How Do Commodity Prices Affect Inflation?

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Abstract. This paper studies the impact of commodity prices on inflation over the period 1973-2022. We employ a novel structural VAR model to estimate the heterogeneous effects of different types of commodity price shocks—energy, food, metals, and common commodity shocks—on various measures of inflation, including headline, core, energy, and food CPI inflation. Our identification of these shocks is motivated by the predictions of a global dynamic stochastic general equilibrium model. We report three main results. First, among commodity-specific shocks, energy and food exert the largest and most persistent impact on headline and core inflation, although their effect on core inflation is less pronounced. Metals and common commodity shocks, in contrast, have more modest and shorter-lived effects. Second, energy-specific shocks dominate energy inflation, with spillovers to food inflation likely driven by higher agricultural input costs. Food-specific shocks, however, primarily affect food prices with minimal effects on energy inflation. Third, the pass-through of commodity shocks to both headline and core inflation has weakened and become less persistent over time across all commodity types.

Keywords: Commodity shock; inflation; medium-sized Bayesian SVAR; core CPI
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I. Introduction

The impact of commodity price movements on inflation has recently become a central topic of interest, given the implications of gyrations in commodity markets for the post-pandemic surge in inflation volatility.[1] The transmission of commodity price fluctuations to inflation largely depends on the nature of price shocks and the underlying commodity. Since energy affects a wide range of industries, energy price shocks are expected to have a much larger impact on inflation than shocks associated with food and metal prices. Persistent commodity price shocks can lead to sustained inflationary pressures, potentially affecting inflation expectations. While the significance of these linkages is well recognized, the literature has yet to present a comprehensive analysis of different types of commodity shocks on various measures of inflation.[2]

This paper addresses this gap in the literature by exploring three key questions: (i) How do commodity price shocks in energy, food, and metal markets affect inflation? (ii) How does the pass-through of these shocks to inflation vary across different measures of inflation, including headline, core, food and energy inflation? (iii) How has the nature of this pass-through evolved over time?

Our analysis follows a two-step approach. First, we introduce a global, multi-sector, dynamic stochastic general equilibrium (DSGE) model that helps us identify the shocks and mechanisms driving the relationship between global commodity prices and domestic inflation. The model features a global commodity market, where energy, food, and metal prices are driven by global demand, supply, and commodity market shocks. It includes four countries, each representing distinct trade structures related to the import and export of energy, food, and metals with sectors dedicated to the production of these commodities.

In the second step, we use the impulse responses from the DSGE model to inform our identification strategy in developing a novel structural vector autoregression (SVAR) model. Our analysis spans the period from January 1973 to December 2022 and covers 26 countries.[3] Specifically, we estimate country-specific SVAR models to assess how non-commodity global demand and global supply shocks, as well as commodity-related shocks—including common and sector-specific shocks—affect domestic inflation. Common commodity shocks are associated with a broad-based increase in global commodity prices through various channels, including surges in inventory demand for multiple commodities amid

[1] Over the 2020-2024 period, the early increase in inflation coincided with sharp rises in various commodity prices, while the subsequent decline was also associated with a drop in commodity prices. For instance, crude oil, wheat, and copper prices increased by 260, 150, and 97 percent respectively, from early 2020 to mid-2022. During this period, global headline inflation also saw a steep increase, exceeding 9 percent by the second half of 2022. Global inflation has declined since June 2022 largely because of the substantial decline in commodity prices, with the global commodity price index falling by nearly 30 percent from mid-2022 to early 2024 (World Bank 2024a).

[2] A few recent studies have examined the impact of different types of commodity shocks on inflation. However, these studies have either focused on a limited set of commodities or examined impacts on specific regions (see, for example, Kilian & Zhou (2023a), Banbura, Bobeica, and Hernández 2023; Castelnuovo, Mori, and Peersman 2024).

[3] We focus primarily on advanced economies because of limited availability of monthly inflation data for the 1973-2022 period.

heightened geopolitical tensions or by increased speculative trading activities in financialized commodity markets.[4] Sector-specific commodity price shocks, such as those in the energy, food, and metal sectors, capture both demand and supply shifts originating from these sectors.

Our findings offer a broad perspective on the evolving relationship between commodity market developments and domestic inflation over the past five decades. First, non-commodity global demand shocks stand out as key drivers of headline and core inflation in the median country. A positive global demand shock raises global output and commodity demand, resulting in a substantial inflationary response. Such shocks have statistically significant effects on headline inflation in over three-quarters of countries. By contrast, global supply shocks, while still influential, have a more muted net effect on headline inflation due to offsetting declines in non-commodity prices. Although both shocks also affect core inflation, their overall impact on core CPI measure is smaller than on headline inflation.

Our results highlight that the impact of non-commodity global shocks on inflation—both headline and core—operates in large part through a "commodity channel." Global demand and supply shocks drive changes in commodity prices, which subsequently shape domestic inflation. The transmission is observed in energy and food inflation, where non-commodity global demand shocks have a particularly strong effect. Although global supply shocks also matter for commodity prices, their impact on energy inflation is more subdued, and their net effect on domestic inflation is consequently smaller.

Second, among commodity-specific shocks, energy shocks emerge as the most persistent and impactful drivers of headline inflation. A one standard deviation energy price shock (equivalent to a 10 percent increase in energy prices) raises headline inflation by approximately 0.33 percentage points within one year and remains elevated, reaching 0.51 percentage points by the third year for the median country. Similarly, a one standard deviation food price shock (equivalent to a 3 percent increase in food prices) contributes 0.20 percentage points to headline inflation within one year but exhibits less persistence, tapering off to 0.29 percentage points by the third year.

Metal price shocks (equivalent to a 5 percent increase in metal prices), transmitted through production chains and intermediate inputs, contribute 0.18 percentage points within one year but are less persistent, flattening to 0.28 percentage points by the third year. In contrast, common commodity shocks (equivalent to a 5 percent increase in the common commodity price factor)—often tied to speculative activity in financialized commodity markets or geopolitical tensions—contribute 0.18 percentage points within one year and grow to 0.32 percentage points by the third year, showing greater persistence than metal shocks yet less impact compared to energy shocks.

Third, commodity-specific shocks also shape core inflation, though their impact is less pronounced than

[4]For example, the Russian invasion of Ukraine led to supply disruptions in both grain and energy markets (World Bank 2022a). Additionally, in our monthly SVAR framework, an immediate spillover (within the same month) from one commodity sector to another (e.g., energy to agriculture or vice versa) is captured as a common commodity shock. For instance, the biofuel revolution has increased the correlation between energy and agricultural prices, making them closer substitutes (see Hertel and Beckman, 2011; Peersman et al., 2021).

on headline inflation. Energy shocks again exert the largest influence, raising core inflation by up to 0.41 percentage points over three years. However, this pass-through remains smaller than for headline inflation, reflecting the indirect nature of energy's impact on broader production costs. Food shocks, while less potent than energy shocks for the median country, contribute an average of 0.26 percentage points to core inflation. In certain cases—such as the United States—food shocks have a larger impact on core inflation than energy shocks, reflecting larger second-round effects, potentially through wages and inflation expectations. Metal shocks have a more moderate influence on core inflation, contributing up to 0.24 percentage points, although their role as critical inputs in production networks ensures a sizable impact. Common commodity shocks produce the smallest and least persistent effects, raising core inflation by approximately 0.23 percentage points on average.

Fourth, our analysis reveals that changes in energy and food CPI inflation are influenced by diverse commodity shocks. Energy shocks—such as oil supply disruptions—are key drivers of energy inflation, with these shocks found to have significant effects in 90 percent of countries. For example, energy shocks increase energy CPI inflation by approximately 1.12 percentage points over three years. Energy shocks also spill over into food inflation, contributing up to 0.34 percentage points to food CPI inflation over three years, reflecting the role of oil prices in influencing agricultural input costs. Conversely, food-specific shocks, while important for food CPI inflation (adding 0.3 percentage points within three years), have limited effects on energy inflation, underscoring the asymmetry in cross-commodity interactions.

Metals also play a role in shaping energy inflation due to their use in energy production and distribution infrastructure. Metal shocks contribute up to 0.79 percentage points to energy CPI inflation over three years, highlighting their importance as critical inputs in drilling equipment, pipelines, and storage facilities. At the same time, common commodity-specific shocks exert sizable but less persistent effects, raising energy CPI inflation by 0.89 percentage points and food CPI inflation by 0.3 percentage points within three year.

Finally, the pass-through of commodity price shocks into inflation has diminished over time, with varying effects across different types of commodities. The pass-through ratio of energy shocks to headline inflation has seen the sharpest reduction, dropping from 0.51 over the full sample period (1973-2022) to 0.14 in the post-2000 period, both measured after 3 years. Metal and common commodity shocks followed a similar trend, with their pass-through ratios dropping from 0.28 to 0.1 and 0.32 to 0.12 percentage points, respectively. In contrast, the decline in the pass-through of food shocks has been more modest, decreasing from 0.29 to 0.16. A similar pattern holds for core inflation, where the pass-through of food, energy, metal, and common commodity shocks has also declined over time.

The paper makes several contributions to the literature. First, we utilize a unified framework to jointly analyze the interconnected movements of different commodity prices and domestic inflation, linking them to their underlying exogenous drivers. Our identification strategy, grounded in a multi-country, multi-sector DSGE model, allows us to identify and isolate the effects of different common and sector-specific

commodity shocks. In order to examine the heterogeneous pass-through effects of commodity price movements to inflation, it is important to disentangle the underlying shocks driving commodity prices. As the recent literature highlights, the response of economic activity and CPI to shifts in commodity prices, such as oil prices, is contingent upon the prevailing global demand and supply conditions.

Second, to accurately assess the impacts of sector-specific commodity shocks on inflation, particularly in metals and agriculture, it is crucial to jointly model their price movements in other commodity sectors, such as energy. This approach is necessary because estimating distinct models for each commodity type might misrepresent the actual drivers of price changes. For example, a narrowly focused analysis of grain prices may ascribe inflationary effects to agriculture-specific shocks, missing the role played by energy costs in agricultural production.

Third, our study examines the heterogeneous effects of commodity shocks on several inflation measures, including headline, core, energy, and food inflation. It dissects both the direct and indirect effects of these shocks, providing a thorough examination of the factors behind commodity price fluctuations and their influence on different measures of inflation.

Related Literature. Our paper contributes to the extensive literature examining the effects of commodity shocks on economic activity and inflation. Much of this research focuses on oil prices, emphasizing that the economic and inflationary impacts depend on the underlying causes of commodity price fluctuations.[5] For instance, Kilian (2009) demonstrates that U.S. real GDP and the consumer price index (CPI) respond differently to oil price changes depending on whether they stem from oil supply disruptions, oil-specific demand shocks, or broader economic activity shocks (see also Peersman & Van Robays, 2012; Kilian & Murphy, 2014; Kilian & Zhou, 2021; Aastveit et al., 2021).

Expanding the analysis beyond oil, Kilian & Zhou (2023a) investigate the effects of various energy price shocks—including gasoline, diesel, jet fuel, natural gas, and electricity—on headline and core inflation. Their findings suggest that focusing on a single energy price shock risks underestimating the broader impact of unexpected energy price fluctuations on inflation. Similarly, Banbura et al. (2023) underscore the growing importance of supply-side factors, such as global supply chain disruptions and gas price fluctuations, in shaping inflation dynamics, highlighting the evolving nature of inflation drivers.

Our study further contributes to this literature by examining the exogenous effects of food and metal shocks on inflation, complementing the small but growing body of research on these shocks (see Peersman, Rüth, & Van der Veken, 2021; Baumeister et al., 2024; Miranda-Pinto et al., 2024). Peersman (2022) investigates the impact of food commodity price shocks on Euro area inflation. Using an external instrument based on global harvest conditions, the study finds that nearly 30 percent of medium-term inflation volatility in the Euro area can be attributed to food price shocks.

[5]For a comprehensive review of the literature on the effects of commodity price shocks on economic activity and inflation, see Appendix A.

Building on these insights, Castelnuovo et al. (2023) incorporate global harvest shocks alongside data on crude oil and industrial input prices to assess their combined effects on U.S. and global macroeconomic conditions. Their analysis distinguishes among different commodity shocks, finding that food price shocks behave like aggregate supply shocks—raising nominal wages and core CPI—while oil shocks mimic adverse demand shocks amplified by financial frictions. In contrast, industrial input price movements are largely driven by responses to non-commodity economic activity shocks. Our study broadens this scope by examining a wider set of commodity shocks—energy, food, metals, and common commodity shocks—and a range of inflation measures, including headline, core, and sectoral food and energy inflation, across multiple countries. This broader perspective uncovers significant heterogeneity in the effects of these shocks on inflation.

This paper is organized as follows. Section II introduces the dynamic stochastic general equilibrium model that motivates our empirical framework. Section III outlines the empirical methodology and data. Section IV presents the main empirical results. Section V provides a rich set of robustness exercises. Section VI concludes.

II. Theoretical Considerations

In this section, we briefly present the key features of a four-country, four-sector DSGE model that allows us to analyze the implications of global commodity shocks for inflation and other macroeconomic variables. In particular, the model serves as the foundation for our subsequent empirical analysis by highlighting the mechanisms that link global commodity prices to domestic inflation.

The model builds on the workhorse international real business cycle models of Backus et al. (1992) and Stockman and Tesar (1995). It incorporates multiple sectors and multiple countries to capture the dynamic effects of changes in global energy, food, and metal markets. The four countries in the model represent distinct trade structures involving the import and export of commodities. Households in each country consume a final good composed of non-commodity goods and an energy-food composite, with consumption influenced by preference shocks. The model also features a monetary authority that follows a Taylor-type rule to set nominal interest rates, and a fiscal authority that balances the budget each period. Monetary and fiscal shocks determine the behavior of interest rates and fiscal balances. These preference, monetary, and fiscal shocks collectively represent non-commodity global demand shocks in the model.

Differentiated intermediate goods in each sector are used to produce final goods in that sector for domestic consumption, investment, or trade. Intermediate non-commodity goods are produced using capital, labor, and an energy-metal composite, with production affected by both country-specific productivity shocks and global productivity shocks, which represent non-commodity global supply shocks. The model also incorporates commodity shocks to the production of intermediate energy, food, and metals. While intermediate food and metal producers utilize capital, labor, and energy, intermediate energy producers

rely solely on capital and labor. Sector-specific shocks drive production in these sectors, with energy shocks directly impacting food and metal production, but not vice versa. Additionally, the model includes a common commodity shock, which captures simultaneous movements in energy, food, and metal prices, reflecting broad-based shifts in global commodity markets.

The model is calibrated so that the steady-state ratios of each country's energy, food, and metal exports to its GDP, as well as each countrys GDP share of the global economy, match observed data. Remaining parameters, not directly tied to these ratios, are set within ranges commonly used in the literature.[6] Figure 1 presents the responses of global output, global inflation, and energy, food, metal, and aggregate commodity prices (an aggregate of energy, food, and metal prices) in the model to global demand, global supply, and commodity-specific shocks, including energy, food, and metal. The impulse responses produced by the model lead to the following observations about the linkages between shocks and inflation and other macroeconomic variables.

Global demand shock: A positive global demand shock (captured as a combination of preference, fiscal, and monetary shocks) shifts household preferences from consumption of non-commodities to commodities (energy and food), raising the demand and prices of commodities, while prices and output in the non-commodity sector decline. The shock also stimulates government spending and lowers nominal interest rates in the four countries, boosting aggregate demand. As a result, global output and prices increase.

Global supply shock: A positive global supply shock is captured as a global productivity increase in the non-commodity sector. Higher productivity lowers marginal cost and increases output. As a result, global inflation decreases while global output rises. Since the non-commodity sector uses commodities as inputs, higher productivity increases the marginal product of all inputs, raising demand and, consequently, the prices of commodities, including energy, food, and metals.

Common commodity shock: A positive common commodity shock simultaneously raises the prices of energy, food, and metals. This increases production costs, as both metals and energy are inputs for producing non-commodity intermediate goods. Additionally, the higher prices reduce consumption of energy and food. Due to the complementarity between the energy-food composite and non-commodities, non-commodity consumption also declines. Consequently, output falls, and inflation rises across countries.

Energy-specific shock: A negative energy shock (i.e., an exogenous disruption in energy production) reduces energy supply globally, driving up energy prices. Since energy is an essential input (i.e., featuring a low elasticity of substitution with other inputs) for producing non-commodities, food, and metals, higher energy prices increase marginal costs across these sectors, leading to reduced global output and higher inflation.

Food-specific shock: A negative food shock reduces food supply, raising food prices globally. This reduces

[6]For details about the model and the calibration exercise, see Appendix B.

both food and non-commodity consumption due to the complementarity between the energy-food composite and non-commodities. This leads to a decline in global output, while higher food prices, included in the CPI, push up global inflation.

Metal-specific shock: A negative metal shock reduces metal supply, raising metal prices across the four countries. As metals are used in non-commodity production, the higher prices increase marginal costs, leading to reduced output and higher prices in the non-commodity sector. Since the non-commodity sector is the largest in the model, this decline in output lowers global output, while the higher prices push up global inflation.

III. Empirical Framework

This section lays out the basics of our unifying empirical framework which allows for the identification of main shocks driving the world commodity prices and for the analysis of their transmission mechanisms to domestic inflation across countries.

III.1 Data

The dataset encompasses monthly observations of commodity price series, global economic activity, and inflation measures, both global and country-specific, spanning from January 1973 to December 2022. The commodity price data is sourced from the World Bank's Commodity Price Database (henceforth, the *Pink Sheet*). This database provides comprehensive coverage of 55 distinct commodity prices and indices, including specialized price indexes for energy, food, and metals. All series are deflated using the U.S. CPI for all urban consumers, which is published monthly by the Bureau of Labor Statistics (BLS). They are then transformed by taking the first differences of logs. Global economic activity is measured using the World Industrial Production Index, as developed by Baumeister & Hamilton (2019). For global inflation, we utilize the OECD inflation rate as a proxy. The global database is augmented with inflation measures from several advanced countries, mainly provided with Ha et al. (2021). Specifically, this includes domestic inflation data from a group of 26 advanced economies, encompassing a range of inflation measures, namely, headline, core, energy, and food CPI. Each CPI dataset is transformed to reflect monthly growth rates. For more detailed regarding the countries and data sources included, a comprehensive list is available in Appendix C.

III.2 SVAR Model

We estimate a set of country-specific SVAR models. The general form of the SVAR model for a country is given as following

$$\mathbf{B_0 y_t} = \sum_{i=1}^{p} \mathbf{B_i y_{t-i}} + \mathbf{w_t}, \tag{1}$$

where $\mathbf{y_t}$ is a $K \times 1$ vector of endogenous variables, p is the lag length, $\mathbf{B_0}$ is the structural impact multiplier matrix, $\mathbf{B_i}$ is a $K \times K$ matrix of coefficients, and $\mathbf{w_t}$ denotes the $K \times 1$ vector of mutually uncorrelated structural innovations.

The vector of endogenous variables $\mathbf{y_t}$ is based on monthly data, where each country-specific model includes a global block and a domestic inflation measure. The global block comprises of seven variables: $\mathbf{y_t^{(global)}} = (\Delta GIP_t, GINF_t, GCF_t, \Delta EPI_t, \Delta FPI_t, \Delta MPI_t, \Delta ACPI_t)'$. Here, ΔGIP_t and $GINF_t$ represent percentage change in global industrial production and global CPI, respectively. The remaining variables represent different commodity prices: GCF_t is a commodity price factor, estimated from the growth rate of 39 commodity price series, using a dynamic factor model.[7] ΔEPI_t, ΔFPI_t, and ΔMPI_t, denote percentage change in price indexes for energy, food, and metals, respectively. ΔNPI_t represents the percentage change in the price of the "anchor" commodity. This anchor commodity is utilized to differentiate between global commodity price shocks and group-specific commodity price shocks. Global shocks affect all commodities, including the anchor commodity, whereas group-specific shocks, such as those specific to energy, do not impact the price of the anchor commodity in the short term. This methodology is in line with Boer et al. (2023). In the identification discussion that follows, we will elaborate on our choice of the anchor commodity and provide additional details about it. The global block is augmented with country-specific inflation measures: $\mathbf{y_t^{(domestic)}} = \Delta DCPI_t^j$, where $\Delta DCPI_t^j$ is the percentage change in the respective CPI measure, where $j = \{headline, core, energy, food\}$ for each country. The sample period is 1973:m1–2022:m12.

The reduced-form representation of (1) is given by

$$\mathbf{y_t} = \sum_{i=1}^{p} \mathbf{A_i} \mathbf{y_{t-i}} + \mathbf{u_t}, \tag{2}$$

where $\mathbf{A_i} = \mathbf{B_0^{-1}} \mathbf{B_i}$ and $\mathbf{u_t} = \mathbf{B_0^{-1}} \mathbf{w_t}$ are the mutually correlated reduced-form innovations with $K \times K$ variance-covariance matrix $E(u_t u_t') = \Sigma_u$.

Identification of Structural Shocks

The SVAR model is set-identified based on a combination of zero and sign restrictions. In particular, as shown in Table 1, zero and sign restrictions are imposed on the impact response of endogenous variables to identify six structural shocks: (i) global demand (**GD**), (ii) global supply (**GS**), (iii) common commodity-specific (**CS**), (iv) energy (**EN**), (v) food (**FO**), and (vi) metals (**ME**). It is useful to consider the restrictions involved in identifying the global and common commodity shocks before discussing the restrictions to identify the commodity-specific, i.e., energy, food, and metal shocks.

[7] The common price factor is comparable to the common output and(or) inflation factors, extract from a dynamic factor model of multiple macroeconomic indicators, as standard in the literature (Aruoba et al. (2011), Ha et al. (2023c), and many others.

Sign restrictions to identify global demand, global supply, and common commodity shocks. The identification of global demand, global supply, and common commodity-specific shocks is achieved by imposing static sign restrictions on the structural impact multiplier matrix, $\mathbf{B_0}$. Global demand shocks are characterized by simultaneous increases in the global industrial production index, global inflation, and the common commodity price factor. These shocks could arise from changes in consumer preferences impacting demand for commodity-intensive goods or from unexpected fiscal policies stimulating commodity-intensive investments. On the other hand, global supply shocks are indicated by an increase in global output coupled with a decrease in global inflation, alongside an elevation in commodity prices. Such shocks are associated with advancements in technology that enhance total factor productivity or productivity-boosting economic reforms such as trade liberalization or privatization measures. An increase in productivity would raise the marginal product of all inputs, including commodities, and, consequently, increase their demand and prices.

We assume that both global demand and supply shocks increase commodity demand. This contrasts with commodity supply shifts, which tend to be more commodity-specific or related to a relatively small group of substitutes, and, thus, do not typically result in a broad-based rise in prices (Bilgin & Ellwanger, 2017; Kabundi & Zahid, 2023). For instance, a labor disruption in one sector (like steel production) might not have a corresponding impact on another sector (such as grain prices), within a month.

The common commodity-specific shock is designed to capture unexpected price movements in commodities that are orthogonal to global demand and supply shocks yet result in synchronized monthly commodity price increases. Examples of these shocks include correlated spikes in prices within financialized commodity markets. This phenomenon is characterized by the transformation of commodity futures into popular asset classes among institutional investors, paralleling traditional stocks and bonds (Lombardi & Van Robays, 2011; Cheng & Xiong, 2013; Peersman, Rüth, & Van der Veken, 2021).

From the early 2000s through 2008, there has been a substantial inflow of capital into commodity futures indices, amounting to approximately $200 billion. This increased financial investor activity in commodity markets, particularly in the context of information asymmetries, can lead to pronounced spillover effects across commodities. An influx of investment capital, primarily for portfolio diversification purposes, can inadvertently drive up futures prices. These elevated prices, potentially misinterpreted by goods and services producers as signals of robust global economic activity, can influence their production decisions. In the presence of informational frictions, a higher futures price might be erroneously perceived as an indicator of strong global demand, prompting producers to increase their output, thereby elevating the demand for commodities (Sockin & Xiong, 2015). This illustrates the capacity of financialized commodity markets to induce widespread increases in commodity prices through the informational channel embedded in commodity pricing dynamics.

Sign and zero restrictions to identify energy, food, and metal shocks. In our methodology, we refine the identification of group-specific commodity shocks by combining sign restrictions with zero

TABLE 1: Restrictions on Impulse Response Functions

	GD	**GS**	**CS**	**EN**	**FO**	**ME**
Global Industrial Production	+	+	-	-	-	-
Global Inflation	+	-	+	+	+	+
Commodity Price Factor	+	+	+	*	*	*
Energy Price Index	+	+	+	+	0	0
Food Price Index	+	+	+	*	+	0
Metal Price Index	+	+	+	*	0	+
Anchor Commodity	+	+	+	0	0	0
Country Inflation	*	*	*	*	*	*

Note. **GD**: Global Demand, **GS**: Global Supply, **CS**: Common (Global) Commodity-specific, **EN**: Energy, **FO**: Food, **ME**: Metals

restrictions. For energy shocks, which exhibit similarities with common commodity shocks, we assume immediate increases in energy prices, a rise in global inflation, and a decline in global industrial production. However, a distinguishing characteristic of energy shocks is their lack of impact on cotton prices within the same month, setting them apart from common commodity shocks. This distinction is crucial for our identification strategy, where we utilize cotton price as an 'anchor' variable—unaffected by energy-specific shocks but responsive to common commodity-specific shocks, as per the zero restriction in Table 1. This approach is based on the premise that energy and cotton are non-substitutable and that energy-specific shocks, such as oil supply or precautionary oil demand shocks, have a minimal contemporaneous effect on cotton prices. While common commodity-specific shocks lead to a generalized increase in commodity prices (including both energy and cotton), disruptions in oil supply primarily affect energy prices without an immediate impact on cotton prices. Utilizing the oil market SVAR model framework in line with Kilian (2009), Mutuc et al. (2011) demonstrate that the impact of oil supply shocks, as well as precautionary oil demand shocks, on cotton prices within a month is negligible and statistically insignificant.[8]

Similarly, for food shocks, we assume a direct impact on food prices without contemporaneous effects on energy, metal, or cotton prices. Conversely, metal shocks lead to a rise in metal prices but do not immediately affect energy, food, or cotton prices. This assumption aligns with the identification strategy of Boer et al. (2023), where metal-specific demand and supply shocks do not immediately influence cotton prices.

Our robustness analysis includes the exploration of alternative anchor variables to further clarify the distinctions between various commodity shocks. A critical aspect of our approach is the joint estimation of different commodity shocks—energy, food, and metals—acknowledging that energy costs can significantly influence the production of certain grains and metals. Moreover, our identification approach, which restricts solely the immediate (impact period) effects of shocks, remains open to potential sign reversals

[8]In our robustness analysis in Section D2.3, we further test our results by including other anchor commodities, specifically tea and tobacco prices.

and general equilibrium effects in subsequent periods. This flexibility in the sign restrictions allows for a comprehensive capture of the shocks' effects beyond the initial impact.

IV. Empirical Results

In this section, we present the empirical findings derived from our country-specific SVAR models, as outlined in the previous section. We delve into the identification of structural shocks, analyze their transmission to domestic inflation, and examine the heterogeneous effects across different measures of inflation and over time.

IV.1 Structural Shocks

Before exploring the impacts of global shocks on inflation, we examine the structural shocks identified by our SVAR model. Figure 2 illustrates the evolution of these shocks over time, with the shocks accumulated to enhance readability. The structural shocks include global demand (GD), global supply (GS), common commodity-specific (CS), energy (EN), food (FO), and metal (ME) shocks.

The patterns of these shocks align broadly with key turning points of the global business cycle, commodity markets, and major policy shifts. For example, large negative global demand shocks in our model coincide with all five global recessions—namely, those occurring in 1975, 1982, 1991, 2009, and 2020. Large positive global supply shocks are observed, for example, during the late 1990s and early 2000s. During this period, significant structural changes occurred in the global economy due to the economic integration of major emerging market economies, notably China and India. China's accession to the World Trade Organization (WTO) in 2001 and India's implementation of economic liberalization policies starting in the early 1990s resulted in a marked expansion of global manufacturing capacity and altered international supply chains (Prasad, 2004).

Large energy shocks in our model are associated with significant historical events that disrupted global oil supply or expectations of oil supply, notably the 1978-1979 Iranian Revolution, the 1980-1988 Iran-Iraq War, and the Gulf War of the early 1990s. These episodes resulted in significant supply shocks and heightened uncertainty in global energy markets. The Iranian Revolution, along with the subsequent hostage crisis and geopolitical tensions such as the Soviet invasion of Afghanistan in 1979, raised concerns about the future availability of oil supplies from the Middle East (Kilian & Zhou, 2023b). The the Iran-Iraq War impeded oil output from two major producers in the region, while the Gulf War in 1990-1991 disrupted oil exports from both Iraq and Kuwait due to military conflict and international sanctions (Hamilton, 2011). Our energy shock effectively captures both the direct disruptions to energy supply and the increased demand for energy storage that arose from fears of future shortages during these periods.

Our estimated food shock series closely aligns with major historical disruptions in global food markets. Key events captured include favorable food shocks such as the 1975 global grain surplus and optimistic

rice forecasts following favorable monsoons, both of which corresponded with increased output and falling prices. The 1977 shocks are particularly illustrative; while our series detects the favorable impact of expected record U.S. and Soviet harvests, it also registers the reversal when these harvests failed due to adverse weather (see, De Winne & Peersman, 2016). More recent events are also reflected, with our series identifying severe droughts in Russia and Eastern Europe in 2010 and global droughts in 2012, both of which substantially impacted cereal production and heightened prices.

The estimated metal shock series captures several notable historical events that impacted metal markets from 1973 to 2022. A significant spike during 1987-1988 corresponds to the sustained price boom in base metals such as copper, nickel, lead, and zinc. This period followed a prolonged phase of low metal prices and was characterized by sharp price increases that continued into 1990. Supply disturbances and historically low inventory levels were critical factors driving metal prices upward, particularly in 1988. While low stocks consistently exerted upward pressure on prices, supply disruptions significantly amplified this effect. However, market fundamentals did not fully account for the magnitude of the price boom, suggesting that excessive speculation may have contributed to the price increases, especially for nickel in 1988 (Choe, 1990). The post-pandemic period depicts a series of metal shocks increasing metal prices, potentially linked to higher-than-expected demand for metals used in renewable technologies and electric vehicles intensified (IEA, 2021).

The SVAR model allows us to disentangle the different roles of commodity shocks over the sample period. For instance, during the 1990 Gulf War, there is a pronounced spike in the energy shock, while the common commodity shock remains subdued. This pattern is consistent with the literature identifying the Gulf War as predominantly an oil-specific shock resulting from significant supply disruptions in the Middle East. The conflict led to a sharp reduction in oil exports from Iraq and Kuwait, causing global oil prices to surge without a corresponding increase in other commodity prices. Moving forward in time, the common commodity shock spikes around the onset of the Global Financial Crisis (GFC), when commodity prices surged despite a downturn in broader macroeconomic indicators. This surge is often attributed to the financialization of commodities, as investors sought alternative safe assets during the crisis (Sockin & Xiong, 2015). More recently, the Russia-Ukraine conflict appears primarily as an energy and food shock, with a smaller contribution from the common commodity shock.

Additionally, the early 2000s surge in metal demand from China's industrial expansion is not captured by our metal shock series but rather by the non-commodity global supply shocks that led to increase in metal demand rather than metal-specific supply disruptions. China's rapid economic growth and infrastructure development significantly boosted global demand for metals, impacting prices through heightened consumption rather than supply constraints. In contrast, we observe a sequence of metal shocks increasing metal prices post-2020. These shocks build more gradually than the sharper movements observed in energy and food shocks and are potentially linked to higher-than-expected demand for metals and minerals due to the rapid growth of digitalization and low-carbon technologies and infrastructure.

IV.2 Non-commodity Global Shocks, Commodity Prices, and Inflation

Having presented the structural shocks in the previous section, we now turn to analyzing their inflationary impact. Commodity prices are determined endogenously in response to global economic conditions and commodity market shocks. In fact, findings in the literature suggest that a significant portion of movements in commodity prices are due to shocks to non-commodity economic activity. For example, Kilian (2009) finds that demand shocks related to global economic activity account for a large share of oil price fluctuations, while Baumeister et al. (2024) show that global demand and supply shocks are important drivers of metal price fluctuations.[9] Thus, we begin by analyzing the impact of non-commodity shocks on commodity prices and domestic inflation.

The impacts of global shocks on domestic headline inflation reveal that a positive one standard deviation global demand shock—equivalent to a 0.6 percentage point increase in global output growth—produces the largest inflationary response, with an estimated 0.7 percentage point rise in inflation for the median country after 12 months. In contrast, the inflationary impact of a one standard deviation (negative) global supply shock is smaller, increasing inflation by 0.2 percentage points for the median country after 12 months (Figure 3A). Global demand shocks exhibit statistically significant effects in over three-quarters of the countries in the sample, while global supply shocks show statistically significant effects in about half of the countries (Figure 3B).[10]

The large positive impact of global demand shocks on headline inflation is consistent with expectations. A global demand shock, such as a more accommodative monetary policy in the United States, boosts domestic economic activity, with effects spilling over to other countries through financial and trade linkages. Higher global economic activity elevates demand for both manufactured goods and a wide range of commodities, resulting in a pronounced impact on headline inflation globally and across countries. Our impulse response functions indicate that the largest effect of this shock materializes within one year. Conversely, a global supply shock, such as a surge in productivity in the non-commodity sector, also increases demand for commodities. However, the inflationary effect of higher commodity prices is offset by deflationary pressures from lower prices of non-commodity goods, leading to a smaller net impact on headline inflation.

Our results also underscore that global demand and supply shocks substantially influence headline inflation through their effects on energy and food prices. To investigate this further, we estimate our baseline regressions using energy and food CPI inflation across countries. The findings show that global demand shocks have the strongest impact on both energy and food inflation for the median country at the 12-month horizon. While global supply shocks also exert a relatively large influence on food inflation,

[9] Kilian (2009) examines the role of global demand shocks in driving energy prices, and Baumeister et al. (2024) analyze the impact of demand and supply shocks on metal prices.

[10] The broad-based transmission of global demand shocks aligns with the findings of Charnavoki & Dolado (2014) and Ha et al. (2023a). For instance, using factor-augmented VAR (FAVAR) models across 55 economies, Ha et al. (2023a) identify both global demand and energy shocks as having statistically significant impacts on domestic inflation in around 70 percent of countries.

their impact on energy inflation is more subdued (Figures 6 and 7). These results align with evidence that non-commodity economic activity shocks are primary drivers of commodity price changes. For instance, Kilian (2009) show that oil price fluctuations are largely driven by non-commodity economic activity shocks (see, also, Peersman & Robays, 2009; Kilian & Murphy, 2014). In the case of food prices, De Winne & Peersman (2016) find that food commodity supply shocks account for approximately 10 percent of food price movements, with the majority of fluctuations driven by other shocks, including demand shocks that influence food prices through channels such as broader income effects tied to global economic activity.[11]

Thus, our results indicate that while global demand shocks, alongside supply shocks, exert a substantial impact on headline inflation, the resulting shifts in commodity prices serve as a key transmission mechanism. Recent studies highlight the significant role of this "commodity channel" in driving inflation transmission. For instance, Miranda-Pinto et al. (2023) demonstrate that changes in U.S. monetary policy have significant effects on commodity prices such as oil, base metals, and food, accounting for a large share of the overall transmission to headline inflation both domestically and internationally. They find that the commodity-price channel explains approximately 41 percent of the total impact of U.S. monetary policy on domestic headline inflation and 66 percent of its effect on other countries headline inflation, with base metals and oil playing particularly prominent roles.

While the impact of global shocks on headline inflation highlights the significant role of commodity price movements, their effects on core CPI inflation—a key variable for monetary policy decisions—are equally important. Core inflation, which excludes volatile items like food and energy, provides a clearer view of persistent inflation dynamics. Over the full sample period (1973-2022), core inflation responds to both global demand and supply shocks. As shown in Figure 5, the overall impact of global demand and supply shocks on core inflation closely mirrors their effect on headline inflation, with global demand shocks exerting the largest influence. Notably, the impact of global supply shocks is larger on core inflation compared to their effect on headline inflation. The larger impact of global supply shocks on core inflation compared to headline inflation may reflect the role of global supply chains in transmitting these shocks across a broad range of goods and services. Unlike headline inflation, which is more sensitive to volatile food and energy prices, core inflation captures more persistent cost pressures, particularly those propagated through interconnected production networks.[12]

[11] Similarly, Baumeister, Ohnsorge, & Verduzco-Bustos (2024) find that economic activity shocks predominantly explain metal price changes.

[12] The critical role of global supply and demand shocks on core inflation is well-documented in the literature. Using a global FAVAR model, Ha et al. (2023c) show that global core inflation is primarily driven by global supply shocks, followed by global demand shocks.

IV.3 Commodity Shocks and their Effects on Headline, Core, and Sectoral Inflation

Having established that global demand and supply shocks significantly influence headline and core inflation—especially through their effects on commodity prices—we now examine the direct impact of commodity-specific shocks on headline inflation and related measures. In addition to headline inflation, we analyze three disaggregated measures classified by the OECD: energy, food, and core CPI inflation. Food inflation reflects price changes in the "food and non-alcoholic beverages" category of the consumer price index (CPI). Energy inflation is derived from a specialized OECD classification that includes electricity, fuel, and other energy-related costs. Core inflation, which varies slightly in its definition across countries, excludes the volatile energy and food components from the overall CPI basket.

Headline inflation. Among the commodity-specific shocks, energy shocks have the most substantial effect on headline inflation, raising it by an estimated 0.45 percentage points in response to a one standard deviation increase in energy prices (equivalent to a 10 percent rise in energy prices). Over different horizons, as shown in Figure 4A and summarized in Table 2, a 10 percent energy price shock leads to an estimated increase in domestic headline inflation of 0.4 percentage points within one year and 0.5 percentage points within two years. The impact of energy shocks was broadly consistent across countries, with interquartile ranges of the impact (within two years) spanning from 0.2 to 0.8. To illustrate, the sharp rise in oil prices following the war in Ukraine—a 26 percent increase between February and June 2022—is estimated to have raised average inflation by approximately 1.3 percentage points, *ceteris paribus*.

Food shocks have a similar impact, increasing headline inflation by nearly 0.4 percentage points following a one standard deviation rise in food prices (equivalent to a 3 percent increase in food prices), as shown in Figure 4B.[13] The estimated impact of an exogenous 3 percent increase in food commodity prices is 0.29 percentage points within two year and 0.34 percentage points in three years. These results are consistent with the broader literature, which highlights energy and food shocks as prominent drivers of headline inflation (Cecchetti & Moessner, 2008; Abbas & Lan, 2020). Energy and food shocks register statistically significant effects on headline inflation in roughly three-fifths of countries within our sample.

For metal shocks, the impact on inflation is comparable to that of food shocks but less persistent. A one standard deviation metal shock—equivalent to a 5 percent increase in metal prices—results in a 0.23 percentage point increase in headline inflation within 12 months, reaching a maximum of 0.29 percentage points after two years (Figure 4C). Metals are key inputs in the production of goods such as electronics, vehicles, and construction materials. Therefore, an increase in metal prices leads to a relatively sizable

[13] Although studies directly examining the impact of global food shocks on domestic inflation are limited, our findings align with those of Outlook (n.d.) and Laborde et al. (2019), who observe that global food price spikes have historically translated to inflation increases in many economies, particularly in low-income countries where food comprises a substantial share of consumption. Similarly, using an SVAR model with an external instrument for global harvest shocks, Peersman (2022) finds that exogenous food price shocks account for 25-30 percent of inflation volatility in the Euro Area.

impact on headline inflation. However, unlike energy and food prices, which are directly reflected in the consumer basket (e.g., electricity, gasoline, and groceries), metals influence inflation through downstream effects in production chains and how these costs are passed on to consumers.

The relatively shorter-lived impact aligns with the nature of metal price fluctuations. Longer-term metal price trends are predominantly shaped by global economic activity shocks—captured by our non-commodity global demand and supply shocks—whereas metal-specific shocks, such as temporary supply disruptions or changes in storage demand, induce short-term volatility (see, Baumeister et al., 2024). As a result, the metal shocks identified here reflect these transient price movements, translating into a less enduring inflationary influence. Nonetheless, it is important to note that under certain conditions—such as when inflation expectations are poorly anchored or wage-setting is inflexible—even brief metal price surges can yield more persistent inflation dynamics. In such cases, second-round effects, including wage-price spirals or heightened inflation expectations, could amplify and prolong the initial impact of metal price shocks.

A one-standard deviation common commodity-specific shock—equivalent to a 5 percent increase in the commodity price factor—results in an increase in headline inflation of 0.25 percentage points within one year, reaching 0.35 percentage points after three years (Figure 4D). Our results indicate that broad-based increases in commodity prices can impact headline inflation through shocks that are uncorrelated with non-commodity global demand and supply shocks. As discussed earlier, these shocks may capture correlated spikes in financialized commodity markets. Recent studies have highlighted the role of speculative activity in driving commodity prices and U.S. inflation during the post-pandemic period of 2020-2022 (Breman & Storm, 2023). The effects of these shocks are statistically significant in less than half of the countries studied.

Core Inflation. Energy shocks have the largest impact on core inflation. A 10 percent increase in energy prices leads to a rise in core inflation of approximately 0.3 percentage points after one year and 0.4 percentage points after three years (see Figure 5 and Table 3). However, as expected, the pass-through of energy shocks to core inflation is smaller than pass-through to headline inflation. Energy shocks impact headline inflation directly through consumer energy prices, while their effects on core inflation arise indirectly through higher production costs, wage adjustments, and changes in inflation expectations. A similar finding is highlighted by Banbura et al. (2023), who emphasize the importance of understanding these second-round effects to assess their role in shaping core inflation dynamics over time.

Additionally, as shown in Figure 5, a 3 percent increase in food prices raises core inflation by about 0.16 percentage points after one year and 0.26 percentage points after three years. While this indicates a smaller pass-through of food shocks to core inflation compared to energy shocks for the median country, considerable cross-country heterogeneity exists. For example, in the United States, food shocks exert a larger effect on core inflation than energy shocks. According to Castelnuovo et al. (2024), food commodity price shocks not only elevate US core CPI but also push up nominal wages; absent any monetary policy

response, these pressures would be even greater. This suggests that food price shocks generate significant second-round effects in the United States that amplify their influence on core inflation, prompting a policy tightening to contain these dynamics. In contrast, oil price shocks tend to reduce nominal wages and have only a marginal, short-lived impact on core CPI, with counterfactuals indicating that US core inflation might decline in the absence of an expansionary policy measure adopted.

The effect of metal shocks on core inflation is comparable to food shocks but smaller than energy shocks, with core inflation rising by 0.15 percentage points after 12 months in response to metal price increases (Figure 5). The sizeable impact of metal shocks on core inflation is consistent with recent studies highlighting the role of base metals as critical intermediate inputs for investment goods in production networks (see, e.g., Miranda-Pinto et al., 2024).[14]

The impact of common commodity-specific shocks on core inflation is the least pronounced among the commodity shocks analyzed. This muted influence likely reflects the less persistent nature of these shocks, which may capture short-term price fluctuations influenced by speculative activity. Such transitory dynamics are less prone to triggering sustained adjustments in pricing strategies across non-commodity sectors, thereby limiting their transmission to core inflation.

Energy and Food Inflation. The importance of energy shocks in driving domestic energy inflation is evident (Figure 6), with significant effects observed in 90 percent of countries (Figure 6A). These shocks also exhibit the strongest influence on domestic energy inflation compared to other commodity shocks analyzed (Figure 6B). Thus, beyond global demand shocks, energy inflation is largely driven by energy market-specific shocks, such as oil supply disruptions caused by geopolitical conflicts or increased oil storage demand in anticipation of heightened risks. The pass-through ratio of global energy shocks to domestic energy inflation is approximately 10 percent, meaning that a 10 percent increase in energy prices corresponds to a 1 percent increase in energy inflation within a year for the median country (Figure 6C). Energy shocks also have a notable impact on food inflation, with statistically significant effects in about half of the countries (Figure 7). This reflects the role of oil prices in shaping food costs through input channels, such as fuel and fertilizers, which often lead to simultaneous changes in energy and food prices (see, for example, Castelnuovo et al., 2024). The biofuel channel further links energy and food prices, as highlighted by De Winne & Peersman (2016).

Our findings reveal that, alongside global demand and energy shocks, food-specific shocks exert a large influence on food inflation for the median country, with statistically significant effects in nearly half the countries in the sample (Figure 7). Food supply shocks, such as weather disasters or unanticipated poor harvests, have been shown to account for substantial variance in food prices (see, De Winne & Peersman,

[14]In contrast to Miranda-Pinto et al. (2024), our findings indicate that energy shocks have a statistically significant and larger impact on core inflation than metal shocks. This difference may stem from our broader definition of metal shocks, which captures both metal supply and inventory demand shocks, whereas Miranda-Pinto et al. (2024) focus exclusively on metal supply shocks.

2016).[15] Our results also suggest that food-specific shocks have a relatively small impact on energy inflation. While the relationship between food and energy inflation has been widely discussed in the context of the biofuel revolution, our findings indicate that food-specific shocks, such as unfavorable harvests, play a limited role in driving energy inflation in the median country (see Figure 6B). This is consistent with Peersman, Rüth, & Van der Veken (2021), who highlight that the transmission of food shocks to energy remains modest.

Our results indicate that metal shocks have a larger impact on energy inflation compared to food shocks (Figure 6). This suggests that metals play an important role in the production and distribution of fossil fuel energy, possibly through their use in drilling equipment, pipelines, storage facilities, and other industrial processes associated with coal, natural gas, and oil. While biofuels have often been highlighted as a key linkage between food and energy, these findings emphasize the importance of metal commodities in driving energy inflation for the median country. These results are statistically significant in about 60 percent of the countries in our sample. In contrast, the impact of metal shocks on food inflation is relatively muted, reflecting the weaker production linkages between metals and food markets (Figure 7).

The impact of common commodity-specific shocks on energy and food CPI inflation is more pronounced. In particular, these shocks have a substantial effect on energy inflation in the median country, with an impact comparable to that of energy-specific shocks, such as oil supply disruptions. These findings are robust, with statistically significant results observed in 80 percent of the countries in our sample (Figure 6). This finding aligns with the fact that energy commodities, particularly crude oil, dominate commodity derivatives markets, making energy prices especially sensitive to shocks in financialized commodity markets (Peersman, Rüth, & Van der Veken, 2021).[16] Similarly, while the effect of these shocks on food CPI inflation is smaller than on energy CPI inflation, it remains significant. This observation corresponds to the prominent role of agricultural commodities, such as corn and soybeans, as traded assets in financialized markets (Figure 7).

IV.4 Changes in Inflationary Effects of Global and Commodity Shocks Over Time

Thus far, we have examined how non-commodity global and commodity-specific shocks influence domestic inflation over the extended period from 1973 to 2022. We now focus on the more recent era (2000-2022), during which the widespread adoption of inflation targeting and more firmly anchored inflation expectations may have altered the nature of these relationships.[17]

[15] De Winne & Peersman (2016) note that during the food price spikes of 2005-2007 and 2009-2012, food supply shocks contributed more than 10 percentage points to price increases in each instance. However, the bulk of these food price spikes were driven by other factors, such as rising income levels in EMDEs.

[16] Alternatively, it is plausible that price increases in the energy sector spill over rapidly to other commodity sectors within a month. Our empirical model may capture such spillover effects as part of common commodity-specific shocks.

[17] For example, Gelos & Ustyugova (2017) find that economies with higher shares of food in their CPI baskets, greater fuel intensities, and higher initial inflation levels are more vulnerable to persistent inflationary effects

As shown in Figures 8 and 9, the sensitivity of headline inflation to both non-commodity global and commodity-specific shocks has diminished over time. Energy shocks have experienced the most significant decline in pass-through to headline inflation, with effects decreasing from 0.5 during the full sample period (1973-2022) to 0.2 in the post-2000 period, both measured over a 2-3 year horizon. Metal and common commodity shocks shocks have shown a similar reduction, with pass-through falling from 0.3 to 0.1. An exception to this pattern is observed for food shocks, where the decline in pass-through ratios is less pronounced. In comparison to other commodity shocks, the decline in the pass-through of food shocks has been more modest, decreasing from 0.3 to 0.2. Additionally, under the full sample, the transmission effects of these shocks persisted for roughly three years. In the more recent sample, however, their influence largely dissipates after about one year, suggesting weaker second-round effects or attenuated sectoral spillovers.[18]

Turning to core inflation (Figures 10A and 10B), its sensitivity to shocks has markedly weakened in the post-2000 period. The literature suggests several reasons for this reduced responsiveness, including lower real wage rigidities, enhanced central bank credibility, and a declining oil intensity in global production processes (Blanchard & Galí, 2007).[19] Our results also indicate a relative increase in the role of supply-driven factors in shaping core inflation during the post-2000 period, reflecting a shift in the balance of global demand and supply shocks. This pattern is consistent with other studies documenting an increased influence of supply shocks, including those related to energy and metals, on inflation following the COVID-19 pandemic (see Ha et al., 2023b; Banbura et al., 2023).

For energy inflation, the median-country responses in the post-2000 period broadly resemble those in the full sample, with global demand, energy, and common commodity-specific shocks exerting substantial effects (Figures 10C and 10D). Global supply shocks appear more influential than before, aligning with the growth-led rise in industrial commodity prices—particularly energy and metals—during the early 2000s commodity boom (Charnavoki & Dolado, 2014; World Bank, 2022). Meanwhile, in the case of food inflation, the impact of food-specific shocks has grown in the post-2000 period, potentially reflecting greater weather-related disruptions. These changes, however, remain statistically significant for only about 40 percent of countries (Figures 10E and 10F).

of commodity price shocks. In contrast, those with more independent central banks and stronger governance frameworks are better able to contain such shocks.

[18]These results align with prior literature indicating that the impact of lagged shocks (Bekkers et al., 2017) and varying inflation regimes (Abbas & Lan, 2020) can shape the transmission of commodity price changes to inflation. Similarly, using a state space approach to estimate time-varying oil-price pass-through coefficients, Chen (2009) document a decline in the average pass-through over time, attributing it to factors such as improved monetary policy, changes in nominal exchange rate behavior, and greater trade openness.

[19]One hypothesis is that the intrinsic effects of commodity shocks on inflation have not changed, but the nature of the shocks themselves has evolved. For example, the severe oil supply disruptions of the early 1970s and speculative episodes in the mid-1970s exerted more pronounced effects compared to commodity price fluctuations in the 2000s, which were tied to productivity gains and robust global demand. Our identification strategy accounts for these varying shock types, yet we still find muted effects on core inflation post-2000.

V. Conclusion

This paper provide novel estimates of the pass-through coefficients of commodity shocks to domestic inflation. This involves analyzing disaggregated commodity prices alongside various inflation metrics across a broad spectrum of countries. We utilize SVAR models on a country-by-country basis to examine the impact of global demand, global supply, and both common and sector-specific (energy, food, and metal) commodity shocks on domestic inflation. Our extensive database, spanning 26 countries from January 1973 to December 2022, enables a rigorous assessment of cross-country variations in pass-through effects.

The findings underscore the key role of commodity markets in shaping domestic inflation. Non-commodity global demand shocks such as a more accommodative monetary policy in a major economy, significantly boosts global output and commodity demand, translating into pronounced inflationary pressures. These effects are broad-based, with statistically significant responses observed in more than three-quarters of the countries examined. In comparison, global supply shocks have a less pronounced net effect on headline and core inflation, as increases in commodity prices are offset by declines in non-commodity prices.

Commodity-specific shocks—particularly those related to energy and food—emerge as key drivers of headline and core inflation. Energy price shocks exert a large and sustained impact, while food price shocks, though slightly smaller, remain significant. Cross-country heterogeneity is evident; for instance, in the United States, food shocks have a greater impact on core inflation than energy shocks. Metal price shocks influence inflation through production chains and intermediate inputs, creating notable but shorter-lived inflationary pressures. In contrast, common commodity-specific shocks, often linked to speculative activity in financialized markets, have more modest and less persistent effects on headline inflation, reflecting their transitory nature.

Our findings highlight that energy market-specific shocks are key drivers of energy inflation, with statistically significant effects in 90 percent of the countries analyzed. Energy shocks also influence food inflation, likely through their impact on agricultural input costs, including fuel and fertilizers. In contrast, food-specific shocks have a substantial impact on food inflation but minimal influence on energy inflation, underscoring the asymmetry between these markets. Metals also play an important role in energy inflation, reflecting their use in energy production and distribution infrastructure such as pipelines and drilling equipment. Additionally, food-specific shocks underline the vulnerability of the food sector to supply-side disruptions, which continue to be a significant driver of food inflation. Common commodity-specific shocks also affect energy and food inflation, though their effects are generally weaker and less persistent compared to other commodity shocks.

Over time, the pass-through of commodity price shocks to inflation has declined, with notable differences across commodities. Energy shocks have exhibited the largest reduction in pass-through to headline inflation, decreasing sharply from 0.5 during the full sample period (1973-2022) to 0.2 in the post-2000 period, measured over a 2-3 year horizon. Metal and common commodity shocks have also seen substantial declines, with their pass-through dropping from 0.3 to 0.1 over the same period. In contrast,

the reduction in the pass-through of food shocks has been more moderate, declining from 0.3 to 0.2. A similar pattern of diminishing pass-through is observed in core inflation, where the effects of food, energy, metal, and common commodity shocks have all weakened over time.

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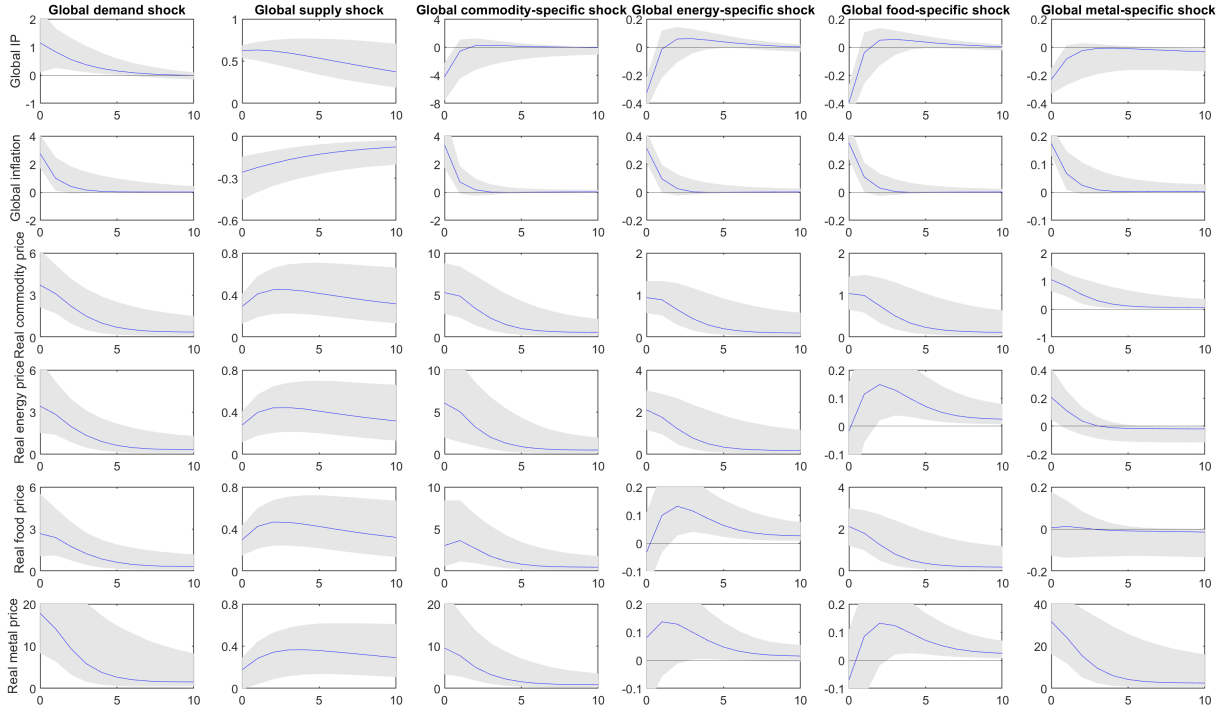
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FIGURE 1: Responses to six global commodity shocks



Notes: The solid lines are the median of the distribution of the responses of each variable, and the areas between the 16th and 84th percentiles of the distribution are shaded. The responses are computed based on 5,000 draws. "Global IP" refers to global industrial production, and real prices are global real prices. The unit on the x-axis is quarters. The unit on the y-axis for global inflation is percentage points, and the unit on the y-axis for the other variables is percent.

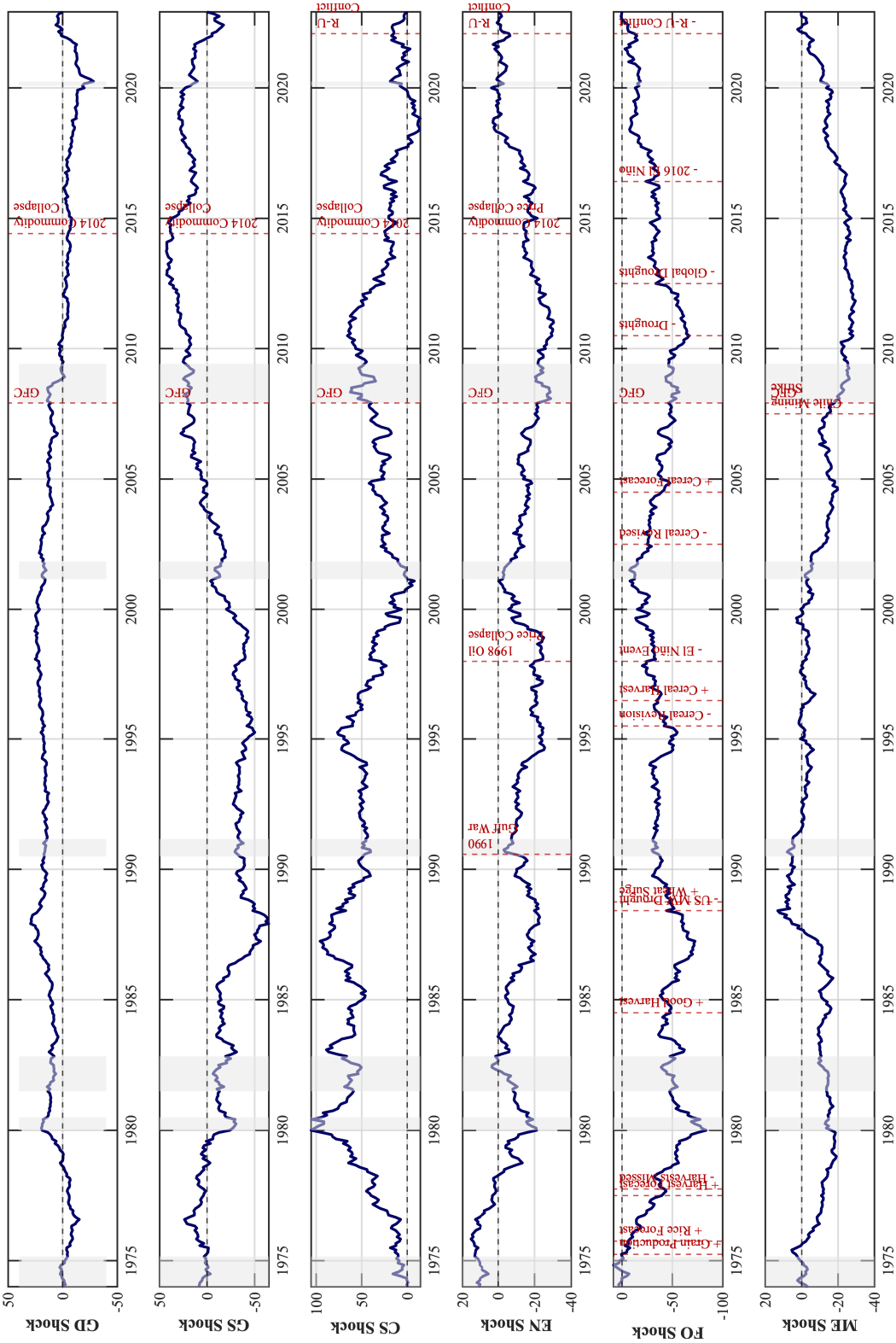
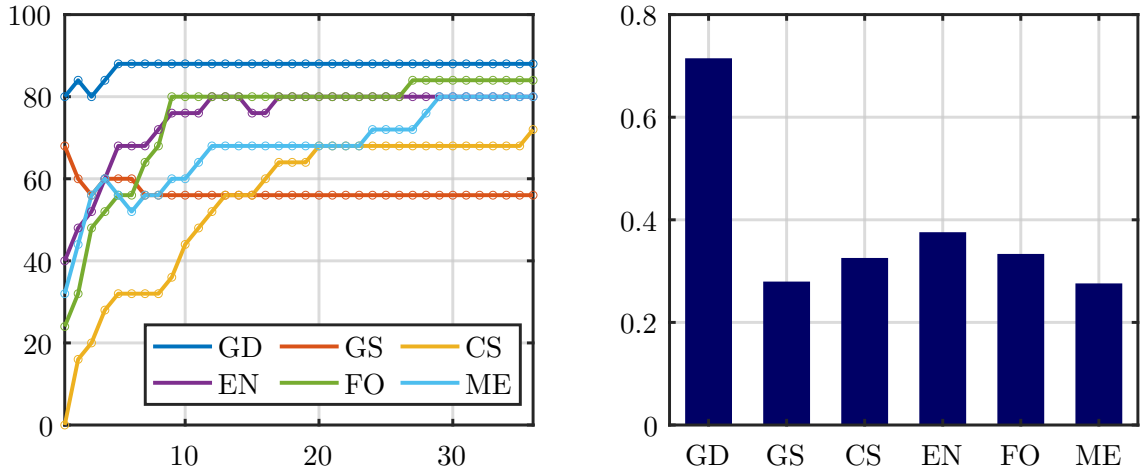


FIGURE 2: ESTIMATED STRUCTURAL SHOCKS (ACCUMULATED)

Note: The model identifies six structural shocks: global demand (GD), global supply (GS), common (global) commodity-specific (CS), energy-specific (EN), food-specific (FO), and metal-specific (ME) shocks.

FIGURE 3: IMPACT OF GLOBAL AND COMMODITY SHOCKS

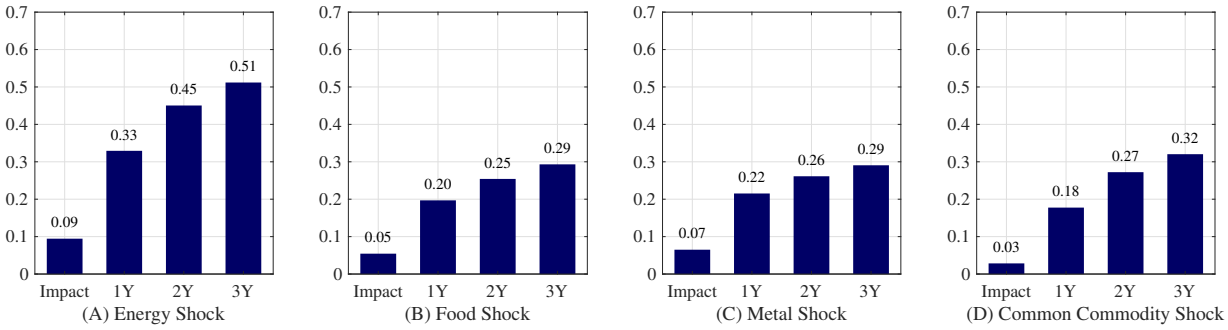


(A) Countries with significant results

(B) Impact of Structural Shocks

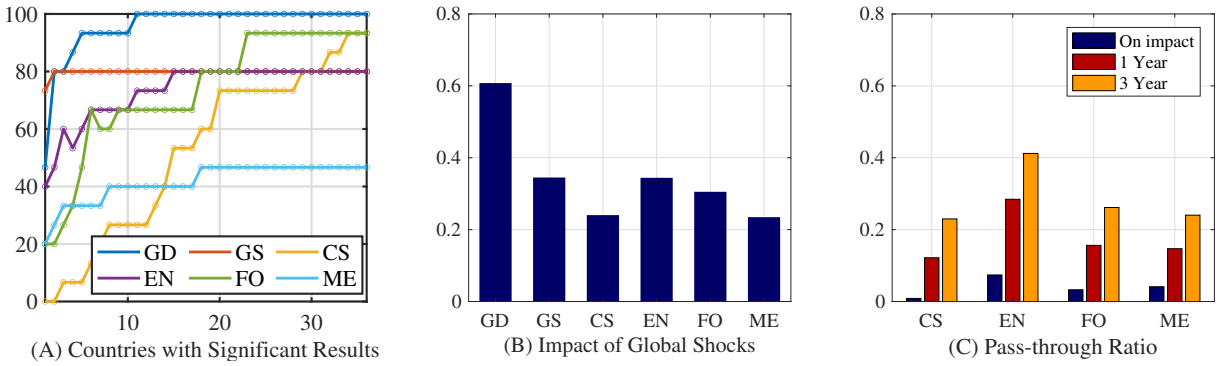
Note: Empirical results are based on the monthly SVAR model of 51 countries (26 advanced economies and 25 EMDEs). The models include global output, inflation, commodity prices, energy prices, food prices, metal prices, and domestic headline CPI inflation. The sample period is 1973-2022. The model identifies six global shocks: global demand (GD), global supply (GS), common (global) commodity-specific (CS), energy-specific (EN), food-specific (FO), and metal-specific (ME) shocks.

FIGURE 4: PASS-THROUGH RATIO OF COMMODITY SHOCKS



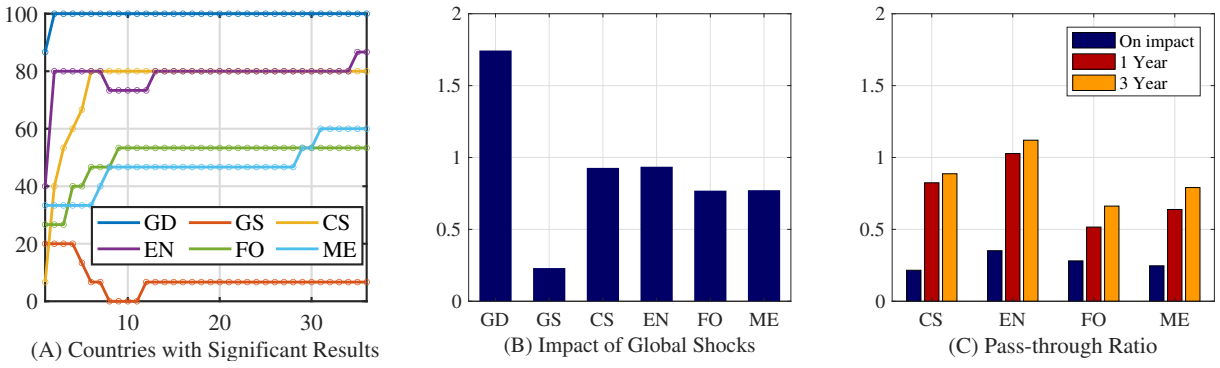
Note: Empirical results present median impulse responses of headline CPI inflation following one standard deviation global shocks, based on the monthly SVAR model of 51 countries (26 advanced economies and 25 EMDEs). The models include global output growth, inflation, commodity prices, energy prices, food prices, metal prices, and domestic headline CPI inflation. The sample period is 1973-2022. The model identifies six global shocks: global demand (GD), global supply (GS), common (global) commodity-specific (CS), energy-specific (EN), food-specific (FO), and metal-specific (ME) shocks.

FIGURE 5: PASS-THROUGH OF COMMODITY SHOCKS TO CORE INFLATION



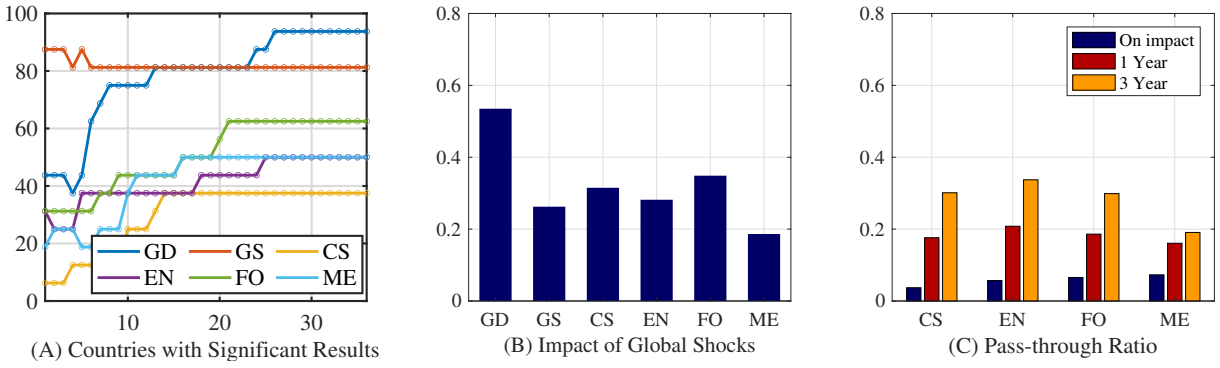
(A) Countries with Significant Results (B) Impact of Global Shocks (C) Pass-through Ratio

FIGURE 6: PASS-THROUGH OF COMMODITY SHOCKS TO ENERGY INFLATION



(A) Countries with Significant Results (B) Impact of Global Shocks (C) Pass-through Ratio

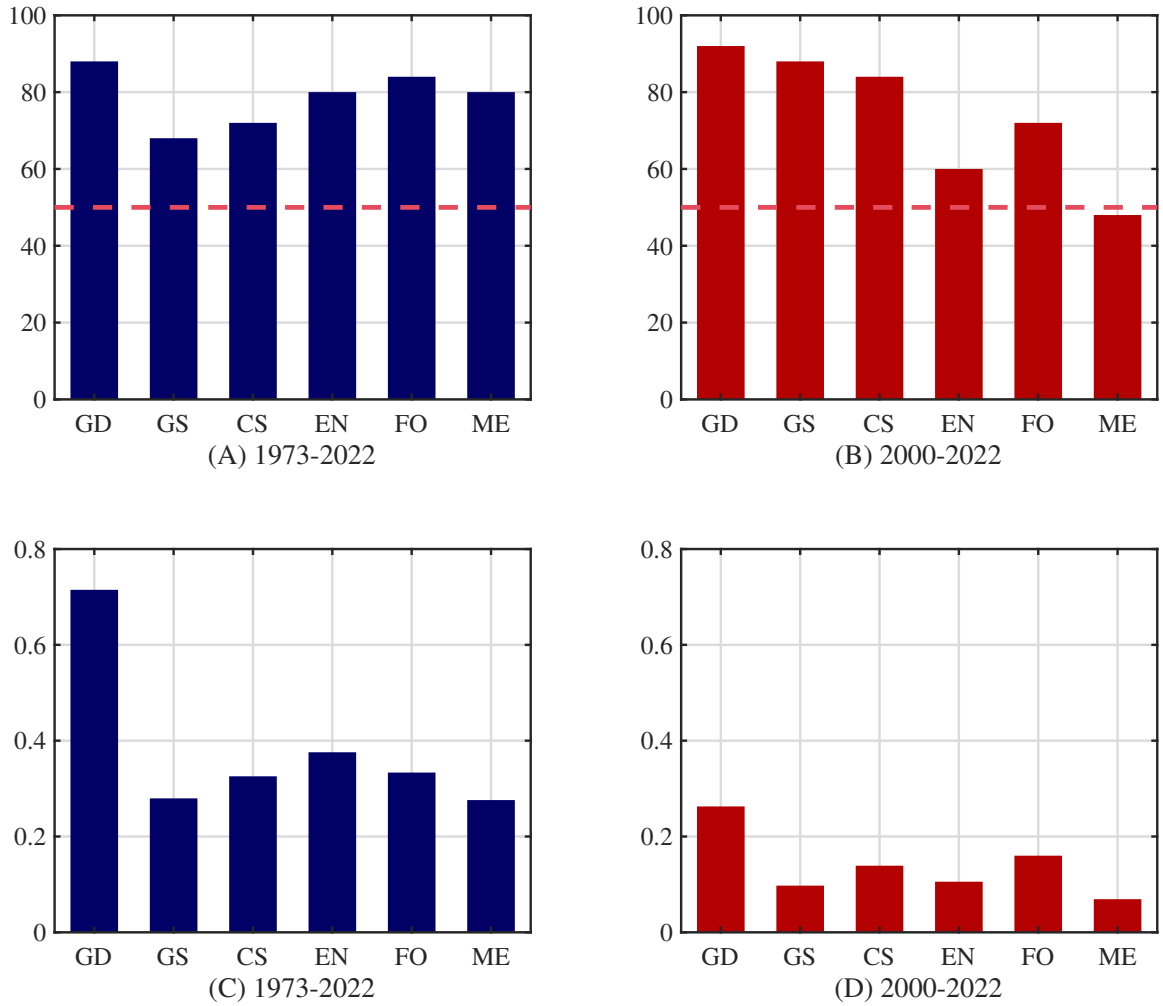
FIGURE 7: PASS-THROUGH OF COMMODITY SHOCKS TO FOOD INFLATION



(A) Countries with Significant Results (B) Impact of Global Shocks (C) Pass-through Ratio

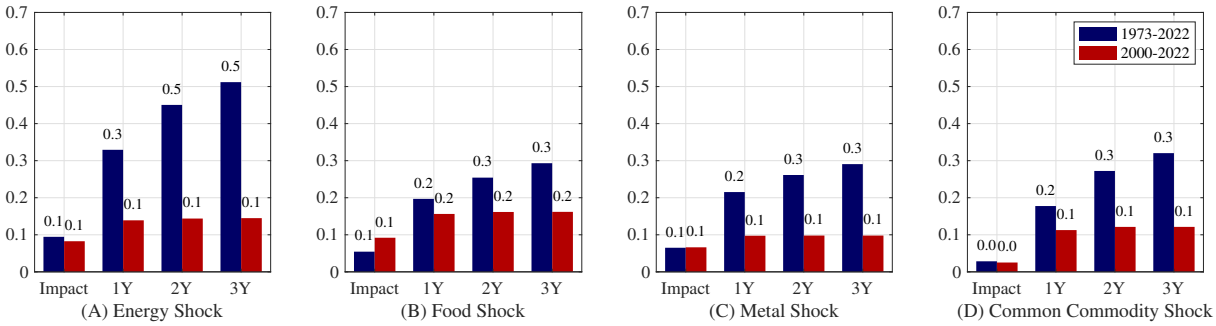
Note: Empirical results based on monthly SVAR model of 15 advanced economies. The models include global output, inflation, commodity prices, energy prices, food prices, metal prices, and domestic energy CPI inflation. The sample period is 1973-2022. The model identifies six global shocks: global demand (GD), global supply (GS), common (global) commodity-specific (CS), energy-specific (EN), food-specific (FO), and metal-specific (ME) shocks.

FIGURE 8: SUBSAMPLE ANALYSIS: *TOP:* COUNTRIES WITH SIGNIFICANT IMPACT OF GLOBAL SHOCKS. *BOTTOM:* IMPACT OF COMMODITY SHOCKS OVER TIME.



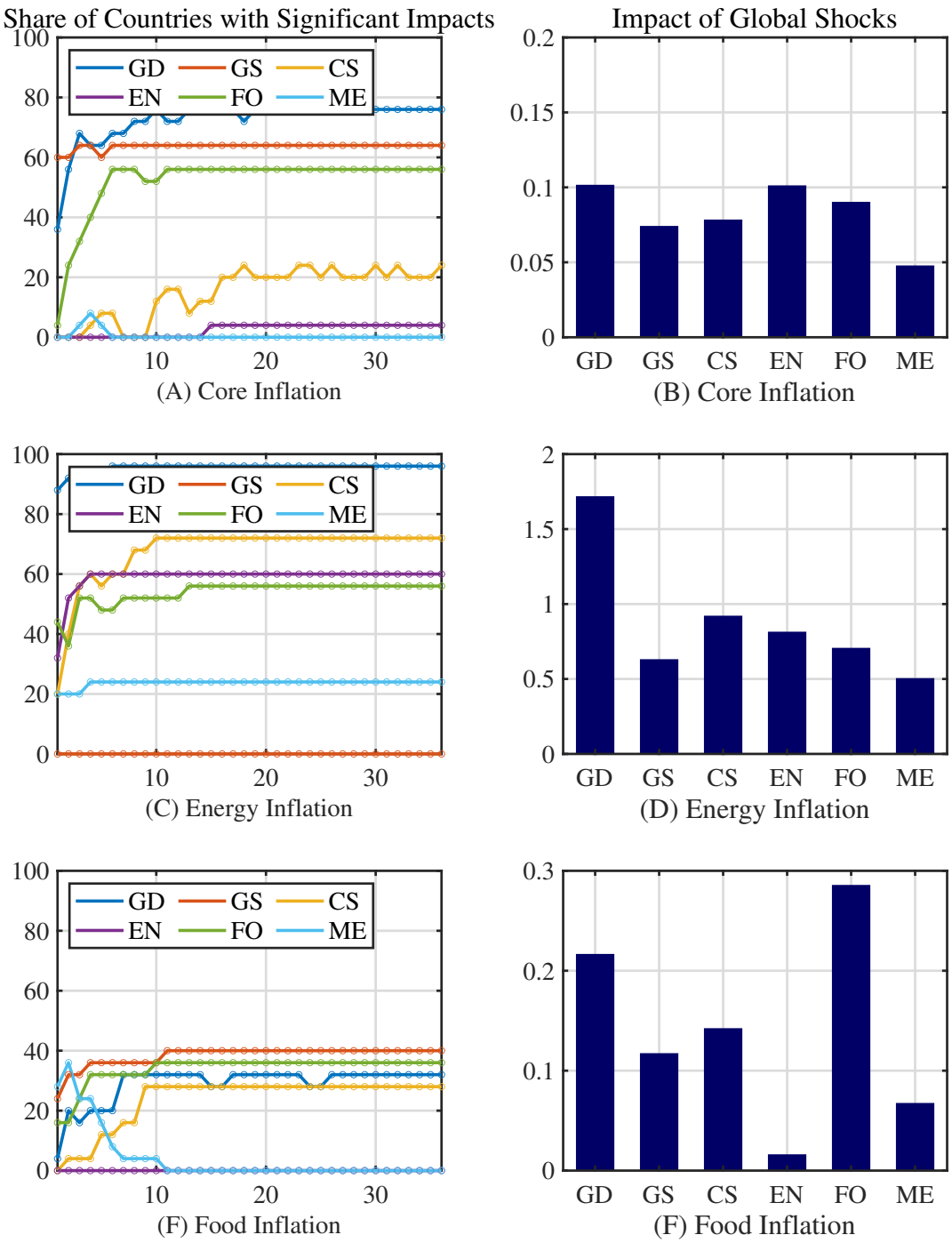
Note: Empirical results based on monthly SVAR model of 15 advanced economies. The models include global output, inflation, commodity prices, energy prices, food prices, metal prices, and domestic energy CPI inflation. The sample period is 1973-2022. The model identifies six global shocks: global demand (GD), global supply (GS), common (global) commodity-specific (CS), energy-specific (EN), food-specific (FO), and metal-specific (ME) shocks.

FIGURE 9: PASS-THROUGH OF COMMODITY SHOCKS



Note: Empirical results based on monthly SVAR model of 15 advanced economies. The models include global output, inflation, commodity prices, energy prices, food prices, metal prices, and domestic energy CPI inflation. The sample period is 1973-2022. The model identifies six global shocks: global demand (GD), global supply (GS), common (global) commodity-specific (CS), energy-specific (EN), food-specific (FO), and metal-specific (ME) shocks.

FIGURE 10: GLOBAL SHOCKS PASS-THROUGH INTO ALT. INFLATION MEASURES: 2000-22



Note: Empirical results based on monthly SVAR model of 15 advanced economies. The models include global output, inflation, commodity prices, energy prices, food prices, metal prices, and domestic energy CPI inflation. The sample period is 1973-2022. The model identifies six global shocks: global demand (GD), global supply (GS), common (global) commodity-specific (CS), energy-specific (EN), food-specific (FO), and metal-specific (ME) shocks.

TABLE 2: Pass-through ratio: 1973-2022

Inflation measures	Commodity shocks	1 month	1 year	2 years	3 years
Headline CPI	Common Commodity	0.03	0.18	0.27	0.32
	Energy	0.09	0.33	0.45	0.51
	Food	0.05	0.20	0.25	0.29
	Metal	0.06	0.18	0.26	0.28

Note. This table presents the estimated pass-through ratio of global commodity shocks (common commodity, energy, food, and metal shocks) into inflation measures based on country-specific SVAR models for the full sample period (1973-2022). The ratios are based on the median across countries. In calculating the pass-through ratios, the size of the shocks is normalized to be 10 percent (energy shock), 5 percent (metal and common commodity shocks), 3 percent (food shocks).

TABLE 3: Pass-through ratio to alternative inflation measures: 1973-2022

Inflation Measures	Commodity Shocks	1 month	1 year	2 years	3 years
Core CPI	Common Commodity	0.01	0.12	0.19	0.23
	Energy	0.07	0.28	0.37	0.41
	Food	0.03	0.16	0.22	0.26
	Metal	0.04	0.15	0.22	0.24
Energy CPI	Common Commodity	0.22	0.82	0.86	0.89
	Energy	0.35	1.03	1.07	1.12
	Food	0.28	0.52	0.64	0.66
	Metal	0.25	0.64	0.76	0.79
Food CPI	Common Commodity	0.04	0.18	0.26	0.30
	Energy	0.06	0.21	0.26	0.34
	Food	0.07	0.19	0.30	0.30
	Metal	0.07	0.16	0.17	0.19

Note: This table presents the estimated pass-through ratio of global commodity shocks (common commodity, energy, food, and metal shocks) into inflation measures based on country-specific SVAR models for the full sample period (1973-2022). The ratios are based on the median across countries. In calculating the pass-through ratios, the size of the shocks is normalized to be 10 percent (energy shock), 5 percent (metal and common commodity shocks), 3 percent (food shocks).

TABLE 4: Pass-through ratio: 2000-2022

Inflation Measures	Commodity Shocks	1 month	1 year	2 years	3 years
Headline CPI	Common Commodity	0.03	0.11	0.12	0.12
	Energy	0.08	0.14	0.14	0.14
	Food	0.09	0.16	0.16	0.16
	Metal	0.09	0.10	0.10	0.10
Core CPI	Common Commodity	0.01	0.09	0.09	0.09
	Energy	0.05	0.11	0.11	0.11
	Food	0.06	0.08	0.09	0.09
	Metal	0.03	0.05	0.05	0.05
Energy CPI	Common Commodity	0.31	1.08	1.10	1.11
	Energy	0.39	0.91	0.92	0.92
	Food	0.38	0.67	0.68	0.68
	Metal	0.36	0.49	0.49	0.49
Food CPI	Common Commodity	0.05	0.16	0.17	0.17
	Energy	-0.04	0.02	0.02	0.02
	Food	0.12	0.26	0.27	0.27
	Metal	0.05	0.07	0.07	0.07

Note: This table presents the estimated pass-through ratio of global commodity shocks (common commodity, energy, food, and metal shocks) into inflation measures based on country-specific SVAR models for the sub-sample period (2000-2022). The ratios are based on the median across countries. In calculating the pass-through ratios, the size of the shocks is normalized to be 10 percent (energy shock), 5 percent (metal and common commodity shocks), 3 percent (food shocks).

How Do Commodity Prices Affect Inflation?

November 2024

Jongrim Ha, Myunghyun Kim, M. Ayhan Kose, and Hamza Zahid

Supplemental Appendix

Not for Publication

This appendix contains:

Appendix A. Literature Review
Appendix B. A Dynamic Stochastic General Equilibrium Model
Appendix C. Data and Empirical Estimation
Appendix D. Further Considerations
Appendix E. Additional Figures and Tables

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A Literature Review

The paper relates to several strands of the existing literature on fluctuations in commodity price and their impact on inflation, which we discuss below.

Underlying Shocks Driving Commodity Price Movements. The first strand of literature includes the significant body of research that has investigated the effects of commodity price shocks on economic activity and inflation. Global geopolitical tensions, the accelerated growth and industrialization of emerging markets, and climate change concerns have spurred an examination of the linkages between commodity price fluctuations and economic activity. The majority of studies focusing on the influence of commodity price fluctuations on business cycles and inflation are often centered on the impact of changes in oil prices on inflation (e.g., I.-M. Kim & Loungani, 1992; Blanchard & Galí, 2007; Kilian, 2009; Peersman & Van Robays, 2012; Crucini et al., 2011; Conflitti & Luciani, 2019; Aastveit et al., 2021; Kilian & Zhou, 2021; Baba & Lee, 2022; Ha et al., 2023a).

A key insight from this literature is that economic activity's response to commodity price fluctuations is contingent upon the underlying cause of the change in commodity prices. For example, Kilian (2009) uses a structural vector autoregression (SVAR) approach to illustrate how the U.S. real GDP and consumer price index (CPI) respond differently to oil price changes, depending on whether these shifts stem from oil supply, oil storage demand, or non-oil market economic activity shockssuch as total factor productivity or monetary policy shocks (see also, Peersman & Robays, 2009; Kilian & Murphy, 2014). More recently, Aastveit et al. (2021), employing a similar framework, show that the pass-through of oil price shocks to inflation and inflation expectations depends on demand and supply drivers. Specifically, they find that economic activity driven changes in oil prices have a considerably more persistent impact on U.S. headline inflation and inflation expectations, while oil inventory demand shocks and oil supply shocks have a relatively transitory corresponding effect.

On the theoretical side, studies have employed quantitative models to explore the optimal monetary policy response to commodity shocks. Bodenstein et al. (2008) utilize a New Keynesian framework to demonstrate that sticky prices and wages lead to increased core inflation and reduced wage inflation following an adverse transitory energy supply shock, with headline inflation rising more substantially than core. The underlying mechanism is the rigidity in wages, which, when coupled with energy supply disruptions that elevate production costs, diminishes the marginal product of labor. As a result, although real wages ought to decline, wage stickiness causes a gradual decrease, thereby expanding the wage gap under rigid versus flexible pricing. This expansion exerts upward pressure on marginal costs, compelling firms to elevate prices and, consequently, core inflation. Plante (2014) addresses a similar question but highlights distinct optimal responses to oil price surges driven by productivity-driven oil demand shocks as opposed to oil supply shocks. Specifically, core inflation increases following an oil supply shock but diminishes in the wake of a productivity shock due to their divergent effects on the marginal product of labor. An exogenous oil supply shock raises production costs, lowering the marginal product of labor and

necessitating a drop in real wages alongside an increase in core inflation, similar to the result observed in Bodenstein et al. (2008). However, a productivity shock boosts demand and oil prices, thereby increasing the marginal product of labor, which results in a rise in real wages and a decrease in core inflation as the optimal adjustment.

Heterogeneity in Commodity Shocks: energy, food, metals. Several studies have explored how different types of commodity shocks influence inflation dynamics. Kilian & Zhou (2023a) investigate the effects of various energy price shocks—including gasoline, diesel, jet fuel, natural gas, and electricity—on headline and core inflation. Their findings suggest that analyzing only one type of energy price shock may lead to underestimating the broader impact of unexpected energy price fluctuations on inflation. Banbura et al. (2023) distinguish between demand and supply drivers of inflation. Supply factors include oil supply shocks, oil-specific demand, gas commodity prices, global supply chain disruptions, domestic supply issues, and labor market dynamics. On the demand side, they consider domestic and international demand shocks. The study finds that disruptions in global supply chains and gas price fluctuations now exert a significantly greater influence on inflation than in the past.

Peersman (2022) examines the effect of shocks associated with food commodity prices on Euro area inflation. Utilizing an external instrument based on global harvest conditions, the study reveals that nearly 30 percent of inflation volatility in the Euro area over the medium term can be attributed to food price shocks. These shocks not only affect retail food prices through the production chain but also lead to indirect inflationary pressures through a depreciation of the euro and significant increases in wages. Castelnuovo et al. (2023) extend this analysis by integrating Peersman's (2022) global harvest shocks with data on crude oil and industrial input prices to assess their collective impact on US and global macroeconomic indicators. Their findings indicate a distinct pass-through effect of these shocks on macroeconomic variables: food price shocks generally act like aggregate supply shocks, causing increases in nominal wages and core CPI, whereas oil shocks typically mimic adverse demand shocks that are exacerbated by financial frictions. Fluctuations in industrial input prices largely reflect demand-driven responses to other shocks.

Changing inflation process, especially in context of commodity price shocks. The literature has also examined the empirical evidence of a notable shift in the inflation process across many countries in recent decades. Evin and Piger (2004) and Cecchetti & Debelle (2006) observe a substantial decrease in the mean of the inflation process across countries. In addition, Williams (2006) and Stock & Watson (2007) highlight a reduction in inflation persistence in the United States. Ha et al. (2021) examine the evolution and drivers of inflation in a large set of both emerging market and developing economies (EMDEs) and low-income countries (LICs) and arrive at similar conclusions, while differentiating between several global and domestic drivers contributing to this change in inflation dynamics.

In context of commodity markets, studies have questioned the relevance of commodity price changes as a major source of fluctuation in economic activity and consumer prices. For example, Blanchard & Galí

(2007) examine the nature of apparent changes in the macroeconomic effects of oil shocks, as well as their possible causes. Using SVARs they find that indeed the effects of a given change in the price of oil have changed substantially over time. Their estimates reveal significantly larger impacts of oil price shocks on inflation and economic activity in the early part of the sample (pre-1983), which includes the two oil shock episodes of the 1970s. Similarly, Mehra & Herrington (2008), employing an SVAR, discover that in the pre-1979 period, unexpected changes in commodity prices trigger a lasting rise in inflation expectations and a sustained decline in the real interest rate. However, in the post-1979 period, a commodity price shock results in only a temporary increase in expectations and an increase in the real interest rate.

To explore the causes for this change, Blanchard & Galí (2007) employ a New Keynesian model, while focusing on three potential underlying explanations. First, they suggest that a decrease in real wage rigidities, leading to more flexible labor markets, might explain the reduced impact of recent oil shocks. Second, they consider the possibility that changes in monetary policyspecifically, a stronger commitment to maintaining low and stable inflation through inflation targetinghave improved the policy response to oil shocks. Third, they suggest that a reduced oil-share in production and consumption since the 1970s has diminished the macroeconomic effects of oil price fluctuations. Similarly, Davis (2015) develops a quantitative general equilibrium model to examine the role of central bank credibility in determining the inflation response to a change in commodity prices that are assumed to be exogenous.

Additionally, it is possible that the impact of changes in commodity prices remained consistent across different periods, but coincided with shocks of markedly different nature. For example, a number of studies have associated the post-2000 commodity boom with increased demand for commodities due to the strong growth in China (see, amongst others, Baffes & Haniotis, 2010; World Bank, 2015; Alquist et al., 2020; Kabundi & Zahid, 2023). China's remarkable growth during this period is often attributed to productivity improvements driven by ownership reforms and trade liberalization (Zhu, 2012). Similar connections have been drawn between India's economic growth and rapid trade reforms (Topalova & Khandelwal, 2011; Kotwal et al., 2011). The commodity cycle of the 2000s has often been described as a "super cycle," indicative of demand-driven price surges in commodities, correlated with the industrialization of the global economy (Cuddington & Jerrett, 2008; Erten & Ocampo, 2013; Buyuksahin et al., 2016). Typically, such extended phases of industrialization correspond with sustained economic growth that can only come from structural changes or policy reforms that increase total factor productivity (see, Zhu, 2012). In particular, Buyuksahin et al. (2016) argue that "the current commodity price supercycle began in the mid- to late 1990s, the same time as a series of important reforms were occurring in China, including its eventual accession to the World Trade Organization (WTO) in 2001." The productivity driven increases in commodity prices since early 1990s would otherwise have a calming impact on global inflationary pressures, while commodity price booms driven by demand shocks, such as, a more accommodative U.S. monetary policy (for example, in the post-Covid 2019 period), would increase inflationary pressures.

Global inflation debate. Global developments can transmit to domestic inflation through several channels: global supply chains, financial market integration, substantial reliance on imports, and ex-

change rate shifts echoing global confidence swings. With the rapid expansion of global supply chains, worldwide supply and demand perturbations, as well as commodity price fluctuations, can proliferate through global input-output links and induce synchronized inflation movements (Auer et al., 2017). Growing trade openness has led to import prices accounting for an increasingly large share of global production costs, thus causing domestic inflation to be more susceptible to global shocks that escalate import prices (Bianchi & Civelli, 2015). Moreover, heightened international competition has diminished domestic inflation's sensitivity to domestic output gaps (Eickmeier & Pijnenburg, 2013; Carney, 2015; Kabukçuolu & Martínez-García, 2018).

The rise in global financial market integration has coincided with enhanced synchronization of financial conditionsincluding financial distressacross nations (Neely & Rapach, 2011; Carney, 2015). As financial turbulence permeates global financial markets, it constricts credit and financial conditions in numerous countries, hence facilitating the propagation of domestic demand weakness and disinflation pressures globally. Additionally, irrespective of disturbances to global trade or financial markets, shocks impacting exchange rates, such as those stemming from domestic confidence, could pass through to inflation (Shambaugh, 2008). Traded goods represent over 60 percent of consumer baskets in EMDEs on average, and 47 percent in advanced economies. Consequently, any exchange rate volatility would be mirrored in import price fluctuations and, subsequently, consumer prices.

B A Dynamic Stochastic General Equilibrium Model

B1 Description of the Model

This appendix describes the four-country, four-sector sticky price model. The world economy consists of country A (the US), country B (a representative non-US advanced economy), country C (a representative EMDE), and country D (the rest of the world). The four countries are fundamentally symmetric, differing primarily in size and their respective commodity trade structures. Specifically, the number of households, which determines country size, is different in each country. Each country has four sectors, the non-commodity, energy, food and metal sectors. Countries A and C are net exporters of food and net importers of energy and metals, country B is a net importer of the three types of commodities, and country D is a net exporter of energy and metals and a net importer of food.

In particular, countries A and C have sufficient production capacity for food to meet their domestic and foreign demand for food, so they do not import food but export it. Countries A and C have insufficient production capacity for energy and metals to meet their domestic demand, so they import them from country D. Country B has insufficient production capacity for the three types of commodities to meet its domestic demand for them, so it imports food from countries A and C, and energy and metals from country D. Country D has sufficient production capacity for energy and metals to meet both its domestic and foreign demand for them, so it does not import them but exports them, but not for food, so it imports food from countries A and C.

Households consume non-commodities, energy and food, but not metals.[20] Final goods firms in each sector produce final goods by combining intermediate goods in the sector. Intermediate goods firms in the non-commodity sector use labor, capital, energy, and metals as inputs, those in the food and metal sectors use labor, capital, and energy as inputs, and those in the energy sector use labor and capital as inputs. International asset markets are assumed to be incomplete.

In the following, we describe the equations for country A. If there is no other explanation, the equations for the other three countries are symmetric with those for country A. The variables with superscripts A, B, C, and D refer to the variables in countries A, B, C, and D, respectively, and those with subscripts A, B, C, and D refer to the variables produced in countries A, B, C, and D, respectively.

B1.1 Households

A representative household in each country seeks to maximize the following utility:

$$U^A = E_0 \sum_{t=0}^{\infty} \beta^t \left(\ln C_t^A - \frac{L_t^{A^{1+\chi}}}{1+\chi} \right), \tag{B.1}$$

[20] Note that metal prices are not included in the CPI.

subject to the budget constraint in real terms:

$$C_t^A + Q_t B_t^A + \frac{1}{2}\zeta {B_t^A}^2 + D_t^A = W_t^A L_t^A + B_{t-1}^A + R_{t-1}^A D_{t-1}^A + \Pi_t^A - T_t^A, \tag{B.2}$$

where C_t^A is aggregate consumption, L_t^A is aggregate labor supply, B_t^A is the quantity of the non-contingent international bond, and Q_t is the price of that bond. To induce stationarity of the model, we assume that the household faces a quadratic bond holding cost $\frac{1}{2}\zeta {B_t^A}^2$ as proposed in Schmitt-Grohé & Uribe (2003). W_t^A, R_t^A, Π_t^A, and T_t^A denote the real wage, the risk-free real return on deposits D_t^A, the real profits remitted by firms, and a lump sum tax paid to the government, respectively.

Aggregate consumption is defined using the constant elasticity of substitution (CES) aggregator.

$$C_t^A = \left[(1 - \upsilon^A \phi_{GD,t})^{\frac{1}{\eta}} {C_{N,t}^A}^{\frac{\eta-1}{\eta}} + (\upsilon^A \phi_{GD,t})^{\frac{1}{\eta}} {C_{EF,t}^A}^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}}, \tag{B.3}$$

where $C_{N,t}^A$ and $C_{EF,t}^A$ are the consumption of non-commodities and the consumption of the composite of energy and food, respectively.[21] $\phi_{GD,t}$ is present in aggregate consumption in all four countries and is an exogenous stochastic shock following the AR(1) process.

$$\ln \phi_{GD,t} = \rho_{GD} \ln \phi_{GD,t-1} + \epsilon_{GD,t}. \tag{B.4}$$

Note that an increase in $\phi_{GD,t}$ shifts household preferences between non-commodities and commodities (i.e., energy and food) in consumption toward commodities in all four countries. Therefore, we consider this shock to be the global demand shock.

Non-commodity consumption consists of the consumption of domestically produced non-commodities ($C_{N,A,t}^A$) and imported non-commodities ($C_{N,B,t}^A$, $C_{N,C,t}^A$, and $C_{N,D,t}^A$).

$$C_{N,t}^A = \left[(1 - \upsilon_{N,A}^A)^{\frac{1}{\eta_N}} {C_{N,A,t}^A}^{\frac{\eta_N - 1}{\eta_N}} + {\upsilon_{N,B}^A}^{\frac{1}{\eta_N}} {C_{N,B,t}^A}^{\frac{\eta_N - 1}{\eta_N}} + {\upsilon_{N,C}^A}^{\frac{1}{\eta_N}} {C_{N,C,t}^A}^{\frac{\eta_N - 1}{\eta_N}} + {\upsilon_{N,D}^A}^{\frac{1}{\eta_N}} {C_{N,D,t}^A}^{\frac{\eta_N - 1}{\eta_N}} \right]^{\frac{\eta_N}{\eta_N - 1}}, \tag{B.5}$$

with $\upsilon_{N,A}^A = \upsilon_{N,B}^A + \upsilon_{N,C}^A + \upsilon_{N,D}^A$.

Consumption of the energy-food composite ($C_{EF,t}^A$) is a function of energy and food consumption ($C_{E,t}^A$ and $C_{F,t}^A$).

$$C_{EF,t}^A = \left[(1 - \upsilon_{EF}^A)^{\frac{1}{\eta_{EF}}} {C_{E,t}^A}^{\frac{\eta_{EF} - 1}{\eta_{EF}}} + {\upsilon_{EF}^A}^{\frac{1}{\eta_{EF}}} {C_{F,t}^A}^{\frac{\eta_{EF} - 1}{\eta_{EF}}} \right]^{\frac{\eta_{EF}}{\eta_{EF} - 1}}. \tag{B.6}$$

Since only country D exports energy, the energy consumption of country A ($C_{E,t}^A$) consists of the

[21] In the following, the subscripts N, E, F, and M refer to non-commodities, energy, food, and metals, respectively.

consumption of domestically produced energy ($C^A_{E,A,t}$) and imported energy from country D ($C^A_{E,D,t}$).

$$C^A_{E,t} = \left[(1-\upsilon^A_E)^{\frac{1}{\eta_E}} C^{A\,\frac{\eta_E-1}{\eta_E}}_{E,A,t} + \upsilon^{A\,\frac{1}{\eta_E}}_E C^{A\,\frac{\eta_E-1}{\eta_E}}_{E,D,t}\right]^{\frac{\eta_E}{\eta_E-1}}. \tag{B.7}$$

Note that while the energy consumption of countries B and C (net energy importers) is symmetric with that of country A, the energy consumption of country D (net energy exporter) is different from that of the other three countries. Specifically, since country D does not import any energy, its energy consumption is equal to the consumption of domestically produced energy (i.e., $C^D_{E,t} = C^D_{E,D,t}$).

Country A is a net food exporter, so its food consumption ($C^A_{F,t}$) is equal to its consumption of domestically produced food ($C^A_{F,A,t}$).

$$C^A_{F,t} = C^A_{F,A,t}. \tag{B.8}$$

While the food consumption of country C (net food exporter) is symmetric with that of country A, the food consumption of countries B and D (net food importers) is different from that of countries A and C. The food consumption of country B ($C^B_{F,t}$) consists of the consumption of domestically produced food ($C^B_{F,B,t}$) and imported food from countries A and C ($C^B_{F,A,t}$ and $C^B_{F,C,t}$). Specifically, $C^B_{F,t} = \left[(1-\upsilon^B_{F,B})^{\frac{1}{\eta_F}} C^{B\,\frac{\eta_F-1}{\eta_F}}_{F,B,t} + \upsilon^{B\,\frac{1}{\eta_F}}_{F,A} C^{B\,\frac{\eta_F-1}{\eta_F}}_{F,A,t} + \upsilon^{B\,\frac{1}{\eta_F}}_{F,C} C^{B\,\frac{\eta_F-1}{\eta_F}}_{F,C,t}\right]^{\frac{\eta_F}{\eta_F-1}}$ with $\upsilon^B_{F,B} = \upsilon^B_{F,A} + \upsilon^B_{F,C}$. The food consumption of country D is symmetric with that of country B.

B1.2 Firms

In each sector there are final goods firms, intermediate goods firms, and capital producers. Final goods firms in each sector use intermediate goods in the sector to produce final goods. Intermediate goods firms, indexed by $j_s \in [0,1]$ ($s \in \{N,E,F,M\}$), produce differentiated intermediate goods.[22] Capital producers have the technology to transform final goods into capital.

Final Goods Firms. Final goods firms in sector s combine intermediate goods in the sector, $Y_{s,t}(j_s)$, to produce final goods, $Y_{s,t}$, according to the following CES technology:

$$Y_{s,t} = \left(\int_0^1 Y_{s,t}(j_s)^{\frac{\varepsilon-1}{\varepsilon}} dj_s\right)^{\frac{\varepsilon}{\varepsilon-1}}. \tag{B.9}$$

Intermediate Goods Firms. To produce differentiated intermediate goods, intermediate goods firms in each sector use different inputs and technologies. Moreover, the intermediate goods firms in each sector set prices based on Calvo price-setting. In particular, in each period, only a fraction $(1-\theta_s)$ of firms can adjust their prices.

[22] In the following, the subscript s denotes the sector.

Intermediate non-commodity producers. Intermediate non-commodity producers use labor, capital, energy, and metals as inputs to produce intermediate non-commodity goods. Their production function is a nested CES as in I.-M. Kim & Loungani (1992) and M. Kim (2022):

$$Y^A_{N,t}(j_N) = \left(\phi_{GS,t} A^A_{N,t}\right) \left\{(1-\gamma) K^A_{N,t}(j_N)^{-\nu} + \gamma Z^A_t(j_N)^{-\nu}\right\}^{-\frac{\alpha_N}{\nu}} L^A_{N,t}(j_N)^{1-\alpha_N}, \tag{B.10}$$

where $Y^A_{N,t}(j_N)$, $A^A_{N,t}$, $K^A_{N,t}(j_N)$, $Z^A_t(j_N)$, and $L^A_{N,t}(j_N)$ denote the output of firm j_N, the common productivity, the capital input of the firm, the input of the composite of energy and metals of the firm, and the labor input of the firm in the sector, respectively. $\phi_{GS,t}$ is present in the production function of intermediate non-commodity producers in all four countries and is an exogenous stochastic shock following the AR(1) process.

$$\ln \phi_{GS,t} = \rho_{GS} \ln \phi_{GS,t-1} + \epsilon_{GS,t}. \tag{B.11}$$

$\phi_{GS,t}$ functions as productivity in the non-commodity sector for all four countries, so an increase in $\phi_{GS,t}$ leads to an increase in the marginal productivity of inputs (including energy and metals). Thus, we interpret this shock as the global supply shock.

The energy-metal composite is defined as ${Z^A_t}^{\frac{\eta_Z-1}{\eta_Z}} = (1-\upsilon^A_Z)^{\frac{1}{\eta_Z}} {E^A_{N,t}}^{\frac{\eta_Z-1}{\eta_Z}} + {\upsilon^A_Z}^{\frac{1}{\eta_Z}} {M^A_t}^{\frac{\eta_Z-1}{\eta_Z}}$, where $E^A_{N,t}$ and M^A_t are energy and metal inputs, respectively. Similar to consumption, energy input consists of domestically produced energy and imported energy from country D, ${E^A_{N,t}}^{\frac{\eta_E-1}{\eta_E}} = (1-\upsilon^A_{N,E})^{\frac{1}{\eta_E}} {E^A_{N,A,t}}^{\frac{\eta_E-1}{\eta_E}} + {\upsilon^A_{N,E}}^{\frac{1}{\eta_E}} {E^A_{N,D,t}}^{\frac{\eta_E-1}{\eta_E}}$. While the energy input of countries B and C (net energy importers) is symmetric with that of country A, the energy input of country D (net energy exporter) differs from that of the other three countries. Specifically, since country D does not import any energy, it uses only domestically produced energy for production (i.e., $E^D_{N,t} = E^D_{N,D,t}$). Metal input also consists of domestically produced metal and imported metal from country D, ${M^A_t}^{\frac{\eta_M-1}{\eta_M}} = (1-\upsilon^A_M)^{\frac{1}{\eta_M}} {M^A_{A,t}}^{\frac{\eta_M-1}{\eta_M}} + {\upsilon^A_M}^{\frac{1}{\eta_M}} {M^A_{D,t}}^{\frac{\eta_M-1}{\eta_M}}$. Since countries B and C are net metal importers like country A, their metal input is symmetric with that of country A. Country D (net metal exporter) uses only domestically produced metal for production (i.e., $M^D_t = M^D_{D,t}$).

Intermediate energy producers. Intermediate energy is produced using labor and capital. The production function of intermediate energy producers is Cobb-Douglas as in M. Kim (2024):

$$Y^A_{E,t}(j_E) = A^A_{E,t} K^A_{E,t}(j_E)^{\alpha^A_E} L^A_{E,t}(j_E)^{1-\alpha^A_E} + (\phi_{EN,t} - \phi_{EN}), \tag{B.12}$$

where $Y^A_{E,t}(j_E)$, $A^A_{E,t}$, $K^A_{E,t}(j_E)$, and $L^A_{E,t}(j_E)$ denote the output of firm j_E, the common productivity, the capital input of the firm and the labor input of the firm in the sector, respectively. The term $(\phi_{EN,t} - \phi_{EN})$ is included in the production function of intermediate energy producers in all four countries, where variables without a time subscript t denote their steady-state values. $\phi_{EN,t}$ is an exogenous stochastic shock following the AR(1) process:

$$\ln \phi_{EN,t} = \rho_{EN} \ln \phi_{EN,t-1} + \epsilon_{EN,t}. \tag{B.13}$$

Supply disruptions in global energy markets can be captured by a fall in $\phi_{EN,t}$, which reduces energy production in all four countries. Therefore, we consider this shock as the global energy-specific shock.

Intermediate food producers. Intermediate food producers use labor, energy, and capital to produce, and their production function is a nested CES:

$$Y^A_{F,t}(j_F) = A^A_{F,t}\left\{(1-\gamma)K^A_{F,t}(j_F)^{-\nu} + \gamma E^A_{F,t}(j_F)^{-\nu}\right\}^{-\frac{\alpha_F}{\nu}} L^A_{F,t}(j_F)^{1-\alpha_F} + (\phi_{FO,t} - \phi_{FO}), \tag{B.14}$$

where $Y^A_{F,t}(j_F)$, $A^A_{F,t}$, $K^A_{F,t}(j_F)$, $E^A_{F,t}(j_F)$, and $L^A_{F,t}(j_F)$ denote the output of firm j_F, the common productivity, the capital input of the firm, the energy input of the firm, and the labor input of the firm in the sector, respectively. The term $(\phi_{FO,t} - \phi_{FO})$ exists in the production function of intermediate food producers in all four countries. $\phi_{FO,t}$ is an exogenous stochastic shock following the AR(1) process:

$$\ln \phi_{FO,t} = \rho_{FO} \ln \phi_{FO,t-1} + \epsilon_{FO,t}. \tag{B.15}$$

Since a fall in $\phi_{FO,t}$ that decreases food production in all four countries can be thought of as a supply disruption in global food markets, we interpret this shock as the global food-specific shock. Energy input is defined as that in the non-commodity sector.

Intermediate metal producers. Intermediate metal producers use labor, energy, and capital to produce, and their production function is a nested CES:

$$Y^A_{M,t}(j_M) = A^A_{M,t}\left\{(1-\gamma)K^A_{M,t}(j_M)^{-\nu} + \gamma E^A_{M,t}(j_M)^{-\nu}\right\}^{-\frac{\alpha_M}{\nu}} L^A_{M,t}(j_M)^{1-\alpha_M} + (\phi_{ME,t} - \phi_{ME}), \tag{B.16}$$

where $Y^A_{M,t}(j_M)$, $A^A_{M,t}$, $K^A_{M,t}(j_M)$, $E^A_{M,t}(j_M)$, and $L^A_{M,t}(j_M)$ denote the output of firm j_M, the common productivity, the capital input of the firm, the energy input of the firm, and the labor input of the firm in the sector, respectively. The term $(\phi_{ME,t} - \phi_{ME})$ is present in the production function of intermediate metal producers in all four countries. $\phi_{ME,t}$ is an exogenous stochastic shock following the AR(1) process:

$$\ln \phi_{ME,t} = \rho_{ME} \ln \phi_{ME,t-1} + \epsilon_{ME,t}. \tag{B.17}$$

When $\phi_{ME,t}$ goes down, metal production in all four countries decreases, so a fall in $\phi_{ME,t}$ can capture supply disruptions in global metal markets. Accordingly, we consider this shock as the global metal-specific shock. Energy input is defined as that in the non-commodity sector.

Capital Producers Capital producers can transform final goods into capital. In each period, capital producers in sector s purchase $I^A_{s,t}$ of final goods at price $p^A_{s,t}$ and $(1-\delta)K^A_{s,t}$ of used capital at price $q^A_{s,t}$

to produce new capital $K^A_{s,t+1}$.[23] Hence, the capital producer's problem is as follows:

$$\max_{I^A_{s,t}} E_t \sum_{h=0}^{\infty} \lambda^A_{t+h} \left[q^A_{s,t+h} \left\{ 1 - \frac{\xi}{2} \left(I^A_{s,t+h}/I^A_{s,t+h-1} - 1 \right)^2 \right\} I^A_{s,t+h} - p^A_{s,t} I^A_{s,t+h} \right], \tag{B.18}$$

subject to the law of motion for capital:

$$K^A_{s,t+1} = (1-\delta) K^A_{s,t} + \left[1 - \frac{\xi}{2} \left(I^A_{s,t}/I^A_{s,t-1} - 1 \right)^2 \right] I^A_{s,t}. \tag{B.19}$$

B1.3 Government, Monetary Policy and Resource Constraints

The government of each country balances its budget in each period: $n^A T^A_t = G^A_t$, where n^i, $i \in \{A, B, C, D\}$, is the number of households in country i.

The monetary authority in each country follows a standard Taylor-type rule,

$$\frac{R^{n^A}_t}{R^{n^A}} = \left(\frac{\pi^A_{CPI,t}}{\pi^A_{CPI}} \right)^{\phi_\pi} \left(\frac{Y^A_t}{Y^A} \right)^{\phi_y} \phi^{-s_{M,GD}}_{GD,t}, \tag{B.20}$$

where $R^{n^A}_t$ is the nominal interest rate, $\pi^A_{CPI,t} = \frac{P^A_t}{P^A_{t-1}}$ is the CPI inflation, and Y^A_t is real GDP.[24] Note that the global demand shock can also be an expansionary monetary shock that stimulates aggregate demand globally. The last term, $\phi^{-s_{M,GD}}_{GD,t}$, is present in the monetary policy rules of all four countries, and an increase in $\phi_{GD,t}$ (the global demand shock) corresponds to an expansionary monetary shock in all four countries. $s_{M,GD}$ determines the relative size of the monetary policy-related global demand shock and the preference-shifting global demand shock.

The output in each sector satisfies[25]

$$n^A Y^A_{N,t} = n^A \left[C^A_{N,A,t} + I^A_{N,t} + s_{G,GD}(\phi_{GD,t} - \phi_{GD}) \right] + n^B C^B_{N,A,t} + n^C C^C_{N,A,t} + n^D C^D_{N,A,t}, \tag{B.21}$$

$$Y^A_{E,t} = C^A_{E,A,t} + E^A_{N,A,t} + E^A_{F,A,t} + E^A_{M,A,t} + I^A_{E,t} + s_{G,GD}(\phi_{GD,t} - \phi_{GD}), \tag{B.22}$$

$$n^A Y^A_{F,t} = n^A \left[C^A_{F,A,t} + I^A_{F,t} + s_{G,GD}(\phi_{GD,t} - \phi_{GD}) \right] + n^B C^B_{F,A,t} + n^D C^D_{F,A,t}, \tag{B.23}$$

$$Y^A_{M,t} = M^A_{N,A,t} + I^A_{E,t} + s_{G,GD}(\phi_{GD,t} - \phi_{GD}). \tag{B.24}$$

[23] Hereafter, the upper case P^A_s refers to nominal prices and the lower case $p^A_s \equiv P^A_s/P^A$ denotes real prices deflated by the CPI P^A_t.

[24] Real GDP is the real value added in the four sectors. Specifically, $Y^A_t = n^A[p^A_{N,A,t} Y^A_{N,t} + p^A_{E,A,t} Y^A_{E,t} + p^A_{F,A,t} Y^A_{F,t} + p^A_{M,A,t} Y^A_{M,t} - p^A_{E,t} \left(E^A_{N,t} + E^A_{F,t} + E^A_{M,t} \right) - p^A_{M,t} M^A_t]$.

[25] The resource constraints in the energy sectors of countries B and C (net energy importers) are symmetric with the constraint of country A (net energy importer), but the constraint of country D (net energy exporter) is $n^D Y^D_{E,t} = n^A C^A_{E,D,t} + n^B C^B_{E,D,t} + n^C C^C_{E,D,t} + n^D \left[C^D_{E,D,t} + I^D_{E,t} + s_{G,GD}(\phi_{GD,t} - \phi_{GD}) \right] + \sum_i n^i \left(E^i_{N,D,t} + E^i_{F,D,t} + E^i_{M,D,t} \right)$. The resource constraint in the food sector of country C (net food exporter) is symmetric with the constraint of country A (net food exporter), while the constraints of countries B and D (net food importers) are $Y^B_{F,t} = C^B_{F,B,t} + I^B_{F,t} + s_{G,GD}(\phi_{GD,t} - \phi_{GD})$ and $Y^D_{F,t} = C^D_{F,D,t} + I^D_{F,t} + s_{G,GD}(\phi_{GD,t} - \phi_{GD})$, respectively. The resource constraints in the metal sectors of countries B and C (net metal importers) are symmetric with the constraint in country A (net metal importer), but that of country D (net metal exporter) is $n^D Y^D_{M,t} = n^A M^A_{N,D,t} + n^B M^B_{N,D,t} + n^C M^C_{N,D,t} + n^D \left[M^D_{N,D,t} + I^D_{M,t} + s_{G,GD}(\phi_{GD,t} - \phi_{GD}) \right]$.

Note that the global demand shock $\phi_{GD,t}$ can also be thought of as unexpected government spending in all four countries. $s_{G,GD}$ determines the relative size of the government spending-related global demand shock to the preference-shifting global demand shock.

B1.4 Price Indices, Inflation and Industrial Production

This subsection provides the definitions of price indices, various inflation rates, and industrial production. The CPI (P_t^A) is defined as

$$P_t^{A^{1-\eta}} = (1-\upsilon^A\phi_{GD,t})P_{N,t}^{A^{1-\eta}} + \upsilon^A\phi_{GD,t}P_{EF,t}^{A^{1-\eta}}, \tag{B.25}$$

where $P_{N,t}^A$ is the nominal price of non-commodities and $P_{EF,t}^A$ is the nominal price of the energy-food composite.

Recall that there are four final goods in this model (non-commodities, energy, food, and metals). Accordingly, core inflation, $\pi_{core,t}^A$, is the growth in the nominal price of non-commodities:

$$\pi_{core,t}^A = P_{N,t}^A/P_{N,t-1}^A. \tag{B.26}$$

The nominal prices of energy, food, and metals ($P_{E,t}^A$, $P_{F,t}^A$, and $P_{M,t}^A$) are defined as[26]

$$P_{E,t}^A = \phi_{CS,t}\left[(1-\upsilon_E^A)P_{E,A,t}^{A^{1-\eta_E}} + \upsilon_E^A P_{E,D,t}^{A^{1-\eta_E}}\right]^{\frac{1}{1-\eta_E}}, \tag{B.27}$$

$$P_{F,t}^A = \phi_{CS,t}^{s_{F,CS}}P_{F,A,t}^A, \tag{B.28}$$

$$P_{M,t}^A = \phi_{CS,t}^{s_{M,CS}}\left[(1-\upsilon_M^A)P_{M,A,t}^{A^{1-\eta_M}} + \upsilon_M^A P_{M,D,t}^{A^{1-\eta_M}}\right]^{\frac{1}{1-\eta_M}}, \tag{B.29}$$

where $P_{s,h,t}^i$ is the nominal price of final goods in sector s produced in country h in country i. Dividing $P_{E,t}^A$, $P_{F,t}^A$, and $P_{M,t}^A$ by the CPI (P_t^A) gives their real prices ($p_{E,t}^A$, $p_{F,t}^A$, and $p_{M,t}^A$).

$$p_{E,t}^A = \phi_{CS,t}\left[(1-\upsilon_E^A)p_{E,A,t}^{A^{1-\eta_E}} + \upsilon_E^A p_{E,D,t}^{A^{1-\eta_E}}\right]^{\frac{1}{1-\eta_E}}, \tag{B.30}$$

$$p_{F,t}^A = \phi_{CS,t}^{s_{F,CS}}p_{F,A,t}^A, \tag{B.31}$$

$$p_{M,t}^A = \phi_{CS,t}^{s_{M,CS}}\left[(1-\upsilon_M^A)p_{M,A,t}^{A^{1-\eta_M}} + \upsilon_M^A p_{M,D,t}^{A^{1-\eta_M}}\right]^{\frac{1}{1-\eta_M}}. \tag{B.32}$$

$\phi_{CS,t}$ exists in the definitions of the real prices of the three types of commodities in all four countries and

[26]The nominal prices of energy and metals in country D and the nominal food price in countries B and D differ. Other nominal prices are symmetric with those in country A. Specifically, $P_{E,t}^D = \phi_{CS,t}P_{E,D,t}^D$, $P_{M,t}^D = \phi_{CS,t}^{s_{M,CS}}P_{M,D,t}^D$, $P_{F,t}^B = \phi_{CS,t}^{s_{F,CS}}\left[(1-\upsilon_{F,B}^B)P_{F,B,t}^{B^{1-\eta_F}} + \upsilon_{F,A}^B P_{F,A,t}^{B^{1-\eta_F}} + \upsilon_{F,C}^B P_{F,C,t}^{B^{1-\eta_F}}\right]^{\frac{1}{1-\eta_F}}$, and $P_{F,t}^D = \phi_{CS,t}^{s_{F,CS}}\left[(1-\upsilon_{F,D}^D)P_{F,D,t}^{D^{1-\eta_F}} + \upsilon_{F,A}^D P_{F,A,t}^{D^{1-\eta_F}} + \upsilon_{F,C}^D P_{F,C,t}^{D^{1-\eta_F}}\right]^{\frac{1}{1-\eta_F}}$.

is an exogenous stochastic shock following the AR(1) process.

$$\ln \phi_{CS,t} = \rho_{CS} \ln \phi_{CS,t-1} + \epsilon_{CS,t}. \tag{B.33}$$

When $\phi_{CS,t}$ increases, the real prices of the three types of commodities increase in all four countries. Since unexpected movements in real commodity prices that cannot be explained by global demand and supply shocks can be captured by this shock, we consider this shock to be the common (global) commodity-specific shock. $s_{F,CS}$ and $s_{M,CS}$ determine the relative size of the common commodity-specific shock to the food and metal price indices compared to the energy price index.

Only energy and metals produced in country D are traded in the global energy and metal markets, so the global prices of energy and metals (expressed in the currency of country A), $P^G_{E,t}$ and $P^G_{M,t}$, are

$$P^G_{E,t} = \mathcal{E}^D_t P^D_{E,D,t} = P^A_{E,D,t}, \tag{B.34}$$

$$P^G_{M,t} = \mathcal{E}^D_t P^D_{M,D,t} = P^A_{M,D,t}, \tag{B.35}$$

where $\mathcal{E}^i_t$, $i \in \{B, C, D\}$ is the nominal exchange rate of country i against country A. Note that the second equality in each equation is due to the law of one price. However, since food produced in countries A and C is traded in the global food market, we define the global food price (expressed in the currency of country A) as a weighted average of the two food prices based on the steady-state consumption of food produced in countries A and C in countries B and D (net food importers).

$$P^G_{F,t} = \frac{C^B_{F,A} + C^D_{F,A}}{C^B_{F,A} + C^D_{F,A} + C^B_{F,C} + C^D_{F,C}} P^A_{F,A,t} + \frac{C^B_{F,C} + C^D_{F,C}}{C^B_{F,A} + C^D_{F,A} + C^B_{F,C} + C^D_{F,C}} E^C_t P^C_{F,C,t}, \tag{B.36}$$

where $C^i_{s,h}$ is the steady-state consumption of final goods in sector s produced in country h in country i. Accordingly, the global real prices of energy, food, and metals ($p^G_{E,t}$, $p^G_{F,t}$, and $p^G_{M,t}$) are defined as

$$p^G_{E,t} = e^D_t p^D_{E,D,t} = p^A_{E,D,t}, \tag{B.37}$$

$$p^G_{F,t} = \frac{C^B_{F,A} + C^D_{F,A}}{C^B_{F,A} + C^D_{F,A} + C^B_{F,C} + C^D_{F,C}} p^A_{F,A,t} + \frac{C^B_{F,C} + C^D_{F,C}}{C^B_{F,A} + C^D_{F,A} + C^B_{F,C} + C^D_{F,C}} e^C_t p^C_{F,C,t}, \tag{B.38}$$

$$p^G_{M,t} = e^D_t p^D_{M,D,t} = p^A_{M,D,t}, \tag{B.39}$$

where $e^i_t = \frac{\mathcal{E}^i_t P^i_t}{P^A_t}$, $i \in \{B, C, D\}$ is the real exchange rate of country i against country A, and $p^i_{s,h,t}$ is the real price of final goods in sector s produced in country h in country i. In addition, we define the global real commodity price, which can correspond to the commodity price factor in the empirical part, as a weighted average of the global real prices of energy, food, and metals, using the steady-state production of the three types of commodities.

$$p_{C,t} = \frac{\sum_i Y^i_E}{\sum_i \sum_s Y^i_s} p^G_{E,t} + \frac{\sum_i Y^i_F}{\sum_i \sum_s Y^i_s} p^G_{F,t} + \frac{\sum_i Y^i_M}{\sum_i \sum_s Y^i_s} p^G_{M,t},\ i \in \{A, B, C, D\},\ s \in \{E, F, M\}. \tag{B.40}$$

Energy, food, and metal inflation rates are

$$\pi^A_{E,t} = P^A_{E,t}/P^A_{E,t-1}, \tag{B.41}$$

$$\pi^A_{F,t} = P^A_{F,t}/P^A_{F,t-1}, \tag{B.42}$$

$$\pi^A_{M,t} = P^A_{M,t}/P^A_{M,t-1}. \tag{B.43}$$

The global inflation rate (π^G_t) is defined as a weighted average of the CPI inflation rates of the four countries, using the steady-state GDP.

$$\pi^G_t = \frac{Y^A}{Y^W}\pi^A_{CPI,t} + \frac{Y^B}{Y^W}\pi^B_{CPI,t} + \frac{Y^C}{Y^W}\pi^C_{CPI,t} + \frac{Y^D}{Y^W}\pi^D_{CPI,t}, \tag{B.44}$$

where $Y^W = Y^A + Y^B + Y^C + Y^D$ is the steady-state real world GDP.

Industrial production (IP^A_t) is a weighted average of production in each sector based on steady-state output.

$$IP^A_t = \frac{Y^A_N Y^A_{N,t} + Y^A_E Y^A_{E,t} + Y^A_F Y^A_{F,t} + Y^A_M Y^A_{M,t}}{Y^A_N + Y^A_E + Y^A_F + Y^A_M}. \tag{B.45}$$

Finally, global industrial production (IP^G_t) is defined as a weighted average of the industrial production of the four countries, using the steady-state GDP.

$$IP^G_t = \frac{Y^A}{Y^W}IP^A_t + \frac{Y^B}{Y^W}IP^B_t + \frac{Y^C}{Y^W}IP^C_t + \frac{Y^D}{Y^W}IP^D_t. \tag{B.46}$$

B2 Parameter Values

In this subsection, we assign values to the parameters in the model. In particular, some parameters are calibrated. We set the values of these parameters to match the ratios of each country's net energy, food, and metal exports to GDP and each country's ratio of GDP to world GDP to those from the data. Other parameters not related to these ratios are allowed to vary within reasonable ranges as in Lippi & Nobili (2012). A period in the model is a quarter.

The calibrated parameters are listed in Table 8. We set the discount factor β to 0.99, the depreciation rate of capital δ to 0.025, and the coefficient of relative risk aversion χ to 2. The capital share of income in the non-commodity, food, and metal sectors in the four countries, α_N, α_F, and α_M, is 0.33. We assume that the steady-state values of aggregate consumption and labor are the same in the four countries, which gives the values of the capital share of income in the energy sectors in each country, α^A_E, α^B_E, α^C_E, and α^D_E. The elasticity of substitution between intermediate goods ε is assumed to be 6. The parameter associated with the elasticity of substitution between capital and commodities in production, ν, is assumed to be 0.7, following I.-M. Kim & Loungani (1992).[27] The parameter related to the weight of commodities in production, γ, is 0.01, determined by β, δ, ν and the steady-state ratio of capital to commodities.[28]

[27] $\nu = 0.7$ implies that the elasticity of substitution between capital and commodities in production, $1/(1+\nu)$, is 0.588.

[28] We assume that the steady-state ratio of capital to the energy-metal composite in non-commodity production

We set the steady-state weights of consumption of the energy-food composite in aggregate consumption in countries A, B, C, and D (υ^A, υ^B, υ^C, and υ^D) to 0.17, 0.22, 0.33, and 0.39, respectively. These values are equal to the weights of energy and food and non-alcoholic beverages in the CPIs for the U.S., advanced economies, EMDEs, and the rest of the world in 2022 from OECD data.[29] The steady-state weights of imported non-commodities in non-commodity consumption in country A, $\upsilon^A_{N,B}$, $\upsilon^A_{N,C}$, and $\upsilon^A_{N,D}$ are set to 0.14, 0.02, and 0.00, respectively, those in country B, $\upsilon^B_{N,A}$, $\upsilon^B_{N,C}$, and $\upsilon^B_{N,D}$, are 0.09, 0.10, and 0.16, respectively, those in country C, $\upsilon^C_{N,A}$, $\upsilon^C_{N,B}$, and $\upsilon^C_{N,D}$, are 0.04, 0.27, and 0.01, respectively, and those in country D, $\upsilon^D_{N,A}$, $\upsilon^D_{N,B}$, and $\upsilon^D_{N,C}$, are 0.05, 0.90, and 0.03, respectively.[30] The steady-state weights of food in the consumption of the energy-food composite in countries A, B, C, and D (υ^A_{EF}, υ^B_{EF}, υ^C_{EF}, and υ^D_{EF}) are assumed to be 0.50, 0.63, 0.67, and 0.60, respectively, which are consistent with the relative weights of food and non-alcoholic beverages to energy in the CPIs for the U.S., advanced economies, EMDEs, and the rest of the world in 2022 from OECD data. The steady-state weights of imported energy in energy consumption in countries A, B, and C (υ^A_E, υ^B_E, and υ^C_E) are set to 0.11, 0.16, and 0.04, respectively, and the steady-state weights of imported energy inputs in total energy inputs in non-commodity, food, and metal production in countries A, B, and C ($\upsilon^A_{N,E}$, $\upsilon^B_{N,E}$, $\upsilon^C_{N,E}$, $\upsilon^A_{F,E}$, $\upsilon^B_{F,E}$, $\upsilon^C_{F,E}$, $\upsilon^A_{M,E}$, $\upsilon^B_{M,E}$, and $\upsilon^C_{M,E}$) are set to 0.11, 0.12, 0.02, 0.10, 0.16, 0.04, 0.11, 0.10, and 0.03, respectively. The steady-state weights of imported food in food consumption in countries B and D ($\upsilon^B_{F,A}$, $\upsilon^B_{F,C}$, $\upsilon^D_{F,A}$, and $\upsilon^D_{F,C}$) are 0.01, 0.01, 0.03, and 0.02, respectively. The steady-state weights of metals in the energy-metal composite in non-commodity production in countries A, B, C, and D (υ^A_Z, υ^B_Z, υ^C_Z, and υ^D_Z) are 0.22, 0.25, 0.16, and 0.21, respectively, and the steady-state weights of imported metal inputs in total metal inputs in non-commodity production in countries A, B, and C (υ^A_M, υ^B_M, and υ^C_M) are 0.10, 0.10, and 0.07, respectively.

With respect to the size of the four countries, the number of households in countries A, B, C, and D is assumed to be 0.27, 0.43, 0.19, and 0.11, respectively. These parameter values generate steady-state ratios of the GDPs of countries A, B, C, and D to world GDP of 0.27, 0.43, 0.19, and 0.11, respectively. These ratios are equal to the average ratios of the GDPs of the U.S. (0.27), our sample advanced economies (0.43), our sample EMDEs (0.19), and the rest of the world (0.11) to world GDP during 1973–2022 from the World Bank's World Development Indicators database.

Under these parameter values, the steady-state ratios of net food, energy, and metal exports to GDP in country A are 0.4%, -1.1%, and -0.1%, respectively; those in country B are -0.3%, -1.5%, and -0.1%, respectively; those in country C are 0.6%, -0.5%, and -0.03%, respectively; and those in country D are -1.0%, 9.3%, and 0.6%, respectively. These steady-state ratios are very close to the 1973–2022 data. Specifically, according to the World Bank's World Development Indicators database, during 1973–2022, the average ratios of net exports of food, fuel, and ores and metals to GDP for the US are 0.2%, -1.1%,

(K_N/Z) and the steady-state ratios of capital to energy in food and metal production (K_F/E_F and K_M/E_M) are all 150.

[29] Because the weights of energy and food and non-alcoholic beverages in the CPI are not available for the full sample period for many of our sample countries, we use the weights in 2022.

[30] Note that the steady-state weight of domestic non-commodities in non-commodity consumption in each country is just 1 minus the steady-state weight of imported non-commodities.

and -0.1%, respectively; for our sample advanced economies, -0.3%, -1.5%, and -0.1%, respectively; for our sample EMDEs, 0.7%, -0.5%, and -0.03%, respectively; and for the rest of the world, -0.6%, 9.3%, and 0.6%, respectively.

TABLE 5: Calibrated parameter values

Definition	Parameter	Values
Discount factor	β	0.99
Depreciation rate of capital	δ	0.025
Coefficient of relative risk aversion	χ	2
Capital share in the non-commodity, food and metal sectors	α_N,α_F,α_M	0.33
Capital share in the energy sectors	α_E^A,α_E^B,α_E^C,α_E^D	0.28,0.28,0.29,0.30
Elasticity of substitution among intermediate goods	ε	6
Elasticity of substitution between capital and commodities in production	$1/(1+\nu)$	0.588
Weight of commodities in production	γ	0.01
Weight of energy-food composite in aggregate consumption	υ^A,υ^B,υ^C,υ^D	0.17,0.22,0.33,0.39
A's weight of imported non-commodities in non-commodity consumption	$\upsilon_{N,B}^A$,$\upsilon_{N,C}^A$,$\upsilon_{N,D}^A$	0.14,0.02,0.00
B's weight of imported non-commodities in non-commodity consumption	$\upsilon_{N,A}^B$,$\upsilon_{N,C}^B$,$\upsilon_{N,D}^B$	0.09,0.10,0.16
C's weight of imported non-commodities in non-commodity consumption	$\upsilon_{N,A}^C$,$\upsilon_{N,B}^C$,$\upsilon_{N,D}^C$	0.04,0.27,0.01
D's weight of imported non-commodities in non-commodity consumption	$\upsilon_{N,A}^D$,$\upsilon_{N,B}^D$,$\upsilon_{N,C}^D$	0.05,0.90,0.03
Weight of food in the consumption of the energy-food composite	υ_{EF}^A,υ_{EF}^B,υ_{EF}^C,υ_{EF}^D	0.50,0.63,0.67,0.60
Weight of imported energy in energy consumption	υ_E^A,υ_E^B,υ_E^C	0.11,0.16,0.04
Weight of imported energy in energy inputs in non-commodity production	$\upsilon_{N,E}^A$,$\upsilon_{N,E}^B$,$\upsilon_{N,E}^C$	0.11,0.12,0.02
Weight of imported energy in energy inputs in food production	$\upsilon_{F,E}^A$,$\upsilon_{F,E}^B$,$\upsilon_{F,E}^C$	0.10,0.16,0.04
Weight of imported energy in energy inputs in metal production	$\upsilon_{M,E}^A$,$\upsilon_{M,E}^B$,$\upsilon_{M,E}^C$	0.11,0.10,0.03
B's weight of imported food in food consumption	$\upsilon_{F,A}^B$,$\upsilon_{F,C}^B$	0.01,0.01
D's weight of imported food in food consumption	$\upsilon_{F,A}^D$,$\upsilon_{F,C}^D$	0.03,0.02
Weight of metals in energy-metal composite in non-commodity production	υ_Z^A,υ_Z^B,υ_Z^C,υ_Z^D	0.22,0.25,0.16,0.21
Weight of imported metals in metal inputs in non-commodity production	υ_M^A,υ_M^B,υ_M^C	0.10,0.10,0.07
Country size	n^A,n^B,n^C,n^D	0.27,0.43,0.19,0.11

TABLE 6: Parameter ranges

Definition	Parameter	Estimate
Parameter associated with investment adjustment costs	ξ	[0.01, 5]
Parameter related to bond holding costs	ζ	[0.01, 5]
Probability that price cannot be adjusted in the non-commodity sector	θ_N	[0.65, 0.85]
Probability that price cannot be adjusted in the energy sector	θ_E	[0.1, 0.7]
Probability that price cannot be adjusted in the food sector	θ_F	[0.1, 0.7]
Probability that price cannot be adjusted in the metal sector	θ_M	[0.1, 0.7]
Elasticity of substitution between non-commodities and energy-food composite	η	[0.1, 0.5]
Elas. of sub. between domestic and imported non-com. in non-com. consumption	η_N	[1.01, 2]
Elas. of sub. between domestic and imported energy in energy consumption and input	η_E	[5, 100]
Elasticity of substitution between domestic and imported food in food consumption	η_F	[5, 100]
Elasticity of substitution between domestic and imported metals in total metal inputs	η_M	[5, 100]
Elasticity of substitution between energy and food in energy-food composite	η_{EF}	[0.1, 0.8]
Elasticity of substitution between energy and metals in energy-metal composite	η_Z	[0.1, 0.8]
Monetary policy weights on inflation	ϕ_π	[1.1, 2]
Monetary policy weights on output	ϕ_y	[0, 0.3]
Size of the global demand shock to government spending	$s_{I,GD}$	[0.5, 3]
Size of the global demand shock to monetary policy	$s_{M,GD}$	[0.5, 3]
Size of the commodity-specific shock to the food price index	$s_{F,CS}$	[0.5, 3]
Size of the commodity-specific shock to the metal price index	$s_{M,CS}$	[0.5, 3]
Persistence of the global supply shock	ρ_{GS}	[0.8, 0.99]
Persistence of the global demand shock	ρ_{GD}	[0, 0.99]
Persistence of the global commodity-specific shock	ρ_{CS}	[0, 0.99]
Persistence of the energy-specific shock	ρ_{EN}	[0, 0.99]
Persistence of the food-specific shock	ρ_{FO}	[0, 0.99]
Persistence of the metal-specific shock	ρ_{ME}	[0, 0.99]

The remaining parameters are uniformly and independently distributed in the ranges shown in Table 9. Specifically, we set the range of the parameter associated with investment adjustment costs, ξ, to be centered around 2.5, which is used in Christiano et al. (2005). The range of the parameter related to bond holding costs, ζ, is assumed to be the same as ξ. Considering that 0.75 is most commonly used in the literature for the probability that prices cannot be adjusted in each period, we set 0.75 as the center of the range of the probability in the non-commodity sector, θ_N. Since commodity prices are more flexible

than non-commodity prices, we assume that the ranges of the Calvo parameters in the energy, food, and metal sectors (θ_E, θ_F, and θ_M) are [0.1, 0.7]. For the elasticity of substitution between the energy-food composite and non-commodities in aggregate consumption (η), we set the range of η to be centered around 0.3, following the estimate of M. Kim (2024), and the range of elasticity of substitution between domestic and imported non-commodities in non-commodity consumption, η_N, to be centered around the value (1.5) used in Backus et al. (1994). Since domestic and imported commodities are highly substitutable, we assume that the ranges of elasticities of substitution between domestic and imported energy, food, and metals (η_E, η_F, and η_M) are [5, 100]. Considering that food and energy are not easily substitutable and that the substitutability between energy and metal is low, we set the ranges of elasticities of substitution between food and energy and between energy and metals (η_{EF} and η_Z) to [0.1, 0.8]. We assume that the ranges of monetary policy weights on inflation and output (ϕ_π and ϕ_y) are centered around the values used in Galí (2015) (i.e., 1.5 and 0.5/4, respectively). We set the ranges of the parameters that determine the relative sizes of the government spending and monetary policy-related global demand shocks to the preference-shifting global demand shock, and those of the common commodity-specific shock to the food and metal price indices to the energy price index to [0.5, 3]. Since the global supply shock functions in the same way as productivity in the non-commodity sector, and since productivity is usually assumed to be highly persistent in the literature, we assume that the range of the persistence parameter for the global supply shock is [0.8, 0.99]. Finally, wide ranges are used for the persistence parameters of the other five shocks (i.e., [0, 0.99]).

B3 Theoretical Model Results

Here we present the responses of global industrial production, global inflation, global real commodity price, and global real energy, food, and metal prices in the model to global demand, global supply, and common commodity, energy, food, and metal-specific shocks. We consider positive 1% global demand, supply, and common commodity-specific shocks and negative 1% global energy, food, and metal-specific shocks.

B3.1 Responses to a Positive Global Demand Shock

Figure 11 shows the responses of the six variables to a positive 1% global demand shock. The shock increases all six variables.

Specifically, the shock shifts household preferences from non-commodities to commodities (i.e., energy and food) in aggregate consumption in the four countries. The demand for energy and food increases, while the demand for non-commodities falls. The increased demand for energy and food increases their real prices and output, while the decreased demand for non-commodities decreases the real price and output of non-commodities. Moreover, although output in the non-commodity sector, where only metals are used in the model, decreases, the demand for metals increases because the real price of metals is relatively lower than that of energy. Hence, the real metal price also increases. Since the share of the non-commodity sector is much larger than the other three commodity sectors in all four countries, the reduced output in this sector decreases aggregate output, and thus global industrial production and global inflation. That is, the preference shift puts downward pressure on global industrial production and global inflation, but upward pressure on the global real commodity price, the global real energy price, the global real food price, and the global real metal price.

The shock also increases government spending, which stimulates aggregate demand in the four countries. Accordingly, output and prices in all sectors increase. Therefore, an increase in government spending due to the shock pushes up all six variables.

Furthermore, the shock lowers the nominal interest rate in the four countries, which stimulates aggregate demand in the four countries. That is, the lower nominal interest rate triggered by the shock puts upward pressure on all six variables.

Taken together, the overall effects of a positive global demand shock on the six variables are positive, i.e., the six variables increase in response to the global demand shock.

B3.2 Responses to a Positive Global Supply Shock

The responses of the six variables to a positive 1% global supply shock are shown in Figure 12. In response to the shock, global inflation falls, but the other five variables increase.

In fact, this shock has the same effect as a global increase in productivity in the non-commodity sector. Hence, in all countries, output in the non-commodity sector rises and the real and nominal prices of non-commodity goods fall. Since the non-commodity sector is much larger than the other three sectors, global industrial production increases, but global inflation falls. Moreover, the increased aggregate demand due

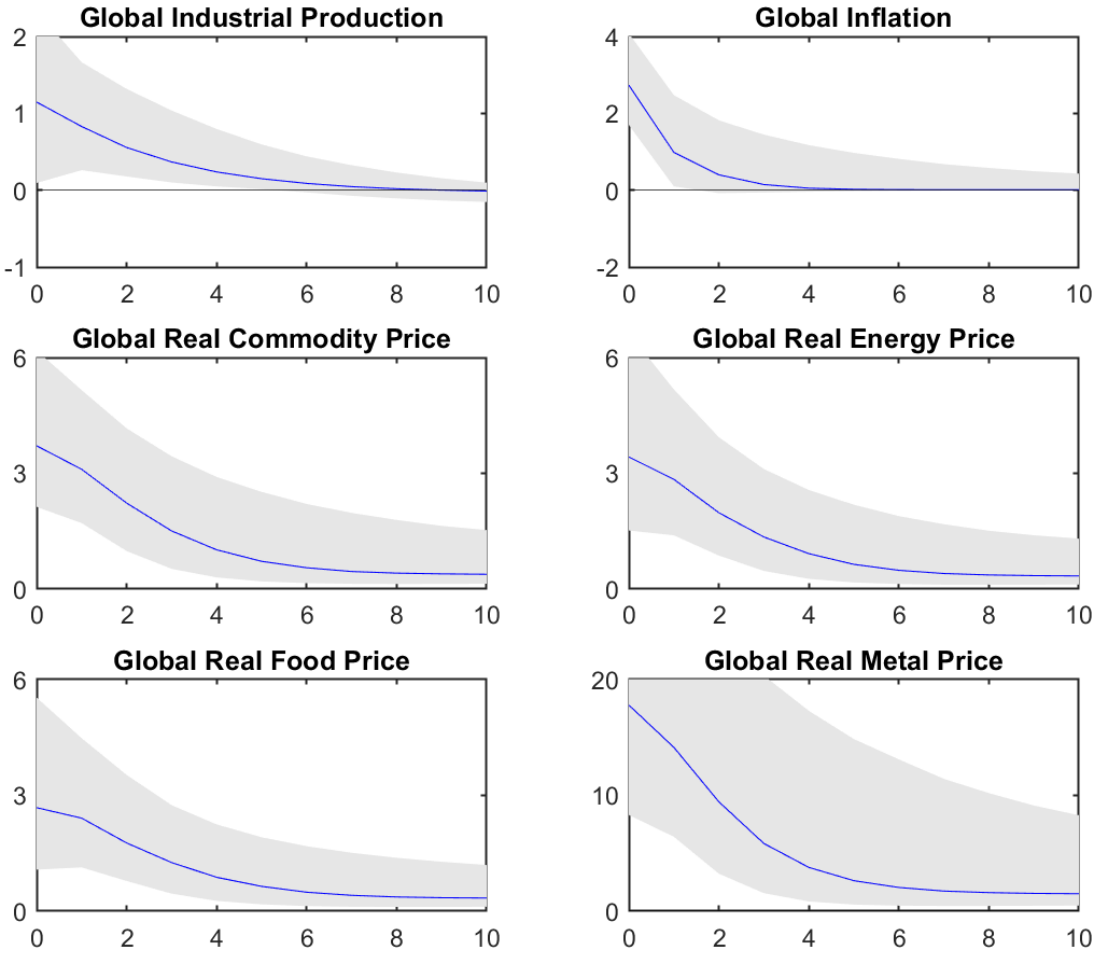


FIGURE 11: Responses to a positive global demand shock

Notes: The solid lines are the median of the distribution of the responses of each variable, and the areas between the 16th and 84th percentiles of the distribution are shaded. The responses are computed based on 5,000 draws. The unit on the x-axis is quarters. The unit on the y-axis for global inflation is percentage points, and the unit on the y-axis for the other variables is percent.

to the shock puts upward pressure on the real prices of the three types of commodities, so that their prices all rise.

B3.3 Responses to a Positive Common (Global) Commodity-Specific Shock

Figure 13 shows the responses of the six variables to a positive 1% common (global) commodity-specific shock. Global industrial production decreases, but the other five variables increase in response to the shock.

This shock increases the real and nominal prices of energy, food, and metals, and thus the global real commodity price. The higher real prices of energy and food decrease their consumption. Given the complementarity between the energy-food composite and non-commodities in consumption ($\eta < 1$), the consumption of non-commodities also falls. Therefore, output in the non-commodity, energy, and food

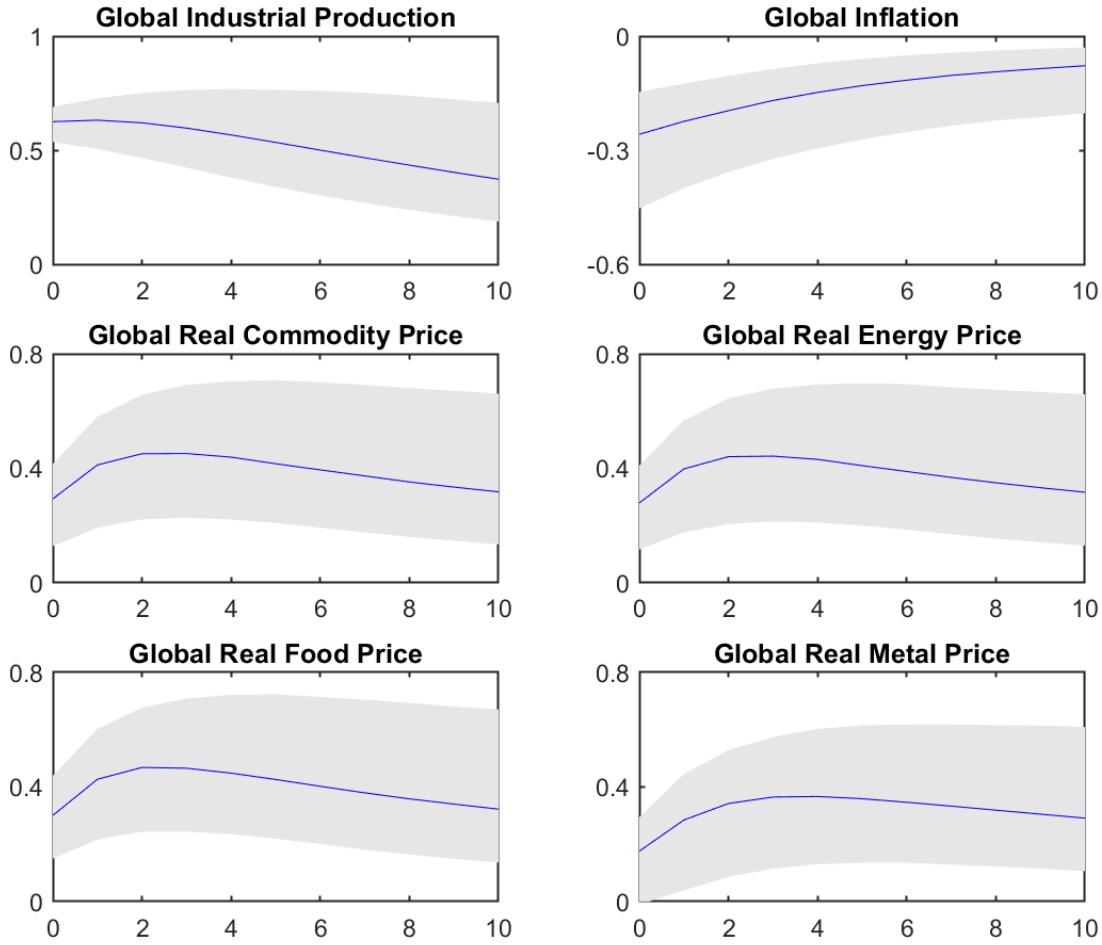


FIGURE 12: Responses to a positive global supply shock

Notes: The solid lines are the median of the distribution of the responses of each variable, and the areas between the 16th and 84th percentiles of the distribution are shaded. The responses are computed based on 5,000 draws. The unit on the x-axis is quarters. The unit on the y-axis for global inflation is percentage points, and the unit on the y-axis for the other variables is percent.

sectors decreases, which leads to a decline in global industrial production. Since energy and metals are used in the production of the non-commodity sector, the higher nominal prices of these two commodities due to the shock increase the nominal marginal cost in this sector, which results in an increase in the nominal price of non-commodities in all countries. As a consequence, global inflation goes up.

B3.4 Responses to a Negative Global Energy-Specific Shock

The responses of the six variables to a negative 1% energy-specific shock are shown in Figure 14. The shock reduces global industrial production, but increases global inflation, the global real commodity price, and the global real energy price.

The shock reduces the supply of energy in the four countries. The nominal and real energy prices, and thus the global real commodity price, increase in response to the shock. Since energy is used in the

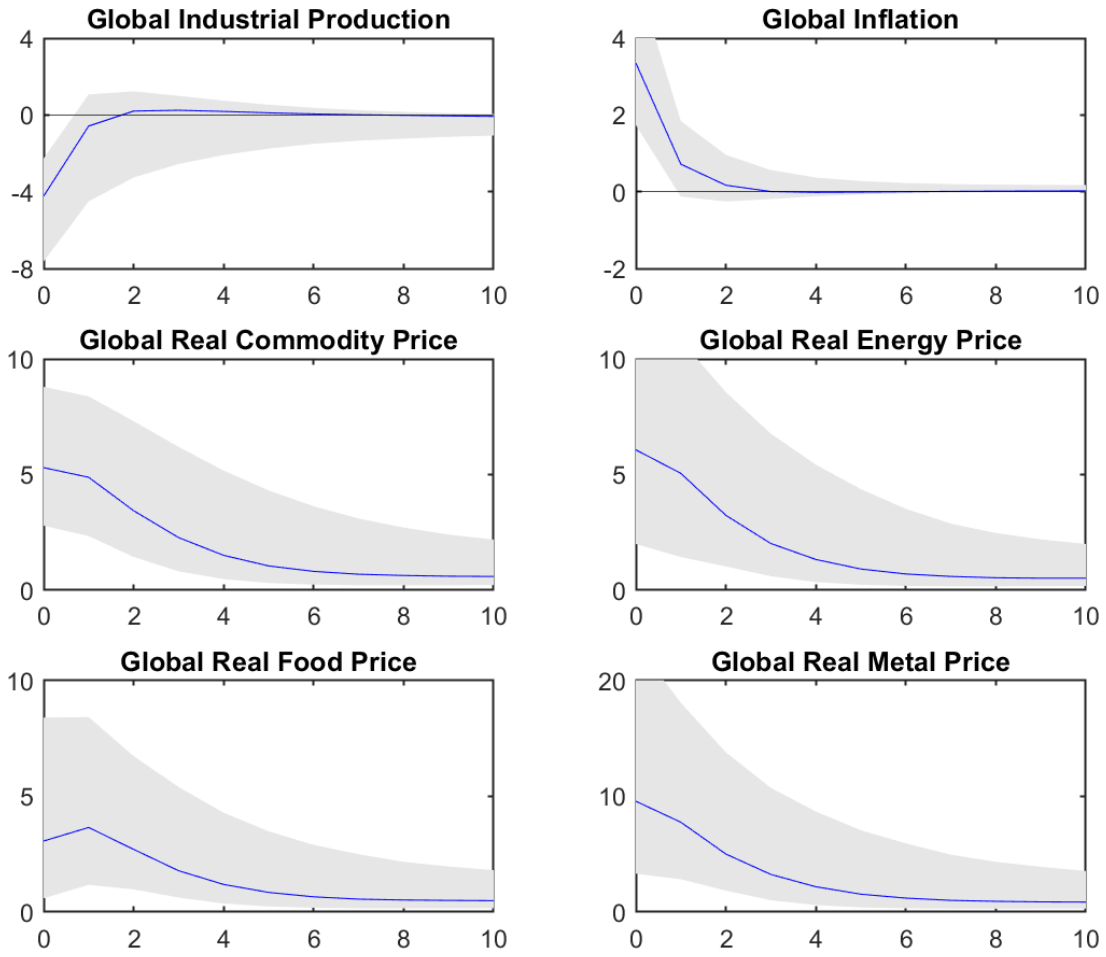


FIGURE 13: Responses to a positive common (global) commodity-specific shock

Notes: The solid lines are the median of the distribution of the responses of each variable, and the areas between the 16th and 84th percentiles of the distribution are shaded. The responses are computed based on 5,000 draws. The unit on the x-axis is quarters. The unit on the y-axis for global inflation is percentage points, and the unit on the y-axis for the other variables is percent.

production of non-commodities and metals, the higher nominal energy price raises the nominal marginal cost in these two sectors, which dampens output and increases nominal prices in these two sectors. Considering that the non-commodity sector is the largest sector in the model, the lower output in this sector decreases global industrial production, and the higher nominal price of non-commodities leads to an increase in global inflation. Note that while the contemporaneous responses of the global real food price and the global real metal price to the shock are not very robust across the different parameter values, they soon become unambiguously positive.

B3.5 Responses to a Negative Global Food-Specific Shock

Figure 15 shows the responses of the six variables to a negative 1% global food-specific shock. Global industrial production falls, but global inflation, the global real commodity price, and the global real food

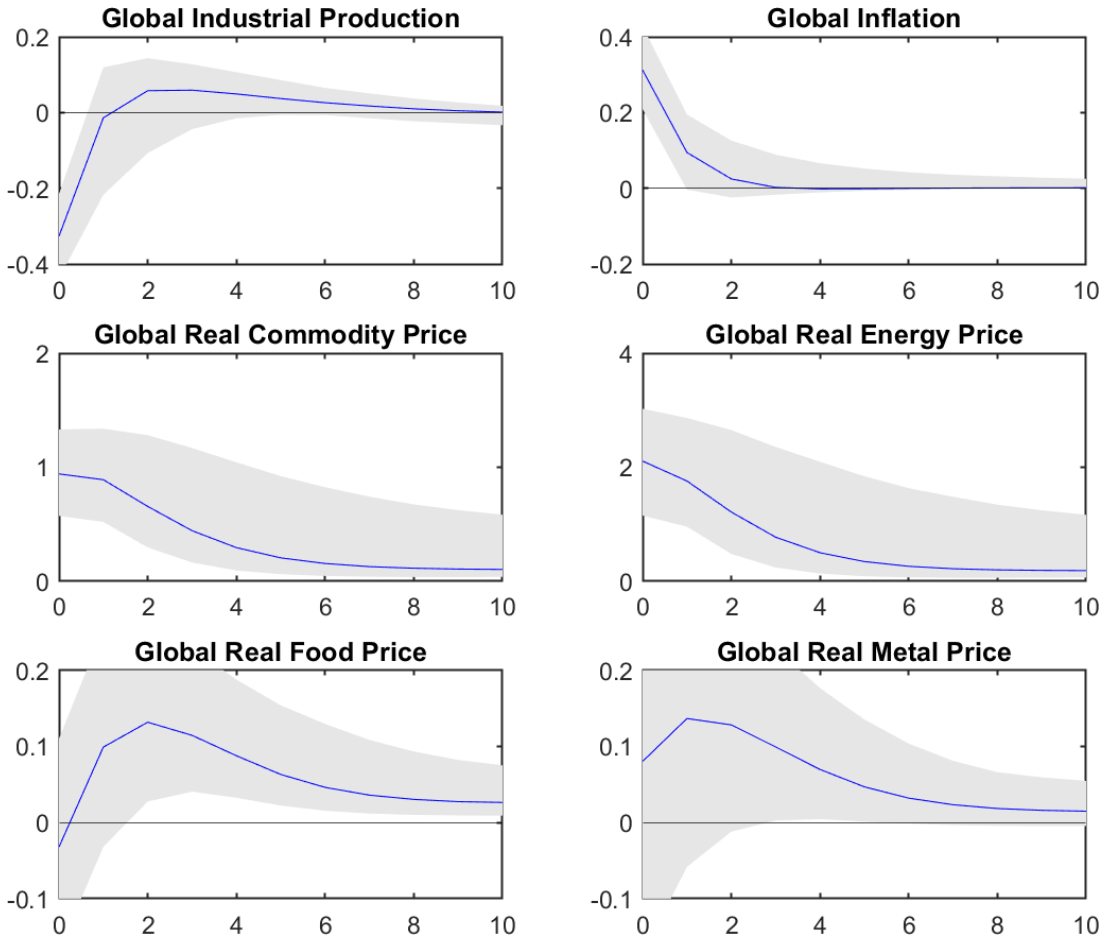


FIGURE 14: Responses to a negative global energy-specific shock

Notes: The solid lines are the median of the distribution of the responses of each variable, and the areas between the 16th and 84th percentiles of the distribution are shaded. The responses are computed based on 5,000 draws. The unit on the x-axis is quarters. The unit on the y-axis for global inflation is percentage points, and the unit on the y-axis for the other variables is percent.

price rise in response to the shock.

This shock decreases the supply of food in the four countries. Accordingly, the nominal and real food prices, and thus the global real commodity price, rise in response to the shock. The higher real food price dampens food consumption. Given the complementarities between energy and food ($\eta_{EF} < 1$) and between the energy-food composite and non-commodities in consumption ($\eta < 1$), non-commodity consumption declines. Therefore, output in the non-commodity sector, the largest sector, decreases, which results in a decrease in global industrial production. Since the nominal food price is included in the CPI, the higher nominal food price increases the CPI, so global inflation goes up. Note that the responses of the global real energy and metal prices to this shock are not robust.

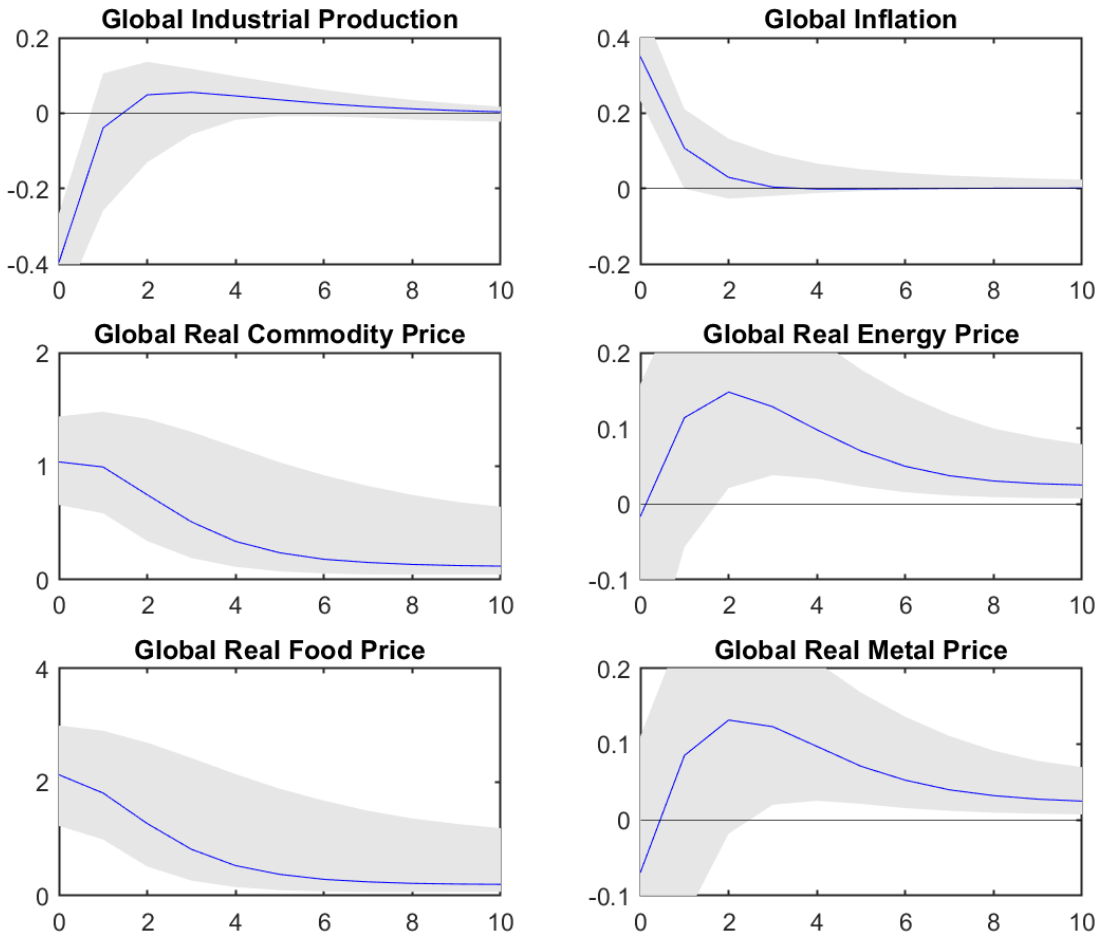


FIGURE 15: Responses to a negative global food-specific shock

Notes: The solid lines are the median of the distribution of the responses of each variable, and the areas between the 16th and 84th percentiles of the distribution are shaded. The responses are computed based on 5,000 draws. The unit on the x-axis is quarters. The unit on the y-axis for global inflation is percentage points, and the unit on the y-axis for the other variables is percent.

B3.6 Responses to a Negative Global Metal-Specific Shock

The responses of the six variables to a negative 1% metal-specific shock are shown in Figure 16. The shock reduces global industrial production but increases global inflation, the global real commodity price, and the global real metal price.

This shock reduces the supply of metals in the four countries. Thus, the nominal and real metal prices, and thus the global real commodity price, increase in response to the shock. Since metals are used in the production of non-commodities, the higher nominal metal price raises the nominal marginal cost in the sector, which dampens output and increases the nominal price in the sector. Since the non-commodity sector is the largest, the decreased output in this sector leads to a fall in global industrial production, and the higher nominal price of non-commodities increases global inflation. Note that the responses of the global real energy and food prices to this shock are not very robust.

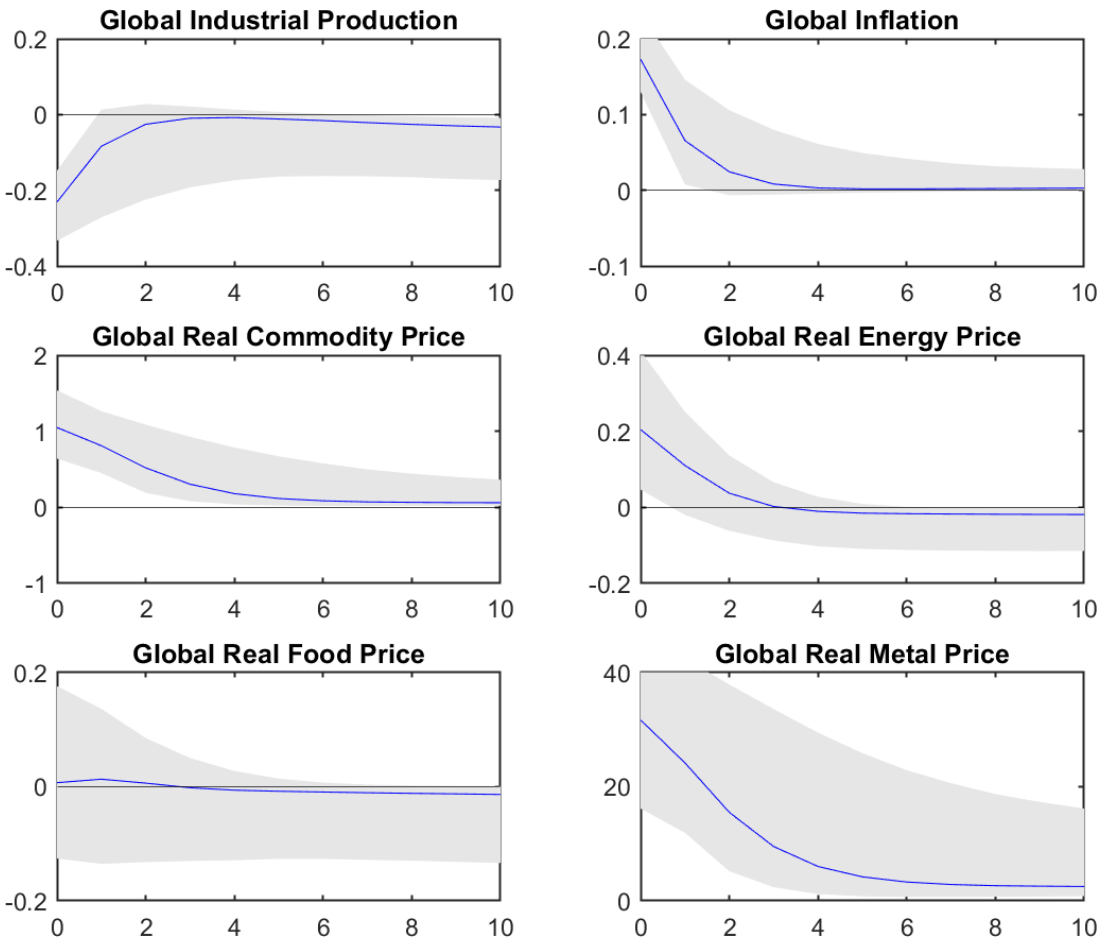


FIGURE 16: Responses to a negative global metal-specific shock

Notes: The solid lines are the median of the distribution of the responses of each variable, and the areas between the 16th and 84th percentiles of the distribution are shaded. The responses are computed based on 5,000 draws. The unit on the x-axis is quarters. The unit on the y-axis for global inflation is percentage points, and the unit on the y-axis for the other variables is percent.

C Data and Empirical Estimation

C1 Data

Advanced Economies (AEs) and Emerging Market and Developing Economies (EMDEs)

Advanced Economies (AEs)	Emerging Market and Developing Economies (EMDEs)
Australia	Azerbaijan
Austria	Botswana
Belgium	Brazil
Canada	Bulgaria
Denmark	Chile
Finland	China
France	Colombia
Germany	Costa Rica
Iceland	Czech Republic
Ireland	Dominican Republic
Israel	Egypt, Arab Rep.
Italy	Greece
Japan	Honduras
Luxembourg	Hungary
Netherlands	India
New Zealand	Indonesia
Norway	Jordan
Portugal	Korea, Rep.
Spain	Malaysia
Sweden	Mexico
Switzerland	Morocco
United Kingdom	North Macedonia, FYR
United States	Philippines
	Poland
	Russian Federation
	Slovak Republic
	Slovenia
	South Africa
	Thailand
	Tunisia
	Türkiye (Turkey)

da

TABLE 7: Countries' included 1973-2022 and 2000-2022

Country	HCPI		CCPI		ECPI		FCPI	
	'73-'22	'00-'22	'73-'22	'00-'22	'73-'22	'00-'22	'73-'22	'00-'22
Austria	X	X	X	X	X	X	X	X
Azerbaijan	X	X						
Belgium	X	X	X	X	X	X	X	X
Botswana	X	X						
Brazil	X	X						
Bulgaria	X	X		X		X		X
Canada	X	X	X	X	X	X	X	X
Chile	X	X		X		X		X
China	X	X						
Colombia	X	X		X		X		X
Costa Rica	X	X						
Cyprus				X		X		X
Czech Republic	X	X		X		X		X
Denmark	X	X	X	X	X	X	X	X
Egypt	X	X						
Estonia				X		X		X
Finland	X	X	X	X	X	X	X	X
France	X	X	X	X	X	X	X	X
Germany	X	X	X	X	X	X		X
Greece	X	X	X	X		X		X
Honduras	X	X						
Hungary	X	X		X		X		X
Iceland	X	X		X		X		X
India	X	X						
Indonesia	X	X						
Ireland	X	X		X		X		X
Israel	X	X		X		X		X
Italy	X	X	X	X	X	X	X	X
Japan	X	X	X	X	X	X	X	X
Jordan	X	X						
Korea	X	X		X		X		X
Latvia				X		X		X
Lithuania				X		X		X
Luxembourg	X	X	X	X	X	X	X	X
Malaysia	X	X				X		X
Mexico	X	X		X		X		X
Morocco	X	X						
Netherlands	X	X	X	X	X	X	X	X
North Macedonia	X	X						
Norway	X	X		X		X		X
Philippines	X	X						
Poland	X	X		X		X		X
Portugal	X	X	X	X	X	X	X	X
Russia	X	X						
Slovakia	X	X		X		X		X
Slovenia	X	X		X		X		X
South Africa	X	X						
Spain	X	X		X		X		X
Sweden	X	X	X	X	X	X	X	X
Switzerland	X	X	X	X	X	X	X	X
TaiwanChina				X		X		X
Thailand	X	X						
Tunisia	X	X						
Turkey	X	X		X		X		X
UK	X	X	X	X	X	X	X	X
USA	X	X	X	X	X	X	X	X

Table 8: Summary of Country Groups

Country	Income Group	EMDE	Region	C	A	M	O	E	Infl Target	Trade Open	Cap Open	ER Regime
Austria	HIC		AME							High	High	Peg
Azerbaijan	UMC	EMDE	ECA	X			X	X		High	High	Peg
Belgium	HIC		AME							High	High	Peg
Botswana	UMC	EMDE	SSA	X		X				High	High	Peg
Brazil	UMC	EMDE	LAC	X	X				X	Low	Low	Float
Bulgaria	UMC	EMDE	ECA							High	High	Peg
Canada	HIC		AME	X			X	X	X	Low	High	Float
Chile	HIC	EMDE	LAC	X		X			X	Low	High	Float
China	UMC	EMDE	EAP							Low	Low	Peg
Colombia	UMC	EMDE	LAC	X			X	X	X	Low	Low	Float
Costa Rica	UMC	EMDE	LAC	X	X				X	Low	High	Peg
Cyprus	HIC		AME							High	High	Peg
Czech Rep.	HIC		AME						X	High	High	Peg
Denmark	HIC		AME							High	High	Peg
Egypt	LMC	EMDE	MNA							Low	Low	Peg
Estonia	HIC		AME							High	High	Peg
Finland	HIC		AME							High	High	Peg
France	HIC		AME							Low	High	Peg
Germany	HIC		AME							High	High	Peg
Greece	HIC		AME							High	High	Peg
Honduras	LMC	EMDE	LAC	X	X					High	Low	Peg
Hungary	HIC	EMDE	ECA						X	High	High	Peg
Iceland	HIC		AME	X	X				X	High	High	Float
India	LMC	EMDE	SAR						X	Low	Low	Float
Indonesia	UMC	EMDE	EAP	X				X	X	Low	Low	Peg
Ireland	HIC		AME							High	High	Peg
Israel	HIC		AME						X	Low	High	Float
Italy	HIC		AME							Low	High	Peg
Japan	HIC		AME						X	Low	High	Float
Jordan	LMC	EMDE	MNA							High	High	Peg
Korea	HIC		AME						X	Low	High	Float
Latvia	HIC		AME							High	High	Peg
Lithuania	HIC		AME							High	High	Peg
Luxembourg	HIC		AME							High		Peg
Malaysia	UMC	EMDE	EAP							High	Low	Float
Mexico	UMC	EMDE	LAC						X	Low	High	Float
Morocco	LMC	EMDE	MNA							Low	Low	Peg
Netherlands	HIC		AME							High	High	Peg
N Macedonia	UMC	EMDE	ECA							High	High	Peg
Norway	HIC		AME	X			X	X	X	Low	High	Float
Philippines	LMC	EMDE	EAP						X	Low	High	Peg
Poland	HIC	EMDE	ECA						X	High	High	Float
Portugal	HIC		AME							High	High	Peg
Russia	UMC	EMDE	ECA	X			X	X	X	Low	Low	Float
Slovakia	HIC		AME							High	High	Peg
Slovenia	HIC		AME							High	High	Peg
South Africa	UMC	EMDE	SSA	X		X			X	Low	Low	Float
Spain	HIC		AME							Low	High	Peg
Sweden	HIC		AME						X	High	High	Float
Switzerland	HIC		AME							High	High	Float
Taiwan	HIC		AME									
Thailand	UMC	EMDE	EAP						X	High	Low	Float
Tunisia	LMC	EMDE	MNA							High	Low	Peg
Turkey	UMC	EMDE	ECA						X	Low	Low	
UK	HIC		AME						X	Low	High	Float
USA	HIC		AME							Low	High	Float

(A) Note. C: Commodity, A: Agriculture, M: Metal, O: Oil, E: Energy.

TABLE 9: Countries in Commodity Exporters Group

Country	HCPI		CCPI		ECPI		FCPI	
	'73-'22	'00-'22	'73-'22	'00-'22	'73-'22	'00-'22	'73-'22	'00-'22
Azerbaijan	X	X						
Botswana	X	X						
Brazil	X	X						
Canada	X	X	X	X	X	X	X	X
Chile	X	X		X		X		X
Colombia	X	X		X		X		X
Costa Rica	X	X						
Honduras	X	X						
Iceland	X	X		X		X		X
Indonesia	X	X						
Norway	X	X		X		X		X
Russia	X	X						
South Africa	X	X						

TABLE 10: Countries in Agriculture Exporters Group

Country	HCPI		CCPI		ECPI		FCPI	
	'73-'22	'00-'22	'73-'22	'00-'22	'73-'22	'00-'22	'73-'22	'00-'22
Brazil	X	X						
Costa Rica	X	X						
Honduras	X	X						
Iceland	X	X		X		X		X

TABLE 11: Countries in Metal Exporters Group

Country	HCPI		CCPI		ECPI		FCPI	
	'73-'22	'00-'22	'73-'22	'00-'22	'73-'22	'00-'22	'73-'22	'00-'22
Botswana	X	X						
Chile	X	X		X		X		X
South Africa	X	X						

TABLE 12: Countries in Oil Exporters Group

Country	HCPI		CCPI		ECPI		FCPI	
	'73-'22	'00-'22	'73-'22	'00-'22	'73-'22	'00-'22	'73-'22	'00-'22
Azerbaijan	X	X						
Canada	X	X	X	X	X	X	X	X
Colombia	X	X		X		X		X
Norway	X	X		X		X		X
Russia	X	X						

TABLE 13: Countries in Energy Exporters Group

Country	HCPI		CCPI		ECPI		FCPI	
	'73-'22	'00-'22	'73-'22	'00-'22	'73-'22	'00-'22	'73-'22	'00-'22
Azerbaijan	X	X						
Canada	X	X	X	X	X	X	X	X
Colombia	X	X		X	X		X	
Indonesia	X	X						
Norway	X	X		X	X		X	
Russia	X	X						

C2 Estimation

A standard estimation approach used to estimate Structural Vector Autoregressions (SVARs) that are set-identified, is to rely on Bayesian methods, notably those involving rejection sampling. Typically, this process begins by selecting parameter values that comply with zero restrictions, but these selections are then subjected to further scrutiny against sign restrictions. Such a methodology, exemplified in studies like Arias et al. (2018), though logically robust, encounters substantial computational challenges. This issue primarily manifests when the identified set, as shaped by sign restrictions, becomes significantly constricted within the bounds set by the zero restrictions. This results in a computationally burdensome iterative process, often demanding a multitude of parameter draws to accumulate a satisfactory collection that meets both the sign and zero restrictions criteria. This problem is more evident in our analysis as we estimate an SVAR model with a relatively large number of parameters.

To address this problem, we use recent the algorithm developed in Korobilis (2022) to facilitate Bayesian inference in large-scale SVARs that are set-identified using a combination of sign and zero restrictions. The starting point is the SVAR model and its corresponding reduced-form described in equations (1) and (2), respectively. The key idea in this approach is to identify a set of $\gamma \leq n$ common forces driving the set of reduced-from shocks in the system of n endogenous variables

$$u_t = \Lambda f_t + v_t, \tag{C.1}$$

where λ is $n \times r$ matrix of factor loadings, f_t is an $r \times 1$ vector of factors, and v_t is $\times 1$ vector of idiosyncratic shocks. [only r common shocks are considered structural, remaining n shocks are nuisance shocks. vt, sigma and ft define. Then mapping from conditional covariance matrix is now of the form:

$$cov\left(u_t|\lambda, \Sigma\right) = \Omega = \Lambda\Lambda' + \Sigma \tag{C.2}$$

Thus, as long as Σ is diagonal, identification via sign restrictions can be achieved by imposing the desired signs on Λ. Additionally, respective elements of Λ can be restricted to zero. Since the covariance matrix of the disturbances, $\Omega = \Lambda\Lambda' + \Sigma$, is directly determined by the structure of Λ. Sign restrictions or zero restrictions on elements of Λ translate into restrictions on the covariance structure of disturbances.

By decomposing the VAR disturbances into factor loadings and idiosyncratic components, we can directly interpret the common factors f_t as the structural shocks driving the SVAR system. As the number of variables n increases, the idiosyncratic components v_t, due to their uncorrelated nature, become asymptotically negligible. This reduction in their influence ensures that the primary drivers of the endogenous variables are the structural shocks encapsulated in the common factors. Through this methodology, we are able to efficiently and accurately estimate the parameters of our large-scale SVAR model, overcoming the computational barriers typically associated with traditional Bayesian inference in set-identified SVARs.

As is standard in the VAR literature, our main workhorse is the impulse response of the variables fol-

lowing the structural global shocks. We start with the impulse response functions following one standard deviation shock. In addition, we also normalize the size of commodity shocks to compare the pass-through of commodity shocks to domestic inflation measures in a harmonized manner. More specifically, we focus on the pass-through of 10 percent energy shock, 5 percent metal and common (global) commodity-specific shock, respectively, and 3 percent food shock into domestic inflation.[31]

[31] The size of these shocks are selected to represent approximately one standard deviation of each commodity shocks over the full sample period (1973-2022).

D Further Considerations

In this Appendix, we check the sensitivity and robustness of the main empirical results presented in Section IV. First, we test the differences across various country groups in the stringency of the transmission of global commodity shocks into domestic inflation.

Second, various types of robustness checks are executed, grouped by two categories: estimation using alternative identification methods and estimation based on alternative endogenous variables and data sets. In testing the robustness of our identification strategy of different commodity shocks, we estimate (a) an alternative model that omits common (global) commodity-specific shocks, (b) the model that allows contemporaneous spillovers from food to energy sectors, to consider biofuels use in energy, and (c) the model with restrictions to impose a positive impact of energy shocks on food and metal prices, and (d) the model with alternative anchor commodities. Next, alternative datasets we test include (e) inflation rates that are winsorized to 100 percent (annualized) to eliminate the effects from outliers, (f) the results that include countries with statistically insignificant impulse responses, (g) alternative measurements of global inflation (global inflation factor), and (h) nominal commodity prices (instead of real ones).

In summarizing the empirical results based on different groups, models and datasets, the estimates of the pass-through ratio (based on the normalized impulse response functions as explained in the previous sections). For the sake of effectiveness, we present the robustness results based on the headline CPI inflation over 1973-2022 while we also test as the recent sample (2000-2022) and other inflation measures. In a nutshell, the results suggest that the transmission of global shocks into domestic inflation differs significantly across country groups: the shock transmission was more significant and sizeable in the countries with higher trade openness and greater intensity of commodity imports. Meanwhile, empirical results are broadly consistent across different models and identification schemes, commodity variables, and alternative endogenous variables and country groups.

D1 Cross-country heterogeneity

While the effects of global demand and commodity-specific shocks on domestic headline inflation were statistically significant in fewer EMDEs compared to advanced economies, the magnitude of these impacts, where significant, was more pronounced in EMDEs. This greater sensitivity in EMDEs likely reflects factors such as more volatile economic conditions and less anchored inflation expectations, which can amplify the inflationary response to external shocks.[32] In EMDEs, all types of commodity shocks—energy, food, and metals—showed sizeable impacts on headline inflation, with effects reaching up to 0.5 percentage points for the median country. Notably, the impacts of energy and food shocks in EMDEs were almost on par with those of global demand shocks. In advanced economies, however, global demand

[32]For instance, Furceri et al. (2016) finds that a 10 percent increase in global food inflation raises domestic inflation by about 0.5 percent in advanced economies, though the impact is notably higher in EMDEs. Similarly, Bekkers et al. (2017) reports significantly greater pass-through of food price shocks to consumer prices in low-income countries compared to other nations.

shocks remained the dominant driver of inflation (0.7 percentage points), followed by energy (0.4 percentage points) and food (0.3 percentage points) shocks. This contrast aligns with our finding that responses to global shocks tend to reach statistical significance more frequently in advanced economies, potentially reflecting stronger, more immediate pass-through facilitated by factors like trade and financial openness and higher commodity import intensity.[33] [revise]

Figure 17 and Figure 18 also present the differences in the transmission of global shocks to inflation across different country groups, based on four key classifications: (1) exchange rate regime (pegged vs. floating), (2) degree of trade openness (higher vs. lower), (3) inflation-targeting framework (inflation targeting vs. non-inflation-targeting), and (4) commodity trade status (net exporter vs. net importer, with further distinctions for energy, food, and metals). In a nutshell, the empirical results collectively suggest that global shocks tend to have a more significant and pronounced impact in countries characterized by higher trade openness, pegged exchange rates, and net commodity imports. Among these factors, trade openness stands out as particularly influential. Greater integration into global trade networks serves as a key mechanism through which commodity price shocks are transmitted to domestic prices.

Trade Linkages. The results clearly suggest that while the impacts of global shocks were statistically significant in much greater portion of countries with higher trade openness than those with lower trade openness, the sensitivity of domestic inflation to the shocks was also much larger following all types of global shocks in the former group of countries. This finding is quite consistent with the theory that countries that are highly integrated into global trade networks are more exposed to fluctuations in international prices. As trade openness increases, domestic consumption and production become more reliant on imported inputs, heightening the sensitivity of domestic prices to global price movements. For instance, an energy-specific shock not only raises domestic production costs through higher energy prices but also increases the cost of foreign intermediate goods. This integration weakens the effectiveness of domestic monetary policy in stabilizing inflation, as global factors increasingly influence domestic price dynamics. Consequently, countries with greater trade openness experience stronger pass-through effects from global commodity price shocks, amplifying their impact on domestic inflation.

These findings align with existing literature as well. Bianchi and Civelli (2015) demonstrate that inflationary responses to global slack are more significant in economies with greater trade openness. Similarly, Martínez-Garcia and Wynne (2010) show that inflation in more open economies is less responsive to domestic slack. Andrews, Gal, and Witheridge (2018) further highlight that deeper integration into global value chains strengthens the transmission of global shocks by amplifying the impact of global economic slack on domestic inflation.

Commodity Trade. In theory, net commodity-importing countries are inherently more exposed to global commodity price shocks as they rely on external sources for critical inputs such as energy, food, and

[33] For example, Ha et al. (2023a) highlight how these country characteristics facilitate a greater degree of pass-through of global shocks in advanced economies. See Appendix D for a more detailed analysis of cross-country differences in the pass-through of various commodity shocks.

metals. When global commodity prices rise, these countries face direct increases in production costs and consumer prices, with a more substantial pass-through effect compared to exporters. While exporters, particularly those of energy, food, or metals, can benefit from higher revenues and currency appreciation that may offset some inflationary pressures, net importers experience increased import costs without these compensatory benefits, leading to stronger inflationary impacts.

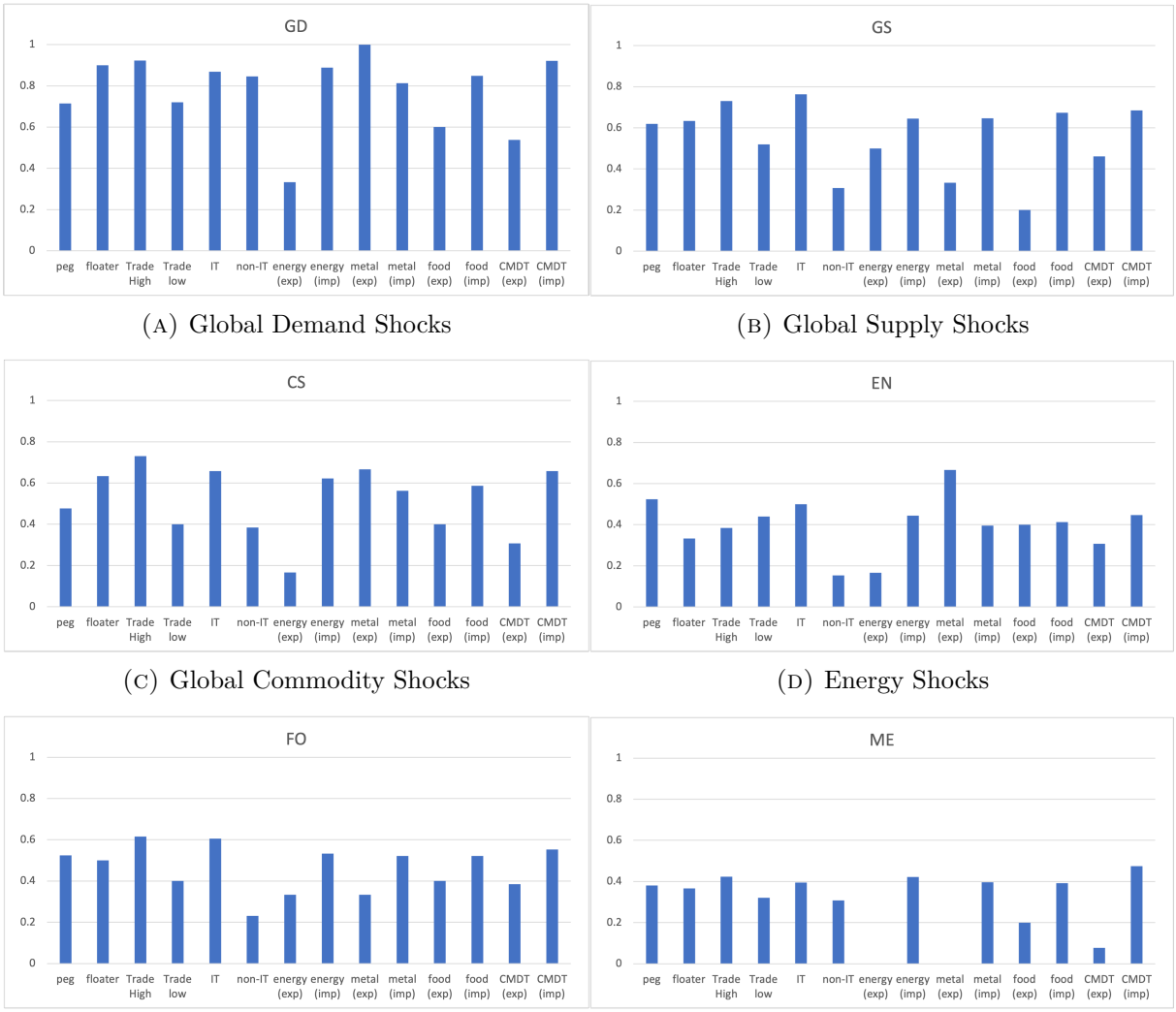
This sensitivity is confirmed in our analysis, as shown in Figures 17 and 18, especially pronounced in countries where commodities like energy or food constitute a large share of the import bill, making even small global shocks capable of triggering disproportionate inflationary pressures.

Inflation Targeting. The results in Figure 20 indicate that countries with an inflation-targeting regime exhibit a more moderated inflation response to all types of commodity shocks compared to non-targeting countries. The inflation-targeting framework influences domestic inflation by providing a more effective anchor for inflation expectations, which reduces the pass-through of external shocks. Central banks with credible commitments to explicit inflation targets can stabilize inflation expectations, thereby mitigating the impact of global demand, supply, and commodity price fluctuations. That said, in highly open economies, the influence of global factors may still significantly affect domestic inflation dynamics, even within inflation-targeting regimes.

Findings in earlier studies, such as Chen (2009), show that the impact of oil price shocks on inflation is diminished when central banks respond by raising policy rates. Other characteristics of central banks, such as independence and leadership stability, did not result in statistically significant differences in the effects of oil price shocks.

Exchange Rate Regime. The results suggest that countries with pegged rates are more vulnerable to global shocks. This could be due to their limited flexibility in adjusting exchange rates in response to external (global) shocks. Unlike floating regimes, where exchange rate adjustments can partially absorb external price shocks by allowing the currency to appreciate or depreciate, pegged regimes prevent such adjustments, leading to greater pass-through of global price changes to domestic inflation, broadly in line with the Trilemma theory. This is especially relevant for commodity price shocks, where the fixed exchange rate amplifies the impact of rising import costs on domestic prices. Moreover, maintaining a pegged exchange rate often necessitates interventionist monetary policies, which can conflict with domestic price stability objectives and exacerbate inflation during periods of global inflationary pressures.

FIGURE 17: SHARE OF COUNTRIES WITH SIGNIFICANT IMPACTS BY COUNTRY GROUPS



(A) Global Demand Shocks

(B) Global Supply Shocks

(C) Global Commodity Shocks

(D) Energy Shocks

(E) Food Shocks

(F) Metal Shocks

Note: Empirical results based on monthly structural VAR model of 39 economies. The models include global output, inflation, commodity prices, energy prices, food prices, metal prices, and domestic core CPI inflation. The sample period is 1973-2022. The model identifies six global shocks: global demand (GD), global supply (GS), common commodity-specific (CS), energy-specific (EN), food-specific (FO), and metal-specific (ME) shocks.

D2 Alternative Identification

D2.1 Excluding Common Commodity-Specific Shocks

We first remove common (global) commodity-specific shocks in the identification (as indicated in Table 14). Since we do not differentiate between energy and common commodity-specific shocks in this speci-

FIGURE 18: IMPACT ON HEADLINE INFLATION BY COUNTRY GROUP



(A) Global Demand Shock

(B) Global Supply Shock

(C) Global Commodity Shock

(D) Energy Shock

(E) Food Shock

(F) Metal Shock

Note: Empirical results based on monthly structural VAR model of 39 economies. The models include global output, inflation, commodity prices, energy prices, food prices, metal prices, and domestic core CPI inflation. The sample period is 1973-2022. The model identifies six global shocks: global demand (GD), global supply (GS), common commodity-specific (CS), energy-specific (EN), food-specific (FO), and metal-specific (ME) shocks.

fication, the anchor variable is accordingly removed from the SVAR model. The model then contains six endogenous variables and identifies five structural global shocks.

As summarized in Table 17 (see the results in the row named "Excluding common commodity-specific shocks"), the pass-through ratio of different commodity shocks into headline CPI inflation is broadly consistent with the baseline results in terms of both magnitude and persistence, although the ratios are

somewhat higher than the baseline estimates across the different commodity shocks. This is possibly because the omitted role of common commodity-specific shocks is added to the pass-through ratios following each commodity shock, in particular, the energy shocks. This observation is consistent across the full sample period and the recent sample period (not shown).

D2.2 Relax Restrictions to Allow Food to Energy Spillovers

In this analysis, we adjust our model to consider the contemporaneous spillover effects of food price shocks on energy prices (within the initial impact period). This adjustment is particularly relevant in light of the recent biofuels revolution and the use of agricultural commodities in fuel production, which suggest that sudden changes in food demand and supply could influence energy prices. We therefore remove the previous "zero" constraint that energy prices do not react to food shocks within the first month. By eliminating this constraint, as shown in Table 15, we allow the model to freely assess the influence of food shocks on energy prices, namely as "alternative spillover model 1".

Additionally, to distinguish more between food and energy shocks, we introduce two types of variations. First, we now specify that metal prices must respond positively to energy shocks, a departure from the earlier identification strategy where this restriction was not imposed. This assumption is justified given that energy costs are a significant factor in metal production. Second, We also explore a variant of the model that does not restrict the effect of energy prices on metals, while assuming a positive impact of food shocks on cotton prices (our anchor commodity), as depicted in Table 16 ("Alternative spillover model 2"). This approach helps differentiate food from energy shocks and permits the examination of spillover effects from food to energy prices.[34]

In all cases, as shown in Table 17 (see the rows named "alternative spillover model 1 and 2"), we do not observe any specific variations of the key results. This suggests that these additional restrictions do not change substantially the identified commodity shocks.

D2.3 Employing Different Anchor Variables

Instead of our benchmark anchor commodity (i.e. cotton), tea and tobacco are tested as anchor commodities due to their specific production characteristics and their significant presence in financial markets. More specifically, tea's production uses relatively less energy thus resulting in a potentially lower immediate impact of energy cost changes. While its pricing reacts to demand and supply expectations via financial markets. As a result, tea prices often mirror future energy cost anticipations.

Tobacco shares similar characteristics, with some of its production stages being less reliant on energy, coupled with their sizeable trading volumes in financial markets. This volume of trading means their

[34] Admittedly, the second assumption is somewhat strong in the sense that cotton prices are unlikely to be influenced by food shocks within the same month, given that planting decisions are made prior to the harvest season.

prices adjust in response to anticipated future market conditions, including changes in energy prices. Again, as shown in Table 17, the estimated pass-through ratios of commodity shocks are consistent with baseline estimates, suggesting that our choice of anchor variable is reasonable and does not produce biased empirical results.

D3 Alternate Endogenous Variables and Other Considerations

As shown in Table 18, the results with winsorized inflation, those that include non-significant cross-country impulse response functions (IRFs), or the results with nominal commodity prices or global inflation factor, do not report any notable differences in the estimation of pass-through ratios of commodity shocks to headline CPI inflation. One observation is that the results with non-significant IRFs deliver somewhat lower pass-through ratios than the benchmark results, which is intuitive in the sense that insignificant results include negative signs. Similar observations were made with nominal commodity prices, and in this case, nominal prices do include general prices, which could lead to underestimation of the pass-through ratios.

TABLE 14: Restrictions on IRFs: Excluding Commodity Speculative Shocks

	GD	**GS**	**EN**	**FO**	**ME**
Global Industrial Production	+	+	-	-	-
Global Inflation	+	-	+	+	+
Energy Price Index	+	+	+	0	0
Food Price Index	+	+	+	+	0
Metal Price Index	+	+	*	0	+
Country Inflation	*	*	*	*	*

Note. **GD**: Global Demand, **GS**: Global Supply, **EN**: Energy, **FO**: Food, **ME**: Metals

TABLE 15: Restrictions on Impulse Response Functions

	GD	**GS**	**CS**	**EN**	**FO**	**ME**
Global Industrial Production	+	+	-	-	-	-
Global Inflation	+	-	+	+	+	+
Commodity Price Factor	+	+	+	*	*	*
Energy Price Index	+	+	+	+	*	0
Food Price Index	+	+	+	*	+	0
Metal Price Index	+	+	+	+	0	+
Anchor Commodity	+	+	+	0	0	0
Country Inflation	*	*	*	*	*	*

Note. **GD**: Global Demand, **GS**: Global Supply, **CS**: Common (Global) Commodity-specific, **EN**: Energy, **FO**: Food, **ME**: Metals

TABLE 16: Restrictions on Impulse Response Functions

	GD	**GS**	**CS**	**EN**	**FO**	**ME**
Global Industrial Production	+	+	-	-	-	-
Global Inflation	+	-	+	+	+	+
Commodity Price Factor	+	+	+	*	*	*
Energy Price Index	+	+	+	+	*	0
Food Price Index	+	+	+	*	+	0
Metal Price Index	+	+	+	*	0	+
Anchor Commodity	+	+	+	0	+	0
Country Inflation	*	*	*	*	*	*

Note. **GD**: Global Demand, **GS**: Global Supply, **CS**: Common (Global) Commodity-specific, **EN**: Energy, **FO**: Food, **ME**: Metals

TABLE 17: Pass-through ratio to headline inflation measures: Alternative identificaiton strategies

Alternative models	Shocks	1 month	1 year	2 years	3 years
Benchmark	Common Commodity	0.03	0.25	0.30	0.35
	Energy	0.09	0.38	0.46	0.52
	Food	0.06	0.21	0.29	0.34
	Metal	0.07	0.23	0.29	0.29
Excluding Common Commodity-specific Shocks	Common Commodity	-	-	-	-
	Energy	0.06	0.35	0.58	0.69
	Food	0.03	0.18	0.29	0.37
	Metal	0.07	0.23	0.33	0.37
Alternative spillovers 1	Common Commodity	0.03	0.21	0.33	0.38
	Energy	0.06	0.23	0.35	0.42
	Food	0.04	0.20	0.27	0.32
	Metal	0.07	0.21	0.28	0.31
Alternative spillovers 2	Common Commodity	0.03	0.21	0.33	0.38
	Energy	0.08	0.42	0.60	0.68
	Food	0.05	0.21	0.29	0.32
	Metal	0.06	0.21	0.32	0.37
Alternative anchor(Tea)	Common Commodity	0.03	0.22	0.31	0.35
	Energy	0.07	0.36	0.55	0.65
	Food	0.04	0.17	0.24	0.29
	Metal	0.08	0.23	0.35	0.43
Alternative anchor(Tobacco)	Common Commodity	0.03	0.23	0.34	0.42
	Energy	0.08	0.26	0.36	0.43
	Food	0.05	0.22	0.31	0.35
	Metal	0.06	0.19	0.27	0.33

Note: This table presents the estimated pass-through ratio of global commodity shocks (commodity speculative, energy, food, and metal shocks) into inflation measures based on country-specific SVAR models for the full sample period (1973-2022). The ratios are based on the median across countries. In calculating the pass-through ratios, the size of the shocks is normalized to be 10 percent (energy shock), 5 percent (metal and Common Commodity shocks), and 3 percent (food shocks).

TABLE 18: Pass-through ratio: alternative datasets

Category	Shocks	1 month	1 year	2 years	3 years
Benchmark	Common Commodity	0.04	0.30	0.36	0.39
	Energy	0.05	0.39	0.49	0.54
	Food	0.13	0.45	0.52	0.54
	Metal	0.06	0.24	0.36	0.43
Winsorized inflation	Common Commodity	0.03	0.23	0.29	0.33
	Energy	0.09	0.34	0.45	0.51
	Food	0.06	0.21	0.27	0.31
	Metal	0.07	0.23	0.26	0.29
Non-significant IRFs	Common Commodity	0.03	0.17	0.27	0.31
	Energy	0.05	0.26	0.38	0.42
	Food	0.06	0.20	0.28	0.31
	Metal	0.06	0.23	0.29	0.29
Nominal commodity prices	Common Commodity	0.01	0.14	0.22	0.27
	Energy	0.06	0.27	0.36	0.41
	Food	0.03	0.14	0.22	0.26
	Metal	0.03	0.10	0.16	0.20
Alternative inflation factor	Common Commodity	0.04	0.20	0.29	0.34
	Energy	0.07	0.31	0.40	0.44
	Food	0.04	0.15	0.21	0.23
	Metal	0.05	0.17	0.20	0.21

Note: This table presents the estimated pass-through ratio of global commodity shocks (commodity speculative, energy, food, and metal shocks) into headline CPI inflation on country-specific SVAR models for the sub-sample period (1973-2022). The ratios are based on the median across countries. In calculating the pass-through ratios, the size of the shocks is normalized to be 10 percent (energy shock), 5 percent (metal and Common Commodity shocks), and 3 percent (food shocks).