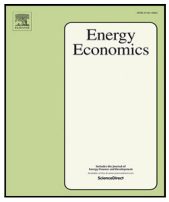
Energy Economics 133 (2024) 107508

Contents lists available at ScienceDirect

Energy Economics

journal homepage: www.elsevier.com/locate/eneeco



# Examining spillovers and connectedness among commodities, inflation, and uncertainty: A quantile-VAR framework ☆

Nikolaos Kyriazis [a,*], Stephanos Papadamou [a], Panayiotis Tzeremes [a], Shaen Corbet [b,c]

[a] University of Thessaly, Filellinon, Volos 382 21, Greece
[b] DCU Business School, Dublin City University, Dublin 9, Ireland
[c] School of Accounting, Finance and Economics, University of Waikato, New Zealand

ARTICLE INFO

*JEL classification:*
E3
E4
E5
F3
G1

*Keywords:*
Inflation
Commodities
Uncertainty
Spillovers
Dynamic connectedness

ABSTRACT

This paper explores dynamic interactions and connectedness between inflation, commodities, and economic and monetary policy uncertainty during various market phases between 1985 and 2022, developing upon the innovative quantile-VAR methodology. Results reveal that inflation exhibits strong interlinkages with money supply, as would be expected, along with the price of gold during periods of low-price levels, while presenting a strong positive relationship with both oil valuations and the money supply during periods representative of moderate or average pricing behaviour. Moreover, inflation is identified to be a receiver of direct influence and broad connectedness, especially during the Global Financial Crisis and during episodes of US-based quantitative easing programmes, while exhibiting even more pronounced effects during the COVID-19 pandemic. Money supply is identified to be the most receptive to overall external influence from the selected variables. Furthermore, economic policy uncertainty is identified as the strongest source of influence, with effects surpassing that of monetary policy uncertainty. Market risk is identified to possess the strongest effects at the highest quantiles. This study provides insight into the interconnectedness of the real economy and financial markets across various economic conditions.

## 1. Introduction

International inflationary pressure has been at the centre of much debate across various economic environments. Broad financial interactions and market connectedness have been particularly relevant due to the onset of the COVID-19 pandemic (Corbet et al., 2020; Smith et al., 2021; Mensi et al., 2021; Huang and Liu, 2021), and the Ukraine-Russia conflict (Diaconaşu et al., 2022). Such events, in particular, have manifested in inflationary pressures predominantly generated by shifting economic conditions due to government regulations to mitigate pandemic-related contagion (Kyriazis et al., 2022; Corbet et al., 2022a,b), and attempted inflationary manipulation through the targeted increases of energy prices by rogue states. Combined with elevated uncertainty due to the worldwide pandemic, irrational sovereign behaviour, and elements of financial fragility that remain from the global subprime collapse, major central banks such as the Federal Reserve, the European Central Bank, and the Bank of England have had to adopt new monetary strategies by increasing interest rates to restrain rapidly increasing price levels. In particular, as US inflation in 2022 reached a 40-year high, debate surrounding the connectedness of money supply and traditional financial assets has gained momentum (Kilian and Zhou, 2022; Azad and Serletis, 2022; Hobijn et al., 2022; Schmitt-Grohé and Uribe, 2022). The same holds concerning the connection with money supply and global uncertainty,[1] in particular that sourced from both economic and monetary policy sources.

These concerns raise three key questions: Firstly, to what extent do monetary, financial, and sentiment-based indices interact with inflation over time? Secondly, at what level and direction do these spillovers change, particularly when examined across alternative economic circumstances such as the Global Financial Crisis, unconventional monetary policy rounds, bull or bear market conditions, or during the COVID-19 pandemic? Finally, we examine whether inflation dynamics constitute or manifest within transmission effects towards each examined variable and how such major economic events influence

☆ The authors would like to thank participants of the European Economics and Finance Society (EEFS) 2022 Conference in Krakow for useful comments in an earlier version of this paper.

* Corresponding author.
*E-mail address:* knikolaos@uth.gr (N. Kyriazis).

[1] To date, there has been no distinct academic study that focuses on financial spillovers between inflation and traditional financial markets, with further novelty sourced across the period of time, and across the range of circumstances analysed.

https://doi.org/10.1016/j.eneco.2024.107508
Received 14 February 2023; Received in revised form 13 March 2024; Accepted 19 March 2024
Available online 7 April 2024

market connectedness and spillovers. To estimate spillovers and market connectedness, we use the novel Quantile Vector Autoregression (QVAR) methodology, developed by Chatziantoniou et al. (2021). This allows for the testing of behavioural differentials across a spectrum of alternative estimations through both time-varying and quantile-based analyses such as: (i) spillover connectedness at the lower, middle, and upper quantiles, (ii) dynamic net pairwise directional connectedness (at the same quantiles), (iii) overall dynamic total connectedness, and (iv) net total directional connectedness. The selected methodological structure allows for the specific examination of differentials across quantiles, allowing for dynamic components of estimations to assess this nexus's evolution over time. Moreover, the examination takes place both in pairs and in groups. This enables estimation of how inflation is affected by major economic, monetary, and financial factors, both in isolation and in combination.

Specifically, results indicate that inflation presents the tightest connection with the money supply, and oil is identified as a net receiver of influence. Such interaction effects are more pronounced during episodes of significant stress, such as the Global Financial Crisis (GFC) and the implementation of US quantitative easing programmes (specifically QE3), with evidence suggesting that such interactions are even more pronounced during the COVID-19 pandemic. Overall market risk is estimated to be stronger at the lower and upper quantiles examined. Moreover, oil is found to act as the most influential traditional asset in the examined methodological structure; however, both EPU and MPU are the most influential measures overall. Furthermore, the GFC is a benchmark for broad spillovers, while the implantation of quantitative easing is particularly important when determining gold's broad connectivity. The months at the beginning of the COVID-19 outbreak are particularly pertinent when presenting evidence of alterations in the direction of spillovers, generating the strongest interactions. Such research is particularly interesting to policymakers, market participants, and regulators, providing in-depth knowledge of the determinants of dynamic connectedness between macroeconomic, monetary, financial, and uncertainty measures that formulate the overall market risk during normal periods and crises.

The remainder of this paper is structured as follows. Section 2 provides the literature review on the main academic work related to the variables investigated. Section 3 lays out the data and methodology adopted in this study. Furthermore, Section 4 presents the empirical outcomes and analyses the economic implications. Finally, Section 5 conclude and propose avenues for further research.

## 2. Literature review

To date, several works are focusing on the interaction between uncertainties and inflation or financial assets, though this field is far from fully explored, so further insights are required. Selmi et al. (2020) reveal that economic and monetary policy uncertainties influence inflation volatility. Moreover, gold and oil are found to be efficient hedgers against inflation when the latter is high in times of elevated economic uncertainty. Athari et al. (2022) partly corroborates these findings by supporting that economic policy uncertainty increases the price level in Japan and that economic stability could achieve lower inflation. Furthermore, Beckmann et al. (2019) argues that economic policy uncertainty influences gold market values while macroeconomic uncertainty and inflation uncertainty negatively affect gold prices. Choi et al. (2018) document that a modest rise in global oil inflation brings about weakly higher domestic inflation, which rapidly fades away if monetary policy is reliable. Moreover, Yang et al. (2023) argues that higher economic policy uncertainty in the US and China leads to larger fluctuations in the global oil price in turbulent eras. The reverse also holds. In a similar mentality, Tiwari et al. (2024) reveals that monetary policy is strongly influenced by energy prices and especially oil market values.

Several high-quality academic studies have focused on the interactions among inflation, major macroeconomic and financial variables, and uncertainty measures. Studies with significant findings surrounding inflation are particularly important, where, for example, Lucas (1973) was one of the first to provide evidence supporting the close interlinkages between output and inflation. Moreover, Gilchrist et al. (2017) found that financial distortions are responsible for price elevations by firms and their decision to avoid external finance. This results in GDP volatility rendering less influential when determining inflation. When investigating the connection between inflation and interest rates, Brunnermeier and Sannikov (2016) revealed that the optimal inflation target depends on the level of financial friction. Apart from this, higher inflation that appears because of higher money growth leads to a decrease in the real interest rate and favours investment in physical capital. Inflation is found to be beneficial for output and welfare, and this is more pronounced in emerging economies. Additionally, Hoffmann et al. (2022) argue that high trust in monetary authorities leads to a positive adjustment of inflation expectations. Moreover, under-average inflation targeting leads to lower inflation fluctuations, and the lower bound of the interest rate is reached less often.

Focusing on the relationship between inflation and unemployment, Heise et al. (2022) detected that decelerating inflation presents weak transmission effects from wages to prices. This is reinforced by higher import competition and market concentration; therefore, a more moderate connection between unemployment and core goods inflation occurs. Furthermore, Conrad et al. (2022) provided evidence that households' perceptions about past and future inflation strongly affect future inflation and unemployment. Perceptions about the interest rate are also influential towards inflation. When inflation is examined through its relationship with financial assets, Gallagher and Taylor (2002) supports the proxy hypothesis explanation of the stock return — inflation puzzle. Moreover, Kilian and Zhou (2022) reveal that oil and gasoline market values influence headline PCE inflation to a larger extent than they impact core PCE inflation. No significant evidence supports the view that long-run household inflation expectations are affected. Monetary policy and money supply have also been at the epicentre of an array of important research. Donaldson and Piacentino (2022) supports the view that during periods of monetary shortage, banks select to acquire funds with demandable debt even though this money fails to circulate in the secondary market. Moreover, Wang (2022) provides evidence that the money supply increases due to the Fed's asset purchases at a larger level than when the Bank of Japan buys assets. Moreover, the relationship between money supply and financial assets is more powerful in the US, whereas bank credit proves to be more influential for the money supply in Japan.

Regarding the relationship between gold and oil and their specific relationship with inflation and interest rates, O'Connor et al. (2015) supports the view that gold is closely connected with inflation and interest rates. At the same time, it can be considered a popular investment. Agyei-Ampomah et al. (2014) provide evidence that palladium and copper outperform gold regarding hedging abilities against sovereign bonds; however, findings are not uniform across various bonds that have been investigated. Poshakwale and Mandal (2016) found that gold does not make an appropriate hedging tool against alterations in interest rates concerning portfolios based on oil and real estate. On the other hand, gold is identified to be an influential hedge against inflation uncertainty in portfolios consisting of bonds. When examination focuses on the relationship of gold and oil, with both currencies and stocks, according to Reboredo (2013), gold presents significant interaction with evidence of lower valuation of dollar-based currency. It is considered to be a safe haven against the US dollar. Luo et al. (2022) argue that important cross-market information spillovers exist across the gold, oil, and stock markets. This is supported to render market fluctuations more predictable in the short run due to sentiment-related determinants. Further, Wen et al. (2022) found that

gold displays safe haven abilities against oil, with such effects found to be quite substantial during the outbreak of the COVID-19 pandemic.

Focusing on economic policy uncertainties, Al-Thaqeb et al. (2022) found that higher EPU resulted in lower levels of consumption, lower debt issuance, lower investment, and higher unemployment, with further evidence of influence presented for gas, oil, and cryptocurrency, while Beckmann and Czudaj (2017) provide evidence that expectations about national currency values depend on economic uncertainty and that higher US EPU results in appreciation of the yen. Goodell et al. (2020) provides evidence that the election probability of the incumbent party in the final stages of US presidential election campaigns influences the US EPU. Considering interaction effects with the markets for gold and oil, Gao et al. (2021) present evidence that EPU is a net spillover receiver from oil. In contrast, a net spillover transmitter to gold and this interaction varies over time. Studies based on the relationship of EPU and stock markets, including (Ma et al., 2022), detected the large spillover impacts of EPU on stock market volatility in the US, Japan and Canada and traced certain regional resemblances. Such effects are also identified in France, Germany, and Italy, where peak influence exists between three and eighteen months thereafter. The global financial crisis and the decision to implement the Brexit campaign in Great Britain generated substantially higher EPU. Moreover, Albrecht et al. (2022) argues that US, Japanese and German stock markets react to EPU shocks with lags that range between two and six months at larger investment plans. Short-term effects are also detected. Further, Husted et al. (2020) constructed the Monetary Policy Uncertainty Index (MPU) and argued that MPU significantly influences output and credit spreads. Moreover, it decreases firm investment through real options and financial frictions. Chen and Tillmann (2021) document that higher MPU in China results in large output, inflation, and investment falls. It also decreases output and asset market values in other Asian countries. MPU is found to constitute an additional transmission channel of Chinese monetary policy. Tillmann (2020) support the view that high MPU causes smaller increases in long-term bond yields when policy tightening is conducted. This is due to the abrupt reduction in term premia during elevated MPU as longer-maturity securities render more substantiative. In the study of De Pooter et al. (2021), it is argued that when MPU is low, monetary policy shocks are more influential on bond yields. Moreover, Kurov and Stan (2018) provides evidence that during high MPU, the macroeconomic news has weaker impacts on crude oil and stock markets while is more influential on the Treasury, interest rate and foreign exchange markets mostly through expectations of future monetary policy.

## 3. Data & methodology

Estimations are conducted based on a substantial period of time to capture the dynamic evolution of spillover impacts and connectedness between pairs at the overall long-term level. The data employed spans the period from January 1985 to January 2022. Therefore, the period investigated includes major influential events affecting inflation, the money supply, gold market values and oil prices, and economic policy and monetary uncertainty. To conduct econometric estimations, a series of variables have been extracted and transformed into monthly logarithmic differences. Specifically, the Consumer Price Index (CPI) represents the price for all times in the United States, and its logarithmic differences serve as a very reliable and widely adopted measure of inflation (Bryan and Cecchetti, 1993; Boskin et al., 1998; Almås, 2012; Sharma, 2016). Apart from this, the monetary base in the US is employed (measured in US dollars) as expressed by the M1 measure that consists of the basic elements of the money supply. This way, comparing earlier times (when forms of liquidity were less developed) with market conditions today can be conducted more accurately. The money supply is crucial for expressing the determinants of nominal GDP and the growth potential in an economy (Baghestani and Mott, 1997; Luo et al., 2022; Calza and Zaghini, 2009; Cysne and Turchick, 2010). It should be underlined that gold serves as a safe-haven asset against market fluctuations and financial crises (Baur and McDermott, 2010) and has proven to be extremely popular to investors in an intertemporal base due to its unique set of qualities such as malleability, density, conductivity, non-destruction, and brilliance (O'Connor et al., 2015). High-quality studies about gold include, among others, Gao et al. (2021), Luo et al. (2022) and Wen et al. (2022). Oil prices are tightly connected with economic development and are often used to reflect economic activity, such as Wen et al. (2019) and Sharma (2016).

When focusing on economic policy uncertainty in the United States, the highly innovative US Daily News Index based as developed by Baker et al. (2016) is employed and transformed into monthly values. This index relies on newspaper archives from over 1000 US newspapers from the Access World News Newsbank service.[2] Further, the Monetary Policy Uncertainty (MPU) index[3] for the US is adopted as in Husted et al. (2020) that depicts not only the normal monetary policy-making during periods of financial market calm but also accurately reflects the extraordinary monetary policy measures employed in financial crises or turmoil. These include the Global Financial Crisis, which began in 2008, the large spectrum of unconventional action-taking such as Quantitative Easing (QE) and the ample liquidity injections due to the COVID-19 crisis. This index measures uncertainty in the Federal Reserve's action when the zero lower bounds are reached and efforts for excess liquidity by exercising conventional monetary policies prove inefficient. The MPU index is constructed by employing hundreds of daily newspapers covered by Access World News, capturing articles that contain one or more terms about central bankers, interest rates, monetary policy measures, or monetary authorities.

Fig. 1 presents the time series plots of the variables scrutinised, while Fig. 2 illustrates their returns as logarithmic differentials. It should be noted that the CPI and money supply are the most stable measures, followed by gold, while oil presents evidence of larger fluctuations. Uncertainty measures are characterised by significantly larger volatility than most other variables examined. It should be highlighted that the MPU index is revealed to be much less stable than the EPU index. This illustrates that monetary policy has often been forced to respond to events in the real economy.

Table 1 presents the summary statistics of the variables investigated. CPI and money supply changes are significantly less variable than those differentials presented across the gold market. On the other hand, crude oil and policy uncertainty display large levels of fluctuations. It should be emphasised that gold exhibits much better risk-adjusted performance than oil. Regarding asymmetry features, it can be observed that the CPI and oil returns display negative skewness while money supply, gold, EPU and MPU show positive levels of asymmetry. Moreover, it is found that the money supply presents the highest level of kurtosis, and the CPI and crude oil returns are also revealed to be leptokurtic. Notably, the Jarque–Bera statistic indicates that all variables suffer from asymmetries. It should also be noted that the ERS unit root test documents the stationarity of variables in first differences, and the Fisher and Gallagher weighted portmanteau test rejects the null hypothesis of an adequately fitted ARCH process.

[2] More specifically, it is constructed by searching for the terms: E: economic, economy, P: congress, legislation, white house, regulation, federal reserve, deficit, U: uncertain, uncertainty. The EPU index has been extremely popular in modern academic research as this measure represents economic uncertainty in an overall sense, which is influential towards every aspect of the real economy and financial markets. Such studies include Albrecht et al. (2022) and Al-Thaqeb et al. (2022).

[3] It should be noted that data about the Consumer Price Index, the money supply (M1), and WTI Crude Oil have been extracted from the FRED Database while the Gold values have been downloaded from DataStream. Estimates for the EPU and the MPU indices have been sourced from Policy Uncertainty respectively.

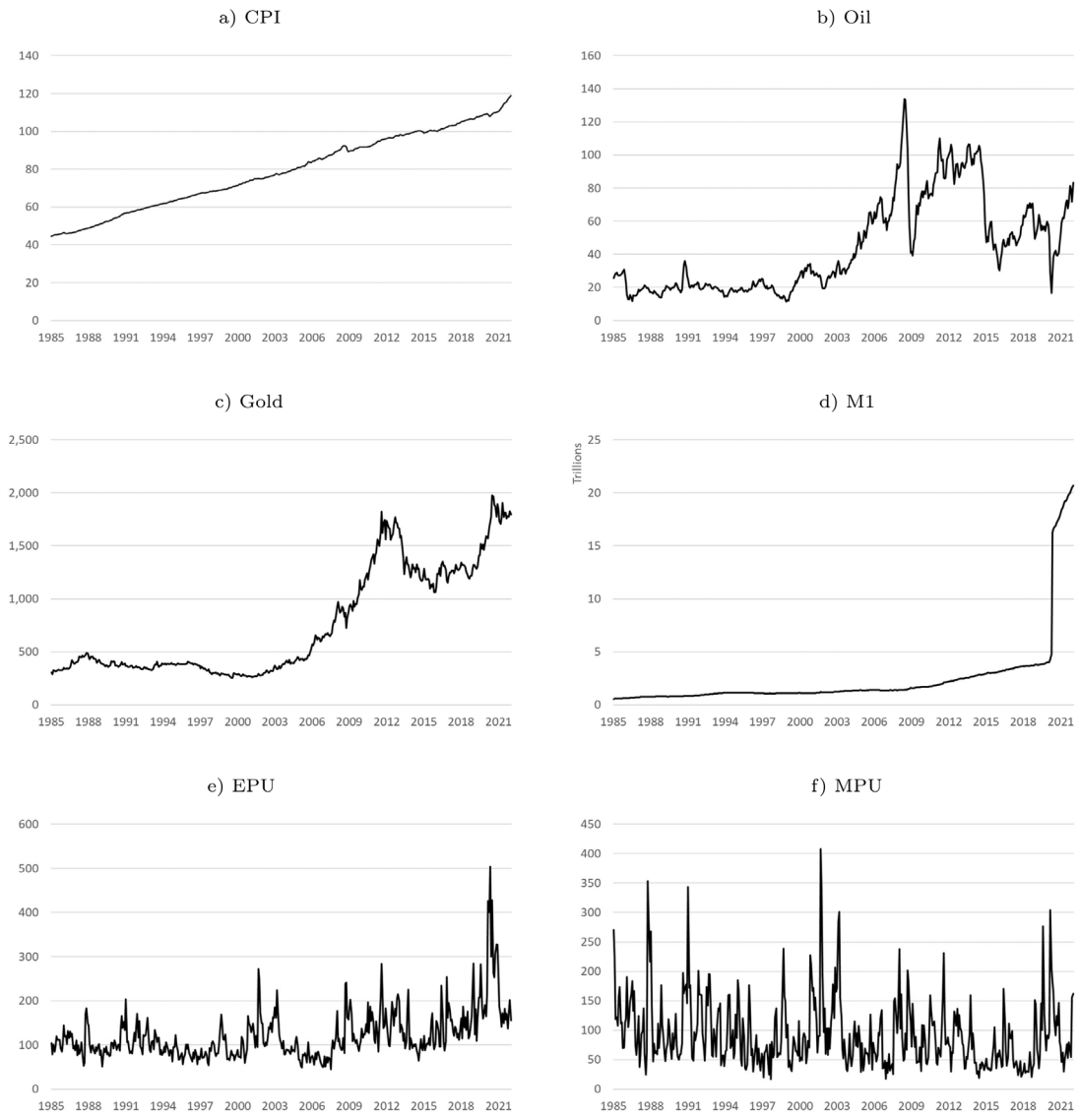



**Fig. 1.** Time series plot of the variables. Note: Estimations are conducted based on a substantial period of time to capture the dynamic evolution of spillover impacts and connectedness between pairs at the overall long-term level. The data employed spans the period from January 1985 to January 2022. Thereby, the period investigated includes multiple major influential events affecting inflation, the money supply, gold market values and oil prices, as well as economic policy and monetary uncertainty have taken place.

**Table 1**
Summary statistics of the investigate variables.

| | CPI | M1 | Gold | Oil | EPU | MPU |
|---|---|---|---|---|---|---|
| Mean | 0.221 | 0.814 | 0.398 | 0.265 | 0.091 | −0.115 |
| Skewness | −1.267*** | 20.093*** | 0.102*** | −0.703*** | 0.495*** | 0.283** |
| Kurtosis | 9.846*** | 413.388*** | 1.031*** | 7.353*** | 1.845*** | 0.416* |
| JB | 1912.34*** | 3,191,333.19*** | 20.43*** | 1036.79*** | 81.12*** | 9.137*** |
| ERS | −3.530*** | −8.750*** | −2.363** | −6.407*** | −3.168*** | −7.871*** |
| Q(20) | 128.720*** | 5.861 | 14.854 | 47.919*** | 42.991*** | 40.779*** |
| Q2(20) | 80.881*** | 0.036 | 31.672*** | 233.602*** | 9.018 | 11.354 |

Note:
* Represent significance at 10% level.
** Represent significance at 5% level.
*** Represent significance at 1% level.

The methodology employed to conduct estimations is the Quantile Vector Autoregression (QVAR) approach as in Chatziantoniou et al. (2021), which is outlined as follows:

$$y_t = \mu_t + \sum_{j=1}^{p} \phi_j(\tau) y_{t-j} + u_t(\tau) \quad (1)$$

where $y_t$ and $y_{t-j}$ are k×1 dimensional endogenous variable vectors, $\tau$ ranges between [0, 1] and stands for the quantile of interest, $\Psi$ represents the lag length of the QVAR model, $\mu(\tau)$ is a $k \times 1$ dimensional conditional mean vector, $\phi_j(\tau)$ is a $k \times k$ dimensional Quantile-VAR coefficient matrix and $u_t(\tau)$ shows the $k \times 1$ dimensional error vector having a k × k dimensional variable–covariance matrix, denoted as $\sum(\tau)$. Furthermore, the effect that a shock in variable $j$ generates on

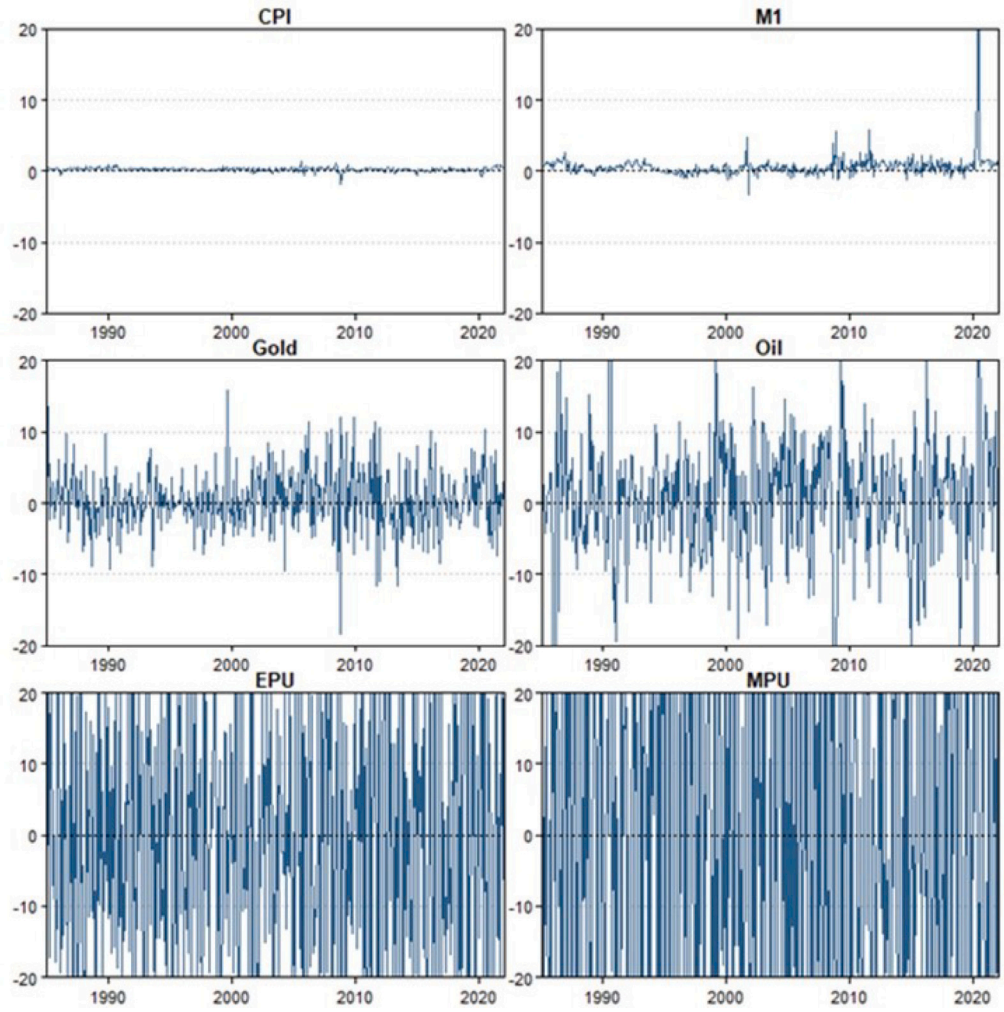



**Fig. 2.** Returns plots of the variables. Note: Estimations are conducted based on a substantial period of time to capture the dynamic evolution of spillover impacts and connectedness between pairs at the overall long-term level. The data employed spans the period from January 1985 to January 2022. Thereby, the period investigated includes multiple major influential events affecting inflation, the money supply, gold market values and oil prices, as well as economic policy and monetary uncertainty have taken place.

variable $i$ is presented as:

$$\Psi_{ij}^{g}(H)\frac{\sum(\tau)_{ii}^{-1}\sum_{h=0}^{H-1}(e_i'\Psi_h e_j)^2}{\sum_{h=0}^{H-1}e_i'\Psi_h(\tau)\sum(\tau)\Psi_h(\tau)'e_j'} \tag{2}$$

$$\tilde{\Psi}_{ij}^{g}(H)=\frac{\Psi_{ij}^{g}(H)}{\sum_{j=1}^{k}\varphi_{ij}^{g}(H)} \tag{3}$$

where $e_i$ stands for a zero vector that displays unity on the $i$th position. This normalisation leads to: $\sum_{j=1}^{k}\tilde{\Psi}_{ij}^{g}(H)=1$ and $\sum_{i,j=1}^{k}\tilde{\Psi}_{ij}^{g}(H)=k$. Moreover, the total connectedness TO variables represents the overall effect that emanates from variable $i$ to all other variables $j$:

$$C_{i\rightarrow j}^{g}(H)=\sum_{j=1,i\neq j}^{k}\tilde{\Psi}_{ji}^{g}(H) \tag{4}$$

Besides this, the influence of shocks from all other variables $j$ on variable $i$ is estimated by the total directional connectedness FROM others:

$$C_{i\leftarrow j}^{g}(H)=\sum_{j=1,i\neq j}^{k}\tilde{\Psi}_{ji}^{g}(H) \tag{5}$$

The net impact that variable $i$ exerts on the network under scrutiny is expressed as the differences between the total directional connectedness TO others and the total directional connectedness FROM others that results in the net total directional connectedness.

$$C_{i}^{g}(H)=C_{i\rightarrow j}^{g}(H)-C_{i\leftarrow j}^{g}(H) \tag{6}$$

Moreover, the adjusted Total Connectedness Index (TCI) of Chatziantoniou et al. (2021) that ranges between [0,1] is adopted to measure market risk as higher TCI values illustrate a higher degree of network interconnectedness.

$$\mathrm{TCI}(H)=\frac{\sum_{i,j=1}^{k}\tilde{\Psi}_{ij}^{g}(H)}{k-1} \tag{7}$$

## 4. Results

A series of econometric procedures have been conducted to estimate spillover connectedness and dynamic net pairwise directional connectedness at the 5th, the 50th, and the 95th quantiles, as well as the dynamic total connectedness of each variable with all the remaining variables under scrutiny across time and quantiles. Empirical outcomes about spillover connectedness at the lowest (5th) quantile investigated are illustrated in Table 2. Notably, inflation receives the largest impact from oil (21.34), while oil is mostly affected by inflation (22.32). Moreover, the money supply is mostly influenced by gold (18.03) and, to a lesser extent, by oil (13.12), EPU (11.73) and inflation (10.45). Gold is mainly affected by the money supply (16.41), while impacts from oil returns (15.50) and inflation (13.31) follow. As regards the

**Table 2**
Estimated spillover connectedness.

| | CPI | M1 | Gold | Oil | EPU | MPU | FROM |
|---|---|---|---|---|---|---|---|
| *Spillover connectedness at the 5th quantile* | | | | | | | |
| CPI | 30.67 | 14.95 | 16.35 | 21.34 | 8.91 | 7.78 | 69.33 |
| M1 | 10.45 | 38.70 | 18.03 | 13.12 | 11.73 | 7.98 | 61.30 |
| Gold | 13.31 | 16.41 | 33.62 | 15.50 | 11.75 | 9.39 | 66.38 |
| Oil | 22.32 | 11.69 | 17.94 | 31.46 | 8.70 | 7.89 | 68.54 |
| EPU | 10.92 | 14.13 | 11.94 | 9.80 | 30.02 | 23.19 | 69.98 |
| MPU | 11.75 | 12.40 | 10.44 | 10.05 | 24.40 | 30.96 | 69.04 |
| TO | 68.75 | 69.59 | 74.70 | 69.80 | 65.49 | 56.23 | 404.56 |
| NET | −0.58 | 8.29 | 8.33 | 1.26 | −4.49 | −12.81 | TCI = 67.43 |
| *Spillover connectedness at the 50th quantile* | | | | | | | |
| CPI | 48.85 | 4.60 | 1.75 | 38.32 | 4.17 | 2.32 | 51.15 |
| M1 | 1.84 | 54.38 | 6.72 | 6.11 | 19.79 | 11.15 | 45.62 |
| Gold | 2.84 | 7.31 | 68.08 | 9.06 | 7.18 | 5.52 | 31.92 |
| Oil | 18.34 | 3.73 | 4.34 | 55.52 | 10.52 | 7.54 | 44.48 |
| EPU | 0.96 | 4.54 | 3.44 | 3.76 | 51.48 | 35.83 | 48.52 |
| MPU | 0.99 | 3.14 | 1.89 | 1.58 | 36.93 | 55.46 | 44.54 |
| TO | 24.97 | 23.32 | 18.14 | 58.84 | 78.60 | 62.36 | 266.23 |
| NET | −26.18 | −22.30 | −13.78 | 14.36 | 30.07 | 17.83 | TCI = 53.25 |
| *Spillover connectedness at the 95th quantile* | | | | | | | |
| CPI | 23.22 | 8.92 | 15.13 | 23.72 | 13.92 | 15.09 | 76.78 |
| M1 | 15.46 | 15.32 | 15.95 | 16.54 | 18.34 | 18.39 | 84.68 |
| Gold | 13.89 | 12.30 | 27.20 | 16.25 | 15.85 | 14.52 | 72.80 |
| Oil | 17.23 | 8.46 | 18.81 | 21.76 | 15.20 | 18.54 | 78.24 |
| EPU | 16.72 | 11.09 | 14.75 | 17.79 | 19.43 | 20.22 | 80.57 |
| MPU | 16.67 | 10.78 | 15.08 | 17.75 | 18.98 | 20.72 | 79.28 |
| TO | 79.97 | 51.56 | 79.73 | 92.05 | 82.29 | 86.75 | 472.34 |
| NET | 3.19 | −33.12 | 6.92 | 13.81 | 1.72 | 7.48 | TCI = 78.72 |

Note: A series of econometric procedures have been conducted to estimate spillover connectedness and dynamic net pairwise directional connectedness at the 5th, the 50th, and the 95th quantiles as well as the dynamic total connectedness of each variable with all the remaining variables under scrutiny across time and quantiles.

determinants of uncertainties, the EPU is mostly affected by monetary policy uncertainty (23.19), money supply (14.13) and gold (11.94). Similarly, MPU primarily receives impacts from economic policy uncertainty (24.40) and money supply (12.40), and inflation, oil, and gold are followed by approximately equal effects.

It should be emphasised that uncertainty indices, that is, EPU (69.98) and MPU (69.04), as well as inflation (69.33) and oil (68.54), constitute the largest impact receivers. On the other hand, gold (74.70) is by far the largest contributor to spillovers. This abides by the safe haven character of gold as in Baur and McDermott (2010). Notably, oil (69.80), money supply (69.59) and inflation (68.75) are also significant sources of impact at the lowest quantile. Moreover, it is particularly interesting that gold (8.33) and money supply (8.29) are the largest net contributors to spillovers, while MPU is the largest net receiver (−12.81), followed by EPU (−4.49). Market risk is identified to be modest (TCI: 67.43) at the 5th quantile.

Furthermore, Table 2 displays the results for spillover connectedness estimations at the 50th quantile to reflect what happens during normal market conditions. It can be easily observed that, in non-extreme conditions, the macroeconomic and financial variables investigated mainly rely (apart from themselves) on spillover impacts stemming from only one of the remaining variables, while the rest prove to be weakly influential. More specifically, oil (38.32) is the principal determinant of inflation, while inflation (18.34) mainly affects oil. Moreover, oil (9.06) weakly influences gold, and EPU (19.79) is the most significant factor impacting the money supply. Intriguingly, the phenomenon of only one important determinant existing also holds concerning EPU (MPU: 35.83) and regarding MPU (EPU: 36.93). Thereby, the interconnectedness between inflation and oil and between EPU and MPU is stronger in normal periods than during stressed eras when distributions of variables reach the lowest or highest levels.

Emphasis should be given to the disparities characterising the net influence of variables. To be more precise, in contrast to findings at the 5th quantile, EPU (30.07) and MPU (17.83) are revealed to be the most significant spillover transmitters. Oil (14.36) follows, whereas inflation (−26.18), money supply (−22.30) and gold (−13.78) are net receivers of spillover impacts. Arguably, four out of six variables present different directions of effects at the 50th quantile in relation to what is found at the 5th quantile. Overall market risk (53.25) is significantly lower at the 50th quantile than at the lowest quantile.

Focusing on the behaviour of spillover connectedness at the upper (95th) quantile, results are presented in Table 2, providing evidence that each of the variables examined receives significant levels of impacts from all the other measures investigated without large differences in spillover transmission among determinants. This is most evident in the case of gold's influential factors (oil: 16.25, EPU: 15.85, MPU: 14.5, inflation: 13.89, and money supply: 12.30) and the money supply determinants (MPU: 18.39, EPU: 18.34, oil: 16.54, gold: 15.95, and inflation: 15.46). Such results also occur when considering the selected uncertainty measures. EPU depends, to a substantial degree, on the following factors: MPU (20.22), oil (17.79), inflation (16.72), gold (14.75), and money supply (11.09). Moreover, MPU is a receiver of spillovers from EPU (18.98), oil (17.75), inflation (16.67), gold (15.08), and money supply (10.78). It should be underlined that similar spillover patterns are estimated regarding inflation, but larger gaps exist between the strongest determinant, which is oil (23.72) and the weakest one, which is money supply (8.92). Similarly, oil spillover interactions[4] behave in a similar manner, where the spillover impact from MPU (18.54) presents a large difference with the effect of money supply (8.46). Overall, the market risk is high (78.72), which is even higher than its value in the case of the 5th quantile examination.

Further, as observed in Table 2, each of the variables investigated are mostly linked with the remaining variables at the upper quantile. It exerts larger effects and receives stronger impacts through spillovers. Notably, the lower quantile follows as concerns the strength of spillover influential impacts, and it is seen that each variable remains a source and a receiver of spillovers but to a lower extent. Finally, it is clear that in normal market conditions, each variable is less impactful and dependent on the remaining ones, and interconnectedness significantly falls. These findings lead to interesting policy recommendations. Better hedging against the impacts of excessive money supply and inflation should occur in periods of elevated economic and monetary policy uncertainty due to the strong linkages among these variables at high levels. Gold could constitute an effective hedger in such occasions. As concerns bear markets (the lower quantile), low levels of money supply, inflation and oil prices, linked with low EPU and MPU, also present significant levels of connectedness (but not as strongly as at the upper quantile). This implies that during low economic activity, the economic and financial systems are interlinked, and changes in one of the variables could cause great instability in the real economy and the financial markets, so investors should also be cautious. On the other hand, in normal economic conditions, the reliance on other factors is much weaker. This reinforces the perspectives for autonomous monetary and fiscal policymaking and allows the markets of major financial assets to avoid externalities. Therefore, policymakers and investors should make decisions without worrying about significant externally imposed mutations in accomplishing their targets.

Apart from the examination of spillover connectedness at various quantiles, this study estimates the dynamic net pairwise connectedness between inflation and the remaining macroeconomic, financial and uncertainty variables at the lowest, middle and highest quantiles, respectively. Figs. 3, 4, and 5 display the results[5] at the lowest (5th), the

[4] It is worth noting that oil (13.81) is the most powerful net transmitter of spillover effects while the money supply is the only net receiver (−33.12).

[5] It is noteworthy that if the upper half of each graph is filled, then the first variable is the source of the impacts whereas the lower half being filled gives evidence for the second variable being the transmitter.

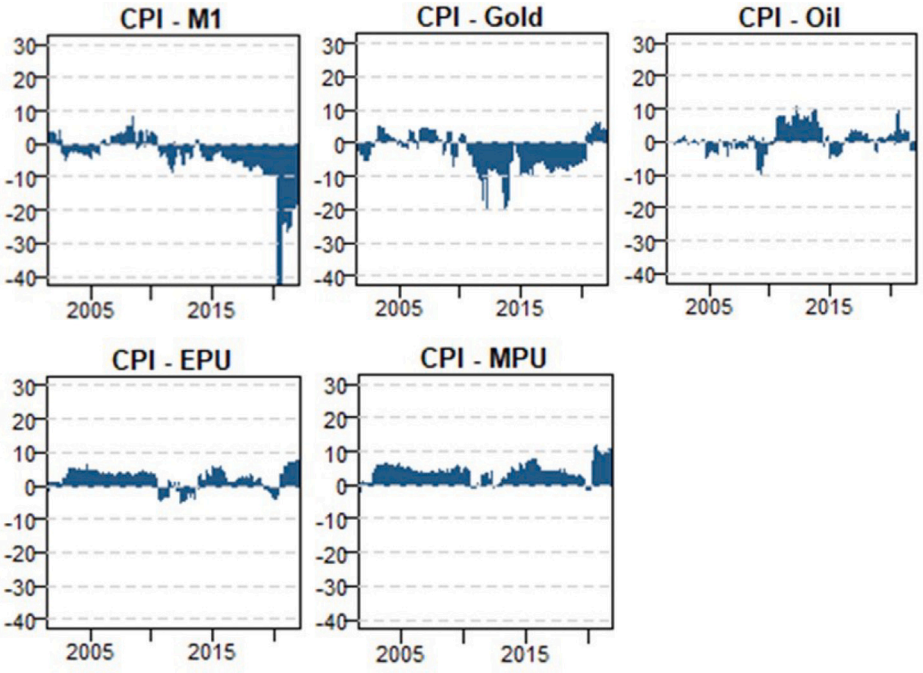



**Fig. 3.** Dynamic net pairwise directional connectedness (at the 5th quantile). Note: The first variable is identified as the source of the impact, whereas the lower half provides the estimate for the second variable being the transmitter, as separated at the lowest (5th), the middle (50th) and the upper (95th) quantiles, respectively.

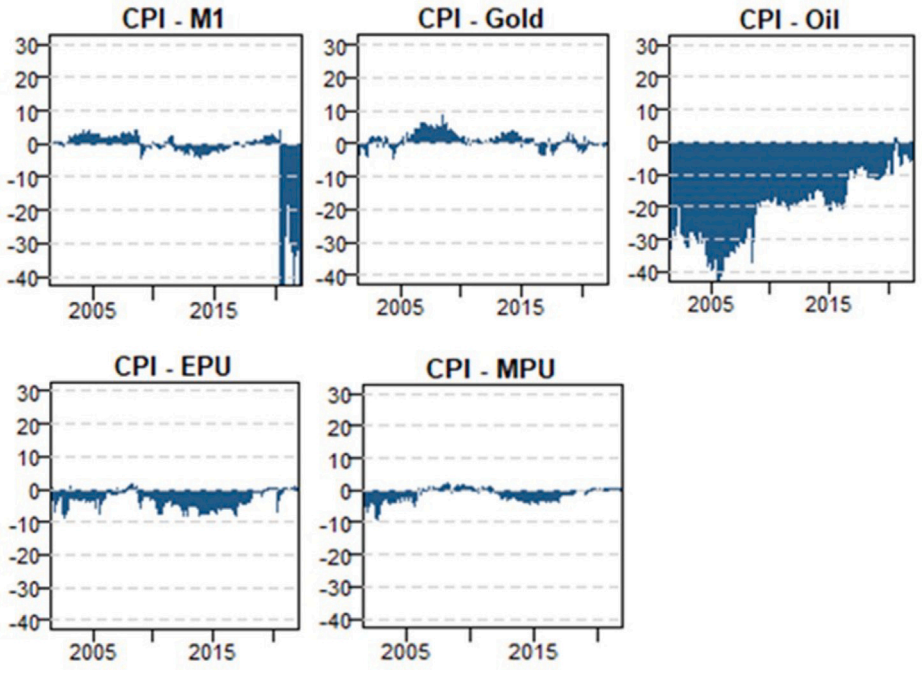



**Fig. 4.** Dynamic net pairwise directional connectedness (at the 50th quantile). Note: The first variable is identified as the source of the impact, whereas the lower half provides the estimate for the second variable being the transmitter, as separated at the lowest (5th), the middle (50th) and the upper (95th) quantiles, respectively.

middle (50th) and the upper (95th) quantiles, respectively. Regarding the relationship between inflation and money supply, it is found that the latter is strongly influential on the former during the outbreak of the COVID-19 pandemic while renders weaker afterwards (5th quantile). Notably, evidence indicates that this impact is very strong during the COVID-19 pandemic based on estimations at the 50th quantile. Further, it can be argued that inflation has been exerting significant impacts on the money supply since 1985, while this connection changes direction and proves to be weak during the pandemic, as denoted by the presented results at the 95th quantile. Furthermore, by focusing on the connection between inflation and gold, it can be supported that gold significantly impacts inflation during QE3 and the QE-tapering period, but inflation affects gold at the lowest quantile during the pandemic. Moreover, inflation was revealed to have an impact on gold at the outbreak of the Global Financial Crisis and to a lower extent during QE rounds, as found in the middle and upper quantiles. This relationship has been much more volatile at the upper quantile. Gold is found to be a powerful transmitter of impacts on inflation during the first two

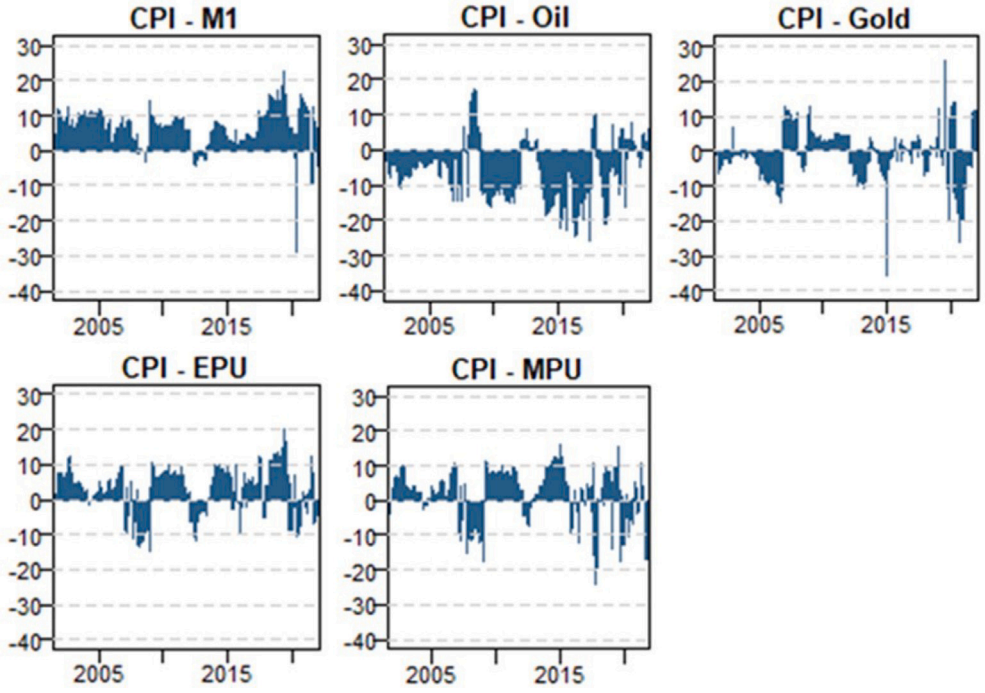



**Fig. 5.** Dynamic net pairwise directional connectedness (at the 95th quantile). Note: The first variable is identified as the source of the impact, whereas the lower half provides the estimate for the second variable being the transmitter, as separated at the lowest (5th), the middle (50th) and the upper (95th) quantiles, respectively.

waves of COVID-19, but the reverse relation is traced at later stages at the extreme quantiles.[6]

When considering the dynamic net pairwise connectedness results, inflation is revealed to be weakly influential towards EPU at the lowest quantile before and the early stages of the GFC, during QE-tapering and somewhat more intensely during the COVID-19 pandemic. On the other hand, EPU is a substantial transmitter of influence, while inflation is a receiver during almost all the periods investigated, as revealed in the middle quantile. Notably, mixed results and stronger connectedness are illustrated at the upper quantile, where inflation is influential for a long horizon before the GFC, during QE1 and QE2, and during the early stages of COVID-19. On the other hand, EPU had significant impacts just before the outbreak of the GFC, during QE3, the late QE-tapering and the late stages of COVID-19. Moreover, by studying the connectedness of inflation with monetary policy uncertainty, it is evident at the lowest quantile that inflation impacts MPU during QE3 and, to a larger degree, during COVID-19, while MPU is constantly a receiver of impacts. Nevertheless, this is not the case at the middle quantile, as MPU is the transmitter of effects for almost all the periods examined. Mixed results are found at the highest quantile. More specifically, MPU mainly affected inflation during the GFC outbreak and the worldwide contagion phase of COVID-19 and the spread of the subsequent Delta variant.

Moreover, heatmaps are created to depict each variable's net total directional connectedness with the other five variables across the investigated time dimension and at each quantile. Specifically, Fig. 6 illustrates the overall dynamic total connectedness. Further, as presented in Fig. 7, inflation is identified to act as a receiver of spillover

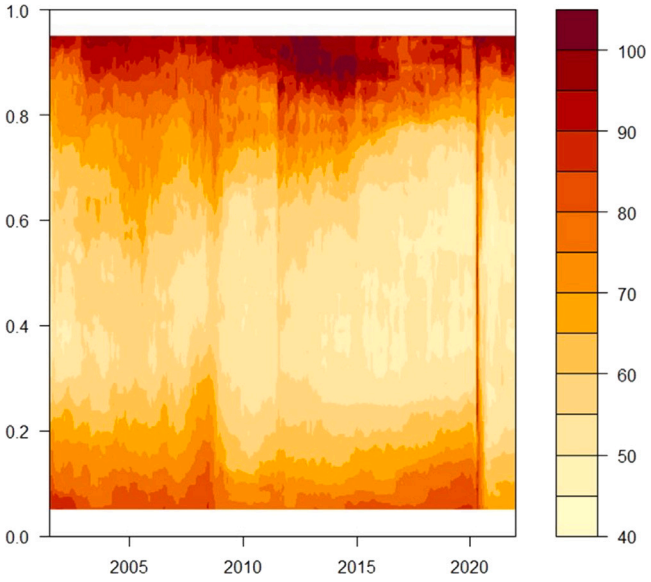



**Fig. 6.** Dynamic total connectedness. Note: Heatmaps are created to depict each variable's net total directional connectedness with the variables analysed across each respective time dimension and quantile examined.

impacts, which is more pronounced during the outbreak of COVID-19 and somewhat, to a lesser extent, during the more mature phase of the evolution of the pandemic. Overall, inflation is influenced by normal conditions but becomes a weak generator during bull or bear markets. This happens as national currency values become more influential substitutes for alternative investments when elevated uncertainty prevails.

Fig. 8 illustrates the strong necessity for enormous money printing and circulation during crises. Extraordinary liquidity requirements during turbulent periods render money supply a respectable generator of causal impacts to revitalise the real economy and markets. This

[6] It is documented that inflation affects crude oil during the second (QE2) and the third (QE3) rounds of unconventional monetary policy measures when the lowest quantile is examined. It should be noted that the significant influence of oil on inflation was detected mostly during the global financial crisis at the central quantile examined. This also concerns the QE-tapering period when tightening of the lax monetary policies occurs, as revealed by results at the upper quantile.

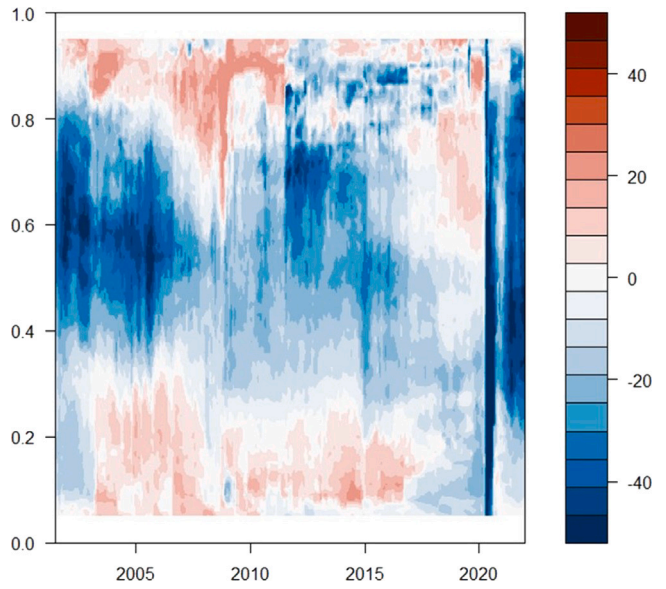



**Fig. 7.** Net total directional connectedness with inflation (CPI). Note: Heatmaps are created to depict the net total directional connectedness that each of the variables presents with the variables analysed across each respective time dimension and quantile examined.

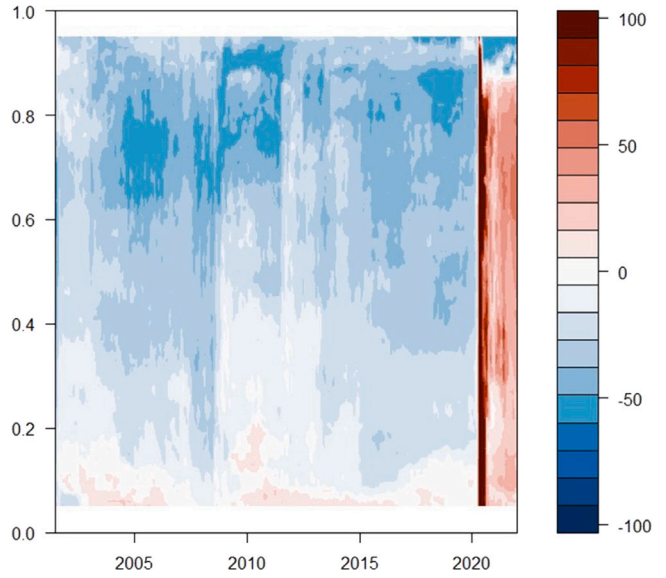



**Fig. 8.** Net total directional connectedness with money supply. Note: Heatmaps are created to depict each variable's net total directional connectedness with the variables analysed across each respective time dimension and quantile examined.

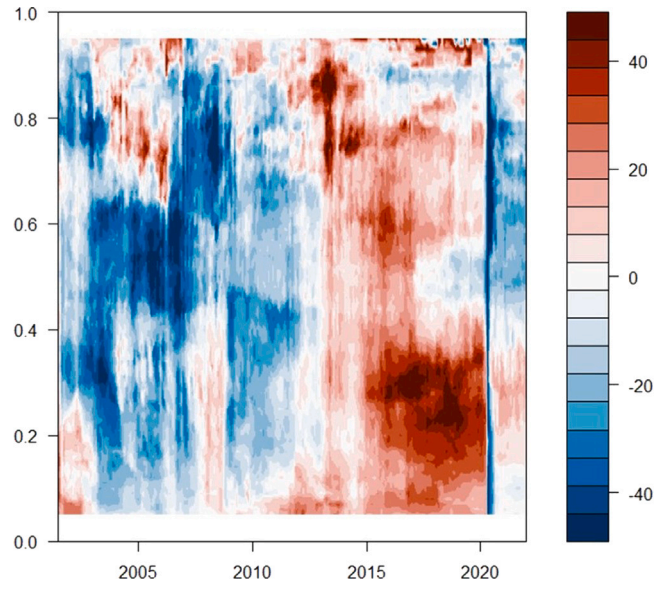



**Fig. 9.** Net total directional connectedness with gold. Note: Heatmaps are created to depict each variable's net total directional connectedness with the variables analysed across each respective time dimension and quantile examined.

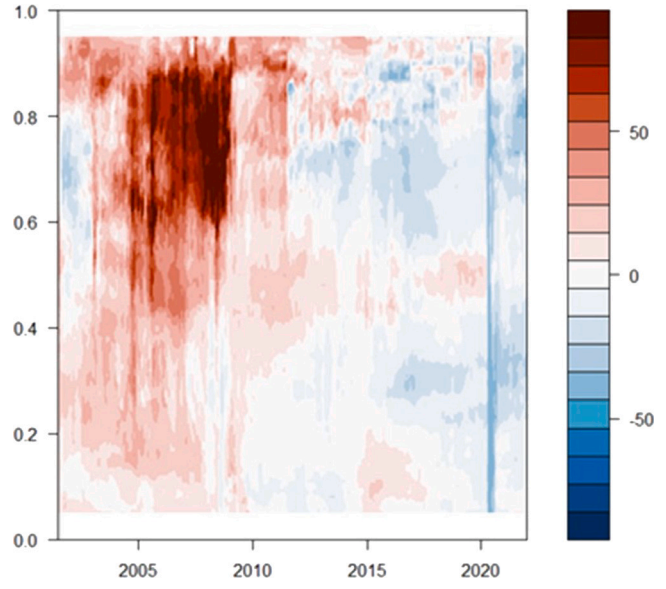



**Fig. 10.** Net total directional connectedness with oil. Note: Heatmaps are created to depict each variable's net total directional connectedness with the variables analysed across each respective time dimension and quantile examined.

contrasts with previous periods (even considering the Global Financial Crisis) when the money supply was weakly important as an absorber of shocks due to the liquidity trap that necessitated unconventional monetary policy measures.

As depicted in Fig. 9, gold predominantly constitutes an absorber of impacts during crises such as the GFC and COVID-19 but generates such effects during recovery periods. It serves as a transmitter, more evidently when low market values appear, broadly a determinant of inflationary pressures, economic policy, and monetary policy. Associated safe haven characteristics are more obvious during the outbreak of major crises. In Fig. 10, it is revealed that oil is weakly connected with macroeconomic variables and policy uncertainties despite being considered an index of economic activity. Its hedging capacities are more obvious when COVID-19 begins. It is an influential generator of effects during economic growth (especially before large negative market reversals). This verifies that oil continues to propagate and influence economies and act as a signal to alert for future economic downturns.

As depicted in Fig. 11, economic policy uncertainty generates spillover impacts towards the system of macroeconomic variables, commodities and MPU almost consistently at normal towards bull market conditions, and this gets stronger with higher market aggressiveness. This is due to the crucial role of investor perceptions in formulating inflation, markets and policy-making, which is reinforced by the modern era of information.

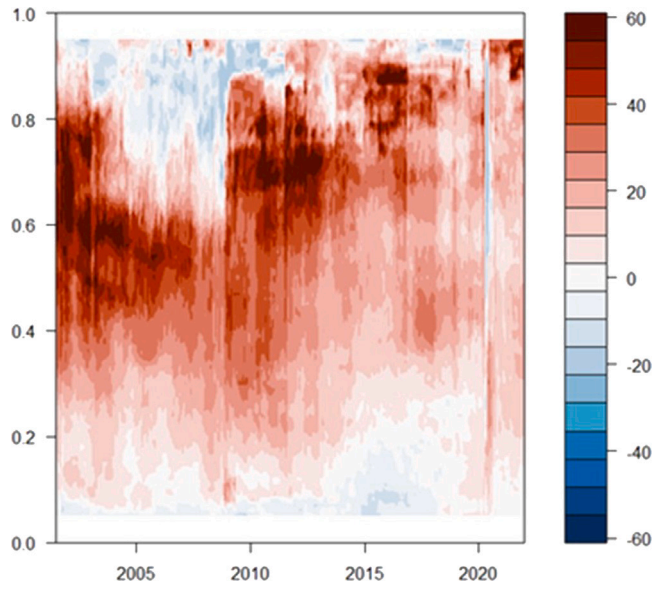



**Fig. 11.** Net total directional connectedness with EPU. Note: Heatmaps are created to depict each variable's net total directional connectedness with the variables analysed across each respective time dimension and quantile examined.

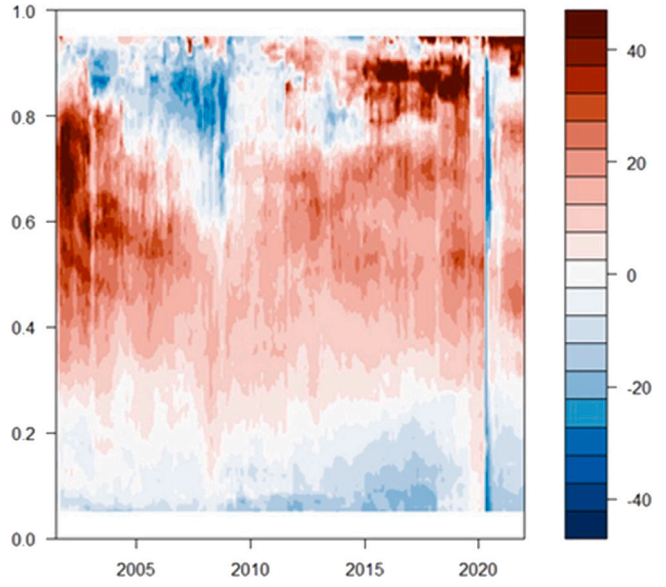



**Fig. 12.** Net total directional connectedness with MPU. Note: Heatmaps are created to depict each variable's net total directional connectedness with the variables analysed across each respective time dimension and quantile examined.

Finally, in Fig. 12, it can be seen that monetary policy uncertainty is an absorber of impacts during the outbreak of the GFC and the COVID-19 crisis, mostly at the upper quantiles and by a weaker level at lower quantiles. MPU is influential during inflationary periods when market values are high. This happens when economies flourish, try to recover or struggle to fight recessionary pressures. The harder the struggle to evade problems, the higher the market values (quantiles) that MPU affects.

Overall, Figs. 7 through 12 show the net total directional connectedness that inflation, money supply, gold, oil, EPU and MPU present with the remaining variables, respectively. It can be observed that the overall dynamic total connectedness reveals more intense transmission impacts at extreme quantiles. Notably, upper quantiles are found to exhibit more intense effects than lower and middle quantiles. Focusing on each variable's net total directional connectedness, evidence indicates that inflation receives impacts mostly in the middle towards upper quantiles. The strongest impacts are traced to exist before the Global Financial Crisis and during QE3. Emphasis should be given to the period of COVID-19 when such interaction effects become even more powerful. Thus, it can be argued that macroeconomic and financial determinants and uncertainty indices have been influential towards inflation in normal times or during the normalisation of policies but also when conditions are extremely adverse. Focusing on the money supply, it can be argued that it constantly receives impacts. This is more evident in upper quantiles. Nevertheless, the money supply generates significant effects during the COVID-19 pandemic while remaining a receiver at the highest quantile. Focusing on the market for gold, results suggest that gold receives substantial external influence before and during the GFC at both the middle and upper quantiles examined, respectively. The direction of influence reverses during QE-tapering at the lower quantiles, whereas gold receives dynamic effects during the COVID-19 era. These findings are in contrast to net total directional connectedness results concerning oil. It is estimated that oil is influential before the GFC at upper quantiles. Furthermore, during the QE-tapering, it becomes a weak receiver of influence, intensifying during the COVID-19 outburst. Considering EPU, it is found to be a source of impacts, and this is more pronounced at middle to upper quantiles. Results further indicate that only during crises does EPU become a receiver of weak effects and during the COVID-19 outbreak at the upper quantiles. It should be emphasised that significant similarities are identified between EPU and MPU. Moreover, uncertainty is found to have a significant influence during COVID-19 at the highest quantile.

Overall, it is found that inflation, money supply and gold are the main impact receivers of spillovers and connectedness. On the other hand, economic policy uncertainty, monetary policy uncertainty and oil are the principal impact transmitters. Interestingly, the evidence shows that oil is the weakest receiver and transmitter of overall effects. Moreover, it should be highlighted that the lowest but mainly the upper quantiles exhibit higher spillover connectedness. Apart from this, intense reversal phenomena in pairwise causality exist at higher quantiles. Arguably, the inflation–money supply and the inflation–oil relations are estimated to be the most pronounced but are not stable across quantiles. Furthermore, medium to higher quantiles generate the most powerful net total directional connectedness levels. Concerning the periods examined, the Global Financial Crisis constitutes a benchmark for alterations in the level and direction of spillovers and connectedness. Moreover, the months surrounding the initial contagion stages of the COVID-19 pandemic are revealed to illustrate the strongest connectedness.

Several results are of specific interest to regulators and policymakers. Firstly, the strong interconnectedness between inflation and money supply necessitates a nuanced approach in monetary policy, where central banks must carefully calibrate money supply adjustments to manage inflationary trends without inducing undue market volatility. This is particularly crucial during crisis periods such as the COVID-19 pandemic, where our findings indicate heightened sensitivity of inflation to monetary policy shifts. Furthermore, the prominent role of commodities, especially oil and gold, in influencing inflation underscores the need for policies that stabilise commodity markets, thereby indirectly curbing inflation volatility. Regulatory bodies might consider implementing measures that enhance market transparency and reduce speculative trading, which often exacerbates commodity price fluctuations. Moreover, our results highlight the significant impact of economic and monetary policy uncertainties on macroeconomic variables, suggesting that clear, consistent, and well-communicated policy decisions are vital in stabilising markets. In addition, the observed spillover effects between different economic segments suggest that a holistic and integrated regulatory approach is essential. Regulatory frameworks should focus on individual market segments and consider the broader interconnected financial ecosystem. This implies enhancing

cooperation among various regulatory bodies, including those overseeing monetary policies, commodity markets, and financial institutions, to ensure cohesive and effective market oversight. Lastly, our study's revelations about the dynamic connectedness in various market conditions, normal, crisis, and recovery phases, offer critical insights for adaptive policy-making. During crisis periods, such as the Global Financial Crisis and the onset of the COVID-19 pandemic, our analysis indicates a more pronounced connectedness, calling for more aggressive and targeted policy interventions. Conversely, in stable or recovery phases, a more measured approach may be warranted, focusing on long-term stability and sustainable growth.

## 5. Conclusions

Studying the spillover impacts and the dynamic connectedness in quantiles among major macroeconomic, monetary, and financial variables and economic and monetary policy uncertainty is important to identify unknown inflation determinants. Moreover, the relationship between pairs of these variables reveals whether safe haven abilities exist concerning these measures during extreme events or normal periods. This paper contributes to both these strands of academic research and brings to the forefront outcomes regarding many unknown aspects of the real economy, financial assets, and investor sentiment. Results lead to a better perception of the hidden dynamic determinants of inflation, money supply, gold, oil, and uncertainty stemming from economic or monetary policy and provide a roadmap for the decision-making of central bankers, policymakers, and investors. Specifically, this paper scrutinises the dynamic interconnectedness at the lower, middle, and upper quantiles among and between pairs of major macroeconomic, financial and investor sentiment measures. The influence of important monetary variables (money supply), drivers of the global financial markets (gold and crude oil), and extremely popular and innovative Economic Policy Uncertainty and Monetary Policy Uncertainty indices on inflation are examined using a Quantile Vector Autoregression. This enables the investigation of spillover connectedness, dynamic net pairwise directional connectedness, dynamic total connectedness and net total directional connectedness at various quantiles.

Econometric findings illustrate that inflation is mostly linked with money supply and oil prices and is mainly a receiver of impacts, which are more pronounced during the Global Financial Crisis, QE3 and even more during the COVID-19 pandemic. Furthermore, money supply and, in some cases, gold receive rather than exert effects. Evidence indicates that dynamic connectedness and overall market risk are stronger at the upper quantiles and the lower ones but to a lesser extent, whereas they are significantly weaker at the middle quantiles. Moreover, findings reveal that oil is the weakest receiver and transmitter of impacts, whereas economic or monetary investor sentiment measures are the most influential determinants overall. It should be highlighted that the direction of pairwise causality alters at higher quantiles. Concerning the presented outcomes based on the time evolution of dynamic connectedness, it can be argued that the GFC constitutes a significant benchmark for the largest spillovers. Besides this, quantitative easing programmes are the most influential for determining gold's behaviour as a transmitter or a receiver of effects. Intriguingly, the months surrounding the most intense period of the COVID-19 outbreak display the highest levels of connectedness and serve as a breakpoint for changes in the direction of causality. Inflation is the recipient of the largest directional impact during the COVID-19 pandemic, in a larger array of quantiles than before the Global Financial Crisis and subsequent international central bank monetary policy responses.

This study provides an in-depth investigation of the determinants of inflation in a manner only captured by dynamic spillovers and connectedness. Notably, it can be concluded that inflation constitutes a receiver of impacts mainly from money supply and oil as well as from gold and investor sentiment measures by a lower degree, and this nexus is stronger at higher quantiles and flourishing periods but also during very intense crises. Moreover, economic and monetary policy uncertainties are revealed to be less influential to each macroeconomic and financial variable and in an overall perspective than expected. Results provide insights into the key influential factors on inflation in light of the recent great elevation of inflationary pressures worldwide. Furthermore, econometric findings provide a deeper understanding of the unknown linkages among the real economy, financial markets, and investors' uncertainty perception. Potential avenues for future research in this field include thoroughly examining alternative measures of inflation and other macroeconomic variables, major financial assets, such as stock indices or cryptocurrencies, and the influence exerted by financial tools with diversifying or hedging abilities by employing advanced econometric methodologies.

## CRediT authorship contribution statement

**Nikolaos Kyriazis:** Writing – review & editing, Writing – original draft, Visualization, Supervision, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Stephanos Papadamou:** Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Formal analysis, Data curation, Conceptualization. **Panayiotis Tzeremes:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Formal analysis, Data curation, Conceptualization. **Shaen Corbet:** Writing – review & editing, Writing – original draft, Visualization, Data curation, Conceptualization.

## Acknowledgements

The authors would like to thank participants of the European Economics and Finance Society (EEFS) 2022 Conference in Krakow for useful comments in an earlier version of this paper.

## References

Agyei-Ampomah, S., Gounopoulos, D., Mazouz, K., 2014. Does gold offer a better protection against losses in sovereign debt bonds than other metals? J. Bank. Financ. 40, 507–521.
Al-Thaqeb, S.A., Algharabali, B.G., Alabdulghafour, K.T., 2022. The pandemic and economic policy uncertainty. Int. J. Finance Econ. 27 (3), 2784–2794.
Albrecht, P., Kapounek, S., Kučerová, Z., 2022. Economic policy uncertainty and stock markets' co-movements. Int. J. Finance Econ..
Almås, I., 2012. International income inequality: Measuring PPP bias by estimating Engel curves for food. Amer. Econ. Rev. 102 (2), 1093–1117.
Athari, S.A., Kirikkaleli, D., Yousaf, I., Ali, S., 2022. Time and frequency co-movement between economic policy uncertainty and inflation: Evidence from Japan. J. Public Aff. 22, e2779.
Azad, N.F., Serletis, A., 2022. Spillovers of US monetary policy uncertainty on inflation targeting emerging economies. Emerg. Mark. Rev 51, 100875.
Baghestani, H., Mott, T., 1997. A cointegration analysis of the US money supply process. J. Macroecon. 19 (2), 269–283.
Baker, S.R., Bloom, N., Davis, S.J., 2016. Measuring economic policy uncertainty. Q. J. Econ. 131 (4), 1593–1636.
Baur, D.G., McDermott, T.K., 2010. Is gold a safe haven? International evidence. J. Bank. Financ. 34 (8), 1886–1898.
Beckmann, J., Berger, T., Czudaj, R., 2019. Gold price dynamics and the role of uncertainty. Quant. Finance 19 (4), 663–681.
Beckmann, J., Czudaj, R., 2017. Exchange rate expectations and economic policy uncertainty. Eur. J. Political Econ. 47, 148–162.
Boskin, M.J., Dulberger, E.L., Gordon, R.J., Griliches, Z., Jorgenson, D.W., 1998. Consumer prices, the consumer price index, and the cost of living. J. Econ. Perspect. 12 (1), 3–26.
Brunnermeier, M.K., Sannikov, Y., 2016. On the optimal inflation rate. Amer. Econ. Rev. 106 (5), 484–489.
Bryan, M.F., Cecchetti, S.G., 1993. The consumer price index as a measure of inflation. Econ. Rev. (Q IV), 15–24.
Calza, A., Zaghini, A., 2009. Nonlinearities in the dynamics of the euro area demand for M1. Macroecon. Dyn. 13 (1), 1–19.
Chatziantoniou, I., Gabauer, D., Stenfors, A., 2021. Interest rate swaps and the transmission mechanism of monetary policy: A quantile connectedness approach. Econom. Lett. 204, 109891.
Chen, H., Tillmann, P., 2021. Monetary policy uncertainty in China. J. Int. Money Finance 110, 102309.

Choi, S., Furceri, D., Loungani, P., Mishra, S., Poplawski-Ribeiro, M., 2018. Oil prices and inflation dynamics: Evidence from advanced and developing economies. J. Int. Money Finance 82, 71–96.
Conrad, C., Enders, Z., Glas, A., 2022. The role of information and experience for households' inflation expectations. Eur. Econ. Rev. 143, 104015.
Corbet, S., Goodell, J., Günay, S., 2020. Co-movements and spillovers of oil and renewable firms under extreme conditions: New evidence from negative WTI prices during COVID-19. Energy Econ. 92.
Corbet, S., Hou, Y., Hu, Y., Oxley, L., 2022a. Did COVID-19 tourism sector supports alleviate investor fear? Ann. Tour. Res. 95, 103434.
Corbet, S., Hou, Y., Hu, Y., Oxley, L., 2022b. Financial contagion among COVID-19 concept-related stocks in China. Appl. Econ. 54 (21), 2439–2452.
Cysne, R.P., Turchick, D., 2010. Money supply and capital accumulation on the transition path revisited. J. Money Credit Bank. 42 (6), 1173–1184.
De Pooter, M., Favara, G., Modugno, M., Wu, J., 2021. Reprint: Monetary policy uncertainty and monetary policy surprises. J. Int. Money Finance 114, 102401.
Diaconaşu, D.E., Mehdian, S.M., Stoica, O., 2022. The reaction of financial markets to Russia's invasion of Ukraine: evidence from gold, oil, bitcoin, and major stock markets. Appl. Econ. Lett. 1–5.
Donaldson, J.R., Piacentino, G., 2022. Money runs. J. Monetary Econ. 126, 35–57.
Gallagher, L.A., Taylor, M.P., 2002. The stock return–inflation puzzle revisited. Econom. Lett. 75 (2), 147–156.
Gao, R., Zhao, Y., Zhang, B., 2021. The spillover effects of economic policy uncertainty on the oil, gold, and stock markets: Evidence from China. Int. J. Finance Econ. 26 (2), 2134–2141.
Gilchrist, S., Schoenle, R., Sim, J., Zakrajšek, E., 2017. Inflation dynamics during the financial crisis. Amer. Econ. Rev. 107 (3), 785–823.
Goodell, J.W., McGee, R.J., McGroarty, F., 2020. Election uncertainty, economic policy uncertainty and financial market uncertainty: a prediction market analysis. J. Bank. Financ. 110, 105684.
Heise, S., Karahan, F., Şahin, A., 2022. The missing inflation puzzle: The role of the wage-price pass-through. J. Money Credit Bank. 54 (S1), 7–51.
Hobijn, B., Miles, R., Royal, J., Zhang, J., et al., 2022. What Is Driving US Inflation amid a Global Inflation Surge. Chicago Fed Letter, Federal Reserve Bank of Chicago, p. 470.
Hoffmann, M., Moench, E., Pavlova, L., Schultefrankenfeld, G., 2022. Would households understand average inflation targeting? J. Monetary Econ..
Huang, S., Liu, H., 2021. Impact of COVID-19 on stock price crash risk: Evidence from Chinese energy firms. Energy Econ. 101.
Husted, L., Rogers, J., Sun, B., 2020. Monetary policy uncertainty. J. Monetary Econ. 115, 20–36.
Kilian, L., Zhou, X., 2022. The impact of rising oil prices on US inflation and inflation expectations in 2020–23. Energy Econ. 113, 106228.
Kurov, A., Stan, R., 2018. Monetary policy uncertainty and the market reaction to macroeconomic news. J. Bank. Financ. 86, 127–142.
Kyriazis, N., Papadamou, S., Tzeremes, P., Corbet, S., 2022. The differential influence of social media sentiment on cryptocurrency returns and volatility during COVID-19. Q. Rev. Econ. Finance.
Lucas, R.E., 1973. Some international evidence on output-inflation tradeoffs. Am. Econ. Rev. 63 (3), 326–334.
Luo, J., Demirer, R., Gupta, R., Ji, Q., 2022. Forecasting oil and gold volatilities with sentiment indicators under structural breaks. Energy Econ. 105, 105751.
Ma, Y., Wang, Z., He, F., 2022. How do economic policy uncertainties affect stock market volatility? Evidence from G7 countries. Int. J. Finance Econ. 27 (2), 2303–2325.
Mensi, W., Al Rababa'a, A., Vo, X., Kang, S., 2021. Asymmetric spillover and network connectedness between crude oil, gold, and Chinese sector stock markets. Energy Econ. 98.
O'Connor, F.A., Lucey, B.M., Batten, J.A., Baur, D.G., 2015. The financial economics of gold—A survey. Int. Rev. Financ. Anal. 41, 186–205.
Poshakwale, S.S., Mandal, A., 2016. Determinants of asymmetric return comovements of gold and other financial assets. Int. Rev. Financ. Anal. 47, 229–242.
Reboredo, J.C., 2013. Is gold a safe haven or a hedge for the US dollar? Implications for risk management. J. Bank. Financ. 37 (8), 2665–2676.
Schmitt-Grohé, S., Uribe, M., 2022. What Do Long Data Tell Us About the Inflation Hike Post COVID-19 Pandemic?. Technical Report, National Bureau of Economic Research.
Selmi, R., Bouoiyour, J., Wohar, M.E., Errami, Y., 2020. Is there an effect of policy-related uncertainty on inflation? evidence from the United States under Trump. Appl. Econ. 52 (35), 3858–3873.
Sharma, S.S., 2016. Can consumer price index predict gold price returns? Econ. Model. 55, 269–278.
Smith, L., Tarui, N., Yamagata, T., 2021. Assessing the impact of COVID-19 on global fossil fuel consumption and CO2 emissions. Energy Econ. 97.
Tillmann, P., 2020. Monetary policy uncertainty and the response of the yield curve to policy shocks. J. Money Credit Bank. 52 (4), 803–833.
Tiwari, A.K., Abakah, E.J.A., Abdullah, M., Adeabah, D., Sahay, V.S., 2024. Time-varying relationship between international monetary policy and energy markets. Energy Econ. 131, 107339.
Wang, L., 2022. The dynamics of money supply determination under asset purchase programs: A market-based versus a bank-based financial system. J. Int. Financ. Mark. Inst. Money 101593.
Wen, F., Min, F., Zhang, Y.-J., Yang, C., 2019. Crude oil price shocks, monetary policy, and China's economy. Int. J. Finance Econ. 24 (2), 812–827.
Wen, F., Tong, X., Ren, X., 2022. Gold or Bitcoin, which is the safe haven during the COVID-19 pandemic? Int. Rev. Financ. Anal. 81, 102121.
Yang, T., Zhou, F., Du, M., Du, Q., Zhou, S., 2023. Fluctuation in the global oil market, stock market volatility, and economic policy uncertainty: a study of the US and China. Q. Rev. Econ. Financ. 87, 377–387.