Commodity Prices and the Terms-of-Trade Disconnect

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October 21, 2026

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Abstract

Terms-of-trade shocks are commonly identified as innovations to the ratio of unit-value-based indices of export and import prices. In emerging market and developing economies (EMDEs), such shocks explain less than 10% of aggregate fluctuations in the country SVARs of Schmitt-Grohé and Uribe (2018), and across countries the variance shares implied by their estimated small open economy model bear no relation to the SVAR estimates, a mismatch they call the terms-of-trade disconnect. I revisit both findings. In EMDEs, where most exports and many imports are commodities, the main source of exogenous variation in the terms of trade is the movement of world commodity prices. This movement raises or lowers export and import prices together, and the ratio discards most of this common movement. I measure terms-of-trade shocks instead as the surprises to country-specific commodity export and import price indices, built from world commodity prices with predetermined trade weights. I find that, measured this way, the shocks account for about 30% of aggregate fluctuations, against 13% when they are measured using a ratio of export to import prices. The surprises that move the two indices together account for about 16% on their own. I then extend the model of Schmitt-Grohé and Uribe (2018) by dividing its exportable and importable sectors into commodity and noncommodity parts and estimate it country by country on the SVAR responses to the commodity-price surprises. I find that the model essentially reproduces the median variance share in the SVARs, 29% against 30%, but across countries its shares are unrelated to the SVAR estimates. The disconnect therefore remains and is at least partly attributable to the model's transmission mechanism, which assigns the largest effects to large commodity importers, whereas the SVARs find them in net commodity exporters.

Keywords: Terms of trade, commodity prices, business cycles, emerging market and developing economies, small open economy models.
JEL codes: C32, E32, F41, F44.

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1 Introduction

How important are terms-of-trade shocks for business cycles in emerging market and developing economies (EMDEs)? The conventional view that terms-of-trade shocks drive a large share of business cycles in these economies is based largely on the calibrated three-sector model of Mendoza (1995), in which they account for nearly half of the variability of GDP. The empirical evidence is mixed. Broda (2004) estimates a panel VAR for 75 developing countries, assuming that the terms of trade are exogenous, that is, unaffected by the domestic variables contemporaneously or with a lag, and finds that terms-of-trade shocks account for about 30% of the forecast-error variance of real GDP at a ten-year horizon in countries with fixed exchange rate regimes and about 10% in countries with flexible regimes. By contrast, in country-level structural vector autoregressions (SVARs) for 38 poor and emerging countries, which also assume that the terms of trade are exogenous, Schmitt-Grohé and Uribe (2018) find that terms-of-trade shocks explain only about 10% of the variance of the trade balance, output, consumption, investment and the real exchange rate in the median country. They then estimate, country by country and on the same data, the type of model on which the conventional view rests: the three-sector small open economy model of Mendoza (1995), with importable (M), exportable (X) and nontradable (N) sectors, which they call the MXN model. With its variables measured as in the data, the model attributes a similar share of the variance to terms-of-trade shocks on average. At the country level, however, the shares in the model are essentially unrelated to those in the SVARs, although both share the same terms-of-trade process. They call this pattern the terms-of-trade disconnect.

Two properties of the conventional measure of the terms of trade, the net barter terms of trade used by Schmitt-Grohé and Uribe (2018), matter for these findings. First, it is the ratio of aggregate indices of export and import unit values, which are affected by the product composition, quality and destination of trade (Schott, 2004; Manova and Zhang, 2012) and, for differentiated goods, by pricing decisions, so that the measured terms of trade need not be exogenous to the domestic economy. Second, as a ratio it eliminates the movement that export and import prices share, although this movement changes a country's income whenever its exports and imports differ in size. In EMDEs, the main source of exogenous variation in export and import prices, and hence in the terms of trade, is the movement of world commodity prices. Commodities make up most of these economies' exports and a large share of their imports (in the 32 economies studied here, a median 82% of merchandise exports and 38% of merchandise imports), and commodity dependence is a central concern in policy assessments of these economies (UN Trade and Development, 2025). These 32 are the emerging and developing economies with at least 30 consecutive years of complete data for

which the country SVAR is stationary and the model has a steady state. Because commodity export and import prices respond to the same global forces, their common movement is large, and it is not neutral: a common increase in commodity prices raises the income of net commodity exporters, lowers that of net importers, and comes with changes in world demand that affect both. This paper shows that the small shares found by Schmitt-Grohé and Uribe (2018) depend in part on how terms-of-trade shocks are measured: within their design, measuring the shocks with commodity export and import prices raises their contribution substantially. It also shows that, with the shocks measured in this way, the cross-country disconnect between the variance shares of the MXN model and those of the SVARs persists, and that this reflects how MXN-style models transmit these shocks to the domestic economy.

I measure terms-of-trade shocks with the country-specific commodity export and import price indices of Gruss and Kebhaj (2019), which weight world commodity prices by each country's lagged trade shares, and I enter the two indices separately, in place of the terms of trade, in the block of exogenous external variables of each country's SVAR. Commodities are standardized goods traded on integrated world markets, on which a single small economy has negligible influence, and the indices vary only with world prices because their weights are predetermined. They are therefore a more credible measure of exogenous terms-of-trade shocks than aggregate unit-value indices. Export and import prices measured in this way move together: in every country of the main sample the correlation between their cyclical components is positive, with a median of 0.72. Other studies also measure external shocks to EMDEs through commodity prices and find large effects on their business cycles (Fernández et al., 2017, 2018; Di Pace et al., 2025); I discuss how this paper relates to them below.

The first of three main results comes from country SVARs that follow the specification of Schmitt-Grohé and Uribe (2018) in every respect except the price measure. The variance share of the commodity-price block counts all the exogenous variation in the two prices, as the surprises actually arrive together, with no direction imposed. Together, the innovations to the commodity export and import prices account for about 30% of the unconditional variance of the domestic variables in the median country, against 13% for the net barter terms of trade. The block divides exactly into a common component, along which the two prices move together, and a relative component, along which they move apart; the common component accounts for 16% and the relative component for 10% across the medians. The commodity terms of trade, the ratio of the same two prices, account for 13%, close to the relative component and about as much as the net barter terms of trade: a ratio keeps the relative movement of the two prices and discards most of their common movement. On the data set of Schmitt-Grohé and Uribe (2018), replacing their terms of trade by the commodity prices raises the median share from 10% to 45%. These magnitudes are much closer to the

conventional view that terms-of-trade shocks drive a large share of business cycles in EMDEs.

The second result is that the two components have different effects. A common increase in commodity prices, an innovation along the first principal component of the two price innovations that raises them by 10% on average, is expansionary: in the median country output rises by 0.4% on impact, investment by 1.4%, and consumption by 0.7% after one year, while the trade balance falls. A relative increase in the export price, an innovation along the second principal component that raises the export price by 10% relative to the import price, raises the trade balance by 0.4% of GDP and lowers consumption by 0.5% and investment by 0.8% on impact, while output barely moves. Panel local projections with country fixed effects (Jordà, 2005) and standard errors robust to cross-country dependence (Driscoll and Kraay, 1998) confirm the expansionary effect of a common increase with considerable precision. Over time, the realized commodity-price surprises kept output in the median country 2.8% below trend over 1992 to 2004 and 3.1% above trend over 2008 to 2014.

The third result is that the disconnect remains once the shocks are measured with commodity prices: a multisector small open economy model does not reproduce their effects. I extend the MXN model of Schmitt-Grohé and Uribe (2018) by dividing each tradable sector into commodity and noncommodity production. Each country's model receives the country's estimated external process, is calibrated to the country's goods trade, trade balance, services share and commodity composition, and is estimated, as in Schmitt-Grohé and Uribe (2018), by matching the SVAR responses to both components of the price block and to the spread. Calibrated to each country, the model approximates the median contribution of commodity prices for most variables, but across countries the Spearman rank correlation between model and SVAR shares, which compares how the two order the countries, is -0.24 for output and -0.01 for each country's median share across the five variables, and no correlation is significantly different from zero. The model and the data rank countries by different characteristics: the model's shares are largest in economies whose commodity imports are large relative to GDP, for which a common price increase raises the cost of imports, whereas the SVAR shares are smallest there and largest in net commodity exporters. The model also transmits the two components differently from the data. I estimate it under two calibrations of the external position: the country calibration, in which the steady-state trade balance is each country's observed one, so that most economies are net creditors, and a common calibration at cross-country averages with the trade surplus of 1% of GDP used by Schmitt-Grohé and Uribe (2018), in which every economy is a net debtor. Under both, the model's response to a relative increase in the export price is expansionary, whereas in the data consumption and investment fall. The model's response to a common increase in commodity prices depends on the external position: under the country calibration consumption and investment fall,

whereas under the common calibration consumption rises and investment rises from the third year on.

The paper contributes to three strands of literature, the first of which studies the contribution of commodity prices and other external shocks to business cycles in emerging and developing economies. Fernández et al. (2017) show, with country-specific SVARs for 138 countries, that world shocks transmitted through agricultural, metal and fuel prices explain about a third of output fluctuations, and that a single world price such as the terms of trade understates their importance. Fernández et al. (2018) find that a common factor accounts for most of the movement in commodity prices and that commodity-price shocks, in large part through this factor, explain more than a third of the variance of output in a multi-country business-cycle model of emerging economies estimated on data for these economies. Drechsel and Tenreyro (2018) show, in a small open economy model estimated on Argentine data, that commodity prices affect an emerging economy both through its income and through the interest rate at which it borrows, and attribute about 38% of the fluctuations in Argentine output growth to commodity-price shocks. I show that the common movement of a country's own commodity export and import prices accounts for the larger part of their contribution to its business cycle, using an exact division of their joint contribution into common and relative components within a standard recursive design.

The second strand concerns the measurement of terms-of-trade shocks. The paper closest to mine, Di Pace et al. (2025), builds export and import price indices from commodity and manufactures prices for a similar sample of developing economies, identifies export-price, import-price and global-activity shocks in country SVARs with sign and narrative restrictions, and finds that export- and import-price shocks together account for up to 30% of output fluctuations in the long run and that global-activity shocks, which move export and import prices together and are therefore largely missed by the terms of trade, have large effects on output; its authors conclude that the disconnect arises because terms-of-trade shocks are not all alike. My empirical results reach a consistent conclusion with a different design: the recursive identification and unconditional variance shares of Schmitt-Grohé and Uribe (2018), applied both to their data set and to a sample of 32 economies over 1980 to 2023 that includes 20 of their 38 countries, in which the division of the price block into its principal components isolates the common movement of the two prices without additional identifying restrictions.

The third strand evaluates small open economy models against the data. Di Pace et al. (2025) extend the model of Schmitt-Grohé and Uribe (2018) to independent export and import prices and characterize its responses over a range of parameter values, finding that a simultaneous increase in both prices raises consumption and investment for most of these parameter values. They use the model to motivate their identifying restrictions and do not

estimate it. My extension of the MXN model of Schmitt-Grohé and Uribe (2018) instead divides each tradable sector into commodity and noncommodity production. I take it to the data country by country, with each country's estimated price process, trade structure and SVAR responses, and compare its variance shares with the SVAR's across countries. The comparison attributes part of the model's failure to the transmission of commodity-price shocks. In the data, a common increase in commodity prices is expansionary, consistent with evidence that commodity prices rise together when global demand is strong (Kilian, 2009). In the model, a common increase in commodity prices affects each economy only through the variables of the external process, the two commodity prices and the U.S. spread, and not through world demand for the economy's goods. The model's response to a common increase therefore depends on each country's commodity trade and net foreign asset position.

The remainder of the paper is organized as follows. Section 2 describes the commodity price indices and the comovement of export and import prices. Section 3 presents the country SVAR estimates. Section 4 describes the model, and Section 5 compares it with the data. Section 6 concludes.

2 Data and Measurement

Terms-of-trade shocks affect an economy because they change what it earns from its exports and pays for its imports at given quantities. An empirical measure of these shocks should therefore reflect the prices the country faces and retain the price movements that change its income. The price series from which the shocks are measured should also be exogenous to the country, that is, unaffected by domestic shocks within the same year. This section argues that, for most emerging and developing economies, country-specific commodity price indices meet these requirements better than conventional terms-of-trade measures. It then describes the indices and the sample and documents the comovement of export and import prices.

2.1 Commodity Price Indices

Three features of emerging and developing economies motivate the use of commodity prices. First, commodities account for most of what they export. In the 32 countries of the main sample defined below, commodities make up a median 82% of merchandise exports and 38% of merchandise imports, and more than half of merchandise exports in 24 countries (country profiles for 2021 to 2023 in UN Trade and Development, 2025). They are standardized goods traded on integrated world markets, on which a single small economy has negligible market power and takes prices as given. Second, the conventional terms of trade, the ratio

of aggregate indices of export and import unit values, is not a price measure in this sense. Aggregate unit values also cover differentiated goods, whose prices depend on pricing decisions and market conditions, and they change when a country changes the composition, quality or destination of what it trades (Schott, 2004; Manova and Zhang, 2012). Such changes are partly domestic decisions, so that a shock to domestic demand or productivity can move measured unit values within the year. Third, a ratio of export to import prices discards the movement the two prices have in common. If both rise by the same proportion, the ratio is unchanged, but a net commodity exporter gains income and a net commodity importer loses it (Section 2.2).

I use the commodity export and import price indices of the IMF Commodity Terms-of-Trade database (Gruss and Kebhaj, 2019). For country i and year t, the log change in each index is a weighted average of log changes in world commodity prices,

$$\Delta \log \tilde{P}^{k}_{i,t} = \sum_{j=1}^{J} \Omega^{k}_{i,j,t} \, \Delta \log P^{w}_{j,t}, \qquad k \in \{x_c, m_c\}, \tag{1}$$

where $P^{w}_{j,t}$ is the world price of commodity j, $\tilde{P}^{x_c}_{i,t}$ is the commodity export price index and $\tilde{P}^{m_c}_{i,t}$ the commodity import price index. With $x_{i,j,t}$ and $m_{i,j,t}$ the dollar values of the country's exports and imports of commodity j, the weights are three-year averages of lagged trade shares,

$$\omega^{x_c}_{i,j,t} = \frac{x_{i,j,t}}{\sum_{\ell=1}^{J} x_{i,\ell,t}}, \qquad \omega^{m_c}_{i,j,t} = \frac{m_{i,j,t}}{\sum_{\ell=1}^{J} m_{i,\ell,t}}, \tag{2}$$

$$\Omega^{k}_{i,j,t} = \frac{1}{3} \sum_{s=1}^{3} \omega^{k}_{i,j,t-s}, \qquad k \in \{x_c, m_c\}. \tag{3}$$

The annual indices cover the 40 commodities listed in Appendix Table 5: energy, metals, food and beverages, and agricultural raw materials.

Because the weights are predetermined, the change in an index within a year is a fixed combination of world price changes: the country's trade pattern determines how much each world price matters for the index, while the price changes themselves originate in world markets. This does not by itself make world prices exogenous for every country, since large producers or consumers of a commodity can move its price.[1] The underlying dollar prices are

[1] Few countries hold large shares of world commodity markets (Gruss and Kebhaj, 2019). For the main-sample countries that do, Brazil and China show no Granger causality from their domestic variables to their commodity export and import price indices. Niger and Peru show some Granger causality in a few specifications, which cannot reflect market power, since the commodities in which they hold large shares are absent from their indices or a small part of them (Appendix B).

deflated by the IMF index of manufactured export unit values (MUV) before aggregation, so the indices measure commodity prices in units of manufactured goods. I use them in this form and denote their logarithms $\tilde{p}^{x_c}_{i,t}$ and $\tilde{p}^{m_c}_{i,t}$. The model in Section 4 defines its exogenous prices in the same units, and the tilde distinguishes these world prices from the model's domestic prices.

For comparison I use two ratio measures: the commodity terms of trade, $\tilde{p}^{x_c}_{i,t} - \tilde{p}^{m_c}_{i,t}$, and the net barter terms of trade from the World Development Indicators, the ratio of aggregate indices of export and import unit values used by Schmitt-Grohé and Uribe (2018). All prices enter the cyclical analysis as residuals from a quadratic trend in logs.

The data cover 46 emerging and developing economies with at least 30 consecutive years of complete data between 1980 and 2023 (Appendix A). The main sample consists of the 32 of them for which both the empirical model of Section 3 and the structural model of Section 4 are defined: eleven economies cannot be represented by the model's steady state (Section 4), and three have SVARs with an estimated root on or outside the unit circle, for which unconditional variance shares do not exist. All results in the main text refer to the main sample, so that the empirical and model-based results concern the same economies; Appendix D reports the empirical results for all 46.

2.2 Comovement of Export and Import Prices

Export and import price indices built from world prices move together for three reasons. The first is the common deflator: both indices are dollar prices divided by the same MUV index, so a rise in the dollar price of manufactures lowers both by the same amount without any change in commodity markets. The second is common drivers of world commodity prices. Shifts in world activity raise the prices of energy, metals and many agricultural goods at the same time (Kilian, 2009; Alquist et al., 2020), and energy is an input into the production and transport of other commodities. Because export and import baskets both load on these broad movements, a global expansion raises both indices even when the two baskets share no commodity. Di Pace et al. (2025) find that global-activity shocks account for much of the correlation between export and import prices in developing economies. The third is overlap between the baskets: many countries export and import goods from the same commodity group, as when an oil producer imports refined fuels or a grain exporter imports other cereals, and a price change in such a group enters both indices.

Only events specific to one commodity, such as a harvest failure in a crop that a country exports but does not import, move one index without the other. Ghana illustrates the point: its commodity exports are mainly gold, cocoa and, since 2011, crude oil, of which the annual

export index includes cocoa and oil (gold is not covered), and its commodity imports are mainly fuels and foods such as rice and wheat. A global boom such as that of 2003 to 2008 raises the prices of all these goods, and over Ghana's estimation window the correlation between the cyclical components of its two indices is 0.75 (Figure 1, panel B). A cocoa supply shock, by contrast, moves the export index alone.

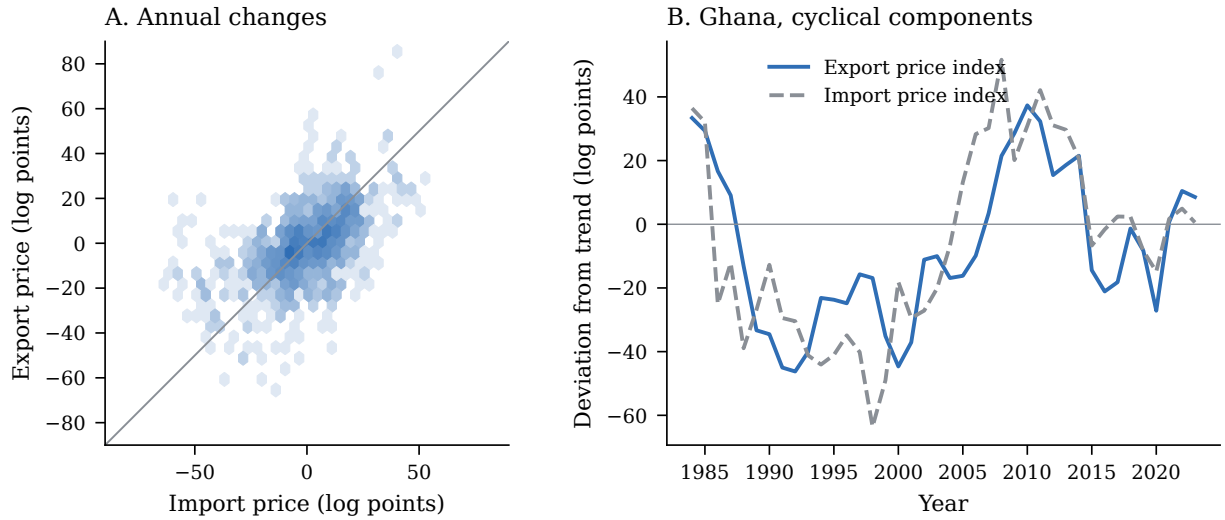

Figure 1: Commodity export and import prices. Panel A: annual log changes in the two indices, pooled over the 32 countries of the main sample and their estimation windows (1,313 country-years); darker hexagons contain more observations, and the diagonal marks equal changes. Panel B: cyclical components (log deviations from a quadratic trend) of Ghana's two indices.

Figure 2, panel A, reports the correlation between each country's commodity export and import prices over its estimation window. The correlation is positive in all 32 countries, with a median of 0.72 for cyclical components and 0.58 for annual changes, and the two prices change in the same direction in 70% of the 1,313 country-years. In the median country the cyclical component of the export price has a standard deviation of 23.2% and that of the import price 29.8%, while the commodity terms of trade, their log ratio, has a standard deviation of 21.6%. In 47% of the countries the ratio is less volatile than either of the two prices.

The commodity indices and the net barter terms of trade measure different objects. Panel B of Figure 2 shows that annual changes in the net barter terms of trade are only loosely related to changes in the commodity terms of trade, with a median correlation of 0.4 across countries (0.35 for cyclical components). The net barter terms of trade are also less volatile, with a standard deviation of the cyclical component of 14.8% in the median country, because aggregate unit values combine commodity prices with the prices of manufactures and services

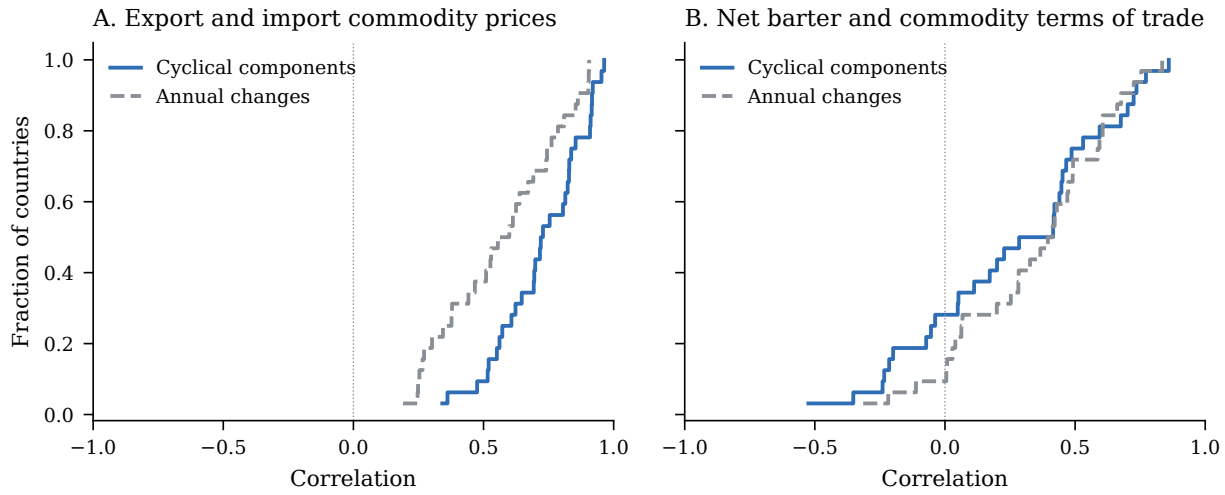

Figure 2: Correlations among external price measures. Cumulative distributions across the 32 countries of the main sample, each computed over the country's estimation window. Panel A: correlation between the commodity export and import price indices, for cyclical components (log deviations from quadratic trends) and annual log changes. Panel B: correlation between the net barter terms of trade and the commodity terms of trade, for cyclical components and annual log changes.

and with the composition effects discussed above.

The common movement of commodity export and import prices matters for income. For a country with commodity exports $a_{x,i}$ and imports $a_{m,i}$ relative to GDP, the change in net commodity receipts at given quantities is

$$d\mathcal{R}_i = a_{x,i}\, d\tilde{p}_i^{x_c} - a_{m,i}\, d\tilde{p}_i^{m_c}. \tag{4}$$

When both prices rise by the same amount dp, the terms of trade are unchanged but receipts change by $(a_{x,i} - a_{m,i})\, dp$: a net commodity exporter gains and a net importer loses. A ratio of export to import prices records none of this.

These facts shape the empirical design: the two commodity prices enter separately, so that their common movement, which a ratio largely removes, is part of the external shocks. Because the two prices share much of their movement, however, a recursive ordering would assign the shared movement to whichever price is ordered first. The analysis therefore reports only objects that do not depend on that order: the joint contribution of the two prices, referred to as the commodity-price block, and the responses to a common increase in both prices.

3 Country-Level Evidence

This section estimates the contribution of commodity prices to business cycles with country SVARs that follow the specification of Schmitt-Grohé and Uribe (2018) in every respect except the price measure, first in the main sample and then in their original data set.

3.1 Empirical Specification

For country i the vector of variables is

$$z_{i,t} = [\tilde{p}^{x_c}_{i,t},\ \tilde{p}^{m_c}_{i,t},\ s_t,\ tb_{i,t},\ y_{i,t},\ c_{i,t},\ i_{i,t},\ rer_{i,t}]'. \tag{5}$$

The first three variables form the external block: the two commodity prices and the U.S. spread s_t, Moody's Baa corporate bond yield minus the federal funds rate, a measure of global financial conditions (Akıncı, 2013) that the benchmark specification includes as a world interest rate. The domestic variables are the trade balance relative to trend output, real output, consumption and investment per capita, and the CPI-based real exchange rate, defined so that an increase is a depreciation. The two commodity prices, output, consumption, investment and the real exchange rate are log deviations from quadratic trends. The trade balance relative to trend output and the spread are deviations from quadratic trends in levels. Each country's window contains 31 to 44 annual observations (Appendix A).

For each country I estimate a first-order VAR

$$z_{i,t} = \mu_i + H_i z_{i,t-1} + P_i \varepsilon_{i,t}, \qquad E[\varepsilon_{i,t}\varepsilon'_{i,t}] = I, \tag{6}$$

equation by equation by OLS, with lagged domestic variables excluded from the external equations, where μ_i is a vector of intercepts, H_i the matrix of autoregressive coefficients and P_i the lower-triangular Cholesky factor of the residual covariance matrix. The external block is therefore exogenous: domestic conditions affect neither commodity prices nor the spread, contemporaneously or with a lag. Placing the prices before the spread allows a price innovation to move the spread within the year. I also estimate two specifications with a single price ratio in place of the two prices: the commodity terms of trade, $\tilde{p}^{x_c}_{i,t} - \tilde{p}^{m_c}_{i,t}$, and the net barter terms of trade, the measure used in the benchmark specification.

The object of interest is the share of the unconditional variance of each domestic variable that is due to the price innovations. The unconditional covariance matrix of $z_{i,t}$, Σ_i, solves $\Sigma_i = H_i \Sigma_i H_i' + P_i P_i'$. The part of it generated by the j-th structural innovation alone, $\Sigma_i^{(j)}$, solves $\Sigma_i^{(j)} = H_i \Sigma_i^{(j)} H_i' + P_i e_j e_j' P_i'$, where e_j is the j-th column of the identity matrix, and

because the innovations are uncorrelated, $\Sigma_i = \sum_j \Sigma_i^{(j)}$. With $[\,\cdot\,]_{vv}$ the diagonal element of a matrix that corresponds to variable v, that is, the variance of v, the share (%) of the variance of domestic variable v due to the price block, the first two innovations, is

$$S_{i,v} = 100\,\frac{\sum_{j=1}^{2}[\Sigma_i^{(j)}]_{vv}}{[\Sigma_i]_{vv}}, \tag{7}$$

with the first innovation alone in place of the two for the ratio specifications. The share is defined only for stationary systems, which all main-sample systems are. Cross-country summaries are medians.

The block share measures the importance of terms-of-trade shocks in the sense that matters for a commodity-dependent economy. In reality, the surprises to a country's export and import prices arrive together, in whatever combinations world markets produce: both prices may rise, both may fall, or one may rise while the other falls. The block share counts all of this exogenous price variation, with the size and correlation of the two surprises estimated from the data and no direction imposed. It answers the question: if commodity-price surprises were the only disturbances, how large would the variance of each domestic variable be, relative to its variance when all disturbances operate? It is the direct counterpart, with two prices, of the terms-of-trade share of Schmitt-Grohé and Uribe (2018). Because it depends only on the covariance of the price residuals, it does not depend on the order of the two prices within the block (Technical Appendix, Section 2).

For the same reason, the block can be divided exactly into two orthogonal components that do not depend on that order. The common component is the innovation along the first principal component of the two reduced-form price innovations, the eigenvector of their covariance matrix with the largest eigenvalue; both prices load positively on it in every country, and it accounts for a median 84% of the variance of the two price innovations. The relative component is the innovation along the second principal component, along which the two prices move in opposite directions. The two components are uncorrelated, so their contributions to the variance of each domestic variable add up to the block share.

3.2 Variance Decomposition

Table 1 reports the shares. The commodity-price block accounts for between 28% (investment) and 34% (trade balance) of the unconditional variance of the domestic variables in the median country, 30% across the five medians. The net barter terms of trade account for 13%, close to the 10% in Schmitt-Grohé and Uribe (2018).

The split of the block shows where this contribution comes from. The common component

accounts for between 13.8% (investment) and 19.1% (trade balance) of the variance in the median country, 15.7% across the five medians, and the relative component for between 8.2% and 13.4%, 9.6% across the medians. The common component is the larger of the two for every domestic variable. The commodity terms of trade, the ratio of the same two prices, account for 13.5% in the median (12.1% for output), about as much as the net barter terms of trade and somewhat more than the relative component: a ratio keeps the relative movement of the two prices and discards most of their common movement, which is the larger part of their contribution. The ratio does not coincide with the relative component. It discards only changes in which both prices move by the same percentage, whereas the common component raises the import price more than the export price in the median country, so about a fifth of the variance of the ratio's innovation lies along the common component; and its share comes from a separate SVAR, in which the price dynamics are those of the ratio alone.

Table 1: Variance shares of the price block in country SVARs

	TB	Y	C	I	RER	Median
Commodity-price block	34.5	30.4	28.4	28.0	33.1	30.4
Common component	19.1	15.2	18.1	13.8	15.7	15.7
Standard error	(4.2)	(6.1)	(4.8)	(4.7)	(5.7)	
Relative component	9.6	10.0	9.2	8.2	13.4	9.6
Standard error	(2.3)	(2.8)	(2.5)	(2.2)	(3.2)	
Commodity terms of trade	20.2	12.1	13.5	11.4	16.6	13.5
Net barter terms of trade	13.4	11.5	14.3	11.0	16.2	13.4

Notes: Median across the 32 countries of the main sample of the share (%) of the unconditional variance of each domestic variable due to the price innovations, equation (7); the last column is the median of the five medians. Common and relative components: contributions of the innovations along the first and second principal components of the two price innovations, which add up to the block share in each country. Standard errors of the medians from 1,999 replications of the calendar-year wild bootstrap. None of the entries depends on the order of the two prices. TB: trade balance; Y: output; C: consumption; I: investment; RER: real exchange rate.

The original data set of Schmitt-Grohé and Uribe (2018) covers 38 poor and emerging countries over 1980 to at most 2011, with the net barter terms of trade as the price variable; 20 of their countries are in the main sample. Using it separates the effect of the price measure from that of the sample. With their data and the estimator used here, the median shares agree with those they report to at least ten decimal places. Replacing their terms of trade with the commodity-price block, constructed for the 37 of their countries covered by the IMF indices and detrended in the same way, while keeping all other series and windows, gives the results in Table 2. On their data the commodity-price block accounts for 44.8% of the variance in the median, against 9.6% for their terms of trade, and, as in the main sample, the block accounts for a larger share than the terms of trade for every domestic variable.

Table 2: Terms of trade and commodity prices in the data set of Schmitt-Grohé and Uribe (2018)

	TB	Y	C	I	RER	Median
Terms of trade, published, without spread	11.5	10.4	9.0	10.2	14.1	10.4
Terms of trade, published, with spread	10.9	7.1	9.6	9.3	11.4	9.6
Terms of trade, reproduced, with spread	10.9	7.1	9.6	9.3	11.4	9.6
Commodity-price block	40.0	54.5	44.8	46.4	44.7	44.8

Notes: Median shares (%) of the unconditional variance due to the price block (annual data, 1980 to at most 2011, 30 to 32 observations per country). "Published": medians of the shares in the replication files of Schmitt-Grohé and Uribe (2018), without and with the spread. "Reproduced": the same specification estimated with the code used in this paper, 38 countries. Commodity-price block: the 34 of the 37 countries covered by the IMF indices that have stationary systems. TB: trade balance; Y: output; C: consumption; I: investment; RER: real exchange rate.

These shares are estimated country by country from three to four decades of annual data and vary considerably across countries (Appendix Table 11).

3.3 Responses to Commodity-Price Shocks

Because the two price innovations are strongly correlated, the recursive innovations do not separate a common increase in commodity prices from a change in their ratio, and the response to each depends on which price is ordered first. I therefore report the responses to the two components of the block, which together describe the effects of any combination of price surprises and do not depend on that order. The common shock is the innovation along the first principal component, scaled so that the two prices rise by 10% on average on impact; the relative shock is the innovation along the second, scaled so that the export price rises by 10% relative to the import price (Technical Appendix, Section 2).

Figure 3 reports the median responses. In the median country the common shock raises the export price by 8.3% and the import price by 11.7% on impact. Output rises by 0.4% on impact (bootstrap standard error 0.07) and by 0.52% after one year, the trade balance falls by 0.34% of GDP on impact and by 0.4% after one year, and the real exchange rate appreciates by 1.1% on impact. Investment rises by 1.4% on impact and consumption by 0.7% after one year, with standard errors of 0.3 and 0.17. A common commodity boom is thus followed by higher output and spending and a lower trade balance, a pattern consistent with the global drivers of commodity prices discussed in Section 2.2.

The relative shock raises the export price by 5.9% and lowers the import price by 4.1% on impact. Its effects are smaller and of a different kind: the trade balance improves by 0.37% of GDP on impact (standard error 0.06), consumption falls by 0.46% and investment

by 0.83% on impact, and output barely moves. An improvement in the terms of trade with no common movement of the two prices thus raises net exports and lowers consumption and investment on impact, unlike a common boom.

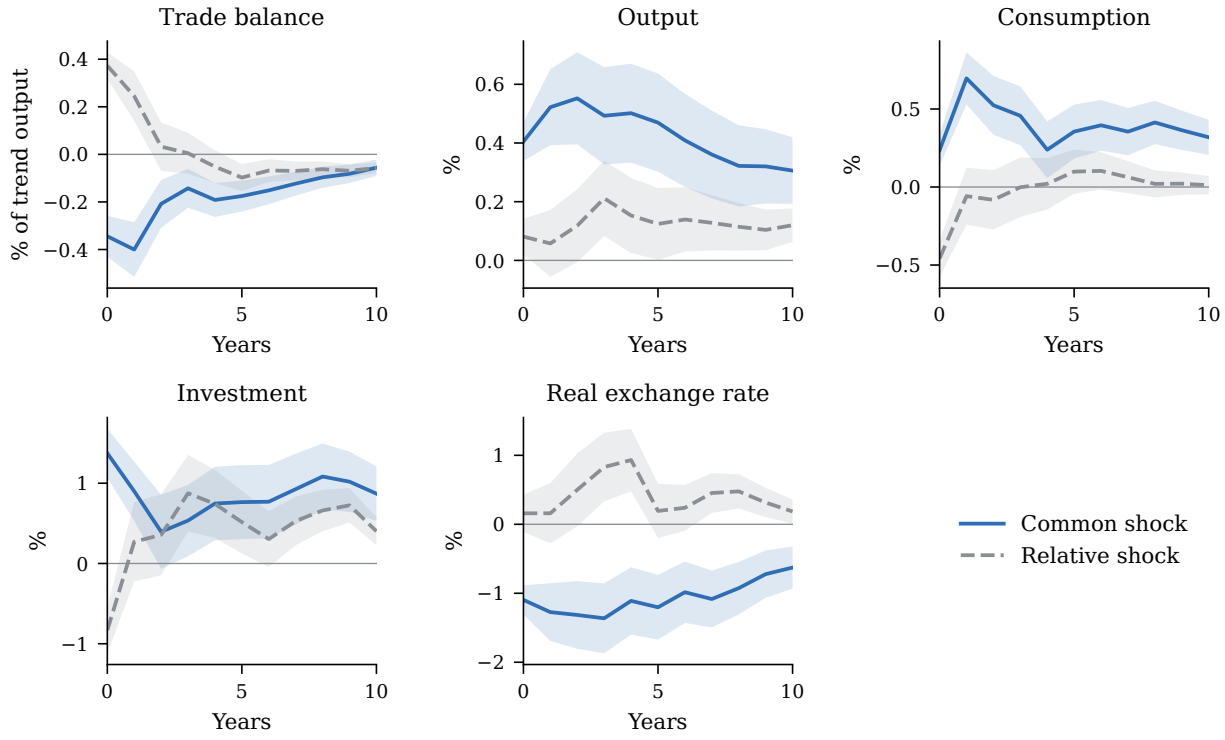

Figure 3: Responses to commodity-price shocks, country SVARs. Median across the 32 countries of the main sample of the responses to the common shock, the innovation along the first principal component of the two price innovations, scaled to raise the two prices by 10% on average on impact, and to the relative shock, the innovation along the second principal component, scaled to raise the export price by 10% relative to the import price. The trade balance is in % of trend output; other variables are in %. The real exchange rate rises with a depreciation. Shaded areas are ± one standard error of the cross-country median, from 1,999 replications of a wild bootstrap with signs shared across countries within a calendar year (Technical Appendix, Section 3). Country-by-country responses are in the online appendix; panel local projections are in Appendix D.

3.4 Historical Decomposition

The block share summarizes the contribution of all commodity-price surprises in a single number. The historical decomposition shows the same contribution over time: for each country and year, it is the part of each domestic variable's deviation from trend that is due to the price surprises that actually occurred, in the combinations in which they occurred. It depends only on the reduced-form price residuals and therefore not on the order of the two

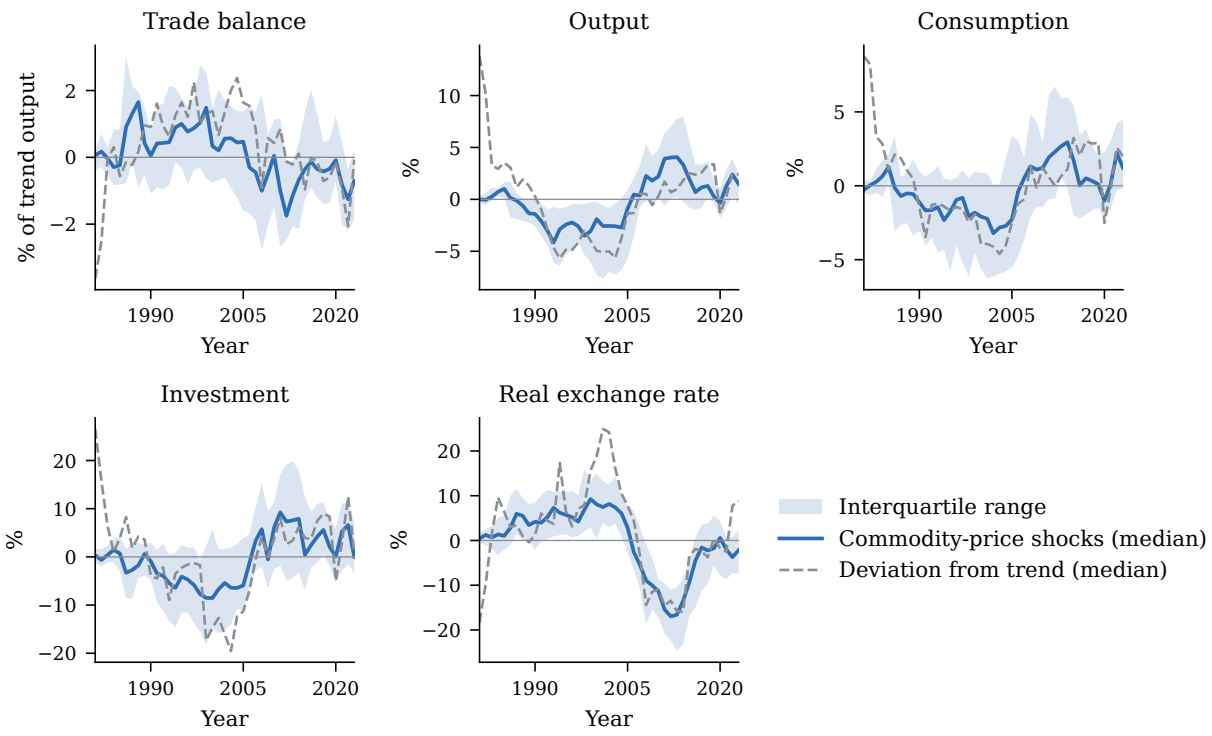

Figure 4: Historical decomposition: contribution of commodity-price shocks. For each country and year, the part of the deviation of each domestic variable from trend that is due to the realized innovations to the two commodity prices, $\sum_{s\leq t} H_i^{t-s} P_{i,\cdot,1:2} \varepsilon_{i,1:2,s}$. Solid line and shaded area: median and interquartile range across the countries of the main sample with data in that year (at least 10). Dashed line: median deviation from trend. Units as in Figure 3.

prices.

Figure 4 reports its distribution across countries by year. The contribution follows the commodity cycle. In the median country, commodity-price surprises kept output below trend by an average of 2.8% over 1992 to 2004 and above trend by an average of 3.1% over 2008 to 2014, the period of high commodity prices. Investment moved with output, by 6.2% below and above trend in the two periods, consumption by about 2%, and the real exchange rate was depreciated in the first period and appreciated in the second. Within countries, the contribution is closely related to the actual deviations of output from trend: the median correlation between the two is 0.58.

4 A Multisector Model with Commodity Trade

The structural benchmark is the three-sector small open economy of Mendoza (1995), in the version that Schmitt-Grohé and Uribe (2018) confront with their SVAR estimates: an

importable, an exportable and a nontradable sector produce with sector-specific capital, and the economy borrows abroad at a debt-elastic interest rate. Schmitt-Grohé and Uribe (2018) call it the MXN model, after its importable (M), exportable (X) and nontradable (N) sectors. I modify it in one respect, needed for it to receive commodity prices: each tradable sector is divided into a commodity and a noncommodity part. As in the extension of Di Pace et al. (2025), export and import prices then move separately, and foreign debt is denominated in a foreign good, whereas the MXN model of Schmitt-Grohé and Uribe (2018) denominates it in the domestic tradable composite. I refer to the extended model, with its commodity (C) sectors, as the MXN-C model. The purpose of the extension is to ask whether this class of models, fed the estimated commodity-price process and calibrated to each economy, transmits commodity-price shocks as the data do. This section presents the model, its steady state and calibration, and its estimation; Appendix C lists the equilibrium conditions and the steady-state algorithm.

4.1 Environment

Production. There are five sectors, $j \in \mathcal{S} = \{m_c, m_{\bar{c}}, x_c, x_{\bar{c}}, n\}$: commodity and noncommodity importables, commodity and noncommodity exportables, and nontradables. Each produces with sector-specific capital and labor,

$$y_t^j = (k_t^j)^{\alpha_j} (h_t^j)^{1-\alpha_j}, \qquad j \in \mathcal{S}, \tag{8}$$

and competitive firms pay labor and capital their marginal products valued at the sector's price p_t^j, so that the wage w_t^j and the rental rate u_t^j equal those values. Capital accumulates as $k_{t+1}^j = (1-\delta)k_t^j + i_t^j$, and changing a sector's capital stock costs $\frac{\phi_j}{2}(k_{t+1}^j - k_t^j)^2$ units of the final good, so that the adjustment costs ϕ_j govern how fast production can move across sectors.

Households. A representative household has preferences

$$E_0 \sum_{t=0}^{\infty} \beta^t \frac{\left[c_t - \sum_{j\in\mathcal{S}} (h_t^j)^{\omega_j}/\omega_j\right]^{1-\sigma} - 1}{1-\sigma}, \tag{9}$$

which have no wealth effect on labor supply (Greenwood et al., 1988), so that sectoral labor supply is $w_t^j = (h_t^j)^{\omega_j - 1}$. It owns the capital stocks and borrows abroad with one-period bonds. Its budget constraint, in units of the final good, is

$$c_t + \sum_{j\in\mathcal{S}} \left[i_t^j + \frac{\phi_j}{2}(k_{t+1}^j - k_t^j)^2 \right] + \varpi_t d_t = \varpi_t \frac{d_{t+1}}{1+r_t} + \sum_{j\in\mathcal{S}} \left(w_t^j h_t^j + u_t^j k_t^j \right), \tag{10}$$

where d_t is debt and ϖ_t is the final-good price of the good in which debt is denominated, the world noncommodity import good, the counterpart of the manufactured goods that deflate the commodity price data.

Goods and prices. A final good, used for consumption, investment and adjustment costs, is a CES aggregate of a tradable composite and the nontradable good; the tradable composite aggregates an importable and an exportable composite; and each of these aggregates its commodity and noncommodity components:

$$a_t^m = A\left(a_t^{m_c}, a_t^{m_{\bar{c}}}\right), \quad a_t^x = A\left(a_t^{x_c}, a_t^{x_{\bar{c}}}\right), \quad a_t^\tau = A\left(a_t^m, a_t^x\right), \quad b_t = A\left(a_t^\tau, a_t^n\right), \tag{11}$$

where b_t is the quantity of the final good, each A is a CES function with its own weight and elasticity and a_t^j is the domestic absorption of good j (Appendix C). The final good is the numeraire, and the prices p_t^j of the five goods, in units of the final good, satisfy the cost-minimization conditions of the aggregators. Imports are absorption in excess of production in the importable sectors, and exports are production in excess of absorption in the exportable sectors,

$$m_t = \sum_{j\in\{m_c, m_{\bar{c}}\}} p_t^j (a_t^j - y_t^j), \qquad x_t = \sum_{j\in\{x_c, x_{\bar{c}}\}} p_t^j (y_t^j - a_t^j), \tag{12}$$

nontradables clear domestically, $a_t^n = y_t^n$, and the final good clears, $b_t = c_t + \sum_j [i_t^j + \frac{\phi_j}{2}(k_{t+1}^j - k_t^j)^2]$.

Foreign borrowing. Combining the budget constraint with market clearing and zero profits gives the external constraint

$$\varpi_t \frac{d_{t+1}}{1+r_t} = \varpi_t d_t + m_t - x_t, \tag{13}$$

and the interest rate rises with debt above its steady-state level $\bar{d}$,

$$r_t = r^* + s_t + \psi\left(e^{d_{t+1}-\bar{d}} - 1\right), \tag{14}$$

where s_t is the U.S. spread and ψ governs how fast the interest rate rises with debt.

World prices. The world prices of commodity exports and imports, in units of the world noncommodity import good, are exogenous, and the world price of noncommodity exports in the same units is constant. The domestic price of each tradable good is its world price times

ϖ_t, which is endogenous. The external state is $q_{i,t} = [\tilde{p}_{i,t}^{x_c}, \tilde{p}_{i,t}^{m_c}, s_t]'$, where $\tilde{p}_{i,t}^{x_c}$ and $\tilde{p}_{i,t}^{m_c}$ are the logarithms of the world prices of the country's commodity exports and imports, in deviations from steady state, the model counterparts of the price indices of Section 2, and s_t is the U.S. spread. It follows

$$q_{i,t+1} = A_i q_{i,t} + B_i \varepsilon_{i,t+1}, \tag{15}$$

where A_i and B_i are the external blocks of H_i and P_i estimated in Section 3. The model therefore receives the same innovations, with the same contemporaneous comovement and the same dynamics, as the SVAR, and the common and relative innovations of Section 3 move the external variables in the same way in the model and in the data.

Observables. The model counterparts of the domestic variables of the SVAR are output, consumption and investment at constant (steady-state) prices, the trade balance relative to trend output, and the real exchange rate. The data measure the real exchange rate as $E_t P_t^{US}/P_t$; its model counterpart is ϖ_t, the final-good price of the foreign good, which holds the ratio of the U.S. consumer price index to the world price of manufactures fixed in response to the shocks, a maintained approximation.[2]

Transmission. A common increase in commodity prices raises the value of commodity exports and the cost of commodity imports. At given quantities its effect on income is the net exposure term of equation (4): a gain for net commodity exporters and a loss for net importers. Higher returns in the commodity export sector draw labor and, gradually, capital into it, and absorption shifts away from imported commodities. A relative increase in the export price raises income in every country that exports commodities. The size of these effects depends on the persistence of the price change, on the adjustment costs, and on the cost of borrowing, which ψ governs. Apart from the estimated response of the U.S. spread, the model has no channel through which higher world commodity prices signal stronger world demand or cheaper external finance.

4.2 Equilibrium, Steady State and Calibration

A competitive equilibrium is a set of processes for allocations and prices such that, given the external process (15), the household maximizes (9) subject to (10) and the laws of motion of capital, firms maximize profits, composite-good producers minimize costs, the markets for nontradables and the final good clear, and the external constraint (13) and the interest rate (14) hold.

[2]The MXN model of Schmitt-Grohé and Uribe (2018) measures the real exchange rate by the relative price of tradables. With prices and debt in units of the world noncommodity good, as here, the final-good price of that good is the direct model counterpart of the measured real exchange rate.

The steady state is the deterministic equilibrium with the spread at zero and world commodity prices at their means. The bond Euler equation then requires $\beta(1+r^*)=1$, the rental rate of capital is $u^j = r^* + \delta$ in every sector, debt is at its anchor $\bar{d}$, and the external constraint gives the trade balance $x - m = \frac{r^*}{1+r^*}\varpi\bar{d}$. A trade surplus therefore corresponds to a net debtor and a deficit to a net creditor.

Preferences and technology follow Schmitt-Grohé and Uribe (2018) where the models overlap (Appendix Table 7): $\sigma = 2$, $\delta = 0.10$, $r^* = 0.11$, a Frisch elasticity of about 2.2, capital shares of 0.35 in tradables and 0.25 in nontradables, an elasticity of substitution of 0.5 between tradables and nontradables and of one in the other aggregators. The steady state is calibrated country by country to six moments of the country's own data over its estimation window, which pin down the CES weights and the debt anchor $\bar{d}$. Because services are nontradable in the model, trade is measured by goods trade. The first four moments are commodity exports, noncommodity exports, commodity imports and noncommodity imports relative to GDP. They are obtained from merchandise exports and imports relative to GDP in the World Development Indicators, each divided into its commodity and noncommodity parts with the commodity shares of merchandise exports and imports from UNCTAD's country profiles (UN Trade and Development, 2025). The fifth moment is the services share of value added, which fixes the size of the nontradable sector. The sixth is the goods trade balance, which follows from the trade moments. The trade balance is taken as observed; it is negative in 27 of the 32 countries of the main sample, so those economies are net creditors in the model's steady state, whereas the calibration of Schmitt-Grohé and Uribe (2018) imposes a surplus of 1% of GDP in every country.

As in the MXN model of Schmitt-Grohé and Uribe (2018), tradable output is divided equally between the importable and exportable sectors. Exports therefore cannot exceed half of tradable output, and a steady state exists only if $2X_i/(1-s_{n,i}) < 1$, with X_i goods exports and $s_{n,i}$ the services share. Eleven countries violate this condition: Chile, Costa Rica, Gabon, Malaysia, Mauritius, Mexico, Panama, the Seychelles, South Africa, Thailand and Tunisia, mostly very open economies or re-export hubs (Appendix Table 8). I do not alter their data: they are excluded from the main sample, and Appendix D reports the empirical results including them. For the other 35 countries the calibrated steady state reproduces every target to machine precision; 32 of them have stationary SVARs and form the main sample.

4.3 Solution and Estimation

The model is log-linearized around the steady state and solved with the generalized Schur decomposition (Klein, 2000). For each country, the six parameters $\vartheta_i = (\phi_{m_c}, \phi_{m_{\bar{c}}}, \phi_{x_c}, \phi_{x_{\bar{c}}}, \phi_n, \psi)$ are estimated by the procedure of Schmitt-Grohé and Uribe (2018): they minimize the distance between the model and SVAR responses of the five domestic variables at horizons zero to four. With two prices, the responses to each recursive price innovation depend on which price is ordered first. The targets are therefore the responses to the three innovations of Section 3 that do not depend on that order: the common innovation c and the relative innovation r, which together span the commodity-price block, and the spread innovation s. The loss is

$$L_i(\vartheta) = \sum_{k\in\{c,r,s\}} \sum_{h=0}^{4} \sum_{v} \frac{\left| IR_{i,v}^{M,k}(h;\vartheta) - \widehat{IR}_{i,v}^{k}(h) \right|}{W_{i,v}^{k}(h)}, \tag{16}$$

where $W_{i,v}^{k}(h)$ is the width of the 66% interval of the SVAR response from a residual bootstrap with 10,000 replications, and the spread innovation is scaled to raise the spread by one unit. Because the model receives the SVAR's external process, the same combinations of price innovations produce the common and relative innovations in the model. Each parameter lies in $[10^{-4}, 80]$. The minimization uses the same stochastic search as Schmitt-Grohé and Uribe (2018), with the original settings: 1,000 rounds, each starting from a random point and making 1,000 proposals that perturb the current point multiplicatively and are accepted by a Metropolis rule on the loss; the estimate is the best point found in all rounds.

The model's variance shares are computed as in equation (7), from the model's own dynamics driven by the two price innovations, and divided by the SVAR's total variance, as in Schmitt-Grohé and Uribe (2018). The model and the SVAR are therefore compared on the same object: the variance generated by all of the exogenous variation in the two commodity prices. Because the model receives the SVAR's impact matrix, its block share does not depend on the ordering of the two prices.

5 Model and Data

This section compares the country-calibrated model with the data in the 32 countries of the main sample. It first compares the responses to the two components of the commodity-price block, which the model is estimated to match, and then compares variance shares across countries, the comparison on which the terms-of-trade disconnect of Schmitt-Grohé and Uribe (2018) is defined.

5.1 Impulse Responses

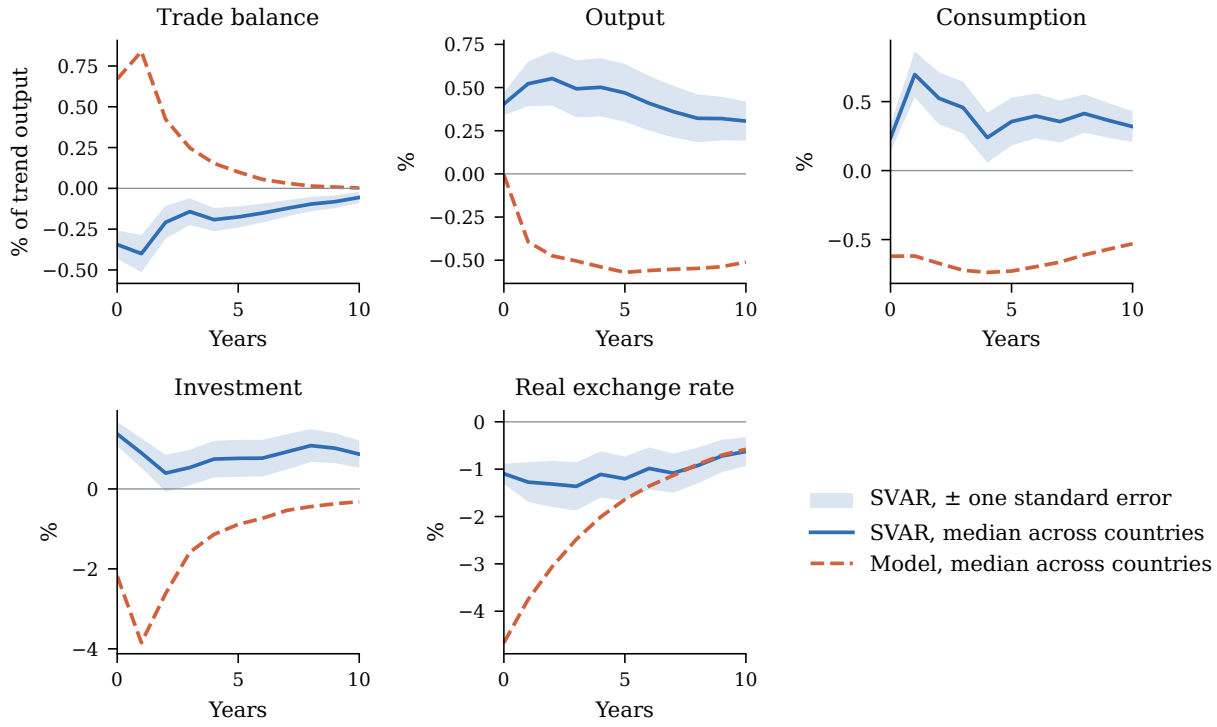

Figure 5: Responses to the common shock, model and SVARs. Median across the 32 countries of the main sample of the responses to the innovation along the first principal component of the two price innovations, scaled to raise the two prices by 10% on average on impact, in the SVARs (solid, with ± one bootstrap standard error of the median) and in the country-calibrated model at its estimated parameters (dashed). Units as in Figure 3.

The estimated model fits the SVAR responses poorly. Its loss, the value of the estimation objective (16) at the estimated parameters, is below the value of the same objective when all model responses are zero in 3 of the 32 countries, and in the median country it is 36% above that benchmark. Several estimates are close to the upper bound of the parameter space (Appendix Table 9): in the median country the adjustment costs in the noncommodity sectors and in nontradables and the debt elasticity ψ are between 70 and 78, against a bound of 80, while the adjustment cost in commodity importables is small, with a median of 4.2. The comparisons below take the model at these estimates.

Figures 5 and 6 compare the median responses of the model and of the SVARs across countries. The model reverses the roles of the two components. After a common increase in commodity prices, output, investment and consumption rise in the data, by 0.4%, 1.37% and 0.24% on impact in the median country, and the trade balance falls by 0.34% of GDP. In the model, output does not rise on impact and is below trend from the first year on,

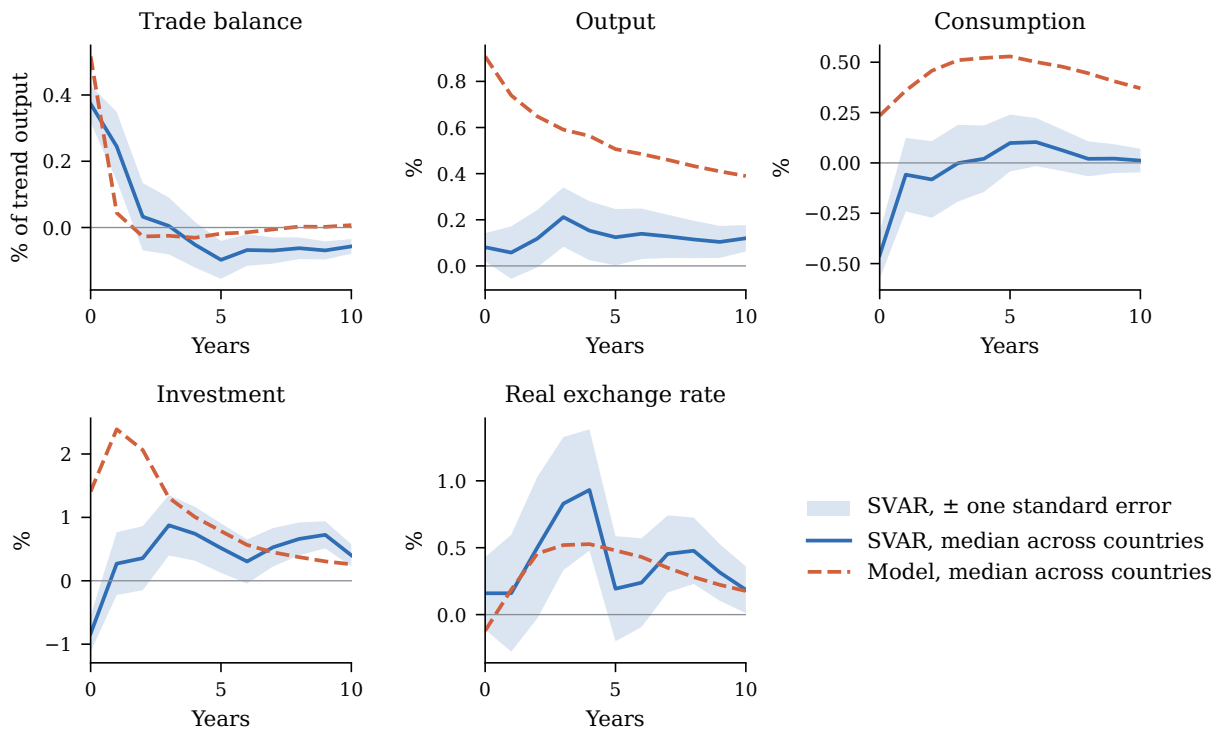

Figure 6: Responses to the relative shock, model and SVARs. As Figure 5, for the innovation along the second principal component, scaled to raise the export price by 10% relative to the import price.

investment falls by 2.2% on impact and by 3.8% after one year, consumption falls by 0.62%, and the trade balance improves by 0.67% of GDP. The real exchange rate appreciates in both, by 4.7% on impact in the model against 1.1% in the data. After a relative increase in the export price, the data show an improvement of the trade balance, by 0.37% of GDP on impact, together with a fall in consumption and investment and almost no change in output. The model reproduces the improvement of the trade balance but raises output by 0.91%, investment by 1.41% and consumption by 0.23% on impact. Across countries, the model's impact response to the common shock has the same sign as the SVAR response in 25% of countries for consumption and 38% for the trade balance.

Two features of the model produce these responses. To isolate the role of the external position, I also estimate the model in the same way under a common calibration at cross-country averages with the trade surplus of 1% of GDP used by Schmitt-Grohé and Uribe (2018), in which every economy is a net debtor (Appendix D). A relative increase in the export price raises the income of commodity exporters at given quantities and draws resources into the export sector, so output and investment rise under both calibrations. The response to a common increase depends on the external position. Under the common calibration the median response to the common shock moves toward the data: output rises by 0.16% on

impact, consumption by 0.04% on impact and 0.21% after five years, and investment, after falling by 1.2% on impact, rises by 0.7% after five years. The real appreciation is almost the same under the two calibrations, 4.7% and 4.6% on impact, so the difference is consistent with a valuation effect: because the net foreign position is denominated in a foreign good, a real appreciation lowers the value of foreign assets for net creditors and the value of debt for net debtors. In the data, the common movement of the two commodity prices is the expansionary component, consistent with the global demand conditions that move commodity prices together, and a pure relative improvement in the terms of trade raises net exports at the expense of consumption and investment.

5.2 Variance Decomposition across Countries

Table 3 reports the variance shares of the commodity-price block in the model and in the SVAR. The model's median shares are close to the SVAR's for the trade balance, consumption, investment and the real exchange rate, and about twice the SVAR's for output (61.6% against 30.4%). Agreement in the medians, however, does not address the disconnect, which concerns the ranking of countries. The model's shares are also dispersed: its output share exceeds the SVAR's total output variance (a share above 100) in 9 of the 32 countries.

Table 3: Variance shares: country-calibrated model and SVAR

	Median share		Correlation across countries		
	SVAR	Model	Pearson	Spearman	90% interval (Spearman)
Trade balance	34.5	25.6	−0.21	−0.12	[−0.40, 0.17]
Output	30.4	61.6	−0.03	−0.24	[−0.54, 0.10]
Consumption	28.4	29.1	−0.22	−0.23	[−0.53, 0.11]
Investment	28.0	31.2	0.08	0.10	[−0.25, 0.44]
Real exchange rate	33.1	27.9	−0.02	−0.02	[−0.29, 0.29]
Median across variables	30.4	29.1	0.02	−0.01	[−0.37, 0.36]

Notes: Shares (%) of the unconditional variance of each domestic variable due to the two commodity-price innovations, in the SVAR and in the country-calibrated model, both divided by the SVAR's total variance; medians across the 32 countries of the main sample. Correlations are across these countries; the interval for the Spearman rank correlation is the 5th to 95th percentile over 2,000 bootstrap resamples of countries. Median across variables: median of the five median shares, and correlations of each country's median share over the five variables.

The disconnect is not closed. Across countries, the Spearman rank correlation between model and SVAR shares, the correlation between the countries' ranks under the two measures, is -0.24 for output, with a 90% interval of $[-0.54, 0.1]$, and -0.01 for each country's median share across the five variables, with an interval of $[-0.37, 0.36]$. The Pearson correlations are

between −0.22 and 0.08. Every interval contains zero: the model's shares are not significantly related to the SVAR's for any variable, and the rank correlations are negative for all variables but investment (Figure 7). The common calibration does no better, with rank correlations of −0.36 for output, whose interval excludes zero, and −0.14 for the median share (Appendix Table 12).

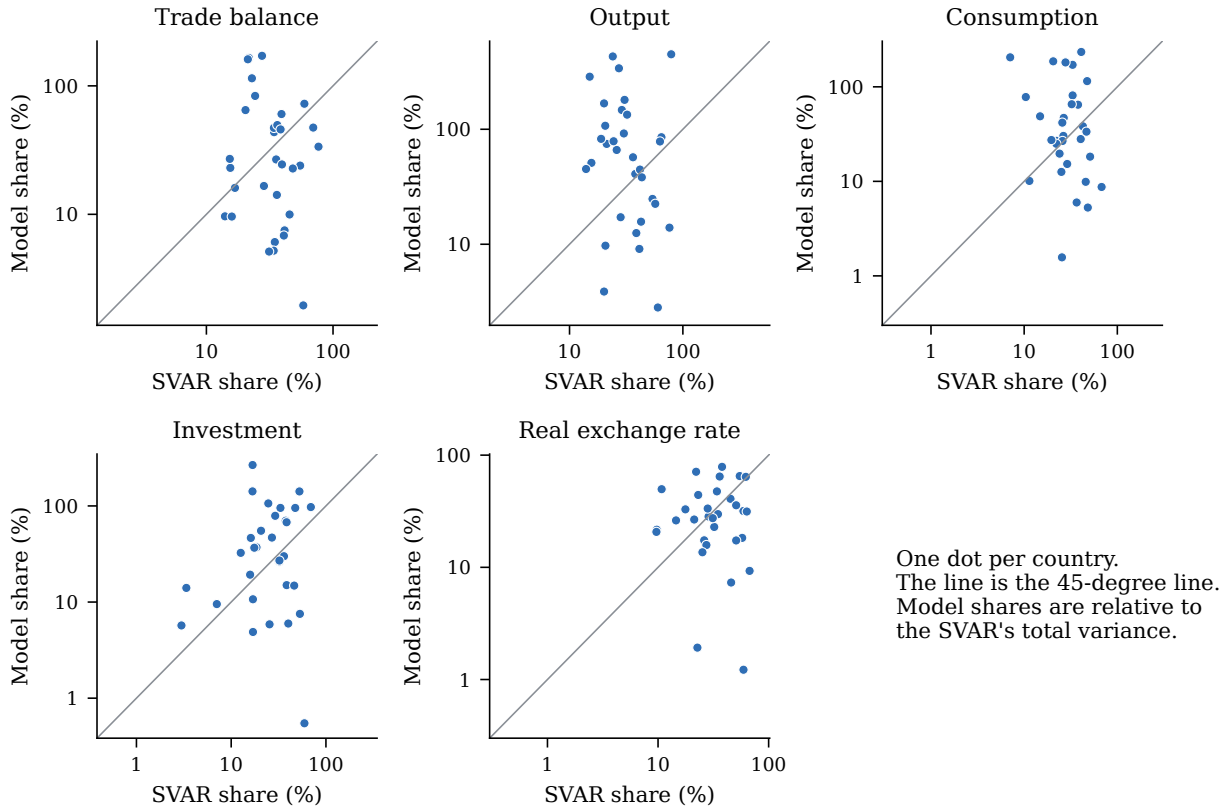

Figure 7: Variance shares, model and SVAR. Share of the variance of each domestic variable due to the commodity-price block, one dot per country of the main sample (log scales). Model shares are divided by the SVAR's total variance and can exceed 100. The line is the 45-degree line.

The model and the data rank countries by different characteristics. Across the 32 countries, the model's median share is higher where commodity imports are larger relative to GDP (rank correlation 0.39, with a 90% interval of $[0.1, 0.61]$), whereas the SVAR's median share is lower there (-0.42, $[-0.63, -0.15]$). The SVAR's median share is higher where net commodity exports are larger (0.37, $[0.09, 0.59]$), and the model's shares are not significantly related to them (-0.16, $[-0.45, 0.15]$). The two are related to the trade balance with opposite signs, negatively in the model (-0.24, $[-0.51, 0.06]$) and positively in the SVAR (0.31, $[-0.01, 0.59]$), but neither correlation is significant. Under the common calibration the model's correlations with commodity imports and with the trade balance have the same signs (0.21 and -0.28)

and are not significant. Commodity imports are goods imports relative to GDP multiplied by the commodity share of goods imports (Appendix Table 8); the intervals are the 5th to 95th percentiles over 2,000 bootstrap resamples of countries. In the model, a common price increase raises the cost of commodity imports, and its effects are largest where these imports are large. In the data, the countries most affected by commodity prices are net commodity exporters, consistent with a common increase being expansionary.

Taken together, the comparison identifies three sources of the disconnect. The country-level SVAR shares are imprecise, which limits any cross-country comparison. The model transmits the two components of commodity-price shocks differently from the data: its response to the relative component is expansionary under both the country and the common calibration, whereas in the data that component lowers consumption and investment, and its response to the common component depends on the calibrated external position, whereas in the data that component is expansionary. And the two rank countries in opposite ways: the model's shares rise with commodity imports relative to GDP, whereas the SVAR's shares fall with them and rise with net commodity exports.

6 Conclusion

In most poor and emerging economies, the main source of exogenous variation in export and import prices is the movement of world commodity prices, and the commodity export and import prices of these economies move closely together, a common movement that a ratio of the two largely removes. Measuring external price shocks with country-specific commodity export and import price indices, treated as separate external variables, raises their estimated contribution to business cycles, in the recursive design of Schmitt-Grohé and Uribe (2018), from about 10% of the variance of domestic variables to about 30%, in line with the magnitudes implied by calibrated models. The commodity terms of trade, the ratio of the same two prices, account for about 13%: a ratio discards most of the common movement of the two prices, which is the larger part of the contribution of commodity prices. A common increase in commodity prices raises output, investment and consumption, a result that panel local projections confirm with considerable precision, whereas a relative increase in the export price raises net exports and lowers consumption and investment.

The multisector small open economy model, extended to distinguish commodity from noncommodity trade, fed with each country's estimated price process and calibrated to its trade, trade balance and sectoral structure, does not close the terms-of-trade disconnect; with the price shocks better measured, part of the remaining discrepancy is attributable to the model's transmission mechanism. Country calibration brings the model's median

shares close to the SVAR's for most variables, but the cross-country correlations remain near zero or negative both under this country calibration and under a common calibration in which every economy is a net debtor. The model attributes the largest effects of commodity prices to economies with large commodity imports, the data to net commodity exporters. The model also transmits the two components of commodity-price shocks differently from the data. The model's response to a relative increase in the export price is expansionary under both the country and the common calibration, whereas in the data consumption and investment fall. The model's response to a common commodity boom depends on the calibrated external position. Under the country calibration, whose observed trade balances make most economies net creditors, consumption and investment fall, while in the data they rise. Under the common calibration, in which every economy is a net debtor, consumption rises and investment rises from the third year on, but investment falls on impact. Under both calibrations the real exchange rate appreciates much more than in the data.

The results point to the elements of the transmission mechanism that the model lacks. World commodity prices have to carry information about the forces that move them, so that a rise in the prices a country pays for its imports can come with stronger demand for what it sells or easier access to credit, as in models in which commodity prices affect borrowing conditions (Drechsel and Tenreyro, 2018; Fernández et al., 2018). Two further extensions are natural. Many commodities enter production as intermediate inputs far from final use, in the sense of the upstreamness measure used by Antràs and Chor (2013), so that changes in their prices are transmitted along domestic production chains as well as through trade. In addition, fiscal policy is procyclical in many developing economies (Alesina et al., 2008), and where public revenue depends on commodities, price changes affect government demand directly. Building such a model and estimating it on the more precise panel evidence is left for future work. The systematic relation between net commodity positions and the effects of commodity prices is also relevant for the assessment of commodity-price risk in these economies.

A Data

This appendix describes the data. The data cover an annual panel of 46 emerging market and developing economies over 1980–2023; the main sample consists of the 32 of them for which both the SVAR and the model are defined (Section 2). The 46 countries are Algeria, Bangladesh, Benin, Bolivia, Brazil, Burkina Faso, Cameroon, Central African Republic, Chad, Chile, China, Colombia, Costa Rica, Dominican Republic, Ecuador, Egypt, El Salvador, Gabon, Gambia, Ghana, Guatemala, Guinea-Bissau, India, Kenya, Madagascar, Malaysia, Mali, Mauritius, Mexico, Morocco, Niger, Pakistan, Panama, Paraguay, Peru, Philippines,

Senegal, Seychelles, South Africa, Tanzania, Thailand, Togo, Tunisia, Türkiye, Uganda, and Uruguay. Each country must have at least 30 consecutive years with complete data on the commodity export-price index, the commodity import-price index, the net barter terms of trade, the trade balance, output, consumption, investment, the real exchange rate, and the U.S. spread; the estimation uses the country's longest such window.

A.1 Sources and Variable Construction

The commodity export- and import-price indices are from the IMF Commodity Terms-of-Trade database of Gruss and Kebhaj (2019), retrieved from the IMF SDMX API (dataflow `IMF.RES:CTOT`, weight type `H_RW_IX`). This is the historical rolling-weights variant, in which the weights are lagged three-year rolling averages of trade shares as in equations (2)–(3). The indices aggregate world commodity prices using country-specific commodity trade weights. The commodity terms of trade used in the descriptive comparisons is the ratio of the commodity export-price index to the commodity import-price index.

Macroeconomic variables are from the World Development Indicators release current as of July 2026. Output is real GDP per capita in constant local currency units. Consumption and investment are constructed by multiplying the corresponding WDI shares of GDP by real GDP per capita. They therefore measure spending deflated by the GDP deflator, which differs from volume indices built with component-specific deflators. The trade balance is constructed as exports minus imports, using WDI exports and imports of goods and services as shares of GDP multiplied by real GDP per capita. The net barter terms of trade is the WDI index. The calibration of the model uses goods trade only, because services are nontradable in the model: merchandise exports and imports in current U.S. dollars divided by GDP in current U.S. dollars, averaged over each country's estimation window. The nominal exchange rate is the period-average local-currency price of the U.S. dollar, and the domestic price level is the WDI consumer price index, normalized to 2010 = 100.

The real exchange rate is constructed as

$$RER_{i,t} = NER_{i,t}\frac{P_t^{US}}{P_{i,t}}, \tag{17}$$

where $NER_{i,t}$ is local currency per U.S. dollar, P_t^{US} is the U.S. CPI, and $P_{i,t}$ is the domestic CPI. The U.S. CPI and the Moody's Baa minus federal funds spread are from FRED. Monthly U.S. series are converted to annual averages. The interest-rate spread is expressed as a decimal and is common across countries.

Table 4: World Development Indicators used in the analysis

Object	World Development Indicators series	Code
Output	GDP per capita, constant LCU	NY.GDP.PCAP.KN
Consumption	Household and NPISH consumption, % of GDP	NE.CON.PRVT.ZS
Investment	Gross capital formation, % of GDP	NE.GDI.TOTL.ZS
Imports	Imports of goods and services, % of GDP	NE.IMP.GNFS.ZS
Exports	Exports of goods and services, % of GDP	NE.EXP.GNFS.ZS
Services	Services value added, % of GDP	NV.SRV.TOTL.ZS
Exchange rate	Official exchange rate, LCU per U.S. dollar	PA.NUS.FCRF
Price level	Consumer price index, 2010=100	FP.CPI.TOTL
Net barter ToT	Net barter terms-of-trade index, 2000=100	TT.PRI.MRCH.XD.WD
Goods exports	Merchandise exports, current U.S. dollars	TX.VAL.MRCH.CD.WT
Goods imports	Merchandise imports, current U.S. dollars	TM.VAL.MRCH.CD.WT
GDP, dollars	GDP, current U.S. dollars	NY.GDP.MKTP.CD

Table 5: Commodity inventory and underlying detailed price series

Category	Commodity	Detailed price series
Agricultural raw materials	Cotton	Cotton Outlook A Index, Middling 1-3/32 inch staple, CIF Liverpool, U.S. cents per pound.
	Hard logs	Best-quality Malaysian meranti, import price Japan, U.S. dollars per cubic meter.
	Hard sawnwood	Dark Red Meranti, select and better quality, C&F U.K. port, U.S. dollars per cubic meter.
	Hides	Heavy native steers over 53 pounds, wholesale dealer price, Chicago, f.o.b. shipping point, U.S. cents per pound.
	Natural rubber	Singapore Commodity Exchange No. 3 Rubber Smoked Sheets, first contract, U.S. cents per pound.
	Soft logs	Average U.S. export price for Douglas fir, U.S. dollars per cubic meter.
	Soft sawnwood	Average U.S. export price of Douglas fir, U.S. dollars per cubic meter.
	Wool	Wool index, including coarse- and fine-wool price indices.
Energy	Coal	Australian thermal coal, 12,000 Btu per pound, less than 1% sulfur and 14% ash, f.o.b. Newcastle/Port Kembla, U.S. dollars per metric ton.
	Crude oil	Crude-oil price index, simple average of Dated Brent, West Texas Intermediate, and Dubai Fateh spot prices.
	Natural gas	Natural-gas price index combining European, Japanese, and U.S. price indices.

Continued on next page

Table 5 continued

Category	Commodity	Detailed price series
Food and beverages	Bananas	Central American and Ecuadorian bananas, f.o.b. U.S. ports, U.S. dollars per metric ton.
	Barley	Canadian No. 1 Western barley, spot price, U.S. dollars per metric ton.
	Beef	Australian and New Zealand 85% lean fores, CIF U.S. import price, U.S. cents per pound.
	Chicken	Whole-bird spot price, ready-to-cook and iced, Georgia docks, U.S. cents per pound.
	Cocoa	Cocoa beans, International Cocoa Organization cash price, CIF U.S. and European ports, U.S. dollars per metric ton.
	Coffee	Coffee price index combining Other Mild Arabicas and Robusta.
	Corn	U.S. No. 2 yellow maize, f.o.b. Gulf of Mexico, U.S. dollars per metric ton.
	Fish	Farm-bred Norwegian salmon export price, U.S. dollars per kilogram.
	Fish meal	Peru fishmeal/pellets, 65% protein, CIF, U.S. dollars per metric ton.
	Groundnuts	Peanuts, 40/50 count per ounce, CIF Argentina, U.S. dollars per metric ton.
	Lamb	Frozen lamb carcass, Smithfield London, U.S. cents per pound.
	Oranges	Miscellaneous oranges, CIF French import price, U.S. dollars per metric ton.
	Palm oil	Malaysian palm-oil futures, first contract forward, 4–5% FFA, U.S. dollars per metric ton.
	Rice	5%-broken milled white rice, Thailand nominal price quote, U.S. dollars per metric ton.
	Shrimp	No. 1 shell-on headless shrimp, 26–30 count per pound, Mexican origin, New York port, U.S. dollars per kilogram.
	Soybean meal	Chicago soybean-meal futures, first contract forward, minimum 48% protein, U.S. dollars per metric ton.
	Soybean oil	Chicago soybean-oil futures, first contract forward, exchange-approved grades, U.S. dollars per metric ton.
	Soybeans	Chicago soybean futures, first contract forward, U.S. No. 2 yellow and par, U.S. dollars per metric ton.
	Sugar	Free-market sugar, Coffee, Sugar and Cocoa Exchange contract No. 11, nearest future, U.S. cents per pound.
	Sunflower-seed oil	U.S. export price from the Gulf of Mexico, U.S. dollars per metric ton.

Continued on next page

Table 5 continued

Category	Commodity	Detailed price series
	Tea	Mombasa, Kenya auction price, best Pekoe Fannings; earlier observations use London auctions, CIF U.K. warehouses, U.S. cents per kilogram.
	Wheat	U.S. No. 1 hard red winter wheat, ordinary protein, Kansas City, U.S. dollars per metric ton.
Metals	Aluminum	Minimum 99.5% purity, LME spot price, CIF U.K. ports, U.S. dollars per metric ton.
	Copper	Grade A cathode, LME spot price, CIF European ports, U.S. dollars per metric ton.
	Iron ore	China import iron-ore fines, 62% Fe, spot CFR Tianjin, U.S. dollars per metric ton.
	Lead	99.97% pure, LME spot price, CIF European ports, U.S. dollars per metric ton.
	Nickel	Melting grade, LME spot price, CIF European ports, U.S. dollars per metric ton.
	Tin	Standard grade, LME spot price, U.S. dollars per metric ton.
	Zinc	High grade, 98% pure, U.S. dollars per metric ton.

Notes: The inventory lists the 40 commodities of the annual indices of Gruss and Kebhaj (2019). Their monthly database, which starts in 1980, also includes gold, olive oil, pork, rapeseed oil and uranium, for which annual international prices or trade data are not available over the full period. The country indices aggregate these international price series using the predetermined trade weights in equations (2)–(3). Source: IMF Commodity Terms-of-Trade database and Gruss and Kebhaj (2019).

A.2 Deflation and Detrending

The IMF commodity-price series are already real world-price indices in the sense that the underlying U.S.-dollar commodity prices are deflated by the IMF manufactured-export unit-value index before aggregation. I use them as published. They measure world commodity prices in units of manufactured goods. This is the unit of the model's exogenous commodity prices, which are defined relative to the world price of noncommodity imports. All strictly positive price and quantity variables enter the SVAR as log deviations from a country-specific quadratic trend. The trade balance is treated separately because it can be negative: it is first expressed relative to trend output and then quadratically detrended in levels. The U.S. interest-rate spread is detrended in levels. Following Schmitt-Grohé and Uribe (2018), each trend is fitted on the longest span over which the series is available for that country, and the detrended series are then restricted to the country's estimation window. The same transformations are used for the descriptive statistics, the SVARs, and the model-matching exercise so that the empirical and theoretical moments refer to the same objects.

A.3 Sample Construction

The starting country universe is the 155 economies classified as emerging market and developing in the April 2024 World Economic Outlook (International Monetary Fund, 2024), as listed in its Statistical Appendix. Membership in the broad descriptive sample is then determined by data availability. Korea, which belongs to the 38-country sample of Schmitt-Grohé and Uribe (2018), is outside this universe because the IMF classifies it as an advanced economy. A country is retained in the main analysis only if all required variables are observed for at least 30 consecutive years between 1980 and 2023. This produces 46 countries. Of these, eleven have goods exports that exceed the output the model's exportable sector can produce when tradable output is divided equally between importables and exportables (Chile, Costa Rica, Gabon, Malaysia, Mauritius, Mexico, Panama, the Seychelles, South Africa, Thailand and Tunisia; Section 4), and three have a joint SVAR with an estimated root on or outside the unit circle (India, Tanzania and Uruguay). The remaining 32 form the main sample, used for all results in the main text; Appendix D reports the empirical results for all 46.

Requiring the full 44 years would leave 30 countries and drop most of sub-Saharan Africa, whose national accounts typically start later. A 30-year minimum keeps the samples long enough for the eight-variable SVAR with one lag while covering a broader set of commodity-dependent economies. The structural model is estimated against each country's SVAR responses over its own window.

A.4 The Data Set of Schmitt-Grohé and Uribe (2018)

Section 3 also uses the data set distributed with Schmitt-Grohé and Uribe (2018): annual detrended series for 38 countries over 1980 to at most 2011, with the terms of trade, the trade balance, output, consumption, investment, the real exchange rate and the U.S. spread, together with their estimated variance shares. For the commodity-price block on their sample, I take the IMF indices for the 37 of their countries that the database covers, compute the log of each index, and remove a quadratic trend fitted on all available years up to the last year of the country's window, as Schmitt-Grohé and Uribe (2018) do for the terms of trade. All other series and the estimation windows are theirs.

B Granger Causality from the Domestic Variables to the Price Indices

Table 6: Granger causality from the domestic variables to the price indices, large producers

		Export price index		Import price index	
Country	Large world share in	1 lag	2 lags	1 lag	2 lags
Brazil	Soybeans, sugar, iron ore	0.59	0.83	0.43	0.37
China	Coal	0.74	0.11	0.46	0.40
Niger	Uranium	0.10	0.13	0.59	0.04
Peru	Fish meal	0.09	0.04	0.05	0.04

Notes: Bootstrap p-values of the Wald test that the lags of the five detrended domestic variables (trade balance, output, consumption, investment and real exchange rate) do not enter the equation of the commodity export or import price, with one or two lags of all variables, over each country's estimation window; 999 replications of a wild bootstrap under the null. Countries: main-sample countries with one of the ten largest world export shares in a commodity category over 2000 to 2015 (Gruss and Kebhaj, 2019, Figure 7).

The SVARs exclude lagged domestic variables from the equations of the two commodity prices. Large producers or consumers of a commodity are the economies for which this exclusion is most in doubt. I test it for the main-sample countries that appear among the ten largest country–commodity shares of world exports in any of the four commodity categories of Gruss and Kebhaj (2019, Figure 7): Brazil, China, Niger and Peru. China is also among the largest importers of metals and energy. For each of these countries, over its estimation window and with the detrended series of the SVAR, each commodity price is regressed on a constant, K lags of the external block (the two prices and the spread) and K lags of the five domestic variables, and W is the Wald statistic for the exclusion of the domestic lags, with $5K$ restrictions. Because the series are short and persistent, the p-values are obtained by a wild bootstrap under the null hypothesis: 999 artificial samples are generated by the country's estimated SVAR, which excludes the domestic lags from the price equations, with the centered residuals multiplied by Rademacher signs, and the p-value is the share of bootstrap statistics at least as large as W.

Table 6 reports the results. Brazil and China show no Granger causality: their p-values are between 0.11 and 0.83 for both indices, with one or two lags. Niger rejects only for its import index with two lags, and its large world share is in uranium, an export that the annual indices do not include. Peru's p-values are between 0.04 and 0.09, below 5% in two of the four specifications, but its large share is in fish meal, a small part of its commodity

exports. In neither case do the rejections involve a market in which the country is large. The tests cannot detect effects of domestic conditions on the prices within the year, which the construction of the indices addresses.

C Model

This appendix states the conditions of the MXN-C model: those of the household, the aggregators and the firms, the market-clearing conditions and the external constraint, and the exogenous processes. It then defines the competitive equilibrium, the steady state and the calibration. The notation follows Section 4. Let $\mathcal{S} = \{m_c, m_{\bar{c}}, x_c, x_{\bar{c}}, n\}$ denote the five production sectors.

C.1 Household Conditions

Let

$$\Lambda_t = \left[c_t - \sum_{j \in \mathcal{S}} \frac{(h_t^j)^{\omega_j}}{\omega_j} \right]^{-\sigma}$$

denote the marginal utility of consumption. Define the budget residual

$$\begin{aligned} \mathcal{B}_t =& \varpi_t \frac{d_{t+1}}{1+r_t} + \sum_{j \in \mathcal{S}} w_t^j h_t^j + \sum_{j \in \mathcal{S}} u_t^j k_t^j + T_t - c_t - \sum_{j \in \mathcal{S}} i_t^j \\ & - \sum_{j \in \mathcal{S}} \frac{\phi_j}{2} (k_{t+1}^j - k_t^j)^2 - \varpi_t d_t, \end{aligned} \tag{18}$$

and the capital-law residual $\mathcal{K}_t^j = (1-\delta)k_t^j + i_t^j - k_{t+1}^j$. The household problem can then be represented by the Lagrangian

$$\mathcal{L} = E_0 \sum_{t=0}^{\infty} \beta^t \left[U(c_t, \{h_t^j\}_{j \in \mathcal{S}}) + \lambda_t \mathcal{B}_t + \sum_{j \in \mathcal{S}} q_t^j \mathcal{K}_t^j \right], \tag{19}$$

where q_t^j is the multiplier on the sectoral capital law. The household takes the country interest rate as given when choosing debt; the debt-elastic premium is imposed as an equilibrium pricing condition. Differentiating with respect to consumption gives $\lambda_t = \Lambda_t$. Differentiating with respect to labor and using $\lambda_t = \Lambda_t$ gives the sectoral labor-supply condition below. The investment and capital-stock first-order conditions can be combined to eliminate q_t^j, yielding the capital Euler equation. The resulting household first-order conditions are

$$\lambda_t = \Lambda_t, \tag{20}$$

$$w_t^j = (h_t^j)^{\omega_j - 1}, \qquad j \in \mathcal{S}, \tag{21}$$

$$\lambda_t \varpi_t = \beta(1 + r_t) E_t \lambda_{t+1} \varpi_{t+1}, \tag{22}$$

$$\lambda_t \left[1 + \phi_j(k_{t+1}^j - k_t^j)\right] = \beta E_t \lambda_{t+1} \left[u_{t+1}^j + 1 - \delta + \phi_j(k_{t+2}^j - k_{t+1}^j)\right], \qquad j \in \mathcal{S}, \tag{23}$$

$$k_{t+1}^j = (1 - \delta) k_t^j + i_t^j, \qquad j \in \mathcal{S}. \tag{24}$$

Here u_t^j is the rental rate of capital in sector j, $\varpi_t = \bar{p}^\tau p_t^{m_{\bar{c}}} / \bar{p}^{m_{\bar{c}}}$ is the final-good price of the foreign unit in which debt is denominated (normalized to equal $\bar{p}^\tau$ in steady state), and T_t is a lump-sum transfer, which is zero in the model estimated here.

Equation (22) is the intertemporal Euler equation for the foreign bond. A higher country interest rate raises the return to postponing consumption, while movements in ϖ_t convert that return into final-good units. Equation (23) equates the marginal cost of installing sector-j capital today to the discounted value of tomorrow's rental return, undepreciated capital, and the saving in future adjustment costs.

C.2 Aggregators and Price Indices

The importable and exportable composites are

$$a_t^m = \left[\chi_{m,c}(a_t^{m_c})^{1-1/\mu_m} + (1 - \chi_{m,c})(a_t^{m_{\bar{c}}})^{1-1/\mu_m}\right]^{\frac{1}{1-1/\mu_m}}, \tag{25}$$

$$a_t^x = \left[\chi_{x,c}(a_t^{x_c})^{1-1/\mu_x} + (1 - \chi_{x,c})(a_t^{x_{\bar{c}}})^{1-1/\mu_x}\right]^{\frac{1}{1-1/\mu_x}}. \tag{26}$$

The tradable and final-good composites are

$$a_t^\tau = \left[\chi_m(a_t^m)^{1-1/\mu_{mx}} + (1 - \chi_m)(a_t^x)^{1-1/\mu_{mx}}\right]^{\frac{1}{1-1/\mu_{mx}}}, \tag{27}$$

$$b_t = \left[\chi_\tau(a_t^\tau)^{1-1/\mu_{\tau n}} + (1 - \chi_\tau)(a_t^n)^{1-1/\mu_{\tau n}}\right]^{\frac{1}{1-1/\mu_{\tau n}}}. \tag{28}$$

The associated price-index first-order conditions are

$$p_t^{m_c} = p_t^m \frac{\partial a_t^m}{\partial a_t^{m_c}}, \qquad p_t^{m_{\bar{c}}} = p_t^m \frac{\partial a_t^m}{\partial a_t^{m_{\bar{c}}}}, \tag{29}$$

$$p_t^{x_c} = p_t^x \frac{\partial a_t^x}{\partial a_t^{x_c}}, \qquad p_t^{x_{\bar{c}}} = p_t^x \frac{\partial a_t^x}{\partial a_t^{x_{\bar{c}}}}, \tag{30}$$

$$p_t^m = p_t^\tau \frac{\partial a_t^\tau}{\partial a_t^m}, \qquad p_t^x = p_t^\tau \frac{\partial a_t^\tau}{\partial a_t^x}, \tag{31}$$

$$p_t^\tau = \frac{\partial b_t}{\partial a_t^\tau}, \qquad p_t^n = \frac{\partial b_t}{\partial a_t^n}. \tag{32}$$

For a generic two-input CES aggregator

$$A_t = \left[\chi a_{1,t}^{1-1/\mu} + (1-\chi) a_{2,t}^{1-1/\mu}\right]^{\frac{1}{1-1/\mu}}, \tag{33}$$

cost minimization by a competitive composite-good producer implies

$$p_{1,t} = P_t \chi \left(\frac{a_{1,t}}{A_t}\right)^{-1/\mu}, \qquad p_{2,t} = P_t (1-\chi) \left(\frac{a_{2,t}}{A_t}\right)^{-1/\mu}, \tag{34}$$

where P_t is the price of the composite. Equations (29)–(32) are repeated applications of (34). These conditions are also the zero-profit restrictions that define the relative price indices in the model. At the calibrated unit elasticities ($\mu_m = \mu_x = \mu_{mx} = 1$), where the CES form in (33) is not defined, the aggregators are implemented as their Cobb–Douglas limits, $A_t = a_{1,t}^{\chi} a_{2,t}^{1-\chi}$, with the corresponding first-order conditions $p_{1,t} a_{1,t} = \chi P_t A_t$ and $p_{2,t} a_{2,t} = (1-\chi) P_t A_t$.

C.3 Firms, Goods Markets, and External Balance

Production in each sector is

$$y_t^j = Z_t^j (k_t^j)^{\alpha_j} (h_t^j)^{1-\alpha_j}, \qquad j \in \mathcal{S}. \tag{35}$$

Profit maximization implies

$$u_t^j = \alpha_j p_t^j Z_t^j (k_t^j)^{\alpha_j - 1} (h_t^j)^{1-\alpha_j}, \qquad j \in \mathcal{S}, \tag{36}$$

$$w_t^j = (1-\alpha_j) p_t^j Z_t^j (k_t^j)^{\alpha_j} (h_t^j)^{-\alpha_j}, \qquad j \in \mathcal{S}, \tag{37}$$

and final-good market clearing is

$$b_t = c_t + \sum_{j \in \mathcal{S}} i_t^j + \sum_{j \in \mathcal{S}} \frac{\phi_j}{2} (k_{t+1}^j - k_t^j)^2. \tag{38}$$

Composite-good definitions require a_t^m, a_t^x, a_t^τ, and b_t to satisfy equations (25)–(28). Non-tradables clear domestically,

$$a_t^n = y_t^n. \tag{39}$$

Imports and exports are

$$m_t = m_t^c + m_t^{\bar{c}}, \qquad m_t^c = p_t^{m_c}(a_t^{m_c} - y_t^{m_c}), \qquad m_t^{\bar{c}} = p_t^{m_{\bar{c}}}(a_t^{m_{\bar{c}}} - y_t^{m_{\bar{c}}}), \tag{40}$$

$$x_t = x_t^c + x_t^{\bar{c}}, \qquad x_t^c = p_t^{x_c}(y_t^{x_c} - a_t^{x_c}), \qquad x_t^{\bar{c}} = p_t^{x_{\bar{c}}}(y_t^{x_{\bar{c}}} - a_t^{x_{\bar{c}}}). \tag{41}$$

The bond law of motion and country premium are

$$\varpi_t \frac{d_{t+1}}{1+r_t} = \varpi_t d_t + m_t - x_t, \tag{42}$$

$$r_t = r^* + s_t + \psi\left(\exp(d_{t+1} - \bar{d}) - 1\right). \tag{43}$$

The commodity terms of trade and aggregate terms of trade are

$$tot_t^c = \frac{p_t^{x_c}}{p_t^{m_c}}, \qquad tot_t = \frac{p_t^x}{p_t^m}. \tag{44}$$

The external constraint. The household sequential budget constraint can be written as

$$c_t + \sum_{j\in\mathcal{S}} i_t^j + \sum_{j\in\mathcal{S}} \frac{\phi_j}{2}(k_{t+1}^j - k_t^j)^2 + \varpi_t d_t = \varpi_t \frac{d_{t+1}}{1+r_t} + \sum_{j\in\mathcal{S}} w_t^j h_t^j + \sum_{j\in\mathcal{S}} u_t^j k_t^j + T_t. \tag{45}$$

Zero profits give $\sum_j (w_t^j h_t^j + u_t^j k_t^j) + T_t = \sum_j p_t^j y_t^j$. The final good is the numeraire. Zero profits in aggregation, final-good market clearing, and the definitions of trade therefore imply

$$c_t + \sum_j i_t^j + \sum_j \frac{\phi_j}{2}(k_{t+1}^j - k_t^j)^2 = \sum_j p_t^j a_t^j = \sum_j p_t^j y_t^j + m_t - x_t, \tag{46}$$

where nontradables clear domestically and exports equal domestic exportable production net of domestic exportable absorption. Substituting this expression into the household budget constraint and collecting the external-trade terms yields

$$\varpi_t \frac{d_{t+1}}{1+r_t} = \varpi_t d_t + m_t - x_t,$$

which is equation (13) in the main text.

C.4 Exogenous Processes and Observables

The external process is equation (15). Its three states are the two world commodity prices and the spread, and its transition and impact matrices equal the empirical external block. Sectoral TFP states have zero persistence and innovation variance in these experiments; they contribute no variation.

World prices are expressed in units of the world noncommodity import good. The logarithms of the world commodity prices, $\tilde{p}_t^{x_c} = \log(p_t^{x_c}/p_t^{m_{\bar{c}}})$ and $\tilde{p}_t^{m_c} = \log(p_t^{m_c}/p_t^{m_{\bar{c}}})$, follow the external process, and the relative world price of noncommodity exports is constant, $p_t^{x_{\bar{c}}}/p_t^{m_{\bar{c}}} = \overline{tot}_{\bar{c}}$. The final-good price of noncommodity imports, and hence ϖ_t, is determined

in equilibrium.

The model counterparts of the observed variables are

$$y_t = \sum_{j \in \mathcal{S}} p_t^j y_t^j, \tag{47}$$

$$i_t = \sum_{j \in \mathcal{S}} i_t^j, \tag{48}$$

$$y_t^0 = \sum_{j \in \mathcal{S}} \bar{p}^j y_t^j, \tag{49}$$

$$c_t^0 = c_t \frac{y_t^0}{y_t}, \qquad i_t^0 = i_t \frac{y_t^0}{y_t}, \tag{50}$$

$$tb_t = \frac{x_t - m_t}{y_t} \frac{y_t^0}{\bar{y}}. \tag{51}$$

The real exchange rate is the final-good price of noncommodity imports, $rer_t = p_t^{m_{\bar{c}}}$ (Section 4).

These definitions follow how the data are measured. The SVAR output series is real GDP per capita; consumption and investment are expenditures deflated by the GDP deflator, expressed as log deviations from quadratic trends. Their model counterparts are therefore the constant-price objects y_t^0, c_t^0, and i_t^0. The trade balance is not logged in either the model or the data; it is expressed relative to trend output. The model object tb_t in (51) follows that same scale.

C.5 Competitive Equilibrium

Given initial debt d_0, initial sectoral capital stocks $\{k_0^j\}_{j \in \mathcal{S}}$, and stochastic processes for commodity prices and the U.S. spread, a competitive equilibrium is a sequence of household allocations

$$\{c_t, h_t^j, i_t^j, k_{t+1}^j, d_{t+1}\}_{j \in \mathcal{S}, t \geq 0},$$

firm allocations

$$\{y_t^j, k_t^j, h_t^j\}_{j \in \mathcal{S}, t \geq 0},$$

composite-good allocations

$$\{a_t^{m_c}, a_t^{m_{\bar{c}}}, a_t^{x_c}, a_t^{x_{\bar{c}}}, a_t^m, a_t^x, a_t^\tau, a_t^n, b_t\}_{t \geq 0},$$

and prices

$$\{p_t^j, p_t^m, p_t^x, p_t^\tau, p_t^n, w_t^j, u_t^j, r_t\}_{j \in \mathcal{S}, t \geq 0}$$

such that the household maximizes expected utility subject to its budget constraint and capital laws of motion (Appendix C.1), composite-good producers minimize expenditure subject to the CES aggregators (Appendix C.2), firms maximize profits in each sector, nontradables and the final good clear domestically, and imports, exports and foreign debt satisfy the external constraint (Appendix C.3), and the exogenous processes for the commodity prices and the spread hold (Appendix C.4). TFP innovations and persistence are set to zero. These are the conditions used for the first-order approximation.

C.6 Steady State

The deterministic steady state sets the spread to zero, sets all TFP levels to one, and sets commodity prices equal to their steady-state values. The discount factor satisfies

$$\beta = \frac{1}{1+r^*}. \tag{52}$$

In steady state, sectoral rental rates satisfy

$$u^j = \frac{1}{\beta} - 1 + \delta, \qquad j \in \mathcal{S}. \tag{53}$$

The six observed share restrictions are

$$\frac{x^c}{y} = s_{x_c}, \qquad \frac{x^{\bar{c}}}{y} = s_{x_{\bar{c}}}, \qquad \frac{m^c}{y} = s_{m_c}, \qquad \frac{m^{\bar{c}}}{y} = s_{m_{\bar{c}}}, \tag{54}$$

$$\frac{p^n y^n}{y} = s_n, \qquad \frac{x-m}{y} = s_{tb}. \tag{55}$$

The sectoral output shares for commodity and noncommodity importables and exportables, denoted σ_{m_c}, $\sigma_{m_{\bar{c}}}$, σ_{x_c}, and $\sigma_{x_{\bar{c}}}$, are disciplined by

$$\begin{aligned} \frac{\sigma_{m_c} + \sigma_{m_{\bar{c}}}}{\sigma_{x_c} + \sigma_{x_{\bar{c}}}} &= 1, \\ \sigma_{m_{\bar{c}}} &= 1 - \sigma_{x_c} - \sigma_{x_{\bar{c}}} - \sigma_{m_c} - s_n, \\ \frac{\sigma_{x_{\bar{c}}}}{\sigma_{x_c}} &= \frac{s_{x_{\bar{c}}}}{s_{x_c}} = 0.532, \\ \frac{\sigma_{m_{\bar{c}}}}{\sigma_{m_c}} &= \frac{s_{m_{\bar{c}}}}{s_{m_c}} = 1.665. \end{aligned} \tag{56}$$

These restrictions imply the sectoral output-share values used in the calibration. Given those shares and the calibrated elasticities, the steady-state relative prices solve the aggregate residual conditions

$$p^m = \chi_m p^\tau \left(\frac{a^m}{a^\tau}\right)^{-1/\mu_{mx}}, \tag{57}$$

$$p^x = (1-\chi_m) p^\tau \left(\frac{a^x}{a^\tau}\right)^{-1/\mu_{mx}}, \tag{58}$$

$$s_{m_{\bar{c}}} = \frac{p^{m_{\bar{c}}} y^{m_{\bar{c}}}}{y}, \tag{59}$$

$$s_{x_{\bar{c}}} = \frac{p^{x_{\bar{c}}} y^{x_{\bar{c}}}}{y}, \tag{60}$$

$$s_n = \frac{p^n y^n}{y}, \tag{61}$$

$$p^\tau = \chi_\tau \left(\frac{a^\tau}{b}\right)^{-1/\mu_{\tau n}}. \tag{62}$$

The four within-composite first-order conditions are imposed as well:

$$\begin{aligned} p^{m_c} &= \chi_{m_c} p^m \frac{a^m}{a^{m_c}}, & p^{m_{\bar{c}}} &= (1-\chi_{m_c}) p^m \frac{a^m}{a^{m_{\bar{c}}}}, \\ p^{x_c} &= \chi_{x_c} p^x \frac{a^x}{a^{x_c}}, & p^{x_{\bar{c}}} &= (1-\chi_{x_c}) p^x \frac{a^x}{a^{x_{\bar{c}}}}. \end{aligned} \tag{63}$$

The residual system is overdetermined because several conditions are algebraically dependent. The calibrated values solve all ten residuals to numerical precision. The resulting steady state pins down all quantities, CES weights, the debt anchor $\bar{d}$, and the output scale used in the linearized model.

For transparency, the numerical calibration can be reconstructed directly from the reported moments. Tradable production accounts for $1 - s_n = 0.505328$ of output and is divided equally between the importable and exportable composites. Within each composite, sectoral production inherits the corresponding commodity-to-noncommodity trade ratio. Hence

$$\begin{aligned} \sigma_{m_c} &= 0.094805, & \sigma_{m_{\bar{c}}} &= 0.157859, \\ \sigma_{x_c} &= 0.164902, & \sigma_{x_{\bar{c}}} &= 0.087762. \end{aligned}$$

Solving equations (57)–(63) with these shares produces the implied preference weights, debt anchor, and relative prices in Panel B of Table 7. These are the values of the common calibration; the country calibrations imply their own values, and in every case the steady-state residuals are zero to machine precision.

C.7 Calibration and Estimated Parameters

Table 7 reports the calibrated parameters. The calibration contains 32 restrictions. Six are inherited from the small-open-economy benchmark: $\delta = 0.10$, $\alpha_n = 0.25$, $r^* = 0.11$, $\mu_{mx} = 1$, $\mu_{\tau n} = 0.5$, and $\sigma = 2$. Four restrictions set the tradable-sector capital shares equal to 0.35. Two restrictions set the commodity-vs-noncommodity elasticities in the importable and exportable composites equal to one. Five restrictions set the labor-disutility curvatures to $\omega_j = 1.455$, corresponding to a Frisch elasticity of approximately 2.2. Five restrictions normalize sectoral TFPs to one. Six moment restrictions pin down steady-state trade and sectoral shares: commodity exports, noncommodity exports, commodity imports, noncommodity imports, nontradable output, and the trade balance as shares of output. Finally, the sectoral output-share relationships in equations (56) above add four implicit restrictions, bringing the calibration count to 32.

The six moments are country specific and computed over each country's estimation window from the data described in Section 4, with the commodity shares $q_{x,i}$ and $q_{m,i}$ of the 2021–2023 UNCTAD profiles, the only years for which they are available: $s_{x_c} = q_{x,i}X_i$, $s_{x_{\bar{c}}} = (1-q_{x,i})X_i$, $s_{m_c} = q_{m,i}M_i$, $s_{m_{\bar{c}}} = (1-q_{m,i})M_i$ and $s_{tb} = X_i - M_i$, with X_i and M_i goods exports and imports relative to GDP, and s_n is the services share of value added. Table 8 reports these moments. Because the importable and exportable sectors each produce $(1-s_n)/2$ of output, a steady state with positive domestic absorption of exportables requires $2X_i/(1-s_n) < 1$; the eleven countries that violate this condition are marked in the table. Each country's steady state is computed by continuation from the common calibration, moving the six moments in 60 equal steps and starting each solve from the previous solution. The common calibration, which uses cross-country means of the moments and the trade surplus of 1% of GDP of Schmitt-Grohé and Uribe (2018), serves only as the starting point of the continuation and as the comparison in Appendix Table 12.

Table 9 reports the six parameters estimated for each country by the procedure of Section 4, which the Technical Appendix, Sections 7 and 8, describes in detail.

Table 7: Calibration

A. Calibrated parameters		
Parameter	Description	Value
δ	Depreciation rate	0.10
α_n	Capital share, nontradables	0.25
$\alpha_{m_c}, \alpha_{m_{\bar{c}}}, \alpha_{x_c}, \alpha_{x_{\bar{c}}}$	Capital shares, tradable sectors	0.35
r^*	World interest rate	0.11
μ_{mx}	Importable-exportable elasticity	1.00
$\mu_{\tau n}$	Tradable-nontradable elasticity	0.50
μ_m, μ_x	Commodity-noncommodity elasticities	1.00
σ	Curvature parameter	2.00
ω_j	Labor disutility curvature, all sectors	1.455
Z^j	Steady-state TFP, all sectors	1.00
$s_{x_c}, s_{x_{\bar{c}}}$	Export shares of output	0.133, 0.071
$s_{m_c}, s_{m_{\bar{c}}}$	Import shares of output	0.073, 0.121
s_n	Nontradable output share	0.495
s_{tb}	Trade-balance share	0.010
B. Implied structural parameters and steady-state prices		
Object	Interpretation	Value
β	Discount factor	0.900901
χ_{m_c}	Commodity weight in importables	0.375223
χ_{x_c}	Commodity weight in exportables	0.652652
χ_m	Importable weight in tradables	0.900309
χ_τ	Tradable weight in final absorption	0.316861
$\bar{d}$	Steady-state external-debt anchor	0.002261
p^n	Nontradable price	0.365473
p^{m_c}	Commodity-importable price	0.276582
$p^{m_{\bar{c}}}$	Noncommodity-importable price	0.306785
p^{x_c}	Commodity-exportable price	0.309519
$p^{x_{\bar{c}}}$	Noncommodity-exportable price	0.272276
p^m	Composite importable price	0.571885
p^x	Composite exportable price	0.564691

Notes: Panel A: parameters above the trade shares are common to all countries; the six trade and sectoral moments are country specific (Table 8), and the values shown are those of the common calibration, at cross-country means and a trade surplus of 1% of GDP, which is used for comparison only. Panel B: values implied by the parameters and moments of Panel A; prices in units of the final good.

Table 8: Country calibration

Country	Exports	Imports	Trade balance	Services	q_x	q_m	$2X/(1-s_n)$
BEN	15.9	23.9	−8.0	45.6	0.93	0.43	0.58
BFA	10.8	21.7	−10.9	44.8	0.96	0.44	0.39
BGD	11.4	17.6	−6.2	50.3	0.05	0.37	0.46
BOL	21.1	21.1	−0.0	47.3	0.95	0.31	0.80
BRA	10.5	8.7	1.7	56.2	0.75	0.25	0.48
CAF	10.2	15.1	−4.9	38.5	0.86	0.36	0.33
CHL*	25.7	24.1	1.6	53.3	0.83	0.33	1.10
CHN	21.1	18.6	2.5	42.8	0.06	0.46	0.74
CMR	13.5	15.3	−1.7	46.5	0.94	0.41	0.50
COL	12.7	14.5	−1.8	53.4	0.80	0.26	0.54
CRI*	27.7	35.7	−8.0	58.6	0.37	0.26	1.33
DOM	18.9	30.4	−11.5	54.0	0.40	0.36	0.82
DZA	26.5	20.1	6.4	44.9	0.96	0.34	0.96
ECU	20.3	19.6	0.7	51.9	0.94	0.37	0.84
EGY	9.7	24.5	−14.8	48.4	0.52	0.43	0.38
GAB*	52.2	22.2	29.9	38.2	0.82	0.26	1.69
GHA	22.2	30.7	−8.4	37.0	0.94	0.36	0.71
GMB	7.9	36.8	−28.9	57.9	0.87	0.42	0.38
GNB	11.4	22.7	−11.3	39.4	0.98	0.57	0.38
GTM	15.8	26.6	−10.7	57.2	0.56	0.36	0.74
IND†	9.6	13.6	−4.1	42.1	0.41	0.55	0.33
KEN	13.2	24.6	−11.4	55.0	0.70	0.38	0.59
MAR	17.2	29.8	−12.6	48.0	0.26	0.38	0.66
MDG	13.2	20.5	−7.2	49.3	0.72	0.38	0.52
MEX*	22.8	23.4	−0.6	59.1	0.18	0.20	1.12
MLI	15.6	22.6	−6.9	43.8	0.96	0.49	0.56
MUS*	30.7	46.4	−15.7	56.6	0.48	0.47	1.42
MYS*	74.5	64.7	9.8	48.1	0.32	0.35	2.87
NER	12.7	20.5	−7.8	39.3	0.91	0.39	0.42
PAK	10.4	17.1	−6.7	49.0	0.26	0.55	0.41
PAN*	16.0	33.9	−18.0	69.2	0.76	0.45	1.04
PER	17.7	16.1	1.6	52.2	0.91	0.32	0.74
PHL	23.4	30.6	−7.2	50.2	0.20	0.33	0.94
PRY	20.1	26.7	−6.6	44.4	0.86	0.24	0.72
SEN	14.0	27.2	−13.1	50.9	0.72	0.47	0.57
SLV	21.0	38.4	−17.4	56.2	0.26	0.37	0.96
SYC*	26.7	65.9	−39.2	56.8	0.86	0.33	1.24
TCD	18.4	19.3	−0.9	38.6	0.99	0.25	0.60
TGO	17.4	29.6	−12.2	47.4	0.84	0.56	0.66
THA*	42.2	44.0	−1.8	54.0	0.28	0.35	1.84
TUN*	30.7	43.7	−13.0	52.1	0.21	0.35	1.28
TUR	14.2	21.3	−7.0	51.6	0.24	0.35	0.59
TZA†	8.5	19.0	−10.6	37.4	0.90	0.34	0.27
UGA	8.7	21.3	−12.7	42.7	0.81	0.40	0.30
URY†	15.1	17.3	−2.3	60.4	0.83	0.33	0.76
ZAF*	21.5	22.5	−0.9	59.0	0.64	0.34	1.05

Notes: Window averages, in % of GDP, of goods exports, goods imports and the goods trade balance (WDI merchandise trade over GDP in current U.S. dollars), and of services value added. q_x, q_m: commodity shares of merchandise exports and imports (UNCTAD, 2021–2023). $2X/(1-s_n)$: goods exports relative to the output of the exportable sector implied by the equal division of tradable output between importables and exportables; a steady state requires a value below one. *: no steady state; †: steady state exists but the joint SVAR is not stationary. Both are outside the main sample.

Table 9: Estimated parameters and output shares, country-calibrated model

									Output share	
Country	ϕ_{m_c}	$\phi_{m_{\bar{c}}}$	ϕ_{x_c}	$\phi_{x_{\bar{c}}}$	ϕ_n	ψ	Loss	Zero	SVAR	Model
BEN	2.40	68.2	7.02	35.1	71.7	28.0	42.7	37.1	60.1	2.8
BFA	19.1	77.1	0.33	8.09	75.8	79.5	79.2	40.2	27.3	339.1
BGD	61.1	75.9	1.38	77.9	79.1	79.8	78.6	29.6	24.1	429.9
BOL	0.09	78.9	0.75	71.7	73.7	6.47	52.6	36.0	28.9	147.2
BRA	60.1	75.4	3.87	59.2	1.00	79.4	49.1	59.9	76.2	13.9
CAF	30.3	79.6	49.5	8.15	59.7	79.3	33.1	29.3	20.2	3.9
CHN	1.03	79.5	12.0	79.1	65.9	74.1	51.3	44.1	20.7	9.7
CMR	3.05	77.3	61.9	75.4	69.0	80.0	64.7	48.7	41.3	9.1
COL	2.49	77.4	12.2	75.4	27.5	78.2	32.7	48.7	53.9	24.8
DOM	6.97	57.8	79.2	69.4	74.2	79.4	64.8	45.1	26.1	66.1
DZA	23.0	78.0	78.8	5.78	79.2	1.81	62.2	54.5	78.9	448.9
ECU	11.3	79.2	1.39	73.1	78.5	12.3	53.0	52.3	64.7	85.3
EGY	11.3	77.8	11.6	71.5	73.7	79.9	53.0	34.4	15.6	51.0
GHA	22.1	67.2	71.5	2.51	75.9	75.1	38.5	34.9	21.3	74.6
GMB	3.72	79.5	71.7	5.48	75.8	0.79	39.3	28.2	14.0	45.1
GNB	0.38	22.3	79.8	38.6	76.9	77.9	73.5	40.1	24.5	78.7
GTM	1.66	76.2	43.9	73.8	73.1	76.7	56.2	43.1	19.0	82.5
KEN	1.01	69.6	75.5	46.8	79.5	68.4	60.9	44.0	42.8	15.7
MAR	0.81	76.2	31.6	76.8	76.7	78.9	82.0	48.9	30.6	180.2
MDG	4.64	74.9	2.42	72.1	62.3	78.3	53.2	39.7	30.1	91.9
MLI	68.6	75.3	73.8	16.0	74.7	79.8	68.9	25.6	15.1	286.5
NER	56.7	66.8	79.2	7.20	60.9	79.6	64.7	42.0	38.0	40.9
PAK	0.62	73.7	4.00	74.4	78.7	79.6	89.7	45.9	20.2	167.9
PER	1.86	19.3	28.2	59.9	11.0	79.6	37.4	40.2	41.8	44.6
PHL	0.77	75.7	65.9	74.8	72.7	74.4	46.2	39.8	57.1	22.5
PRY	3.26	77.7	38.6	31.2	78.6	77.7	57.2	56.3	38.8	12.5
SEN	0.47	78.3	9.24	76.9	76.4	76.8	70.4	40.6	32.2	133.9
SLV	3.50	79.8	9.36	77.8	79.9	68.4	76.3	45.3	20.7	107.3
TCD	70.3	68.7	78.4	71.4	62.0	79.4	40.5	36.8	28.2	17.2
TGO	51.7	68.2	76.2	16.2	78.6	30.7	51.0	37.1	62.8	78.3
TUR	40.5	76.8	6.01	73.8	79.1	76.6	51.3	38.9	36.3	57.1
UGA	13.4	76.4	13.5	65.2	75.1	78.4	61.4	34.4	43.4	38.2

Notes: One parameter vector per country, estimated against the SVAR responses to the common and relative price innovations and to the spread innovation at horizons zero to four, with the country's own steady state. ϕ_j: capital adjustment costs; ψ: debt elasticity of the interest rate; all bounded by $[10^{-4}, 80]$. Loss: value of equation (16); zero: its value when all model responses are zero. Output shares: share of output variance due to the commodity-price block in the SVAR and the model (%), both relative to the SVAR's total variance. The 32 countries of the main sample.

D Robustness

D.1 Full Sample and Country-Level Shares

The main sample excludes eleven economies whose goods exports exceed what the model's sectoral structure allows and three whose joint SVARs are not stationary. Table 10 repeats Table 1 for all 46 countries, using the 43 stationary joint systems (44 for the two ratio specifications). The commodity-price block accounts for 32.4% of the variance in the median, of which the common component accounts for 16% and the relative component for 9.3% across the five medians; the commodity terms of trade account for 14.2% and the net barter terms of trade for 13.7%. The panel local projections on all 46 countries (1,842 country-years at $h = 0$) give an output response to the common innovation of 0.5% on impact ($t = 2.3$) and 1% after five years ($t = 7.5$). The results do not depend on the restriction to the main sample.

Table 10: Variance shares of the price block, all 46 countries

	TB	Y	C	I	RER	Median
Commodity-price block	34.6	30.1	32.4	27.6	33.0	32.4
Common component	19.1	15.2	20.4	16.0	15.4	16.0
Standard error	(4.1)	(6.0)	(5.0)	(4.7)	(5.5)	
Relative component	9.3	10.7	9.0	8.4	12.0	9.3
Standard error	(2.1)	(2.4)	(2.3)	(2.0)	(2.7)	
Commodity terms of trade	20.4	12.4	15.9	11.5	14.2	14.2
Net barter terms of trade	17.1	11.5	13.7	10.3	14.9	13.7

Notes: As Table 1, for all countries with stationary systems among the 46: 43 for the commodity-price block and its components, 44 for the two terms-of-trade measures. TB: trade balance; Y: output; C: consumption; I: investment; RER: real exchange rate.

Table 11 reports the variance shares of the commodity-price block for each of the 46 countries, together with the output shares of the commodity terms of trade (CTOT) and the net barter terms of trade (NBTT). The shares vary considerably across countries.

D.2 Panel Local Projections

The country SVARs estimate each country's responses from 31 to 44 observations. Pooling the identified innovations across countries estimates the average response from about 1,300 country-years, at the cost of describing the average economy in the sample. The shocks come from the external block of each country's SVAR; because the external equations contain no domestic variables, their residuals are predetermined with respect to domestic activity under

Table 11: Variance shares by country

		Commodity-price block					Output	
Country	T	TB	Y	C	I	RER	CTOT	NBTT
BEN	32	58.2	60.1	58.9	59.3	59.2	47.8	12.4
BFA	44	27.5	27.3	22.2	24.6	34.8	26.0	17.2
BGD	38	55.0	24.1	26.6	33.1	21.2	6.8	16.8
BOL	44	69.8	28.9	20.5	26.9	45.2	9.7	2.3
BRA	44	34.7	76.2	67.8	53.1	26.1	34.2	13.7
CAF	44	15.4	20.2	25.5	3.0	9.7	6.6	3.5
CHL*	44	50.5	58.3	57.5	54.8	54.9	8.6	13.0
CHN	38	14.0	20.7	36.6	12.6	14.5	5.5	10.7
CMR	44	36.0	41.3	45.8	40.1	36.1	5.5	10.3
COL	44	41.4	53.9	51.0	38.5	28.6	31.3	43.8
CRI*	44	28.0	38.8	29.6	44.6	11.0	21.3	23.6
DOM	44	34.2	26.1	26.4	37.6	27.4	25.3	1.7
DZA	44	59.4	78.9	41.0	52.5	59.2	73.8	72.3
ECU	44	28.5	64.7	33.1	38.4	44.9	35.0	57.5
EGY	44	20.4	15.6	14.8	15.8	25.2	13.6	4.6
GAB*	44	52.1	28.8	48.9	52.7	44.1	1.8	10.4
GHA	40	15.3	21.3	25.1	7.1	57.7	1.3	59.0
GMB	44	24.3	14.0	24.0	17.0	9.7	11.8	9.8
GNB	37	15.9	24.5	29.0	17.5	28.1	5.8	5.6
GTM	44	34.1	19.0	33.1	18.5	37.9	12.5	1.6
IND†	44						19.6	17.9
KEN	44	36.3	42.8	25.8	31.8	23.1	7.4	23.6
MAR	44	76.8	30.6	37.9	69.3	32.2	4.6	3.6
MDG	44	16.8	30.1	11.4	17.0	63.5	12.7	4.6
MEX*	44	9.6	17.2	9.2	9.3	13.2	18.5	22.4
MLI	36	22.9	15.1	7.1	16.8	50.9	6.5	25.3
MUS*	44	35.8	19.2	42.5	23.1	30.0	10.0	7.1
MYS*	44	60.7	35.9	51.2	45.7	65.8	11.7	18.4
NER	42	38.5	38.0	40.5	25.4	50.9	32.3	7.1
PAK	44	48.1	20.2	47.4	16.8	54.8	4.5	49.1
PAN*	43	4.7	55.1	49.2	11.4	64.5	51.8	5.0
PER	44	34.0	41.8	32.4	32.3	17.7	1.5	46.0
PHL	43	45.4	57.1	27.8	36.1	31.2	18.9	11.2
PRY	44	40.9	38.8	48.2	46.2	67.3	12.4	5.0
SEN	44	39.2	32.2	10.4	20.7	10.8	7.2	11.8
SLV	44	35.6	20.7	25.7	29.1	22.7	12.3	1.5
SYC*	39	10.8	25.4	16.0	10.1	20.1	18.2	6.7
TCD	41	31.3	28.2	22.2	3.4	34.1	1.8	48.7
TGO	43	21.7	62.8	42.7	16.1	22.1	38.2	11.8
THA*	44	34.6	8.0	30.3	21.2	33.5	6.9	4.3
TUN*	41	32.0	30.1	64.8	27.6	33.0	27.1	45.3
TUR	44	39.5	36.3	19.6	32.3	45.8	2.8	5.3
TZA†	34							
UGA	31	21.2	43.4	46.6	47.4	62.2	42.7	28.2
URY†	36							
ZAF*	44	35.2	92.9	87.9	84.2	17.2	86.6	10.1

Notes: Shares (%) of the unconditional variance due to the commodity-price block in the joint SVAR, and of output variance due to the commodity terms of trade (CTOT) and the net barter terms of trade (NBTT) in the corresponding SVARs. T: number of observations. Blank: the system is not stationary. *: no steady state under the country calibration; †: nonstationary joint SVAR. Countries without a mark form the main sample. TB: trade balance; Y: output; C: consumption; I: investment; RER: real exchange rate.

the same assumption as in the SVAR. For each domestic variable y and horizon $h = 0, \ldots, 10$, I estimate

$$y_{i,t+h} = \alpha_{i,h} + \beta_h \hat{m}_{i,t} + \delta_h \hat{q}_{i,t} + \gamma_h \hat{\varepsilon}^s_{i,t} + \sum_{l=1}^{2} \Gamma_{l,h} z_{i,t-l} + e_{i,t+h}, \tag{64}$$

where $\hat{m}_{i,t}$ and $\hat{q}_{i,t}$ are the coordinates of the surprises in the two log prices, the residuals $\hat{u}_{i,t}$ of the export- and import-price equations, along the country's first principal component v_i and the direction orthogonal to it, $\hat{u}_{i,t} = v_i \hat{m}_{i,t} + v_i^{\perp} \hat{q}_{i,t}$; $\hat{\varepsilon}^s_{i,t}$ is the standardized spread innovation; $z_{i,t}$ is the vector in equation (5); and $\alpha_{i,h}$ is a country fixed effect (Jordà, 2005); the other coefficients are common across countries. The responses to the common and relative innovations of Section 3 are $0.1\beta_h$ and $-0.05\delta_h$ (Technical Appendix, Section 4). Commodity prices are common to many countries, so the regression errors are correlated across countries within a year, and overlapping horizons make them serially correlated; standard errors follow Driscoll and Kraay (1998). Combining fixed effects with lagged controls biases the control coefficients by an amount of order $1/T$ (Nickell, 1981); with 31 to 44 years per country, and shocks that are uncorrelated with the lagged controls by construction, the effect on the response coefficients is small. The estimation sample covers the 32 countries of the main sample, with 1,281 country-years at $h = 0$.

Figure 8 reports the responses. The common innovation raises output by 0.5% on impact ($t = 2.2$) and by 1% after five years ($t = 7.3$). Investment rises by 1.7% on impact ($t = 3.4$) and by 2.5% after five years, and consumption, which does not move on impact, rises by 0.8% after five years ($t = 5.4$). The real exchange rate appreciates by 1.9% on impact. The trade balance is negative from four years after the increase on, and after five years it is 0.3% of GDP below trend ($t = -3.0$). The panel estimates thus confirm, with considerable precision, that a common increase in commodity prices is followed by an expansion of output, investment and consumption. The responses to the relative innovation are small: none is significantly different from zero on impact, and output and consumption fall slightly below trend from five years on.

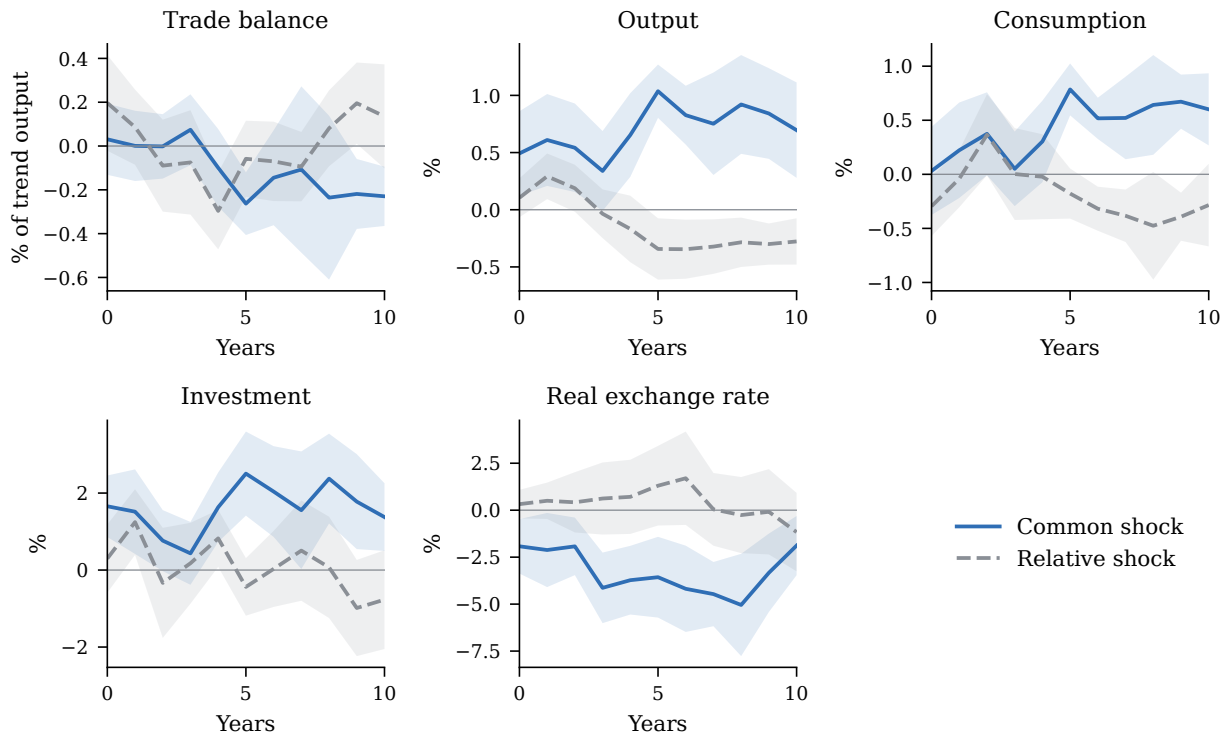

Figure 8: Panel local projections. Responses $0.1\beta_h$ and $-0.05\delta_h$ from equation (64) to the common shock, which raises the two prices by 10% on average on impact, and to the relative shock, which raises the export price by 10% relative to the import price; 32 countries of the main sample. Units as in Figure 3. Shaded areas are 90% confidence intervals based on Driscoll–Kraay standard errors.

D.3 Bias-Corrected SVAR Estimates

OLS estimates of autoregressive coefficients are biased toward zero in short samples. Correcting the bias as in Kilian (1998), with the bias estimated from 500 replications of the wild bootstrap and the correction shrunk where needed to keep the system stationary, raises the persistence of the estimated systems: in the main sample the median largest root rises from 0.86 to 0.98, and 15 of the 32 systems end up with a root of at least 0.99. Because the unconditional shares cumulate responses over all horizons, they rise as well: the median share of the commodity-price block is 39.8% for the trade balance, 42.6% for output, 39.4% for consumption, 33.9% for investment and 51.1% for the real exchange rate. The correction moves many systems close to the unit-root region, where unconditional shares are sensitive to small changes in the estimated roots, so I use the OLS estimates, as Schmitt-Grohé and Uribe (2018) do. The ranking of commodity prices above the terms of trade is unaffected: with the correction, the median across variables is 39.8% for the commodity-price block and 14.6% for the net barter terms of trade.

D.4 Country and Common Calibration

Table 12 compares the country-calibrated model with the same model under a common calibration, in which every country has the cross-country average trade and sectoral shares and a trade surplus of 1% of GDP, as in Schmitt-Grohé and Uribe (2018). Both are estimated with the same targets, weights, bounds and optimizer, on the 32 countries of the main sample. The country calibration raises the model's median share of the trade balance from 4.2% to 25.6%, close to the SVAR's 34.5%, and brings the medians of the other variables closer to the SVAR's except for output. The common calibration fits the responses better: its loss is below that of zero responses in 8 of the 32 countries, against 3. Under neither calibration is the cross-country correlation between model and SVAR shares significantly positive for any variable. The two differ in the model's median response to the common shock, as discussed in Section 5: under the common calibration, in which every country is a debtor, consumption rises and investment rises from the third year on, while under the country calibration, in which 27 of the 32 countries are creditors, they fall. The response to the relative shock is expansionary under both.

Table 12: Country and common calibration

		Median model share					Rank correlation	
Calibration	Beats zero	TB	Y	C	I	RER	Output	Median
Country calibration	3	25.6	61.6	29.1	31.2	27.9	−0.24	−0.01
Common calibration	8	4.2	36.9	21.4	15.0	26.0	−0.36	−0.14
SVAR		34.5	30.4	28.4	28.0	33.1		

Notes: "Beats zero": number of countries, of 32, in which the estimated model's loss is below that of zero responses. Median model share: median across countries of the model's share (%) of each variable's unconditional variance due to the commodity-price block, relative to the SVAR's total variance; the last row gives the SVAR's medians. Rank correlation: Spearman rank correlation across countries between model and SVAR shares, for output and for each country's median share across the five variables. TB: trade balance; Y: output; C: consumption; I: investment; RER: real exchange rate.

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