World Shocks, Commodity Prices and Domestic Inflation

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Abstract

We evaluate the importance of world shocks for explaining domestic inflation fluctuations. To this end, using a factor model we extract the co-movements of commodity prices to proxy for world prices. Then, we devise a structural vector autoregressive model, in which world shocks affect domestic economies through changes in common factors of commodity prices and the world interest rate. The model is applied to a set of 67 advanced and emerging countries, for the period from 1970 to 2014. Our results indicate that world shocks can explain between twenty six and thirty seven percent of inflation fluctuations in the median country. We evaluate the role of world shocks on inflation fluctuation while controlling for different country-specific indicators. Our results highlight the need for using the co-movement of commodity prices in assessing the effects of world shocks. Single-world-price vector autoregression models have been previously found to significantly underestimate the importance of world shocks for domestic business cycles. Similarly, we find that a fraction of the inflation variance explained by world shocks falls by more than half (below thirteen percent in the median country) when a single-world-price is included in the model. Finally, our results are robust to a range of alternative specifications.

Key words: world shocks, commodity prices, domestic inflation
JEL classification: E31, E32, F44, F62

1 Introduction

The extent to which world shocks in general and commodity price shocks in particular influence domestic inflation is debatable. Previous papers have discussed the role of commodity price changes on domestic inflation, via their impact on commodity prices as final goods and as intermediary goods (Kilian, 2008; Sapsford & Singer, 1998). When trying to study the importance of commodity price changes on explaining inflation fluctuations, Gelos and Ustyugova (2017) find that food price shocks alone explain less than ten percent of inflation fluctuations which is the highest fraction of inflation fluctuations that is explained by commodity shocks. Potential drawbacks associated with this set of papers is that they rely on single indicators or price indices in order to capture the volatility of commodity shocks. Yet, to the extent that these techniques do not capture the true variability of commodity price fluctuations, they are likely to underestimate the true magnitude of their impact on domestic inflation. This paper tries to investigate this impact using the co-movement of commodities rather than indices to obtain the true variability of commodity price fluctuations.

In this paper, we re-visit the importance of world shocks mediated by the co-movement of commodity prices in explaining changes in domestic inflation. To do so, we include a large set of commodity prices which we aggregate using a factor model. Our approach is based on the idea that commodity prices follow common trends and feature sharp price peaks in the short-run (Byrne, Fazio, & Fiess, 2011; Fernandez, 2015; Rossen, 2015). Using factor model, we extract the co-movement of commodity prices to capture the impact of commodity price shocks. Thus, the co-movement of commodity prices can be efficiently summarized via common factors to investigate their impact on inflation fluctuations (Forni, Hallin, Lippi, & Reichlin, 2000; Stock & Watson, 1998). This method allows us to measure the fraction of domestic fluctuations in inflation that can be explained by the co-movement of commodity prices.

In order to measure the effect of world shocks, we plug into our structural vector-autoregressive (SVAR) model the co-movement of commodity prices obtained from the factor model. Since prices of internationally traded commodities, such as food, metal, and fuel, reflect changes in supply and demand conditions of the world markets, all these prices are informative about world shocks (Jiménez-Rodríguez & Sánchez, 2005; Kilian, 2008). We obtain our results by adapting the SVAR model proposed by Fernández, Schmitt-Grohe, and Uribe (2017) to the study of inflation fluctuations for a sample of 67 countries. The model is built on the insight that the world shocks are transmitted to small open economies via changes in the world prices (co-movement of commodity prices). Even though our approach does not identify the structural shocks driving the world prices directly, it provides means to assess the historical contribution of world shocks to inflation fluctuations. Our main statistics of interest is the fraction of the variance of inflation (for each country in the data sample) that can be attributed to the world shocks mediated by the co-movement of commodity prices. Our results suggest that commodity price shocks has a 26% impact on domestic inflation.

Our paper is related to the literature that applies factor model to capture the co-movement of economic indicators. Gospodinov and Ng (2013)'s empirical work extracts the common factors in a panel of 23 commodity convenience yields which statistically and significantly are informative to forecast inflation. Moreover, using a dynamic latent factor model, Neely and Rapach (2011) find that the common fluctuations in international inflation rates around their long-run averages as a global inflation to explain domestic inflation fluctuations (35%) while our results explain the cross-sectional variation of domestic inflation using commodity shocks. Our paper also documents on the theoretical channels through which commodity price shocks affect domestic prices. Commodity price shocks affect consumer prices through commodity prices alone—the first-round effect (Auer, Borio, & Filardo, 2017; Gelos & Ustyugova, 2017; Kaldor, 1976; Kose, 2002; Neely & Rapach, 2011), and accordingly, commodity price shocks could spill over into the price of goods and services other than commodities through the production cost in other industries—the second-round effect (Sekine & Tsuruga, 2018).

Our paper contributes to the literature on world-price models to capture world shocks. Some focus on the role of single-price models, most notably of the oil prices, on inflation (Broda, 2004; Kose, 2002; Mendoza, 1995). Our results find that single measures of world prices may not provide sufficient information to explain the channels through which the world shocks are transmitted to domestic business cycles (Fernández et al., 2017). Empirically, Gelos and Ustyugova (2017) estimate country-by-country Phillips curves augmented by commodity prices for the period 2001–2010 using food/oil price indices. They find the median long-term pass-through of a 10 percentage-point food price shock to domestic inflation is 0.2 percentage-point for advanced economies and almost 0.8 percentage-point for emerging economies. We find that co-movement of commodities explain 26% of inflation variations for the median country after correcting for small sample bias. More recently, Kamber and Wong (2019) study the role of foreign shocks in driving the inflation trend and the inflation gap. They find the share of commodity price shocks compared to other global shocks on inflation gap is on average 25% for 28 countries.

This paper, to our knowledge, is the first paper which investigates the importance of world shocks on domestic inflation using co-movements of commodity prices to explain the variation of domestic inflation. Our analysis includes 67 advanced and emerging economies over the period 1970-2014. Compared to previous studies, we include more commodity series (43 commodities) into our factor model to extract their co-movement to proxy for commodity price shocks. Our results suggest that commodity prices can explain twenty six percent of inflation fluctuations in the median country after correcting for small sample bias. This statistics implies an increased contribution of world shocks to changes in domestic inflation rates compared to previous studies. We also investigate the impact of commodity price shocks through the second-round effect which suggest that headline inflation responses to world shocks are almost 10 percentage-points more than core inflation responses. This finding is consistent with the theory that core inflation does not include the food and energy sector price information (Sekine & Tsuruga, 2018).

Finally, this paper also highlight the importance of other mechanisms which contributes to domestic inflation fluctuations. For instance, we confirm the importance of world interest rate as an additional transmission channel of world shocks to domestic inflation (Gruber & Vigfusson, 2018; Kose, 2002). When the world's real interest rate is included in the SVAR model, the fraction of inflation explained by world shocks increases to thirty four percent. We apply annual and quarterly data to investigate this mechanism in our model. To discuss the impact of global economic environment (Bernanke, Gertler, Watson, Sims, & Friedman, 1997; Gisser & Goodwin, 1986; Halka & Kotlowski, 2017; Mork, 1989), I also include global economic indicator in the SVAR which explain thirty eight percent of inflation fluctuations. Furthermore, domestic inflation fluctuations falls by more than half when single-world-price is used in the estimation. In this respect, our results echo the conclusions of Fernández et al. (2017) and Rodriguez, Gonzalez, and Fernández Martin (2016) who demonstrate the importance of using multiple world prices for output fluctuations.

The rest of the paper is organized as follows. Section 2 describes the co-movement of commodity prices. Section 3 describes the empirical strategy and data. Section 4 presents the main results. Section 5 describes the alternative specifications. Section 6 concludes.

2 Co-movement of commodity prices

Commodities play a major role in the international supply chain and impact production and final good prices. In addition, commodities such as oil or metals often represent the main source of revenue of emerging economies and are in high demands in advanced economies (Deaton, 1999; Murphy & Hall, 2011). Thus, commodity price shocks can have a large impact on macroeconomic performance and living standards in many countries and global economic activity (Kyrtsou & Labys, 2006).

Previous studies have defined world shocks using a single variable. In these studies, the evolution of commodity prices captured by a single index constructed as weighted average of fuel, metal, and agricultural spot prices but this technique has proven to be less predictive when forecasting inflation (Chen, Turnovsky, & Zivot, 2014). Moreover, Fernández et al. (2017) discuss how using single measures underestimate the impact of world shocks on domestic business cycles. They suggest multiple commodity price indices can explain macroeconomic indicators' fluctuation better. However, since commodity price indices are the weighted averages of spot prices of oil, fuel, and agricultural, they fail to capture the true volatility of commodity prices.

We try to circumvent this issue by using a factor model in order to capture all commodity price's volatility. We use the resulting outcome to study the impact of commodity price shocks on domestic inflation. Several recent studies have discussed the fact that commodity prices tend to move together. Large co-movements among fuel, metal, and agricultural indices, have been documented since the early 1970s, followed by some gradual decline for all three commodity prices in the 1980s and 1990s, and rapid increase in the early 2000s until the Great Contraction of 2008 (Fernández et al., 2017).

Previous papers propose to use factor augmented autoregressive (FAVAR) model in a large panel of commodity series as a useful method to capture the co-movement of commodity prices in order to reflect their central characteristics (Cuddington & Jerrett, 2008; De Nicola, De Pace, & Hernandez, 2016; Gospodinov & Ng, 2013; Pindyck & Rotemberg, 1990). West and Wong (2014) document empirically that factor models do better than any of the other models since commodity prices consistently display a tendency to revert towards the extracted factor to mitigate the impact of world shocks on domestic business cycles. In this regard, Byrne et al. (2011) find significant evidence of co-movement for a variety of metal commodities using factor analysis.

Table 1: Factor loadings associated to commodities

Commodity	Coefficient of 1^{st} factor	Commodity	Coefficient of 2^{nd} factor	Commodity	Coefficient of 3^{rd} factor
			Agricultural prices		
Urea	0.21	Sugar, world	0.17	Wheat	0.28
Maize	0.21	Rubber, SGP/MYS	0.12	Logs	0.23
Rice, Thai 5%	0.21	Orange	0.10	Coffee	0.21
DAP	0.20	Beef	0.09	Banana, US	0.19
TSP	0.20	Sawnwood, Malaysian	0.07	Phosphate rock	0.13
Sorghum	0.20	coffee	0.07	Potassium chloride	0.00
Soybean oil	0.20	Logs	0.07	Tobacco, US import u.v.	-0.01
Barley	0.20	Wheat	0.07	Orange	-0.01
Coffee	0.19	Banana, US	-0.01	Tea	-0.01
Logs	0.19	Rice, Thai 5%	-0.02	Sugar, world	-0.01
Palm oil	0.19	Urea	-0.03	TSP	-0.04
Wheat	0.19	TSP	-0.03	Sorghum	-0.07
Rubber, SGP/MYS	0.18	DAP	-0.06	Maize	-0.10
Copra	0.18	Cotton, A Index	-0.06	DAP	-0.11
Coconut oil	0.17	Potassium chloride	-0.06	Groundnut oil	-0.12
Soybeans	0.17	Barley	-0.08	Urea	-0.14
Groundnut oil	0.15	Sorghum	-0.14	Rice, Thai 5%	-0.14
Sugar, world	0.14	Shrimps, Mexican	-0.14	Barley	-0.16
Cotton, A Index	0.14	Copra	-0.14	Shrimps, Mexican	-0.16
Potassium chloride	0.14	Coconut oil	-0.16	Meat, chicken	0.02
Phosphate rock	0.10	Soybeans	-0.16	Sawnwood, Malaysian	0.01
Sawnwood, Malaysian	0.10	Phosphate rock	-0.16	Soybean oil	0.29
Banana, US	0.03	Maize	-0.17	Cotton, A Index	0.28
Cocoa	0.02	Palm oil	-0.20	Cocoa	0.25
Tea	0.02	Groundnut oil	-0.21	Beef	0.05
Orange	0.01	Soybean oil	-0.22	Soybeans	0.01
Beef	-0.04	Cocoa	-0.23	Palm oil	-0.02
Tobacco, US import u.v.	-0.04	Tobacco, US import u.v.	-0.25	Rubber, SGP/MYS	-0.17
Meat, chicken	-0.09	Tea	-0.27	Coconut oil	-0.22
Shrimps, Mexican	-0.10	Meat, chicken	-0.28	Copra	-0.24
			Fuel prices		
Crude oil, average	0.16	Crude oil, average	0.04	Coal, Australian	0.14
Coal, Australian	0.16	Coal, Australian	0.03	Gas	0.11
Gas	0.05	Gas	-0.02	Crude oil, average	0.32
			Metal prices		
Tin	0.19	Platinum	0.31	Iron ore, cfr spot	0.23
Gold	0.18	Copper	0.22	Tin	-0.05
Silver	0.18	Nickel	0.20	Nickel	-0.07
Copper	0.17	Aluminum	0.20	Gold	-0.08
Lead	0.15	Lead	0.18	Silver	-0.10
Zinc	0.12	Gold	0.16	Lead	-0.11
Iron ore, cfr spot	0.11	Silver	0.14	Platinum	-0.11
Nickel	0.09	Zinc	0.07	Zinc	-0.11
Aluminum	0.07	Iron ore, CFR spot	0.02	Copper	-0.14
Platinum	0.07	Tin	-0.06	Aluminum	-0.01

Note: This table displays factor loadings of 1^{st}, 2^{nd}, and 3^{rd} components of commodity price series obtained from FAVAR model. The commodity price series includes 43 prices. The commodity prices are standardized in our estimation.

In order to document the impact of world shocks in the form of commodity price volatility, we extract the co-movements of 43 commodity prices using the FAVAR approach to capture such global commodity movements that carry important implications for researchers and policy makers. We use HP filter method over commodity series to take the cyclical component of real commodity prices and normalize each series by its standard deviation. Then, we extract the common factor of these series to diagnose the co-movement of commodity prices. Table 1 lists factor loadings of 1^{st}, 2^{nd}, and 3^{rd} components of commodity price series obtained from factor model. By looking at this table, it is clear that none of those factors solely explain the variability of fuel, metal, and agricultural prices. In other words, we need to use multiple factors to capture the co-movement of commodities in order to proxy for world shocks mediated by fuel, metal, and agricultural prices. This finding is consistent with Fernández et al. (2017)'s paper which finds that single-world-price models underestimate the importance of world shocks on domestic business cycles. Following the method suggested by Bai and Ng (2002), we find that the first three leading factors are optimally explaining the variability of commodity prices and are therefore used in our analysis. Table A1 reports the test results.

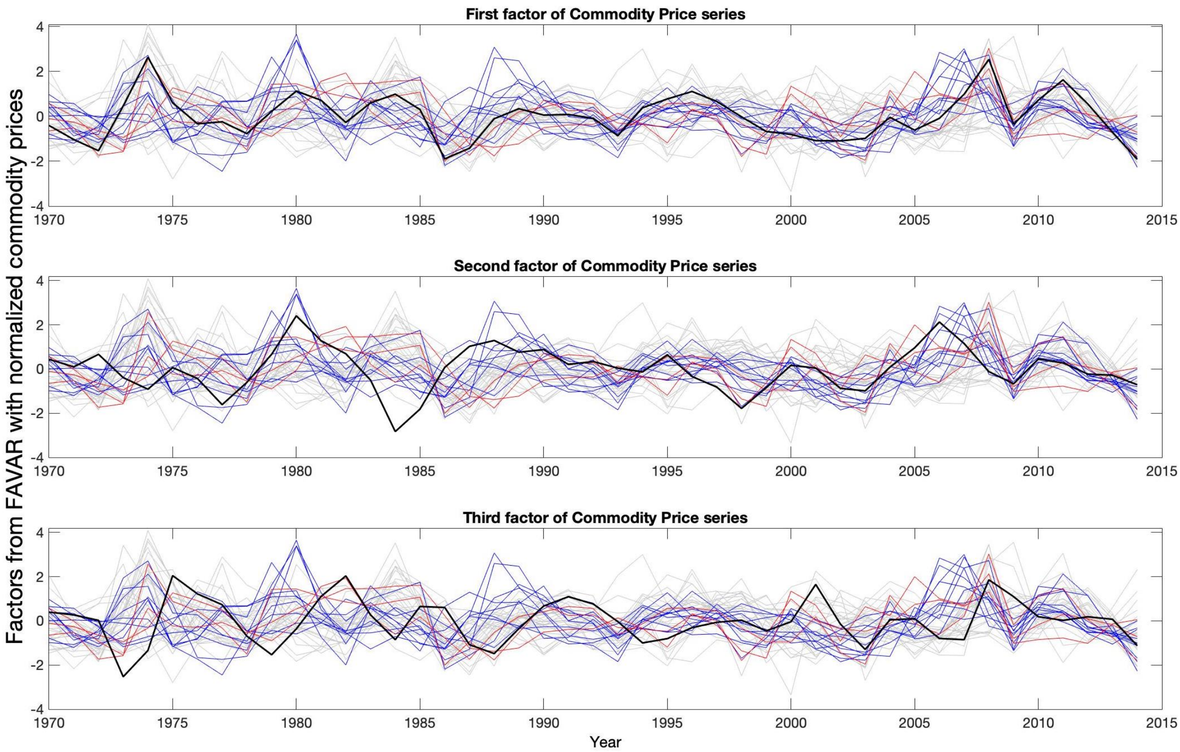

Fig. 1: The comovement of commodity series over the period 1970-2014
Note: The grey, blue, and red lines are the cyclical components of agricultural, metal, and fuel series in percent deviations from trend obtained by HP(100) filtering. The black lines display the comovement of commodity series, 1^{st}, 2^{nd}, and 3^{rd} factor of commodity price series over the period 1970-2014. These factors capture the highest volatility of series which proxy for world shocks in this paper.

Figure 1 displays 1^{st}, 2^{nd}, and 3^{rd} factors of commodity series, over the period 1970-2014—the black lines. Two observations are worth pointing out. First, commodity price factors are volatile which suggests that commodity price changes could be a potentially important source of inflation fluctuations. Second, there is a relatively strong co-movement among commodity series. These features are confirmed in Table A2, which shows second moments of commodity price factors. We also use the scree plot to select the number of factors which carry sufficient information of commodity series. Figure 2 displays the scree plot for common factors of commodity series which confirms 90% of the variation of the commodity price series are explained by three leading factors. Thus, in this paper, we apply three common factors of commodities to proxy for commodity price shocks. Table A3 in the Appendix lists all commodity series used in our sample. We regress the normalized commodity price series on the common factors obtained from factor model to show how much these factors can explain each commodity (R^2). Table A4 reports the R^2 of the OLS analysis including one, three, six, and ten factors. This table shows if we use three factors in the SVAR model, they can explain on average 54% of commodity series.

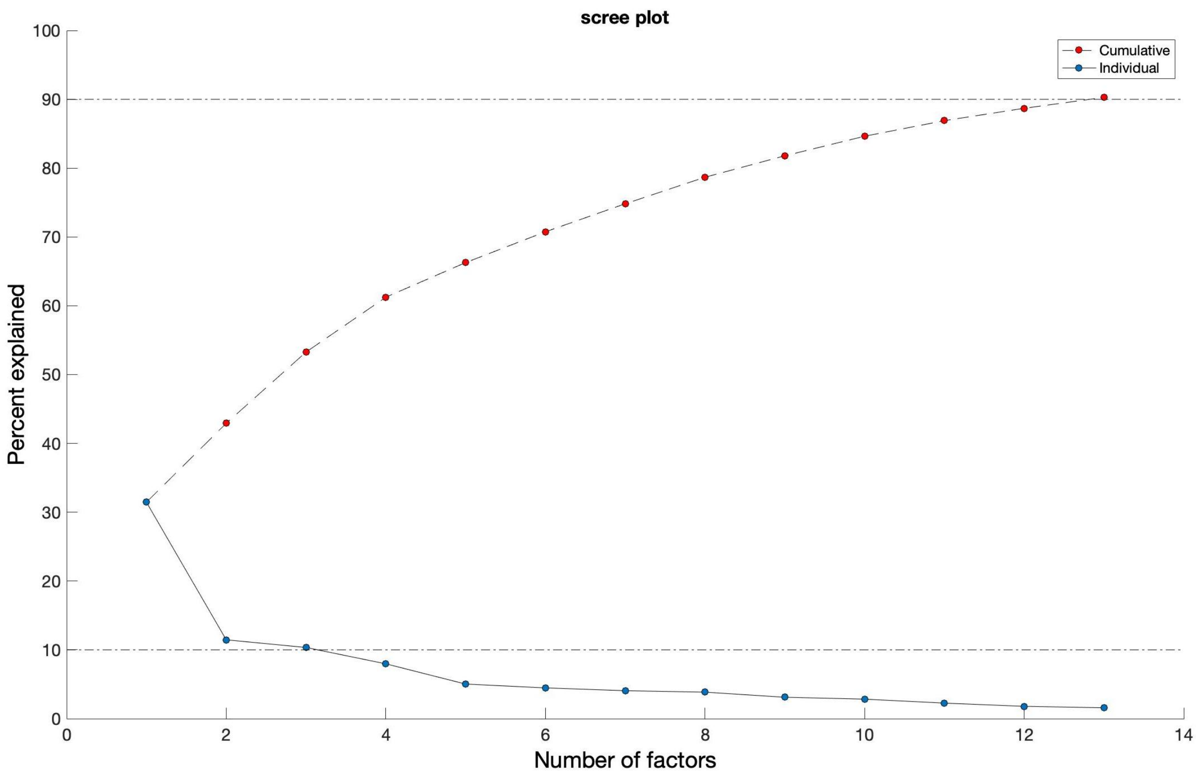

Fig. 2: The scree plot of factor loadings for commodity series.
Note: The panel displays that 90% of the variation of commodity price series are explained by the first three factors. The red dots shows the cumulative percentage explained by factors and the blue dots shows the percentage explained by the i^{th} factor.

To our knowledge, the most related approach to our own are Yin and Han (2015) and Gospodinov and Ng (2013). The first one puts a monthly data set of 24 commodities to characterize the co-movements in commodity prices using a dynamic latent factor model that decomposes commodity returns into global, sectoral, and idiosyncratic components. The second one decomposes commodity convenience yields into factors and uses these estimated factors for forecasting inflation. They explore modeling co-movements of real commodity prices via a static factor model for 23 commodity convenience yields. They find that two leading factors of individual convenience yields incorporate useful information for predicting both inflation and commodity prices.

Data on commodity price series Data on commodity prices are obtained from the World Bank's Pink Sheet.[1] We use the annual series globally-traded commodities for which we have no missing data yielding a total of 43 commodities. The series are expressed in U.S. dollars in real prices in World Bank's Pink Sheet and include commodity prices in agricultural, fuel, and metal prices. The agricultural series includes prices of beverages (e.g. cocoa, coffee, and tea), food (e.g. fats and oils, grains, and other foods), and agricultural raw materials (e.g. timber and other raw materials). The metals and minerals series includes spot prices of aluminum, copper, iron, ore, lead, nickel, steel, tin, and zinc. The fuel prices includes Crude oil, Coal, and gas.[2] In our estimation, we apply the cyclical components of these series in percent deviations from trend obtained by HP(100) filtering. Then, we extract the common factor of these series to diagnose the co-movement of commodity prices. We also use the commodity price indices to proxy for world prices in section 4.8 as an alternative measure for world shocks which the data are obtained from the World Bank's Pink Sheet.

3 Empirical strategy

3.1 SVAR model

Our empirical framework follows the approach advanced by Fernández et al. (2017). We augment their model in two ways. First we apply the factor model to extract the commonalities of commodity prices to include them in foreign bloc as a proxy for world shocks, second, our focus in on the annual changes of inflation in domestic bloc as a critical macroeconomic indicator. Specifically, we study the joint behaviour of the world price vector p_t and of the vector of domestic macroeconomic indicators for country i denoted by Y_t^i from a perspective of a small open economy. This behaviour is characterized by a

[1]The data is publicly available at http://www.worldbank.org/en/research/commodity-markets.

[2]Table A3 in the Appendix lists all commodity series used in our sample.

block-recursive SVAR model.

The foreign bloc In our baseline specification, the world price vector consists of three factors of real prices of agricultural, fuel, and metal series pc_t^1, pc_t^2, and pc_t^3, which we obtained from the factor augmented autoregressive model applied in section 2,

$$p_t = \begin{bmatrix} {pc_t}^1 \\ {pc_t}^2 \\ {pc_t}^3 \end{bmatrix}$$

We later augment this price vector to include other world prices such as the world interest rate, r_t. We assume that the world prices are independent of domestic macroeconomic variables for each individual country. Further, we assume that they follow the first-order vector autoregressive system.

$$p_t = Ap_{t-1} + \mu_t, \tag{3.1}$$

where A represents a matrix of coefficients, and μ_t is an i.i.d mean-zero random vector with the variance matrix Σ_μ. The vector μ_t captures the effects of unobservable structural world shocks. It is important to note that no assumptions are imposed to identify these shocks in the model. Instead, the focus here, as in Fernández et al. (2017), is on the estimating the *joint contribution* of μ_t to domestic inflation in individual countries.

The domestic bloc The vector of domestic macroeconomic indicators Y_t^i includes the annual changes of inflation rate. We later augment this vector to include other country-specific macroeconomic indicators with inflation rate. The domestic variables are influenced by country-specific shocks ε_t^i and world shocks μ_t. We assume that ε_t^i and μ_t are uncorrelated; as a result, there is no restrictions on domestic bloc in terms of Cholesky decomposition in our model. Further, the world shocks can affect the small open economy only through changes in the contemporaneous or past world prices p_t. These assumptions give rise to the following model,

$$Y_t^i = B^i p_t + C^i \, Y_{t-1}^i + D^i \, p_{t-1} + \varepsilon_t^i. \tag{3.2}$$

The innovations vector ε_t have mean-zero and the variance matrix $\Sigma_{\varepsilon_t}^i$.

The SVAR model Combining 3.1 into equation 3.2, we obtain a first-order block-recursive structural vector autoregressive model in the form

$$\begin{bmatrix} p_t \\ Y_t^i \end{bmatrix} = \begin{bmatrix} A & 0 \\ B^i A + D^i & C \end{bmatrix} \begin{bmatrix} P_{t-1} \\ Y_{t-1}^i \end{bmatrix} + \begin{bmatrix} I & 0 \\ D^i & I \end{bmatrix} \begin{bmatrix} \mu_t \\ \varepsilon_t^i \end{bmatrix}, \tag{3.3}$$

$$E \begin{bmatrix} \mu_t \mu_t^{'} & \mu_t \varepsilon_t^{i'} \\ \varepsilon_t^i \mu_t^{'} & \varepsilon_t^i \varepsilon_t^{i'} \end{bmatrix} = \begin{bmatrix} \Sigma_\mu & 0 \\ 0 & \Sigma_\varepsilon^i \end{bmatrix}.$$

The coefficients of the foreign bloc A and Σ_μ are estimated by the ordinary least squares (OLS), equation by equation, using annual data from 1970 to 2014. The $R^2 = [0.41\ 0.18\ 0.45]$ for the three equations in the model suggests how much contemporaneous shocks explain the movements of factors in commodity prices. We then estimate the domestic bloc, equation 3.2, by the OLS for every 67 countries in the sample. With the parameters of the SVAR at hand, we perform variance decomposition to estimate the joint contribution of world shocks μ_t to movements in domestic macroeconomic indicators in a specific country.

Implementation details To overcome problems with the relatively small number of observations, we follow the suggestions of Fernández et al. (2017). First, we estimate the parameters of the domestic bloc in two ways. (i) We include only one domestic indicator (the inflation rate) in Y_t and estimate the domestic bloc per country. (ii) We include two country-specific indicators (the inflation rate with another macroeconomic indicator—extended model) in the vector Y_t^i, which results in a maximum number on the degrees of freedom.

Another issue is the possibility of a small-sample upward bias in the estimation of the model. This small-sample upward bias might occur due to two reasons. First, any negative or positive correlation between the foreign bloc and the domestic bloc may result in a positive share of commodity price shocks in the variance matrix Σ_ε^i. Second, the estimates obtained from OLS regressions are known to be biased in a short sample. To overcome these issues, we follow the Monte Carlo procedure suggested by Fernández et al. (2017) to create artificial data. We estimate the model to calculate the non-corrected estimates using the real data and subtract the small sample bias obtained from the Monte Carlo procedure to get the corrected estimates. In discussing the results, we will focus on the estimates corrected for the small sample bias. While our baseline results are based on estimating a VAR model using factors of commodity prices, we evaluate the implications of using a single factor model in section 4.10.

3.2 Data

Our analysis relies on country-specific rates of headline and core inflation, real GDP, nominal interest rate, terms of trade, exchange rate, world interest rates, and global economic index.

The world indicators We take the real three-month U.S. Treasury bill rate as a proxy for the world interest rate. To obtain this measure, we subtract the monthly U.S. CPI inflation rate from the monthly Treasury bill rate, and then average the monthly data into the annual frequency. We later use this indicator into the price vector in equation 3.1 to include the world interest rate r_t. We also use the global economic index suggested by Baumeister, Korobilis, and Lee (2020) to consider the global economic factor in our analysis. They build a new index of global economic conditions and measures for assessing future energy demand and oil price pressures. This new measure is useful for quantifying the main factors behind the severe contraction of the global economy and the price risks. The data is available quarterly over 1973-2015. We compute the annual data by taking the average of quarterly sample of the index over the period 1973-2014.

Country-specific macroeconomic variables Macroeconomic variables are from the World Development Indicators (WDI) of the World Bank.[3] The key variable of interest, inflation rate, is measured by the annual changes of the consumer price index (CPI). This variable, headline inflation, reflects the cost to the average consumer of acquiring a basket of goods and services. The use of annual changes of inflation specification are suggested by the conventional Augmented Dickey-Fuller tests. Section 4.2 investigates the impact on core inflation instead of headline inflation in the SVAR model. We work with quarterly sample of core inflation rate in the 24 countries, using the data from the OECD database. We obtain the annual changes of core inflation by taking the average of quarterly sample over the period 1980-2014. Core inflation contains the Consumer Price Index for all urban consumers, all items in U.S. City Average, index 1982-1984=100, Monthly, Seasonally Adjusted.

We also consider the GDP data in constant local currency units. We use the cyclical component of the natural logarithm of real GDP as captured by the HP filter with a

[3] The WDI database is publicly available at http://data.worldbank.org.

smoothing parameter of 100. The other country-specific indicators are the terms of trade and the nominal interest rate. We apply the natural logarithm of the terms of trade and the annual changes of the nominal interest rate in our specification as suggested by Fernández et al. (2017). The use of annual changes of nominal interest rate specification are also suggested by the conventional Augmented Dickey-Fuller tests. We apply country specific exchange rate which is the official exchange rate determined by national authorities or to the rate determined in the legally sanctioned exchange market. It is calculated as an annual average based on monthly averages (local currency units relative to the U.S. dollar).

In our estimation, after the small-sample bias correction using Mont-Carlo simulation, there are some countries with negative inflation variation in response to world shocks. By checking their data, we notice that highly volatile data are created in Mont-Carlo simulation for countries with too noisy data, or high standard deviation. Thus, we exclude those countries from our sample; we also exclude countries with hyperinflation for multiple years. Since it sends the value of the currency plummeting the foreign exchange markets (expensive foreign goods), making the country import less goods, and the unemployment rate rises as companies fold. As a consequence, the government tax revenues reduces, and the government prints more money to pay its bills, which worsens the hyperinflation. Table A5 in the Appendix lists the information for each country regarding this. Our baseline sample contains 67 countries, for the period from 1970 to 2014. The annual sample is unbalanced. The longest sample contains 45 years (1970-2014) and the shortest sample contains 20 years (1994-2014).

Quarterly data In the robustness section, we also work with quarterly sample of headline inflation rate in the 29 countries, using the data from the OECD database. We require that a country has at least 100 consecutive quarterly observations to be included in the quarterly sample. Table A6 in the Appendix describes country-by-country information about its sample period and the data source.

4 Results

This section starts with a discussion of the contribution of world shocks to explain inflation fluctuations in the baseline model with three factors from the levels of the real commodity prices (Section 4.1). We then consider several variations of the model. Section 4.2 compares the results using core inflation with headline inflation. Section 4.3 and 4.4 investigate how world shocks contribute to domestic inflation while we control for nominal interest rate and exchange rate. Section 4.5 examine the role of including the output and nominal interest rate with inflation into the SVAR. We consider the global economic conditions in our analysis in Section 4.6 to investigate how this index affects the results. Section 4.7 show how much our result is affected if we include four factors of commodities into the SVAR. Section 4.8 compares the impact of world shocks using factors of commodity prices vs commodity price indices. Section 4.9 examines the role of including the world interest rate into the SVAR. Section 4.10 analyzes the impact of using a single proxy for the world prices.

4.1 Commodity price shocks and inflation fluctuations

To answer what portion of country-specific headline inflation fluctuations is explained by commodity price shocks, we include factors of commodity prices in the foreign bloc and inflation in the domestic bloc. We perform variance decomposition country by country using the estimated SVAR system (equation 3.3). Column 1 in Table 2 displays the cross-country median shares of the variances of inflation explained by commodity price shocks. In this estimation, we consider one domestic macroeconomic indicator in equation 3.2, only inflation. These statistics are computed by estimating the VAR model and computing the relevant variance decomposition for each of the 67 counties, and then computing the median values. MAD stands for the cross-country median absolute deviation which displays the interval of the estimated variance share. Column 2 in Table 2 displays the average of inflation responses to world shocks mediated by commodity price shocks over 67 countries. In this estimation, we also consider one domestic macroeconomic indicator in equation 3.2, only inflation. By looking at the results, we find that the estimation result is the same for both median country and average share of variances for all countries in the sample.

The non-corrected estimates show that commodity price shocks explain on average 37% of the variation of the inflation for median country and 38% of inflation fluctuations for the average share of variances over 67 counties. After correcting for small-sample bias, 26% and 27% of the variation of inflation are explained by world shocks for the median country and the average share of variances. We treat the results obtained in the corrected

Table 2: Share of inflation variations explained by world shocks—Baseline result

	Median	Mean
Non-corrected estimate	0.37	0.38
Small-sample bias	0.11	0.11
Corrected estimate	0.26	0.27
MAD of corrected estimate	0.08	
Number of countries	67	67

Note: Variance decompositions are based on country-by-country estimates of the SVAR system (equation 3.3) over the period 1970-2014. In column 1 and 2, vector Y_t of domestic variables contains only one domestic indicator, inflation rate. The small-sample bias in the variance decomposition for inflation is on average almost 11 percentage-point. MAD stands for the cross-country median absolute deviation which displays the interval of the estimated variance share. Statistics are computed across 67 advanced and emerging economies.

estimates for inflation fluctuations (26%) as the baseline result in our paper. Figure 3 displays the variance shares of inflation, in terms of frequency distribution for all country. Table A7 in the Appendix reports the results for each country (σ^{π}) separately. Note that our sample is unbalanced, and the number of observations for the domestic bloc is different across countries (20 to 45 across 67 countries). It also reports the confidence interval of estimates for each country to show the uncertainty of our baseline results at 5% level. Figure 6 in the Appendix display the inflation responses of each country to commodity price shocks respectively, over the period 1970-2014.

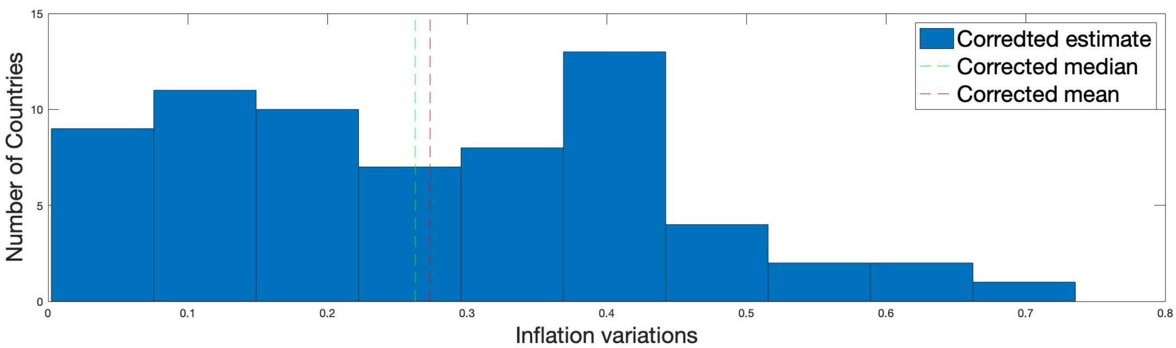

Fig. 3: The frequency distribution of inflation responses of each country to commodity price shocks, over the period 1970-2014.

It is useful to put our estimates in the context of the literature. For example, Gelos and Ustyugova (2017) estimate the impact of one-world price shocks on inflation fluctuations on domestic inflation. They indicate that the median long-term pass-through of a

10 percentage-point food price shock to domestic inflation is 0.2 percentage-point for advanced economies and almost 0.8 percentage-point for emerging economies. They suggest that economies with higher food shares in CPI baskets, fuel intensities, and pre-existing inflation levels are more prone to experience sustained inflationary effects from commodity price shocks. Furthermore, Sekine and Tsuruga (2018) find that the effects of commodity price shocks on headline inflation, on average, are increased by 1.87 percentage-point in response to a 10 percentage-point increase in commodity prices. This paper find that 26% of variation of inflation fluctuation are explained by commodity price shocks. This result indicates an increased contribution of world shocks to changes in domestic inflation rates compared to previous studies.

4.2 Results with country-specific core inflation

To answer what portion of country-specific core inflation fluctuations is explained by commodity price shocks, we include co-factors of commodity prices in foreign bloc and core inflation and headline inflation (inflation rate) in the domestic bloc, separately. Headline inflation includes the price change in a basket of goods that includes commodities like food and energy. It is different from core inflation, which excludes food and energy prices while calculating inflation. Thus, we expect that world shocks mediated by the co-movement of commodity prices contributes more to explain headline inflation fluctuations compared to core inflation (see e.g., Sekine and Tsuruga (2018)).

Table 3: Share of variances explained by world shocks—Core & headline inflation

	Median		Mean	
	A. Core inflation	B. Inflation	C. Core inflation	D. Inflation
Non-corrected estimate	0.38	0.45	0.38	0.46
Small-sample bias	0.12	0.11	0.11	0.11
Corrected estimate	0.27	0.35	0.28	0.36
MAD of corrected estimate	0.08	0.07		
Number of countries	24	24	24	24

Note: Variance decompositions are based on country-by-country estimates of the SVAR system (equation 3.3) over the period 1980-2014. The small-sample bias in the variance decomposition for inflation is on average almost 11 percentage-point. MAD stands for the cross-country median absolute deviation which displays the interval of the estimated variance share. Statistics are computed across 24 advanced and emerging economies.

In this section, we perform variance decomposition country by country using the estimated SVAR system (equation 3.3). Due to data availability for core inflation, we include 24 countries for both estimation to have a consistent comparison. In first column, vector Y_t of domestic variables contains only core inflation, in second column, vector Y_t contains only headline inflation rate, in third column and fourth column, we display the same estimation result for the average responses of both domestic indicators (core inflation and inflation rate) to world shocks mediated by commodity price shocks over 24 countries. Table A8 in the Appendix displays the list of countries included in this section.

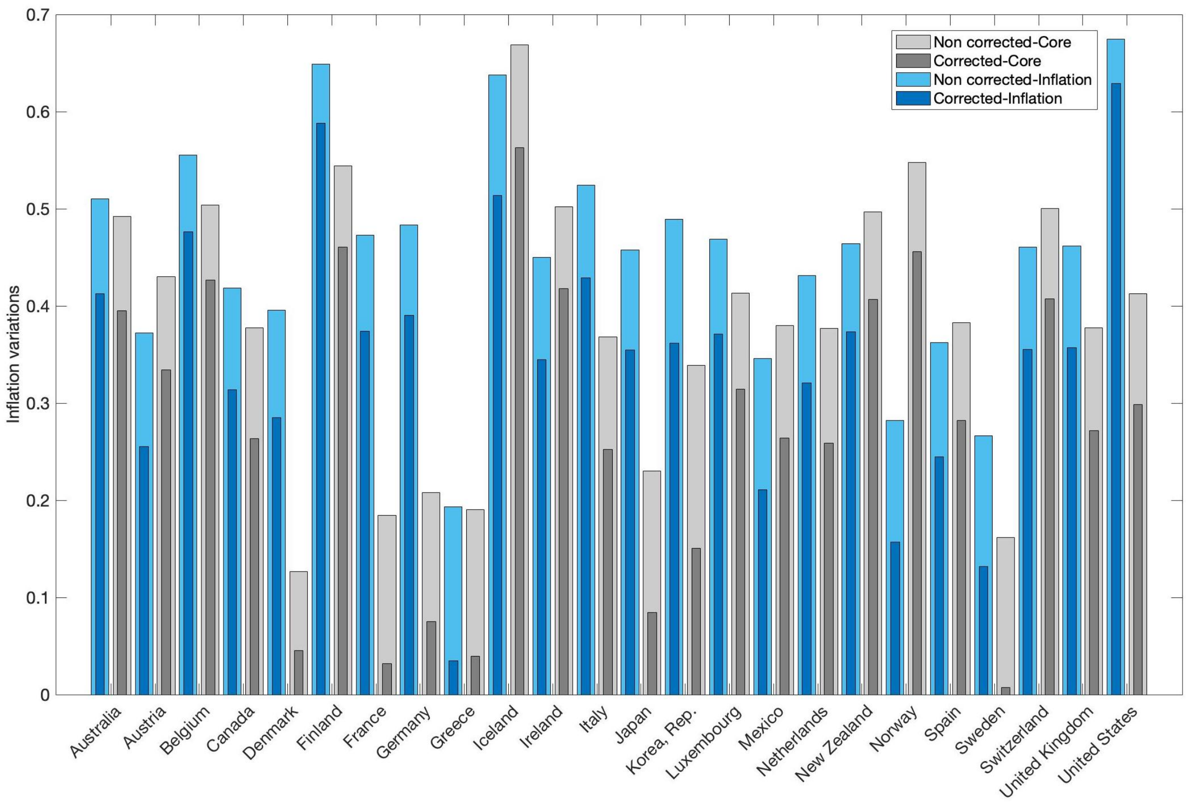

Fig. 4: The headline inflation and core inflation fluctuations in response to commodity price shocks, over the period 1980-2014.

The non-corrected estimates in Table 3 show that commodity price shocks explain on average 38% of the variation of core inflation and 45% of inflation fluctuations for median country, and 38% of the variation of core inflation and 46% of the inflation fluctuations for the average share over 24 countries. After correcting for small-sample bias, 27% of the variation of core inflation and 35% of inflation fluctuations for median country, and 26% of the variation of core inflation and 32% of the inflation fluctuations for the average share over 24 countries are explained by world shocks for the median country. Our estimation result is consistent in this section which shows that the headline inflation responses to

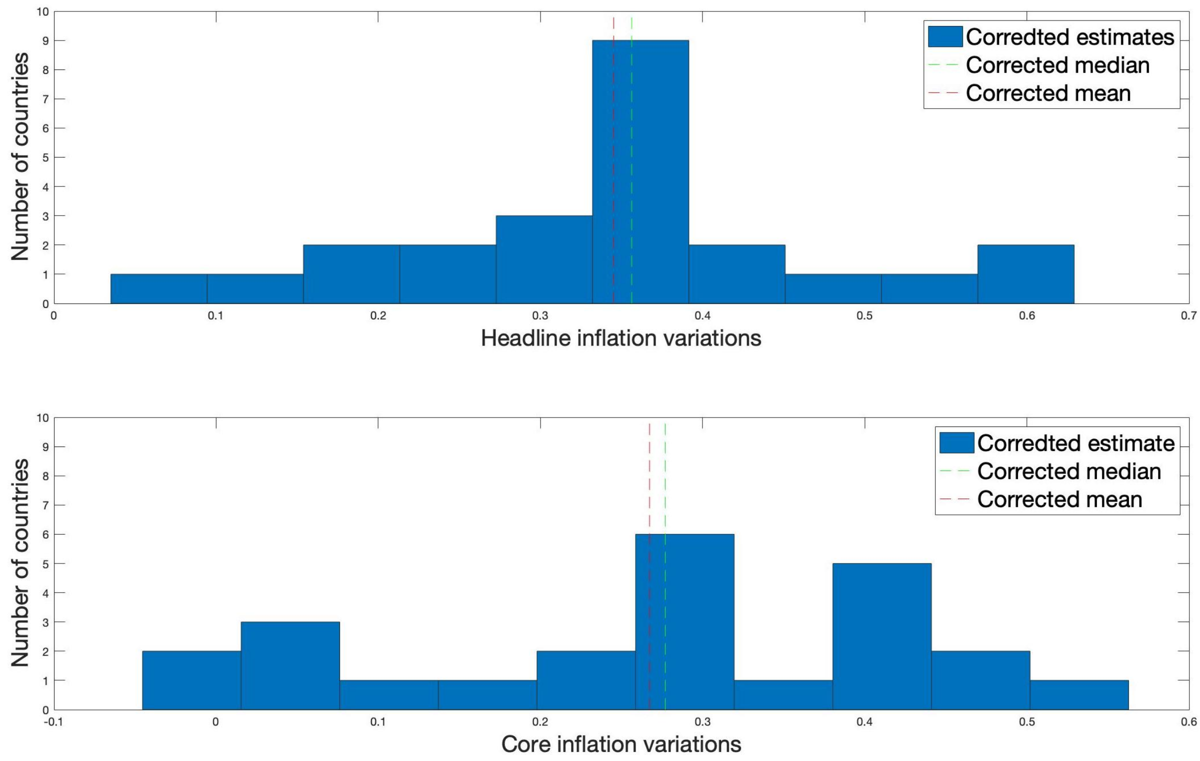

Fig. 5: The headline inflation and core inflation fluctuations in response to commodity price shocks, over the period 1980-2014.

world shocks are almost 10 percentage-points more than core inflation responses (Sekine & Tsuruga, 2018). Since core inflation is the change in the costs of goods and services but does not include those from the food and energy sectors, the change in price of food and energy are not included in this measure. Figure 4 displays the result for headline inflation responses, the indicator that we use in the baseline estimation, and the core inflation responses of each country to commodity price shocks respectively, over the period 1980-2014. Figure 5 displays the variance shares of headline inflation and core inflation, in terms of frequency distribution for all countries.

4.3 Results with country-specific nominal interest rate

Several literature discuss the channel through which changes in short-run nominal interest rates alter the cost of working capital and affect pricing decisions of firms (Chowdhury, Hoffmann, & Schabert, 2006; Crowder & Hoffman, 1996). Thus, this cost channel of monetary policy transmission matters for inflation dynamics in industrialized countries. In this section, we extend the domestic bloc to control for country-specific nominal interest rate to investigate how much commodity price shocks explain the inflation fluctuations.

We take the annual domestic real interest rate, and subtract the annual U.S. CPI inflation rate from it to obtain the nominal interest rate. To answer the question posed in this section, we include factors of commodity prices in the foreign bloc, equation 3.1, and inflation rate and nominal interest rate separately and jointly in the domestic bloc, equation 3.2. We perform variance decomposition country by country using the estimated SVAR system (equation 3.3). Due to availability of data, only 38 countries are included in this estimation. Table A9 in the Appendix displays the list of countries included in this section.

Table 4 reports the estimation result with extended domestic bloc in our estimation. Column A in Table 4 displays the estimation result for inflation fluctuations separately and jointly while we control for nominal interest rate in the extended domestic bloc. In first column, vector Y_t of domestic variables contains only the inflation rate, in second column, vector Y_t contains both two domestic indicators (headline inflation rate and nominal interest rate). The non-corrected estimates show that commodity price shocks explain on average 38% and 39% of the variation of inflation fluctuations for both estimations in 38 countries. After correcting for small-sample bias, 26% of inflation fluctuations, and 26% of the variation of inflation in the extended model are explained by world shocks for the median country. This result indicates that the share of inflation explained by commodity price shocks is not affected while we control for nominal interest rate.

4.4 Results with country-specific exchange rate

In this section, we control for the exchange rate in our estimation to investigate what portion of country-specific inflation fluctuations is explained by commodity price shocks. The increase in the foreign exchange rate contributes to cheaper domestic goods for foreign consumers, increasing the exports and total demands. As a result, the exchange rate fluctuations can significantly affect the general level of prices in countries (Mishkin, 2007; Shapiro, 1975). We include factors of commodity prices in the foreign bloc, equation 3.1, and the inflation rate and the exchange rate separately and jointly in the domestic bloc, equation 3.2. The data for exchange rate that we use in this estimation is the official exchange rate.[4] We perform variance decomposition country by country using the estimated SVAR system, equation 3.3. In this estimation, 53 countries are included in

[4]The exchange rate data includes LCU per US$, period average.

this estimation due to availability of data for country-specific exchange rate. Table A10 in the Appendix displays the list of countries included in this section.

Table 4: Share of inflation variations explained by world shocks—Extended domestic bloc

	A. Nominal interest rate		B. Exchange rate		C. Output and interest rate	
		Extended model		Extended model		Extended model
	Inflation	Inflation	Inflation	Inflation	Inflation	Inflation
Non-corrected estimate	0.39	0.39	0.36	0.36	0.39	0.44
Small-sample bias	0.14	0.14	0.11	0.11	0.14	0.13
Corrected estimate	0.26	0.25	0.25	0.25	0.25	0.32
MAD of corrected estimate	0.07	0.07	0.08	0.07	0.08	0.06
Number of countries	38	38	53	53	38	38

Note: Variance decompositions are based on country-by-country estimates of the SVAR system (equation 3.3) over the period 1970-2014. In each panel (A, B, C), the first column reports the estimation result when only inflation is included in domestic bloc. The second column shows the result when we control for another macroeconomic indicator in domestic bloc.

Column B in Table 4 displays the estimation result for inflation fluctuations separately and jointly while we control for the exchange rate in extended domestic bloc. In first column, the domestic variables contains only the inflation rate, in second column, it contains both domestic indicators (inflation rate and exchange rate). The non-corrected estimates show that commodity price shocks explain on average 36% of the variation of inflation fluctuations for both estimations in 53 countries. After correcting for small-sample bias, 25% of inflation fluctuations for both settings are explained by world shocks for the median country. This result indicates that the share of inflation explained by commodity price shocks is the same as when we control for exchange rate.

4.5 Results with the output and nominal interest rate

In this section, we control for the output and nominal interest rate in our estimation to answer what portion of country-specific inflation fluctuations is explained by commodity price shocks. In general, when interest rates decreases, the economy grows, and inflation increases. In contrast, when interest rates increases, the economy slows down, and inflation decreases (Mishkin, 2007; Trigari, 2009). We use the same data for nominal interest rate from section 4.3, and the data for the output is the GDP data in constant local currency units. We use the cyclical component of the natural logarithm of real GDP as captured by HP filter with a smoothing parameter of 100. We include factors of commodity prices in the foreign bloc, equation 3.1, and the inflation rate, output, nominal interest rate jointly in the domestic bloc, equation 3.2. We perform variance decomposition country by country using the estimated SVAR system, equation 3.3. In this estimation, 38 countries are included in this estimation due to availability of data for country-specific nominal interest rate.[5]

Column C in Table 4 displays the estimation result for inflation fluctuations separately and jointly while we control for the output and nominal interest rate in the extended domestic bloc. In first column, vector Y_t of domestic variables contains only the inflation rate, in second column, vector Y_t contains three domestic indicators (inflation rate, output, and nominal interest rate). The non-corrected estimates show that commodity price shocks explain on average 39% and 44% of the variation of inflation fluctuations for both estimations in 38 countries. After correcting for small-sample bias, 25% of inflation fluctuations, and 32% of the variation of inflation in the extended model are explained by world shocks for the median country. This result indicates that the share of inflation explained by commodity price shocks is almost seven percentage points smaller compared to when we control for output and nominal interest rate.

4.6 Results with global economic indicator

In this section, we consider the global economic index which can be viewed as another mechanism through which world shocks can affect domestic inflation fluctuation. This estimation is based on what Kamber and Wong (2019) suggest in their empirical paper. They consider common factors of global economic indicators from five advanced economies besides commodity price indices in the foreign bloc to estimate the inflation gap. Here, we use a global economic indicator which is taken from Baumeister et al. (2020)'s analysis to consider this mechanism. They build a new index of global economic conditions and measures for assessing future energy demand and oil price pressures. This new measure is useful for quantifying the main factors behind the severe contraction of the global economy and the price risks. So, we include the economic global indicator in the foreign bloc besides three factors of commodity prices, equation 3.1, and the inflation rate in the domestic bloc, equation 3.2. We perform variance decomposition country by country using the estimated SVAR system, equation 3.3.

First column in Table 5 displays the estimation result explained by worlds shocks,

[5]Table A9 in the Appendix displays list of countries included in this section.

mediated by three factors of commodity prices and the global economic indicator. The statistics points to the increased importance of the world shocks for explaining inflation movements in our model. The non-corrected estimates show that commodity price shocks explain on average 51% of the variation of inflation fluctuations across 67 countries. Based on the corrected estimates, the shares of inflation fluctuations explained by world shocks (three factors of commodity prices and the global economic index) now account for 38% of the variation of inflation rate in the median country. These shares are about twelve percentage points higher relative to the benchmark SVAR model with the commodity prices in section 4.1. This result is consistent with what Fernández et al. (2017) suggest about other mechanisms explaining domestic business cycles; using multiple world prices provide more statistical characteristics to capture the impact of the world shocks on inflation fluctuations in advanced and emerging countries. If we consider same countries included in Kamber and Wong (2019), co-movements of commodity prices and the global economic index, in our paper, explain 37% of inflation fluctuations after correcting for small sample bias (53% non-corrected estimates). In their paper, they use five common factors of global indicators from five advanced countries besides three commodity indices which can explain 40% of inflation gap.

4.7 Results with four factors of commodity prices

In this section, we investigate if we include more factors in the foreign bloc, how much the contribution of commodity price shocks to domestic inflation fluctuation is affected. This estimation is based on what Fernández et al. (2017) suggest in their empirical paper. They indicate that considering multiple (more) world prices in the foreign bloc explain higher fluctuations of macroeconomic indicators. Thus, we include four factors of commodity prices from the factor model obtained in section 2 in the foreign bloc, equation 3.1, and the inflation rate in the domestic bloc, equation 3.2. We perform variance decomposition country by country using the estimated SVAR system, equation 3.3.

In general, Table 5 reports the estimation result with extended foreign bloc in our estimation. First column reports the baseline result for the sake of comparison with other settings in the extended foreign bloc. Second column in Table 5 reports the estimation result using four factors of commodity prices to proxy for world shocks. The non-corrected estimates show that commodity price shocks explain on average 52% of the variation of inflation fluctuations when we use four factors in the foreign bloc in 67 countries. After correcting for small-sample bias, 42% of inflation fluctuations are explained by world shocks for the median country. This result indicates using more factors (more prices) in foreign bloc, equation 3.1 has more explanatory power for domestic inflation fluctuations.

Table 5: Share of inflation variations explained by world shocks—Extended foreign bloc

	Extended foreign bloc				Extended both blocs
	Global economic indicator	Four factors	Commodity indices	Commodity prices & r	Commodity prices & r
Non-corrected estimate	0.51	0.52	0.25	0.46	0.56
Small-sample bias	0.13	0.10	0.12	0.13	0.13
Corrected estimate	0.38	0.42	0.14	0.34	0.43
MAD of corrected estimate	0.10	0.09	0.10	0.09	0.12
Number of countries	67	67	67	67	38

Note: Each column represents the estimation result for inflation with an extended foreign bloc. Column 1 displays the result using global economic indicator and three factors of commodity prices. Column 2 displays the result using four factors of commodity prices. Column 3 reports the result using commodity price indices replicated from Fernández et al. (2017)'s model to compare the result. The source of commodity price indices is WDI. The data covers the period 1970-2014. In column 4 and 5, r_t is measured by the real Treasury bill rate to proxy for world interest rate. Column 5 includes the nominal interest rate as a control variable for the estimation (extended domestic bloc).

4.8 Results with the commodity price indices

In our baseline results, we compute the co-movement of commodity price series to proxy for the world shocks. Although this measure provides a good description of actual data, as mentioned by Gospodinov and Ng (2013), it also generates distortions for regressors especially under small sample. The authors suggest applying a bootstrap method for inference that accounts for uncertainty associated with the estimation of principal components. Their proposed bootstrap algorithm is based on a moving-block re-sampling of the original data for the correction of generated regressors. We re-estimate our model with the cyclical components of the commodity price indices obtained with the HP-filter with the smoothing parameter $\lambda = 100$ to compare this result with our baseline estimation. The use of indices has been criticized on different grounds. For instance, the choice of three indices included in foreign bloc is arbitrary.[6]

Table A11 in the Appendix displays the correlation between the three factors obtained from the factor model in section 2 and commodity price indices (agricultural, fuel, and metal prices). It shows that the first factor is highly correlated with the three commodity

[6]Although the commodity price indices are based on actual data and there is not need for correction.

indices while the second factor is highly correlated with the metal index, and there is some correlation between third factor and fuel. In the third column of Table 5 we show the results using commodity price indices instead of factors of commodity price series (the baseline estimation). The corrected estimates show that there is a difference between these two measures as a proxy for world shocks. The results display a decrease in the importance of world shocks for inflation by twelve percentage points, relative to the baseline results in Table 2. We find that using co-movements of commodity prices provide better statistical characteristics of commodity market compared with commodity price indices and is thus better able to capture the impact of the world shocks on inflation fluctuations.

4.9 Results with the world interest rate

In this section, we display the result which echo the conclusions of Fernández et al. (2017) and Rodriguez et al. (2016) who demonstrate the importance of using multiple prices for output fluctuations. The results highlight the importance of the world interest rate as an additional transmission channel of world shocks to domestic inflation. Changes in world prices can be viewed as the key mechanism through which world shocks are transmitted to small open economies (Lubik & Teo, 2005). While real commodity prices represent the relative prices of goods in the same period, the real interest rate represents the relative price of goods dated in different periods. A possible link from the world interest rate into domestic inflation is its impact on the production costs and the availability of intermediate goods (Auer et al., 2017; Kaldor, 1976; Neely & Rapach, 2011). Motivated by theoretical predictions that movements in the world interest rate should affect domestic production and domestic inflation, we augment the price vector p_t in the foreign bloc, equation 3.1, to include the world interest rate and re-estimate the SVAR model for each country. Our results suggest that the world interest rate does act as an important transmitter of the world shocks.

$$p_t = \begin{bmatrix} {p_t}^a \\ {p_t}^f \\ {p_t}^m \\ r_t \end{bmatrix} \tag{4.1}$$

Results with annual data The resulting shares of the variances explained by worlds shocks, mediated by three factors of commodity prices and the world interest rate, are reported in fourth column of Table 5 for annual data in the 67 countries. The statistics in column four in Table 5 point to the increased importance of the world shocks for explaining output and inflation movement in all estimations. Based on the corrected estimates, the shares of inflation fluctuations explained by world shocks now account for 34% of the variation of inflation rate in the median country. These shares are about ten percentage points higher relative to the benchmark SVAR model with the commodity prices in section 4.1.

Several papers suggest that U.S. monetary policy generates sizable macroeconomic spillovers to the rest of the world (see e.g., (Q. Chen, Filardo, He, & Zhu, 2016; Georgiadis, 2016)). It has been argued that the economic growth of each country is driven by a global financial cycle, which in turn appears to be determined to a large extent by the U.S. monetary policy. To control the impact of U.S. monetary policy on each country's monetary policy, we extend the domestic bloc and consider country-specific nominal interest rate with inflation in the domestic bloc, equation 3.2. This analysis includes 38 countries over the period 1970-2014 due to the availability of the data. Last column in Table 5 displays the estimates for this analysis. The non-corrected estimates in Table 5 show that commodity price shocks explain on average 56% of inflation fluctuations in extended model estimation in 38 countries. After correcting for small-sample bias, we find that world shocks explain 43% of fluctuation fluctuations in the median country.

Results with quarterly data We have re-estimated the SVAR model with three factors of commodity prices and the world interest rate using quarterly data. Due to the data limitations, the number of countries in our sample decreased to twenty nine. These countries and the available sample periods are listed in the last column of Table A6 in the Appendix. Table 6 reports the results for the estimation which only inflation is included in domestic bloc. We find that 30% of the variance of inflation is explained by world shocks using quarterly data and 35% of the variance of inflation is explained by world shocks using annual data. The estimate using annual data for all 67 countries of the sample is 34%. These estimates indicate that the results are consistent using quarterly data compared to the baseline result.

Table 6: World shocks mediated by commodity prices and world interest rate—quarterly data

	Cross-country median variance share of inflation		
	Quarterly data	Annual data	Annual data
Non-corrected estimate	0.43	0.47	0.46
Small-sample bias	0.13	0.13	0.13
Corrected estimate	0.30	0.35	0.34
MAD of corrected estimate	0.19	0.17	0.09
Number of countries	29	29	67

Note: Variance decompositions are based on country-by-country estimates of the SVAR system over the period 1970-2014 using quarterly data and annual data. MAD stands for the cross-country median absolute deviation. Statistics are computed across 29 countries. The domestic bloc contains only one country-specific indicator, inflation rate. The small-sample bias in the variance decomposition is almost 13 percentage-point. Here, r_t is measured by the real U.S. interest rate.

4.10 Single-world-price model specification

Many previous studies have focused on the impact of a single commodity price, such as the price of oil or the price of food, on domestic inflation. Schmitt-Grohé and Uribe (2016) and Fernández et al. (2017) demonstrate that such approach underestimates the importance of world shocks in explaining output fluctuations. In this section, we analyze the implications of using single measure to proxy for world shocks on inflation fluctuations. To this end, we include one of the factors and single price indices at a time in the foreign bloc, equation 3.1, and estimate a number of single-world-price SVAR models to compare the results of these models relative to the SVAR with commodity price factors and the world interest rate. Overall, our results emphasize the need for using multiple price specification in assessing the effects of world shocks.

The comparative results are reported in Table 7. We examine 8 alternative single price models. Our focus is on the share of the variances of inflation explained by the world shocks. We report the estimates for the estimation that are corrected for the small-sample bias. For the ease of comparison, first row in Table 7 reproduces the results from the SVAR model with factors of commodity price series and the world interest rate from Section 4.9 (column five in Table 5).

We first estimate the SVAR models with one of the three factors of commodity prices obtained in section 1. The results in Table 7 show that single-factor models can explain only a small fraction of inflation fluctuations. We next examine other world prices (three commodity price indices obtained in section 4.8), the world interest rate, the country-

Table 7: Share of variances using one-price specifications

Model specification	Inflation
Four world prices, pc^1, pc^2, pc^3, r	0.34
1. First factor loading, pc^1	0.13
2. Second factor loading, pc^2	0.01
3. Third factor loading, pc^3	0.11
4. One world price, p^a	0.05
5. One world price, p^f	0.04
6. One world price, p^m	0.06
7. World interest rate, r	0.02
8. Terms of trade, tot	0.03

Note: The reported variance shares are group-specific medians using annual data. The domestic bloc includes only inflation rate. Statistics are medians across 67 countries, corrected for small-sample bias. The first row is reproduced from column 5 in Table 5. Here, r_t is measured by the real Treasury bill rate.

specific terms of trade in the foreign bloc. The terms of trade series is defined as the ratio of trade weighted export to import price indices. Schmitt-Grohé and Uribe (2016) indicate that country-specific terms-of-trade shocks represent a major source of business cycles in emerging economies. The results for the specifications 4 to 8 also indicate that when only one world price is included in the foreign bloc, world shocks explain on average less than 6% of the variances of inflation in the median country (across 67 countries). The results for the specifications 1 to 8 indicate that when only one world price is included in the foreign bloc, world shocks explain on average less than 13% of the variances of inflation in the median country (across 67 countries). Overall, our results emphasize the need for using multiple price specification in assessing the effects of world shocks on domestic inflation fluctuations.

5 Alternative specifications

This section demonstrates that our results on the importance of world shocks for explaining inflation fluctuations are robust on different dimensions. We report the estimates for the estimation that are corrected for small-sample bias. For the ease of comparison, first row in Table 8 reproduces the results from the SVAR model with the commodity price factors from Table 2 — the baseline result. For each exercise, the name of countries included in the estimation are listed in a separate table in the Appendix.

Excluding large commodity exporters. There is a possibility of market power among countries that might violate our identification assumption of exogeneity of commodity prices to each country. To address this concern, we exclude large commodity exporters from the sample. We identify the top 20% largest exporters for each of the three commodity groups using the annual averages of exports of fuel, agricultural, and metal commodities from the WDI database (1970-2014). This exercise excludes 22 countries as large commodity exporters. Panel A in Table 8 reports the results for the remaining 45 countries. World shocks appear to explain 31% of the variation of inflation in this modified sample. These statistics are almost similar to the baseline results. We conclude that the market power in commodity production does not impact the economy's susceptibility to world shocks. Table A12 in the Appendix shows the list of countries included in this estimation.

Table 8: Heterogeneity among countries in response to world shocks

	Share of variance explained by world shocks	
Model specification	Number of countries	Inflation
Baseline estimation	67	0.26
A. Excluding large commodity exporters	45	0.31
B. Oil		
Exporters	14	0.18
Importers	53	0.28
C. Net commodity traders		
Exporters	23	0.31
Importers	42	0.35
D. Level of development		
High income	40	0.28
Low income	24	0.31

Note: The reported variance shares are group-specific medians using annual data. The foreign bloc consists of three factors of commodity price series. The domestic bloc includes inflation only and variance shares are corrected for small sample bias.

Oil exporters and oil importers. We compute the country-specific median of net exports of fuels since 1970, using the annual information on exports and imports of fuel commodities from the WDI database. A country is defined as an oil exporter (importer) if the median net fuel export share in GDP is positive (negative). Based on this specification, there are 14 oil exporters and 53 oil importers in the analysis (see Panel B of Table 8). The effects of commodity price shocks on inflation fluctuations in oil-importing countries (28%) are much stronger than in oil-exporting countries (18%). This result indicates that higher oil prices may induce increases in the industry costs and hence in the inflation rates in oil-importing countries. This result is in line with the discussion in Barsky and Kilian (2004): world shocks appear to be more important for explaining business cycles in oil importer countries than in oil exporter countries. Table A13 in the Appendix shows the list of countries included in this estimation.

Net commodity traders. World shocks appear to be more important for explaining macroeconomic indicators fluctuations in countries that are net commodity importers than in countries that are net commodity exporters (Barsky & Kilian, 2004; Fernández et al., 2017). In our analysis, we consider a country as a commodity exporter (importer) if there is a positive (negative) trade balance on average in the group of three commodities (agricultural, fuel, and metals) since 1970. We use annual data on agricultural, fuel, and metals commodities to calculate the net trade-in for each category. This classification yields 23 commodity exporters and 42 commodity importers. Panel C of Table 8 indicates that commodity importers experience more fluctuations in response to world shocks compared to commodity exporters which is consistent with the existing literature. Table A14 in the Appendix shows the list of countries included in this estimation.

Level of development. Some papers discuss how the level of development affects the importance of world shocks as drivers of domestic business cycles. On one hand, some papers indicate that advanced countries, by having more service oriented economies, and hence a larger share of nontradables, are less exposed to world shocks. On the other hand, some argue that advanced countries, especially small economies, tend to be more integrated to the rest of the world. This tighter links could imply a larger exposure to world shocks (Fernández et al., 2017). We divide countries into two categories: the high income (40 countries) and the low income (26 countries). The categorization is based on the data of per capita gross national incomes in the World Development Indicator in 2015.[7] Panel D of Table 8 shows the result of this estimation. The share of variance of inflation explained by world shocks in the high-income group is 3 percentage points higher compared to the low-income group. The results are fairly robust across income groups. There are no clear differences in the share of inflation variance explained by world shocks

[7]The results are robust to basing the categorization on income levels in 1990.

across income groups. Table A15 in the Appendix shows the list of countries included in this estimation.

6 Conclusion

Our research evaluates the historical importance of world shocks for explaining changes in domestic inflation. We demonstrate that world shocks are more important than was thought previously. This result sheds light on the origin of inflation fluctuations in advanced and emerging economies. The key innovation of our paper is the use of co-movement of commodity price series to proxy for world shocks. Previous studies typically rely on a single commodity price, which underestimates the importance of world shocks for domestic inflation. The findings show that twenty six percent of the fluctuations of inflation can be explained by world shocks mediated through the co-movement of commodity prices after correcting for small sample bias. We find an increased contribution of world shocks to changes in domestic inflation rates relative to the previous studies.

We identify some structural factors that may explain the estimated differences in the importance of world shocks across the countries. The knowledge of the drivers of domestic inflation is critical for determining optimal policy in controlling inflation. Most modern central banks aim to achieve low, stable, and predictable inflation, creating favorable economic conditions for economic decisions. Yet, central banks may not be always successful in mitigating the effects of world shocks. This information can also be used to find better institutional arrangements to shelter domestic inflation from world shocks.

One limitation of our analysis is the absence of explicit identification of structural world shocks. For example, these shocks can be driven by productivity shocks, shock to monetary or fiscal policy, or shocks to global uncertainty. Our method is unable to differentiate the origin of the world shocks. Further analysis in this regards would be useful.

Appendices

Table A1: The Bai & Ng test result for number of commodity factors

	common factor
According to IC(1) criteria	3
According to IC(2) criteria	1
According to IC(3) criteria	10
According to PC(1) criteria	9
According to PC(2) criteria	3
According to PC(3) criteria	10
According to BIC(3) criteria	3
According to AIC(3) criteria	3

Note: IC(1) is most commonly used. BIC(1) is not recommended for small N relative to T. (where N is the cross-section dimension and T is the time dimension and; in our paper it is 67 to 45.) And, AIC(3) and BIC(3) take into account the panel structure of the data. AIC(3) performs consistently across configurations of the data while BIC(3) performs better on large N data sets.

Table A2: World prices: second moments of cyclical components

	pc^1	pc^2	pc^3	r
Standard Deviation, $\sigma(x)$	3.69	2.12	2.36	0.02
Serial Correlation, $\rho(x)$	0.31	0.23	0.41	0.70
Relative Standard Deviation, $\sigma(p)/\sigma(gdp)$	0.93	0.53	0.59	0.56

Note: Annual data from 1970 to 2014. The variables pc^1, pc^2, and pc^3 denote co-factors of 43 real commodity prices (agricultural, metal, and fuel), respectively. The variable r denotes the real three-month Treasury bill rate (same specification used in section 4.9). The relative standard deviation with respect to GDP is the median over the 67 country-specific relative standard deviations in the sample.

Table A3: List of commodity price series

List of commodity price series			
Agricultural		Metal	Fuel
Urea	Coconut oil	Tin	Crude oil, average
Maize	Soybeans	Gold	Coal, Australian
Rice, Thai 5%	Groundnut oil	Silver	Gas
DAP	Sugar, world	Copper	
TSP	Cotton, A Index	Lead	
Sorghum	Potassium chloride	Zinc	
Soybean oil	Phosphate rock	Iron ore, CFR spot	
Barley	Sawnwood, Malaysian	Nickel	
coffee	Banana, US	Aluminum	
Logs	Cocoa	Platinum	
Palm oil	Tea		
Wheat	Orange		
Rubber, SGP/MYS	Beef		
Copra	Tobacco, US import u.v.		
	Meat, chicken		
	Shrimps, Mexican		

Note: List of commodities included in equation 3.1 to obtain foreign bloc. The data is annual prices available in real terms, 2010 US dollars, 1970 to present. Source: World Bank Commodity Price Data (The Pink Sheet)

Table A4: The R^2 of common factors—over the period 1970 to 2014

	1^{st} factor	three factors	six factors	ten factors
Aluminum	0.06	0.35	0.57	0.70
Banana, US	0.01	0.30	0.49	0.57
Barley	0.55	0.58	0.63	0.76
Beef	0.01	0.16	0.20	0.59
Coal, Australian	0.35	0.83	0.87	0.94
Cocoa	0.01	0.36	0.50	0.70
Coconut oil	0.40	0.75	0.84	0.87
coffee	0.50	0.89	0.91	0.96
Copper	0.41	0.72	0.86	0.90
Copra	0.42	0.78	0.85	0.88
Cotton, A Index	0.26	0.35	0.40	0.68
Crude oil, average	0.37	0.43	0.44	0.49
DAP	0.58	0.59	0.71	0.79
Gas	0.04	0.13	0.18	0.77
Gold	0.44	0.60	0.88	0.90
Groundnut oil	0.33	0.55	0.58	0.64
Iron ore, cfr spot	0.18	0.43	0.66	0.66
Lead	0.29	0.50	0.63	0.74
Logs	0.50	0.89	0.92	0.96
Maize	0.60	0.74	0.76	0.89
Meat, chicken	0.12	0.55	0.60	0.64
Nickel	0.12	0.34	0.75	0.81
Orange	0.002	0.12	0.29	0.67
Palm oil	0.50	0.81	0.84	0.89
Phosphate rock	0.14	0.50	0.70	0.82
Platinum	0.06	0.59	0.67	0.75
Potassium chloride	0.26	0.48	0.64	0.65
Rice, Thai 5%	0.58	0.59	0.75	0.81
Rubber, SGP/MYS	0.44	0.65	0.71	0.86
Sawnwood, Malaysian	0.13	0.21	0.23	0.32
Shrimps, Mexican	0.15	0.26	0.31	0.56
Silver	0.42	0.56	0.90	0.95
Sorghum	0.55	0.65	0.69	0.89
Soybean oil	0.55	0.86	0.86	0.90
Soybeans	0.33	0.63	0.67	0.76
Sugar, world	0.27	0.41	0.70	0.82
Tea	0.01	0.37	0.60	0.82
Tin	0.51	0.53	0.77	0.80
Tobacco, US import u.v.	0.03	0.49	0.60	0.82
TSP	0.56	0.57	0.74	0.80
Urea	0.61	0.82	0.87	0.88
Wheat	0.49	0.89	0.93	0.96
Zinc	0.2	0.28	0.58	0.86
Average	0.32	0.54	0.66	0.78

Note: We regress the normalized commodity price series on the common factors of FAVAR model. Then, we list the R^2 of the OLS analysis in this table.

Table A5: List of countries excluded from our estimation

Country	Data	Average	Standard deviation
Algeria	Noisy data	9.20	7.87
Angola	High standard deviation	456.46	988.32
Bahamas, The	Noisy data	4.26	3.09
Bahrain	High standard deviation	4.04	6.43
Botswana	Noisy data	9.85	2.70
Bulgaria	High standard deviation	68.17	202.05
Burkina Faso	High standard deviation	4.73	7.19
Central African Republic	High standard deviation	4.18	7.54
Chad	High standard deviation	4.02	10.66
Cote dIvoire	High standard deviation	6.33	6.50
Croatia	High standard deviation	161.62	386.13
Egypt, Arab Rep.	Noisy data	10.66	5.83
Eswatini	Noisy data	10.15	5.20
Guatemala	Noisy data	9.97	8.50
Guinea-Bissau	High standard deviation	20.61	26.24
Honduras	Noisy data	9.96	7.15
India	Noisy data	8.06	5.11
Indonesia	Noisy data	11.62	9.98
Iran, Islamic Rep.	Noisy data	17.99	9.23
Madagascar	Noisy data	12.90	9.79
Malawi	Noisy data	20.33	14.84
Mali	High standard deviation	2.98	5.77
Mongolia	High standard deviation	27.58	57.13
Niger	High standard deviation	4.79	8.62
Papua New Guinea	Noisy data	7.54	4.67
Romania	High standard deviation	56.18	78.69
Russian Federation	High standard deviation	78.64	192.10
Senegal	High standard deviation	5.30	7.69
Slovak Republic	Not informative	6.53	5.19
Slovenia	High standard deviation	87.84	235.08
Solomon Islands	Noisy data	9.65	3.92
Sudan	High standard deviation	34.37	34.76
Tanzania	Noisy data	16.86	10.82
Togo	High standard deviation	5.72	8.57
Trinidad and Tobago	Noisy data	8.77	4.52
Tunisia	Noisy data	4.75	2.00

Note: List of countries excluded from our sample.

Table A6: List of countries — baseline results

	Annual data set				Quarterly data set	
Country name	Real GDP	Inflation	Data source	Balanced sample	Time period	Data source
Australia	1970-2014	1970-2014	WDI	1970-2014	1970Q3-2014Q4	OECD
Austria	1970-2014	1970-2014	WDI	1970-2014	1970Q3-2014Q4	OECD
Bangladesh	1970-2014	1987-2014	WDI	1987-2014		
Barbados	1970-2014	1986-2014	WDI	1986-2014		
Belgium	1970-2014	1977-2014	WDI	1977-2014	1970Q3-2014Q4	OECD
Benin	1970-2014	1993-2014	WDI	1993-2014		
Bolivia	1970-2014	1980-2014	WDI	1980-2014		
Burundi	1970-2014	1980-2014	WDI	1980-2014		
Cabo Verde	1970-2014	1984-2014	WDI	1984-2014		
Cameroon	1970-2014	1980-2014	WDI	1980-2014		
Canada	1970-2014	1970-2014	WDI	1970-2014	1970Q3-2014Q4	OECD
Chile	1970-2014	1971-2014	WDI	1971-2014	1980Q3-2014Q4	OECD
China	1970-2014	1987-2014	WDI	1987-2014		
Congo, Rep.	1970-2014	1986-2014	WDI	1986-2014		
Cyprus	1970-2014	1977-2014	WDI	1977-2014		
Czech Republic	1970-2014	1992-2014	WDI	1992-2014	1995Q3-2014Q4	OECD
Denmark	1970-2014	1970-2014	WDI	1970-2014	1970Q3-2014Q4	OECD
Dominican Republic	1970-2014	1978-2014	WDI	1978-2014		
El Salvador	1970-2014	1979-2014	WDI	1979-2014		
Equatorial Guinea	1980-2014	1986-2014	WDI	1986-2014		
Ethiopia	1970-2014	1981-2014	WDI	1981-2014		
Finland	1970-2014	1970-2014	WDI	1970-2014	1970Q3-2014Q4	OECD
France	1970-2014	1970-2014	WDI	1970-2014	1970Q3-2014Q4	OECD
Gambia, The	1970-2014	1970-2014	WDI	1970-2014		
Germany	1978-2014	1978-2014	WDI	1978-2014	1970Q3-2014Q4	OECD
Greece	1970-2014	1970-2014	WDI	1970-2014	1970Q3-2014Q4	OECD
Haiti	1970-2014	1974-2014	WDI	1974-2014		
Hong Kong SAR, China	1970-2014	1982-2014	WDI	1982-2014		
Iceland	1970-2014	1977-2014	WDI	1977-2014	1976Q2-2014Q4	OECD
Ireland	1970-2014	1970-2014	WDI	1970-2014	1976Q2-2014Q4	OECD
Italy	1970-2014	1970-2014	WDI	1970-2014	1970Q3-2014Q4	OECD
Japan	1970-2014	1970-2014	WDI	1970-2014	1970Q3-2014Q4	OECD
Jordan	1975-2014	1974-2014	WDI	1974-2014		
Kenya	1970-2014	1979-2014	WDI	1979-2014		
Korea, Rep.	1970-2014	1970-2014	WDI	1970-2014	1970Q3-2014Q4	OECD
Kuwait	1970-2014	1979-2014	WDI	1979-2014		
Lesotho	1970-2014	1980-2014	WDI	1980-2014		
Libya	1970-2014	1990-2014	WDI	1990-2014		
Luxembourg	1970-2014	1970-2014	WDI	1970-2014	1970Q3-2014Q4	OECD
Malaysia	1970-2014	1970-2014	WDI	1970-2014		
Malta	1970-2014	1983-2014	WDI	1983-2014		
Mauritania	1970-2014	1986-2014	WDI	1986-2014		
Mauritius	1970-2014	1978-2014	WDI	1978-2014		

Continue on the next page

Table A6: List of countries — baseline results (cont.).

	Annual data set				Quarterly data set	
Country name	Real GDP	Inflation	Data source	Balanced sample	Time period	Data source
Mexico	1970-2014	1980-2014	WDI	1980-2014	1970Q3-2014Q4	OECD
Myanmar	1970-2014	1982-2014	WDI	1982-2014		
Netherlands	1970-2014	1970-2014	WDI	1970-2014	1970Q3-2014Q4	OECD
New Zealand	1970-2014	1970-2014	WDI	1970-2014	1970Q3-2014Q4	OECD
Nigeria	1970-2014	1980-2014	WDI	1980-2014		
Norway	1970-2014	1970-2014	WDI	1970-2014	1970Q3-2014Q4	OECD
Pakistan	1970-2014	1980-2014	WDI	1980-2014		
Panama	1970-2014	1980-2014	WDI	1980-2014		
Poland	1970-2014	1984-2014	WDI	1984-2014	1995Q3-2014Q4	OECD
Rwanda	1970-2014	1980-2014	WDI	1980-2014		
Saudi Arabia	1970-2014	1981-2014	WDI	1981-2014		
Seychelles	1970-2014	1983-2014	WDI	1983-2014		
Singapore	1970-2014	1978-2014	WDI	1978-2014		
South Africa	1970-2014	1980-2014	WDI	1980-2014	1970Q3-2014Q4	OECD
Spain	1970-2014	1970-2014	WDI	1970-2014	1970Q3-2014Q4	OECD
Sri Lanka	1970-2014	1980-2014	WDI	1980-2014		
Sweden	1970-2014	1970-2014	WDI	1970-2014	1970Q3-2014Q4	OECD
Switzerland	1970-2014	1970-2014	WDI	1970-2014	1970Q3-2014Q4	OECD
Thailand	1975-2014	1970-2014	WDI	1970-2014		
Turkey	1970-2014	1977-2014	WDI	1977-2014	1970Q3-2014Q4	OECD
United Kingdom	1970-2014	1970-2014	WDI	1970-2014	1970Q3-2014Q4	OECD
United States	1970-2014	1970-2014	WDI	1970-2014	1970Q3-2014Q4	OECD
Yemen, Rep.	1970-2014	1990-2014	WDI	1990-2014		
Zambia	1970-2014	1986-2014	WDI	1986-2014		

Table A7: List of countries—baseline results with confidence intervals at 95% level

	Confidence interval at 95\% level				
Country	$\hat{\sigma^{\pi}}$	Confidence interval	Country	$\hat{\sigma^{\pi}}$	Confidence interval
Australia	0.21	[0.21, 0.22]	Kenya	0.30	[0.24, 0.25]
Austria	0.40	[0.38, 0.39]	Korea, Rep.	0.41	[0.40, 0.41]
Bangladesh	0.33	[0.32, 0.34]	Kuwait	0.26	[0.27, 0.28]
Barbados	0.19	[0.19, 0.20]	Lesotho	0.16	[0.15, 0.17]
Belgium	0.52	[0.51, 0.53]	Libya	0.18	[0.17, 0.19]
Benin	0.03	[0.03, 0.05]	Luxembourg	0.49	[0.48, 0.49]
Bolivia	0.10	[0.08, 0.10]	Malaysia	0.37	[0.37, 0.38]
Burundi	0.03	[0.05, 0.06]	Malta	0.33	[0.33, 0.35]
Cabo Verde	0.14	[0.11, 0.12]	Mauritania	0.06	[0.06, 0.07]
Cameroon	0.02	[0.04, 0.05]	Mauritius	0.30	[0.29, 0.30]
Canada	0.03	[0.07, 0.08]	Mexico	0.21	[0.21, 0.23]
Chile	0.27	[0.24, 0.25]	Myanmar	0.18	[0.17, 0.18]
China	0.24	[0.23, 0.24]	Netherlands	0.46	[0.46, 0.47]
Congo, Rep.	0.40	[0.37, 0.38]	New Zealand	0.25	[0.25, 0.26]
Cyprus	0.14	[0.22, 0.23]	Nigeria	0.00	[0.00, 0.02]
Czech Republic	0.48	[0.40, 0.41]	Norway	0.18	[0.17, 0.18]
Denmark	0.33	[0.41, 0.43]	Pakistan	0.42	[0.42, 0.43]
Dominican Republic	0.37	[0.35, 0.37]	Panama	0.42	[0.42, 0.43]
El Salvador	0.36	[0.31, 0.32]	Poland	0.12	[0.12, 0.13]
Equatorial Guinea	0.19	[0.17, 0.21]	Rwanda	0.13	[0.13, 0.15]
Ethiopia	0.14	[0.13, 0.15]	Saudi Arabia	0.28	[0.28, 0.29]
Finland	0.30	[0.30, 0.32]	Seychelles	0.26	[0.24, 0.25]
France	0.66	[0.64, 0.66]	Singapore	0.62	[0.62, 0.63]
Gambia, The	0.54	[0.54, 0.55]	South Africa	0.03	[0.03, 0.04]
Germany	0.10	[0.11, 0.12]	Spain	0.14	[0.13, 0.14]
Greece	0.41	[0.39, 0.41]	Sri Lanka	0.27	[0.26, 0.27]
Haiti	0.16	[0.15, 0.16]	Sweden	0.15	[0.14, 0.15]
Hong Kong SAR, China	0.07	[0.10, 0.11]	Switzerland	0.35	[0.34, 0.35]
Iceland	0.42	[0.37, 0.39]	Thailand	0.44	[0.44, 0.45]
Ireland	0.01	[0.08, 0.09]	Turkey	0.20	[0.18, 0.20]
Italy	0.48	[0.46, 0.47]	United Kingdom	0.42	[0.41, 0.42]
Japan	0.44	[0.45, 0.46]	United States	0.74	[0.73, 0.74]
Jordan	0.42	[0.38, 0.39]	Yemen, Rep.	0.12	[0.12, 0.13]

Note: List of countries including in the baseline estimation with the results. Our sample is unbalanced, and the number of observations for the domestic bloc is different across countries (20 to 45 across 67 countries). The confidence interval is also mentioned here to show the uncertainty of the results.

Table A8: List of countries in the estimation using core inflation

Australia	France	Japan	Norway
Austria	Germany	Korea, Rep.	Spain
Belgium	Greece	Luxembourg	Sweden
Canada	Iceland	Mexico	Switzerland
Denmark	Ireland	Netherlands	United Kingdom
Finland	Italy	New Zealand	United States

Note: List of countries including core inflation in the estimation. Our sample is unbalanced, and the number of observations for the domestic bloc is different across countries (20 to 45 across 24 countries).

Table A9: List of countries in the estimation with nominal interest rate

Albania	Gambia, The	Myanmar
Australia	Honduras	Panama
Bahrain	Hong Kong SAR, China	Seychelles
Bangladesh	Iceland	Singapore
Barbados	Indonesia	Solomon Islands
Bolivia	Italy	South Africa
Burundi	Japan	Sweden
Canada	Kenya	Tanzania
Chile	Kuwait	Thailand
China	Lesotho	United Kingdom
Czech Republic	Malaysia	United States
Dominican Republic	Mauritania	Zambia
Ethiopia	Mauritius	

Note: List of countries including nominal interest rate in the estimation. Our sample is unbalanced, and the number of observations for the domestic bloc is different across countries (20 to 45 across 38 countries).

Table A10: List of countries in the estimation with exchange rate

Australia	Congo, Rep.	Haiti	Netherlands
Austria	Cyprus	Hong Kong SAR, China	New Zealand
Bangladesh	Czech Republic	Iceland	Norway
Belgium	Denmark	Ireland	Panama
Benin	Dominican Republic	Italy	Poland
Bolivia	El Salvador	Japan	Rwanda
Burkina Faso	Equatorial Guinea	Jordan	Saudi Arabia
Burundi	Ethiopia	Lesotho	Seychelles
Cabo Verde	Finland	Luxembourg	Spain
Cameroon	France	Malaysia	Sweden
Canada	Gambia, The	Mauritania	Switzerland
Chile	Germany	Mauritius	United States
China	Greece	Myanmar	Yemen, Rep.
			Zambia

Note: List of countries including the exchange rate in the estimation. Our sample is unbalanced, and the number of observations for the domestic bloc is different across countries (20 to 45 across 53 countries).

Table A11: Correlation between commodity factors and indices

	1^{st} factor	2^{nd} factor	3^{rd} factor
Agricultural index	0.35	-0.02	-0.08
Fuel index	0.36	0.10	0.20
Metal index	0.43	0.36	-0.10

Note: This table shows the correlation between factors of commodity prices with commodity price indices.

Table A12: List of countries—Excluding large commodity exporters

Countries included in the estimation			Large commodity exporters	
Angola	Hong Kong SAR, China	Seychelles	Australia	Sweden
Bahamas, The	Iceland	Singapore	Austria	Switzerland
Bangladesh	Ireland	Spain	Belgium	Thailand
Barbados	Japan	Sri Lanka	Canada	United Kingdom
Benin	Jordan	Turkey	Chile	United States
Bolivia	Kuwait	Yemen, Rep.	China	
Burundi	Lesotho	Zambia	Denmark	
Cabo Verde	Libya		Ethiopia	
Cameroon	Luxembourg		Finland	
Congo, Rep.	Malta		Gambia, The	
Cyprus	Mauritania		Italy	
Czech Republic	Mexico		Kenya	
Dominican Republic	Myanmar		Korea, Rep.	
El Salvador	New Zealand		Malaysia	
Equatorial Guinea	Pakistan		Mauritius	
France	Panama		Netherlands	
Germany	Poland		Nigeria	
Greece	Rwanda		Norway	
Haiti	Saudi Arabia		South Africa	

We exclude large commodity exporters from the sample. We identify the top 20% largest exporters for each of the three commodity groups; then we exclude the union of these large exporters from the panel. This yields the exclusion of 22 countries from the sample which results in 45 countries used in the estimation.

Table A13: List of countries—Oil exporters vs oil importers

Oil importers			Oil exporters
Bahrain	Guatemala	Papua New Guinea	Australia
Bangladesh	Haiti	Poland	Bolivia
Benin	Hong Kong SAR, China	Saudi Arabia	Cameroon
Botswana	Iceland	Seychelles	Canada
Bulgaria	Iran, Islamic Rep.	Singapore	Congo, Rep.
Burkina Faso	Ireland	Slovak Republic	Egypt, Arab Rep.
Burundi	Italy	Slovenia	France
Chad	Japan	South Africa	India
Chile	Kuwait	Spain	Korea, Rep.
China	Luxembourg	Sri Lanka	Lesotho
Cote d'Ivoire	Madagascar	Sweden	Mauritius
Croatia	Malta	Switzerland	Nigeria
Denmark	Mauritania	Tanzania	Norway
Dominican Republic	Mexico	Thailand	Yemen, Rep.
El Salvador	Mongolia	Turkey	
Ethiopia	Myanmar	Zambia	
Finland	New Zealand		
Gambia, The	Pakistan		
Germany	Panama		

We compute the net trade in fuel oil for each country. We compute the country-specific median of net exports of fuels since 1970, using annual information on exports and imports of fuel commodities from World Development Indicator. A country is an oil exporter (importer) if the median net fuel export share in GDP is positive (negative).

Table A14: List of countries—Net commodity traders

Net commodity importers			Net commodity exporters	
Austria	Iceland	Thailand	Bahrain	Sri Lanka
Bangladesh	Ireland	Turkey	Benin	Togo
Barbados	Italy	United Kingdom	Bolivia	Yemen, Rep.
Belgium	Japan	United States	Burkina Faso	Zambia
Burundi	Jordan		Cameroon	
Cabo Verde	Kuwait		Canada	
China	Libya		Chile	
Cyprus	Luxembourg		Congo, Rep.	
Czech Republic	Malaysia		Equatorial Guinea	
Denmark	Mauritania		France	
Dominican Republic	Pakistan		Korea, Rep.	
El Salvador	Rwanda		Lesotho	
Ethiopia	Saudi Arabia		Malta	
Finland	Senegal		Mauritius	
Gambia, The	Singapore		Mexico	
Germany	South Africa		Nigeria	
Greece	Spain		Norway	
Haiti	Sweden		Panama	
Hong Kong SAR, China	Switzerland		Seychelles	

We consider a country as a commodity exporter (importer) if there is a positive (negative) trade balance on average in the group of three commodities (agricultural, fuel, and metals) since 1970. To do so, we use annual data on agricultural, fuel, and metals commodities from World Development indicator. Then, we calculate the net trade in each category. This classification yields 39 commodity exporters and 64 commodity importers.

Table A15: List of countries—Income level

High income countries			Low income countries	
Australia	Japan	Sweden	Bangladesh	Spain
Austria	Kenya	Switzerland	Benin	Sri Lanka
Barbados	Korea, Rep.	Thailand	Bolivia	Yemen, Rep.
Belgium	Kuwait	Turkey	Burundi	Zambia
Canada	Lesotho	United Kingdom	Cabo Verde	
Chile	Libya	United States	Cameroon	
China	Malaysia		Congo, Rep.	
Cyprus	Malta		El Salvador	
Czech Republic	Mauritania		Germany	
Denmark	Mauritius		Greece	
Dominican Republic	Mexico		Haiti	
Equatorial Guinea	Myanmar		Iceland	
Ethiopia	Netherlands		Jordan	
Finland	Nigeria		Luxembourg	
France	Norway		New Zealand	
Gambia, The	Pakistan		Panama	
Hong Kong SAR, China	Poland		Rwanda	
Ireland	Singapore		Saudi Arabia	
Italy	South Africa		Seychelles	

Note: We divide countries into two categories: The high income (59 countries) and the low income (24 countries). The categorization is based on the world Development Indicator and is based on the per capita gross national incomes in 2015. The results are robust to basing the categorization on income levels in 1990.

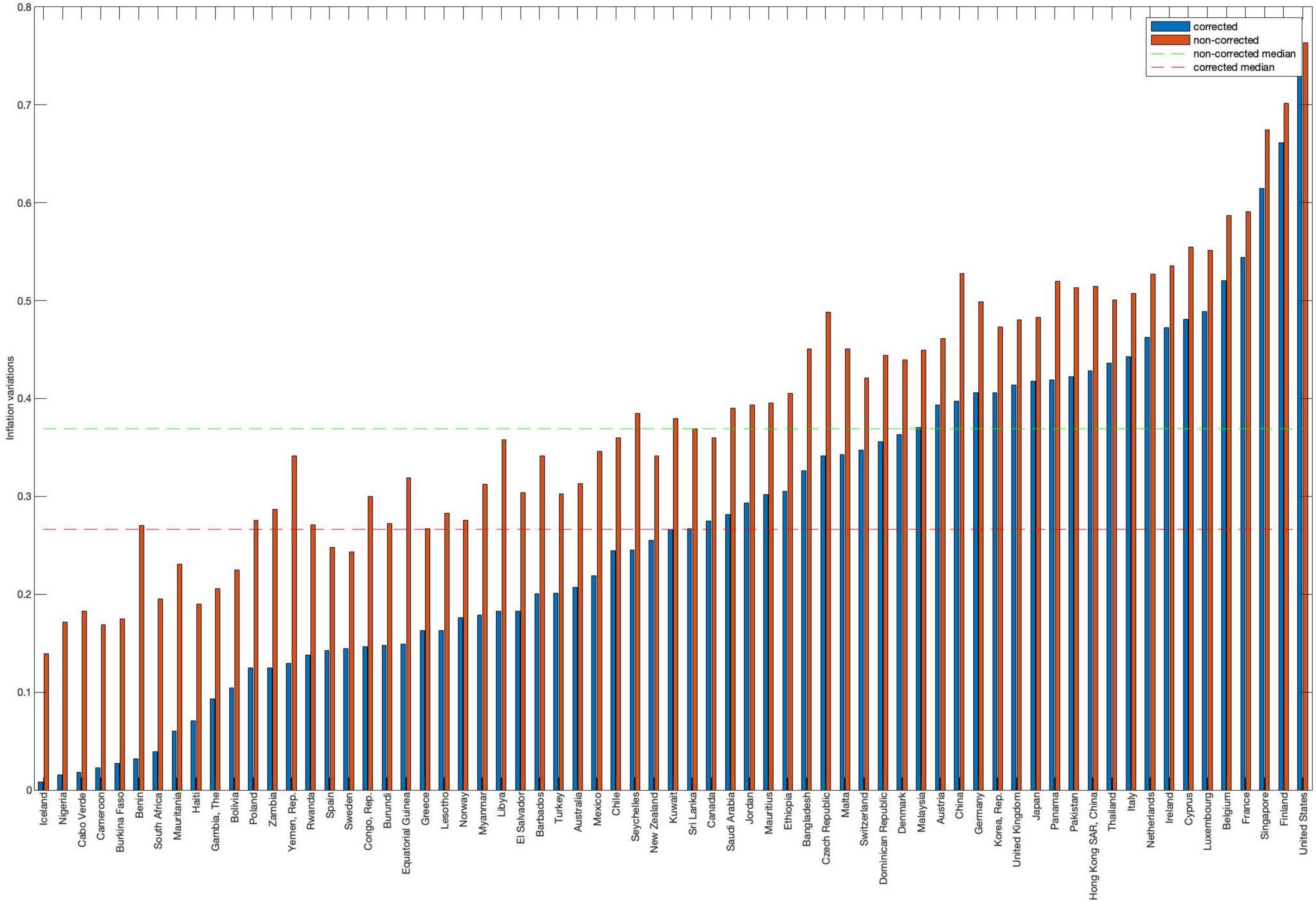

Fig. 6: Inflation responses in response to commodity prices shocks – Baseline result.

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