Commodity Price Volatility
and the Economic Uncertainty of Pandemics

Dimitrios Bakas [a,c†] and Athanasios Triantafyllou [b]

[a]*Nottingham Business School, Nottingham Trent University, UK*
[b]*Essex Business School, University of Essex, UK*
[c]*Rimini Centre for Economic Analysis (RCEA), Canada*

Abstract

We empirically investigate the impact of economic uncertainty related to global pandemics on the volatility of the broad commodity price index as well as on the sub-indexes of crude oil and gold. The results show that uncertainty related to pandemics have a strong negative impact on the volatility of commodity markets and especially on crude oil market, while the effect on gold market is positive but less significant.

Keywords: *Pandemics, Commodity Markets, Economic Uncertainty, Volatility*

JEL Classification: *C32, Q02, I10*

1. Introduction

The sharp increase in uncertainty during the current coronavirus disease (COVID-19) pandemic has a massive effect on the real economy and the financial sphere. Typically, rising uncertainty about pandemics is associated with falling aggregate demand and disruption in economic activity. For instance, the world industrial production index (Baumeister and Hamilton, 2019) has fallen by 4.5 percent in the first quarter of 2020 as a result of the recent COVID-19 pandemic episode. A number of recent works has emerged in the literature exploring the economic and market effects of pandemics (Baker *et al.*, 2020a,b; Jordà *et al.*, 2020; Ma *et al.*, 2020; among others). Baker *et al.* (2020a) show the enormous negative effect of COVID-induced economic uncertainty on US real GDP, while Ma *et al.* (2020) provide further evidence of a persistent negative impact on real GDP growth for a panel of 210 countries, and of a negative stock market response. Baker *et al.* (2020b) show that the COVID-19 pandemic has an unpresented positive impact on stock-market volatility when compared with the respective effect of various other infectious diseases. In addition, Jordà *et al.* (2020) provide evidence that pandemics reduce the real rate of interest in the long-run. Furthermore, a significant body of the recent empirical literature is focusing on the impact of economic uncertainty shocks on the volatility of commodity markets (Bakas and Triantafyllou, 2018; Prokopczuk *et al*., 2019; Van Robays, 2016; among others).[1] However, while there is some empirical evidence showing the market effects of pandemic shocks, and a vast empirical literature on the role of various types of uncertainty on commodity volatility, there is no

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[1] Bakas and Triantafyllou (2018) show that macroeconomic uncertainty has a positive impact on the volatility of agricultural, metals and energy commodities, while Prokopczuk *et al.* (2019) find a strong co-movement between economic uncertainty and volatility in major commodity markets. Furthermore, Van Robays (2016) shows that higher macroeconomic uncertainty alters the price elasticity of oil supply and demand and hence, for the same demand or supply shock, the reaction of oil prices is stronger. Thus, oil price response will be higher since there will be less adjustment though quantities and more adjustment through changing prices. Therefore, lower price elasticity of demand results to higher oil price volatility. Baumeister and Peersman (2013) provide empirical insights by showing that the drop in the price elasticity of oil demand and supply is the key economic mechanism which explains the negative relationship between oil production volatility and oil price volatility.

work exploring the effect of uncertainty shocks related to global pandemics on commodity markets. In this paper, we fill this gap in the literature, by examining empirically, using a VAR model, the dynamic impact of a pandemic uncertainty shock on the volatility of commodity markets.

Commodity prices are driven by aggregate demand and supply shocks, so, in times of higher probability of an economic disruption (higher uncertainty about a future pandemic), the price elasticity of commodity supply and demand increases, with both supply and demand falling rapidly and steadily over time. For example, in the recent coronavirus pandemic episode, the International Energy Agency (IEA) forecasts a 435 thousand barrels a day drop in global demand for oil, while the reaction of the Organization of the Petroleum Exporting Countries (OPEC) is an analogous cut in oil production. Thus, the equilibrium price in the commodity markets comes via the more elastic price adjustment of supply and demand. As a result, commodity prices adjust to the falling production and demand levels by declining instantly and monotonically (i.e., decreasing commodity price fluctuations) to reflect the anticipated drop in economic activity. A clear evidence of this is that the Standard & Poor's 'Goldman Sachs Commodity Index' (S&P GSCI) commodity price index has lost 40.6% of its value during the first quarter of 2020, with the oil price index has experienced a loss of 56.3%, while the gold price index has increased by 26.4%. The rapid increase in the gold price and the fall in the oil price in the first quarter of 2020 is a clear indication of rising demand for gold and falling demand for oil during the recent pandemic shock.[2]

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[2] This rapid increase in price and demand for gold during times of extreme market stress is in line with the literature that identify gold as safe haven for investors during turbulent times (Baur and McDermott, 2010).

Our VAR analysis shows that the response of commodity volatility to a pandemic uncertainty shock is negative and remains statistically significant for approximately one year after the initial shock. Our paper is the first to reveal a negative and significant response of commodity volatility to pandemic uncertainty shocks. This provides further empirical insights on the role of pandemics on commodity markets as it implicitly signifies that a pandemic is associated with falling aggregate demand for commodities, hence, decreasing volatility in commodity markets. In simple words, higher uncertainty about a pandemic is transferred to economic agents as less uncertainty about aggregate demand and supply conditions, hence, less uncertainty (or volatility) in commodity prices. Moreover, our analysis is the first to show that, unlike the positive response of equity market volatility during pandemics (Baker *et al*., 2020b), the response of commodity market volatility is the opposite.

We additionally examine the impact of a pandemic uncertainty shock on oil and gold price volatility. Our findings show that volatility in the oil market reduces substantially after a pandemic uncertainty shock, while the response of gold volatility is positive. The negative response of oil volatility is in line with the findings of Van Robays (2016) and Baumeister and Peersman (2013). Thus, we implicitly show that pandemic uncertainty results to rising elasticity of aggregate demand and supply in the oil market and hence, the equilibrium comes through adjustment of quantities and less through oil price fluctuations, and therefore a lower oil volatility after the occurrence of a pandemic episode. On the other hand, the positive response of gold volatility in the fear of a pandemic, is in line with the safe haven property of gold in recessionary times (Baur and McDermott, 2010).[3]

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[3] Our findings on the positive effect on the gold market signify that rising volatility in gold markets is essentially demand driven. A stylized fact in commodity markets is that rising demand for a commodity results to a rapid rise in

2. Data and VAR Models

2.1 Data

We obtain the daily excess returns data of the S&P GSCI broad commodity index and the sub-indexes of crude oil and gold from Datastream. The quarterly commodity volatility measure (*RV*) is computed as the realized variance of the daily excess returns for each index, following Bakas and Triantafyllou (2018).[4] In addition, we compute the quarterly log returns measure (*LR*) for each index. The world pandemic uncertainty index (*WPUI*) is based on the work of Ahir *et al.* (2019) and measures economic uncertainty related to pandemics and other disease outbreaks across the world as reflected in the *Economist Intelligence Unit* country reports. The world industrial production index (*WIP*) is based on the work of Baumeister and Hamilton (2019) and measures the industrial production of the OECD plus 6 other major countries, while the geopolitical risk index (*GPR*) is based on the work of Caldara and Iacoviello (2018) and measures uncertainty related to geopolitical tensions as reflected in leading international newspapers.[5] The quarterly dataset covers the period from January 1996 to March 2020 (1996Q1-2020Q1) due to data availability of the *WPUI* index.

2.2 VAR Models

We estimate three 5-factor VAR models for the volatility of commodity markets (*broad commodity index*, *crude oil* and *gold*), in which we include the logarithm of the world industrial production

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both the commodity price and volatility, where unlike equity markets, prices and volatility in commodity markets are positively associated (Pindyck, 2004).

[4] Previous literature shows evidence that commodity prices are I(1) series (Ghoshray, 2011). We confirm this using the ADF unit root test on the underlying daily commodity series. In addition, we show that the quarterly *RV* series are stationary. The results of the unit root tests can be provided upon request.

[5] The *WPUI* index is downloaded from https://worlduncertaintyindex.com/, the *WIP* index is downloaded from Christiane Baumeister's webpage (https://sites.google.com/site/cjsbaumeister/), while the *GPR* index is downloaded from Matteo Iacoviello's webpage (https://www.matteoiacoviello.com/gpr.htm).

index (*LWIP*), the log returns (*LR*) and the volatility (*RV*) measures for each commodity index, the logarithm of the geopolitical risk index (*LGPR*) and the world pandemic uncertainty index (*WPUI*).[6] Following Jurado *et al.* (2015), we use a recursive identification procedure where the uncertainty measures are placed last in the VAR ordering. Hence, the VAR ordering is $[LWIP_t \ LR_t \ RV_t \ LGPR_t \ WPUI_t]$, where *LR* and *RV* are the measures for each commodity index (*broad commodity index*, *crude oil* and *gold*), respectively. The rest of the variables are common for all VAR models.

3. Empirical Analysis

Figure 1 shows the volatility in commodity markets while **Figure 2** shows the synchronous movement of commodity volatility and the world pandemic uncertainty index.

[**Figures 1-2**]

From **Figure 1** we observe that the volatility of the broad commodity index and of oil market is significantly higher compared to gold for the whole sample. Moreover, from **Figure 2** we can observe that jumps in the pandemic uncertainty index are mainly associated with falling commodity price uncertainty.

3.1 Main Results

Here we present the results of our 5-factor VAR models. **Figure 3** shows the generalized impulse response functions (IRFs) for the volatility of the broad commodity index, which do not depend

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[6] We include two lags following the optimal-lag length criterion of Akaike.

on the VAR ordering, to a one-standard deviation increase in the world pandemic uncertainty shock.

[**Figure 3**]

According to **Figure 3**, a positive shock in pandemic uncertainty reduces commodity volatility by approximately 1.9% one quarter after the shock, with the effect remaining significantly negative for about 4 quarters after the initial shock. In this multivariate VAR setting, we control for aggregate demand and commodity specific demand (via commodity price returns) shocks, hence, we take into account the possible dynamic interactions of pandemic uncertainty with demand shocks. In this way, we implicitly control for the aggregate demand shocks when estimating the impact of pandemic uncertainty on commodity volatility.

Figures 4-**5** report the generalized impulse response functions of crude oil and gold price volatility to a one-standard deviation increase in the pandemic uncertainty shock.

[**Figures 4**-**5**]

From **Figures 4**-**5** we observe that a positive pandemic uncertainty shock reduces oil price volatility about 270 basis points one quarter after the shock, with the effect remaining significant for four quarters after the initial shock. On the other hand, a positive pandemic uncertainty shock increases gold price volatility about 30 basis points one quarter after the initial shock while the effect fades away quickly. Our results are the first to show the opposite effect of world pandemic

uncertainty shocks to gold and oil price volatility. Our evidence reveals that the pandemic uncertainty shock results to rising demand for gold and falling demand for oil, since we find a substantial reduction to oil price volatility and a substantial increase in gold price volatility after the pandemic uncertainty shock. The negative response of oil volatility is in line with the findings of Van Robays (2016) and Baumeister and Peersman (2013), while the positive response of gold volatility is in line with the literature on the safe haven property of gold (Baur and McDermott, 2010).

3.2 Robustness

Finally, we estimate alternative VAR models to check the robustness of our main results. In specific, a) we employ a bivariate VAR setting with the different commodity volatility measures and the world pandemic uncertainty index, b) we estimate the orthogonalized IRFs using a Cholesky decomposition based on our VAR ordering, instead of the generalized IRFs, and finally, c) we explore the robustness of both the 5-factor VARs and the bivariate VARs to the recent coronavirus outbreak by excluding the observation of 2020Q1. From **Figures 6-8** we can observe that our main results and conclusions are qualitatively the same.

[**Figure 6-8**]

Interestingly, when excluding the observation for the recent COVID-19 outbreak (2020Q1) we find that the negative response of oil price volatility to a pandemic uncertainty shock decreases slightly in magnitude. This finding implicitly shows the unprecedented impact of the recent coronavirus pandemic on the global oil market. On the other hand, the positive response of gold

price volatility remains roughly the same (when we exclude 2020Q1) showing that the impact of the COVID-19 pandemic does not have substantially different effect on the gold market when compared with the effect of the previous pandemic episodes.

4. Conclusions

This paper examines the impact of economic uncertainty of pandemics on the volatility of commodity markets. The broad measure of commodity volatility and the volatility in oil market are significantly reduced when uncertainty about pandemics rises, with the effect remaining negative and statistically significant for about a year after the uncertainty shock. In contrast, the effect on the gold market is positive but less significant. The main channel through which pandemic uncertainty shocks reduce commodity price volatility comes via the disruption in global demand in pandemic times. This paper provides a first insight on the impact of pandemics on commodity markets, however as the COVID-19 episode is currently in progress, more empirical research is needed when the pandemic is finally over.

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Figures

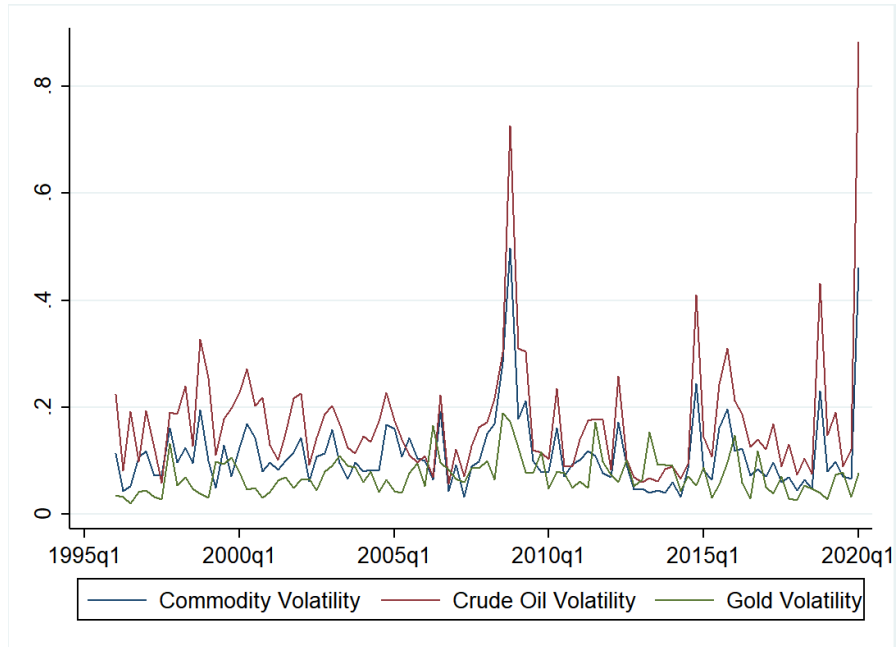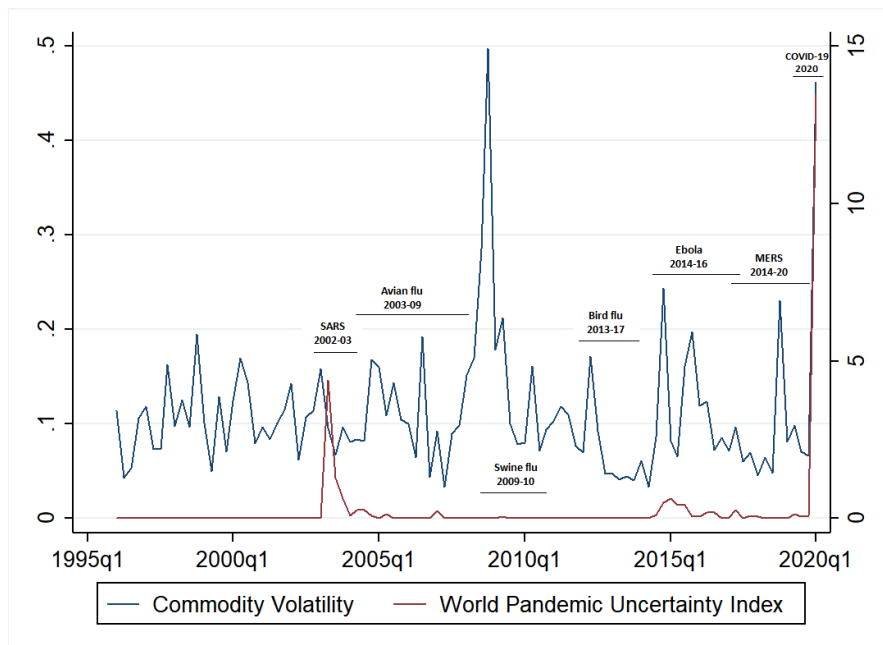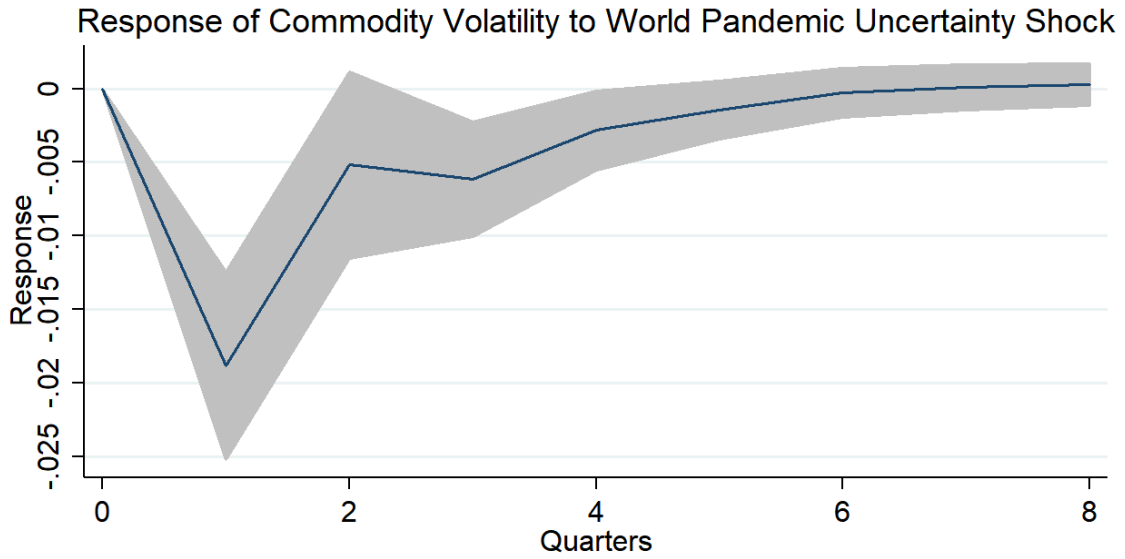## Figure 1. Volatility in Commodity Markets

Figure 2. Volatility in Commodity Markets
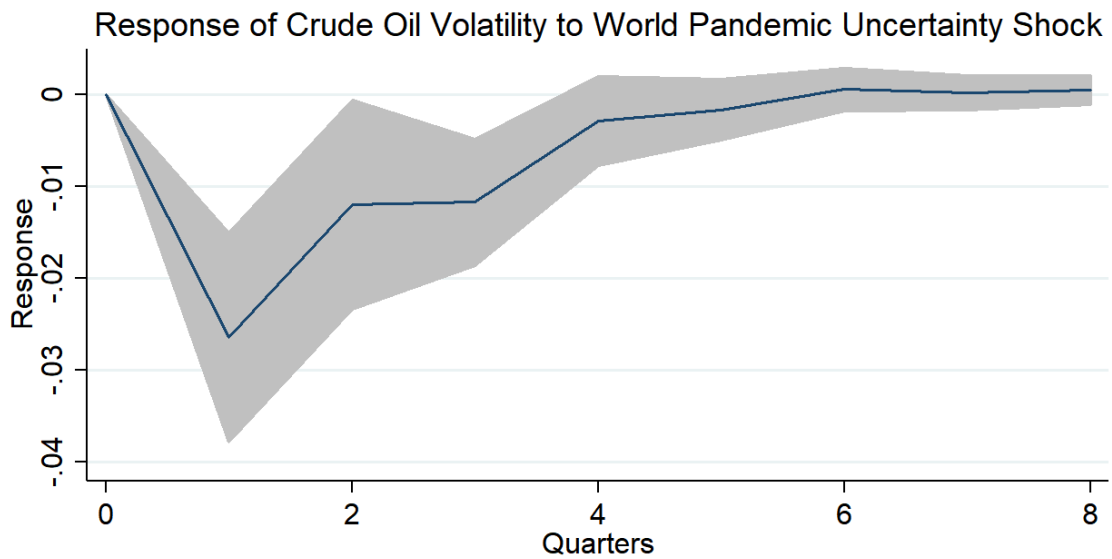## and World Pandemic Uncertainty Index

Figure 3. World Pandemic Uncertainty Shock
and Commodity Volatility

Response of Commodity Volatility to World Pandemic Uncertainty Shock
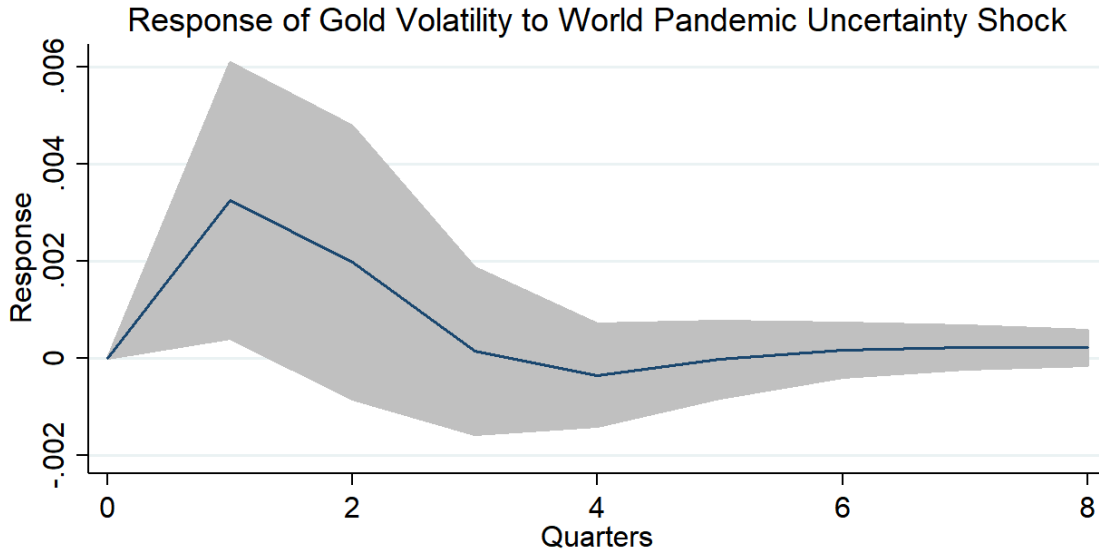

Notes: The grey shaded areas are one-standard error bands. The error bands are constructed via bootstrap with 1000 replications.

Figure 4. World Pandemic Uncertainty Shock
and Crude Oil Volatility

Response of Crude Oil Volatility to World Pandemic Uncertainty Shock

Notes: The grey shaded areas are one-standard error bands. The error bands are constructed via bootstrap with 1000 replications.

Figure 5. World Pandemic Uncertainty Shock
and Gold Volatility

Response of Gold Volatility to World Pandemic Uncertainty Shock

Notes: The grey shaded areas are one-standard error bands. The error bands are constructed via bootstrap with 1000 replications.

Figure 6. World Pandemic Uncertainty Shock
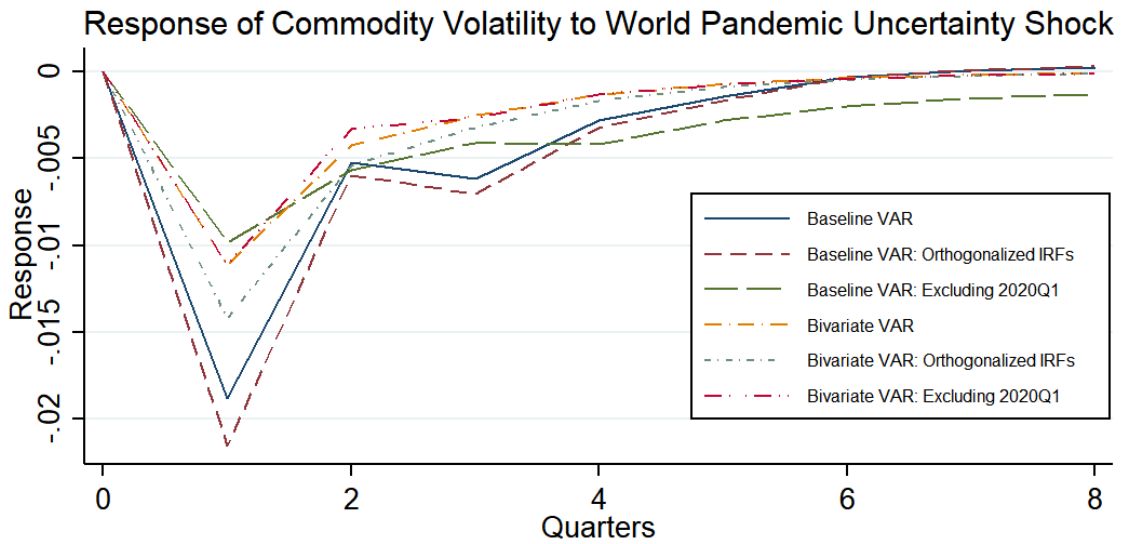## and Commodity Volatility (Alternative VARs)

Response of Commodity Volatility to World Pandemic Uncertainty Shock

Figure 7. World Pandemic Uncertainty Shock

and Crude Oil Volatility (Alternative VARs)

Response of Crude Oil Volatility to World Pandemic Uncertainty Shock
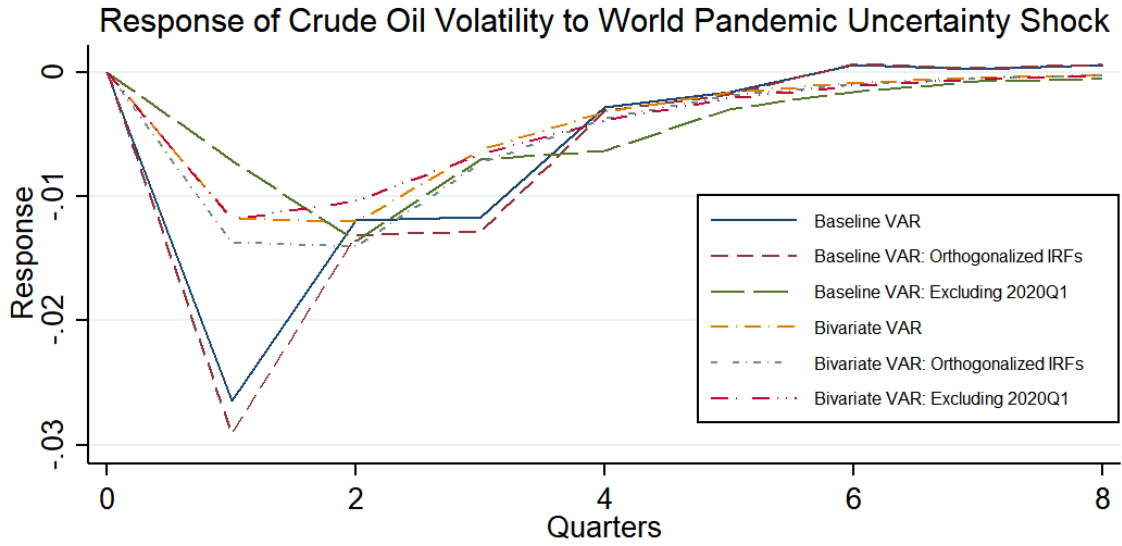
Figure 8. World Pandemic Uncertainty Shock

and Gold Volatility (Alternative VARs)

Response of Gold Volatility to World Pandemic Uncertainty Shock