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Commodity-driven Macroeconomic Fluctuations:

Does Size Matter?

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ABSTRACT: Commodities play a central yet often underappreciated role in shaping macroeconomic fluctuations across both advanced economies (AEs) and emerging market and developing economies (EMDEs), with the latter exhibiting greater volatility. This paper examines how the domestic interconnectedness of the commodity sector conditions the transmission of commodity price shocks. Rather than focusing only on sectoral size, we emphasize production linkages, measured by the network-adjusted value-added share (NAVAS) of the commodity sector. Using panel local projections for OECD countries, we show that greater interconnectedness amplifies the positive effects of terms-of-trade gains on consumption while mitigating the negative effects of declines. To interpret these results, we develop a small open economy model with production networks. The model highlights how commodity interconnectedness strengthens wealth channels but dampens real wage channels, shaping the overall macroeconomic response. Our findings underscore the importance of network structures in explaining commodity shock propagation and the heightened volatility observed in EMDEs.

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WORKING PAPERS

Commodity-driven Macroeconomic Fluctuations: Does Size Matter?

Prepared by Patricia Gomez-Gonzalez, Maximiliano Jerez-Osses, Vida Maver, Jorge Miranda-Pinto, Jean-Marc Natal¹

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1 Introduction

Commodities play a central, yet often underappreciated, role in shaping macroeconomic fluctuations across both advanced economies (AEs) and emerging market and developing economies (EMDEs), with the latter typically experiencing greater macroeconomic volatility (e.g., [Drechsel and Tenreyro, 2018](#); [Kohn et al., 2021](#); [Juvenal and Petrella, 2024](#); [Miranda-Pinto et al., 2025](#)). Understanding the macroeconomic consequences of commodity price movements has become increasingly important amid climate-related supply disruptions, geopolitical tensions, and evolving global trade dynamics.

This paper examines how the linkages between commodity sectors and the broader economy differ between EMDEs and AEs, and how these upstream and downstream connections affect the propagation of commodity price shocks to the rest of the economy. Drawing on empirical analysis and a general equilibrium framework, it shows that the macroeconomic impact of these shocks depends less on the sector’s size than on its interconnectedness with the rest of the economy. This interconnectedness is captured by the Network-Adjusted Value-Added Share (NAVAS), which helps explain cross-country variation in consumption responses to commodity terms of trade fluctuations. These findings challenge the conventional emphasis on measures of direct sectoral importance, such as size or net exports, as the primary driver of the increased volatility of the EMDEs’ heightened business cycle.

The paper begins by documenting stylized facts on the size (*Domar* weight) and interconnectedness of the commodity sector, separately for AEs and EMDEs.¹ Using data from 66 countries, roughly evenly split between EMDEs and AEs, we find that commodity sectors are generally larger and somewhat more interconnected within domestic production networks in EMDEs compared to AEs. We quantify this interconnectedness using the NAVAS introduced by [Silva et al. 2024](#), which captures the share of total factor income generated by the commodity sector, accounting for all direct and indirect linkages, both upstream and

¹Domar weight ([Domar, 1961](#)) is the ratio between industry gross output and aggregate GDP.

downstream and show that both size and NAVAS exhibit substantial heterogeneity across commodity types (including energy, metals, and agriculture) and across countries. Importantly, we show that NAVAS is a key variable in explaining cross-country heterogeneity in consumption responses to commodity terms of trade shocks.

To gauge the relationship between consumption and terms of trade shocks, the paper applies panel local projection (LP) methods following [Jordà \(2005\)](#) to examine how the characteristics of the commodity sector shape the transmission of commodity terms of trade shocks. Our specification allows us to assess whether greater sectoral interconnectedness—measured via the commodity sector’s NAVAS—amplifies or dampens the propagation of these shocks, after controlling for commodity sector size. Following [Kilian 2009a](#), who emphasizes the importance of shock origin, the analysis distinguishes between supply-side disruptions and demand-driven price increases. Using exogenously identified series from [Baumeister and Guérin 2021](#) and [Baumeister and Hamilton 2019](#), our results show that demand-driven shocks consistently generate positive consumption responses and that the commodity sector’s interconnectedness, measured by its NAVAS, comoves positively with the consumption response. Instead, the effect of the commodity sector’s size in propagating commodity price shocks is modest and is not statistically significant at all horizons.

In contrast, supply-driven commodity price shocks have a negative effect on consumption, and, as before, the effect of NAVAS on consumption is positive, large, and significant at all horizons, after controlling for commodity sector size, suggesting that the commodity sector’s interconnectedness is a distinct and quantitatively more relevant transmission channel of commodity price shocks. Taken together, the empirical results underscore that relying solely on Domar weights understates the true transmission mechanism of commodity price shocks to consumption and that NAVAS is key to understanding the macroeconomic impact of commodity price shocks in small open economies.²

²Our results complement those in [Castillo \(2022\)](#), who provides evidence of the role of production network structures, beyond size, in driving the effect of commodity price shocks on real GDP.

To formalize these findings, we develop a dynamic small open economy model with production networks that clarifies the transmission channels involved, building on the framework introduced by [Silva et al. \(2024\)](#). The model allows us to distinguish between two key transmission mechanisms between terms of trade shocks and consumption: an income effect and a wealth effect.

The income effect arises as global commodity prices increases raise the real wage. Higher revenues in the commodity sector increase labor demand, putting upward pressure on nominal wages throughout the economy. This nominal wage increase is partially offset in real terms due to increased input costs in downstream sectors, which are passed through to sectoral and aggregate prices. The more interconnected the commodity sector is, the smaller the economy-wide response of real wages is, because the commodity sector's suppliers push up the commodity sector's marginal cost.

Second, commodity price movements affect the valuation of net foreign assets (NFA), generating wealth effects, which affect the path of consumption. Our model's simulations show that if the downstream propagation of commodity price shocks via the production network is strong, then the value of NFA drops on impact, generating a negative wealth effect. After that, in those cases, the increasing path of the NFA valuation incentivizes countries to decrease consumption on impact, increase NFA, and smooth the consumption increase into the future. The comovement between the commodity sector NAVAS and these wealth effects is positive, in line with the empirical evidence. In our calibrated model, the wealth effects dominate the consumption response, and we observe, in line with the empirical evidence, a positive comovement between the commodity sector's interconnectedness as measured by NAVAS and consumption responses on impact.

Our model simulations also show that the relationship between commodity sector size and consumption responses on impact is weak suggesting, in line with the empirical evidence, that the NAVAS is a stronger transmission mechanism of commodity price shocks in small

open economies.

Finally, we use the model to compare terms of trade shocks with productivity shocks along two dimensions: i) their effects on aggregate consumption, and ii) how these effects interact with the commodity sector’s interconnectedness. Our results highlight the central role of wealth effects. When NFA are valued in units of the importable good, their valuation follows an increasing path. In this case, the impact responses of consumption to positive terms-of-trade and productivity shocks are qualitatively similar. Moreover, the positive relationship between NAVAS and the consumption response on impact requires the presence of wealth effects through NFA. However, whether the valuation path of NFA is increasing or decreasing is irrelevant for this relationship.

Related literature and contribution This paper contributes to several strands of literature, with a focus on both theoretical modeling and empirical analysis. First, we contribute to the growing body of work on production networks and macroeconomic fluctuations. Much of this literature features closed-economy frameworks, as in [Baqae and Farhi 2019](#), [Bigio and La’o 2020](#), and [Rubbo 2023](#), while others extend to multi-country models such as [Caliendo and Parro 2015](#) and [McNerney et al. 2022](#). Our paper is most closely related to the models of small open economies (SOEs), including [Drechsel and Tenreyro 2018](#), [Cao and Dong 2020](#), [Kohn et al. 2021](#), [Silva et al. 2024](#), [Miranda-Pinto et al. 2025](#), [Romero 2025](#), and [Qiu et al. 2025](#). Our contribution lies in introducing a dynamic small open economy framework that allows for a comparative analysis of consumption responses to terms-of-trade shocks. Unlike the aforementioned papers, we emphasize the role of commodity network linkages in shaping the income and wealth effects of commodity terms of trade shocks. We also show how commodity terms of trade shocks can differ from productivity shocks to the commodity sector.

Second, we contribute to the international economics literature by emphasizing the role of domestic production structures in shaping the transmission of commodity price shocks

(Kilian 2009a, Schmitt-Grohé and Uribe 2018, Baumeister and Hamilton 2019, Baumeister et al. 2022, Albrizio et al. 2023, Benguria et al. 2024, Boer et al. 2024, Di Pace et al. 2025). We focus on the importance of considering the intersectoral linkages in the domestic production networks when investigating the transmission channel of commodity price shocks, and broaden the scope to include a wider set of commodities and countries in our empirical analysis. The paper is the closest to Silva et al. 2024, who introduce the NAVAS measure of sectoral interconnectedness, which we adopt. We contribute to this literature by disentangling two distinct transmission channels –an income effect and a valuation channel– connected with this measure, enabling a more nuanced understanding of how commodity price shocks are transmitted through the economy. While Silva 2024 examine the implications of interconnectedness for inflation, our focus is on consumption.

Finally, in addition to our theoretical contributions, we provide extensive empirical documentation of the NAVAS measure for both AE and EMDE economies, by country and sector. On the empirical front, we estimate panel local projections following Jordà 2005. In line with existing literature, we instrument commodity price shocks with exogenously identified series. Specifically, due to the potentially distinct economic effects of shocks originating from different sources (Kilian 2009a), we conduct two separate analyses: one based on demand-driven fluctuations (Baumeister and Guérin 2021) and another reflecting supply-side disturbances (Baumeister and Hamilton 2019). Our contribution lies in providing empirical evidence on the transmission of commodity price shocks across a broad set of countries, distinguishing their effects on the real economy according to the nature of the shock, and based on the degree of commodity sector interconnectedness as measured by NAVAS.

Outline The remainder of the paper is structured as follows. Section 2 presents the empirical analysis, beginning with a description of the data and the construction of the Network-Adjusted Value-Added Share measure. It then documents key stylized facts and examines cross-country heterogeneity in commodity sector linkages, followed by the estimation of con-

sumption responses to commodity price shocks using panel local projection methods. Section 3 introduces a small open economy model that provides a theoretical framework to interpret the empirical findings. It outlines the model setup and calibration strategy, and analyzes consumption responses to both commodity price and productivity shocks, with a particular focus on disentangling the income and wealth transmission channels. Finally, Section 4 summarizes the main findings and discusses their policy implications.

2 Empirics

2.1 Data

Our analysis draws on an unbalanced annual panel comprising 66 countries, classified into AE and EMDEs according to the IMF taxonomy. The sample spans the period from 1990 to 2018 (extended through 2023 when data availability permits), with 37 countries in the AE group and 29 in the EMDE group. A complete list of included countries is provided in Table II in the Appendix. The dataset integrates three primary sources. First, commodity price data are sourced from the IMF’s Commodity Terms of Trade database. As a proxy for country-level export commodity prices, we use the Commodity Net Export Price Index, which is weighted by net exports as a share of GDP. To account for time-varying changes in the weights, we use rolling windows to reflect potential shifts in the composition of commodity trade.

Second, macroeconomic indicators and control variables are obtained from the Global Macro Database (GMD, Müller et al. 2025). All variables, including commodity prices, are deflated using the U.S. consumer price index (CPI) and expressed in U.S. dollars. Third, to capture the interlinkages of the commodity sector with the broader domestic economy, we rely on input-output data from the 2018 edition of the OECD Input-Output Tables (IOT).

2.2 Commodity Sector Network-Adjusted Value-Added Share

A key statistic our analysis relies on, following [Silva et al. \(2024\)](#), is the commodity sector’s NAVAS. This metric captures how much of the value created in commodity production comes from domestic factors and inputs, taking into account the entire chain of the commodity sector’s suppliers. It captures both upstream linkages, where the commodity sector acts as a buyer of inputs, and downstream ones, where it serves as a supplier to other industries. NAVAS is calculated as a weighted sum of the commodity sector’s value-added share, which we denote as a_{N+1} . We use the subscript $N + 1$ since in the model there are N non-commodity and non-tradable sectors and one commodity sector, the sector $N + 1$. The value-added share of the commodity sector equals:

$$a_{N+1} = 1 - \frac{\sum_i P_i M_{N+1,i}}{P_{N+1} Q_{N+1}} \quad (1)$$

where $P_i M_{N+1,i}$ denotes the value of intermediates purchased by the commodity sector from sector i —be domestic or imported intermediates—, expressed as a share of the commodity sector’s total sales ($P_{N+1} Q_{N+1}$). This formulation captures the portion of output not attributed to intermediates, that is, the value-added share of output.³

To account for indirect exposure throughout the production network, the commodity sector’s value-added share is weighted by the Leontief inverse, capturing the full chain of upstream—direct and indirect commodity suppliers—production linkages. The resulting NAVAS, denoted as \tilde{a}_{N+1} , is given by:

$$\tilde{a}_{N+1} = \sum_{i=1}^{N+1} \Psi_{N+1,i} a_i \quad (2)$$

where $\Psi_{N+1,i}$ comes from the Leontief inverse matrix $\Psi = (I - \Gamma)^{-1}$, and Γ represents the

³Note that, by the national accounting identity, the value-added share of output equals the factor incomes share of output.

input-output (IO) structure, where each element $\Gamma_{i,j}$ refers to the share of inputs from sector j used by sector i . Hence, the sum in Equation (2) is made across the elements in row $N + 1$, which capture the total use of intermediates by the commodity sector.

Constructed in this way, NAVAS can be high due to several factors. First, when the commodity sector itself generates a large share of value-added. Second, when it relies on intermediate inputs from sectors that also create a lot of value-added. Third, when it relies more on domestic rather than imported intermediate inputs. And finally, when it supplies key inputs to sectors that, directly or indirectly, supply intermediates back into commodity production.

When commodity prices increase, production costs rise through two main channels. The first affects sectors that use commodities as inputs, while the second operates through higher wages across the economy. The first channel amplifies cost pressures when the commodity sector plays an important role as a supplier (high NAVAS). The second channel works in the opposite direction and it depends on the importance of the commodity sector as a buyer of domestic factors (directly and indirectly). A higher NAVAS reduces the need for wage increases, since commodity firms are already facing higher marginal costs due to more expensive intermediate inputs. Because this second effect tends to dominate, a higher NAVAS ultimately leads to smaller overall increases in wages and prices. In this sense, the commodity sector acts as a cost absorber. The result is an increase in real wages and in the real price of commodities—both of which are important for assessing the value of the economy’s net foreign assets. The Appendix offers a more detailed explanation of the role of NAVAS. To build intuition, we present two illustrative examples based on a three-sector framework, showing how the commodity sector’s upstream and downstream centrality affect NAVAS. The first example explores supplier centrality heterogeneity and the second examines how shifting customer centrality toward labor-intensive sectors—while holding supplier centrality constant—can influence NAVAS.

2.3 Heterogeneity in Commodity Linkages Across Country Groups

It is well established that, on average, EMDEs have much larger commodity sectors than AE (Kohn et al. 2021). Indeed, in our sample, the average size or Domar weight of the commodity sectors in EMDEs is twice as large for metals, three times as large for energy and almost four times as large for agriculture compared to AEs (see Tables VI and VII in the Appendix). Such differences in Domar weights suggest that EMDEs might be more vulnerable to commodity price-driven fluctuations. Yet, sectoral size alone provides an incomplete picture of the commodity sector’s systemic relevance and the economy’s total exposure to commodity price shocks.

To gauge at how commodity sectors are embedded within domestic production structures we compare the NAVAS measure across the two country groups. On average, the commodity sector’s NAVAS is 31% higher in EMDEs than in AEs, with energy exhibiting the biggest difference in its average NAVAS across country groups and metals and agricultural products the smallest. The distributional heterogeneity of NAVAS across sectors is also noteworthy. Agricultural sectors show consistently high NAVAS, which means that these sectors use a substantial amount of domestic capital and labor, in a network sense. There is also a smaller variation in agriculture NAVAS across countries, indicating their structural importance across EMDEs and AEs. Energy, by contrast, shows a greater dispersion in their use of domestic factor, as indicated by the standard deviations in both country groups.⁴ Metals display moderate NAVAS and comparatively lower variability in both country groups.⁵ Detailed country-specific NAVAS values—both for the aggregate commodity sector and disaggregated by energy, metals, and agricultural products—are presented in Tables IV and V in the Appendix.

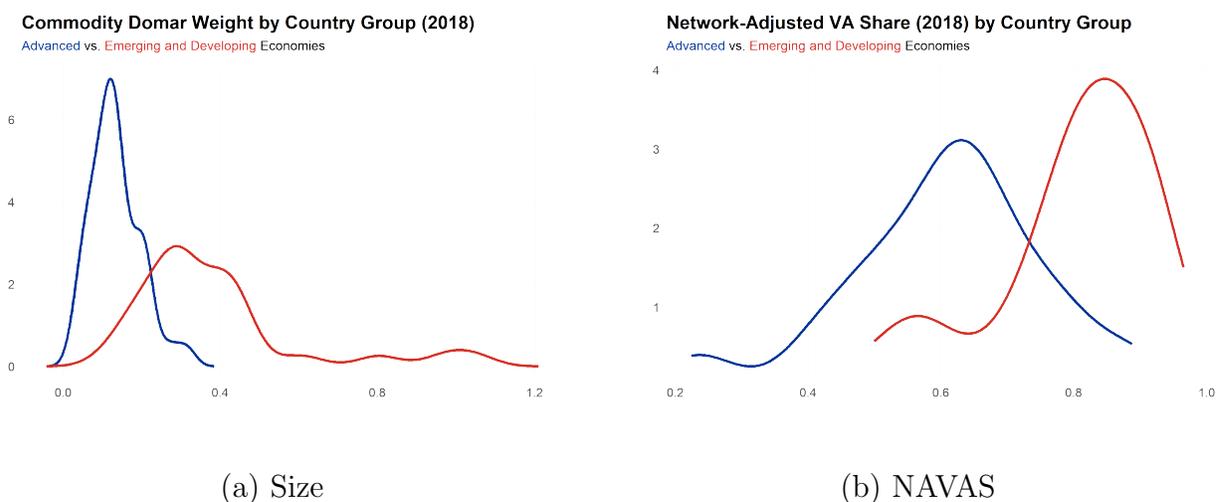
In Figure XIX of our Appendix we plot the relationship between commodity sector size

⁴Energy sectors comprise mining of energy and petroleum products.

⁵Metal sectors comprise mining of metals and basic metal products.

and commodity sector NAVAS. While across country groups size and NAVAS are correlated, within AEs there is practically no correlation between size and NAVAS. On the other hand, within EMEDs there is only a weak positive relationship, indicating that to some extent larger commodity sectors in EMEDs also tend to be central buyers of inputs in the domestic production network.

Figure I: Size and NAVAS across country groups



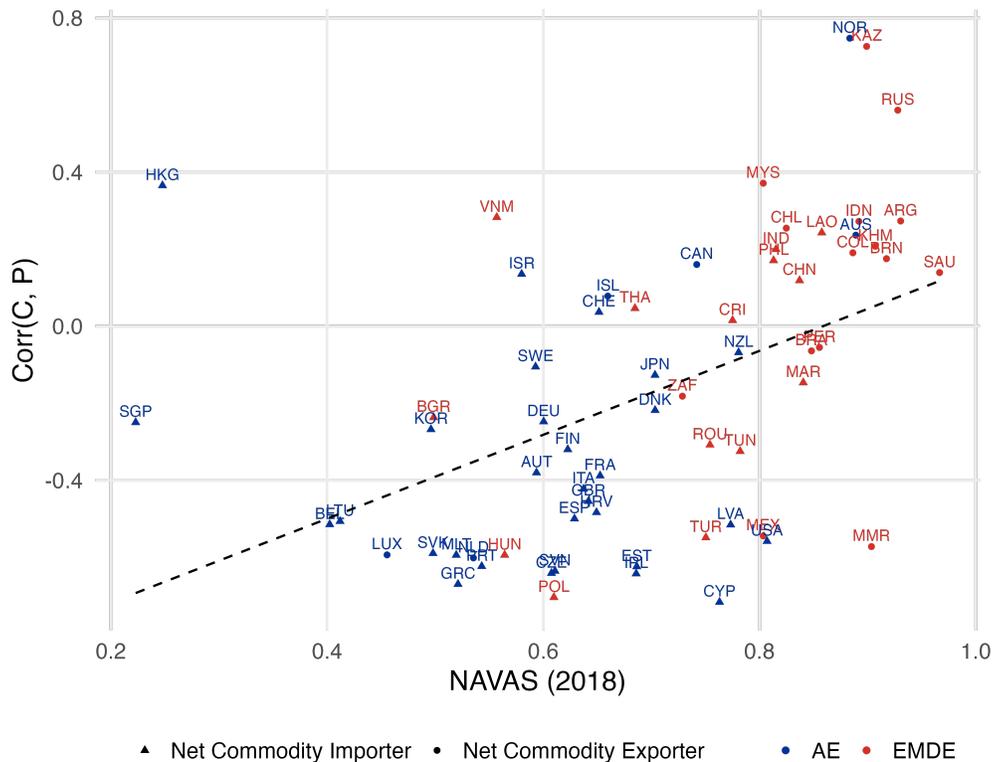
Source: OECD Input-Output (IO) Tables (2018) for 66 countries.

Note: The Domar weight of the commodity sector is the ratio of the nominal value of the commodity sector gross output to GDP. Network-Adjusted VA share is the sum of commodity sector value-added share and commodity suppliers' VA shares weighted by the Leontief inverse elements that capture downstream and upstream linkages of the commodity sector.

Taken together, these findings suggest that commodity sectors are much larger and slightly more interconnected within the production network in EMDEs relative to AEs. Figure I, panel (a) shows that the size of the commodity sector tends to be small in AEs, but its importance for macroeconomic fluctuations, as captured by its NAVAS (Figure I, panel (b)) which averages around 0.6, is likely greater than the size of the commodity sector only would suggest. Furthermore, the right tail of the NAVAS distribution in AEs markedly overlaps with the left tail in EMDEs, indicating that commodity sectors in many AEs are more interconnected than those in EMDEs. As we will see, shocks to the commodity sector in these AEs may have larger and more persistent effects on economic activity, and relying

solely on size-based indicators would underestimate the total impact of these shocks. As the model in Section 3 will show, incorporating NAVAS allows for a more accurate assessment of how commodity price shocks propagate through labor markets and asset positions, affecting key aggregate variables such as consumption. Indeed, Figure II suggests that the commodity sector’s NAVAS is a relevant variable to explain the cross-country heterogeneity in consumption.

Figure II: Cross-country Correlation



Source: IMF CTOT database for commodity price data. OECD IO Tables (2018) for 66 countries for Domar weights. Global Macro Database (Müller et al. 2025) for country-level consumption.
Note: The figure shows the correlation between countries’ cyclical consumption and cyclical commodity prices, computed for 66 countries. Commodity prices are measured by the Commodity Net Export Price Index, weighted by net exports as a share of GDP and deflated using the U.S. consumer price index (CPI). Countries in the AE group are shown in blue, while those in EMDE are shown in red. Additionally, triangles represent commodity net importers, while circles indicate commodity net exporters.

NAVAS and the Correlation between Commodity Prices and Aggregate Consumption The scatterplot in Figure II displays the relationship between the NAVAS on

the horizontal axis and the correlation between countries’ cyclical consumption and cyclical commodity prices, both measured annually over the period 1990–2023. It shows that countries with a more interconnected commodity sector tend to exhibit stronger co-movement between aggregate consumption and commodity prices. Notably, several advanced economies, such as Australia, New Zealand, and Canada, display both higher NAVAS and stronger comovements compared to EMDEs like Bulgaria, Hungary, Poland, and South Africa. Interestingly, the sign of the correlation is not directly tied to a country’s status as a net importer or exporter of a commodity, as often assumed. In fact, many net importers exhibit a positive correlation between commodity price shocks and consumption, while many net exporters show a negative one. This counterintuitive pattern motivates a deeper investigation, which we pursue both empirically using panel projections and theoretically using a small-open economy model.

2.4 Panel Local Projections

Propagation of the Commodity Price Shock To empirically investigate how commodity price fluctuations affect real economic activity, and to examine whether intersectoral linkages amplify or dampen the transmission of aggregate shocks, we apply the instrumental variable local projection (LP-IV) framework developed by [Jordà 2005](#) in a panel setup. This approach is particularly well-suited for our analysis, as it facilitates the inclusion of interaction terms needed to isolate the additional effect of NAVAS alongside the baseline commodity price shock. We estimate the following dynamic regression specification to trace out impulse responses across horizons $h = 0, 1, \dots, H$:

$$\begin{aligned}
 y_{i,t+h} - y_{i,t-1} = & \alpha_h + \mu_i + \sum_{j=1}^J \delta_h^{(j)} \cdot \Delta y_{i,t-j} + \beta_h^{(0)} \cdot \varepsilon_{i,t} + \sum_{l=1}^L \phi_{l,h} \cdot \varepsilon_{i,t-l} \\
 & + \beta_h^{(1)} \cdot (\varepsilon_{i,t} \times \text{NAVAS}_i) + \gamma_h \cdot (\varepsilon_{i,t} \times \text{size}_i) + u_{i,t+h}
 \end{aligned} \tag{3}$$

The dependent variable, $y_{i,t+h} - y_{i,t-1}$, is defined as the cumulative change in log real consumption for country i , denominated in U.S. dollars. To control for unobserved time-invariant heterogeneity, the specification includes country fixed effects (μ_i).⁶ The specification further includes lagged values of the dependent variable to control for dynamic persistence. To capture potential delayed transmission effects, we additionally incorporate lagged values of the commodity price shock ($\varepsilon_{i,t}$). A detailed description on how we identify the commodity price shock is below. Following the approach of [Cloyne et al. 2023](#), we include the terms $\varepsilon_{i,t} \times NAVAS_i$ and $\varepsilon_{i,t} \times size_i$, which interact the commodity price shock with the country-level commodity sector’s NAVAS and size, in deviation from the cross-country NAVAS and size averages.⁷ This ensures that the interaction term captures country-specific heterogeneity relative to the annual cross-country mean, thereby eliminating level effects that may confound the interpretation of dynamic responses.

The interpretation of the key coefficients $\beta_h^{(0)}$ and $\beta_h^{(1)}$ in Equation 3 is the following: $\beta_h^{(0)}$ captures the average direct effect of commodity price shocks on consumption and $\beta_h^{(1)}$ captures the amplification or attenuation effect the production network characteristics (NAVAS) has in the relationship between commodity price shocks and consumption. Critically, the effect NAVAS has on the relationship between the commodity price shock and consumption is independent of the effect the country’s commodity sector size has on this relationship, as we include $\varepsilon_{i,t} \times size_i$.

As a robustness check, we extend the specification to include an interaction between the commodity price shock and a measure of labor market slack, allowing us to examine whether labor market conditions influence the transmission mechanism. The results remain qualitatively unchanged, suggesting that the baseline findings are robust to this alternative specification. Full results are reported in the Appendix.

⁶We do not include time fixed effects, as a principal component analysis of country-level commodity export prices reveals that the first factor accounts for approximately 81% of total variation (consistent with [Fernández et al. 2018](#)). This high explanatory power indicates strong co-movement in commodity prices across countries and suggests the presence of a dominant global commodity price factor.

⁷This transformation isolates cross-sectional deviations within each year.

Shock Identification To address potential endogeneity in commodity prices, we employ externally identified commodity price shocks as instrumental variables. Commodity prices may rise either due to positive demand shocks or negative supply shocks, and the source of the shock matters (Kilian 2009b). Therefore, we consider two instruments, one that captures demand and one that captures supply.

To capture demand, we instrument commodity prices using the real commodity price factor in Baumeister and Guérin 2021, which extracts a common demand factor from 23 industrial and agricultural commodities. This factor serves as a suitable instrument for analyzing price increases stemming from positive global activity shocks. To capture supply, we use oil supply shocks from Baumeister and Hamilton 2019. We treat oil supply shocks as proxies for broader supply-side disturbances across commodity markets, reflecting their systemic impact beyond the energy sector.⁸ For the purpose of interpreting the estimated impulse responses, the structural shocks are scaled to produce a 5 percent contemporaneous increase in real commodity prices. This normalization is implemented using the LP-IV framework, following Stock and Watson 2018. The time series of structural shocks, which serve as instruments for commodity price fluctuations in our analysis, are illustrated in the Appendix.⁹

For robustness, we also adopt the identification strategy proposed by Schmitt-Grohé and Uribe 2018, which assumes that individual countries possess limited market power and therefore cannot influence global commodity prices.¹⁰ The resulting country-specific commodity price residuals, aggregated by country group, along with the corresponding estimation results, are also provided in the Appendix.¹¹

⁸A substantial body of literature employs oil supply shocks to capture general supply-side dynamics, particularly when direct instruments for aggregate supply disruptions are unavailable or difficult to identify. See, for example, Kilian 2009b, Herrera and Rangaraju 2020, Forni et al. 2025.

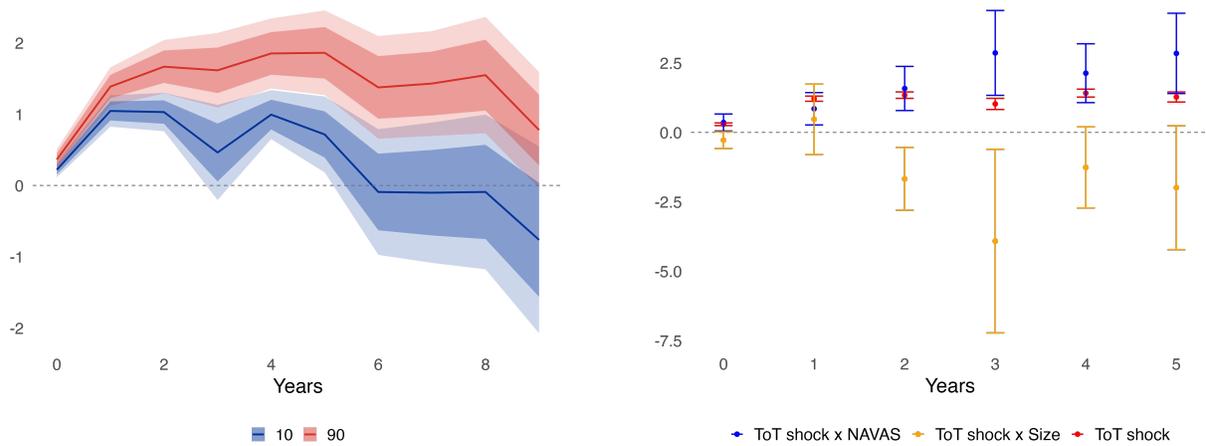
⁹See Figure XI, panel (b).

¹⁰Domestic exposure is captured through unexpected innovations derived from an AR(1) process, which closely reflects the behavior observed in the data.

¹¹See Figure XI, panel (a), and Figure X.

Results The empirical results support the patterns observed in Figure II showing that commodity sector interconnectedness, as measured by NAVAS, plays a significant role in shaping the transmission of commodity price shocks to consumption, even after controlling for the role of size. Figures III and IV illustrate this relationship by presenting the cumulative impulse responses of aggregate consumption over annual horizons following a structural shock, originating from either demand or supply factors, that increases commodity prices by 5% on impact. In particular, the figures compare responses for countries at the 10th (blue) and 90th (red) percentiles of NAVAS, allowing for a comparison between economies with low and high degrees of commodity sector interconnectedness. These impulse responses reflect both the direct impact of commodity price shocks and their indirect propagation through production networks.

Figure III: Effects of Demand-Driven Commodity Price Shocks on Consumption



(a) Consumption IRFs

(b) LP coefficients at different horizons

Source: IMF staff calculations; [Baumeister and Guérin 2021](#) for real commodity price factor.

Note: Panel (a) presents cumulative impulse responses of real consumption in response to a demand-driven shock that increases commodity prices by 5% on impact, with 68 and 90 percent confidence intervals. The overall impact, which includes both direct and indirect effects through countries' NAVAS, is depicted for the 10th and 90th percentiles (shown in blue and red, respectively). Panel (b) presents consumption coefficient estimates from panel local projections at annual horizons, along with their respective standard deviations. Estimates are shown for the direct commodity price shock, its interaction with NAVAS, and its interaction with the Domar weight in red, blue, and orange, respectively.

Figure III, panel (a), shows that real consumption responds positively and significantly

on impact to a commodity price increase driven by demand-side fluctuations, with effects that persist over time. However, the magnitude of this response varies with the degree of commodity sector interconnectedness. Specifically, countries in the 90th percentile of NAVAS (denoted in blue) exhibit a stronger consumption response than those in the 10th percentile (shown in red), and the difference between the two groups is statistically significant across horizons of interest. In particular, countries with a higher commodity sector NAVAS exhibit larger consumption responses to the same demand-driven commodity price shock, pointing to NAVAS acting as an amplifier of commodity price shocks.

Indeed, Figure III, panel (b), confirms that sectoral interconnectedness plays a key amplifying role in shaping a country’s consumption response to commodity price shocks. It shows coefficient estimates for the direct effect of the commodity price shock $\beta^{(0)}$, as well as interaction terms with NAVAS ($\beta^{(1)}$) and size (γ), along with their delta-method standard errors. The structural shock, interpreted as a positive demand shock, leads to a statistically significant increase in commodity prices across all horizons (shown in red). The interaction with NAVAS (shown in blue) amplifies the effect of the shock on domestic consumption.¹² In contrast, the coefficients linked to size suggest a dampening effect, generally moving in the opposite direction to NAVAS across most horizons. Their magnitude remains modest relative to the amplification observed under NAVAS, and in some periods, the estimates are not statistically significant.

In contrast to demand-driven shocks, the effects of an oil supply shock that raises real commodity prices are more ambiguous and depend critically on the degree of the commodity sector’s interconnectedness. Figure IV, panel (a), shows that countries at the 10th percentile of NAVAS (in blue) experience a persistently negative and statistically significant consumption response, suggesting that economies with weakly integrated commodity sectors experience a contraction in aggregate consumption. However, the response of countries at

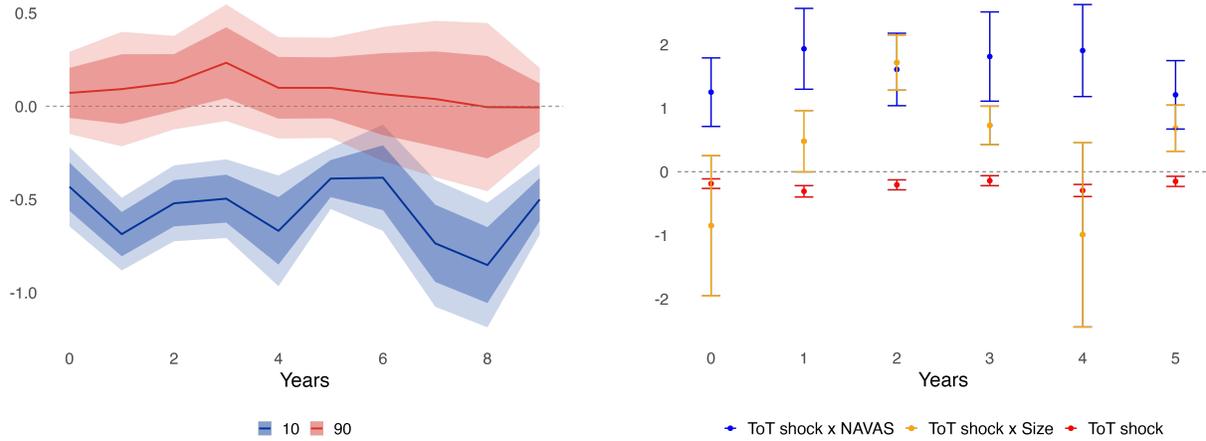
¹²The same point can be verified based on specific country cases. For example, although Thailand’s commodity sector is six times larger than Switzerland’s, their NAVAS values are nearly identical (0.68 and 0.65, respectively), resulting in a very similar impact of commodity price shocks on consumption.

the 90th percentile (in red) is statistically insignificant. Nonetheless, the upward trajectory persists across most horizons, indicating that higher interconnectedness may help buffer the adverse effects of supply-driven commodity price shocks.¹³

Figure IV, panel (b), reveals a negative and statistically significant direct effect of commodity price shocks on consumption across most horizons. Notably, the interaction between these shocks and NAVAS produces positive and consistently significant coefficients, suggesting that greater interconnectedness within the commodity sector amplifies the transmission of price shocks to consumption. Moreover, the NAVAS interaction effect is markedly larger in magnitude than the corresponding size interaction. As in the previous case, NAVAS coefficients often display a sign opposite to that of the size variable, underscoring a distinct and more potent transmission channel.

¹³Using oil supply shocks as instruments for commodity prices yields results that closely mirror those obtained through the shock identification strategy of [Schmitt-Grohé and Uribe 2018](#), as shown in Figure X in the Appendix.

Figure IV: Effects of Supply-Driven Commodity Price Shocks on Consumption



(a) Consumption IRFs

(b) LP coefficients at different horizons

Source: IMF staff calculations; [Baumeister and Hamilton 2019](#) for oil supply shock series.

Note: Panel (a) presents cumulative impulse responses of real consumption in response to a supply-driven shock that increases commodity prices by 5% on impact, with 68 and 90 percent confidence intervals. The overall impact, which includes both direct and indirect effects through countries' NAVAS, is depicted for the 10th and 90th percentiles (shown in blue and red, respectively). Panel (b) presents consumption coefficient estimates from panel local projections at annual horizons, along with their respective standard deviations. Estimates are shown for the direct commodity price shock, its interaction with NAVAS, and its interaction with the Domar weight in red, blue, and orange, respectively.

These findings suggest that differences in commodity sector linkages drive variation in macroeconomic responses to commodity price fluctuations through the interplay between real income and real wealth effects. When commodity prices rise due to demand-side factors, consumption responses vary with the degree of sectoral interconnectedness, although the effects remain positive across the board. In contrast, price increases driven by supply-side shocks tend to resemble negative wealth shocks, with the adverse wealth effect outweighing the positive income effect. Crucially, these results underscore that relying solely on Domar weights may understate the true transmission mechanisms, highlighting the importance of incorporating NAVAS when analyzing the propagation of commodity price shocks.

3 Dynamic Model

In this section, we develop a quantitative model to understand the mechanisms that drive the empirical relationships documented in the previous section. In particular, why is it that countries with higher NAVAS display stronger consumption responses to shocks to commodity terms of trade?

3.1 Set-up

This paper builds on the framework developed by [Silva et al. 2024](#), adapting it to examine the transmission of commodity price shocks in a multi-sector open economy. The economy consists of $N + 1$ domestic production sectors, where each firm combines labor, domestic intermediate inputs, and imported intermediates to produce output. The representative household supplies labor, consumes a composite bundle of goods, and has access to international financial markets, where it can borrow or save at a fixed interest rate r .

Households The household solves the following intertemporal optimization problem:

$$\begin{aligned} \max_{\{C_t, B_t\}_{t=0}^{\infty}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{C_t^{1-\rho} - 1}{1-\rho} \\ \text{s.t. } P_t C_t + P_{N+1,t}(B_t + g(B_t)) \leq W_t \bar{L} + (1+r)P_{N+1,t} B_{t-1}, \\ \text{given } B_{-1} \end{aligned}$$

Here, β denotes the discount factor, and ρ is the inverse of the intertemporal elasticity of substitution. The variable C_t refers to the aggregate consumption, with P_t as its associated price index. Similar to [Di Pace et al. 2025](#), the foreign asset position B_t is denominated in units of the commodity good, priced at $P_{N+1,t}$.¹⁴ Asset holdings are subject to adjustment

¹⁴[Di Pace et al. 2025](#) show that denominating foreign assets in units of the foreign consumption basket, which include export prices, provides a better fit of the data in terms of matching the asymmetric macroeconomic effects of export price shocks and import price shocks.

costs captured by the function $g(B_t) = \frac{\chi}{2}(B_t - \bar{B})^2$, where $\chi > 0$ determines the cost intensity and \bar{B} is the steady-state level of debt. The (nominal) wage rate is denoted by W_t is the (nominal) wage rate, and labor supply \bar{L} is assumed to be fixed.

Given a path for aggregate consumption, the household minimizes the cost of allocating consumption across goods:

$$PC = \min_{\{C_i\}_{i=1}^{N+1}, C_M} \left\{ \sum_{i=1}^{N+1} P_i C_i + P_M C_M \right\} \quad (4)$$

subject to the household consumption bundle:

$$\left(\frac{C_M}{\beta_M} \right)^{\beta_M} \cdot \prod_{i=1}^{N+1} \left(\frac{C_i}{\beta_i} \right)^{\beta_i} \geq C \quad (5)$$

The parameters β_i and β_M represent consumption shares, satisfying $\sum_{i=1}^{N+1} \beta_i + \beta_M = 1$. Sectors $i = 1, \dots, N+1$ are domestic sectors of production, with sector $N+1$ corresponding to the commodity sector, while sector M captures the bundle of imported goods.

Production Each sector in the economy produces output using labor and a composite of intermediate inputs, which includes both domestic and imported components. Variables with a bar denote their steady-state values. The production function for sector i is given by:

$$\frac{Q_i}{\bar{Q}_i} = Z_i \left(a_i \left(\frac{L_i}{\bar{L}_i} \right)^{\frac{\sigma_i-1}{\sigma_i}} + (1-a_i) \left(\frac{M_i}{\bar{M}_i} \right)^{\frac{\sigma_i-1}{\sigma_i}} \right)^{\frac{\sigma_i}{\sigma_i-1}}, \quad (6)$$

where a_i is the labor share and $(1-a_i)$ is the share of intermediate inputs. The elasticity of substitution between labor and intermediates is denoted by σ_i . The intermediate input bundle M_i is composed of domestic and imported intermediate goods:

$$\frac{M_i}{\bar{M}_i} = \left(\omega_i^D \left(\frac{M_i^D}{\bar{M}_i^D} \right)^{\frac{\epsilon_i-1}{\epsilon_i}} + (1-\omega_i^D) \left(\frac{M_{iM}}{\bar{M}_{iM}} \right)^{\frac{\epsilon_i-1}{\epsilon_i}} \right)^{\frac{\epsilon_i}{\epsilon_i-1}} \quad (7)$$

The parameter ω_i^D represents the expenditure share on domestic intermediates, while $(1-\omega_i^D)$ corresponds to the imported intermediate inputs share. The elasticity of substitution between domestic (M_i^D) and imported (M_i^M) inputs is given by ϵ_i .

The domestic intermediate bundle is itself a composite of inputs from all domestic sectors:

$$\frac{M_i^D}{\bar{M}_i^D} = \left(\sum_{j=1}^{N+1} \omega_{ij} \left(\frac{M_{ij}}{\bar{M}_{ij}} \right)^{\frac{\epsilon_i^D - 1}{\epsilon_i^D}} \right)^{\frac{\epsilon_i^D}{\epsilon_i^D - 1}}, \quad (8)$$

here, ω_{ij} denotes the share of expenditure on good i within the domestic intermediate bundle, satisfying $\sum_{j=1}^{N+1} \omega_{ij} = 1$. The elasticity of substitution among domestic intermediates is denoted by ϵ_i^D .

Exogenous Processes The model incorporates two key exogenous processes: the evolution of the commodity price in foreign currency, denoted by $P_{N+1,t}^*$, and sector-specific productivity, represented by $Z_{i,t}$:

$$\begin{aligned} \log P_{N+1,t}^* &= \rho_{N+1} \log P_{N+1,t-1}^* + \varepsilon_{N+1,t} \\ \log Z_{i,t} &= \rho_Z \log Z_{i,t-1} + \varepsilon_{i,t} \end{aligned}$$

The parameters ρ_{N+1} and ρ_Z govern the degree of persistence, and $\varepsilon_{N+1,t}$ and $\varepsilon_{i,t}$ are assumed to be i.i.d. shocks.

Market Clearing In each period, goods, labor, and financial markets are assumed to clear. Output in each sector is fully absorbed by domestic final consumption and intermediate input demand. Labor supply is fixed and allocated inelastically across sectors, implying full employment. The evolution of the foreign asset position reflects the trade balance and captures the net resource flow between the domestic economy and the rest of the world. The

market clearing conditions are given by Equations 9–12:

$$Q_{i,t} = C_{i,t} + \sum_{j=1}^{N+1} M_{ji,t}, \quad \text{for } i = 1, 2, \dots, N \quad (9)$$

$$Q_{N+1,t} = C_{N+1,t} + X_t + \sum_{j=1}^{N+1} M_{j,N+1,t}, \quad (10)$$

$$\bar{L} = \sum_{i=1}^{N+1} L_{i,t}, \quad (11)$$

$$B_t = (1+r)B_{t-1} - g(B_t) + X_t - \underbrace{\frac{P_{M,t}}{P_{N+1,t}} \left(\sum_{i=1}^{N+1} M_{iM,t} + C_{M,t} \right)}_{\text{Trade Balance}} \quad (12)$$

3.2 Static Model Intuition

To build intuition for the transmission mechanisms in the model, we begin by examining the static equilibrium relationships that link commodity price movements to aggregate consumption and prices:

$$C_t = \frac{W_t \bar{L}}{P_t} + \frac{P_{N+1,t}}{P_t} ((1+r)B_{t-1} - (B_t + g(B_t))) \quad (13)$$

As shown in Equation 13, given a level of net foreign assets B_{t-1} and B_t , global shocks to commodity prices affect aggregate consumption through two channels: via the real wage W/P and through the valuation of net foreign assets (NFA) captured by the relative price, P_{N+1}/P . Commodity prices denominated in domestic currency are expressed as $P_{N+1} = eP_{N+1}^*$, where e denotes the nominal exchange rate, and P_{N+1}^* represents the global commodity price.

3.2.1 Aggregate Price Index

From the intratemporal problem of households, we derive the following expression for the aggregate price level:

$$\begin{aligned} \log P_t = & \sum_{i=1}^N (\beta_i \log P_i - \beta_i \log \beta_i) \\ & + \beta_{N+1} \log P_{N+1} + \beta_M \log P_M - (\beta_{N+1} \log \beta_{N+1} + \beta_M \log P_M) \end{aligned} \quad (14)$$

where P_M represents the price of imported goods, while β_i denotes the consumption share of the good produced in sector i . The term β_M corresponds to the consumption share of the imported good. For tractability, we set the nominal exchange rate as the numeraire of the economy (i.e., $e = 1$), which implies $P_M = P_M^*$ and $P_{N+1} = P_{N+1}^*$, thereby expressing all prices in units of the foreign currency. Without loss of generality, the exogenous import price is normalized to $P_M = P_M^* = 1$, such that fluctuations in commodity price P_{N+1} correspond to changes in relative prices. Under these assumptions, differentiating Equation 14 yields:

$$d \log P_t = \sum_{i=1}^{N+1} \beta_i d \log P_i$$

Moreover, using the static model's solution for sectoral prices and wages, we obtain:

$$d \log P_t = \left[\frac{1}{\tilde{a}_{N+1}} \sum_{i=1}^{N+1} \beta_i \tilde{a}_i \right] d \log P_{N+1} = \frac{\beta' \tilde{a}}{\tilde{a}_{N+1}} d \log P_{N+1} \quad (15)$$

This expression captures the passthrough of commodity price changes to the aggregate consumption price level. The coefficient $\frac{\beta' \tilde{a}}{\tilde{a}_{N+1}}$ reflects the amplification effect of sectoral linkages.

3.2.2 Wage Response

The effect on nominal wages is captured by:

$$d \log W_t = \frac{1}{\tilde{a}_{N+1}} d \log P_{N+1}. \quad (16)$$

This expression highlights that nominal wages are inversely related to the input share of the commodity sector. A higher \tilde{a}_{N+1} implies a smaller pass-through from commodity prices to wages, reflecting the dilution of price shocks through production linkages. Intuitively, the increase in global commodity prices propagates into the domestic economy as increases in wages and prices, with the distribution depending on how strongly the commodity sector is connected through labor, directly and indirectly via input-output networks. If the commodity sector NAVAS is high due to its stronger linkages to labor-intensive suppliers, the necessary increase in the wage is smaller since commodity suppliers' prices are rising—they also face increased wages—and creating extra pressure on the commodity sector's marginal cost.

To evaluate the effect on real wages, combine the wage response with the aggregate price index response to obtain:

$$d \log \frac{W_t}{P_t} = \frac{(1 - \beta' \tilde{a})}{\tilde{a}_{N+1}} d \log P_{N+1}. \quad (17)$$

The real wage is decreasing in $\beta' \tilde{a}$, as this term captures how a terms of trade shock travels downstream and affects the consumer price index. When sectoral linkages provide strong downstream amplification to CPI ($\beta' \tilde{a}$), terms of trade shock mitigates the increase in nominal wages, relative to the importable good price.

In addition to the wage response, there is a valuation effect embedded in Equation (13). This valuation effect is driven by the relative price of the commodity sector to the aggregate price index:

$$d \log \frac{P_{N+1}}{P_t} = \frac{\tilde{a}_{N+1}}{\beta' \tilde{a}}. \quad (18)$$

The magnitude of this response depends on the commodity sector NAVAS \tilde{a}_{N+1} and the consumption-weighted average NAVAS, summarized by $\beta'\tilde{a}$. A larger \tilde{a}_{N+1} or a smaller overall NAVAS (i.e., a smaller $\beta'\tilde{a}$) leads to a stronger valuation effect. The intuition is simple. A higher commodity sector NAVAS creates smaller wage pressures and therefore a weaker increase in overall prices. This effect can be counteracted by a strong downstream propagation of the shock captured by $\beta'\tilde{a}$.

Commodity Price Shocks vs Productivity Shocks Before moving to the quantitative section, we briefly discuss the key differences between shocking the global price of commodities and shocking the productivity of the domestic commodity sector.

$$d \log W = \frac{1}{\tilde{a}_{N+1}} \Psi_{N+1,N+1} d \log Z_{N+1} \quad (19)$$

$$d \log P_t = \sum_{i=1}^{N+1} \beta_i \left(\frac{\tilde{a}_i}{\tilde{a}_{N+1}} \Psi_{N+1,N+1} - \Psi_{i,N+1} \right) d \log Z_{N+1} \quad (20)$$

Unlike the shock to global commodity prices, the change in commodity sector productivity creates a direct and immediate change in the marginal cost of commodity producers. These direct but also indirect effects of changed marginal costs are indeed captured by the new terms $\Psi_{N+1,N+1}$ and $\Psi_{i,N+1}$. These terms give a greater role to the downstream linkages of the commodity sector compared to the measures in Equations 17 and 18 when the shock directly affects the global price of commodities.

3.3 Calibration

We quantitatively assess the role of production network structures in shaping the transmission of commodity price shocks in our dynamic and stochastic multisector model. We calibrate the model using the same OECD data used in Figure II, which covers 66 countries and 44 sectors. The calibration matches each country's sectoral final consumption shares,

IO linkages, and the commodity sector’s net exports from 2018.¹⁵ For more details refer to Table I.

Table I: Calibrated Parameters

Parameter	Value	Description	Source
β	0.961	Discount rate	Match interest rate $r = 4\%$
ρ	2	Intertemporal elasticity of substitution	Uribe and Schmitt-Grohé 2017
ψ	0.000742	Bond holdings adjustment cost	Schmitt-Grohé and Uribe 2003
ρ_{N+1}	0.53	Commodity price persistence	Uribe and Schmitt-Grohé 2017
ϕ	0.15	Commodity price elasticity to demand shifter	Baumeister and Hamilton 2019
χ	1	Export demand elasticity	Cobb-Douglas Foreign Demand
\bar{B}	-	Country-specific steady-state asset level	Trade balance/GDP (Müller et al. 2025)
σ_i	3	Labor and intermediate inputs elasticity	Silva et al. 2024
ϵ_i	0.6	Domestic and imported inputs elasticity	Silva et al. 2024
ϵ_i^D	0.2	Elasticity across domestic intermediate inputs	Silva et al. 2024

Note: This table reports the calibrated parameters used in the model.

3.4 Results

Consumption Response to a Terms of Trade Shock We examine the relationship between NAVAS and the co-movement of consumption with commodity prices, replicating the empirical pattern in Figure II. Figure V plots the first-period percentage change in real consumption following a 1 percent increase in terms of trade. The model simulations closely mirror the data. Higher NAVAS is associated with stronger consumption-price co-movement, with EMDEs generally exhibiting both higher NAVAS and higher correlations. Some advanced economies also display elevated NAVAS and strong co-movement, underscoring heterogeneity across countries.

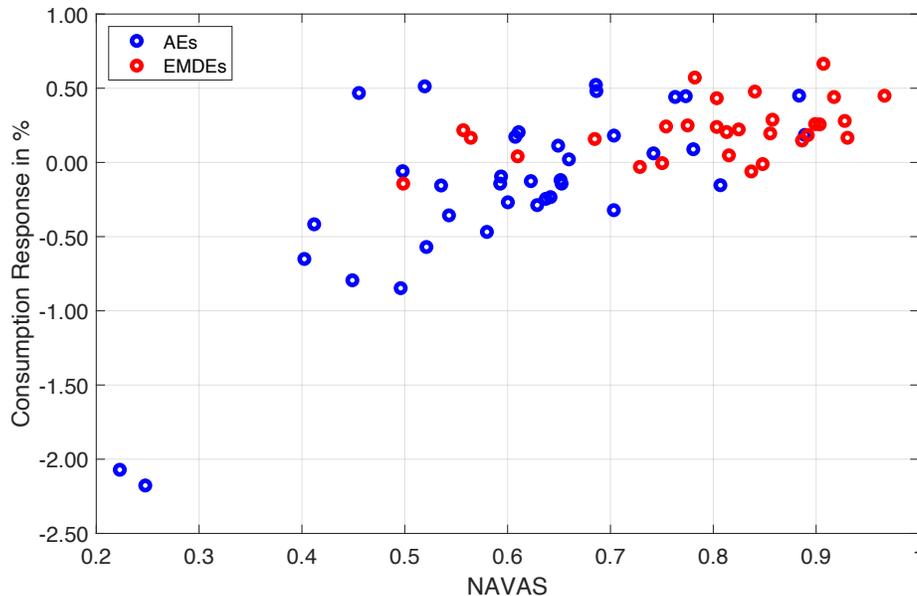
The observed variation in consumption-price correlations at similar NAVAS in the dynamic model suggests a nuanced propagation mechanism, akin to the one shown in Equations 17 and 18 for the static version of the model, involving both factor prices (wages) and the passthrough of intermediate input costs and wages to the CPI.

¹⁵For tractability, six commodity sectors are aggregated into one, yielding a benchmark setup with one commodity sector and 38 non-commodity sectors. The aggregation simplifies the model while preserving sectoral heterogeneity across countries.

Indeed, on the one hand, a higher commodity sector NAVAS unambiguously implies a lower nominal wage in response to a terms of trade shock, as shown in Equation 16, but this positive relationship is mitigated by the passthrough of increased costs to final sectoral prices and thus to the CPI. On the other hand, a higher CPI decreases the magnitude of the terms of trade increase in real terms, and in some cases, if the CPI increase is larger than the terms of trade increase, $\frac{P_{N+1}}{P}$ falls on impact and increases over time.

We explore the two transmission channels mentioned above in detail next, but what emerges from Figure V is that in the dynamic model, consumption responses to terms of trade shocks and commodity sector NAVAS comove positively. In contrast, Figure VI shows that there is no clear relationship between the responses of consumption to terms of trade shocks and the size of the commodity sector, captured by its Domar weight.

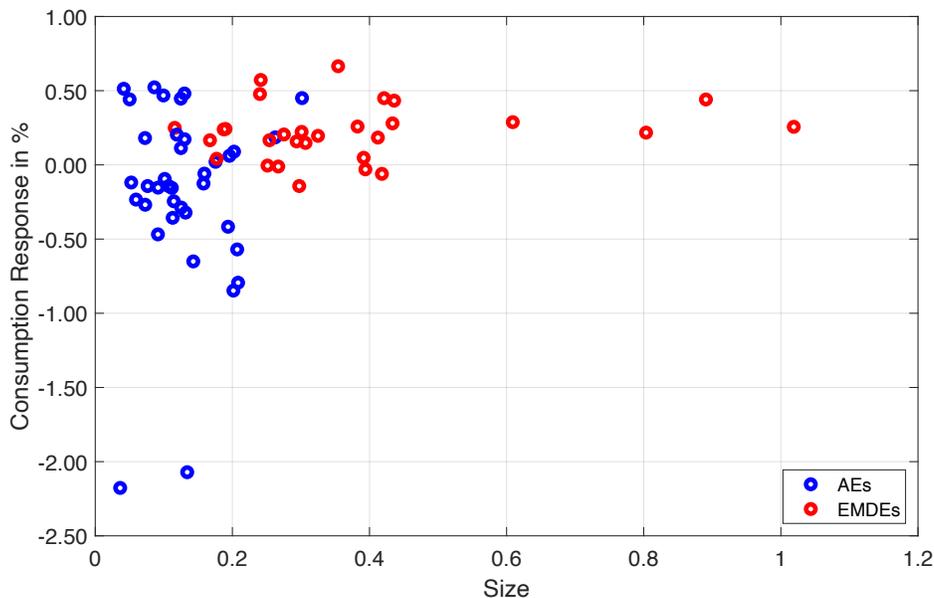
Figure V: Aggregate Consumption Response to a Terms of Trade Shock and the Commodity Sector NAVAS



Source: OECD and IMF staff calculations.

Note: NAVAS refers to the network-adjusted value-added share of the commodity sector. The figure displays the first-period response of real consumption (in percent) to a 1 percent terms-of-trade shock. AEs = advanced economies. EMDEs = emerging and developing economies.

Figure VI: Aggregate Consumption Response to a Terms of Trade Shock and the Commodity Sector Size



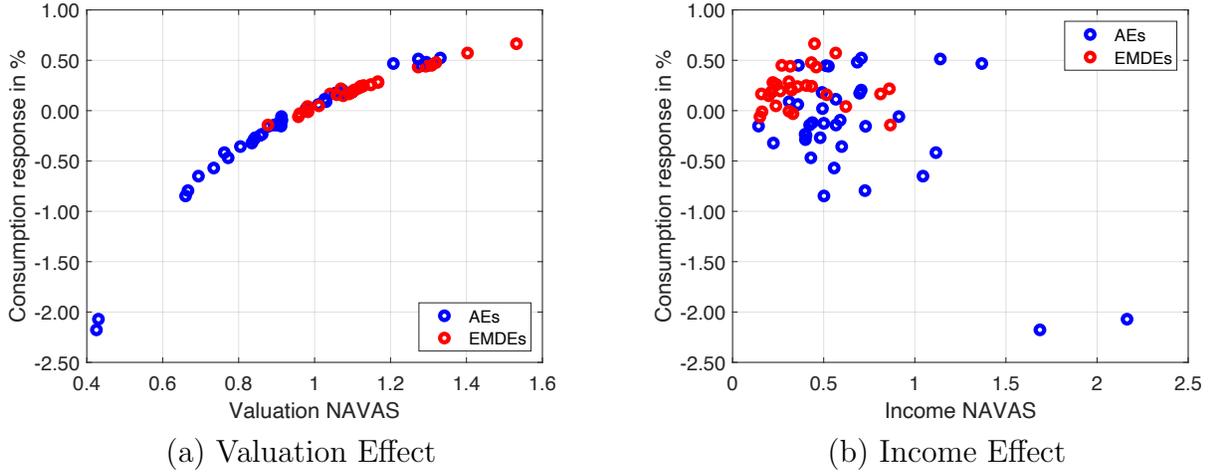
Source: OECD and IMF staff calculations.

Note: NAVAS refers to the network-adjusted value-added share of the commodity sector. The figure displays the first-period response of real consumption (in percent) to a 1 percent commodity price shock.

Disentangling the Channels Section 3.2 provides a closed-form static decomposition of the key channels affecting aggregate consumption: the real wage (an income effect) and the path of the NFA valuation (a valuation effect). Figure VII shows how these two channels relate to NAVAS in the dynamic model. Both panels report the first-period percentage change in real consumption following a 1 percent increase in commodity prices. Panel (a) illustrates how the valuation of NFA depends on the commodity sector NAVAS. Panel (b) shows how the real wage channel depends on the commodity sector NAVAS.

As predicted by Equation 18, panel (a) highlights the positive relationship between the valuation effect and the commodity sector NAVAS. When foreign assets are denominated in commodity units, a rise in commodity prices that increases P_{N+1}/P , increases the real value of NFA for commodity-exporting economies. This positive wealth effect tends to boost consumption in EMDEs, which often hold positive NFA positions in commodity terms.

Figure VII: Consumption Responses against Wealth and Income NAVAS to a ToT shock



Source: OECD and IMF staff calculations.

Note: NAVAS operates through two transmission channels, the valuation of NFA, shown in panel (a), and real wages, shown in panel (b). Both panels display the first-period percentage response of real consumption to a 1 percent commodity price shock.

Importantly, as we will see in the case studies, the countries that experience these positive income and wealth effects do not increase their NFA to smooth consumption over time because the path of P_{N+1}/P implies that the NFA valuation gets eroded over time.

In contrast, most AEs, shown in blue, experience a negative consumption response, reflecting net debtor positions that imply a negative wealth shock on impact, as the value of their debt increases. Furthermore, in a dynamic setting, it can also reflect a stronger downstream propagation that reverses the path of P_{N+1}/P , making it increasing, and thus incentivizing countries to increase their NFA on impact to finance increased consumption in the future.¹⁶ This behavior exemplifies the permanent income hypothesis (PIH) and countries' incentives to smooth consumption.

Panel (b) captures the income effect via real wages. As in Equation 17, a higher commodity sector NAVAS dampens the response of the real wage. In EMDEs, higher commodity prices typically raise revenues and labor demand in the commodity sector, pushing up

¹⁶The path of P_{N+1}/P reverses when the increase in the CPI (P) is larger than the terms of trade shock.

wages and supporting consumption. This positive income effect is evident in the majority of EMDEs. For AEs, however, the impact is often negative, as higher input costs in downstream sectors compress margins and dampen labor income. Ultimately, consumption contracts on impact because the positive income effect diminishes, and the increasing path of NFA valuation, present in many AEs, dominates the consumption response.¹⁷

NFA denominated in units of the imported goods The literature on small open economies typically denotes foreign assets in units of the importable good. The exception is [Di Pace et al. \(2025\)](#), who highlight the importance of valuing assets in units of the foreign consumption bundle, which includes domestic exports. Here we show that the positive relationship between consumption responses and NAVAS on Figure VII, panel (a), also holds when foreign assets are denominated in units of the importable good (see Figure XIV in the Appendix). The only difference is that the overall consumption response on impact is negative for all countries.

All countries decrease consumption on impact when NFA are denominated in units of the importable good because, after a terms of trade shock, $\frac{P_M}{P}$ decreases on impact, as P_M is fixed and P increases due to downstream propagation of the increased commodity prices. After the initial drop, $\frac{P_M}{P}$ follows an increasing path as the CPI (P) increase moderates. The increasing path of the NFA valuation incentivizes countries to increase their NFA on impact by consuming less on impact to finance a slightly higher consumption for a longer period of time, in line with the PIH and consumption smoothing.

Case Studies We investigate the transmission mechanisms in more depth by comparing two net commodity exporters: Kazakhstan and South Africa. Both countries have similarly sized commodity sectors, accounting for 39 percent of GDP, but differ in interconnectedness,

¹⁷Figure IX, panel (d), shows the consumption response on impact to a terms of trade shock in a model with income effects only, that is, without NFA valuation effects as NFAs are valued in units of the domestic consumption bundle. Note that, in that case, the relationship between consumption responses on impact and NAVAS is negative, which runs counter to the empirical evidence in Figure II.

with NAVAS values of 0.90 for Kazakhstan and 0.73 for South Africa. We consider the benchmark model in Figure VII with foreign assets valued in units of the commodity good. Figure VIII presents the impulse response functions to a 1% term of trade shock.

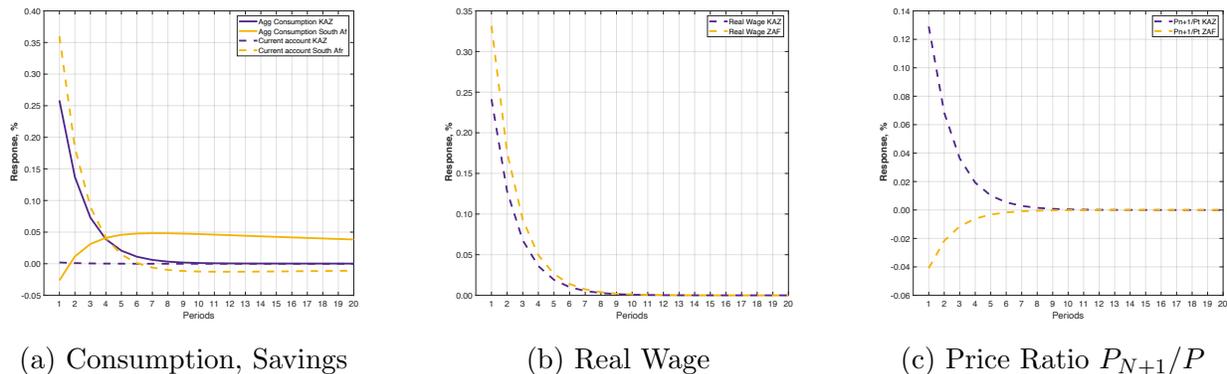
Both countries experience a positive income effect since a positive terms of trade shock increases real wages in both South Africa and Kazakhstan (Figure VIII, panel (b)). Consistent with Equation 17, this positive income effect is larger in South Africa because its commodity sector is less interconnected than the one in Kazakhstan. As mentioned above, intuitively, this happens because South Africa faces less cost pressures from the sectors it is buying intermediates from, resulting in needing a bigger wage increase to ensure zero profits in the commodity sector.

Despite the common behavior for real wages, the results reveal a stark contrast regarding consumption: Kazakhstan experiences a large positive consumption response (blue line in panel (a)), while South Africa displays a negative impact response (yellow line in panel (a)). This divergence highlights how production network structures, captured by NAVAS, and foreign asset denomination can fundamentally alter the macroeconomic effects of commodity terms of trade shocks.

The key to understanding these responses lies in the evolution of $\frac{P_{N+1,t}}{P_t}$. As we can see in panel (b), the South African aggregate price index increases substantially more than in Kazakhstan, leading to a temporary decline in the valuation of NFA in South Africa, via $\frac{P_{N+1,t}}{P_t}$, compared to the increased valuation of NFA in Kazakhstan. Thus, South Africa endures a negative wealth shock, while Kazakhstan experiences a positive wealth shock. Furthermore, the evolution of P_{N+1}/P erodes the valuation of the NFA in Kazakhstan (see panel (c)), incentivizing it to increase consumption mirroring the increased real wages, leaving NFA unchanged (panel (a)). South Africa's path of P_{N+1}/P implies an increasing path for its NFA, which makes saving and smoothing consumption more attractive. Indeed, panel (a) shows that South Africa increases its current account and is able to increase consumption

for a longer period of time, albeit by a smaller amount.

Figure VIII: Impulse Response Functions to a Terms of Trade Shock for Kazakhstan and South Africa.



Source: OECD and IMF staff calculations.

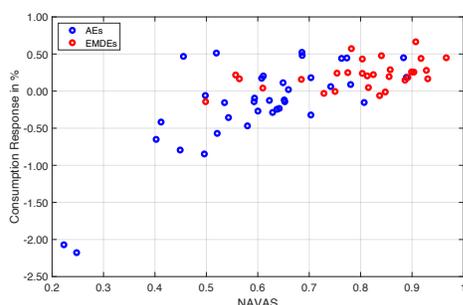
Note: The figure illustrates the impact of a commodity price shock on two distinct exporting economies, both calibrated to start with an equal initial trade balance. The calibration is based on each economy’s input-output structure. Data labels in the figure use International Organization for Standardization (ISO) country codes.

Terms of Trade Shock vs. Productivity Shock Kehoe and Ruhl (2008) show that terms of trade shocks are not productivity shocks. While the former has no effect on real GDP, the latter does change real GDP. Silva et al. (2024) extend this result to multisector small open economies with production networks. Here, we study the differences between terms of trade shocks and commodity sector productivity shocks in terms of their impact on aggregate consumption, under different NFA denominations. Our goal is to shed light on how these shocks can be akin to one another or not, and under what circumstances.

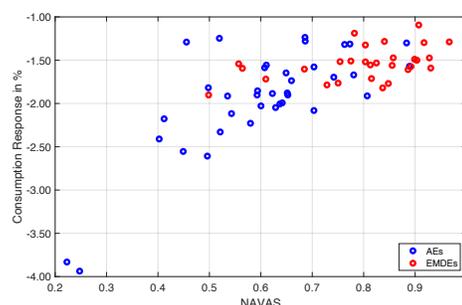
Figure IX plots the relationship between the NAVAS of the commodity sector and the response of consumption to a shock in terms of trade and a productivity shock in the commodity sector under different assumptions of the valuation of the NFA. Panel (a) plots the benchmark model, panel (b) the terms of trade shock with NFA denominated in imported goods, panel (c) the terms of trade shock with NFA denominated in the domestic consump-

tion bundle, and panel (d) depicts the effects of a productivity shock.

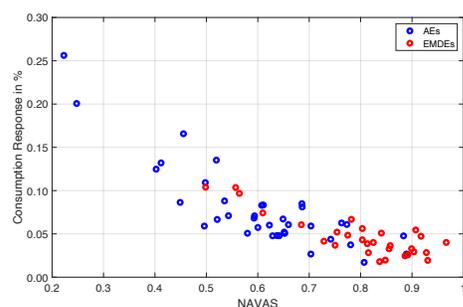
Figure IX: Consumption responses under different economic shocks and models



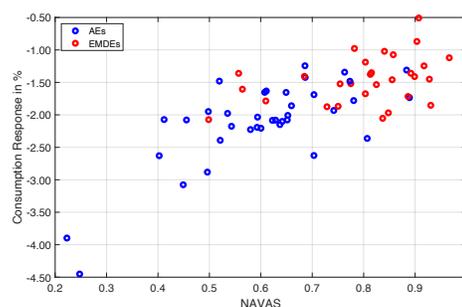
(a) ToT shock (benchmark model)



(b) ToT shock (assets denominated in P_m)



(c) ToT shock (no valuation effect)



(d) Productivity shock

Source: OECD and IMF staff calculations.

Note: The figure presents the first-period response of real consumption (in percent) across different models and different shocks across NAVAS. Panel (a) displays the response to a 1 percent ToT shock (the benchmark model). Panel (b) illustrates the same ToT shock applied to an alternative specification in which assets are denominated in imported prices P_m rather than P_{n+1} . Panel (c) depicts the response to a 1 percent ToT shock in a model where assets are denominated in P_t , thereby eliminating the valuation mechanism. Panel (d) shows the impact of a 1 percent productivity shock in the commodity sector in the benchmark model.

A key finding emerges from Figure IX: the positive relationship between commodity sector NAVAS and consumption responses is present when considering terms of trade shocks, with assets denominated in commodity units (panel a) or in units of the imported good (panel b), and productivity shocks (panel d).¹⁸ Instead, without NFA valuation effects, and

¹⁸The productivity shock exercise assumes that assets are denominated in units of the commodity good. However, in this case, the effects are the same when foreign assets are denominated in units of the importable good.

only income effects, the relationship between commodity sector NAVAS and consumption is negative, which runs against the empirical evidence in Figures II, III, and IV.¹⁹

In panel (d), we observe that the response of consumption to a productivity shock in the commodity sector is qualitatively similar to a terms of trade shock when assets are denominated in units of the importable good. In fact, Figure IX, panels (b) and (d), show that both shocks cause consumption to decrease with impact for all countries and by similar magnitudes. Nevertheless, the channels at play are very different as Figures XV and XVI in the Appendix show.

4 Conclusion

The transmission of terms of trade shocks is largely influenced by the structure of intersectoral linkages between the commodity sector and the rest of the economy, more than by the size of the commodity sector or its relevance as a net exporter. We show evidence of the importance of the commodity sector network-adjusted value-added share (NAVAS)—a measure of factor demand from the commodity sector that accounts for the commodity sector’s suppliers’ factor usage— in amplifying the positive effects of terms-of-trade gains on consumption while mitigating the negative effects of declines.

We develop a dynamic small open economy model that features domestic production networks, imported intermediates, and a commodity sector. We focus on the response of aggregate consumption to terms of trade shocks. The model rationalizes the evidence as follows. Commodity sector linkages amplify the wealth effect of terms of trade shocks by increasing the value of net foreign assets of the economy. On the other hand, a very interconnected commodity sector mitigates the response of the real wage (income effect). Overall, the wealth effect dominates and explains the positive relationship in the data between com-

¹⁹Note that the negative relationship between consumption responses on impact and NAVAS is also present when considering productivity shocks and no valuation channel. See Figure XX in the Appendix.

modity sector linkages and aggregate consumption responses.

For policymakers, the main takeaway is that macroeconomic and monetary policy frameworks should be adapted to account for the structure of domestic production networks. Central banks should account for production network structures when calibrating their response to commodity price movements. Doing so can reduce the risk of policy miscalibration and enhance macroeconomic stability across both advanced and emerging market economies, regardless of their net commodity trade position.

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A Appendix

Table II: List of Included Countries by Country Group

Advanced Economies	Emerging and Developing Economies
Australia	Argentina
Austria	Brazil
Belgium	Brunei Darussalam
Canada	Bulgaria
Croatia	Cambodia
Cyprus	Chile
Czech Republic	China
Denmark	Colombia
Estonia	Costa Rica
Finland	Hungary
France	India
Germany	Indonesia
Greece	Kazakhstan
Hong Kong SAR	Lao P.D.R.
Iceland	Malaysia
Ireland	Mexico
Israel	Morocco
Italy	Myanmar
Japan	Peru
Korea	Philippines
Latvia	Poland
Lithuania	Romania
Luxembourg	Russia
Malta	Saudi Arabia
New Zealand	South Africa
Norway	Thailand
Portugal	Tunisia
Singapore	Turkey
Slovak Republic	Vietnam
Slovenia	
Spain	
Sweden	
Switzerland	
Taiwan Province of China	
The Netherlands	
United Kingdom	
United States	

Table III: OECD sectoral classification

Commodity Sectors	Other Sectors
Agriculture, hunting, forestry	Electricity, gas, steam and air conditioning supply
Fishing and aquaculture	Construction
Mining and quarrying, energy producing products	Wholesale and retail trade; repair of motor vehicles
Mining and quarrying, non-energy producing products	Land transport and transport via pipelines
Coke and refined petroleum products	Water transport
Basic metals	Air transport
	Warehousing and support activities for transportation
	Postal and courier activities
	Food products, beverages and tobacco
	Textiles, textile products, leather and footwear
	Wood and products of wood and cork
	Paper products and printing
	Publishing, audiovisual, and broadcasting activities
	Chemical and chemical products
	Telecommunications
	IT and other information services
	Financial and insurance activities
	Real estate activities
	Fabricated metal products
	Computer, electronic and optical equipment
	Electrical equipment
	Machinery and equipment, nec
	Professional, scientific, and technical activities
	Administrative and support services
	Education
	Human health and social work activities
	Arts, entertainment and recreation
	Other service activities
	Manufacturing nec; repair and installation of machinery and equipment
	Water supply; sewerage, waste management and remediation activities
	Pharmaceuticals, medicinal chemical and botanical products
	Public administration and defence; compulsory social security
	Mining support service activities
	Motor vehicles, trailers, and semi-trailers
	Other transport equipment
	Rubber and plastics products
	Other non-metallic mineral products

Sources: Organisation for Economic Co-operation and Development (OECD); and IMF staff calculations.

Note: To maximize the sample of countries available, we merge *Mining support service activities* with *Other service activities*, *Motor vehicles, trailers, and semi-trailers* with *Other transport equipment*, and *Rubber and plastics products* with *Other non-metallic mineral products*. These aggregations help ensure broader coverage while preserving sectoral relevance.

A.1 Commodity Sector Network-Adjusted Value-Added Share

To build some intuition, consider the following simplified economy with three sectors: sector C (the commodity sector), and two other sectors, A and B . Let the vector of value-added shares be $a = (0.3, 0.3, 0.6)'$, where the ordering reflects sectors C , A , and B , respectively. Intuitively, if the sector itself does not purchase intermediate inputs, then the factor shares are not adjusted by the network as this sector is isolated from the network. If $\Gamma_{N+1,i} = 0$, for all i , that is, the commodity sector does not buy intermediates from any sector (including itself) and production relies exclusively on factors (labor and capital), then $\tilde{a}_{N+1} = a_{N+1}$ because the $N + 1$ row of $\Psi = (I - \Gamma)^{-1}$ is $[1, 0, \dots, 0]$. However, in the data, the commodity sector typically buys intermediate inputs, so they cannot be neglected. We consider two examples in this economy:

Example 1: Supplier centrality heterogeneity with intermediate inputs To explore the importance of supplier centrality heterogeneity for NAVAS, consider the following two IO matrices:

$$\Gamma_1 = \begin{bmatrix} 0.2 & 0.2 & 0.2 \\ 0.2 & 0.2 & 0.2 \\ 0.1 & 0.1 & 0.1 \end{bmatrix}, \quad \Gamma_2 = \begin{bmatrix} 0.2 & 0.2 & 0.2 \\ 0.25 & 0.2 & 0.2 \\ 0.15 & 0.1 & 0.1 \end{bmatrix}$$

In both IO structures, Γ_1 and Γ_2 , sector C buys from all sectors equally (including itself). A critical difference between these two matrices is the commodity sector's *supplier centrality*. In Γ_1 , the input demands of sectors A and B are evenly distributed across all suppliers. The total domestic intermediate input share is 0.6, 0.6, and 0.3, the value-added shares are 0.3, 0.3, and 0.6, meaning that each sector displays a share of imported intermediate inputs of 0.1. In contrast, in Γ_2 sectors A and B are buying a larger fraction of intermediates from sector C , making it more central as a supplier. Notice that for this to happen, each sector must be reducing its reliance on imported intermediates (keeping value-added shares fixed).

The inclusion of domestic intermediate inputs leads to higher NAVAS values due to ex-

panded indirect labor use via input–output linkages. Specifically, greater domestic supplier importance in Γ_2 leads to a higher NAVAS compared to the case with lower supplier importance: 0.85 versus 0.78 (and 0.3 in the case in which the commodity sector does not buy domestic intermediate inputs as $\tilde{a}_{N+1} = a_{N+1} = 0.3$ in this example).

Example 2: Shifting customer centrality to labor-intensive suppliers with fixed supplier centrality Consider now a setting in which the supplier centrality of the commodity sector remains constant, that is, the commodity sector does not serve as a major supplier to the other sectors, but *customer centrality* varies across two cases, specifically in terms of where the commodity sector buys from. In Γ_3 , the commodity sector allocates a greater share of its purchases to a more labor-intensive supplier (sector B), while in the Γ_4 , it relies more heavily on a less labor-intensive one (sector A):

$$\Gamma_3 = \begin{bmatrix} 0.1 & 0.1 & 0.4 \\ 0.2 & 0.2 & 0.2 \\ 0.1 & 0.1 & 0.1 \end{bmatrix}, \quad \Gamma_4 = \begin{bmatrix} 0.1 & 0.4 & 0.1 \\ 0.2 & 0.2 & 0.2 \\ 0.1 & 0.1 & 0.1 \end{bmatrix}$$

This asymmetry in customer centrality highlights the importance of labor intensity of the commodity sector’s upstream linkages. Despite keeping supplier share of the commodity sector fixed, NAVAS can vary depending on the composition of intermediate inputs it buys. When the commodity sector allocates a larger share of its intermediate input purchases toward the more labor-intensive sector B , NAVAS increases accordingly (0.79 vs. 0.77). This effect reflects the heightened contribution of indirect labor embedded in upstream production, as the composition of intermediates is tilted towards more labor-intensive suppliers.

Table IV: Advanced Economies NAVAS (2018)

Country	Aggregate	Energy	Metals	Agriculture
Australia	0.89	0.91	0.88	0.88
Austria	0.59	0.39	0.59	0.77
Belgium	0.40	0.27	0.48	0.60
Canada	0.74	0.78	0.63	0.79
Croatia	0.65	0.49	0.65	0.79
Cyprus	0.76	0.66	0.57	0.79
Czech Republic	0.61	0.50	0.54	0.72
Denmark	0.70	0.71	0.60	0.71
Estonia	0.69	0.73	0.57	0.70
Finland	0.62	0.42	0.60	0.83
France	0.65	0.33	0.65	0.81
Germany	0.60	0.47	0.57	0.80
Greece	0.52	0.24	0.67	0.83
Hong Kong SAR	0.25	0.44	0.21	0.76
Iceland	0.66	0.83	0.56	0.75
Ireland	0.69	0.79	0.59	0.55
Israel	0.58	0.36	0.78	0.78
Italy	0.64	0.43	0.59	0.87
Japan	0.70	0.72	0.62	0.88
Korea	0.50	0.26	0.59	0.84
Latvia	0.77	0.66	0.76	0.77
Lithuania	0.41	0.21	0.60	0.71
Luxembourg	0.46	-	-	-
Malta	0.52	0.55	0.73	0.69
New Zealand	0.78	0.49	0.86	0.87
Norway	0.88	0.94	0.60	0.77
Portugal	0.54	0.24	0.63	0.77
Singapore	0.22	0.21	0.37	0.72
Slovak Republic	0.50	0.27	0.47	0.76
Slovenia	0.61	0.81	0.49	0.76
Spain	0.63	0.28	0.66	0.85
Sweden	0.59	0.21	0.71	0.78
Switzerland	0.65	0.59	0.63	0.77
Taiwan Province of China	0.45	0.23	0.48	0.83
The Netherlands	0.54	0.37	0.56	0.73
United Kingdom	0.64	0.55	0.71	0.78
United States	0.81	0.76	0.82	0.90

Table V: Emerging and Developing Economies NAVAS (2018)

Country	Aggregate	Energy	Metals	Agriculture
Argentina	0.93	0.92	0.91	0.94
Brazil	0.85	0.79	0.83	0.89
Brunei Darussalam	0.92	0.92	0.95	0.69
Bulgaria	0.50	0.26	0.49	0.71
Cambodia	0.91	0.43	0.80	0.91
Chile	0.82	0.23	0.88	0.86
China	0.84	0.71	0.82	0.91
Colombia	0.89	0.87	0.87	0.91
Costa Rica	0.78	0.69	0.64	0.80
Hungary	0.56	0.37	0.46	0.72
India	0.82	0.48	0.71	0.96
Indonesia	0.89	0.82	0.90	0.94
Kazakhstan	0.90	0.91	0.87	0.90
Lao P.D.R.	0.86	0.79	0.76	0.91
Malaysia	0.80	0.82	0.60	0.85
Mexico	0.80	0.75	0.79	0.88
Morocco	0.84	0.65	0.74	0.87
Myanmar	0.90	0.72	0.72	0.95
Peru	0.86	0.66	0.89	0.96
Philippines	0.81	0.53	0.60	0.93
Poland	0.61	0.49	0.56	0.75
Romania	0.75	0.67	0.69	0.83
Russia	0.93	0.95	0.89	0.89
Saudi Arabia	0.97	0.98	0.84	0.91
South Africa	0.73	0.61	0.79	0.76
Thailand	0.68	0.47	0.57	0.85
Tunisia	0.78	0.65	0.51	0.88
Turkey	0.75	0.43	0.77	0.84
Vietnam	0.56	0.48	0.37	0.65

A.2 Heterogeneity in Commodity Linkages Across Country Groups

Table VI: Descriptive Statistics – Advanced Economies

	Size				NAVAS			
	Energy	Metals	Agriculture	Aggregate	Energy	Metals	Agriculture	Aggregate
Mean	0.05	0.04	0.04	0.13	0.50	0.61	0.78	0.61
Median	0.04	0.04	0.04	0.13	0.48	0.60	0.78	0.62
SD	0.05	0.03	0.03	0.06	0.22	0.13	0.07	0.15
Min	0.00	0.00	0.00	0.04	0.21	0.21	0.55	0.22
Max	0.23	0.11	0.12	0.31	0.94	0.88	0.90	0.89

Table VII: Descriptive Statistics – Emerging and Developing Economies

	Size				NAVAS			
	Energy	Metals	Agriculture	Aggregate	Energy	Metals	Agriculture	Aggregate
Mean	0.14	0.08	0.15	0.39	0.66	0.73	0.86	0.80
Median	0.10	0.05	0.11	0.31	0.67	0.77	0.88	0.82
SD	0.18	0.06	0.14	0.22	0.21	0.16	0.08	0.12
Min	0.00	0.01	0.01	0.12	0.23	0.37	0.65	0.50
Max	0.95	0.23	0.74	1.05	0.98	0.95	0.96	0.97

A.3 Panel Local Projections

Shock Identification Empirical literature on small open economies commonly treats international commodity prices as exogenous, based on the premise that individual countries lack market power to influence global price dynamics. [Fernández et al. 2018](#), [Drechsel and Tenreyro 2018](#), and [Schmitt-Grohé and Uribe 2018](#), among others, support this view by

modeling commodity price movements as external shocks that propagate through domestic channels. Within this identification framework, domestic exposure is captured by unexpected innovations arising from a specified process that adequately reflects observed dynamics in the data.

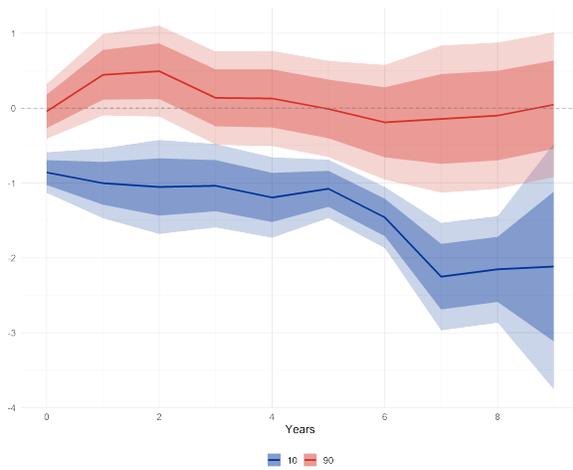
To evaluate the robustness of our results, we adopt this approach. In the dataset, a simple autoregressive specification, AR(1), is sufficient to capture the persistence in commodity price fluctuations. At the country level, the residuals from this process reflect unanticipated changes and display properties akin to white noise, as confirmed by standard diagnostic tests such as the Ljung-Box statistic.²⁰ When estimating the effects of aggregate commodity price shocks on domestic macroeconomic variables, these residuals can therefore be used directly in empirical specifications.²¹

Figure (X) closely mirrors the results presented in Figure (IV), reaffirming that commodity sector interconnectedness, as measured by NAVAS, plays a critical role in shaping the consumption response to commodity price shocks even after controlling for the role of size. The figure presents dynamic cumulative impulse responses of aggregate consumption to a commodity price shock scaled to increase the real commodity price by 5 percent on impact. In economies with lower NAVAS, the consumption response is significantly negative and persistent, reflecting both heightened exposure to commodity price volatility and amplification mechanisms within the domestic production network. By contrast, in countries with higher NAVAS, the response is positive but statistically insignificant, suggesting that greater interconnectedness may help buffer the adverse effects of the shock.

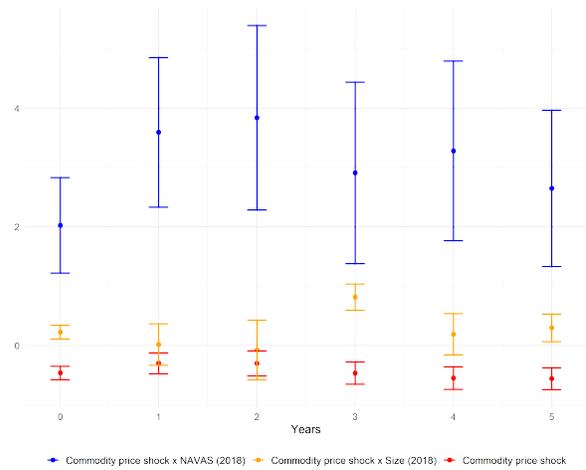
²⁰The only country for which the null hypothesis of no serial autocorrelation is rejected is Latvia. However, given that this exception pertains to just one out of 66 countries, the assumption of an AR(1) process is considered sufficiently robust for all cases.

²¹The absence of serial correlation indicates that the shocks are not systematically predictable, thereby supporting their interpretation as exogenous disturbances to domestic economic conditions.

Figure X: Effects of Commodity Price Shocks on Consumption



(a) Impulse responses

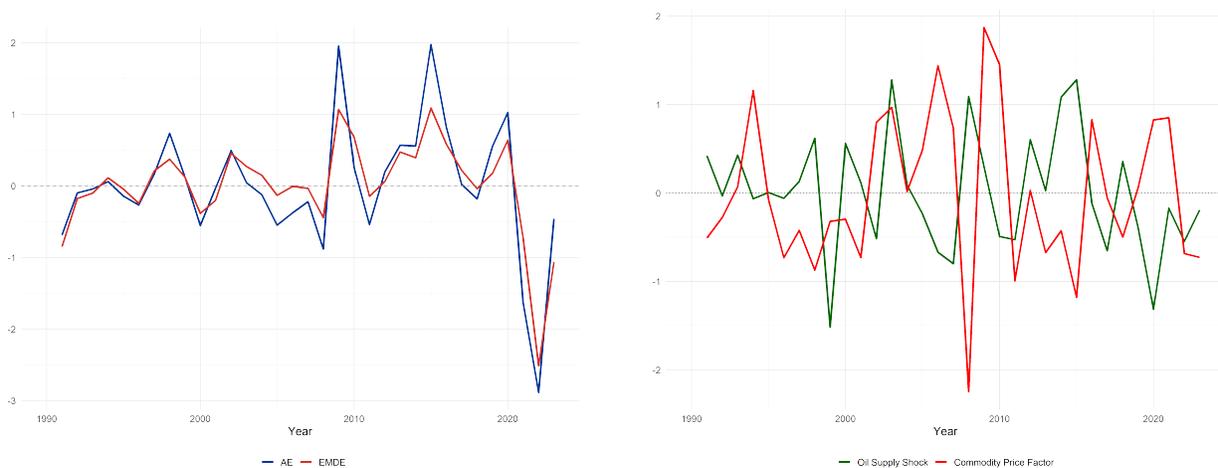


(b) LP coefficients at different horizons

Source: IMF staff calculations.

Note: Panel (a) shows cumulative impulse responses of real consumption following a shock scaled to increase real commodity price by 5 percent on impact with 68 and 90 percent confidence intervals. The overall impact, which includes both direct and indirect effects through countries' NAVAS, is depicted for the 10th and 90th percentiles (shown in blue and red, respectively). Panel (b) presents consumption coefficient estimates from panel local projections at annual horizons, along with their respective standard deviations, in response to a shock in commodity prices. Estimates are shown for the direct commodity price shock, its interaction with NAVAS, and its interaction with the Domar weight in red, blue, and orange, respectively.

Figure XI: Country-specific and Aggregate Commodity Price Shocks



(a) Commodity Price Residuals

(b) Instruments for Commodity Prices

Source: IMF CTOT database; IMF staff calculations. Oil supply shocks data are obtained from [Baumeister and Hamilton 2019](#), while the commodity price factor is sourced from [Baumeister and Guérin 2021](#).

Note: Panel (a) illustrates the evolution of country-specific surprise components, extracted from an AR(1) process and aggregated by country group for illustrative purposes. The blue line depicts standardized residuals for AE countries, while the red line corresponds to the EMDE countries. Panel (b) presents the standardized time series of the externally identified real commodity price factor (in red) and oil supply shocks (in green).

Figure(XI), panel (a), shows the evolution of country-specific surprise components derived from an AR(1) process, aggregated by country group for illustrative purposes. The blue line represents the standardized residuals for AE countries, while the red line corresponds to the EMDE countries. Prior to the COVID-19 pandemic, residuals reached their trough during the onset of the Global Financial Crisis (GFC) across both AE and EMDE groups, followed by a pronounced rebound in 2009, particularly among AE economies, indicative of a strong countercyclical stimulus response. Between 2010 and 2014, residuals fluctuated moderately, maintaining a generally positive trajectory, likely supported by stable commodity prices and moderate global growth. A renewed spike in residuals during 2015–2016 may reflect the sharp decline in oil prices and the implementation of accommodative monetary policies in response to sluggish economic conditions. The 2020s mark a period of heightened volatility, beginning with a sharp increase in residuals in 2020, attributed to COVID-19-

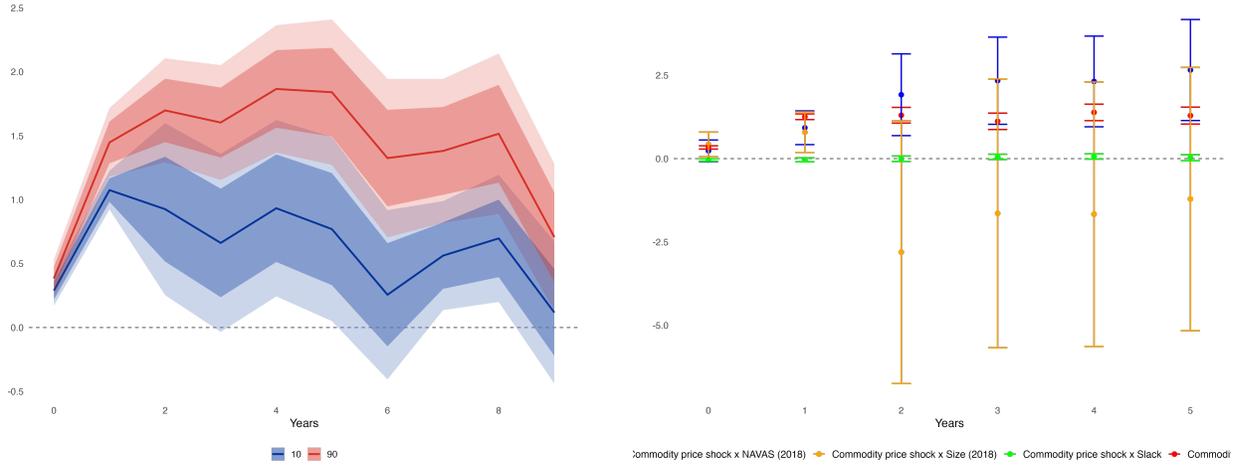
related supply chain disruptions and commodity price instability. This was followed by a steep decline in 2021–2022, likely driven by post-pandemic inflationary pressures. Although a partial recovery is observed in 2023, residuals remain in negative territory, suggesting persistent global uncertainty, tight monetary policy, and geopolitical fragmentation.

Propagation of the Commodity Price Shock Since macroeconomic conditions such as labor market slack may influence the consumption response to commodity price shocks beyond what is captured by NAVAS, we include an additional interaction term between the commodity price shock and a proxy for labor market slack as a robustness check. We proxy slack using the deviation of each country’s unemployment rate from its trend and incorporate this measure into the specification as follows:

$$\begin{aligned}
 y_{i,t+h} - y_{i,t-1} = & \alpha_h + \mu_i + \sum_{j=1}^J \delta_h^{(j)} \cdot \Delta y_{i,t-j} + \beta_h^{(0)} \cdot \varepsilon_{i,t} + \sum_{l=1}^L \phi_{l,h} \cdot \varepsilon_{i,t-l} \\
 & + \beta_h^{(1)} \cdot (\varepsilon_{i,t} \times \text{NAVAS}_i) + \gamma_h \cdot (\varepsilon_{i,t} \times \text{size}_i) + \zeta_h \cdot (\varepsilon_{i,t} \times \text{slack}_i) + u_{i,t+h}
 \end{aligned} \tag{21}$$

We examine two cases, with the first focusing on LP-IV results in response to demand-driven increases in commodity prices, as illustrated in Figure XII. Comparing the impulse responses of consumption to those presented in Figure III, the results remain robust even after including the interaction with labor market slack. This is largely due to the statistical insignificance of the slack interaction, highlighted in green in panel (b) of Figure XII. In addition, the interaction with sectoral size loses significance across most horizons, reflecting an increase in standard errors.

Figure XII: Effects of Commodity Price Shocks on Consumption



(a) Impulse responses

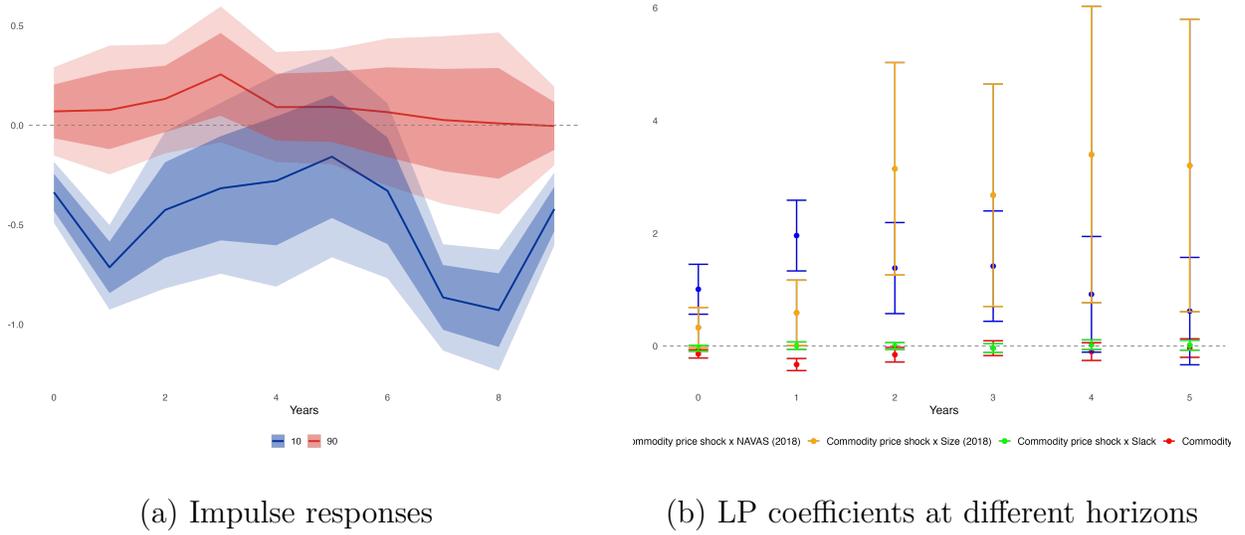
(b) LP coefficients at different horizons

Source: IMF staff calculations.

Note: Panel (a) shows cumulative impulse responses of real consumption following a shock scaled to increase real commodity price by 5 percent on impact with 68 and 90 percent confidence intervals. The overall impact, which includes both direct and indirect effects through countries' NAVAS, is depicted for the 10th and 90th percentiles (shown in blue and red, respectively). Panel (b) presents consumption coefficient estimates from panel local projections at annual horizons, along with their respective standard deviations, in response to a shock in commodity prices. The estimates presented correspond to the direct commodity price shock, its interaction with NAVAS, its interaction with the Domar weight, and its interaction with labor market slack, which is measured as the deviation of each country's unemployment rate from its trend. These are shown in red, blue, orange, and green, respectively.

Turning to the LP-IV results for supply-driven commodity price increases, presented in Figure XIII, we find that the consumption responses remain fairly robust and closely resemble those in Figure IV, irrespective of whether the interaction with labor market slack is included in the regression. As in the demand-driven case, panel (b) of Figure XIII shows that the standard errors surrounding the interaction with sectoral size increase. However, unlike the case of demand-driven commodity price increases, the coefficients remain statistically significant across most horizons.

Figure XIII: Effects of Commodity Price Shocks on Consumption



Source: IMF staff calculations.

Note: Panel (a) shows cumulative impulse responses of real consumption following a shock scaled to increase real commodity price by 5 percent on impact with 68 and 90 percent confidence intervals. The overall impact, which includes both direct and indirect effects through countries' NAVAS, is depicted for the 10th and 90th percentiles (shown in blue and red, respectively). Panel (b) presents consumption coefficient estimates from panel local projections at annual horizons, along with their respective standard deviations, in response to a shock in commodity prices. The estimates presented correspond to the direct commodity price shock, its interaction with NAVAS, its interaction with the Domar weight, and its interaction with labor market slack, which is measured as the deviation of each country's unemployment rate from its trend. These are shown in red, blue, orange, and green, respectively.

A.4 Model

Total differentiating sectoral marginal costs yields

$$d \log P_i = a_i d \log W + \sum_{j=1}^{N+1} \Omega_{ij} d \log P_j + \eta_i d \log P_M - d \log Z_i \quad \text{for all } i = 1, 2, \dots, N + 1, \quad (22)$$

where

$$a_i = \frac{WL_i}{P_i Q_i} = \frac{WL_i}{TC_i}; \quad \eta_i = \frac{P_M M_{iM}}{TC_i}; \quad \Omega_{ij} = \frac{P_j M_{ij}}{TC_i} \quad \text{for all } i = 1, 2, \dots, N + 1,$$

is how much producer i spends on either labor, imported intermediate input, and domestic intermediate inputs as a fraction of its sales, $P_i Q_i$, which, due to the constant returns to scale assumption of the production function, equals total costs (TC_i), $P_i Q_i = TC_i$.

Choosing a numeraire, we can solve for domestic price changes as a function of commodity price changes. Let $P_M^* = 1$ and the nominal exchange rate be the numeraire. Hence, all prices are expressed in units of foreign currency, $d \log P_i - d \log \mathcal{E} = d \log P_i$. Stacking the system into matrix/vector form, we have

$$d \log P = \Omega d \log P + a d \log W - d \log Z$$

Inverting the system we arrive at

$$d \log P = \Psi a d \log W - \Psi d \log Z \implies \quad (23)$$

$$d \log P_i = \left(\sum_{h=1}^{N+1} \Psi_{ih} a_h \right) d \log W - \sum_{h=1}^{N+1} \Psi_{ih} d \log Z_h \text{ for all } i = 1, 2, \dots, N + 1 \quad (24)$$

Note that we can write the above expression as

$$d \log P = \tilde{a} d \log W - \Psi d \log Z$$

where we define the typical element of $\tilde{a} = \{\tilde{a}_i\} = \left\{ \sum_{h=1}^{N+1} \Psi_{ih} a_h \right\}$, that represents the *network-adjusted* labor share of producer i .

We now make use of the fact that $d \log P_{N+1} - d \log \mathcal{E} = d \log P_{N+1}^*$ is exogenously given to express changes in wages, $d \log W$, as an explicit function when only commodity sector productivity changes and global commodity prices are unchanged.

A.4.1 Terms of trade shock

$$\begin{aligned} d \log P_{N+1}^* &= \tilde{a}_{N+1} d \log W \implies \\ d \log W &= \frac{1}{\tilde{a}_{N+1}} d \log P_{N+1}^* \end{aligned} \quad (25)$$

Replacing this expression into change price dom stack, we get

$$\begin{aligned} d \log P_i &= \left(\sum_{h=1}^{N+1} \Psi_{ih} a_h \right) \frac{1}{\tilde{a}_{N+1}} d \log P_{N+1}^* \\ d \log P_i &= \frac{\tilde{a}_i}{\tilde{a}_{N+1}} d \log P_{N+1}^* \end{aligned} \quad (26)$$

$$d \log P_t = \sum_{i=1}^{N+1} \beta_i d \log P_i$$

$$d \log P_t = \sum_{i=1}^{N+1} \beta_i \frac{\tilde{a}_i}{\tilde{a}_{N+1}} d \log P_{N+1}^*$$

A.4.2 Productivity shock to the commodity sector

The positive productivity shock has stronger effects on the real wage when the commodity sector is an important supplier of intermediates to the economy. This is expressed in the price equation where $\Psi_{i,N+1}$ mitigates the price increases of commodity buyers, but also in the wage, which depends positively on $\Psi_{N+1,N+1}$.

$$\begin{aligned}
d \log P_{N+1}^* &= \tilde{a}_{N+1} d \log W - \Psi d \log Z = 0 \implies \\
d \log W &= \frac{1}{\tilde{a}_{N+1}} \Psi_{N+1, N+1} d \log Z_{N+1}
\end{aligned} \tag{27}$$

Replacing this expression into change price dom stack, we get

$$\begin{aligned}
d \log P_i &= \left(\sum_{h=1}^{N+1} \Psi_{ih} a_h \right) \frac{1}{\tilde{a}_{N+1}} \Psi_{N+1, N+1} d \log Z_{N+1} - \Psi_{i, N+1} d \log Z_{N+1} \\
d \log P_i &= \left(\frac{\tilde{a}_i}{\tilde{a}_{N+1}} \Psi_{N+1, N+1} - \Psi_{i, N+1} \right) d \log Z_{N+1}
\end{aligned} \tag{28}$$

$$d \log P_t = \sum_{i=1}^{N+1} \beta_i d \log P_i$$

$$d \log P_t = \sum_{i=1}^{N+1} \beta_i \left(\frac{\tilde{a}_i}{\tilde{a}_{N+1}} \Psi_{N+1, N+1} - \Psi_{i, N+1} \right) d \log Z_{N+1}$$

A.5 Denomination of Assets

We further examine the market clearing condition in Equation 12 to explore how the denomination of foreign assets—either in units of the commodity good or in units of the importable good—shapes the interpretation of changes in the terms of trade, defined as $ToT = \frac{P_{N+1}}{P_M}$.

When assets are denominated in commodity units, an increase in the terms of trade

lowers the relative price of imports and raises the domestic valuation of foreign assets, as both are measured against the rising price of the commodity good:

$$\begin{aligned}
 P_{N+1,t}B_t &= (1+r)P_{N+1,t}B_{t-1} - P_{N+1,t}g(B_t) + \underbrace{P_{N+1,t}X_t - P_{M,t}\left(\sum_{i=1}^{N+1} M_{iM,t} + C_{M,t}\right)}_{\text{Trade Balance}} \\
 B_t &= (1+r)B_{t-1} - g(B_t) + \underbrace{X_t - \frac{P_{M,t}}{P_{N+1,t}}\left(\sum_{i=1}^{N+1} M_{iM,t} + C_{M,t}\right)}_{\text{Trade Balance}}.
 \end{aligned}$$

Conversely, when assets are denominated in units of the importable good, an increase in ToT enhances the value of exports and increases the real value of foreign assets relative to the importable good:

$$\begin{aligned}
 P_{M,t}B_t &= (1+r)P_{M,t}B_{t-1} - P_{M,t}g(B_t) + \underbrace{P_{N+1,t}X_t - P_{M,t}\left(\sum_{i=1}^{N+1} M_{iM,t} + C_{M,t}\right)}_{\text{Trade Balance}} \\
 B_t &= (1+r)B_{t-1} - g(B_t) + \underbrace{\frac{P_{N+1,t}}{P_{M,t}}X_t - \left(\sum_{i=1}^{N+1} M_{iM,t} + C_{M,t}\right)}_{\text{Trade Balance}}.
 \end{aligned}$$

A.5.1 Euler Equation for Different Assets denomination

Denominated in units of exportable good (P_{N+1})

$$\text{Budget constraint: } P_t C_t + P_{N+1,t}(B_t + g(B_t)) \leq W_t \bar{L} + (1+r)P_{N+1,t}B_{t-1}. \quad (29)$$

Lagrangian

$$\mathcal{L} = \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[\frac{C_t^{1-\rho} - 1}{1-\rho} + \lambda_t \left(W_t \bar{L} + (1+r) P_{N+1,t} B_{t-1} - P_t C_t - P_{N+1,t} (B_t + g(B_t)) \right) \right] \quad (30)$$

FOCs

$$\frac{\partial \mathcal{L}}{\partial C_t} : \quad \beta^t C_t^{-\rho} - \lambda_t P_t = 0 \quad \Rightarrow \quad \lambda_t = \frac{\beta^t C_t^{-\rho}}{P_t} \quad (31)$$

$$\frac{\partial \mathcal{L}}{\partial B_t} : \quad -\lambda_t P_{N+1,t} (1 + g'(B_t)) + \beta^{t+1} \mathbb{E}_t [\lambda_{t+1} (1+r) P_{N+1,t+1}] = 0 \quad (32)$$

Euler Equation (general prices). Substitute (36) into (37) and simplify:

$$\frac{C_t^{-\rho}}{P_t} = \frac{\beta(1+r)}{1+g'(B_t)} \mathbb{E}_t \left[\frac{C_{t+1}^{-\rho}}{P_{t+1}} \cdot \frac{P_{N+1,t+1}}{P_{N+1,t}} \right]. \quad (33)$$

Denominated in units of importable good (P_M)

$$\text{Budget constraint:} \quad P_t C_t + P_{M,t} (B_t + g(B_t)) \leq W_t \bar{L} + (1+r) P_{M,t} B_{t-1}. \quad (34)$$

Lagrangian

$$\mathcal{L} = \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[\frac{C_t^{1-\rho} - 1}{1-\rho} + \lambda_t \left(W_t \bar{L} + (1+r) P_{M,t} B_{t-1} - P_t C_t - P_{M,t} (B_t + g(B_t)) \right) \right]. \quad (35)$$

FOCs

$$\frac{\partial \mathcal{L}}{\partial C_t} : \quad \beta^t C_t^{-\rho} - \lambda_t P_t = 0 \quad \Rightarrow \quad \lambda_t = \frac{\beta^t C_t^{-\rho}}{P_t}, \quad (36)$$

$$\frac{\partial \mathcal{L}}{\partial B_t} : \quad -\lambda_t P_{M,t}(1 + g'(B_t)) + \beta^{t+1} \mathbb{E}_t[\lambda_{t+1}(1 + r)P_{M,t+1}] = 0. \quad (37)$$

Euler Equation Substitute (36) into (37) and simplify:

$$\frac{C_t^{-\rho}}{P_t} = \frac{\beta(1 + r)}{1 + g'(B_t)} \mathbb{E}_t \left[\frac{C_{t+1}^{-\rho}}{P_{t+1}} \cdot \frac{P_{M,t+1}}{P_{M,t}} \right]. \quad (38)$$

Special case (denominated in P_t). If the export good is the numeraire so that $P_{N+1,t} \equiv 1$ for all t , (38) collapses to:

$$\frac{C_t^{-\rho}}{P_t} = \frac{\beta(1 + r)}{1 + g'(B_t)} \mathbb{E}_t [C_{t+1}^{-\rho}]. \quad (39)$$

Here to get a deeper understanding of the mechanism behind a ToT and a Productivity shock.

Figure XIV: Consumption Response and NAVAS: Assets Denominated in Units of the Imported Good

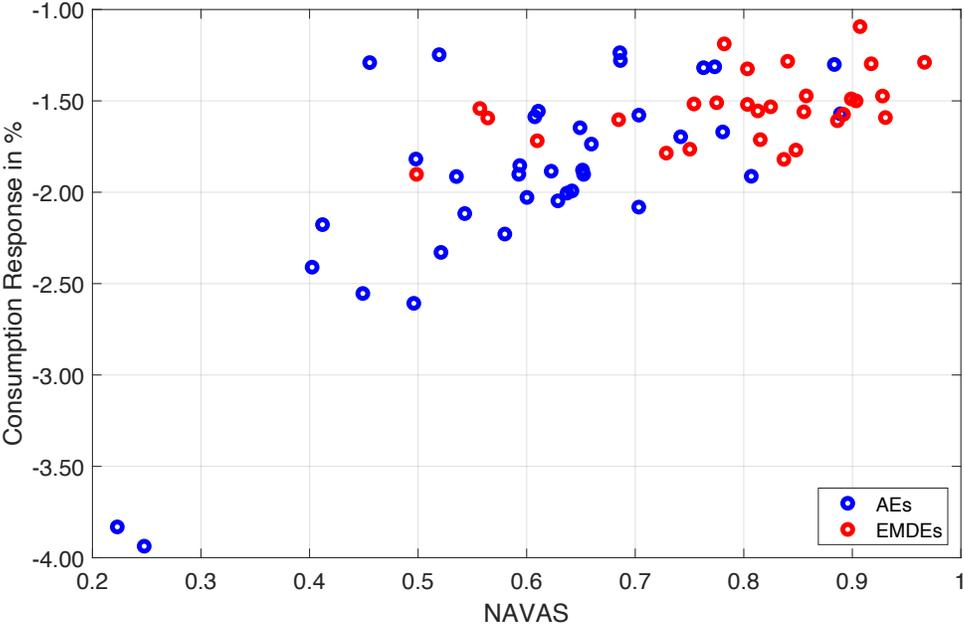
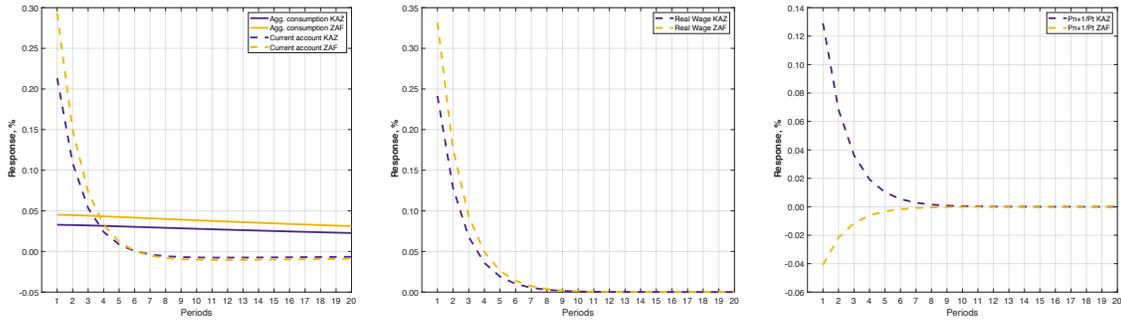
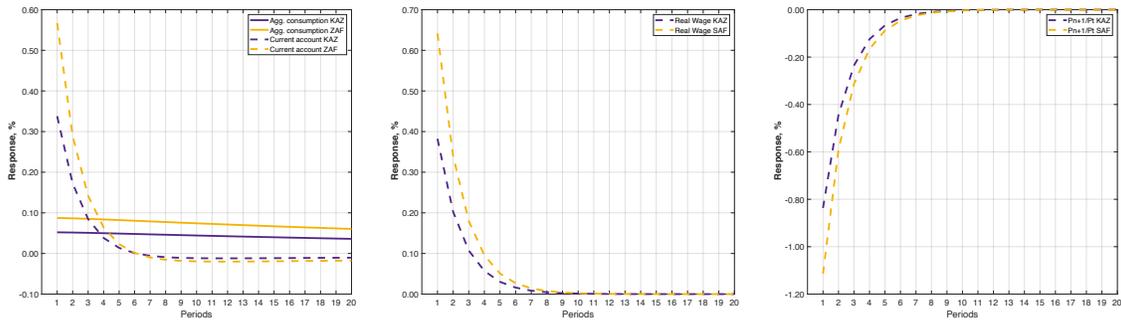


Figure XV: Mechanism reactions to a ToT shock and a productivity shock, no valuation

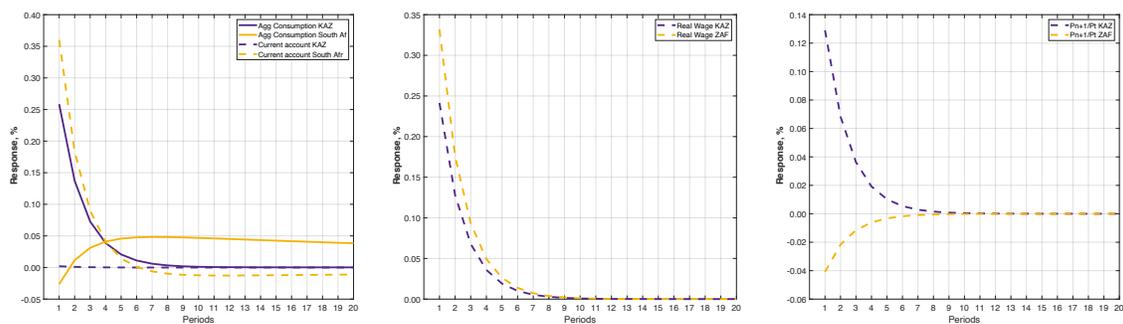


1) Commodity price shock no valuation effect

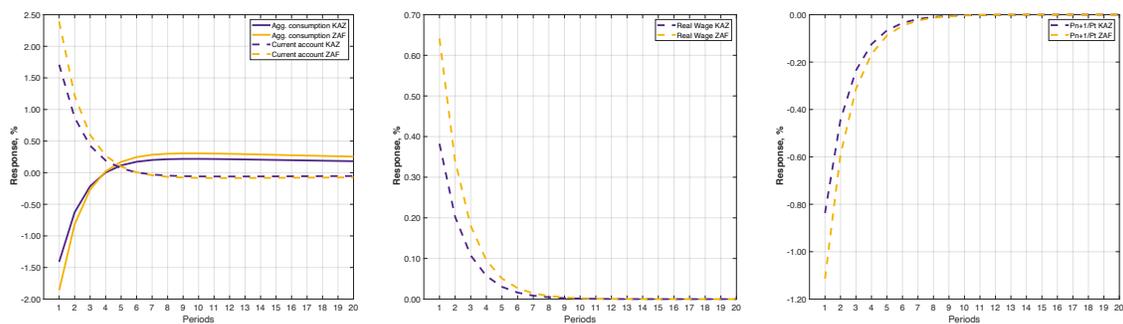


2) Productivity shock no valuation effect

Figure XVI: Mechanism reactions to a ToT shock and a productivity shock.



1) Commodity price shock



2) Productivity shock

Figure XVII: Mechanism reactions to a ToT shock with assets denominated on Pm(units of the foreign good).

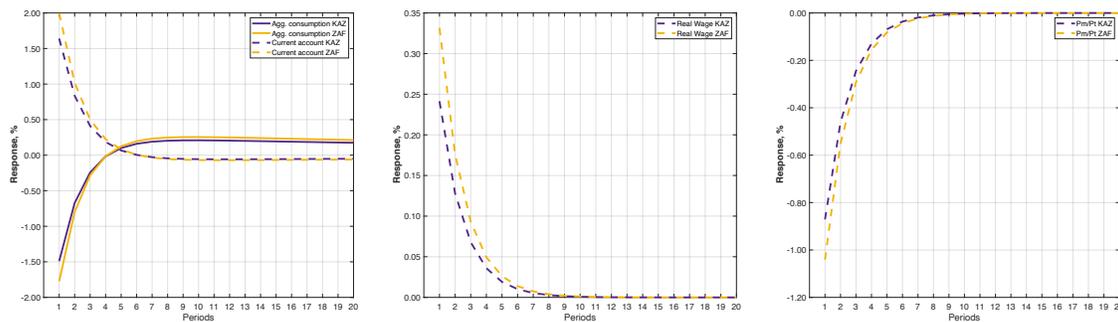
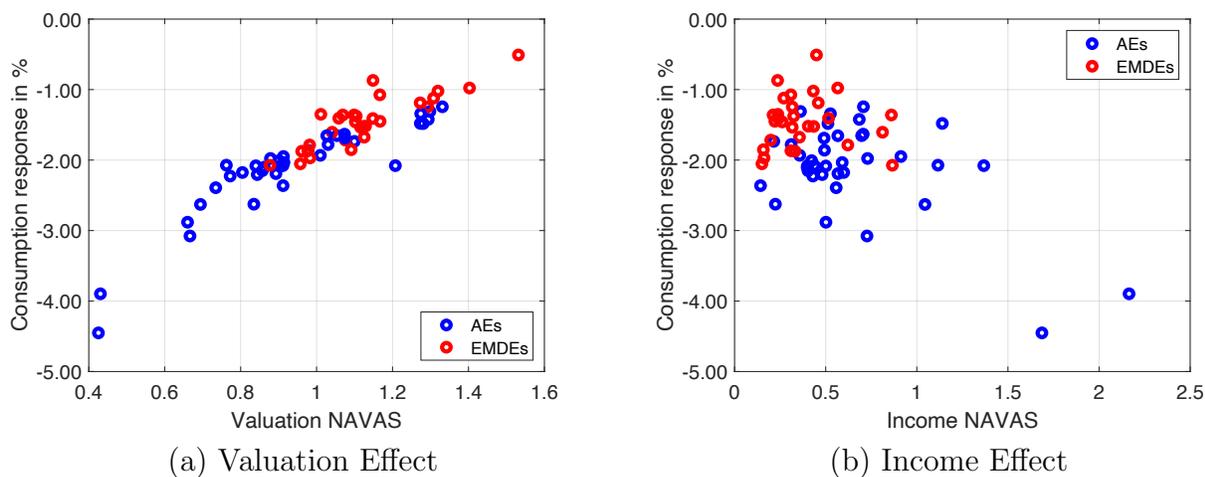


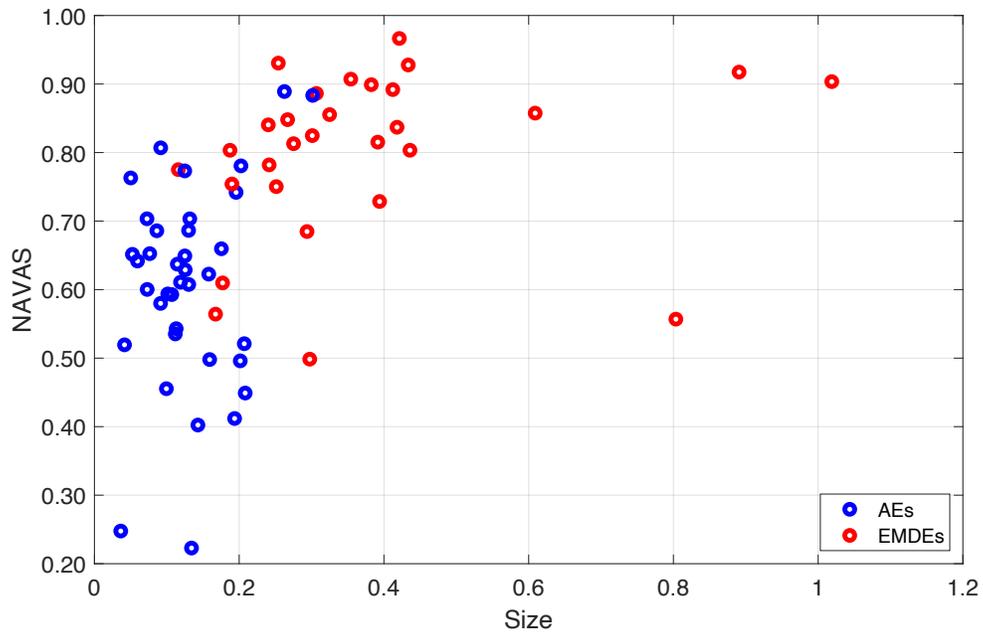
Figure XVIII: Consumption Responses against Wealth and Income NAVAS Productivity shock



Source: OECD and IMF staff calculations.

Note: NAVAS operates through two transmission channels, the valuation of NFA, shown in panel (a), and real wages, shown in panel (b). Both panels display the first-period percentage response of real consumption to a 1 percent commodity sector productivity shock.

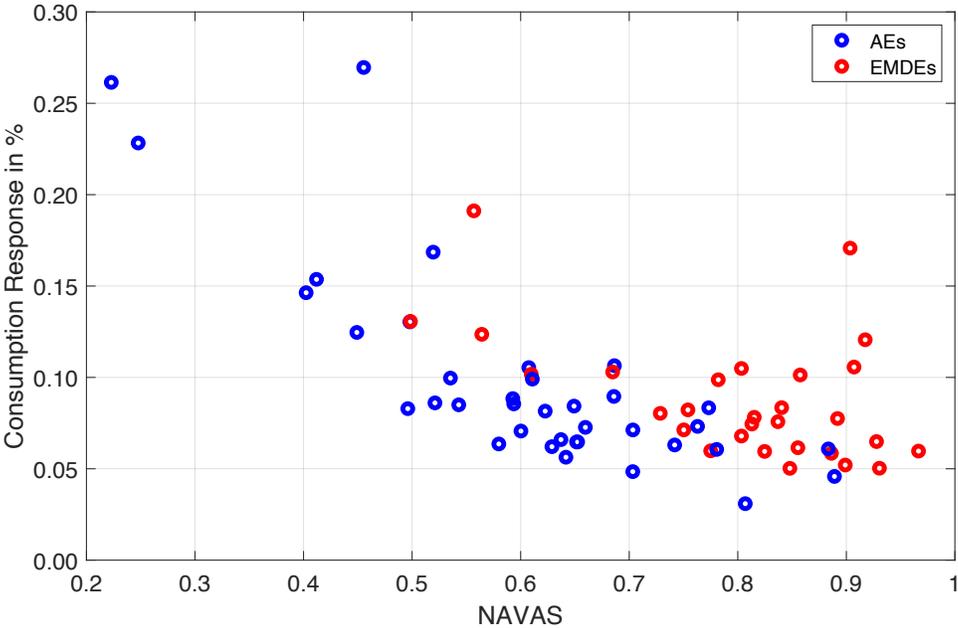
Figure XIX: Size and NAVAS of the Commodity Sector



Source: OECD and IMF staff calculations.

Note: Size is the ratio between commodity sectors total sales to GDP in 2018. NAVAS is the network-adjusted value-added share of the commodity sector in 2018.

Figure XX: Productivity shock no valuation



Source: OECD and IMF staff calculations.

Note: NAVAS is the network-adjusted value-added share of the commodity sector in 2018.



PUBLICATIONS

Commodity-driven Macroeconomic Fluctuations: Does Size Matter?
Working Paper No. WP/2025/208