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Original Article

Gold Price, Oil Price, and Stock Market Return Spillovers: Empirical Evidence from Vietnam

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Abstract: This paper analyzes the spillovers of oil prices, gold prices and stock market returns in Vietnam. By adopting the time-varying parameter vector autoregression model (TVP-VAR), the results show a moderate interdependence among the variables from 2010-2022. Additionally, the relationship between oil prices, gold prices, and stock market returns changes over time and is influenced by economic and political events. Overall, stock market returns are net shock transmitters with the highest volatility among all the variables, while the oil and gold markets are net recipients. Finally, our results remain robust to Vietnam's alternative stock market index.

Keywords: Oil price, gold price, Vietnam stock market, TVP-VAR.

1. Introduction

Vietnam has recently witnessed many events that hugely influence the financial markets, such as market manipulations, the spread of false rumors, the divestment of state-owned enterprises, and shocks in corporate bond markets. Due to this complicated context, investors have been more interested in finding assets to hedge risks. Gold tends to be one of the appropriate assets for investors to diversify their portfolios, especially when other markets show negative signs (Baur & Lucey, 2010). Besides, oil also gains increasing concern from investors in recent years because it is an investment channel (Li et al., 2019) and an essential energy source in the economy (Wu & Wang, 2021). The paper aims to analyze the interaction among gold price, oil price, and stock market returns on the Vietnamese stock market and gives some recommendations for investors, especially in the context of financial market changes in recent years.

This paper combines with, and relates to, three strands of literature. Firstly, our research examines the interactive relationship between oil prices and stock market returns. While many studies proved the positive impact of oil prices on stock market returns (Tran, 2015; Tursoy & Faisal, 2018), recent evidence also suggests the negative impacts of oil price on stock market returns (Elyasiani et al., 2011; Kang et al., 2015). Secondly, Nguyen & Nguyen (2013) and

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Singhal et al. (2019) showed that gold prices have a positive relationship with stock market returns. The negative relationship impact of stock market returns on the gold market are also found in studies by Xiaozhong et al. (2022) and Kareem et al. (2020). Finally, many authors have compiled literature focusing on exploring the relationship between gold prices and oil prices (Salem et al., 2022; Chai et al., 2021; Singhal et al., 2019). Most studies in this field have only focused on developed countries such as the United States, the United Kingdom, Australia, Canada, and other European countries (Ansari & Sensarma, 2019; Managi et al., 2022; Tursoy & Faisal, 2018). However, there is limited research on this topic in frontier and emerging countries, including Vietnam.

The aim of this paper is to examine the relationship among gold prices, oil prices and stock market returns in an emerging country – Vietnam. By adopting the time-varying parameter vector autoregression (TVP-VAR) and data collected from January 2010 to October 2022, this study shows that the relationship among gold prices, oil prices, and stock market returns change over time, depending on economic and political events. The findings make an essential contribution to research in the field of financial and commodities markets. The findings also give several policy implications for managing these markets.

2. Literature review

2.1. Oil prices and stock market returns

There has been little agreement on the relationship between oil prices and stock market returns. The authors show positive, negative, or no significant relationship between oil prices and stock market returns. Firstly, oil prices have a weak or no relationship with stock market returns. Berk and Aydogan (2012) found a weak influence of oil price changes on the Istanbul Stock Exchange from 1990-2011. This result is consistent with another study conducted by Gokmenoglu and Fazlollahi (2015).

On the other hand, oil prices have a clear relationship with stock market returns. Tursoy and Faisal (2018) concluded that Turkey's crude oil prices and stock market returns have a positive relationship. Similarly, in the Vietnamese stock market, Tran (2015) also found a positive correlation between global oil prices and stock market returns. However, the study conducted by Elyasiani et al. (2011) provides evidence that oil price volatility constitutes a systemic risk to asset prices at the industry level. The findings reveal that fluctuations in oil prices impact the profitability of 9 out of the total 13 industry indices examined. Kang et al. (2015) also suggested that positive shocks in the oil market are associated with negative impacts on stock market profitability and volatility.

These conflicting views on the relationship between oil prices and stock market returns, especially in Vietnam, indicate that it is still an important issue that requires further research and is a significant factor in explaining stock price fluctuations.

2.2. Gold prices and stock market returns

Some studies have shown that gold prices positively correlate with stock market returns. According to Nguyen and Nguyen (2013), changes in gold prices are positively correlated with the changes in the VN-Index. This result is also confirmed in a study conducted in the Mexican market (Singhal et al., 2019). Gold is considered a haven and an alternative investment during unfavourable market fluctuations (Akbar et al., 2019; Jain & Biswal, 2016).

However, many studies show an inverse relationship between gold prices and stock market returns. Xiaozhong et al. (2022) concluded that gold prices negatively impact the profitability of the Chinese stock market. Similarly, Truong and Vo (2010) found that when gold prices increase (decrease) by 1%, the stock returns will decrease (increase) by 0.72%. This finding is consistent with results in several studies conducted in the Hong Kong market (Garefalakis et al., 2011), the Malaysian stock market (Kareem et al., 2020), and the Pakistani market (Ali et al., 2020).

Overall, only a few studies have been conducted in the context of Vietnam. Although most indicate a positive correlation in the relationship between gold prices and stock market returns, debate has continued about the direction of this relationship.

2.3. Oil prices and gold prices

Few studies have shown an insignificant correlation between gold and oil prices (Chang et al., 2013; Seyyedi, 2017). Chang et al. (2013) also demonstrated that oil prices, gold prices and exchange rates are significantly independent in the Taiwan stock market. Similarly, Seyyedi (2017) investigated the Indian market and found no correlation or interdependence between oil and gold prices.

In contrast, several studies have found a mutual impact between gold and oil prices, and they move in the same direction. Chai et al. (2021) concluded that crude oil and VIX profit shocks positively affect gold prices. Ben Salem et al. (2022) obtained similar results during the COVID-19 period. In other words, oil prices and gold prices have a positive relationship. Gold and oil prices also have an inverse relationship (Singhal et al., 2019). The relationship between gold and oil prices has only been indirectly explained through their relationship with exchange rates (Chang et al., 2013; Ewing & Malik, 2013; Malliaris & Malliaris, 2009). However, researchers have yet to detail the relationship between gold and oil prices in Vietnam.

3. Data and methodology

3.1. Data

The research data in this paper is drawn from three primary sources: Data on stock market indices for Vietnam (VN-Index) was collected from the Fiinpro Platform, which is a financial database in Vietnam. Data on the Brent crude oil price was collected from the US Energy Information Administration, and the Vietnam Gold Price Index (Gold Index) was collected from the General Statistics Office of Vietnam. We used monthly data between January 2010 and October 2022 to examine the relationship among variables under many national and international economic and political events. Monthly data is appropriate when studying the dependency structure between variables because, according to Reboredo (2013), monthly data can avoid noise and biases more than daily or weekly data. It helps to avoid distorting the dependent relationship and complicating the marginal distribution model due to many reasons, such as non-stationary variables, skewed distributions, or the presence of serial correlation in the original data series. The data was processed using monthly growth estimates.

3.2. Research method

The research study utilizes the Time-varying parameter vector autoregressions (TVP-VAR) model, introduced by Antonakakis and Gabauer (2017) in conjunction with the connectedness approach, introduced by Diebold and Yilmaz (2014), and Koop and Korobilis (2014) to analyze the impact and degree of connectivity between oil prices, gold prices, and stock returns in Vietnam. The TVP-VAR model has the main benefit of not having to choose the window size, no loss of observations, no exogenous problems, and not too volatile or too fixed parameters. TVP-VAR assigns equal weights to each observation, allowing for a more comprehensive understanding of the interplay of shocks.

$$y_t = \beta_t z_{t-1} + \epsilon_t$$
$$\epsilon_t | F_{t-1} \sim N(0, S_t) \quad (3.1)$$
$$vec(\beta_t) = vec(\beta_{t-1}) + v_t$$
$$v_t | F_{t-1} \sim N(0, R_t) \quad (3.2)$$

In there:

y_t are matrices of size $N \times 1$

$z_{t-1} = (y_{t-1}\; y_{t-2}\; \vdots\; y_{t-p})$ are matrices of size $Np \times 1$

$\beta_t = (\beta_{1t}\; \beta_{2t}\; \dots\; \beta_{pt})$ is a time-varying parameter matrix of size $N \times Np$

β_{kt} is the time-varying parameter matrix at the delay *k,* size matrix $N \times N$

ϵ_t is a residual matrix of size $N \times 1$

F_{t-1} is representative of all information available to date *t - 1*

S_t is the time-varying covariance-variance matrix $N \times N$

$vec(\beta_t), vec(\beta_{t-1})$ is vectorization β_t and β_{t-1}, these are matrices of size $N^2p \times 1$

v_t is a matrix of size $N^2p \times 1$

R_t are matrices of size $N^2p \times N^2p$

The use of the TVP-VAR model in this study serves two purposes: (1) To analyze Generalized Impulse Response Functions (GIRF) to examine the impact of shocks that vary from one variable to all variables in the system; and (2) To analyze Generalized Forecast Error Variance Decomposition (GFEVD) to understand the amount of information that each variable contributes to other variables in the autoregressive process (Koop et al., 1996; Pesaran & Shin, 1998).

After estimating the time-varying parameters, the TVP-VAR model is transformed into a Vector Moving Average (VMA) representation, following the Wold representation theorem, in order to analyze the generalized impulse response and generalized forecast error variance decomposition.

$$y_t = \sum_{j=0}^{\infty} L' W_t^j L \epsilon_{t-j} = \sum_{j=0}^{\infty} A_{jt} \epsilon_{t-j} \quad (3.3)$$

In which:

$L = (I \; 0 \; \vdots \; 0)$ is a matrix of size $Np \times N$

$W_t = \begin{pmatrix} \beta_t & I_{N(p-1)} & 0_{N(p-1)\times N} \end{pmatrix}$ is a matrix of size $Np \times Np$

$A_{jt} = L' W_t^j L$ is a matrix of size $N \times N$

Subsequently, the study analyses the impulse response function and the variance decomposition. Firstly, it represents the response of all variables to a shock generated by variable *i*. As we assume no structural changes, this response can be measured by the difference between the forecast values at period *J* with the shock from variable *i* and without the shock from variable *i*. This difference is attributed to the shock of variable *i* and is calculated by the formula:

$$GIRF_t(J, \delta_{j,t}, F_{t-1}) = E(Y_{t+J} | \epsilon_{j,t} = \delta_{j,t}, F_{t-1}) - E(F_{t-1}) \quad (3.4)$$

$$\varphi_{j,t}^g(J) = \frac{A_{J,t} S_t \epsilon_{j,t}}{\sqrt{S_{ij,t}}} \frac{\delta_{j,t}}{\sqrt{S_{ij,t}}}, \quad \delta_{j,t} = \sqrt{S_{ij,t}}$$

$$\varphi_{j,t}^g(J) = S_{jj,t}^{-\frac{1}{2}} A_{J,t} S_t \epsilon_{j,t}$$

In which: $\varphi_{j,t}^g(J)$ is the response function of the variable *j*; *J* is the forecast period; $\delta_{j,t}$ is the vector with values of 1 at position j and 0 at other positions.

Secondly, the generalized forecast error variance decomposition (GFEVD) can be understood as examining the variance of one variable's influence on other variables. $\tilde{\phi}_{ij,t}^g(J)$ is a pairwise connection in the direction from *j* to *i*, which implies that the shock effect of variable *j* to variable *i*, is determined as follows:

$$\tilde{\phi}_{ij,t}^g(J) = \frac{\sum_{t=1}^{J-1} \varphi_{ij,t}^{2,g}}{\sum_{j=1}^{N} \sum_{t=1}^{J-1} \varphi_{ij,t}^{2,g}} \quad (3.5)$$

In which: $\sum_{j=1}^{N} \tilde{\phi}_{ij,t}^g(J) = 1$ and $\sum_{i,j=1}^{N} \tilde{\phi}_{ij,t}^N(J) = N$.

In the above formula, the denominator represents the cumulative impact of all shocks, while the numerator illustrates the cumulative impact of a shock from variable *i*.

This overall net directed connectedness can be understood as the influence of variable *i* in the analyzed network. To calculate more specific measures of connectedness, based on the equation above, the net pairwise directional connectedness (NPDC) index is used to assess the influence between variable *i* and variable *j*:

$$NPDC_{ij}(J) = \tilde{\phi}_{ji,t}(J) - \tilde{\phi}_{ij,t}(J) \quad (3.6)$$

$NPDC_{ij}(J)$ has a positive or negative value that corresponds to the respective significance of variable *i* influencing, or being influenced by, variable *j*. In this study, the data after being statistically processed, calculated, and tested for stationarity using Excel and Eviews software will be inputted into the data processing website for TVP-VAR modeling.

4. Empirical results

4.1. Descriptive statistics

Figure 1 exhibits the evolution of the series during the sample period. In general, gold price, oil price and the VN-Index exhibit similar trends. All three variables peaked and bottomed in September 2011, the third quarter of 2016, and April 2020. These periods coincide with economic events, such as high inflation in 2011, China's HD-981 oil rig placement in Vietnamese waters in 2015, the Brexit event in June 2016, and the US Presidential election results on 9/11/2016. In the gold market in 2012, stability in volatility began in 2012 due to the management of the State Bank for SJC gold. Comparing the chart showing the change in oil price at the same time, the VN-Index has reached three consecutive peaks. However, the oil price change was insignificant because the participation of oil and gas enterprises in the stock market was still limited at that time. Generally, the relationship between these three markets is positive, but in the face of adverse shocks, the gold market is more sensitive than the others.

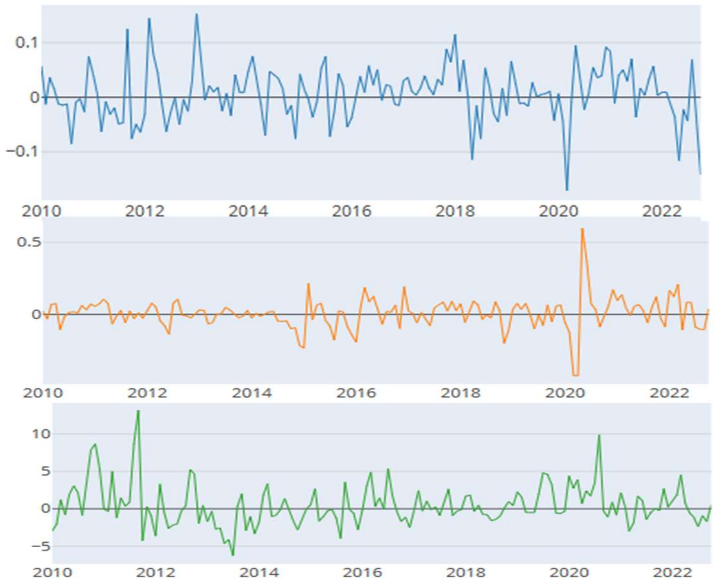

Figure 1: Time series plot of VN-Index, Oil prices, Gold prices from January 2010 to October 2022
Source: Author's calculation.

Table 1 reports descriptive statistics of the VN-Index for the variables. The positive mean of values of these variables indicates an increasing trend in price. Regarding variance, gold price is the variable with the most volatility or vulnerability with the highest variance index. The VN-Index is the least volatile variable. These return series show skewness and kurtosis, indicating that these chains are not normally distributed, in which the VN-Index is the left-skewed variable, and oil price and gold price are right skewed. More specifically, the Jarque-Bera statistic has shown that all these returns have a normal distribution with a significance level of 10%. VN-Index and gold prices are stationary at a 5% significance level, and oil prices at a 1% significance level. All variables are not normally distributed, so the TVP-VAR model with time-varying covariances is appropriate.

Table 1: Summary statistics

	VN-Index	**Oil Price**	**Gold Index**
Mean	0.006	0.008	0.498
Variance	0.002	0.012	7.671
Skewness	-0.194	0.344*	1.254***
Ex.Kurtosis	1.267**	7.611***	3.267***
JB	11.269***	374.732***	108.868***
ERS	-2.430**	-5.848***	-2.118**
Q(10)	10.194*	21.734***	28.157***
Q2(10)	2.305	91.617***	22.492***

Notes: ***, **, and * denote significance at 1%, 5% and 10% significance levels respectively; Skewness: D'Agostino (1970) test; Kurtosis: Anscombe and Glynn (1983) test; JB: Jarque and Bera (1980) normality test; ERS: Stock et al. (1996) unit root test; Q(10) and Q2(10): Fisher and Gallagher (2012) weighted portmanteau test.
Source: Author's own calculation.

4.2. Correlation matrix

Table 2 presents the pairwise correlation matrix of the variables in the regression model. The three variables' positive correlation coefficients show a positive correlation between gold price, oil price and stock market profitability. This result is consistent with (Chai et al., 2021; Mo et al., 2018; Tursoy & Faisal, 2018) when suggesting a positive relationship between oil prices and stock market returns. Table 2 also shows a positive correlation between the gold price and stock returns, which have the same index between the gold price and oil price and are at approximately 0.1. This finding is consistent with previous studies (Kaliyamoorthy & Parithi, 2012; Singhal et al., 2019; Truong & Vo, 2010), which indicated a positive relationship between gold prices and stock market returns. Among the correlation pairs, oil prices have the strongest positive correlation with stock market returns and a high correlation coefficient of about 0.3095. This result is consistent with previous studies such as Managi et al. (2022) and Tran (2015).

Table 2: Pairwise correlation matrix

Probability	VN-Index	Oil Price	Gold Index
VN-Index	1.000.000		
Oil Price	0.309592	1.000.000	
Gold Index	0.103014	0.121239	1.000.000

Source: Calculation from Eviews 10.0.

4.3. The time-varying relationship between oil prices, gold prices, and stock market returns

4.3.1. Stationary test results

The degree of stationarity of the data series uses the Augmented Dickey-Fuller (ADF) test proposed by Engle & Granger (2015) and uses the Phillips-Perron test (Phillips & Perron, 1988). All variables are stationary at a significance level of 1%.

4.3.2. Dynamic total connectedness

The time-varying connectedness measures of the oil prices, gold prices and stock market returns are shown in Figure 2. Overall, the total connectedness index among the three variables changes over time, and it is at the moderate level over the study period, ranging from 13% to 41%. Furthermore, connectedness has increased during economic turmoil, geopolitical instability, and unfavourable natural conditions. The highest connection was in 2010-2012, when high global and domestic inflation rates in Vietnam increased, there was a real estate freeze, and record-breaking gold prices. Figure 2 also shows that after this period, when the macroeconomic situation became more stable, the spillover decreased slightly. However, it increased again in early 2017 when the stock market developed and strongly heated up. The possible reason is that the OPEC commitment positively impacted Vietnam's stock market by influencing corporate oil and gas industry stocks. From 2020 to the end of 2021, the level of connectedness remained at a high level of nearly 20%, due to the complicated developments of the COVID-19 pandemic, the import and export of crude oil, and gold, silver, and gems were hindered.

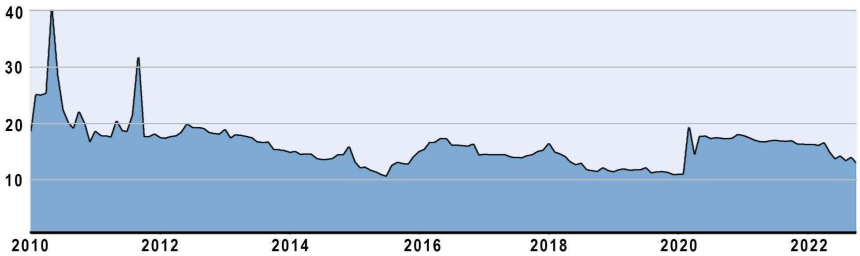

Figure 2: Dynamic total connectedness.
Notes: Results are based on a TVP-VAR model with a lag length of order two (BIC) and a 10-step-ahead generalised forecast error variance decomposition.
Source: Author's own calculation.

4.3.3. Averaged dynamic connectedness

The results in Table 3 indicate the average level of spillover among variables. Each row of the table corresponds to the influence of each variable on the other two. At the same time, each column shows the variance of the forecast error that the other variables contributed to each variable separately. Elements above the main diagonal (bold) indicate individual variable effects, while elements off the diagonal represent a transmit/receive effect on other elements. The total connectedness index is approximately 16.05%, so the interdependence between the variables in the study range is at a moderate level of connection. These results indicate that about 85% of the variance in forecast errors can be attributed to individual variability innovations. In addition, the NET spillover effect index shows that the stock market returns are the transmitter of shocks, while oil and gold prices are the recipients.

Table 3: Averaged dynamic connectedness table

	VN-Index	**Oil Price**	**Gold Index**	**FROM**
VN-Index	89.37	6.85	3.78	10.63
Oil Price	7.27	88.08	4.66	11.92
Gold Index	7.98	1.56	90.46	9.54
TO	15.24	8.42	8.44	32.10
Inc.Own	104.61	96.49	98.90	cTCI/TCI
NET	4.61	-3.51	-1.10	16.05/10.70
NPDC transmitter	2.00	0.00	1.00	

Notes: Values reported are variance decompositions for the estimated TVP-VAR(2) model.
A lag length of order 2 was selected by the Bayesian information criterion.
Variance decompositions are based on a 10-step-ahead forecast.
Source: Author's own calculation.

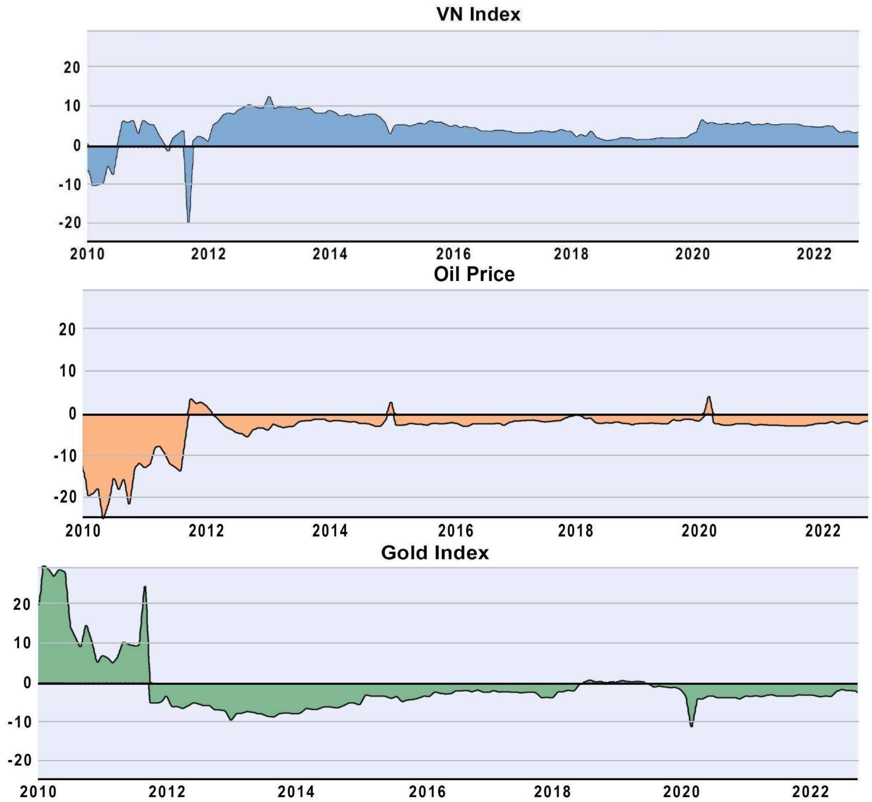

Figure 3: Net directional connectedness.
Notes: Results are based on a TVP-VAR model with a lag length of order two (BIC) and a 10-step-ahead generalised forecast error variance decomposition.
Source: Author's own calculation.

As can be seen from Figure 3, the variable with positive connectedness (above line 0) is the variable that transmits the shock, and vice versa. During the 2010-2012 period of the study, the gold price was the principal transmitter of shocks. A possible reason may be that since 2012, the Vietnamese government has issued a series of policies for the “anti-goldenization” of the financial market; such as prohibiting the mobilization and lending of gold by commercial banks and by declaring SJC to become the only national gold bar brand. The above policies eliminated the impact of gold prices on the whole system. From the end of 2011 onwards, the gold price was mainly a net recipient by the influence of high inflation. The stock market’s strong performance simultaneously suppressed the sharp increase in the gold price, resulting in a period where the role of the stock market alternated between transmitting and receiving impacts. In the remaining period from 2012 to 2022, the VN-Index will ultimately be a net transmitter.

4.3.4. Net pairwise directional connectedness (NPDC)

Figure 4 illustrates that the impact direction of this pair of variables remains the same, with the stock market as the transmitting factor to influence gold prices. The connectedness between the stock market index and gold prices is relatively strong during the research period. However, at the beginning of 2010 and the end of 2012, fluctuations in the value of gold had a significant impact on the stock market. This was primarily triggered by the legal action taken against individuals such as Mr. Nguyen Duc Kien and Mr. Tran Bac Ha, who were members of the Board of Directors at the Asia Commercial Joint Stock Bank. They committed illegal business, tax evasion, and unauthorized trading in gold at the end of 2012.

Figure 4: Net pairwise directional connectedness
Notes: Results are based on a TVP-VAR model with a lag length of order two (BIC) and a 10-step-ahead generalised forecast error variance decomposition.
Source: Author’s own calculation.

In addition, the connection between the stock market and the gold price in Vietnam is stronger than the spillover between the stock market and the oil price. This may be due to the habit of Vietnamese people in keeping gold. Figure 4 shows the price of Oil acted as a shock transmitter to the stock market in 2011 and the period 2015-2020.

Meanwhile, the stock market is the agent that transmits shock to the oil price in 2010, 2012-2014 and 2020-2022. In the period from 2010 to 2020, the gold price is the factor that plays a role in influencing oil prices. Nevertheless, from 2020 to 2022, the gold price becomes the recipient, and the oil price is the transmission factor affecting the gold price.

4.4. Robustness tests

To do the robustness test, we repeat the above steps with the HNX-Index instead of the VN-Index. The HNX-Index's data has been tested for stationarity by the ADF and Phillips-Perron methods before being included in the analysis website.

Dynamic total connectedness

It can be seen from Figure 5 that the graph shape is similar to Figure 2; the level of connectivity is highest in the period 2010-2014 and then tends to decrease and stabilize.

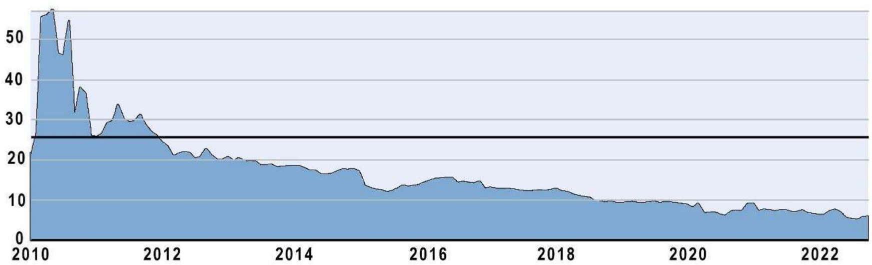

Figure 5: Dynamic total connectedness, using HNX-Index
Notes: Results are based on a TVP-VAR model with a lag length of order two (BIC) and a 10-step-ahead generalised forecast error variance decomposition.
Source: Author's own calculation.

Table 6: Averaged dynamic connectedness table, using the HNX-Index

	HNX index	Oil Price	Gold Index	FROM
HNX index	92.77	5.81	1.42	7.23
Oil Price	7.34	90.50	2.16	9.50
Gold Index	13.94	1.83	84.22	15.78
TO	21.28	7.64	3.58	32.50
Inc.Own	114.05	98.14	87.81	cTCI/TCI
NET	14.05	-1.86	-12.19	16.25/10.83
NPT	2.00	0.00	1.00	

Notes: Results are based on a TVP-VAR model with a lag length of order two (BIC) and a 10-step-ahead generalised forecast error variance decomposition.
Source: Author's own calculation.

The results of average connectivity based on data from the Hanoi Stock Exchange - HNX, the Brent oil price and gold price are shown in Table 6. It can be seen that the TCI value when using data on HNX (10.83%) is higher but not significantly higher than when using data on HOSE (10.7%). However, the interdependence between the variables is still moderate. Similar to Table 6 above, the authors' results observing the NET spillover effect find that the stock market still maintains the role of an impact transmission factor. In contrast, oil and gold prices are the influencing factors.

Net directional connectedness (NDC)

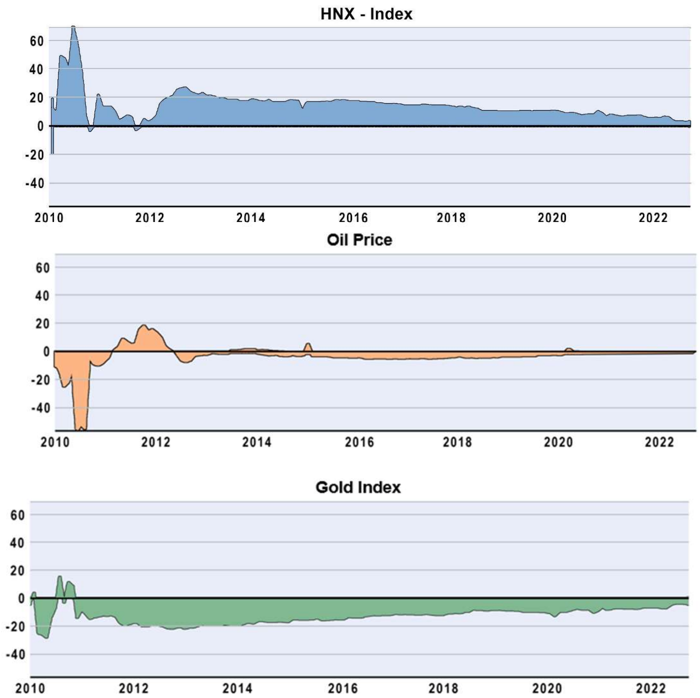

Figure 6: Net directional connectedness, using HNX-Index
Notes: Results are based on a TVP-VAR model with a lag length of order two (BIC) and a 10-step-ahead generalised forecast error variance decomposition.
Source: Author's own calculation.

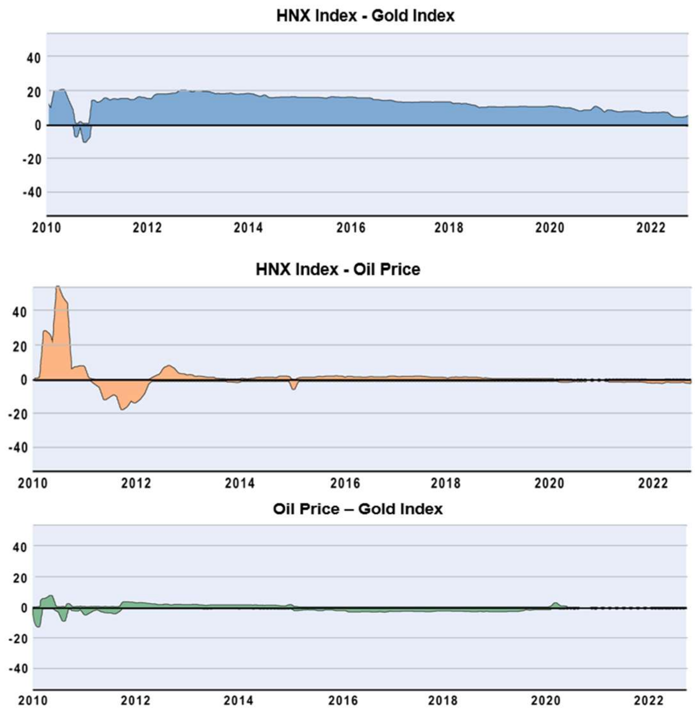

Figure 7: Net pairwise directional connectedness, using HNX-Index
Notes: Results are based on a TVP-VAR model with a lag length of order two (BIC) and a 10-step-ahead generalised forecast error variance decomposition.
Source: Author's own calculation.

Figure 6 depicts the degree of directional connection of three variables and has similar results with the data set using the VN-Index. Most of the time, the HNX-Index plays an influential role and is quite strong compared to the HOSE stock market. In addition to the oil price, the gold price still plays the role of transmitting/receiving the impact and mainly receiving the impact from the remaining variables. It can be seen that the degree of influence of the oil price is lower than the result in Figure 3. In contrast, gold prices showed a strong influence and remained at 10-20% during the study period.

Net pairwise directional connectedness (NPDC)

The results of connectedness with the direction of the pair of variables also give similar results with the data set VN-Index, oil prices, and gold prices. Finally, after testing the robustness of the results, we further confirmed the accuracy of the research results, showing that the analytical results are meaningful and highly accurate. In addition, it can be confirmed that in some periods, the HNX-Index has more relevance to the two variables of oil price and gold price in the Vietnamese economy.

5. Conclusions and recommendations

The objective of this paper is to investigate the relationship between gold prices, oil prices, and stock market returns in an emerging country – Vietnam. We established a network consisting of three variables by employing a time-varying parameter vector autoregression (TVP-VAR)-based spillover framework. Our results show a moderate connectedness among gold prices, oil prices, and stock market returns from 2010 to 2022. Moreover, the spillover tends to be driven by time-specific developments and events. We found that the spillover tends to increase in times of turmoil, geopolitical instability, and unfavorable natural conditions; for instance, in 2010-2012, 2017, and 2020. The second significant finding was that the stock market tends to be the principal net transmitter of shocks, while oil and gold prices are the net receivers in the network.

The finding of a moderate relationship among gold prices, oil prices, and stock market returns suggest that a shock in one of three markets will likely influence the others, thus posing spillover risks to the whole system. Thus, the Vietnamese government should monitor the system in all three above variables before implementing policies in each market. Secondly, the total connectedness is also driven by time-specific developments and events, suggesting increased systematic risks in times of turmoil, geopolitical instability, and unfavorable natural conditions. This indicates that the government needs to be careful in issuing new policies in these periods. Thirdly, the stock market is one of the decisive factors in the performance of commodity markets in Vietnam. From a market heavily influenced by gold trading activities (before 2012), Vietnam's financial system is now mainly influenced by the stock market. An implication of this is the possibility that the Vietnamese government should closely monitor abnormal changes in the stock market because any shocks in the stock market can contribute to the systematic risk to the financial market.

However, this study currently adopts the Brent crude oil price to represent changes in oil prices instead of those in Vietnam. This is because oil prices in Vietnam are currently tightly regulated by the government with a frequency of every ten days, so we used the Brent oil prices to reflect continuous changes in oil prices reasonably. This limitation means that study findings need to be interpreted cautiously. In addition, this study examined merely three concepts in the spillover network. Further studies can examine other typical concepts in emerging markets, such as investor sentiment and commodity prices.

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