Monetary Policy Transmission through Commodity Prices*

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Abstract

Monetary policy influences inflation through its impact on commodity prices. At high frequencies, a 10 basis point increase in the US policy rate lowers commodity prices by 1% to 5.4% within 18–24 business days. Beyond dollar appreciation, effects are stronger for storable and industrial commodities, reflecting cost of carry and expected demand. Over longer horizons, commodity prices significantly shape inflation. Three-month price responses of oil and base metals explain 58% of US headline inflation's total monetary policy effect and 68% abroad. For core inflation, commodity prices account for 65% of the total effect in the US and 74% internationally, mainly via base metals.

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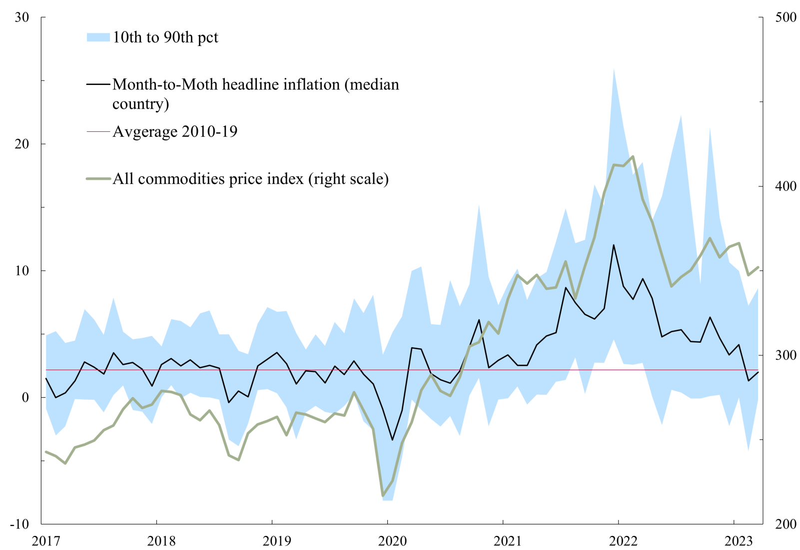
1 Introduction

Sharp fluctuations in commodity prices, in addition to pandemic-related dislocations and policy actions, have been blamed for the recent global surge in inflation (e.g., Gagliardone and Gertler, 2023; Bernanke and Blanchard, 2023; Ball et al., 2022) and for its subsequent fall (Figure 1). Commodity prices, however, are not exogenous with respect to the macroeconomy (e.g., Barsky and Kilian, 2004; Jacks and Stuermer, 2020). Indeed, part of the recent monetary policy reaction may have worked through a commodity-price channel as policy actions from major central banks affect global activity and financial conditions, which are typically major drivers of fluctuations in commodity prices. But, how quantitatively important is the commodity price channel of monetary policy—especially US monetary policy—in driving inflation in the US and worldwide?

Figure 1. Headline inflation and commodity prices 2017-2023



Note: Year to year headline inflation distribution (shaded area) covers countries accounting for around 83.9% of WEO World GDP (in weighted purchasing power parity terms). Sources: Haver Analytics; IMF, Primary Commodity Price System; IMF staff calculations.

Empirical analysis of this question has been limited (Degasperi et al., 2020; Breitenlechner et al., 2022; Ider et al., 2023). This paper contributes to filling this gap by estimating the effects of monetary policy shocks on a variety of commodity prices and, through this channel, their spillback to the domestic economy and spillovers to consumer prices in other countries. In addition to focusing on headline inflation, we emphasize the role of metals prices in affecting core inflation.

The analysis focuses on the Federal Reserve and, to a less extent, the ECB—given the special role of the US dollar as a reserve currency and in the international payment system. Conceptually, US monetary policy can affect commodity prices through i) a cost of carry channel (by affecting the opportunity cost of commodity storage) ii) a real economy channel (by affecting current and future commodity consumption and uses) iii) a liquidity and portfolio channel (by affecting financial conditions and, thus, trading liquidity in physical and derivative markets), and iv) an exchange rate channel (as most commodities are traded in USD). Since monetary policy has typically long lags before affecting the real economy, an immediate effect of a monetary policy shock through the real-economy channel could only work through expectations and, thus, only for easy-to-store commodities.[1]

We start by investigating the high-frequency, daily, response of 39 USD-denominated commodity prices to monetary policy shocks. Using local projection methods for the period 1990-2019, we find large and heterogeneous responses of commodity prices to US monetary policy shocks: base metals, crude oil, cotton and rubber, beverages, precious metals, and cereals decline by 5.4%, 4.2%, 4%, 2.8%, 2.3%, and 1.7%, respectively, to a positive 10 basis points shock to the US monetary policy rate.[2] These responses are larger and more

[1]Recent evidence in Jacobson, Matthes, and Walker (2023) and Buda, Carvalho, Corsetti, Duarte, Hansen, Ortiz, Rodrigo, and Rodríguez Mora (2023) show that monetary policy can have high-frequency effects—days or weeks—on the economy.

[2]Our benchmark set of monetary policy surprises is based on Jarociński and Karadi (2020). In particular,

persistent than the ones implied by the 0.9% US dollar appreciation followed by the monetary policy tightening. Furthermore, for most metals and oil, inventories typically decline after a monetary policy tightening shock. Taken together, these results highlight the importance of the expected demand and the cost of carry channel. We repeat the previous analysis to study the effects of ECB monetary policy shocks on commodity prices. Our results suggest that, unlike the case of US monetary policy, ECB monetary policy shocks affect oil prices only.

To investigate the importance of the commodity-price channel in the transmission of monetary policy to consumer prices, we extend our analysis to a monthly frequency proxy-SVAR which jointly considers the different transmission mechanisms of monetary policy, including the real demand effects, the financial channel, and the commodity-price channel. We study the domestic and international effects of the commodity-price channel of US and ECB monetary policy.

In particular, similar to Cesa-Bianchi et al. (2020), we reestimate the impulse response functions imposing that monetary policy has no effect on commodity prices (oil and base metals) prices. Our results for the US show that the commodity-price channel—mainly through oil and base metals—accounts for about 58% (41%) of the first 3-months effect of US monetary policy on US headline (core) CPI. The contribution of the commodity-price channel increases to 71% (65%) for the 12-month response of headline (core) inflation. The main commodity affecting headline inflation is oil, while core inflation is mostly affected by base metals prices (e.g., copper and aluminum).[3]

we make use of the surprises that are cleaned from the informational effect of monetary policy. Our results are also robust to using the monetary policy surprises in Bauer and Swanson (2023). The authors extend the surprises in Gertler and Karadi (2015) by including more FED announcement dates. In addition, the authors clean the surprises from any predictable information from previous macroeconomic variables.

[3]In an alternative exercise, in the spirit of Sims and Zha (2006), we shut down the response of commodity prices to monetary policy surprises using additional economic shocks. Following the strategy in McKay and Wolf (2023), we use externally identified shocks to oil supply and copper price surprises, rather than hypothetical shocks, to infer the inflationary effects of monetary policy shocks, absent the response of oil

In our final section, we use a sample of 24 countries to analyze the inflation spillovers of US monetary policy through the commodity price channel. We document large and heterogeneous effects. For the average country, the commodity-price channel drives more 68% of the 3-month total effect of US monetary policy on headline inflation. The channel manifests more strongly in advanced economies, in which a lower prevalence of price controls/subsidies could increase the pass-through of commodity prices to final consumer prices. Finally, for a subsample of countries, we explore the impact of the commodity price channel on foreign countries' core inflation. Our results suggest an important role of oil and base metals in the total 12-month effect of US monetary policy on foreign countries core inflation. In particular, 17% of the 12-month response of core inflation is explained by oil prices while an additional 57% is due to the effect of base metal prices.

Our paper makes contributions to three strands of literature. First, we contribute to the literature that studies the drivers of commodity price fluctuations as in Kilian (2009), Hamilton (2009), Alessio Anzuini and Pagano (2013), Frankel (2014), Kilian and Murphy (2014)) Hammoudeh, Nguyen, and Sousa (2015), Rosa (2014), Baumeister and Kilian (2016), Alam and Gilbert (2017), Alessio Anzuini and Pagano (2013), Jacks and Stuermer (2020), among others. We contribute to these studies by using local projections and documenting high-frequency responses to a broader set of commodity prices, using recent identified monetary policy price shocks as in Jarociński and Karadi (2020). We also provide monthly responses using proxy-SVAR approach.

We also contribute to the literature studying the spillovers of monetary policy decisions in major central banks (e.g., Dedola et al., 2017; Camara, 2021). Different from these papers, we disentangle a particular channel in which monetary policy can affect foreign headline and

or/and metal prices to monetary policy shocks. The results are similar to those in our main exercise.

core inflation: the commodity-price channel.

Finally, our results also shed light on the literature investigating the transmission channels of monetary policy in Blanchard and Galı (2007), Gertler and Karadi (2015), Nakamura and Steinsson (2018), Jarociński and Karadi (2020), Gagliardone and Gertler (2023), and Bernanke and Blanchard (2023), among others. All these studies, consider how commodity price shocks affect monetary policy decisions, taking commodity prices as exogenous. Nevertheless, our results point to the importance of taking into account the effects of monetary policy on commodity prices. Complementing the results in Degasperi, Hong, and Ricco (2020), Miranda-Agrippino and Rey (2022), Breitenlechner, Georgiadis, and Schumann (2022) and Ider, Kriwoluzky, Kurcz, and Schumann (2023), we document that US and ECB monetary policy transmission channels greatly hinge on how different commodities react and then affect domestic and international headline and core inflation.[4]

2 Conceptual Framework

Among central banks, the US Federal Reserve plays a special role. This is because the bulk of cross-border capital flows are denominated in US dollar and US monetary policy is a key driver of the global financial cycle (Miranda-Agrippino and Rey, 2020; Dées and Galesi, 2021); changes in US interest rates have, thus, pronounced repercussions for the rest of the world (e.g., Rey, 2016). Kearns, Schrimpf, and Xia (2018) document that the importance of the ECB's spillovers has increased over time, especially after the European debt crises. The authors also show that spillovers from other major central banks, such as the Bank of Japan of the Bank of England, are only mild. Therefore, this analysis will focus on the effects of US

[4]In a related but different question, Castelnuovo, Mori, and Peersman (2024) study how systematic monetary policy reacts to shocks to commodity prices.

and ECB monetary policy shocks.[5]

2.1 Transmission mechanisms

Conceptually, monetary policy can affect commodity prices through, at least, four channels. The first channel is the so-called cost of carry channel. Changes in interest rates affect the opportunity cost of commodity storage. Hence, a substantial increase in the Fed funds rate provides investors an incentive to reduce commodity storage and search for higher yields in the bond markets. Frankel (2014) also highlights another consequence of higher interest rates: they undermine the incentive for oil-producing countries to keep crude oil under the ground. By extracting oil instead of preserving it, OPEC countries could invest the proceeds at interest rates that were higher than the return to leaving it in the ground. Higher extraction rates increase supply; both lower demand and higher supply contribute to a fall in oil prices.[6] The same mechanisms apply to decisions about extracting minerals, logging forests, harvesting crops, etc.

A second channel is the real economy. Changes in interest rates affect investment and consumption, which then drives current and future commodity consumption. While the real effects of monetary policy take time to materialize, forward-looking agents in commodity markets adjust their portfolios today in expectation of future changes. Moreover, as documented by Ottonello and Winberry (2020), monetary policy has important effects on investment, especially for financially healthy firms. Hence, as several commodities, for example, base metals, have a large exposure to investment demand, commodity prices of

[5]In our Appendix, Table A3, we use Granger causality tests to show that US and ECB monetary policy shocks tend to drive other major central banks monetary policy shocks. Hence, our results for the US and ECB could represent a lower bound to total commodity-price channel of *global* monetary policy.

[6]In the Hotelling's resource model, higher interest rates raise the opportunity cost of holding the resource (above or underground); the resource owner is, thus, incentives to accelerate the extraction rate to capitalize on the higher present value of the resource's revenue reducing today's price of the exhaustible resource.

more industrial commodities are also expected to react to monetary policy shocks.

A third channel is liquidity. Monetary policy of major central banks affects global financial conditions and, thus, it drives liquidity trading in physical and derivative markets (e.g., Miranda-Agrippino and Rey, 2022). Finally, as we consider commodities that are internationally traded in USD, there is the exchange rate channel. An appreciation of the USD dollar, all else equal, increases the price of commodities in foreign local currency, which then decreases demand and stimulates supply, thus, putting downward pressure on prices.

In our first analysis of the effects of monetary policy on commodity prices, we consider daily high-frequency data. Since monetary policy has typically long lags affecting the real economy, an immediate effect of a monetary policy shock through the real-economy channel can only work through expectations and, thus, for easy-to-store commodities. In our next sections we study the longer-term effects of monetary policy for which we explicitly consider the current real demand channel.

3 High-frequency responses of commodity prices to monetary policy shocks

3.1 Data

We use disaggregated daily data on nominal commodity price futures (rolling front month contracts) from Bloomberg L.P., denominated in USD, for 39 different commodities (see Table 1 in our Appendix). We also aggregate these commodities prices, only those with data for the whole sample period 1990-2019, using trade weights from the IMF Primary Commodity Price System (PCPS) database into 11 sub-indexes (e.g., agriculture, energy, metals, food). Table A2 in our Appendix shows the commodities we use along with their weights.

Our measure of monetary policy shocks, for the USA and Europe, follows Jarociński and Karadi (2020). In particular, we use the *pure* monetary policy shock identified within their proxy-SVAR. This is the exogenous interest rate shocks that correlate negatively with the stock market on the day of the announcement.

In our Appendix, we show that similar results hold when using an alternative measure of US monetary policy surprises. In particular, we use the shocks constructed by Bauer and Swanson (2023). The authors expand the set of monetary policy announcement events by including, in addition to the FOMC announcements, press conferences, speeches, and testimony by the chair of the Federal Reserve. In addition, the authors remove any predictable component in monetary policy surprises by regressing the surprises on the economic and financial variables before announcements. The new shocks are the residuals of that regression.

3.2 Empirical strategy

Following Jordà (2005) we run the following Local Projection (LP) regression

$$\ln y_{i,t+h} - \ln y_{i,t-1} = \alpha_{i,t} + \beta_{i,h} MPS_t + \sum_{l=1}^{L} \phi_{x,l} \mathbf{x}_{t-l} + \mu_{i,t} \tag{1}$$

in which $y_{i,t+h}$ is the price of commodity i at time $t+h$, for $h = 0, 1, \ldots, 24$. The variable MPS_t is the monetary policy shock, measured in basis points of futures' rates, around a 30-min window of the monetary policy announcement.[7] The vector x_{t-l} includes the l^{th} lag of $\ln y_{i,t} - \ln y_{i,t-1}$ and the shock, MPS_t, with $L = 12$. Our sample for the US covers the

[7]For the US, Jarociński and Karadi (2020) obtain the 1st principal component of the surprises in interest rate derivatives with maturities from 1 month to 1 year (MP1, FF4, ED2, ED3, ED4, in their paper). The S&P500 is used to construct the shocks. For the ECB shocks, the authors obtain the 1st principal component of the Monetary Event-window changes in overnight index swaps (OIS) with maturities 1-, 3-, 6-months and 1-year (Identifiers: OIS1M, OIS3M, OIS6M, OIS1Y). The Euro Stoxx 50 is used to construct the shocks.

business days for the period 1990M2-2019M5, while the ECB data cover the business days in the period 1999M1-2020M6.

3.3 United States: US monetary policy shocks

Before looking at commodity prices, we present the responses of the fed funds and the US dollar to a typical US monetary policy shock. Figure 2 depicts the impulse response function of a US monetary policy shock on the Fed Fund Rate (FFR) and the dollar exchange rate index (DXY). We can see that the shock has the expected effect on the Feds Fund Rate (left panel). We normalize the impact effect of the shock to a 10 basis points increase in the Fed Fund Rate. The effect is persistent throughout the month. The dollar index also appreciates as expected with a peak response of 0.93% after 2 business days, however, the effect vanishes after a week (Figure 2, right panel).

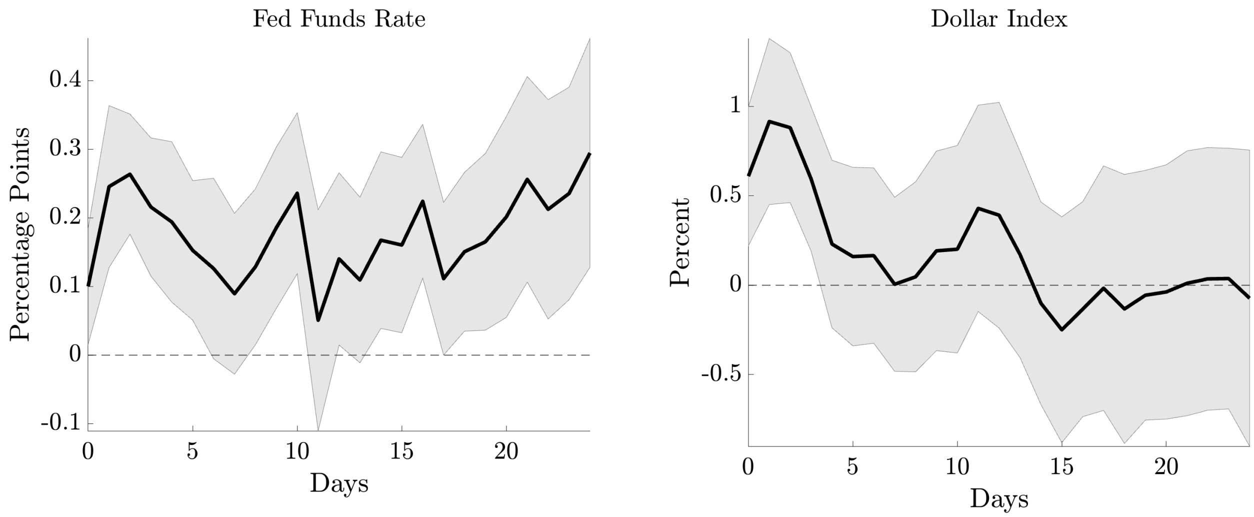
We now report the peak response of commodity prices sub-indexes to a 10 basis points increase in US monetary policy. Figure 3 shows that base metals and energy commodities are the most responsive commodity prices. After a 10 basis points increase in the Fed Funds Rate, base metal prices decline 5.42% (after 18 business days), and energy commodities (WTI and Brent oil prices) decline by 4.2% (after 21 business days). Other commodities such as cotton and rubber, beverages, precious metals, and cereals also show significant declines.[8] The correlation between the US dollar and commodity prices conditional to a monetary policy shock is, thus, in general, negative.[9]

In Figure A1 of the Appendix we show the commodity-specific response to a broader set of commodity prices. We observe that a large fraction of commodity prices decline after a

[8] Similar results hold when we use Bauer and Swanson (2023) US monetary policy surprises (see Figure A3).

[9] The negative correlation between commodity prices and the US dollar is robust to choosing a more recent subsamples.

Figure 2. Impulse response of Fed Funds Rate and Dollar Index to a US monetary policy shock

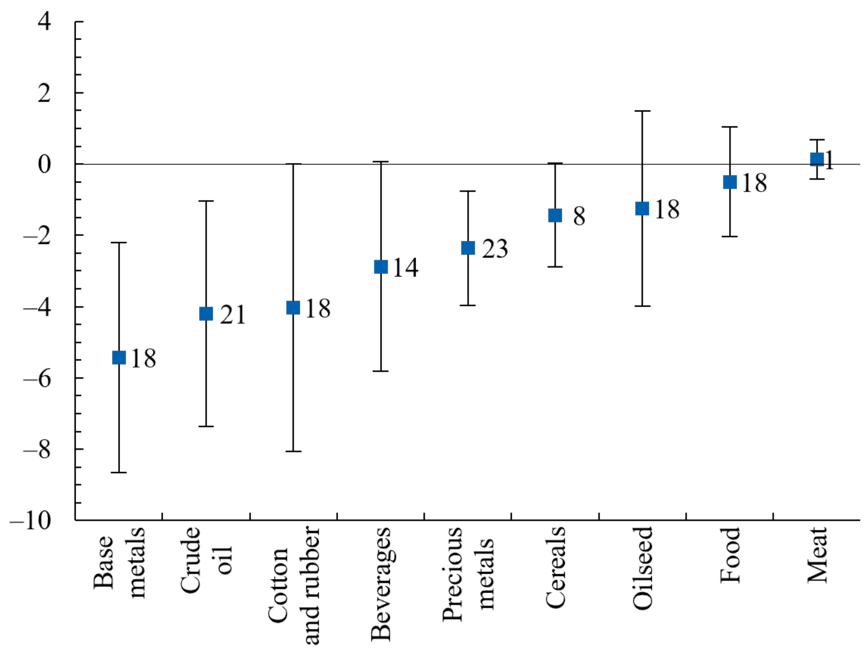


Note: This figure reports the 24-day (x-axis) response of the Fed Funds rate (left panel), normalized to be 10 basis points on impact, and dollar index (right) to a contractionary US monetary policy shock. The blue area represents 90% confidence bands, calculated using robust standard errors at each horizon.

US monetary tightening. For example, the prices of coffee, sugar, wheat, and milk display a peak decline of 5.3%, 4.6%, 3.2%, 2.7%, respectively. All these responses are larger than the exchange rate responses, which implies that commodity prices overshoot, due to the channels emphasized above. In particular, as expected, more storable and industrial commodities are the most responsive. The response of gold prices sets a floor for storable metals, regarding the cost of carry channel. Therefore, the differential between base metals or oil and gold indicates the strength of the expected demand and investment channel.

In our Appendix Figure A7 we plot the response of daily commodity inventories for a sub sample of energy and base metal commodities for which we have daily information since 2016. While the responses are not precisely estimated we observe that, consistent with the price responses, base metals display a larger decline inventories after the monetary policy tightening. Hence, while real economic conditions do not respond immediately, the rise in

Figure 3. Peak response of commodity price sub-indexes to a 10bp increase in Fed funds rate.



Note: This Figure shows the peak response of commodity prices, to a 10-basis points increase in the Fed funds rate, from estimating Equation (1). 90% confidence bands reported. The numbers by the box indicate the day (h) of the peak response.

the opportunity cost of storing commodities appears to operate in the direction and in the magnitude we expect.

3.3.1 The case of Natural Gas

The response of natural gas prices deserves special attention. The Henry Hub price in Figure A1 of our Appendix shows no response to US monetary policy shocks.[10] However, the natural gas market in the US went through important structural changes in the last decade as shale

[10] Henry Hub is a crucial benchmark and distribution point for natural gas in the United States. It is physically located in Erath, Louisiana, where several interstate and intrastate natural gas pipelines converge. The Henry Hub serves as a pricing reference point for natural gas futures and spot contracts traded on the New York Mercantile Exchange (NYMEX) and for LNG contracts.

gas production increased dramatically and found its export markets as liquefied natural gas (LNG). This has increased its storability and integration in the global LNG market increasing its co-movement with other gas prices.[11] Contrary to the whole sample, over the sample period 2016-2019 Henry Hub prices respond significantly to US monetary policy shocks. Indeed, Figure A2 in our Appendix shows that for the sample 2016-2019 Henry Hub prices are the most responsive commodity price to US monetary policy shocks.

3.4 Europe: ECB monetary policy shocks

Here we estimate the impact of ECB monetary policy shocks, estimated by Jarociński and Karadi (2020), on commodity prices. As additional control in the specification (1) we add 24 business days lags of the one-year US bond yield to control for US monetary policy stance. Figure 4 presents the results for the 9 subindexes. The effects on oil prices are like those documented for the US but less precisely estimated. However, we find no effect on base metals, raw materials, and cereals. The results for disaggregated commodity prices (Figure A5 in the Appendix) provide a similar conclusion. In general, ECB shocks have negative effects on commodity prices, but the responses are not refsely estimated.[12] [13]

4 The Commodity-Price Channel of US Monetary Policy

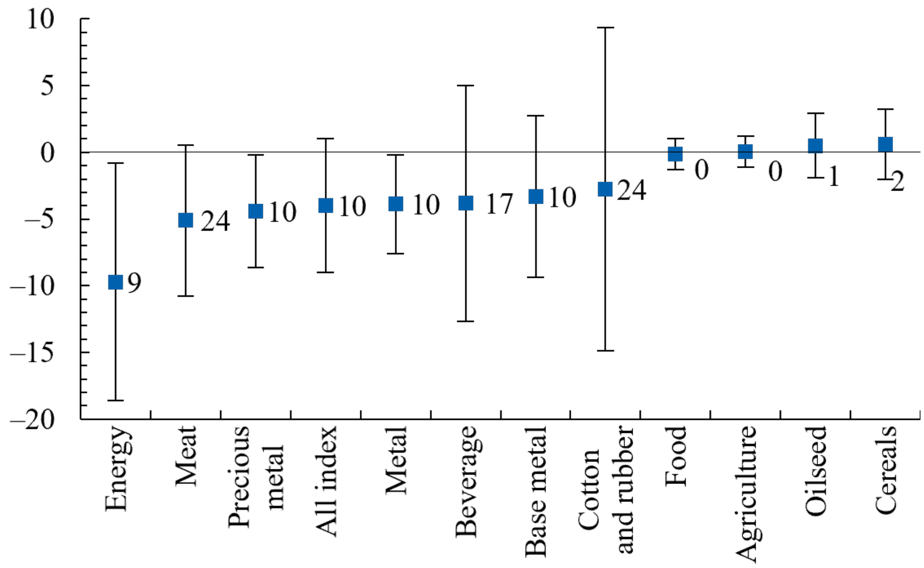
Having documented the importance of major central banks monetary policy in driving commodity prices, we now study the spillbacks and spillovers of US monetary policy on

[11] During the energy crisis in Europe in 2021-22, US LNG exports hit their capacity limit temporarily isolating US natural gas prices from international gas prices.

[12] In Figure A4 we show the responses of commodity prices to US monetary policy for a comparable sample, 1999-2019. There is a slight change in the ranking but the results stay the same. US monetary policy has larger and more precise effects on a wide range of commodity prices.

[13] In Figure A6 we show the effects of UK monetary policy shocks, estimated by Cesa-Bianchi et al. (2020), on commodity prices. Responses are small and not statistically significant.

Figure 4. Peak response of commodity price sub-indexes to a 10bp increase in ECB funds rate.



Note: 90% confidence bands reported. The numbers by the box indicate the day (h) of the peak response.

inflation.

4.1 Proxy-SVAR

This section identifies the spillbacks effects of different commodity prices on the US (and other countries) prices after a monetary policy shock by employing a Proxy-SVAR. In particular, we consider the following structural SVAR:

$$A_0 Y_t \quad = \quad \sum_{j=1}^{p} A_j Y_{t-j} + B\varepsilon_t$$

Where Y_t is a vector containing n variables of interest, ε_t is a vector of unobservable zero mean white noise processes or structural shocks (with a diagonal variance and covariance matrix), A_j is the dynamic matrix, and B contains the coefficients with the impact effects of the structural shocks to the variables of interest. The structural SVAR above admits the following reduced form representation:

$$Y_t = \sum_{j=1}^{p} D_j Y_{t-j} + \mu_t$$

Where μ_t is a vector with the reduced-form residuals or innovations of the system $\mu_t = A_0^{-1} B \varepsilon_t$ and $D_j = A_0^{-1} A_j$. We focus on the identification of a monetary policy shock and, following a vast part of the literature, we use an instrument (a variable that is external to the VAR) to identify a particular structural shock. A key element for this strategy is that the instrument has to be correlated with the shock of interest and uncorrelated with other structural shocks, i.e.,

$$\begin{aligned} E[\epsilon_t^{MP}, z_t^{'}] &\neq 0 \\ E[\epsilon_t^{others}, z_t^{'}] &= 0 \end{aligned}$$

In addition to the monetary policy instrument, our baseline specification considers seven macroeconomic variables: one-year treasury bill yield, the US headline Consumer Price Index (CPI), US core CPI, US industrial production (IP), World Industrial Production (WIP) from Kilian (2019), the excess bond premium (EBP), end-of-month U.S. dollar index (DXY), and end-of-month commodity prices as measured by the WTI oil price and the base metals price index.[14] The data span from 1990M1 to 2019M12. The pure monetary policy shock

[14] We use the *pure* monetary policy shock identified by Jarociński and Karadi (2020), which cleans the monetary policy surprises associated with positive stock market comovement. To avoid timing problems in estimating the effects of high-frequency shocks, a emphasized by Kilian (2024), our monthly commodity prices are end-of-the-month futures prices. Our base metal price index uses aluminum prices (32%) and

that we use as an instrument is by construction associated with monetary policy surprises and orthogonal to any other structural shocks. Then, we employ the two-stage traditional procedure to identify the impact effects of the monetary policy shock on all the macroeconomic variables. In the first stage, we regress the monetary policy surprise (our instrument) on the reduced-form VAR innovation for the one-year treasury bill. This step allows us to identify the impact effect of the monetary policy shock on the interest rate, commodity prices and inflation.

The second stage regresses the predicted value from the first stage regression on the remaining VAR innovations. The coefficients from these regressions identify, up to a scaling factor, the impact coefficients of the matrix B, that shapes the effects of a structural monetary policy shock. Once we have identified the impact effects of the monetary policy shock, we compute the impulse response functions in a traditional way for the monetary policy shock (e.g., in position i), where:

$$IR_t = (A_0^{-1}B)_i \quad \text{for} \quad t = 0$$

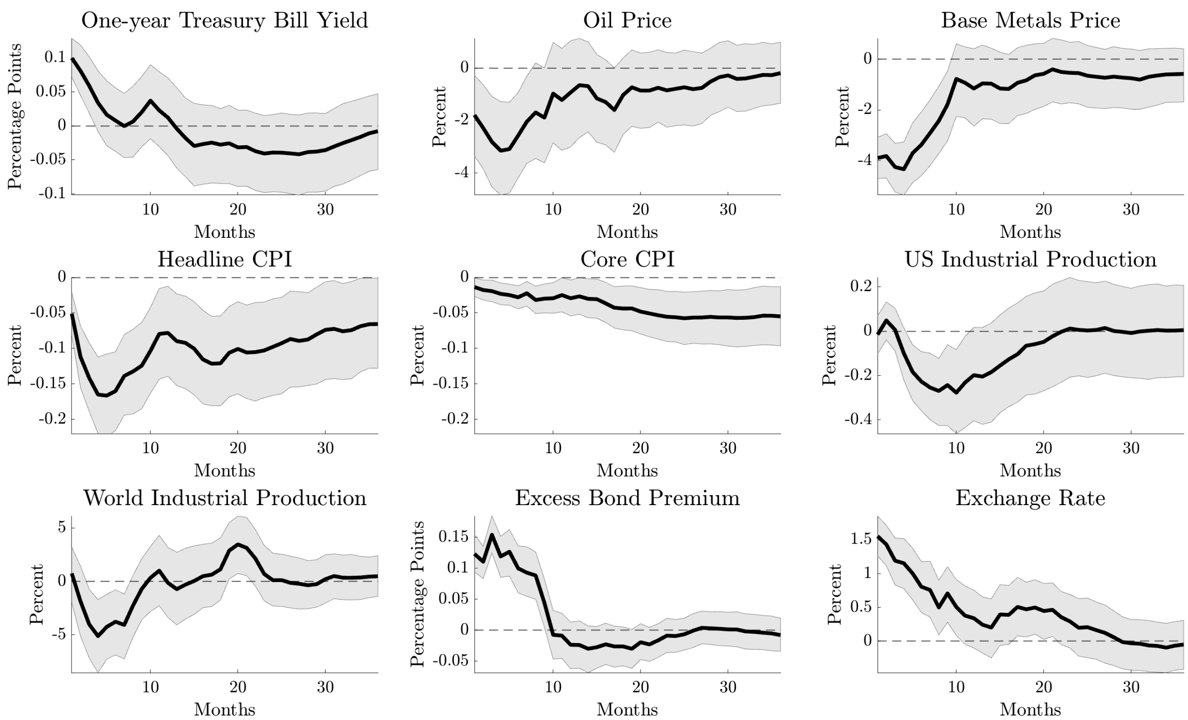
$$IR_t = \boldsymbol{D} \cdot \boldsymbol{IR}_{t-1} \quad \text{for} \quad t = 1, 2, \ldots, H$$

where (B_i is)the i-th column of the impact matrix B. Figure 5 reports the IRF of our proxy-SVAR. A 10 basis point increase in the US Federal Funds Rate induces a decline in oil prices of 2 percent on impact and the effect persists for 8 months. Consistent with the high-frequency estimation, base metal prices are the most responsive of all commodities. A 10 bps increase in the fed funds rate reduces base metal prices by 4% after two months, with

copper prices (68%). These weights reflect the relative importance of each metal in the IMF base metal price index. Because the IMF index only begins in 1992, we construct our own measure—using aluminum and copper—to cover the period 1990-2019.

the effect vanishing after ten months.[15]

Figure 5. Impulse response to US monetary policy using proxy-SVAR.



Note: The x-axis denotes months after the shock. The grey area denotes 68% confidence bands

The responses of headline CPI and IP are in line with the textbook implications of a monetary policy tightening. On impact, the one-year treasury bill increases, headline inflation declines, and industrial production and core inflation take about a year to display a more significant decline. We also observe significant increase in the excess bond premium and the US dollar index, consistent with previous literature (e.g., Miranda-Agrippino and Rey, 2020; Jarociński and Karadi, 2020; Cesa-Bianchi and Sokol, 2022; Degasperi et al., 2020).

[15]In our Appendix, Figure A8 we show that food prices decline by 1 percent and the effect is less persistent.

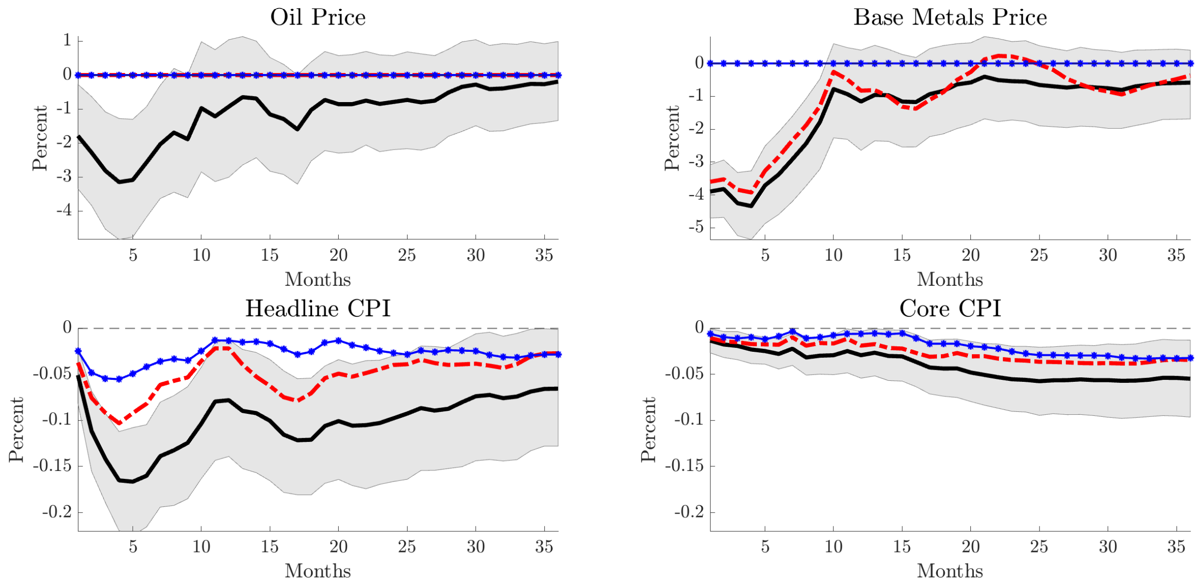
4.2 Commodity-price channel of US monetary policy

To quantify the contribution of the oil and base metal prices in the effect monetary policy shocks on inflation, we use a simple and transparent approach. We follow Cesa-Bianchi and Sokol (2022) and perform a decomposition exercise where commodity prices are held at their steady-state value. This is equivalent to assuming that the US is a small open economy with respect to commodity prices. We achieve this exercise by assuming that commodity prices do not respond on impact to US monetary policy shocks and that by assuming that commodity prices do not react to endogenous changes in all other variables in the model. For more details, see our Appendix A1.

Figure 6 depicts the results from our decomposition. Clearly, US monetary policy has now smaller effects on the CPI. Absent oil prices responses (red line), in panel 3, headline CPI would have declined by 0.09 percentage points rather than by 0.16 percentage points (black line) in the first semester. The blue line indicates the response of headline CPI absent the response of oil and base metals. In this case, headline CPI would have declined 0.05 percentage points instead. Over a period of three years, without the response of oil prices, headline CPI would have declined 0.041 percentage points rather than 0.075 in the benchmark. If instead, oil and metal prices stayed constant, headline CPI would have decreased by 0.029 percentage points.

Panel 4 of Figure 6 shows the importance of the commodity price channel on core inflation. We observe a limited impact of oil prices in core inflation within the first fifteen months. However, after three years, core inflation would have declined by 0.048 percentage points, rather than by 0.061 percentage points, absent the oil price response. Base metal prices, on the other hand, have a larger role in accounting for the response of core inflation. Indeed, within the first 18 months, absent the response of base metal prices, core inflation would

Figure 6. Impulse response to US monetary policy using proxy-SVAR: the role of oil and base metal prices



Note: The black line represents the benchmark estimation. The red lines show the responses of inflation under the assumption that oil prices do not react to monetary policy shocks. The blue line shows the response of inflation under the assumption that oil and base metal prices do not react to monetary policy.

have declined by 0.01 percentage points only.

The significant effects of commodity prices on core inflation are consistent with recent evidence in Minton and Wheaton (2023) and Miranda-Pinto et al. (2024) for the case of oil prices and base metal prices, respectively. As emphasized by the authors, oil and metals are key suppliers to important downstream industries such as the construction sector. An additional force driving this result is the effect that changes in commodity prices have on the US dollar. As we will see in the next section, absent the commodity price channel, the US dollar appreciates less than in the benchmark scenario. Therefore, global demand for commodities drops less absent the decline in oil prices and base metal prices.

4.2.1 Robustness

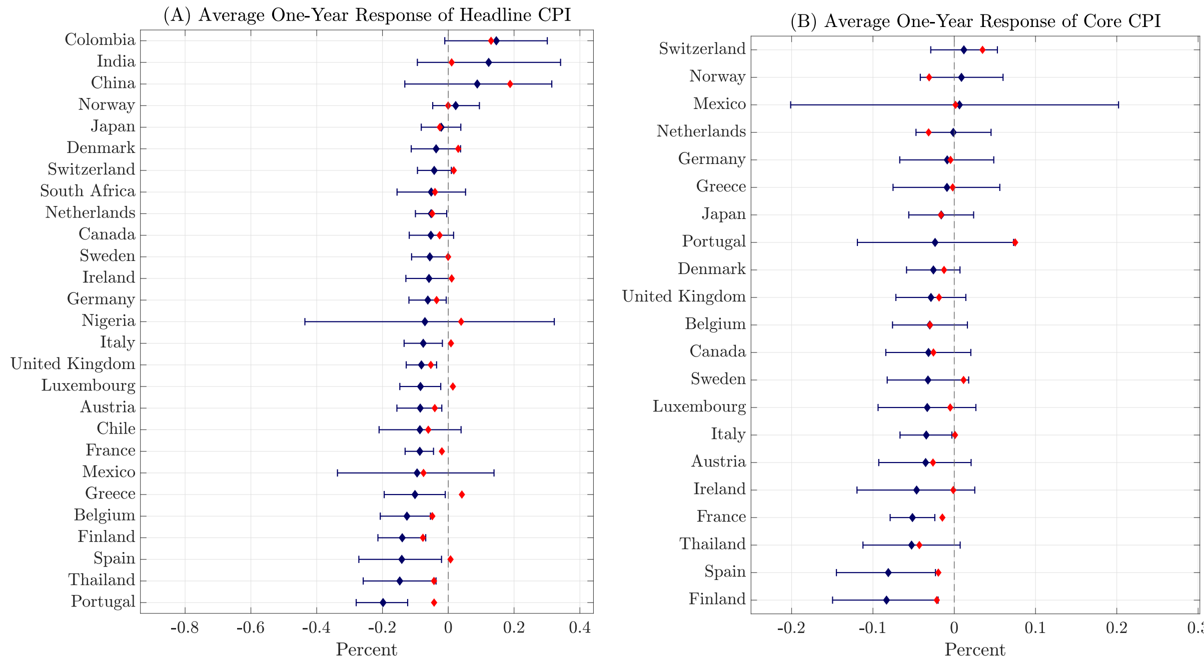
In our Appendix A1.1, we present the results of performing an alternative decomposition. In the spirit of Sims and Zha (2006) and McKay and Wolf (2023), instead of imposing zero responses in the SVAR, we use additional external instruments to identify two additional orthogonal shocks to oil and base metal prices and use them to shut down the response of oil and base metal prices. The results are very similar to those in Figure 6. For headline inflation, oil and base metal prices account for 44% (45%) of the total 6-months (12-months) decline in inflation. In terms of core inflation, the commodity price channel accounts for 59% (36%) of the 6-months (12-months) decline in core CPI.

5 Cross-country spillovers

Here we investigate the importance of the commodity price channel in accounting for the spillovers of monetary policy on foreign inflation. To this end, we augment the proxy-SVAR including countries' CPI and the bilateral exchange rate between the US and each country. Our main focus is on the effects on headline inflation of oil and base metals prices. However, we also estimate the effects on core CPI for a subsample of countries for which we have data available.

On the one hand, in Panel (A) of Figure 7 we report the effects of US monetary policy on countries' headline CPI (in blue) along with the effect of US monetary policy on countries' CPI absent the commodity-price channel (red) of oil and base metal prices. As expected, most countries' CPI decline after a US monetary policy tightening. From top to bottom, we organize the countries based on the size of the CPI decline. For example, over a period of 12 months, a 10 basis point increase in the US monetary policy rate induces a 0.12% decline in

Figure 7. Panel (A) shows the results for headline CPI and Panel (B) for core CPI.



Note: Note: Blue square represents the 12-month response of headline CPI to US monetary policy. 68% confidence bands are displayed. The red square represents the response of CPI assuming commodity prices do not react to monetary policy.

the headline CPI of Spain. Notably, all this effect is mediated by the response of oil and base metal prices.

On the other hand, Panel (B) in Figure 7 we show the effects of the US monetary policy shocks on countries' core inflation of countries (in blue) and their corresponding effects in the absence of the endogenous response from oil and base metals (in red). From top to bottom, we organize the countries based on the size of the core CPI decline. For example, over a period of 12 months, a 10 basis point increase in the US monetary policy rate induces a 0.08% decline in the core CPI of Finland. After removing the impact of oil and metals, Finland's core CPI falls by only 0.02%.

In Figure A9 of our Appendix we also show the response of the bilateral exchange rate between the US and each of the countries. As expected, in most countries we observe an appreciation of the US dollar. While these responses are less precisely estimated, the exchange rate channel is an additional channel in which US monetary policy can affect foreign inflation. The exchange rate channel is not independent of the commodity price channel. For instance, take the case of Switzerland, a small open economy commodity exporter. A US monetary policy tightening depreciates the Swiss Franc, but this depreciation is mitigated once commodity prices are assumed not to decline in response to US monetary policy.

The role of the commodity-price channel is quantitatively important. Table 1 reports the relative importance of the spillbacks of oil and base metal prices on US inflation, along with the spillovers of oil and base metal prices on foreign prices.

Table 1. Average role of the commodity price channel on headline and core inflation

Variable	Counterfactual	0-3 Months	0-12 Months
United States			
Headline CPI	No oil	33%	51%
	No oil, no base metals	59%	71%
Core CPI	No oil	22%	35%
	No oil, no base metals	50%	65%
Other countries			
Headline CPI	No oil	39%	38%
	No oil, no base metals	68%	94%
Core CPI	No oil	16%	17%
	No oil, no base metals	39%	74%

Note: Note: This table presents the average relative importance of the commodity price channel to the total effect of US monetary policy on inflation.

In the U.S., the commodity-price channel explains 59% of the headline CPI's three-month response. In contrast, for the average country, it accounts for 68% of the initial inflation spillover from U.S. monetary policy. Both of these numbers increase if we consider a 12-month horizon. In this case, the commodity-price channel explains 71% in the U.S and 94% worldwide. These results align with those estimated by Degasperi et al. (2020). Our results provide additional insights on the relative role of specific commodities. Specifically, oil prices drive a larger portion of the spillback effect in U.S. headline inflation, while base metals play a relatively greater role in transmitting inflation spillovers in other countries.

The analysis of core inflation reveals an even more pronounced influence of base metals. In both the U.S. and cross-country comparisons, base metals contribute more to core inflation than oil prices do—both at the 3-month and 12-month horizons.

Conclusion

Monetary policy has a strong direct effect on commodity prices, especially for industrial and storable commodities such as oil and metals. Spillbacks and spillovers to other countries from US monetary policy shocks are fast. After a 10 bps monetary policy surprise, the decline in oil and base metal prices over the course of 12 months reduce domestic inflation by 0.07 percentage points (from 0.08% to 0.01%). In terms of spillovers, for the average country, a 10 bps monetary policy surprise reduces inflation by 0.05%. Most of this response is mediated by the commodity-price channel. This result implies that the commodity price channel of US monetary policy has relatively larger spillovers to other countries than spillbacks to the US. While the commodity-price channel accounts for 71% of the total decline in US headline CPI (12-month), it accounts for 94% of the total decline in headline CPI for the average country in the sample. Spillovers from US monetary policy shocks tend to be more relevant for consumer prices in other AEs, while the reaction of consumer prices in EMs and also their commodity price channel are less precisely estimated, as EMs tend to have more regulated prices. The commodity channel for core inflation is also important, accounting for a 65% and 74% in the US and for the average countries, and it is mainly driven by base metals (i.e., copper and aluminum). Major central banks should take into consideration their spillback and spillovers through a commodity price channel when setting their policy objectives. Finally, as the Federal Reserve tends to set the tone for the global monetary policy stance, and given that other major central banks such as the ECB can also affect commodity prices, the commodity price channel could be strengthened in periods of high monetary policy coordination.

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A1 The commodity-price channel

Our baseline decomposition is based on Cesa-Bianchi et al. (2020). We note here that this is not a policy experiment. We are not after a structural change in the relation between commodity prices and the rest of the economy (which would be severely subject to Lucas' critique), but a decomposition of the inflation response.

Suppose that x represents US interest rate, y is the commodity price, and z an additional control. The SVAR representation of the model is as follows

$$\underbrace{\begin{bmatrix} a_{1,1} & a_{1,2} & a_{1,3} \\ a_{2,1} & a_{2,2} & a_{2,3} \\ a_{3,1} & a_{3,2} & a_{3,3} \end{bmatrix}}_{A_0} \begin{bmatrix} x_t \\ y_t \\ z_t \end{bmatrix} = \sum_{j=1}^{p} A_j \begin{bmatrix} x_{t-1} \\ y_{t-1} \\ z_{t-1} \end{bmatrix} + B_0 \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \\ \varepsilon_{3,t} \end{bmatrix}.$$

We can rewrite the system as

$$\begin{bmatrix} x_t \\ y_t \\ z_t \end{bmatrix} = \sum_{j=1}^{p} \underbrace{A_0^{-1} A_j}_{D_j} \begin{bmatrix} x_{t-1} \\ y_{t-1} \\ z_{t-1} \end{bmatrix} + \underbrace{A_0^{-1} B_0}_{B} \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \\ \varepsilon_{3,t} \end{bmatrix},$$

$$\begin{bmatrix} x_t \\ y_t \\ z_t \end{bmatrix} = \sum_{j=1}^{p} \begin{bmatrix} d_{1,1} & d_{1,2} & d_{1,3} \\ d_{2,1} & d_{2,2} & d_{2,3} \\ d_{3,1} & d_{3,2} & d_{3,3} \end{bmatrix} \begin{bmatrix} x_{t-j} \\ y_{t-j} \\ z_{t-j} \end{bmatrix} + \begin{bmatrix} b_{1,1} & b_{2,1} & b_{1,3} \\ b_{2,1} & b_{2,2} & b_{2,3} \\ b_{3,1} & b_{3,2} & b_{3,3} \end{bmatrix} \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \\ \varepsilon_{3,t} \end{bmatrix}.$$

The decomposition below imposes that commodity price y does not react contemporaneously to monetary policy shocks ($\varepsilon_{1,t}$) and it does not respond to the dynamic effects from lags of x, y, z either. Therefore, tracing the effects of a shock to ε_1 would, thus, work only through its direct effect on x and z and the internal dynamics through lags in z and x.

$$\begin{bmatrix} x_t \\ y_t \\ z_t \end{bmatrix} = \sum_{j=1}^{p} \begin{bmatrix} d_{1,1} & d_{1,2} & d_{1,3} \\ 0 & 0 & 0 \\ d_{3,1} & d_{3,2} & d_{3,3} \end{bmatrix} \begin{bmatrix} x_{t-j} \\ y_{t-j} \\ z_{t-j} \end{bmatrix} + \begin{bmatrix} b_{1,1} & b_{2,1} & b_{1,3} \\ 0 & b_{2,2} & b_{2,3} \\ b_{3,1} & b_{3,2} & b_{3,3} \end{bmatrix} \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \\ \varepsilon_{3,t} \end{bmatrix}.$$

Hence, we effectively assume that the US economy is a small open economy with respect to global commodity prices.

A1.1 Alternative counterfactual

We construct and alternative counterfactual by estimating impulse responses on the variable of interest, which then shut down the response of commodity prices to US monetary policy. To achieve this, we use additional external instruments to identify two additional orthogonal shocks to oil and base metal prices and use them to shut down the response of oil and base metal prices.

Our procedure is similar in spirit to Sims and Zha (2006) and McKay and Wolf (2023). However, rather than constructing hypothetical shocks, we use externally identified shocks, as in McKay and Wolf (2023) to perform empirical counterfactual scenarios that are robust to the Lucas' critique. The key difference in our exercise is that we use one shock at a time to shut down the response of one variable of interest. In our exercise, we will use two external instruments to replicate the responses of oil and base metal prices, at the time that we construct the corresponding responses from other variables to these shocks. This procedure will allow us to shut down the response of the commodity prices at the time in which we construct the counterfactual responses of other variables under this scenario, giving us a straightforward interpretation and address the following question: What is the counterfactual behavior of our variables of interest to a monetary policy shock if oil prices would have had no reaction giving an external shock that is proper to its market?

To make a more specific example, assume there are three variables, where x is the fed funds rate (ε_1 is the monetary policy shock), y is commodity price (ε_1 is the commodity price shock), and z is a set of other variables, for example, IP and CPI. We discuss the identification of the shocks, via proxy-SVAR, below. As shown above, the SVAR representation of the model is

$$\begin{bmatrix} x_t \\ y_t \\ z_t \end{bmatrix} = \sum_{j=1}^{p} \begin{bmatrix} d_{1,1} & d_{1,2} & d_{1,3} \\ d_{2,1} & d_{2,2} & d_{2,3} \\ d_{3,1} & d_{3,2} & d_{3,3} \end{bmatrix} \begin{bmatrix} x_{t-j} \\ y_{t-j} \\ z_{t-j} \end{bmatrix} + \begin{bmatrix} b_{1,1} & b_{2,1} & b_{1,3} \\ b_{2,1} & b_{2,2} & b_{2,3} \\ b_{3,1} & b_{3,2} & b_{3,3} \end{bmatrix} \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \\ \varepsilon_{3,t} \end{bmatrix}.$$

Up to this point, we have not identified the shock to the fed funds rate and the shock to commodity prices. Our identification entails the use of identified monetary policy shocks and identified commodity supply shocks in the first stage to obtain a point estimate for the corresponding elements in matrix B. In particular, we use the estimated monetary policy shock in Jarociński and Karadi (2020) to obtain $\hat{b}_{1,1}$, $\hat{b}_{2,1}$, $\hat{b}_{2,1}$. This, we estimate the effect of the monetary surprise on the fed funds rate, on the commodity price itself, and inflation. We repeat the process with the oil supply shock in Kilian (2024) to obtain $\hat{b}_{2,1}$, $\hat{b}_{2,2}$, $\hat{b}_{2,3}$. We then have

$$
\begin{bmatrix} x_t \\ y_t \\ z_t \end{bmatrix} = \sum_{j=1}^{p} \begin{bmatrix} d_{1,1} & d_{1,2} & d_{1,3} \\ d_{2,1} & d_{2,2} & d_{2,3} \\ d_{3,1} & d_{3,2} & d_{3,3} \end{bmatrix} \begin{bmatrix} x_{t-j} \\ y_{t-j} \\ z_{t-j} \end{bmatrix} + \underbrace{\begin{bmatrix} \hat{b}_{1,1} & \hat{b}_{2,1} & b_{1,3} \\ \hat{b}_{2,1} & \hat{b}_{2,2} & b_{2,3} \\ \hat{b}_{3,1} & \hat{b}_{3,2} & b_{3,3} \end{bmatrix}}_{\hat{B}} \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \\ \varepsilon_{3,t} \end{bmatrix}.
$$

We still, however, need to trace the effects of a shock to ε_1 on z, in the counterfactual case in which y is constant. To this end, define the impulse response functions (IR) as

$$
IR_t = \hat{B}_i \quad \text{for} \quad t = 0
$$

$$
IR_t = \boldsymbol{D} \cdot \boldsymbol{IR}_{t-1} \quad \text{for} \quad t = 1, 2, \ldots, H
$$

where $\hat{B}_i$ is the i-th column of the impact matrix B. The counterfactual exercise consists of finding the path of $\{\epsilon_{2t}\}_{t=0}^{T}$ (oil supply shock) that keeps y_t fixed over the T periods, call it $\{\tilde{\epsilon}_{0t}\}_{t=0}^{T}$. For instance, for period $t = 0$, $IR_t^y = 0$ implies

$$
\begin{aligned}
\hat{b}_{2,1}\epsilon_{1,0} &= \hat{b}_{2,2}\tilde{\epsilon}_{2,0}, \\
\tilde{\epsilon}_{2,0} &= \frac{1}{\hat{b}_{2,2}}\hat{b}_{2,1}\epsilon_{1,0}.
\end{aligned}
$$

For base metal prices we use the log difference between futures and spot copper prices as a proxy for external instrument. To isolate the effect of oil and base metal prices we rely on a recursive approach. We first use one external shock to shut down the response of, say, oil prices. Then, we use the second shock to shut down of metal prices, in this case. This second shock also affects oil prices, so we repeat the procedure until we converge to a zero response of both commodities over the whole period.

A2 Additional Tables

Table A1. Commodities, units, and trading volumes

Commodity Name	Exchange	Unit	Trading Volume
Arabica coffee	ICE Futures US Softs	USD/lb.	4,096,534
Brent Crude Oil	ICE Futures Europe Commodities	USD/bbl.	64,355,775
Class III Milk	Chicago Mercantile Exchange	USD/cwt	46,951
Cocoa	ICE Futures US Softs	USD/MT	2,995,523
Copper	Commodity Exchange, Inc.	USD/lb.	10,342,374
Copper	London Metal Exchange	USD/MT	4,396,941
Corn	Chicago Board of Trade	USD/bu.	37,904,454
Cotton	ICE Futures US Softs	USD/lb.	2,574,415
Feeder Cattle	Chicago Mercantile Exchange	USD/lb.	765,089
Frozen Concentrate Orange Juice	ICE Futures US Softs	USD/lb.	206,598
Gasoline	New York Mercantile Exchange	USD/gal.	14,036,792
Gold	Commodity Exchange, Inc.	USD/t oz.	31,960,854
Hard Red Winter Wheat	Chicago Board of Trade	USD/bu.	5,829,377
Heating Oil	New York Mercantile Exchange	USD/gal.	11,822,198
Henry Hub Natural Gas	New York Mercantile Exchange	USD/MMBtu	35,657,120
Lead	London Metal Exchange	USD/MT	1,029,971
Lean Hogs	Chicago Mercantile Exchange	USD/lb.	3,294,821
Live Cattle	Chicago Mercantile Exchange	USD/lb.	3,518,903
Low Sulphur Gas Oil	ICE Futures Europe Commodities	USD/MT	14,113,332
Newcastle Coal	ICE Futures Europe Commodities	USD/MT	7,058
Nickel	London Metal Exchange	USD/MT	2,506,100
Oats	Chicago Board of Trade	USD/bu.	81,026
Palladium	New York Mercantile Exchange	USD/t oz.	747,480
Platinum	New York Mercantile Exchange	USD/t oz.	3,533,576
Richards Bay Coal	ICE Futures Europe Commodities	USD/MT	6,278
Robusta Coffee	ICE Futures Europe Commodities	USD/MT	1,119,074
Rotterdam Coal	ICE Futures Europe Commodities	USD/MT	11,553
Rough Rice	Chicago Board of Trade	USD/cwt	131,613
Primary Aluminum	London Metal Exchange	USD/MT	7,549,365
Silver	Commodity Exchange, Inc.	USD/t oz.	12,409,386
Soybean	Chicago Board of Trade	USD/bu.	18,607,309
Soybean Meal	Chicago Board of Trade	USD/T.	8,328,540
Soybean Oil	Chicago Board of Trade	USD/lb.	8,709,643
Sugar No.11	ICE Futures US Softs	USD/lb.	16,502,918
Sugar No.16	ICE Futures US Softs	USD/lb.	37,125
Tin	London Metal Exchange	USD/MT	144,824
Wheat	Chicago Board of Trade	USD/bu.	11,920,664
WTI Crude Oil	New York Mercantile Exchange	USD/bbl.	147,772,482
Zinc	London Metal Exchange	USD/MT	2,691,901

Note: Average daily trading value in 2019

Table A2. Commodities weights in indexes

Commodity	All	Agriculture	Energy	Metal	Food	Base Metal	Beverage	Precious Metal	Soft	Cereal	Meat	Vegatable Oil
Aluminum	3.1%			8.9%		23.9%						
Beef	4.0%	14.4%			18.2%						57.6%	
Brent Crude	18.4%		50.0%									
Cocoa	1.2%	4.5%					46.1%					
Coffee Arabica	1.4%	5.2%					53.9%					
Copper	6.5%			18.4%		49.6%						
Corn	2.1%	7.6%			9.6%					34.8%		
Cotton	1.6%	5.7%							51.7%			
Gold	19.7%			55.4%				87.9%				
Lead	0.7%			2.0%		5.3%						
Nickel	1.3%			3.7%		10.1%						
Oats	0.1%	0.4%			0.5%					1.7%		
Orange	2.1%	7.5%			9.5%							
Palladium	0.6%			1.6%				2.6%				
Platinum	0.8%			2.4%				3.8%				
Rice	1.2%	4.2%			5.3%					19.1%		
Rubber	1.5%	5.4%							48.3%			
Silver	1.3%			3.6%				5.7%				
Soybeans	3.6%	13.0%			16.4%							85.8%
Soybeans Oil	0.6%	2.1%			2.7%							14.2%
Sugar No. 11	2.7%	9.7%			12.2%							
Swine	2.9%	10.6%			13.4%						42.4%	
Tin	0.3%			0.9%		2.4%						
Wheat	2.7%	9.7%			12.3%					44.4%		
WTI Crude	18.4%		50.0%									
Zinc	1.1%			3.2%		8.6%						

Note: this table presents the list of commodity prices that cover the whole sample period (1990-2019).

A2.1 Testing independence across central banks

To test the hypothesis that monetary policy shocks in one country do not Granger-cause central bank decisions of another country, we run a series of pairwise Granger tests. We test for causality in both directions. In a regression of current values of a given shock (x) on its own lags and on the lags of another monetary policy shocks (y), rejecting the null hypothesis that coefficients on the lags of y are jointly zero provides evidence that y precedes - Granger causes - x. We focus on US, Canada, Japan and the ECB. Some of the pairwise tests do not reject the null of no Granger causality, although in three cases we find that monetary policy decisions of one central bank - ECB, US, US - have affected decisions of another monetary authority - US, ECB, UK - respectively. In the case of US and European monetary authority decisions, the influence is mutual and Granger causality runs both ways.

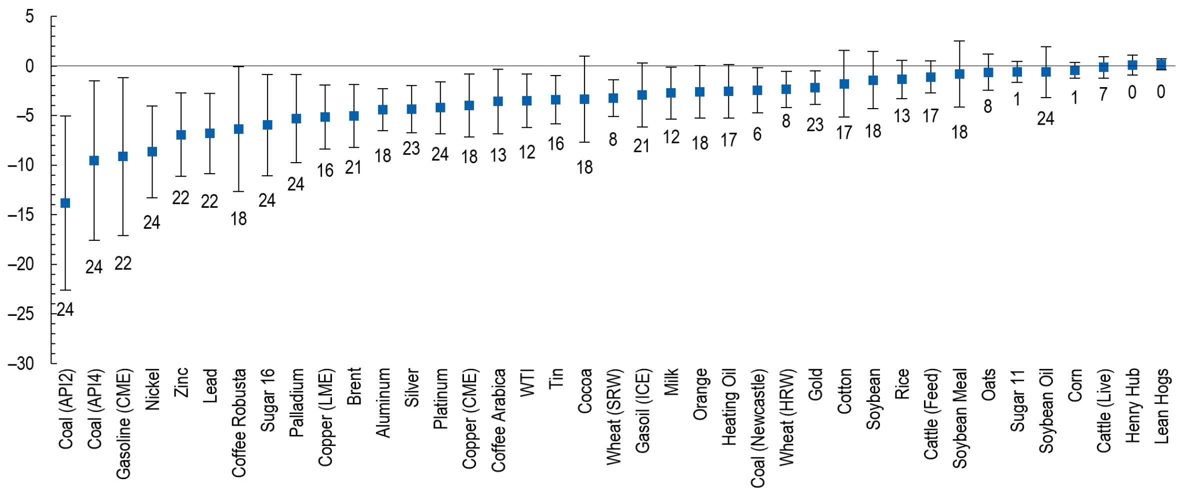
Table A3. Granger test results

Equation	Controls	Prob >chi2
US	Canada	0.109
Canada	US	0.267
US	Japan	0.658
Japan	US	0.374
US	ECB	0.012
ECB	US	0.029
US	UK	0.093
UK	US	0.007

Note: The third column shows the p value of a Wald test of the null hypothesis that the coefficients of the lagged values of the controls are jointly zero.

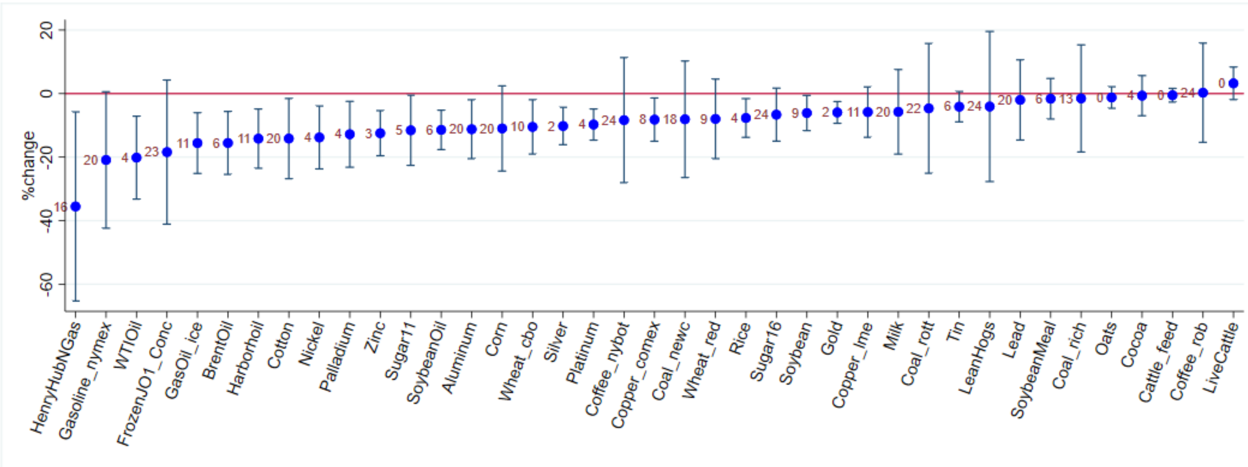
A3 Additional Figures

Figure A1. Peak cumulative response of commodity prices to a 10bp increase in Fed funds rate.



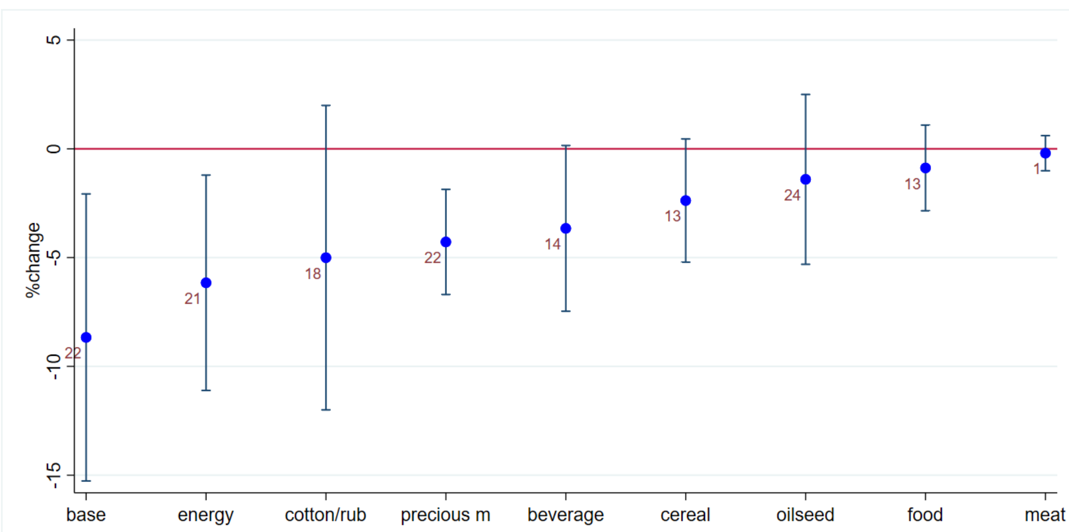
Note: 90% confidence bands reported. The numbers next to the box represent the day of the peak response.

Figure A2. Peak cumulative response of commodity prices to a 10bp increase in Fed funds rate (2016-2019).



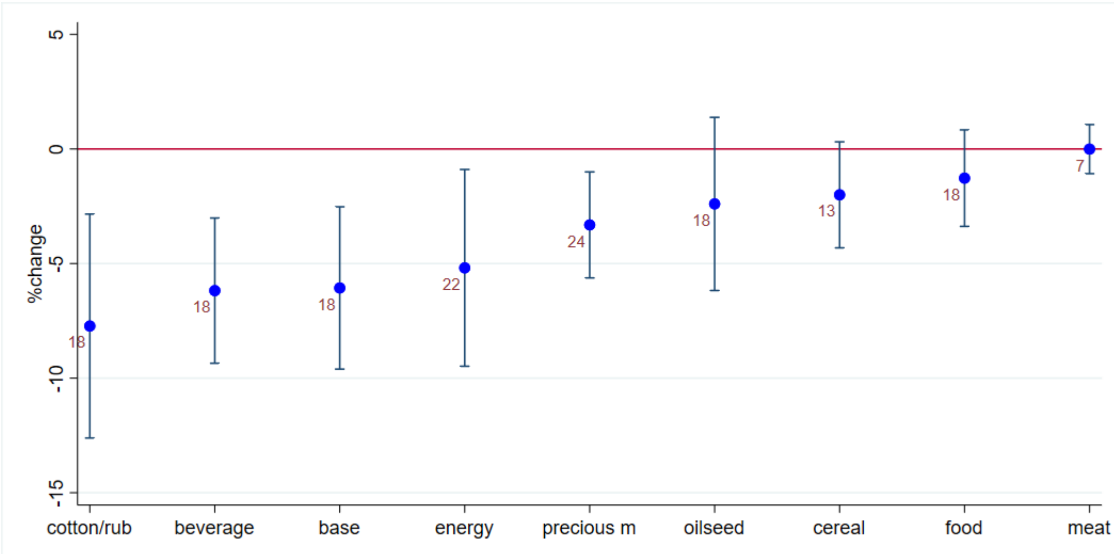
Note: 90% confidence bands reported. The numbers next to the box represent the day of the peak response.

Figure A3. Peak cumulative response of commodity prices to a 10bp increase in US rate: Bauer and Swanson (2023) shock



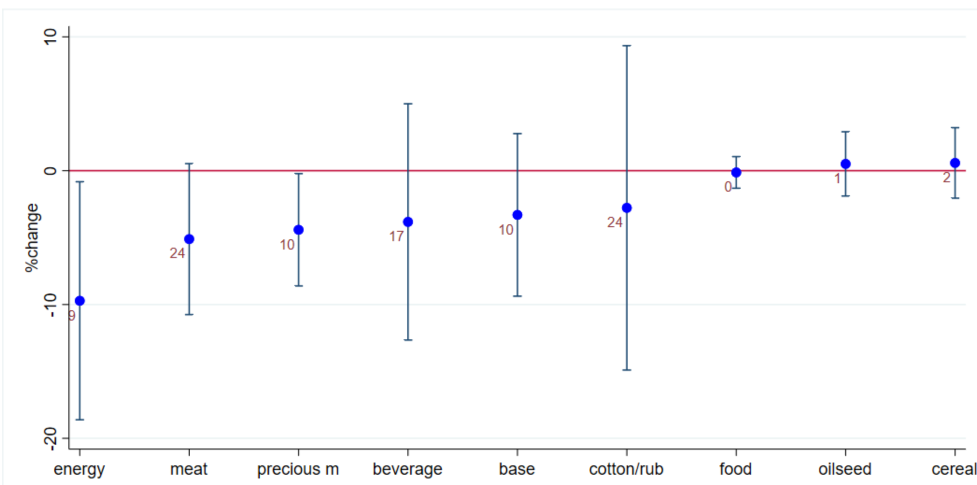
Note: 90% confidence bands reported. The numbers next to the box represent the day of the peak response.

Figure A4. Peak cumulative response of commodity prices to a 10bp increase in US rate: 1999-2019.



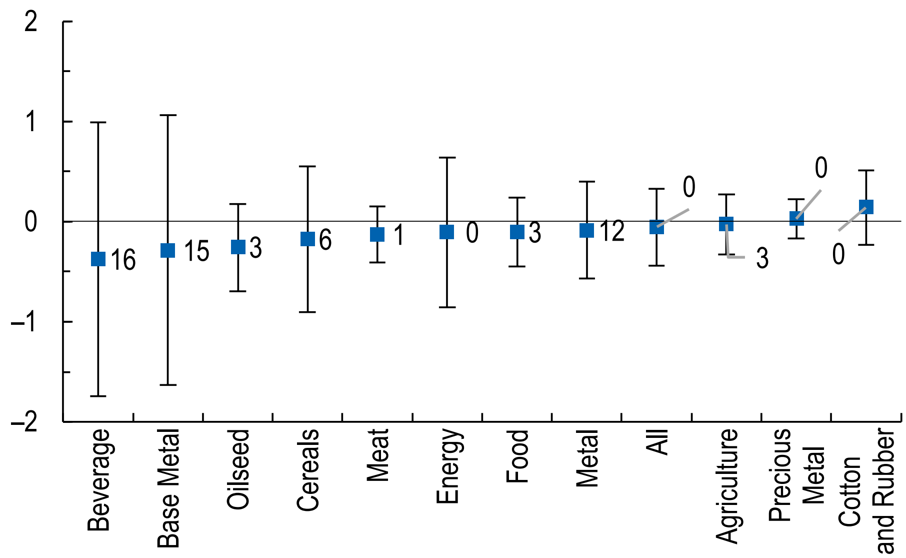
Note: 90% confidence bands reported. The numbers next to the box represent the day of the peak response.

Figure A5. Peak cumulative response of commodity prices to a 10bp increase in ECB rate.



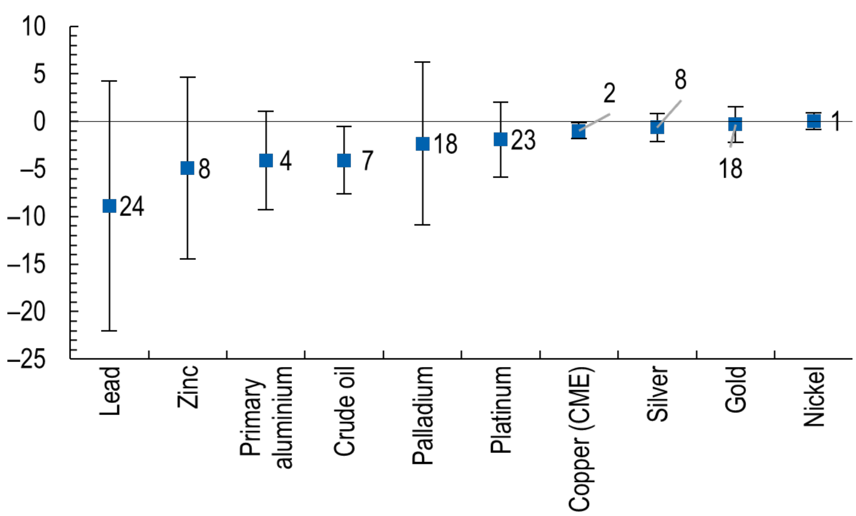
Note: 90% confidence bands reported. The numbers next to the box represent the day of the peak response.

Figure A6. Peak response of commodity price sub-indexes to a 10bp increase in UK interest rate



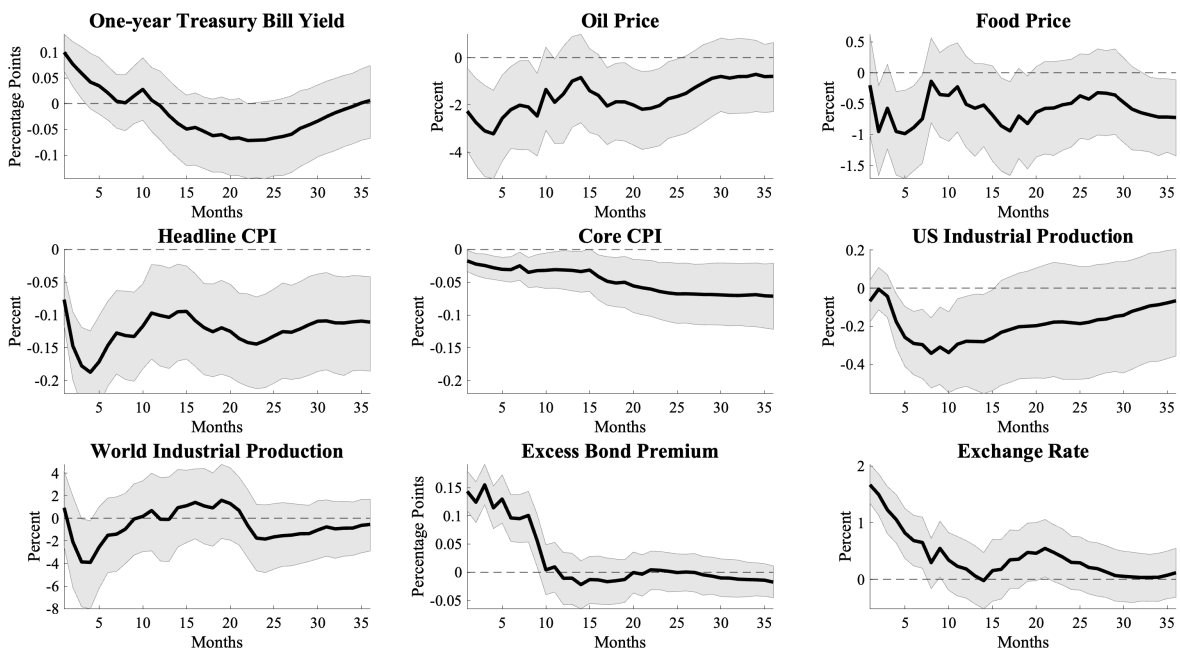
Note: 90 % confidence bands are reported. The sample period is 1990 to 2014. The numbers by the box indicate the day (h) of the peak response.

Figure A7. Peak response of commodity inventories to a 10bp increase in Fed funds rate.



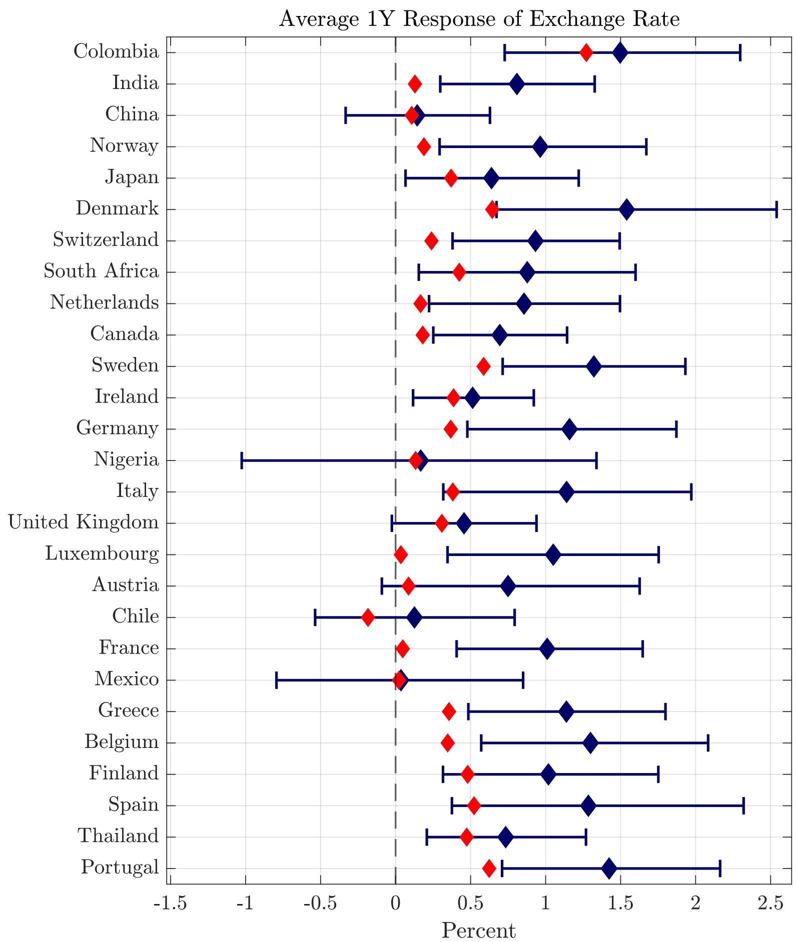
Note: 90% confidence bands reported. The numbers by the box indicate the day (h) of the peak response.

Figure A8. Impulse response to US monetary policy using proxy-SVAR: oil and food prices



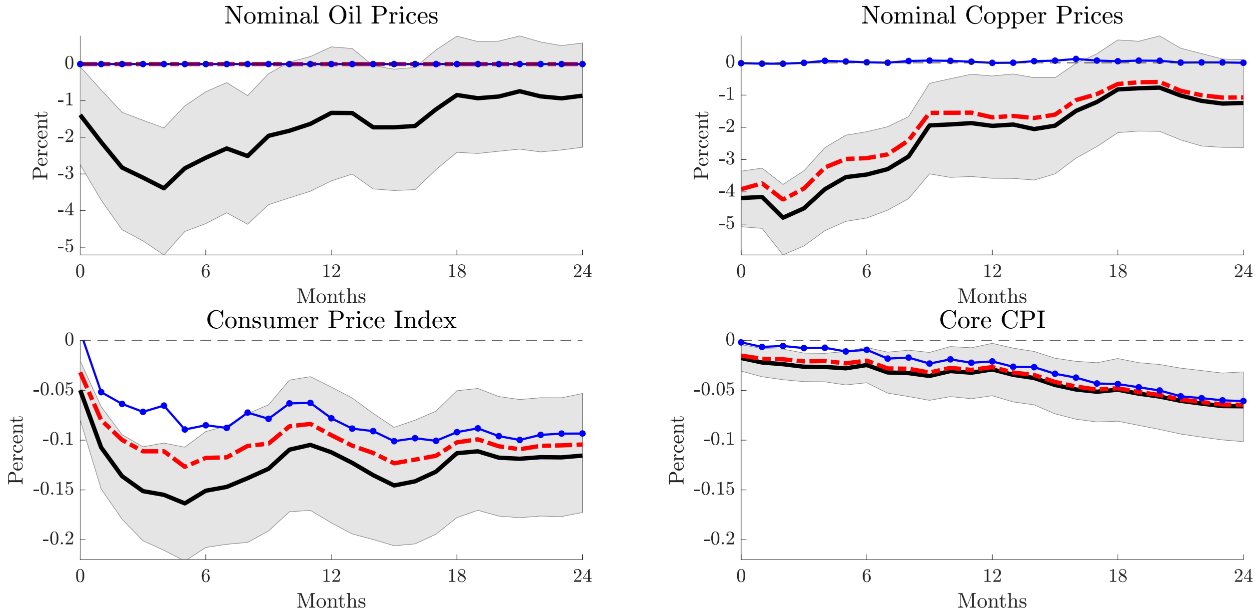
Note: The x-axis denotes months after the shock. The grey area denotes 68% confidence bands

Figure A9. 12-month effect of US monetary policy on countries exchange rate (proxy-SVAR): oil and food



Note: Blue and red squares are the average one year response of exchange rate after an increase of 10 basis points in the US interest rate. 68 percent confidence intervals are displayed.

Figure A10. Impulse response to US monetary policy using proxy-SVAR: the role of oil and base metal prices (alternative counterfactual)



Note: The black line represents the benchmark estimation. The red lines show the responses of inflation under the assumption that oil prices do not react to monetary policy shocks. The blue line shows the response of inflation under the assumption that oil and base metal prices do not react to monetary policy.