporaneous C and RER deviations from simulation mean at the sudden stop date; CA/Y reversal is the CA/Y ratio at the sudden stop date. SP simulation uses Bianchi's exact algorithm and welfare is computed by value function iteration. $\kappa^* = 0.3403$.

Table 9: Welfare Gains and Optimal Macroprudential Tax

	NCE ($\alpha = 0.05$)	MID-CE ($\alpha = 0.225$)	CE ($\alpha = 0.40$)
Welfare gain λ (%)	0.011	0.059	0.113
Avg. tax $E[\tau_t]$ (%)	5.33	5.24	5.06
Avg. tax $E[\tau_t \mid \tau_t > 0]$ (%)	5.37	5.31	5.12
CE/NCE welfare ratio		10.27×	

Notes: Welfare gain λ is the consumption equivalent gain from the constrained efficient allocation: $W_{\text{SP}} = W_{\text{DE}}(1+\lambda)^{1-\sigma}$, computed by value function iteration Bianchi (2011). Tax $\tau_t = \mu_T^{SP}(b_t, s_t)/E_t[\mu_T^{SP}] - 1$ along the SP simulation path; $\tau_t = 0$ at binding states and where negative. $E[\tau_t]$: unconditional mean over all periods. $E[\tau_t \mid \tau_t > 0]$: mean in the tax active region. The lower unconditional tax for CE reflects stronger precautionary savings (mean debt/Y shifts by 0.81 pp for CE vs 0.19 pp for NCE), which keeps the economy further from the constraint boundary. At any given debt level, the tax function $\tau(b, s)$ is strictly higher for CE—see Figure 6.

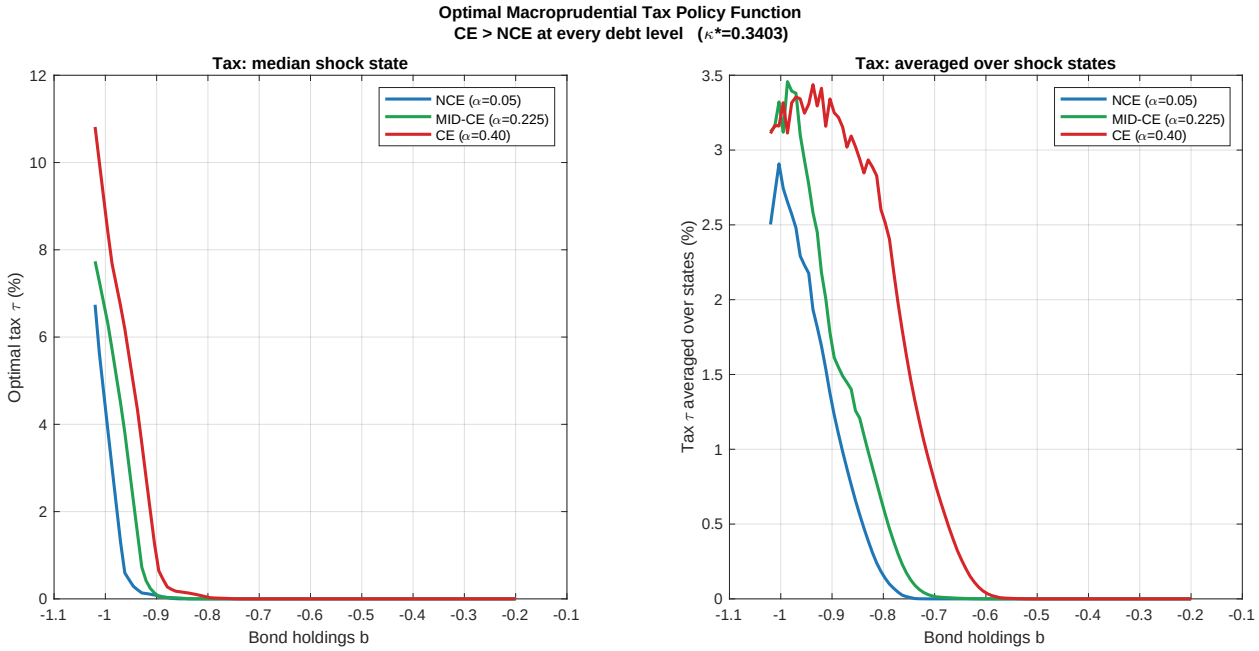


Figure 6: Optimal Macroprudential Tax Policy Function

Notes: Optimal tax $\tau(b, s) = \mu_T^{SP}(b, s)/E[\mu_T^{SP}(b', s')] - 1$, zero at binding states and where negative. Left panel: tax at the median joint shock state. Right panel: tax averaged across all 125 shock states. At every debt level b, the tax is strictly higher for CE ($\alpha = 0.40$, red) than MID-CE ($\alpha = 0.225$, green) and NCE ($\alpha = 0.05$, blue), confirming Proposition 1 for the normative dimension: the optimal macroprudential tax is monotone in the commodity share. The lower *unconditional* average tax for CE (Table 9) reflects stronger precautionary savings, not a weaker policy prescription. $\kappa^* = 0.3403$.

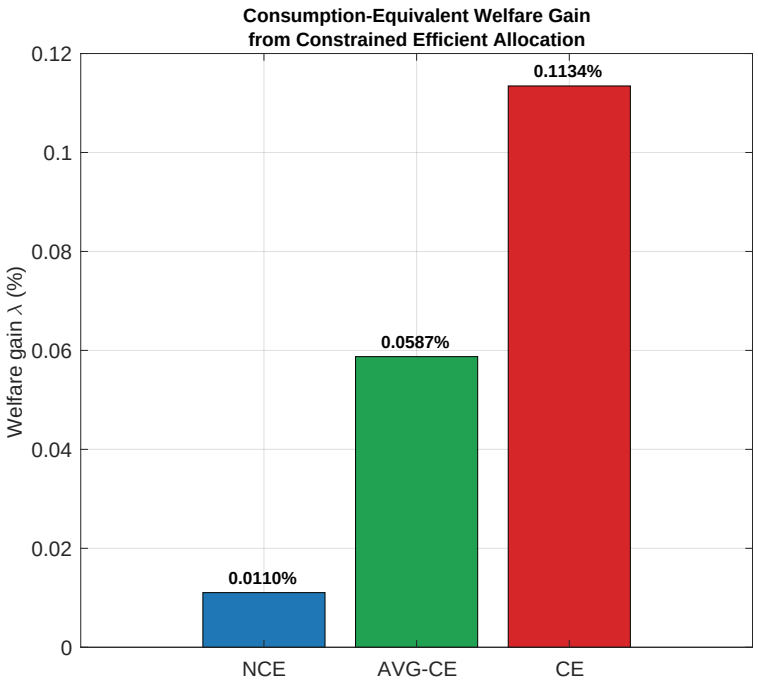


Figure 7: Consumption Equivalent Welfare Gain from Optimal Policy

Notes: Welfare gain λ (%) from moving to the constrained efficient allocation. The gain is strictly increasing in the commodity share α: 0.011% for NCE, 0.059% for MID-CE, and 0.113% for CE—a ratio of 10.27× between CE and NCE. The CE gain of 0.113% is comparable to the 0.13% reported by Bianchi (2011) for his baseline emerging market economy.

10 Conclusion

This paper studies why sudden stops are more severe in some economies than in others. The central argument is that the composition of tradable income matters for crisis amplification. Economies that rely more heavily on commodity exports are exposed to large and persistent fluctuations in world commodity prices. When external financing tightens, this exposure magnifies the adjustment required in tradable absorption and the current account. Commodity exporter status is therefore not only a feature of trade structure; it is also a source of macro financial vulnerability.

The empirical results show that the most robust difference between commodity exporters and non commodity exporters is the size of the external adjustment during sudden stops. Commodity exporters experience substantially larger current account reversals, both in simple event study comparisons and in local projection difference in differences specifications that compare countries within development groups. Consumption, investment, and stock prices also move in the direction of more severe crises, with consumption losses and equity declines persistent across all three post-crisis years and significant at the 1 % level at one year after onset. Real exchange rate depreciations are directionally consistent at all horizons but estimated less precisely. Together, these results support the view that sudden stops are more intense in commodity exporting economies along all the dimensions emphasized by the Fisherian sudden stop literature.

The quantitative model provides a mechanism for this severity premium. I extend the Fisherian sudden stop framework of Bianchi (2011) by allowing tradable income to depend on a commodity price component. This modification generates two amplification channels. First, a fall in commodity prices directly reduces tradable income in economies with higher commodity exposure. Second, when the collateral constraint binds, the decline in tradable absorption lowers the relative price of nontradables, further reducing collateral values and tightening borrowing capacity. The same financial friction can therefore generate more severe crises in commodity exporters than in otherwise similar non commodity exporters. This does not mean that every sudden stop in a commodity exporter is caused by a fall in commodity prices. Rather, commodity price declines are especially powerful amplification forces when they occur in economies with high commodity exposure.

The model is not intended to match every crisis moment in absolute terms. As in many endowment sudden stop models, the simulated crises can be sharper than those observed

in the data because the framework abstracts from investment, fiscal policy, imported intermediates, and other margins of adjustment. Its main contribution is instead to show that differences in commodity exposure alone can generate the correct ordering of crisis severity across economies. In particular, higher commodity dependence produces larger current account reversals, stronger real exchange rate depreciations, and larger consumption losses, consistent with the empirical evidence.

The analysis also has a normative implication. Because commodity exporting economies face stronger crisis amplification, the constrained efficient allocation features a larger precautionary motive. The welfare gains from macroprudential policy are therefore larger when commodity exposure is higher. This result provides a rationale for policy frameworks that build buffers during commodity booms and relax constraints during busts, including macroprudential instruments, reserve accumulation, and fiscal stabilization funds. The point is not that commodity exporters always need higher average tax rates, but that the cost of being close to the borrowing constraint is larger for them.

Several limitations remain. The model treats commodity dependence as exogenous and abstracts from investment, production reallocation, fiscal policy, and the long run process of export diversification. These omissions are useful for isolating the Fisherian amplification mechanism, but they also limit the scope of the quantitative exercise. Future work could extend the framework to include capital accumulation and sectoral production, allowing commodity price shocks to affect both current collateral values and future productive capacity. Another useful extension would be to study how stabilization funds or reserve policies interact with macroprudential instruments in commodity dependent economies.

Overall, the paper shows that export composition helps explain why sudden stops differ so sharply across countries. Once tradable income is allowed to depend on commodity prices, the standard sudden stop mechanism links commodity exposure, collateral values, and external adjustment in a natural way. This perspective shifts attention from whether countries experience sudden stops to how severe those episodes become once they occur, and it suggests that commodity dependence should be treated as a central determinant of external crisis vulnerability.

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A Sample and Sudden Stop Episodes

Table A1 distinguishes between the sudden stop episodes used for the descriptive event evidence and the systemic sudden stop episodes used in the main LP-DiD analysis.

Table A1: Sudden Stop Episodes by Development Status, Commodity Exporter Status, and Systemic Classification

Country	EM	Commodity exporter	Year	Systemic SS episode
ARG	1	1	1982	1
ARG	1	1	1990	0
ARG	1	1	1995	1
ARG	1	1	2002	1
AUS	0	1	2008	0
AUT	0	0	2014	0
BGR	0	0	1994	0
BGR	0	0	2009	1
BRA	1	1	1983	1
BRA	1	1	1984	0
BRA	1	1	1987	0
BRA	1	1	2003	0
CAN	0	1	1982	1
CAN	0	1	1996	0
CHE	0	0	2010	0
CHL	1	1	1982	0
CHL	1	1	1983	1
CHL	1	1	1986	0
CHL	1	1	1999	1
CHN	1	0	1992	0
CHN	1	0	2005	0
CIV	1	1	1984	1
COL	1	1	1989	0
COL	1	1	1999	1
DEU	0	0	1981	0
DEU	0	0	2004	0
DEU	0	0	2006	0

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Country	EM	Commodity exporter	Year	Systemic SS episode
DEU	0	0	2009	0
DNK	0	0	1999	1
DNK	0	0	2010	0
DOM	1	0	1981	0
DOM	1	0	1987	0
DOM	1	0	1994	0
DOM	1	0	2011	0
DZA	1	1	1991	0
DZA	1	1	1999	0
ECU	1	1	1983	1
ECU	1	1	1988	0
ECU	1	1	1999	1
EGY	1	0	1991	0
ESP	0	0	1984	0
ESP	0	0	2009	0
ESP	0	0	2012	0
FIN	0	0	1986	0
FIN	0	0	1995	0
FIN	0	0	2000	1
FRA	0	0	1983	0
FRA	0	0	1997	1
FRA	0	0	2015	0
GBR	0	0	1981	0
GBR	0	0	1991	1
GRC	0	0	1993	0
GRC	0	0	2012	0
HRV	1	0	1998	0
HRV	1	0	2003	0
HRV	1	0	2015	0
HUN	0	0	1995	0
HUN	0	0	2009	1
IDN	1	1	1984	0
IDN	1	1	1998	1

Continued on next page

Country	EM	Commodity exporter	Year	Systemic SS episode
ISL	0	1	2001	1
ISL	0	1	2009	1
ITA	0	0	1983	1
ITA	0	0	1993	0
ITA	0	0	2012	0
JPN	0	0	2015	0
KOR	1	0	1998	1
LBN	1	0	1990	0
LBN	1	0	1992	0
LBN	1	0	1997	0
LBN	1	0	2000	1
LBN	1	0	2004	0
MAR	1	0	1983	1
MAR	1	0	1997	1
MAR	1	0	2003	0
MEX	1	0	1983	1
MEX	1	0	1987	0
MEX	1	0	1995	1
MYS	1	0	1994	0
MYS	1	0	1998	1
NGA	1	1	1984	1
NGA	1	1	1992	0
NGA	1	1	1995	0
NGA	1	1	2000	0
NGA	1	1	2005	0
NLD	0	0	1981	0
NLD	0	0	2003	1
NLD	0	0	2009	0
NOR	0	1	1990	1
NOR	0	1	1999	1
NOR	0	1	2008	0
NZL	0	1	2009	0
PAK	1	0	1997	0

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Country	EM	Commodity exporter	Year	Systemic SS episode
PAK	1	0	2002	0
PAK	1	0	2009	1
PAN	1	0	1995	0
PAN	1	0	1998	0
PAN	1	0	2009	0
PER	1	1	1983	1
PER	1	1	1985	0
PER	1	1	1998	1
PHL	1	0	1984	0
PHL	1	0	1998	1
PHL	1	0	2009	1
POL	1	0	1999	0
PRT	0	0	1982	1
PRT	0	0	2012	0
RUS	1	1	1998	1
RUS	1	1	1999	0
SLV	1	0	1982	1
SLV	1	0	1999	0
SWE	0	0	1983	0
SWE	0	0	1994	0
SWE	0	0	2001	1
SWE	0	0	2003	0
SWE	0	0	2006	0
THA	1	0	1998	1
TUN	1	0	1982	1
TUN	1	0	2007	0
TUN	1	0	2016	0
TUR	1	0	1988	0
TUR	1	0	1994	1
TUR	1	0	1999	1
TUR	1	0	2001	0
UKR	1	1	1999	0
URY	1	1	1982	0

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Country	EM	Commodity exporter	Year	Systemic SS episode
URY	1	1	1984	1
URY	1	1	2009	1
USA	0	0	1991	1
USA	0	0	2009	1
VEN	1	0	1983	1
VEN	1	0	1990	0
VEN	1	0	1996	0
ZAF	1	1	1983	1
ZAF	1	1	1985	0
Total episode-years			135	51

Notes: This table reports the episode level classification used in the paper. Each row is a country year sudden stop episode. $EM = 1$ denotes emerging markets and $EM = 0$ denotes developed economies. *Commodity exporter* equals one for commodity exporting economies and zero otherwise. *Systemic SS episode* equals one if the country year is a systemic sudden stop episodes, which is the baseline sample used in the LP-DiD estimates and robustness exercises. Episodes with *Systemic SS episode* equal to zero are non systemic sudden stop episodes from Bianchi and Mendoza database, which is used for the descriptive event evidence in Table 1.

B Empirical Evidence

This section documents unconditional business cycle moments. The broad message is that commodity exporters and non commodity exporters differ systematically, and that these differences are visible even within the same level of development.

B.1 Business Cycle Differences Between Commodity Exporters and Non Commodity Exporters

The first fact is that commodity exporter status is strongly associated with macroeconomic volatility. This is visible in both long historical data and in the post 1960 period with richer national accounts measures.

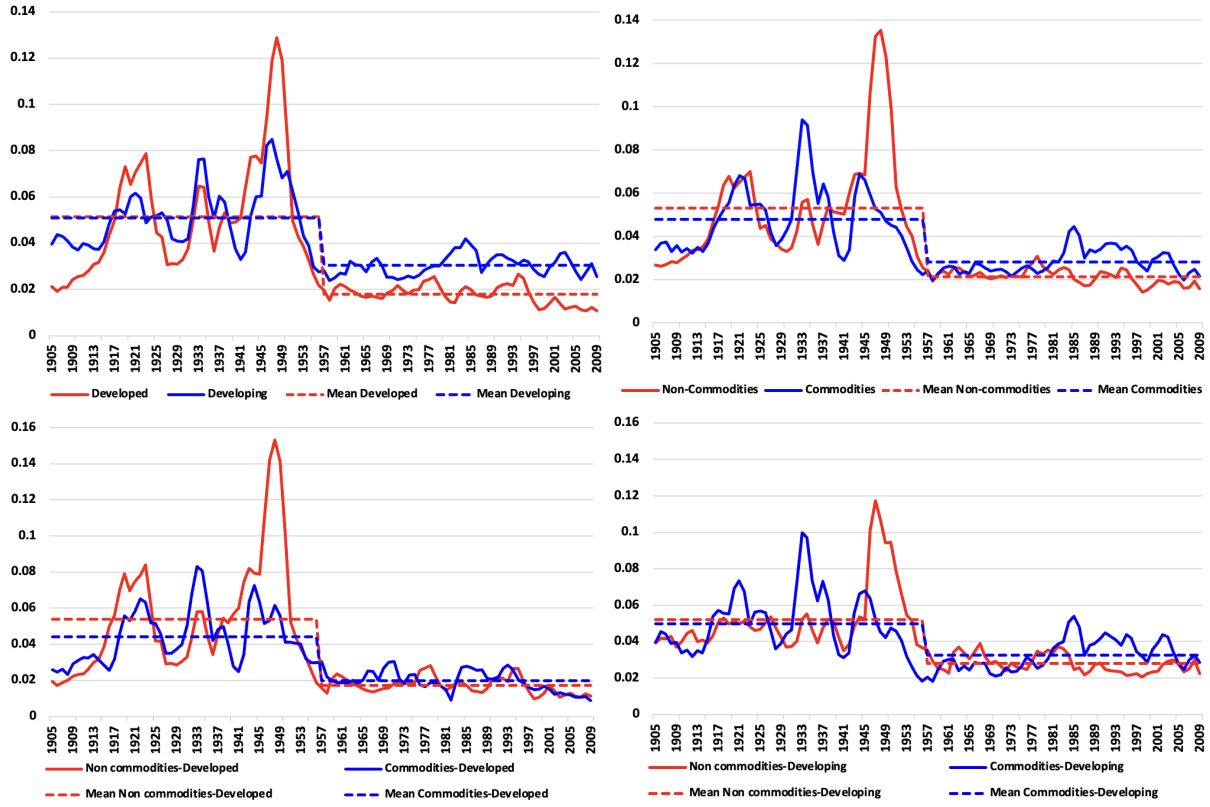
Each country is categorized based on its status as a commodities exporter (coded as 1 for commodities exporters and 0 otherwise) and its developmental stage (coded as 1 for economies in transition or developing economies and 0 otherwise). Commodities exporter classification relies on the list provided by Global Economic Prospects (January 2022), from the World Bank. "An economy is defined as commodity exporter when, on average in 2017-19, either (1) total commodities exports accounted for 30 percent or more of total exports or (2) exports of any single commodity accounted for 20 percent or more of total exports". While the United Nations (UN) classification guides the identification of developing countries.

A useful starting point is the long-run evidence from Barro and Ursúa (2008). When countries are classified both by development level and by commodity exporter status, the usual comparison between developed and developing countries becomes more nuanced. In the first half of the twentieth century, non commodity exporters tended to be more volatile than commodity exporters. In the second half, however, that pattern reversed: commodity exporters became more volatile than non commodity exporters in both developed and developing groups. Since a large share of developing countries in the sample are commodity exporters, while only a minority of developed countries are, part of the standard developed versus developing contrast is in fact a comparison between commodity exporters and non commodity exporters (8).

The same point emerges even more clearly for consumption. Historical evidence shows that consumption volatility is consistently higher in commodity exporters than in non commodity exporters, and higher in developing countries than in developed countries, but the commodity dimension is crucial for understanding the cross country pattern. Among devel-

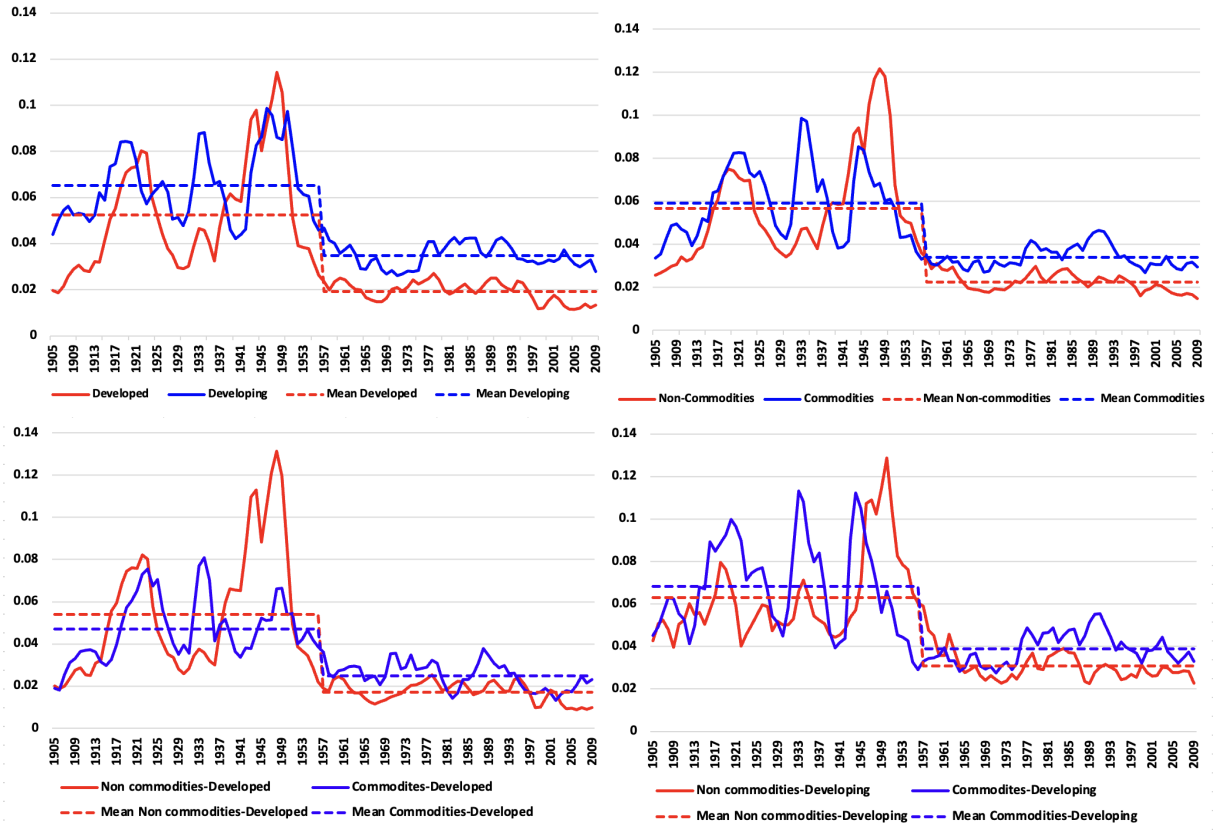
oping countries, commodity exporters exhibit higher consumption volatility throughout both halves of the twentieth century. Among developed economies, the same reversal observed for output also appears for consumption: commodity exporters become more volatile than non commodity exporters in the second half of the century (9).

Figure 8: Real GDP Volatility



Database of Barro and Ursúa (2008)

Figure 9: Real Consumption Volatility



Database of Barro and Ursúa (2008)

The post 1960 evidence reinforces this interpretation. Using World Development Indicators data for 1960-2023, A2 shows that commodity exporters exhibit greater volatility in GDP, consumption, investment, government spending, imports, and the trade balance to output ratio than non commodity exporters within the same development category. For instance, among developed economies, GDP volatility is higher in commodity exporters than in non commodity exporters, and consumption volatility rises from 2.28 to 2.94 when moving from non commodity exporters to commodity exporters. Among developing economies, the same comparison yields substantially higher volatility in both GDP and consumption for commodity exporters. In A3, I can see that the ratio $\sigma(C)/\sigma(Y)$ is also systematically higher in commodity exporters: 1.19 versus 1.04 in developed economies and 1.24 versus 1.02 in developing economies. These patterns indicate that the classical fact that consumption is relatively more volatile in developing countries is closely related to commodity exporter status.

These differences are not limited to the level of volatility. The Comovement patterns also differ (A4). In developing countries, consumption, investment, government spending, and imports are more procyclical among commodity exporters than among non commodity exporters. The trade balance to output ratio is also more strongly countercyclical in commodity exporting developing economies. These patterns point to a stronger role for external shocks and external adjustment in commodity exporters.

Table A2: Summary Statistics: Volatility (average)

Commodities	Developing	Std. GDP	Std. C	Std. I	Std.G	Std.X	Std. M	Std. TB/Y
0	0	2.20	2.28	6.06	1.84	4.84	5.42	2.66
1	0	2.41	2.94	8.46	2.09	4.60	6.98	3.91
0	1	3.59	3.57	11.57	4.43	9.56	12.21	3.57
1	1	4.13	4.98	13.40	5.34	8.58	15.01	3.57

Table A3: Summary Statistics: Relative Volatility (to gdp, average)

Commodities	Developing	$\sigma(C)/\sigma(Y)$	$\sigma(I)/\sigma(Y)$	$\sigma(G)/\sigma(Y)$	$\sigma(X)/\sigma(Y)$	$\sigma(M)/\sigma(Y)$
0	0	1.04	2.78	0.85	2.23	2.49
1	0	1.19	3.41	0.93	2.04	3.04
0	1	1.02	3.57	1.42	3.10	3.76
1	1	1.24	3.35	1.44	2.20	3.83

Table A4: Summary Statistics: Correlations (average)

Commodities	Developing	Corr(C,Y)	Corr(I,Y)	Corr(G,Y)	Corr(X,Y)	Corr(M,Y)	Corr(TB/Y,Y)
0	0	0.78	0.83	0.19	0.53	0.80	-0.22
1	0	0.76	0.72	0.16	0.36	0.64	-0.15
0	1	0.66	0.69	0.30	0.37	0.57	-0.25
1	1	0.76	0.82	0.52	0.36	0.73	-0.35

A natural candidate mechanism is the terms of trade. Commodity exporters face more volatile terms of trade than non commodity exporters, and this difference appears in both developed and developing groups. In A5, we can see that terms of trade volatility is 6.69 for developed commodity exporters and 2.29 for developed non commodity exporters. Among developing economies the corresponding numbers are 8.05 and 7.60. Thus, commodity exporters are systematically more exposed to a source of external volatility that directly affects tradable income and external adjustment.

Table A5: Summary Statistics: Average Terms of Trade Volatility

Commodities	Developing	Std. ToT
0	0	2.29
1	0	6.69
0	1	7.60
1	1	8.05

Taken together, these facts suggest that the standard developed versus developing comparison misses an important dimension of heterogeneity. Commodity exporters differ systematically from non commodity exporters in unconditional volatility, in the relative behavior of consumption and output, in trade balance dynamics, and in exposure to terms of trade shocks. This makes commodity exporter status a natural candidate for explaining differences not only in ordinary business cycles, but also in external crises.

C LP-DiD Subgroup Impulse Response Paths

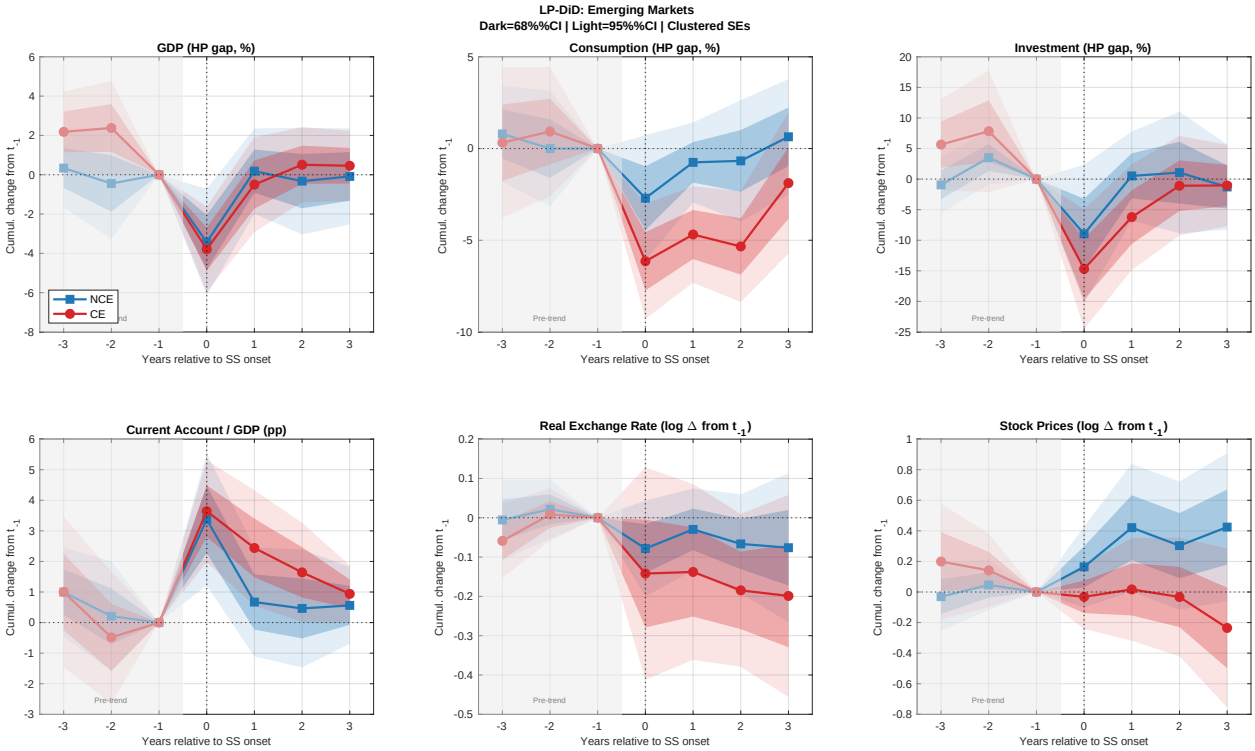


Figure B1: Sudden Stop Dynamics: Emerging Markets

Notes: EM subsample. Red: CE. Blue: NCE. Consumption -3.5 pp at $h = 0$ and -3.5 pp at $h = 1$ (approaching significance); CA $+0.8$ pp, $+1.6$ pp, $+1.8$ pp at $h = 0$–2. **Note:** positive GDP pre trend ($+2.83$ pp, $p = 0.056$) indicates CE EM countries were in a commodity boom phase before the episode; interpret GDP results for this group as lower bounds.

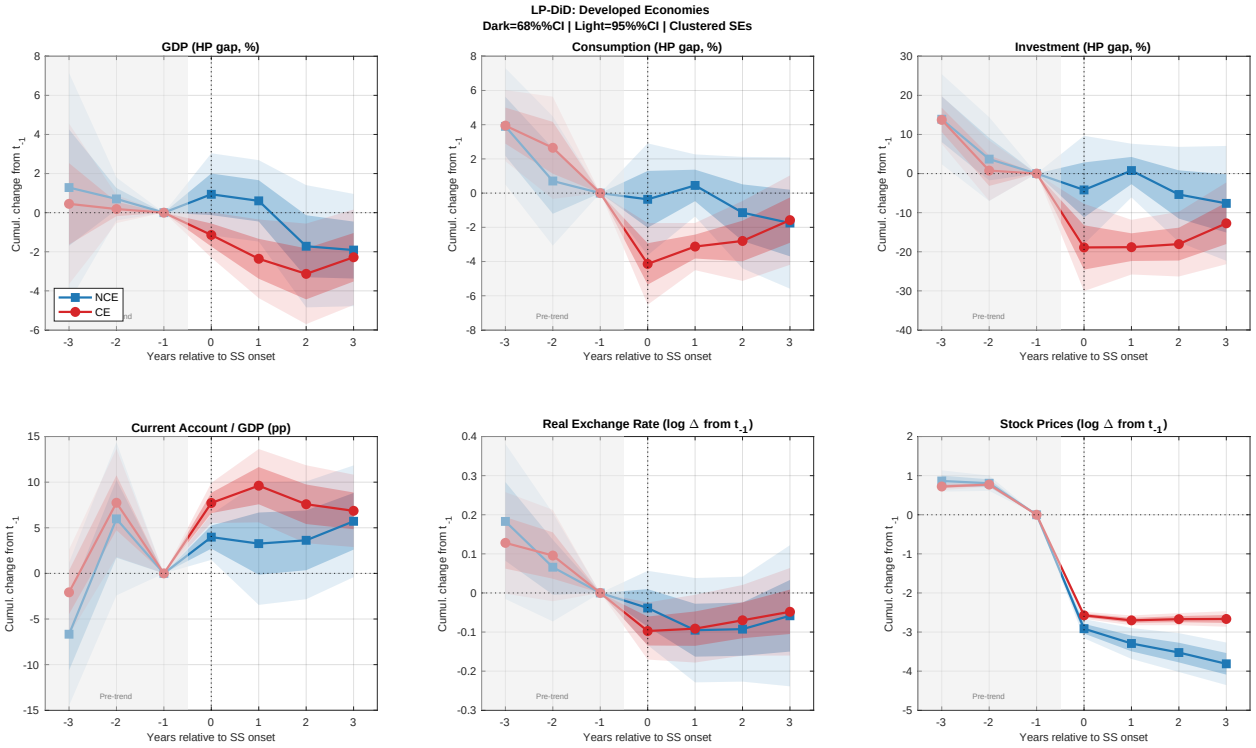


Figure B2: Sudden Stop Dynamics: Developed Economies

Notes: Estimated IRF paths from equation (2), developed economies only. Red: CE. Blue: NCE. Dark band: 68 % CI. Light band: 95 % CI. Investment significantly more negative for CE at $h = 0$–$h = 2$ ($p < 0.01$). CA/GDP significantly larger for CE at $h = 0$–$h = 2$ ($p < 0.01$). Consumption significantly more negative at $h = 0$–$h = 1$ ($p < 0.01$). Pre trend passes for investment and GDP; consumption and CA show positive pre trends (biasing against CE result).

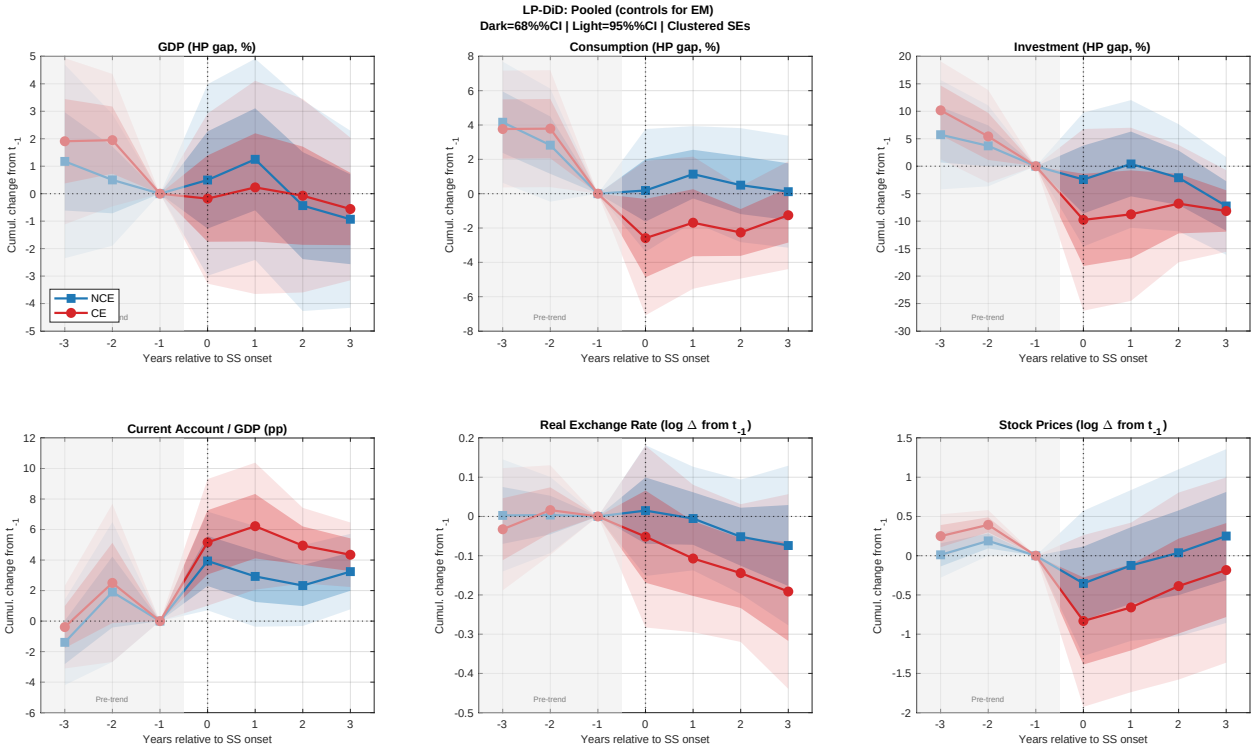


Figure B3: Sudden Stop Dynamics: Pooled Sample

Notes: Full pooled sample with $SS_{it} \cdot EM_i$ control. $\hat{\delta}_h$ on $SS_{it} \cdot CE_i$ measures CE/NCE gap conditional on development level.

D Robustness: Continuous Commodity Dependence

Specification. CE_i replaced by $\widetilde{CD}_i = (CD_i - \bar{CD})/\sigma_{CD}$, the standardized commodity export share (UNCTAD, 2021–2023, $\bar{CD} = 46.5\,\%$, $\sigma_{CD} = 28.7\,\%$):

$$\Delta^h y_{it} = \alpha_i + \gamma_t + \beta_h SS_{it} + \delta_h^{CD} SS_{it} \cdot \widetilde{CD}_i + \theta_h SS_{it} \cdot \Delta \log P_{it} + SS_{it} \cdot \mathbf{X}'_{t-1} \boldsymbol{\lambda}_h + \varepsilon_{i,t+h}. \quad (48)$$

Reported statistic: IQR differential $\hat{\delta}_h^{CD} \times (\widetilde{CD}_{p75} - \widetilde{CD}_{p25})$, evaluated at p75 (81 %) vs p25 (26 %). Delta method SEs.

Table C1: IQR Differential – Continuous Commodity Dependence, Pooled

	IQR Differential ($\hat{\delta}_h^{CD} \times$ IQR, p25 = 26 %, p75 = 81 %)				
Variable	$h = 0$	$h = 1$	$h = 2$	$h = 3$	Pre trend p
GDP	+0.38	−0.12	+0.52	+0.93	0.19
	(0.96)	(1.00)	(1.08)	(0.91)	
Consumption	−1.77	−2.36***	−2.57**	−1.03	0.34
	(1.30)	(0.90)	(1.12)	(1.08)	
Investment	−3.71	−5.29	−2.90	+1.48	0.42
	(4.54)	(3.74)	(3.34)	(2.90)	
CA/GDP (pp)	+0.12	+2.79***	+2.58***	+0.89**	0.10
	(1.03)	(0.97)	(0.73)	(0.45)	
RER (log-diff)	−0.004	−0.082	−0.091*	−0.131	0.85
	(0.064)	(0.054)	(0.048)	(0.081)	
Stock prices (log-diff)	−0.304**	−0.409***	−0.331**	−0.329*	0.15
	(0.140)	(0.132)	(0.164)	(0.169)	

Notes: Pooled specification of equation (48) with $SS_{it} \cdot EM_i$ control. Reported values are the IQR differential $\hat{\delta}_h^{CD} \times (\widetilde{CD}_{p75} - \widetilde{CD}_{p25})$, evaluating the slope of the standardized commodity dependence measure $\widetilde{CD}_i$ between the 25th percentile of the SS-episode distribution of CD (26 %) and the 75th percentile (81 %), a range of 54.6 percentage points (equivalently 1.91 standard deviations of $\widetilde{CD}$). Delta-method standard errors in parentheses. $^*p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. $h = -1$ omitted (normalization). The pre trend column reports the p-value of $\hat{\delta}_{-2}^{CD}$. GDP, consumption, and investment are HP-filtered % deviations from trend; CA/GDP in percentage points; RER and stock prices in log differences.

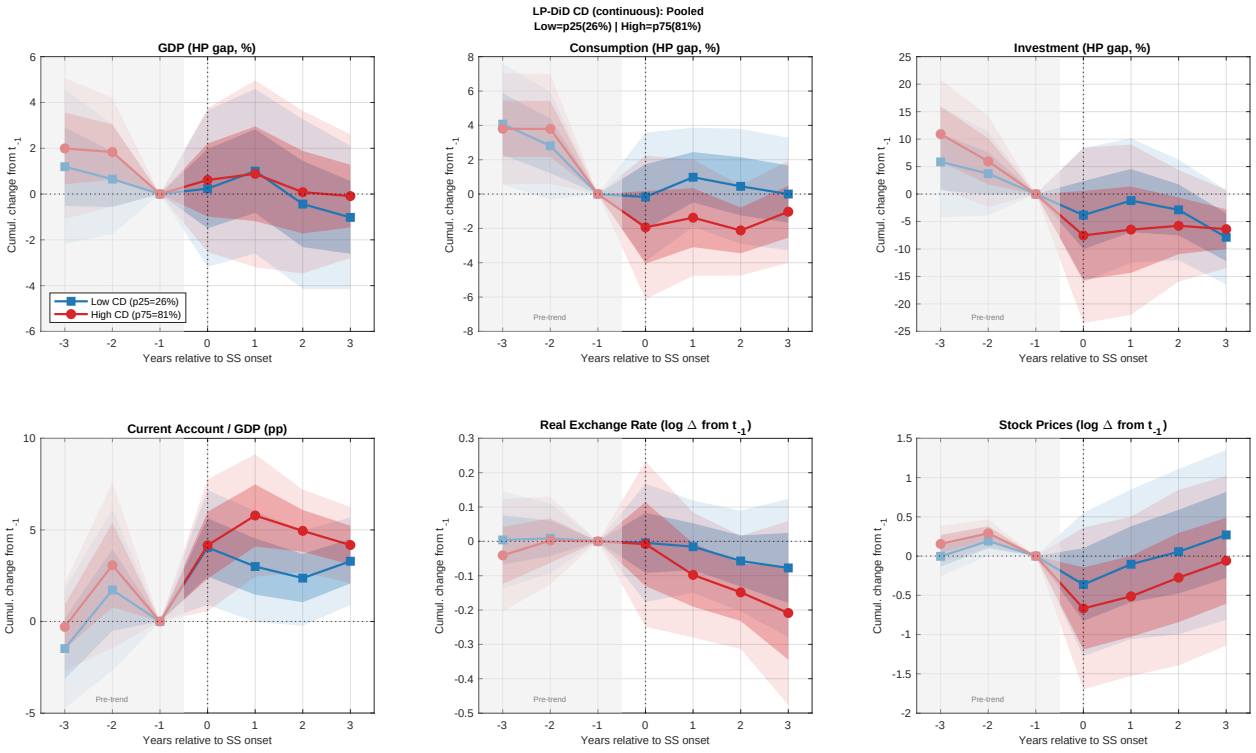


Figure C1: Sudden Stop Dynamics by Commodity Dependence Percentile (Pooled)

Notes: Estimated LP paths from equation (48), evaluated at p25 (26 %, blue) and p75 (81 %, red).

E Robustness: Income Level

Income groups defined by GDP per capita (constant 2015 USD, WDI 2021–2023 average).

The **Low Income** group (< p25, \$5,765) presents pre trend violations for GDP at $h = -2$ is +7.5 pp ($p < 0.001$) and investment +9.2 pp ($p < 0.001$), indicating that CE and NCE low income countries were on systematically different macro trajectories before the sudden stop.

The **High Income** group passes pre trends for GDP ($p = 0.24$), investment ($p = 0.08$), CA ($p < 0.01$, positive), and RER ($p = 0.68$). The CA pre trend is significant and positive (biasing against finding a larger CE reversal), making the post crisis results a lower bound.

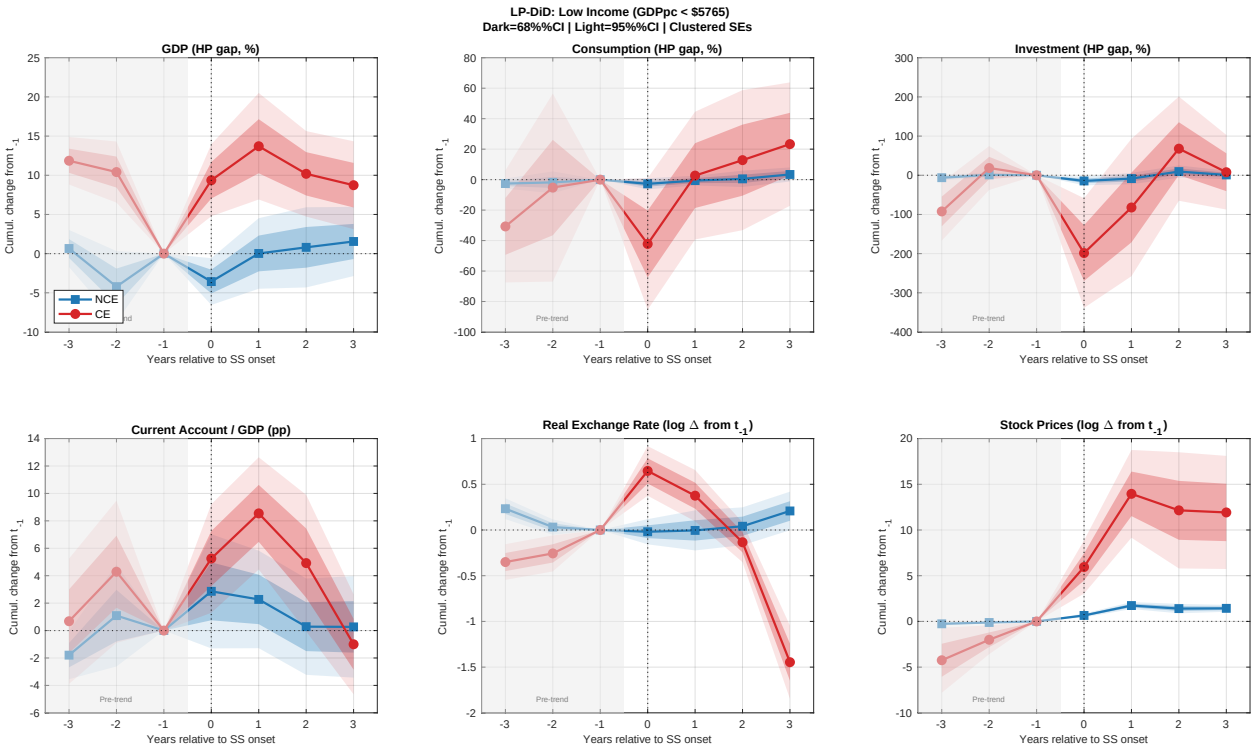


Figure D1: Sudden Stop Dynamics: Low Income Countries (< \$5,765)

Notes: Red: CE. Blue: NCE. Every outcome significantly more severe for CE at $h = 0$ or $h = 1$. Positive pre trends for GDP and Investment bias *against* finding the CE differential.

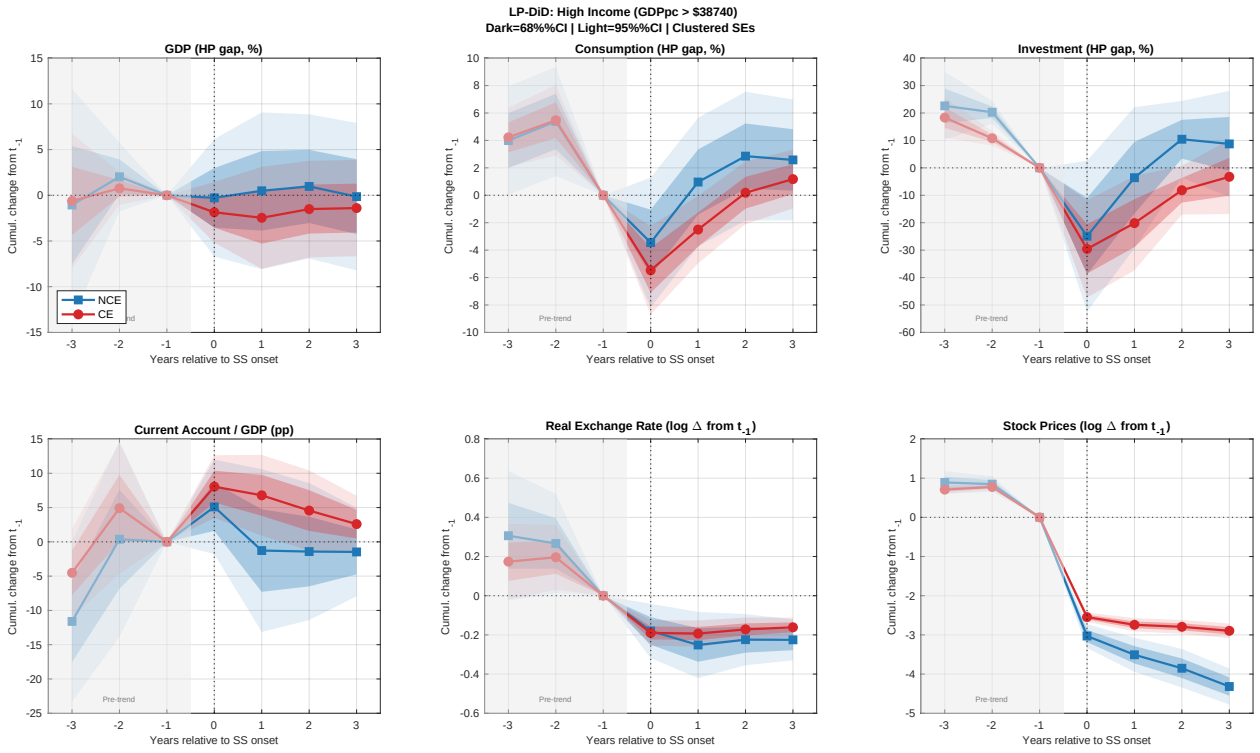


Figure D2: Sudden Stop Dynamics: High Income Countries (> $38,740)

Notes: Red: CE (Canada, Iceland, Norway, etc.). Blue: NCE. Every outcome significantly more severe for CE at $h = 0$ or $h = 1$. Positive pre trends for CA/GDP, consumption, and stock prices bias *against* finding the CE differential.

F Robustness: World Interest Rate and Pre-trend Conditioning

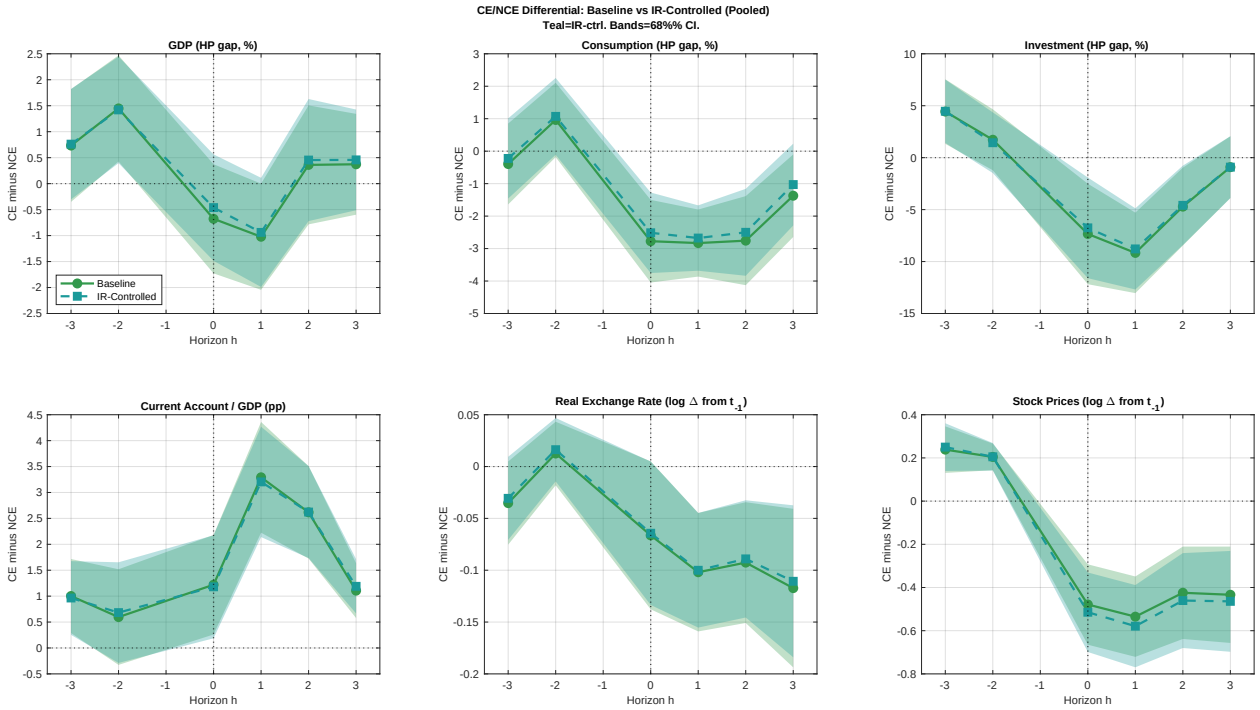


Figure E1: CE/NCE Differential: Baseline vs IR-Controlled (Pooled)

Notes: Green: baseline. Teal dashed: adds $SS_{it} \cdot \Delta R_t^{world}$. Bands = 68 % CI. CA/GDP and consumption survive with 1 % significance (attenuation of 3 % and 5 % respectively). RER shows minimal attenuation ($< 2\,\%$ at $h = 1$), confirming the RER result is not driven by the global credit tightening channel. $\phi_3 = -0.000771$ ($p = 0.629$): commodity prices show no additional co-movement with world rates during SS episodes.

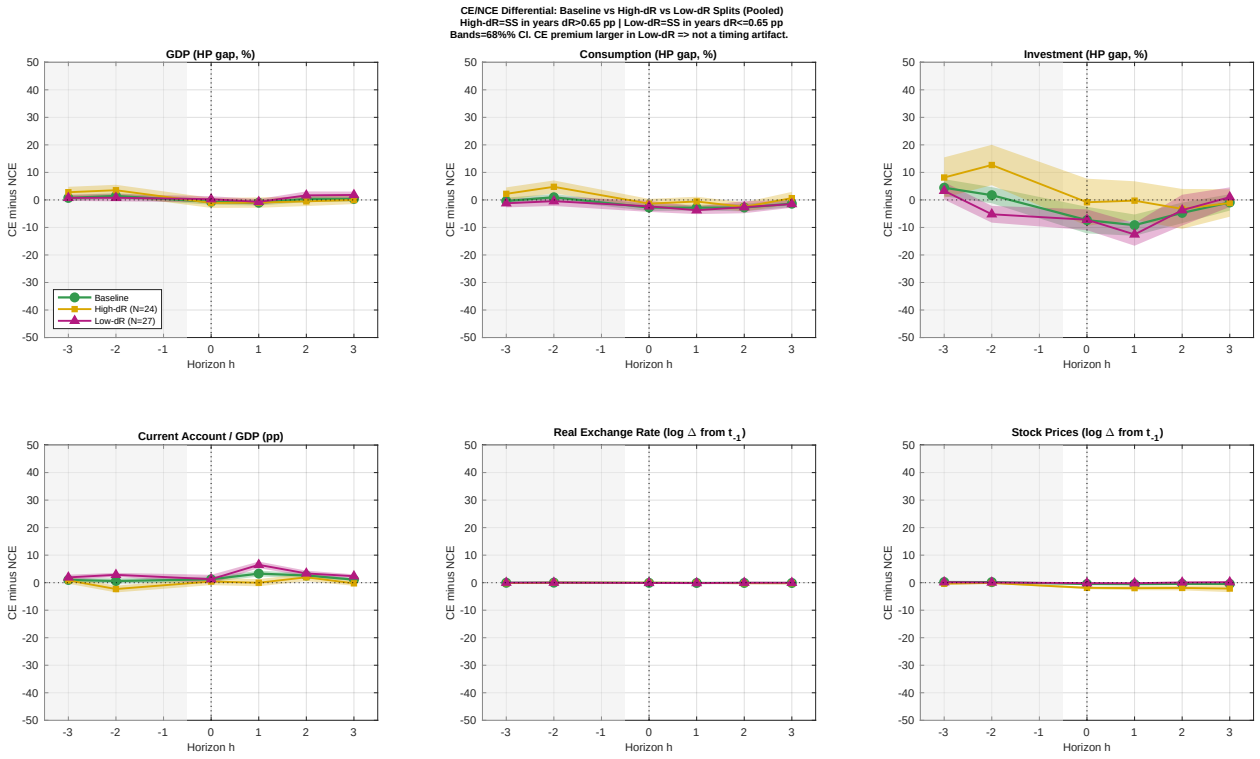


Figure E2: CE/NCE Differential: Baseline vs High-ΔR vs Low-ΔR Year Splits (Pooled)

Notes: Green: baseline. Gold: SS episodes in years with $\Delta R > 0.65$ pp (24 episodes). Magenta: SS episodes in years with $\Delta R \leq 0.65$ pp (27 episodes). CA/GDP and consumption CE premiums are concentrated in low-ΔR years, confirming the commodity price channel. Stock price CE premium is concentrated in high-ΔR years, consistent with an additional equity channel through global credit tightening. Bands = 68 % CI.

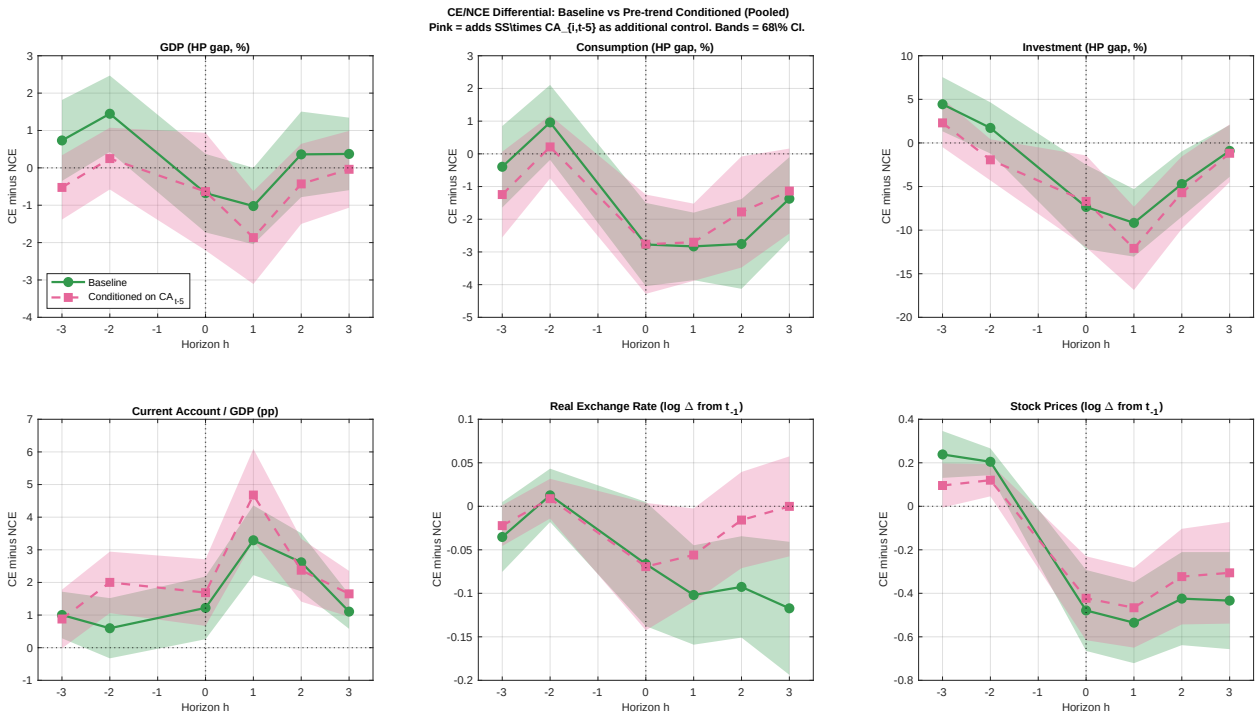


Figure E3: CE/NCE Differential: Baseline vs Pre-trend Conditioned (Pooled)

Notes: Green: baseline. Pink: adds $SS_{it} \cdot CA_{i,t-5}$ to control for the pre-crisis CA/GDP level. The CA/GDP differential increases from +3.29 pp to +4.68 pp at $h = 1$ after conditioning, confirming the positive pre-trend biases against rather than toward the result. Bands = 68 % CI.