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"Dimitrios Bakas, Athanasios Triantafyllou"

Essex Business School, University of Essex, Wivenhoe Park, Colchester, CO4 3SQ
Web site: http://www.essex.ac.uk/ebs/

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

In this paper, we empirically investigate the impact of pandemics on commodity price volatility. In specific, we explore the impact of economic uncertainty related to global pandemics on the volatility of the S&P GSCI commodity 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. Our findings remain robust to a series of robustness checks.

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

JEL Classification: *C32, Q02, I10*

† ***Corresponding author***: Dimitrios Bakas, Department of Economics, Nottingham Business School, Nottingham Trent University, Burton Street, NG1 4BU, Nottingham, United Kingdom. Tel: +44 (0)115 848 4191.
E-mail addresses: dimitrios.bakas@ntu.ac.uk (D. Bakas), a.triantafyllou@essex.ac.uk (A. Triantafyllou).

1. Introduction

There is a significant body of literature focusing on the positive impact of economic uncertainty shocks on the volatility of commodity markets (Van Robays, 2016; Bakas and Triantafyllou, 2018; among others).[1] Following the recent coronavirus outbreak, the question on the impact of the pandemic on commodity markets has started to appear in financial news (CRU, 2020; Fortune, 2020). However, while the empirical literature has extensively shown the role of various types of uncertainty on commodity volatility, there is no work exploring the effect of uncertainty shocks related to global pandemics on commodity markets.

Typically, when uncertainty about pandemics is rising, the subsequent uncertainty about macroeconomic fluctuations deteriorates, since economic agents in the fear of the pandemic anticipate a future drop and disruption in economic activity. 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, IEA forecasts a 435 thousand barrels a day drop in global demand for oil, while OPEC's reaction is an analogous cut in oil production. Thus, the equilibrium price in the oil market 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

[1] Van Robays (2016) shows that higher macroeconomic uncertainty alters the price elasticitity 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.

economic activity. A clear evidence of this is that the S&P GSCI commodity price index has lost 40.55% of its value during the first quarter of 2020, with the oil price index has experienced a loss of 56.30%, while the gold price index has increased by 26.38%. 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]

In this paper, we fill this gap in the literature, by examining empirically the dynamic impact of a pandemic uncertainty shock on the volatility of commodity markets. 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 uncertainty regarding macroeconomic outcomes, 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.

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).

[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).

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. 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]

The rest of the paper is organized as follows. **Section 2** describes the data and outlines the empirical methodology. **Section 3** presents the empirical analysis and discusses our robustness checks, while **Section 4** concludes.

2. Data and VAR Models

2.1 Data

We obtain daily data for the S&P GSCI broad commodity index and for 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 returns for each index, following Bakas and Triantafyllou (2018). In addition, we compute the quarterly price log returns (*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

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

of Caldara and Iacoviello (2018) and measures uncertainty related to geopolitical tensions as reflected in leading international newspapers. 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 index (*LWIP*), the price log returns (*LR*) and the volatility measure (*RV*) for each commodity index, the logarithm of the geopolitical risk index (*LGPR*) and the world pandemic uncertainty index (*WPUI*).[4] Following Jurado *et al.* (2015), we use a recursive identification procedure where the uncertainty measures placed last in the VAR ordering. Hence, the VAR ordering is $[LWIP_t \;\; LR_t \;\; RV_t \;\; LGPR_t \;\; WUPI_t]$, where *LR* is the log returns and *RV* is the volatility measure 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**]

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

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 associated with falling commodity price uncertainty.

3.1 Main Results

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

3.2 Robustness

We, first, 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 the Cholesky decomposition based on our VAR ordering, instead of the generalized IRFs, and 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 the IRFs for the volatility of the *broad commodity index* and for the *crude oil* and *gold* price volatility in **Figures 6-8** we can observe that our main results and conclusions remain unaltered.

[**Figures 6-8**]

Finally, we also estimate alternative VAR models for the volatility of the *broad commodity index*, to check the robustness of our main results to alternative indicators of economic uncertainty. Hence, we employ the baseline 5-factor VAR model where we replace the logarithm of the geopolitical risk index (*LGPR*) with alternative measures of uncertainty that have been suggested by the literature. In specific, we use the logarithm of 6 different uncertainty measures; that is the world uncertainty index (*WUI*) of Ahir *et al.* (2019), the global economic policy uncertainty index (*GEPU*) of Davis (2016), the newspaper-based US economic policy uncertainty index (*EPU*) of Baker *et al.* (2016), the newspaper-based equity market volatility tracker (*EMV*) of Baker *et al.* (2019), the CBOE volatility index (*VIX*) as suggested by Bloom (2009), and the unobservable macroeconomic uncertainty index (*MU*) of Jurado *et al.* (2015) (**Figure 9**). Furthermore, we employ a 6-factor VAR model where we add each different measure of uncertainty as an additional variable in our baseline VAR model (**Figure 10**). The IRFs from **Figures 9-10** show that our main results do not change when controlling for alternative measures of economic uncertainty and therefore our main findings and conclusions remain unaltered.

[**Figures 9-10**]

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. Our results are robust to a battery of robustness tests.

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Figures

Figure 1. Volatility in Commodity Markets

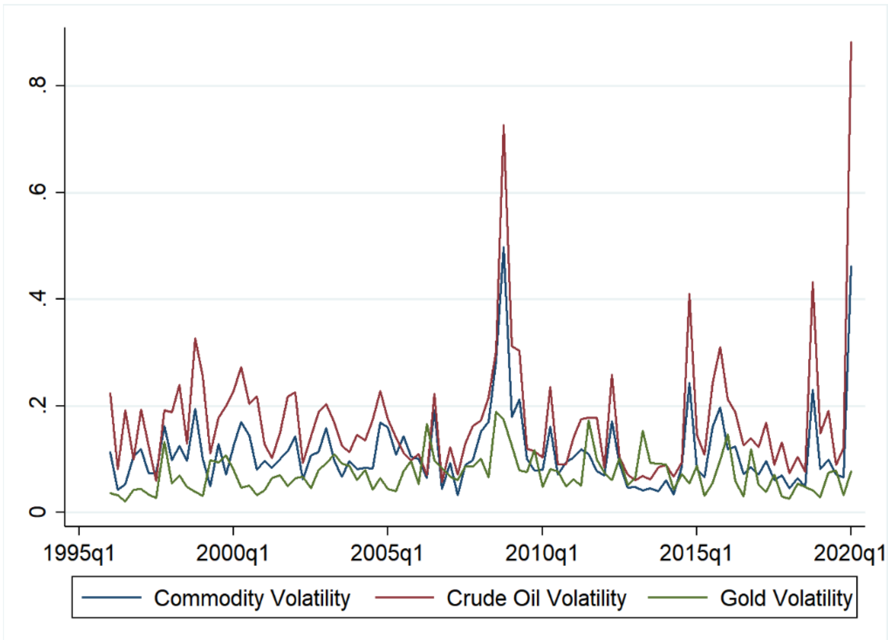


Figure 2. Volatility in Commodity Markets and World Pandemic Uncertainty Index

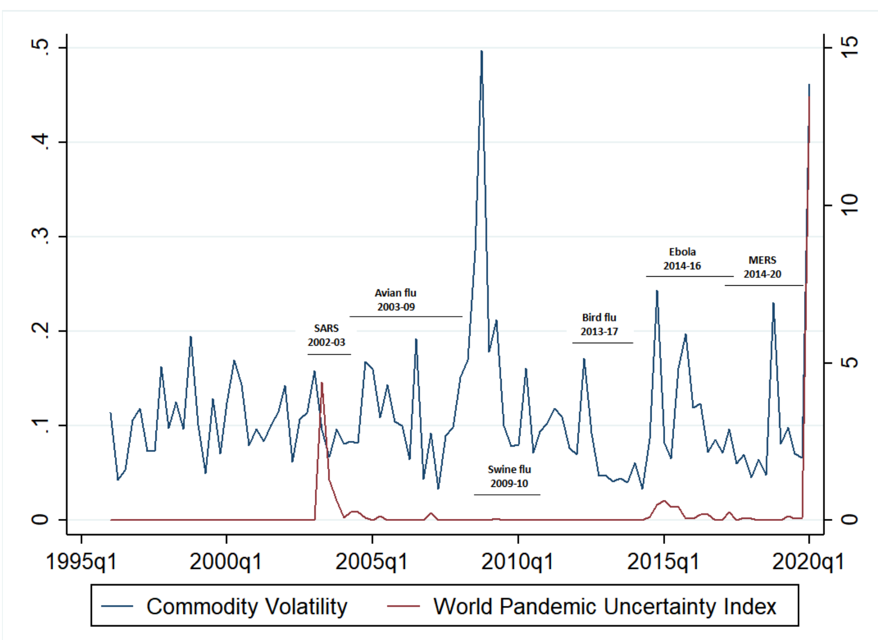
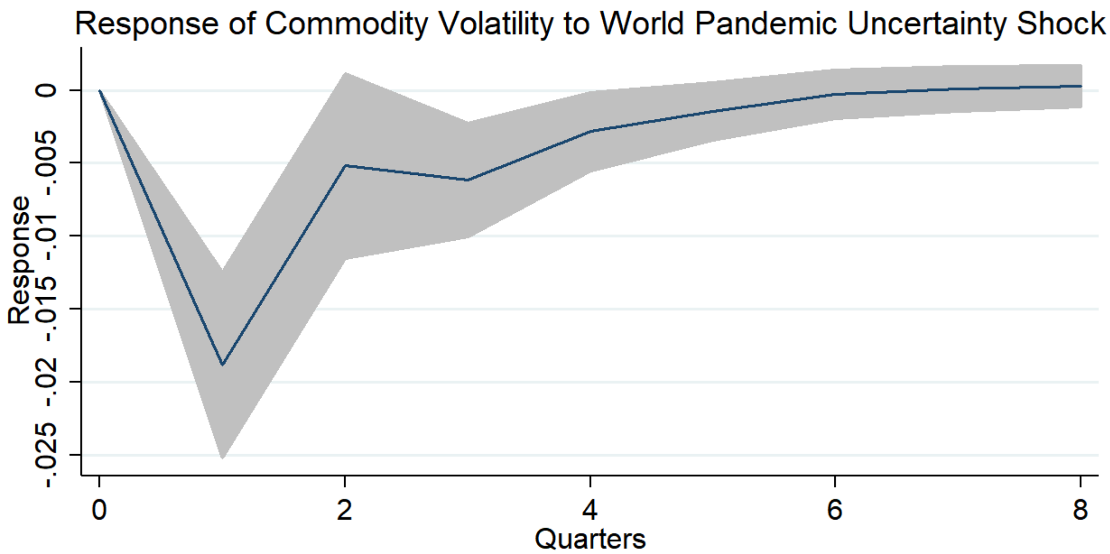


Figure 3. World Pandemic Uncertainty Shock

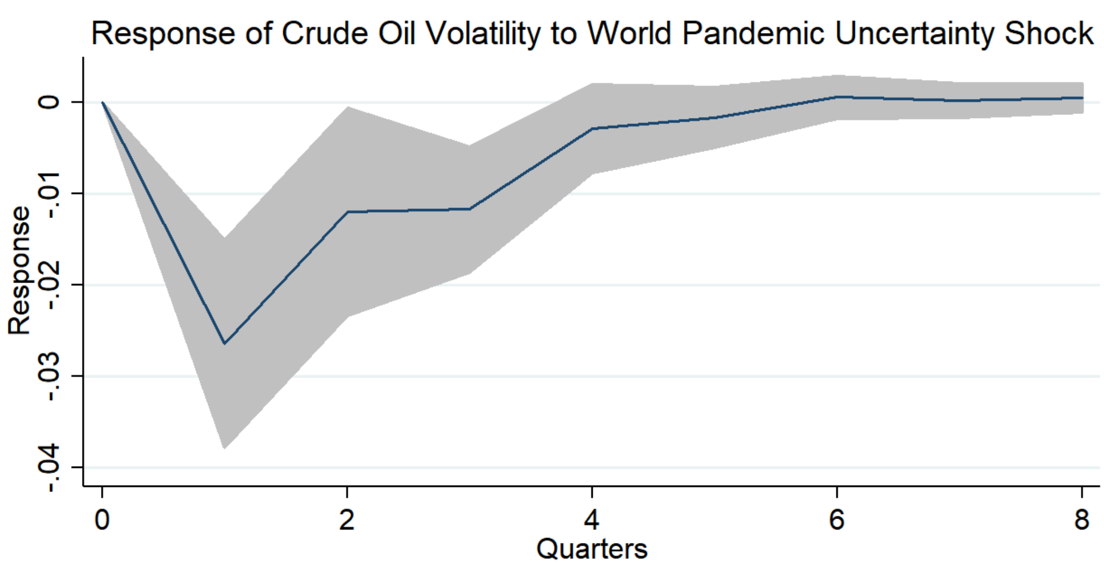
and Commodity Volatility (Baseline VAR)



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

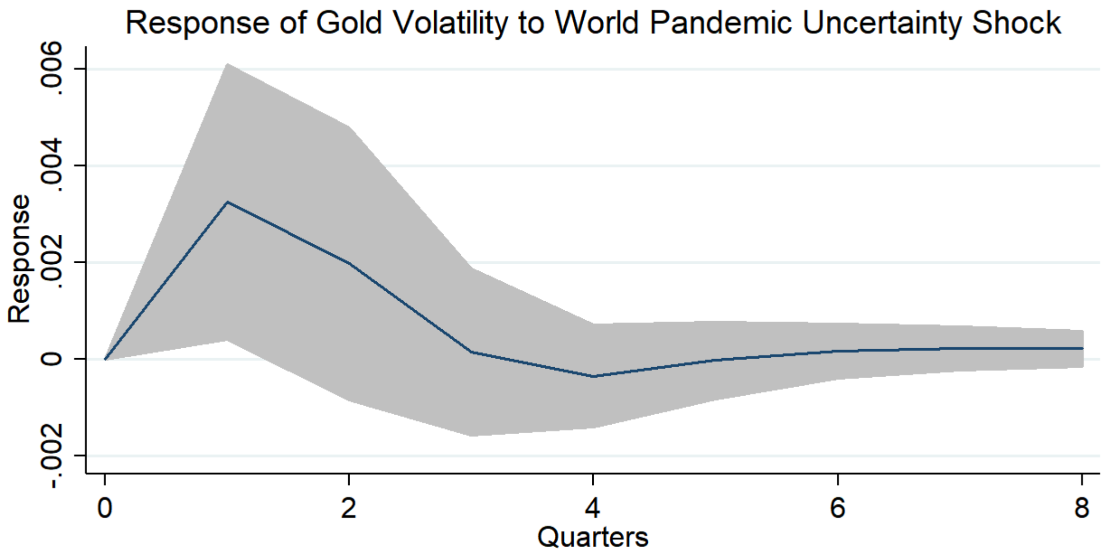
Figure 4. World Pandemic Uncertainty Shock

and Crude Oil Volatility (Baseline VAR)



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 (Baseline VAR)



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)

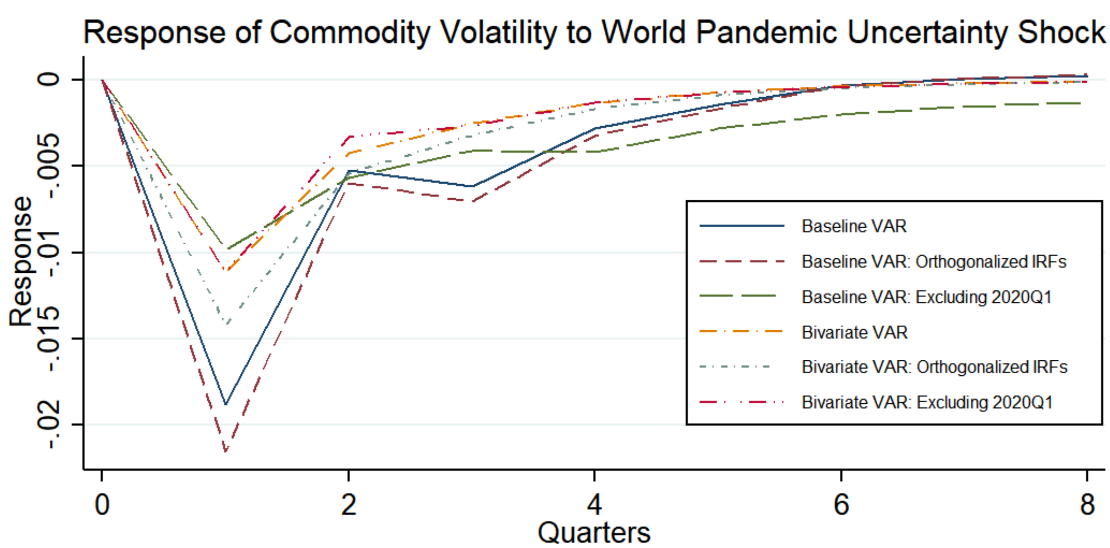


Figure 7. World Pandemic Uncertainty Shock

and Crude Oil Volatility (Alternative VARs)

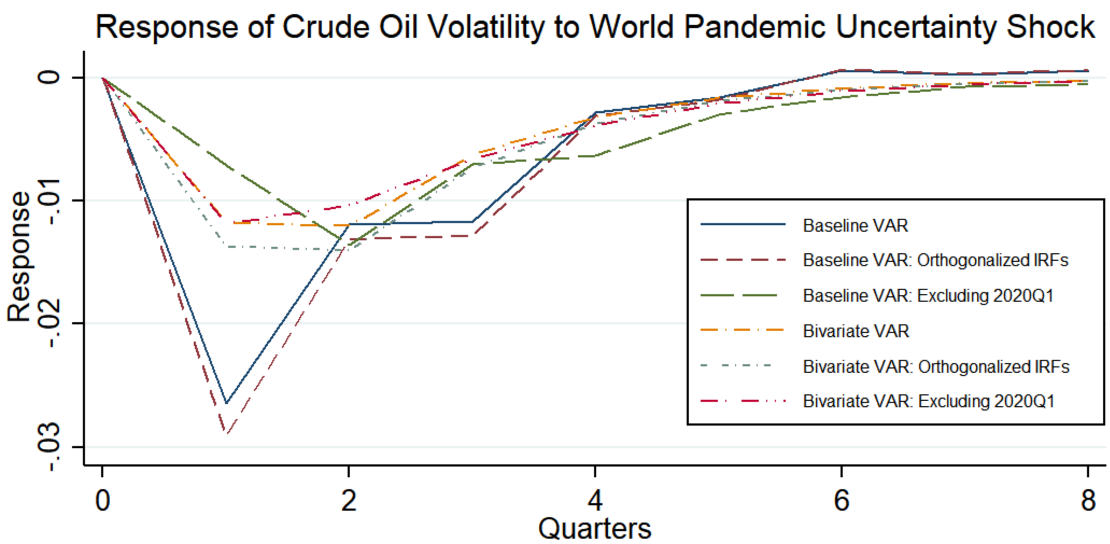


Figure 8. World Pandemic Uncertainty Shock

and Gold Volatility (Alternative VARs)

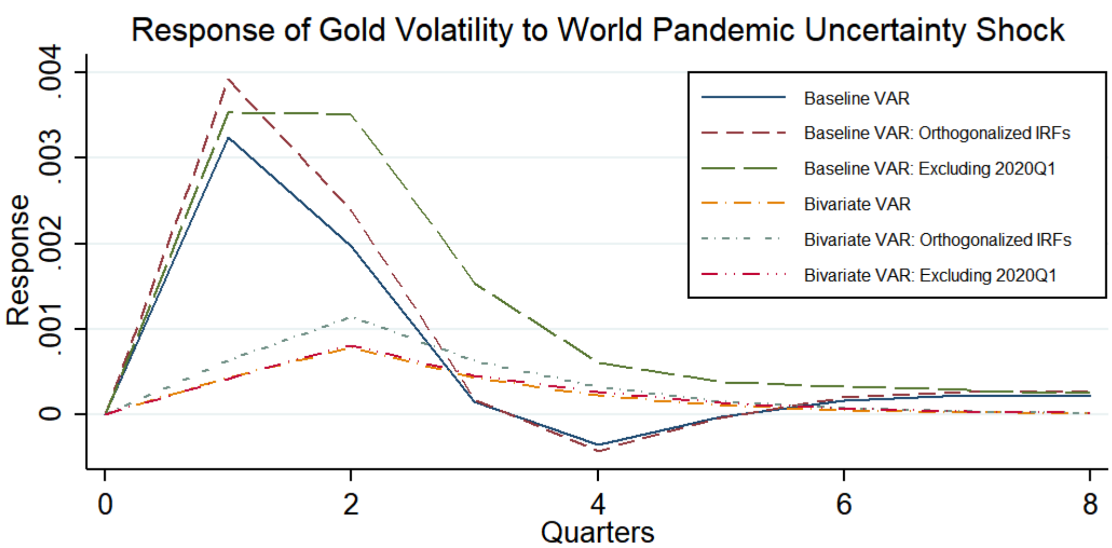


Figure 9. World Pandemic Uncertainty Shock

and Commodity Volatility (Alternative Uncertainty Measures)

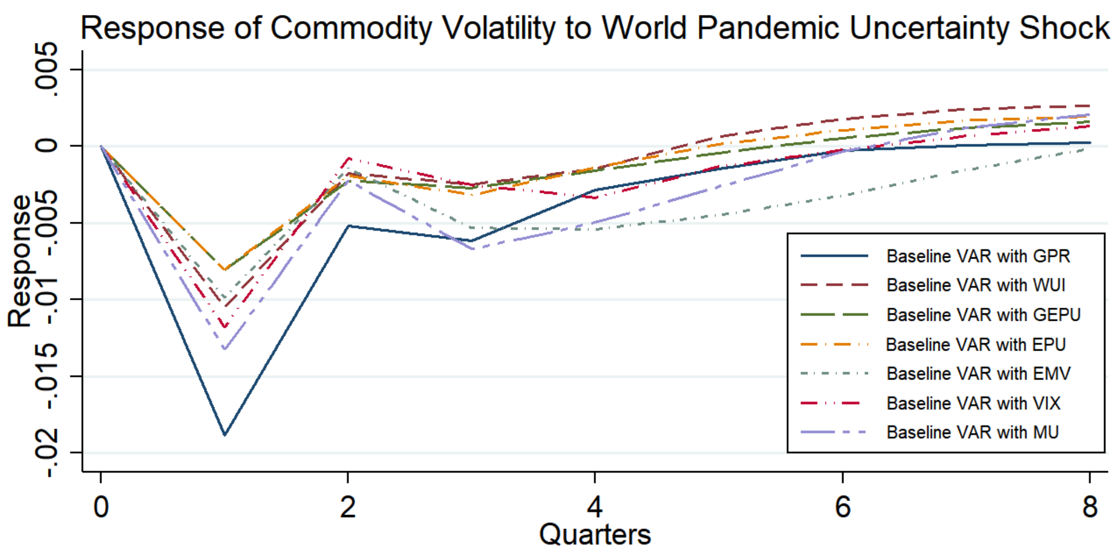


Figure 10. World Pandemic Uncertainty Shock

and Commodity Volatility (Additional Uncertainty Measures)