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| DETERMINANTS OF THE VIETNAMESE GOLD PRICE IN THE PERIOD OF COVID-19 | |
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| **DINH, Dai Nam**  **Supervisor: M.Sc. Bui Duong Hai** | |
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| A project presented in part requirement of the degree of Bachelor of Arts with honors in Banking and Finance of the University of the West of England, Bristol | |
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| Faculty of Business and Law | |
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|  |  |  |  | ***Thank you,***  ***Dinh Dai Nam*** |

# **Abstract**

**The article explores the impact of factors affecting the price of gold in Vietnam during the pandemic. The regression model, VAR model, and GARCH model are used to estimate the relationship among variables.** The result shows that, the exchange rate, Interest rate, CPI index, and Covid-19 epidemic waves have influenced domestic gold prices during the pandemic period.

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# **Chapter 1: Introduction**

Currently, investment channels are fluctuating unpredictably because of the impact of the pandemic. The price of gold is one of the factors affected by that volatility. Gold plays a crucial role in a country's economy, especially in the current context of the global economic crisis, prolonged domestic inflation, and volatility in the stock market. With the people's long-standing practice of hoarding gold, gold has become an important investment channel to preserve the value of assets held.

Moreover, the outbreak of a new coronavirus, SARS-CoV-2, China, has rapidly escalated into an epidemic dubbed Covid-19. To prevent the spread of Covid-19 inside nations, a variety of preventative methods are utilized, including lockdown, social distance, isolation, and quarantine. Therefore, the prices of most commodities during this period fluctuated abnormally.

Gold is no exception. Currently, there is no research document on the issue of gold price related to Covid in Vietnam. Therefore, it is particularly important to learn about this issue. In this research, I will focus on understanding the change of Vietnam gold price before and during covid with two research questions:

**What factors influenced Vietnam's gold price before and during the pandemic?**

**How has the Covid-19 pandemic affected the price of gold in Vietnam?**

**The next chapter will be literature review and hypothesis building. Chapter 3 will be about data and methodology. Chapter 4 is the results and comments. Chapter 5 is the conclusion. Chapters 6 and 7 are references and appendix, respectively.**

**Chapter 2: Literature review and Hypothesis development**

## **2.1 Role of gold in economic**

In general, gold is valuable in four respects: gold is a precious metal; gold is a special commodity; gold is an investment; and gold is the national reserve. Therefore, the fluctuation of the gold price is correlated with the variability of the socio-economic situation.

In Vietnam, according to the State Audit Office of Vietnam in 2012, Vietnamese population stored approximately four hundred tons of gold, equivalent to 20 billion USD, approximately 13% of GDP at that time (155.8 billion USD). Gold reserves account for a substantial proportion of the economy. Therefore, investors, as well as reserve people, are extremely interested in the fluctuation of gold price.

The World Gold Council (WGC, 2021) has published an inquiry study on individual gold investment in Vietnam, concluding that Vietnam is Southeast Asia's largest gold consumer market with development potential. In 2020, a study of over two thousand retail gold investors in Vietnam found that interest in gold is extremely high, as the Vietnamese believe that gold is an excellent hedge. Gold is the preferred investment product of the Vietnamese, accounting for 68% of investors, more than any other asset class. 81% agree that gold is a good hedge against periods of uncertainty. The gold market in Vietnam has a positive outlook; 81% of those who buy gold consider buying more gold.

## **2.2 Unit of measurement**

On the world market, gold is usually measured in units of ounces or troy ounces, 1 ounce is equivalent to 31.103476 grams, usually listed as follows:

• Price listing unit (normal): USD/ounce

• 1 ounce = 1 troy ounce = 0.83 taels

• 1 tael = 1.20556 ounces

In Vietnam, the volume of gold is measured in units of tael or mace. An amount of tael weighs 37.50 grams. One mace is only 1/10 of the amount of tael, listed as follows:

• Price listing unit: VND/tael

Formula to convert gold price from USD/oz unit to VND/tael:

Converted price (in local currency) = (International price (USD) + freight + insurance) × (1 + gold import tariff) × USD/VND exchange rate + fabrication fees + custom fees.

## **2.3 Previous research on factors affecting gold price**

Researchers have developed numerous approaches to the elements affecting the price of gold. Numerous scholars have examined the relationship between the gold price and the rate of inflation (Shafiee and Topal, 2010; Oloko et al., 2021). Other scholars have examined gold investments as "safe-haven" assets (El Hedi Arouri, Lahiani and Nguyen, 2015; Salisu, Vo and Lucey, 2021), the relationship between gold and oil prices (Wang and Chueh, 2013a), and the linkage between business periods (Pierdzioch, Risse and Rohloff, 2014). Other researchers, on the other hand, have concentrated their efforts on the relationship between gold prices and currency exchange rates (Beckmann, Czudaj and Pilbeam, 2015; Tanin, Sarker and Brooks, 2021). Some articles also use the time series model to predict gold price rather than understand the effects of other factors on price. Research by Ping, Miswan, & Ahmad (2013) aim is to forecast Malaysian gold price, two approaches are considered, ARIMA and GARCH model. Using Akaike's information criterion (AIC) to select the appropriate model, the study concludes that GARCH is a more appropriate model. Or (Yaziz et al., 2016) use the ARIMA-TGARCH model of 2845 daily world gold price from January 2, 2003, to June 12, 2014, to predice the price.

However, there is no consensus among researchers on the core determinants of gold prices. Therefore, when building a model to find out the factors that affect the gold price, scholars based on the research purpose and the general situation of the economy to add independent variables suitably. Commonly used variables when building gold price models in regions are the combination of the local currency's exchange rate against the US dollar, the world gold price, and other macro variables such as CPI, inflation rate, or GDP. According to Cai, Cheung, and Wong (2001), The Employment report, GDP, CPI, and personal income, proved to be the most significant announcements for the US gold market (Cai, Cheung, and Wong, 2001). Moreover, there are no updated studies on the gold price during the COVID-19, especially with the research object being the Vietnamese gold price and the variables related to the pandemic. Therefore, an updated study on the gold price during the pandemic in Vietnam is necessary.

This article will use five independent variables to examine the volatility of Vietnam's gold price, including the world gold price, the exchange rate of USD/VND, the Consumer Price Index (CPI), the interest rate, and the dummy variables, which are the 4 waves of the pandemic. Below is a summary of previous studies on 5 issues in the research paper:

**1.World gold price**: In an open market, trading goods with the world, the value of domestic goods is always orrelated with the world value of goods. Gold price is no exception, there is always a correlation between domestic gold price and world gold price.

**2.The exchange rate of USD/VND**: Most studies show that the dollar's value is inversely proportional to the price of gold. USD is a global payment currency, so goods and transactions worldwide are priced in USD, including gold. Therefore, any impact that increases or decreases the USD value will also affect the price of gold. On the other hand, gold is also a popular hedging tool of large institutions to hedge risks when the USD depreciates. When the USD depreciates against other currencies, gold increases and vice versa, but this is not always the case because many other factors that affect the price of gold must be considered. Conclusions drawn from the study of Yen and Hoang in 2014, they use VAR model for Vietnam gold price and macro variables, data is monthly data and from 08/2003 to 07/2013 (Yen and Hoang, 2014). The depreciation of the US dollar during this period will attract capital to US-denominated gold products for hedging, speculation, or capital conservation purposes. As a result, the subsequent period's gold price will increase. Research using TECM model and daily data from January 2, 1989, through December 20, 2007. (Wang and Chueh, 2013b). In the study of Fang, Fan, and Lu (Fang, Fan and Lu, 2012), use the VAR model for the monthly data series from January 2007 to June 2009, the USDX index is used to measure the dollar's value. They also indicate that the USDX index is negatively correlated with the gold price, while the CRB (Commodity Research Bureau Futures Price) index in the US is positively correlated with the gold price. However, there are also some studies that show the opposite Ganesh Mani and Srivyal Vuyyuri (Vuyyuri and Mani, 2005) use a multivariable regression model of yearly data from 1978 to 2000 to examine the factors affecting the gold price in India, including expected inflation, expected interest rates, the exchange rate between the US dollar and Indian rupees, the stock price index, silver price, and gold price lag. The results show that the exchange rate has a positive effect on the gold price in Indian.

**3. Consumer Price Index**: Indicators related to prices and inflation. For example: Consumer Price Index (CPI), inflation rate, or Commodity Research Bureau Futures Price Index (CRB). These indicators are usually positively correlated with the price of gold. Srivyal Vuyyuri (Vuyyuri and Mani, 2005b) indicate that inflation and gold prices share a positive relationship, but the relationship is low. Fang, Fan, and Lu (Fang, Fan and Lu, 2012b) also show that CRB index in the US is positively correlated with the gold price. However, In Vietnam, Yen and Hoang, (Yen and Hoang, 2014) show that CPI, in general, has no impact on the domestic price of gold. Meanwhile, in the opposite direction, the effect from the shock of gold price fluctuations on CPI is quite strong immediately.

**4. The interest rate**: Indicators related to interest rate. There is a close relationship between gold prices and interest rates. The signal of reducing interest rates by the Central Bank will lead to an increase in money for the economy, leading to an increase in inflation, thereby increasing the demand to buy gold to preserve its value against inflation. Leading to the gold price will also increase. In the short term, rising interest rates will push down gold prices but push up crude oil prices. The long-term effect is quite similar to the short-term because interest rates reflect market fundamentals (Wang and Chueh, 2013c). A similar result, Individuals may convert their current "liquid" assets to gold in response to an increase in expected future prices. Increases in expected interest rates will result in a downward adjustment of the gold price. (Neill, 1987). Using the GARCH method, Tully and Lucey built two gold price models in two periods of crisis and normal. Their results show that interest rates in both periods are negatively correlated with gold prices. However, the interest rate in the crisis period has a larger effect than the interest rate in the normal period on gold prices (Tully and Lucey, 2007). In general, interest rates are inversely proportional to the price of gold.

**5. Pandemic waves**: The complicated situation of the epidemic has pushed up the prices of every commodity, and gold is no exception. The Covid-19 pandemic is expected to continue to have a significant financial, economic, and social impact on countries and the global financial system (Phan and Narayan, 2020; Goodell, 2020). Gold enables investors to diversify their holdings and reduce macroeconomic and financial risks. As a result, gold is viewed as a safe-haven asset under both stressful and uncertain economic times, motivating investors to purchase gold as a hedge against currency swings. (El Hedi Arouri, Lahiani and Nguyen, 2015b; Beckmann, Berger and Czudaj, 2015; Ji, Zhang, and Zhao, 2020). There are four waves of the epidemic in the world right now. The epidemic waves in Vietnam are similar. The first case of covid in Vietnam was on January 23, 2020. Soon after, the situation was brought under control, and the first wave of epidemics took place from March 2020 to May 2020 and peaked on March 30. The second wave was from July 2020 to September 2020. The third wave was from January 2021 to March 2021. The fourth wave - the most severe epidemic wave ever in Vietnam - from May 2021 to now. The fourth wave of epidemics caused enormous damage to Vietnam's economy and society. Since the onset of the Covid epidemic, it has infected 1.76 million people and killed 32.831 Vietnamese people (data updated January 3, 2022[[1]](#footnote-1)). This article will add four dummy variables corresponding to four outbreaks in Vietnam. The article expects to find a correlation between the pandemic wave and the gold price.

## **2.4 Hypotheses**

After reviewing previous studies, this paper will build a gold price model in Vietnam based on five independent variables as mentioned above.

H1: There is a positive relation between World gold price and gold price in Vietnam.

H2: There is a negative relation between Exchange rate and gold price in Vietnam.

H3: There is a negative relation between Vietnam's consumer price index and gold price in Vietnam.

H4: There is a negative relation between Deposit interest rate and gold price in Vietnam.

H5: There is a positive relation between Epidemic waves and gold price in Vietnam.

For a broader view, the general equation of the study is:

|  |  |
| --- | --- |
|  | (1) |

Where:

: Vienam gold price

: World gold price

: Exchange rate USD/VND

: Interest rate

: Pandemic waves

: Random eror

The study expects that the coefficients in the model (1) will have the following results:

This chapter presents the contents of the literature review related to the factors affecting the gold price and builds a general research model of the article. The next chapter of the study will discuss the data and research methods.

# **Chapter 3: Data and Methodology**

## **3.1 Data**

Vietnam gold prices are collected from January 1, 2017, to December 31, 2021, at the website of Saigon Commercial Joint Stock Bank (SCB). Initial data is daily gold price; however, macroeconomic indicators are monthly data. So, the author will take the average of the everyday gold price in one month to get gold price data by month. Deposit interest rates are monthly data from the International Monetary Fund (IMF) website. World gold prices are monthly data taken from World Gold Council. The exchange rates between the Vietnamese Dong and US Dollar (USD/VND) are monthly data sourced from the Trading Economics website. Data on the Vietnamese consumer price index by month are obtained from the website of the General Statistics Office of Vietnam. Dummy variables have a value of 1 when they coincide with the epidemic wave and 0 when it does not.

Table 1: The Covid-19 epidemic wave in Vietnam

|  |  |  |
| --- | --- | --- |
| Wave of Covid-19 | From | To |
| D1 | March 2020 | May 2020 |
| D2 | July 2020 | September 2020 |
| D3 | January 2021 | March 2021 |
| D4 | May 2021 | Steptember 2021 |

Table 2: Abbreviations for variables and Expected sign of effect

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Role | Variable | Description | Source | Expected sign |
| Dependent | PVN | Vietnam gold price | Sai Gon Joint Stock Commercial Bank |  |
| Independent | PW | World gold price | World Gold Council | + |
| Independent | EX | Exchange rate USD/VND | Trading Economics | - |
| Independent | CPI | Vietnam's consumer price index | General Statistics Office of Vietnam | - |
| Independent | INT | Interest rate | International Monetary Fund | - |
| Independent | D1 to D4 | Epidemic waves dummies |  | + |

## **3.2 Methodology**

### **3.2.1 Modeling the factors that affect Vietnam's gold price**

**Descriptive Statistics**

In this section, descriptive statistics include the mean and standard deviation, and min and max as measures of variability of variable; time plots of variables to give a better insight; and a correlation matrix used to show the correlation coefficient between variables.

**Unit root test**

Testing for stationarity of variables. To check this, the Augmented Dickey-Fuller Test was applied in which a null hypothesis was hypothesized as the existence of a unit root (Dickey and Fuller,1981).

The regression to test is below:

H0: There exists a unit root

Where ‘’ indicates the time series, ‘’ is the time period, ‘’ is the optimum number of lags, ‘’ is the constant value and ‘’ is known as the error term.

**Regeression model for variables**

This paper uses the Regression Model to answer the first research question. A regression model provides a function that describes the relationship between one or more independent variables and a response, dependent, or target variable. Therefore, to find out the dependence of Vietnam's gold price on macroeconomic indicators (interest rates, consumer price indexes, exchange rates, world gold prices), the regression model is one of the suitable models. The study uses four variables to analyze and evaluate the factors affecting the price of gold in Vietnam. The model is represented by the equation below:

|  |  |
| --- | --- |
|  | (2) |

**Multicollinearity test for regeression model**

The term collinearity implies that two variables are near perfect linear combinations of one another. When more than two variables are involved, it is often called multicollinearity. The primary concern is that as the degree of multicollinearity increases, the regression model estimates of the coefficients become unstable and the standard errors for the coefficients can get wildly inflated. This paper will use the *VIF* command in Stata to check for this error in the model. If *VIF* is less than or equal to 10 then there is no multicollinearity.

**Serial corelation test for regeression model**

Autocorrelation is a mathematical representation of the degree of similarity between a given time series and a lagged version of itself over successive time intervals. This paper will use the *estat bgodfrey* in stata to check for this error in the model. H0: no serial correlation.

**Finding the optimal lag length for VARs**

The purpose is to select the number of lagged variables included in the model, avoiding omitting important explanatory variables to find the optimal model.

The test reports the final prediction error (FPE), Akaike’s information criterion (AIC), Schwarz’s Bayesian information criterion (SBIC), and the Hannan and Quinn information criterion (HQIC) lag order selection statistics for a series of vector autoregressions of order 1 through a requested maximum lag. A sequence of likelihood-ratio test statistics for all the full VARs of the order less than or equal to the highest lag order is also reported.

**VAR model**

To better clarify the effects of macroeconomic variables on gold prices, this paper uses a Vector Automatic Recovery (VAR) model. The VAR model aims to predict and analyze the dynamic interrelationships between key economic variables (Spanos et al., 1997). The VAR method mainly depends on the availability of reliable and interpolated quarterly data over a sufficiently long period. It is appropriate to investigate the influence of macro variables. The article's goal is to find out the relationship between macro variables and gold price, so using the VAR model is reasonable. The paper applies the VAR model with the following equation to consider the interaction of the relationship between variables:

|  |  |
| --- | --- |
|  | (3) |

Where:

* is the lag of the variables in the model
* is the vector of variables in the equation including stationary series of difference of PVN, PW, EX, INT, CPI
* is the vector of constants
* is the error vector

**The autocorrelation test**

The formula for the LM test statistic at lag j is

Where is the number of observations in the VAR; d is the number of coefficients estimated in the augmented VAR;   is the maximum likelihood estimate of the variance–covariance matrix of the disturbances from the VAR; and is the maximum likelihood estimate of Σ from the following augmented VAR.

**Impulse response analysis**

Impulse response analysis is crucial in econometric analyses is employed vector autoregressive models. Their primary purpose is to describe the evolution of a model’s variables in reaction to a shock in each variable. This feature allows to trace the transmission of a single shock within an otherwise noisy system of equations and, thus, makes them handy tools in assessing economic policies.

**Variance decomposition**

The variance decomposition displays the percentage of the error made forecasting a variable over time due to a specific shock. In other words, how much of the variability in the dependent variable is explained by its “own shock” vs “the shock of the other variables in the model”

### **3.2.2 Modeling the effect of Covid-19 on Vietnam’s gold price**

#### Descriptive Statistics

In this study, descriptive statistics include the standard deviation, minimum and maximum values as measures of variability. Time plots of price and daily returns of gold have been displayed to give a better insight. The returns of gold were calculated through the natural log difference approach using the below formula:

Where is daily return on Vietnamese gold price, is the price of gold at day t and is the price of gold at the day

**Unit root test**

Because the price of Vietnamese gold by date and its return are both time series, I will perform the ADF test as above.

**ARCH effect test**

The autoregressive conditional heteroscedasticity–Lagrange Multiplier Test (ARCH–LM) was used to check for heteroscedasticity, for residuals and to check the presence of the ARCH/GARCH effect (Engle, 1982)

The following auxiliary regression model is used to evaluate the ARCH of order :

Where ‘’ is the residual, which can be measured by the primary mean regression model; however, in a secondary regression model, ‘’ lags are incorporated.

The null hypothesis in this test is that there is no ARCH effect:

#### ARCH model

The GARCH model (Bollerslev, 1986) and the autoregressive conditional variance -ARCH (Engle,1982) have become the standard tools for measuring the volatility of financial variables. Sadorsky (2006) claims that this model is particularly beneficial for spotting skewed behavior or clustering volatility in financial markets without using higher-order models. The model works by producing a weighted average of: The long-term average. The anticipated variance in the previous period. Information regarding observed volatility in the last period to predict conflict in the current period.

The conditional mean's equation is:

The conditional variance equation in a GARCH (p, q) model is expressed as follows:

The conditional variance equation in a GARCH (1,1) model is expressed as follows:

(\*)

Where is the conditional mean, is the conditional variance, and are constants, is the ARCH term, is the GARCH term, and is the error term.

Finally, we add a dummy variable to the conditional variance equations (Equations \*) to analyse the impact of the coronavirus on gold volatility, as follows

|  |  |
| --- | --- |
|  | (4) |

This chapter demonstrated the steps for data analysis. The next chapter will be the result of the analysis and the author's commentary.

# **Chapter 4:** **Results and Discussions**

## **4.1 Factors that influenced Vietnam's gold price**

### **4.1.1 Period of 2017-2019**

**Descriptive statistic**

After collecting data and calculating the variables included in the research model in this period, the results of descriptive statistics of the dependent variable and the independent variables are summarized as follows.

Table 3: Descriptive statistics of variables for the period 2017 - 2019

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | PVN | PW | EX | CPI | INT |
| Unit | VND | $ | USD/VND | % | % |
| Mean | 3746277 | 1306.29 | 22985.46 | 112.80 | 4.84 |
| Std.dev | 183624.20 | 88.75 | 267.11 | 4.59 | 0.12 |
| C.V | 0.049 | 0.067 | 0.011 | 0.043 | 0.024 |
| Min | 3629154 | 1190.49 | 22572.50 | 105.12 | 4.60 |
| Max | 4217167 | 1511.31 | 23415.50 | 119.51 | 5 |
| Observations | 36 | 36 | 36 | 36 | 36 |

Source: Author's calculation

The results in Table 3 show that, the average Vietnamese gold is VND 3.74 million VND/thread, of which the highest is VND 4.21 and the lowest is 3.62. The average world gold price is 1306.29 USD/ounce, in which the highest is 1511.31 and the lowest is 1190.49. The average exchange is 22985 VND/USD in which the highest data is 23415 and the lowest is 22572. The average CPI is 112.80 in which the highest is 119.51 and the lowest is 105.12. The average deposit interest rate is 4.84%/year, of which the highest data is 5% and the lowest is 4.6%. The volatility of the world gold price (CV =0.067) is the highest, followed by the volatility of Vietnam's gold price (CV =0.049). The volatility of Vietnam's gold price is approximate to the volatility of the CPI (CV=0.043). Following are the graphs of the variables for the period 2017-2019:

|  |  |  |
| --- | --- | --- |
| Figure 1: Vietnam gold price from 2017-2019 |  | Figure 2: Word gold price from 2017-2019 |
|  |  |  |
|  |  |  |
| Figure 3: Exchange rate from 2017-2019 |  | Figure 4: Interest rate from 2017-2019 |
|  |  |  |
|  |  |  |
| Figure 5: Consumer price index from 2017-2019 | | |
|  | | |

Source: Author's calculation

Table 4: Correlation matrix between variables

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | PVN | PW | EX | INT | CPI |
| PVN | 1.0000 |  |  |  |  |
| PW | 0.9089 | 1.0000 |  |  |  |
| EX | 0.3805 | 0.2734 | 1.0000 |  |  |
| INT | 0.3685 | 0.4722 | 0.5051 | 1.0000 |  |
| CPI | 0.4437 | 0.6435 | 0.8193 | 0.4191 | 1.0000 |

Source: Author's calculation

During this period, the correlation between Vietnam's gold price and world's gold price is the highest, at 0.90. Although there is a similarity in volatility with Vietnam's gold price (shown in Table 3), the correlation between Vietnam gold price and CPI is 0.44. The correlation between Vietnam gold price and bank interest rate and exchange rate are 0.36 and 0.38, respectively. The correlation between the exchange rate and CPI is high (0.81). Therefore, to check whether there is a multicollinearity error between the variables, the paper will perform the test in the following section.

The next step is using the Augmented Dickey-Fuller (ADF) test to determine if the time series data sets gathered in the research are stationary:

Table 5: Result of Augmented Dickey-Fuller (ADF) test

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ADF | -value | -statistics | 1% Critical Value | 5% Critical Value | 10% Critical Value |
| Pvn | 0.9869 | 0.573 | -3.682 | -2.972 | -2.618 |
| Ptg | 0.8648 | -0.627 | -3.682 | -2.972 | -2.618 |
| Ex | 0.7279 | -1.067 | -3.682 | -2.972 | -2.618 |
| Int | 0.6210 | -1.318 | -3.682 | -2.972 | -2.618 |
| Cpi | 0.9975 | 1.498 | -3.682 | -2.972 | -2.618 |

Source: Author's calculation

Because all -value of ADF test is larger than 0.05, all the absolute values of the -statistic are smaller than each absolute value of the critical values. The variables are not stationary. So, continuing to consider the first difference of the above variables, we have the following results:

Table 6: Result of Augmented Dickey-Fuller (ADF) test for first difference

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ADF | -value | -statistics | 1% Critical Value | 5% Critical Value | 10% Critical Value |
| dPVN | 0.0255 | -3.114 | -3.689 | -2.975 | -2.619 |
| dPW | 0.0002 | -4.488 | -3.689 | -2.975 | -2.619 |
| dEX | 0.0000 | -5.621 | -3.689 | -2.975 | -2.619 |
| dINT | 0.0006 | -4.218 | -3.689 | -2.975 | -2.619 |
| dCPI | 0.0058 | -3.596 | -3.689 | -2.975 | -2.619 |

Source: Author's calculation

The results after running the test show that all variables are stationary series at the first difference with a significance level of 5%.

**Regeression model**

Table 7 shows the results of regression model estimation of the variables in the period 2017-2019.

Table 7: Result of regression model

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Coef. | Std. Err. |  |  |
| PW | 2286.85 | 263.69 | 8.67 | 0.000 |
| EX | 320.36 | 117.71 | 2.72 | 0.011 |
| INT | -369422.50 | 132598 | -2.79 | 0.009 |
| CPI | -18786.61 | 11681.51 | -1.61 | 0.118 |
| \_Cons | -2755887 | 1511785 | -1.82 | 0.078 |
| R2 | 0.8761 | | | |
| Adj R2 | 0.8602 | | | |

Source: Author's calculation

From 2017 to 2019, except for the exchange rate, the remaining variables have the same influence as the author expected. The variables of world gold price, exchange rate, and interest rate are significant at a 5% significance level. The consumer price index has turned out to be insignificant. However, because the number of observations is small, this result of CPI is still acceptable. The independent variables in the model can explain 87% of the variation in the Vietnamese gold price (=0.8761).

The difference in the expectations and estimated coefficient of the regression model of the exchange rate can be attributed to two reasons. Firstly, the USD/VND exchange rate policy of the State Bank of Vietnam is a controlled floating policy. Therefore, the exchange rate volatility is not significant, and the return rate when investing in the Dollar is not high. Secondly, the Vietnamese behavior is hoarding gold rather than foreign currency. Therefore, despite the higher exchange rate, most people still invest in gold. Lastly, unlike gold exchanges globally, which are more sensitive, gold prices instantly reflect external shocks. Vietnam's gold trade is a standard commodity exchange, so the sensitivity of the Vietnamese gold market to macro indicators is not instantaneous. So, it usually takes a certain amount of delay when there is an external change to affect the price of gold. (This issue will be explored in more detail later in this paper).

* **Multicollinearity test and Serial corelation test**

The test results show that the model does not have two errors above. (See more in the appendix)

**VAR Model**

* **Finding the optimal lag length**

The criterion for choosing the optimal lag of the model is based on the lag that meets the most criteria. But must ensure additional conditions on the number of degrees of freedom in the model match the data. Although a lag of 8 satisfies the most criteria, degrees of freedom will not be satisfactory if the lag is selected. So, the appropriate lag is 1.

Table 8: Obtain lag-order selection statistics for VARs

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| lag | LL | LR |  |  | FPE | AIC | HQIC | SBIC |
| 0 | -120.56 |  | 25 |  | 2.3e+14 | 47.27 | \*47.34 | \*47.46 |
| 1 | -1172.70 | 55.72 | 25 | 0.000 | 2.1e+14 | 47.16 | 47.59 | 48.30 |
| 2 | -1151.50 | 42.29 | 25 | 0.017 | 2.5e+14 | 47.31 | 48.11 | 49.39 |
| 3 | -1133.84 | 35.43 | 25 | 0.081 | 3.6e+14 | 47.60 | 48.75 | 50.63 |
| 4 | -1107.79 | 52.08 | 25 | 0.001 | 4.0e+14 | 47.56 | 49.08 | 51.53 |
| 5 | -1091.70 | 32.18 | 25 | 0.153 | 7.5e+14 | 47.90 | 49.79 | 52.83 |
| 6 | -1047.59 | 88.22 | 25 | 0.000 | 5.5e+14 | 47.16 | 49.40 | 52.03 |
| 7 | -1030.11 | 34.95 | 25 | 0.089 | 1.6e+15 | 47.45 | 50.06 | 54.27 |
| 8 | -948.10 | \*164.02 | 25 | 0.000 | 6.4e+14 | \*45.21 | 48.18 | 52.98 |

\* Criteria for choosing the lag of the model

Source: Author's calculation

* **Estimated VAR**

From Tables 5 and 6, the initial data series of the variables is nonstationary, and the first difference series is stationary. That's why we use 1st difference series in the VAR model.In addition, the variables PVN, INT, CPI, and EX are endogenous variables and PW are exogenous variables. Therefore, we have the complete equation of the VAR model in this section, which is rewritten from equation 3 as follows:

Where:

is the vector of constants

is the error vector

Table 9 shows the results of the estimated VAR:

Table 9: Summary statistics for VAR model

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Coef  S.E  p-value | **dPVN** | **dEX** | **dCPI** | **dINT** |
| **dPVN L1** | 0.2957858  0.0830072  0 | 0.0000175  0.0001253  0.889 | -1.05E-06  7.45E-07  0.16 | -5.90E-08  9.68E-08  0.542 |
| **dEX**  **L1** | -86.182  87.14495  0.323 | 0.0719515  0.1315716  0.584 | 0.0002341  0.0007818  0.765 | -0.0001082  0.0001016  0.287 |
| **dCPI**  **L1** | 21170.78  14340.88  0.14 | 4.240881  21.65188  0.845 | 0.2802352  0.1286594  0.029 | 0.0303794  0.0167192  0.069 |
| **dINT**  **L1** | -21205.96  103370  0.837 | 134.6773  156.0682  0.388 | -1.119403  0.9273852  0.227 | 0.3658721  0.1205133  0.002 |
| **Cons** | 8817.92  9687.096  0.363 | 3.75498  14.62559  0.797 | 0.1806509  0.0869079  0.038 | -0.019209  0.0112936  0.089 |
| **dPW** | 1657.036  188.201  0 | -0.0148005  0.2841461  0.958 | -0.0005976  0.0016884  0.723 | -0.0000982  0.0002194  0.654 |
|  |  | | | |
| FPE | 2.1e+14 | AIC | 47.1648 |
| HQIC | 47.599 | SBIC | 48.3012 |

Source: Author's calculation

If the mentioned variable is the PVN because the -values are all greater than 0.05, the variables CPI, INT, and EX have no impact (or minimal impact) on PVN. It can be explant by the current fluctuations in domestic gold due to speculative activities and the influence of the Government's regulatory policies. So, changes in CPI, deposit interest rates, and the exchange rate on the gold price are not apparent.

On the other hand, domestic gold prices also have a minor impact on macro indicators, in which the impact of gold price on CPI is the highest, then on EX and bank INT.

* **The autocorrelation test**

The results show that, the model has no autocorrelation between the residuals in the model. . (See more in the appendix)

* **Impulse response**

|  |  |  |
| --- | --- | --- |
| Figure 6: Response of dEX to dPVN |  | Figure 7: Response of dPVN to dEX |
|  |  |  |
| Figure 8: Response of dCPI to dPVN |  | Figure 9: Response of dPVN to dCPI |
|  |  |  |
| Figure 10: Response of dINT to dPVN |  | Figure 11: Response of dPVN to dINT |
|  |  |  |

Source: Author's calculatin

Figure 6 shows how an exchange rate shock can affect the price of gold. The change in the exchange rate has almost no impact on the gold price in the first month. Gold prices started to fall in the 2nd month after the impact of the shock. At the end of the second month, the gold price stabilizes. The impact of the shock lasted seven months. Conversely, Figure 7 shows how a shock in the gold price affects the exchange rate. The exchange rate fell in the first month when the gold price shock was impacted. Then stabilizes in the 2nd month, and the effect ends in the 5th month.

Figures 8 and 9 show the impact of CPI shocks on gold prices and vice versa. A shock from the CPI led to an increase in gold prices in the first month. Then gradually decrease from 2nd to 4th month. The effect stabilized in the 5th month and ended in the 8th month. On the other hand, a shock from the gold price also causes the CPI to increase immediately in first month. Then stabilize and end at 6 months.

Figures 10 and 11 show the impact of interest rate shocks on gold prices and vice versa. The shock from interest rates caused gold prices to drop in the first month. Increase again in the second to 5th month. Then stabilize and end in the 8th month. In the opposite direction, a shock from the gold price leads to an interest rate hike in the first month and the half of the 2nd month. Then it stabilizes and ends in the 5th month.

* **Variance decomposition**

Table 10: Results of Variance decomposition for dPVN

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Step | dPVN | dEX | dCPI | dINT |
| 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 0 | 0 | 0 |
| 2 | 0.945233 | 0.000081 | 0.021435 | 0.033252 |
| 3 | 0.919126 | 0.001397 | 0.032062 | 0.047414 |
| 4 | 0.912336 | 0.002194 | 0.034908 | 0.050562 |
| 5 | 0.911028 | 0.002404 | 0.035472 | 0.051096 |
| 6 | 0.910818 | 0.002444 | 0.035564 | 0.051174 |
| 7 | 0.910788 | 0.002450 | 0.035578 | 0.051184 |
| 8 | 0.910784 | 0.002451 | 0.035580 | 0.051185 |

Source: Author's calculation

From the obtained results, we see that: The EX-variable explaining PVN 0% at step 1 and 2, 0.13% at step 3; and approximately 0.2% in the following steps. The CPI variable explaining PVN at 0% at step 1; 2.1% at step 2; and approximately 3% in the following steps. Similarly, the INT variable explaining PVN at 0% at step 1; 3% at step 2; and approximately 5% in the following steps.

### **4.1.2 Period of 2020-2021**

**Descriptive statistic**

Table 11: Descriptive statistics of variables for the period 2020 – 2021

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | PVN | PW | EX | CPI | INT |
| Unit | VND | $ | USD/VND | % | % |
| Mean | 5426972 | 1784.63 | 23098 | 117.49 | 3.74 |
| Std.dev | 476080.50 | 102.96 | 214.44 | 1.27 | 0.52 |
| C.V | 0.087 | 0.057 | 0.009 | 0.010 | 0.140 |
| Min | 4361650 | 1558.67 | 22690 | 115.20 | 3.34 |
| Max | 6124444 | 1968.03 | 23590 | 119.51 | 4.8 |
| Observations | 24 | 24 | 24 | 24 | 24 |

Source: Author's calculation

The results in Table show that the average Vietnamese gold price in the period 2020 – 2021 is VND 5.42 million VND/thread, of which the highest is VND 6.12 and the lowest is 4.36. The average world gold price is 1784.63 USD/ounce, in which the highest is 1986.03 and the lowest is 1558.67. The average exchange rate is 23098 VND/USD in which the the highest is 23590 and the lowest is 22690. The average CPI is 117.49 in which the highest is 119.51 and the lowest is 115.2. The average deposit interest rate is 3.74%/year, of which the highest is 4.8% and the lowest is 3.34%. Following are the graphs of the variables for the period 2020-2021:

|  |  |  |
| --- | --- | --- |
| Figure 12: Vietnam gold price from 2020-2021 |  | Figure 13: Word gold price from 2020-2021 |
|  |  |  |
| Figure 14: Exchange rate from 2020-2021 |  | Figure 15: Interest rate from 2020-2021 |
|  |  |  |
|  |  |  |
| Figure 16: Consumer price index from 2020-2021 | | |
|  | | |

Source: Author's calculation

Table 12: Correlation matrix between variables

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | PVN | PW | EX | INT | CPI |
| PVN | 1.0000 |  |  |  |  |
| PW | 0.7673 | 1.0000 |  |  |  |
| EX | -0.7259 | -0.2339 | 1.0000 |  |  |
| INT | -0.9331 | -0.7041 | 0.6788 | 1.0000 |  |
| CPI | 0.4437 | -0.0949 | -0.8115 | -0.4677 | 1.0000 |

Source: Author's calculation

The correlation between Vietnam's gold price and world's gold price was the highest, at 0.7653 Then the correlation between Vietnam gold price and CPI is 0.4437 The correlation between Vietnam gold price and bank interest rate and exchange rate are -0.931 and -0.7259 respectively. There is a difference between the period 2017-2019 and this period, a negative correlation has appeared. Ex: correlation between Vietnam gold price and exchange rate (-0.72) as well as the bank interest rate (-0.93). We can also see from Tables 14 and 15 that the exchange rate and bank interest rate tended to decrease while the gold price increased (Tables 12).

The next is using the Augmented Dickey-Fuller (ADF) test to determine if the time series data sets gathered in the research are stationary*.* The results of the test are in Table 13.

Table 13: Result of Augmented Dickey-Fuller (ADF) test

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ADF | -value | -statistics | 1% Critical Value | 5% Critical Value | 10% Critical Value |
| PVN | 0.3127 | -1.942 | -3.750 | -3.000 | -2.630 |
| PW | 0.1300 | -2.443 | -3.750 | -3.000 | -2.630 |
| EX | 0.9202 | -0.337 | -3.750 | -3.000 | -2.630 |
| INT | 0.1497 | -1.864 | -3.750 | -3.000 | -2.630 |
| CPI | 0.7278 | -1.068 | -3.750 | -3.000 | -2.630 |

Source: Author's calculation

All the variables are all non-stationary series. So, keep using the ADF test for those variables at difference of order one. The results of the test are in Table 14.

Table 14: Result of Augmented Dickey-Fuller (ADF) test for first difference

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ADF | -value | -statistics | 1% Critical Value | 5% Critical Value | 10% Critical Value |
| dPVN | 0.0103 | -3.420 | -3.750 | -3.000 | -2.630 |
| dPW | 0.0088 | -3.470 | -3.750 | -3.000 | -2.630 |
| dEX | 0.0002 | -4.552 | -3.750 | -3.000 | -2.630 |
| dINT | 0.0162 | -3.271 | -3.750 | -3.000 | -2.630 |
| dCPI | 0.0038 | -3.722 | -3.750 | -3.000 | -2.630 |

Source: Author's calculation

The results show that, all -value of test are smaller than 0.05, and all the abslute value of -statistic are larger than absolute value of critical value. So, after testing ADF for the first difference, all the variables are stationary.

**Regeression model for variable**

Table 15 shows the results of regression model estimation of the variables in the period 2020-2021.

Table 15: Result of regression model

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Coef. | Std. Err. |  |  |
| PW | 1756.279 | 474.4175 | 3.7 | 0.002 |
| EX | -766.8222 | 252.5447 | -3.04 | 0.007 |
| INT | -392137.6 | 108284.3 | -3.62 | 0.002 |
| CPI | -1311.508 | 42148.58 | -0.03 | 0.976 |
| \_Cons | 2.16E+07 | 1.03E+07 | 2.11 | 0.048 |
| R2 | 0.9448 | | | |
| Adj R2 | 0.9331 | | | |

Source: Author's calculation

From 2020 to 2021, the estimated results are as expected sign (Table 2). The variables –world gold price, exchange rate, interest rate, significance at 5% level of significance. The consumer price index is also insignificant, same as period 2017-2019. The independent variables in the model can explain 94% of the variation in the Vietnamese gold price (R2=0.9448). When the world gold price increases by 1 dollar, the price of Vietnamese gold increases by 1756 dong. If the exchange rate increases by 1 unit, the price of gold will decrease by 767 dong. If bank interest rate increases by 1%, gold price will decrease by 392138 VND. When the consumer price index increases by 1%, the price of gold decreased by 1311 dong.

There is a difference from the pre-covid-2019 period when the sign of the exchange rate has changed. This can be explained by the impact of the pandemic. Firstly, it makes investor sentiment more sensitive, so gold prices are affected immediately when there are external shocks, especially shocking news. Secondly, the change in the exchange rate is also a sign to consider the health of the economy, especially in uncertain times. Lastly, in times of instability, gold, and USD, for the Vietnamese, are a haven asset. Therefore, investors will have consideration to deciding to buy gold or USD. This leads to a reversal of the impact of the exchange rate on gold prices when compared to the pre-covid period.

* **Multicollinearity test and Serial corelation test**

The test results show that the model does not have two errors above. (See more in the appendix)

**VAR model**

* **Finding the optimal lag length**

Table 16: Obtain lag-order selection statistics for VARs

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Lag | LL | LR |  |  | FPE | AIC | HQIC | SBIC |
| 0 | -389.78 |  |  |  | 1.5e+12 | 39.378 | 39.417 | 39.578 |
| 1 | -348.17 | 83.237 | 16 | 0.000 | \*1.2e+11 | 36.817 | \*37.011 | \*37.812 |
| 2 | -330.68 | \*34.974 | 16 | 0.004 | 1.3e+11 | \*36.668 | 37.018 | 38.460 |
| 3 | -322.80 | 15.767 | 16 | 0.469 | 6.1e+11 | 37.480 | 37.985 | 40.068 |

Source: Author's calculation

The lag that meets the most criteria is better. So, based on the table, lag 1 is the suitable option for this model.

* **Estimated VAR**

Similar to the pre-covid period, we have the equation:

Where:

is the vector of constants

is the error vector

Table 17 shows the results of the estimated VAR in period 2020-2021:

Table 17: Summary statistics for VAR model

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Coef  S.E  p-value | **dPVN** | **dEX** | **dCPI** | **INT** |
| **dPVN**  **L1** | 0.2191761  0.1302018  0.092 | 0.0000722  0.0001572  0.646 | 1.89E-07  9.89E-07  0.848 | 3.33E-08  1.14E-07  0.77 |
| **dEX**  **L1** | -49.61648  204.5938  0.808 | -0.1354309  0.2469494  0.583 | 0.0000494  0.0015544  0.975 | *-0.0003208*  *0.0001787*  *0.073* |
| **dCPI**  **L1** | 54542.57  33304.96  0.101 | -30.95621  40.19984  0.441 | -0.0207966  0.253037  0.934 | -0.0080229  0.0290978  0.783 |
| **dINT**  **L1** | 22218.11  44531.05  0.618 | 17.86143  53.74999  0.74 | -0.5522779  0.3383281  0.103 | 0.8921917  0.0389057  0 |
| **Cons** | -45570.28  163387.6  0.78 | -101.2681  197.2126  0.608 | 2.08857  1.24135  0.092 | 0.3305362  0.1427479  0.021 |
| **dPW** | 1941.459  353.0451  0 | 0.2781832  0.4261335  0.514 | -0.001175  0.0026823  0.661 | -0.0002434  0.0003084  0.43 |
|  |  | | | |
| FPE | 1.2e+11 | AIC | 36.817 |
| HQIC | 37.0114 | SBIC | 37.8127 |

Source: Author's calculation

* **The autocorrelation test**

The results show that, the model has no autocorrelation between the residuals in the model. (See more in the appendix)

* **Impulse response**

|  |  |  |
| --- | --- | --- |
| Figure 17: Response of dEX to dPVN |  | Figure 18: Response of dPVN to dEX |
|  |  |  |
| Figure 19: Response of dCPI to dPVN |  | Figure 20: Response of dPVN to dCPI |
|  |  |  |
| Figure 21: Response of dINT to dPVN |  | Figure 22: Response of dPVN to dINT |
|  |  |  |

Source: Author's calculation from Stata

Figure 17 shows how an exchange rate shock can affect the price of gold. The shock from the exchange rate causes the gold price to decrease in the first month and increasing slightly in the second month. Increase more strongly in the 3rd and 4th months and then gradually stabilize and end in the 8th month. Conversely, Figure 18 shows how a shock in the gold price affects the exchange rate. The exchange rate increase in the first month when the gold price shock was impacted. Then stabilizes in the 2nd month, and the effect ends in the 5th month.

Figures 19 and 20 show the impact of CPI shocks on gold prices and vice versa. A shock from the CPI led to an increase in gold prices in the first month. Then gradually decrease from 2nd to 4th month. The effect stabilized in the 5th month and ended in the 8th month. On the other hand, a shock from the gold price also causes the CPI to decrease immediately in first month. Then stabilize and end at 6 months.

Figures 21 and 22 show the impact of interest rate shocks on gold prices and vice versa. The shock from interest rates caused gold prices to increase in the first month and reduce in the 2nd and 3rd months. Then stabilize and end in the 8th month. In the opposite direction, a shock from the gold price leads to an interest rate hike in the first month and drop in 2nd month. Then it stabilizes and ends in the 5th month.

It can be seen that the impact of shocks from macro variables has a more significant effect on gold prices when compared to the period before Covid-19. The direction of the effect also changes in some indicators. For example, the exchange rate immediately impacts the gold price in the first month; there is no longer a 1-month lag like in the 2017-2019 period. During the Covid-19 period, interest rates were lowered continuously to boost the economy, so people did not deposit their savings in banks anymore. Instead, they buy gold as a haven. Moreover, in Vietnam, the dollar in crisis time is also a safe asset, and it will also be hoarded by people with gold more when compared to the previous period. Therefore, the impact of exchange rate changes will be immediate during the epidemic period.

* **Variance decomposition**

Table 18: Results of Variance decomposition for dPVN

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Step | dPVN | dEX | dCPI | dINT |
| 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 0.023223 | 0.008757 | 0.087437 |
| 2 | 0.945233 | 0.023183 | 0.007521 | 0.081975 |
| 3 | 0.919126 | 0.023990 | 0.007698 | 0.081705 |
| 4 | 0.912336 | 0.024170 | 0.007838 | 0.081594 |
| 5 | 0.911028 | 0.024194 | 0.007872 | 0.081695 |
| 6 | 0.910818 | 0.024196 | 0.007877 | 0.081397 |
| 7 | 0.910788 | 0.024197 | 0.007878 | 0.081524 |
| 8 | 0.910784 | 0.024197 | 0.007878 | 0.081684 |

Source: Author's calculation from Stata

From the obtained results, we see that: The EX-variable explaining PVN 2% at step 1; and approximately 2.3% in the following steps. The CPI variable explaining PVN at 0.8% at step 1; and approximately 0.7% in the following steps. The INT variable explaining PVN at 8%.

Again, when compared Variance decomposition with the period 2017-2019, we see that macro factors have a greater impact on gold prices during the pandemic. Especially the exchange rate and bank interest rate.

### **4.1.3 Findings**

In the pre-covid period, the regression estimation results show that the influence sign of the independent variables on the gold price was not as initially expected. During the covid period, the influence sign of the macro variables is similar to the initial expectation.

In genaral, economic variables such as CPI, exchange rate, and interest rates showing their role in the domestic gold price are exceptionally low, reflected in the frequency of impact, the strength of the effects, and the level of explanation for the gold price in the domestic market is relatively low. This is because:

* The domestic gold price depends on the world gold price. Vietnam is an importer of over 95% of raw gold from the external market.
* Moreover, with the characteristic that the difference between domestic and international gold prices is often extremely high, creating a favorable environment for gold speculation to thrive. The gold price does not reflect the true nature of the market's supply and demand.
* Another reason is the gold market is under the strict control of the State Bank, the gold price is often strongly influenced by changes in policy and administrative regulation by management.

The three reasons mentioned above are the main factors that make the gold price in Vietnam different from other markets and do not correctly reflect changes in other economic variables.

From the analysis results, we also see that the Vietnamese gold price is more sensitive to these indicators when compared to the pre-epidemic period, especially bank interest rates and foreign exchange rates. This happens because:

* During a pandemic, the money supply of the central bank increases to boost the economy. Leads to an increase in the prices of assets.
* People's fear of a gloomy economy in the future makes them invest their money in safe assets such as real estate, gold, and dollars. Again, causing the value of these properties to increase. This leads to a larger impact of macro factors on gold prices.

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## **4.2 The effect of Covid-19 on Vietnam’s gold price**

**Descriptive Statistics**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Mean | Std.dev | Min | Max | Observations |
| Price | 4424551 | 890215.6 | 3620000 | 6230000 | 1491 |
| Return | .0003507 | .0057589 | -.053955 | .0744188 | 1940 |

Source: Author's calculation

Table 19: Descriptive statistics of variables for the period 2017 - 2021

The results in Table show that the daily average Vietnamese gold price in the period 2017 – 2021 is VND 4.42 million VND/thread, of which the highest Vietnamese gold price in the analyzed data was VND 3.62 million VND/thread and the lowest was 3.62 million VND/thread.

The average daily return in the period 2017 - 2021 was 0.35%, in which the highest return in the analyzed data was -5.39% and the lowest was 7.44%.

|  |  |  |
| --- | --- | --- |
| Figure 23: Daily gold price in Vietnam |  | Figure 24: Daily return of gold price in Vietnam |
|  |  |  |

Source: Author's calculation from Stata

Table 20: Result of checking the stationarity of the return series

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ADF | -value | -statistics | 1% Critical Value | 5% Critical Value | 10% Critical Value |
| R | 0.0000 | -39.920 | -3.430 | -2.860 | -2.570 |

Author's calculation

The absolute value of calculated by the test is 39.92, larger than the value of 3.43; 2.86;2.57, so reject the null hypothesis, means that the return series is stationary at 1%.

**ARMA model for Return**

|  |  |  |
| --- | --- | --- |
| Figure 25: PAC of Return |  | Figure 26: AC of Return |
|  |  |  |

Source: Author's calculation

The ACF and PACF histograms are used in conjunction with the ARMA model in order to obtain the p and q order. As can be seen from charts, the partial autocorrelation is at the lags, 3,12,16,32 and the autocorrelation are at the lags 3, 12,16. To find the most suitable AR and MA, we must use the experimental and comparison method (comparing AIC to find the most suitable predictive model). The comparison results show that the AR (3) and MA (12) is the most suitable model for the data set.

Table 21: ARMA model regression results

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| R | Coef. | Std.Err. |  | >׀z׀ |
| \_cons | 0.0003 | 0.00016 | 2.12 | 0.034 |
| ARIMA AR |  |  |  |  |
| L3 | -0.0977 | 0.01136 | -8.60 | 0.000 |
| MA |  |  |  |  |
| L12 | 0.0683 | 0.01401 | 4.88 | 0.000 |
| Σ | 0.0057 | 0.00002 | 225.27 | 0.000 |

Source: Author's calculation

Table 22: Test results for stationarity and ARCH effect of residuals

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ADF | value | -statistics | 1% Critical Value | 5% Critical Value | 10% Critical Value |
| Resid | 0.0000 | -38.498 | -3.430 | -2.860 | -2.570 |
|  | | | | | |
| Lags(p) | | | chi2 | df | Prob>chi2 |
| 1 | | | 300.153 | 1 | 0.000 |
| Ho:no ARCH effect | | | | | |

Source: Author's calculation

The absolute value of calculated by the test is 38.498, larger than the value of 3.430; 2.860;2.570, so reject the null hypothesis, means that the data series is stationary at 1%.

The null hypothesis in this test is that there is no ARCH effect, while an alternative effect is that there is an ARCH effect. The ARCH LM test results provide convincing evidence for rejecting the null hypothesis for the data series. So, there is the existence of ARCH effects in the series of residuals in the mean equation.

**GARCH model**

Table 23: Summary statistics for GARCH (1,1)

|  |  |  |
| --- | --- | --- |
|  | Coefficient | -value |
| Conditional variance equation | | |
| Const | 1.06e-06 | 0.986 |
| ARCH (1) | 0.31105 | 0.000 |
| GARCH (1) | 0.67894 | 0.000 |
| Dummy variables of Covid-19 | | |
|  | 1.06277 | 0.211 |
|  | 2.43814 | 0.000 |
|  | 0.93459 | 0.081 |
|  | 0.66942 | 0.016 |
| Log likelihood | 6255.995 | |

Source: Author's calculation

The GARCH (1,1) model estimates volatility for daily gold returns. I use dummy variables in this analysis to indicate whether the coronavirus is influencing gold returns or not, where 1 represents the coronavirus period, and 0 indicates all other dates. It can be seen in Table 25 that the ARCH effects () are significant and positive, which implies substantial volatility clustering. Similarly, the GARCH effect () is also positive and significant, indicating persistent volatility. Dummy variables also show that most are positive and significant, except for . The results are consistent with the hypothesis 5 of the article. This is true of the reality of Vietnam when in the first wave of the epidemic, infections were very few, and people believed in the government's anti-epidemic strategy. Moreover, the impact of the Covid-19 epidemic is growing in the next wave of epidemics. Thus, the variance equation suggests that the Covid-19 virus plays a significant role in the volatility of gold returns.

Figure 27: Variance of GARCH model (1,1)

|  |
| --- |
|  |

Author's calculation

The figure above shows the volatility of the variance of the gold price. It can be seen that, before 2020, the fluctuation amplitude is not large. However, since 2020 - the covid pandemic began - the gold price has suffered a great deal. There were two major fluctuations in the gold price during the pandemic, the first was at the end of February 2020 and the second was at the beginning of August 2020. They are coinciding with the first and second epidemic waves in Vietnam. In the third and fourth waves of epidemics, the gold price fluctuations were minor compared to the first and second waves. However, it is still significant compared to the pre-epidemic period. This happens because people's psychology was extremely sensitive to the shocking news at the early stage of the pandemic when the economy was affected by blockade policies. So, they invest their money in gold which is a safe asset—causing the price of gold to fluctuate strongly. In the later pandemic stages (third and fourth waves), people's psyche is less sensitive, and they are also familiar with the new normal during the pandemic. So, they also look for new investment channels, making gold prices less volatile compared to the early stage of the pandemic.

From the results of the data analysis, chapter 4 provides detailed information about the problem that the article needs to answer. Chapter 5 will be the conclusion of the article.

# **Chapter 5: Conclusion**

The article used the regression model and VAR model to analyze how factors of world gold price CPI, bank interest rate, and exchange rate affect the gold price of Vietnam in two periods: before the pandemic (2017-2019) and during the pandemic (2020-2021). The article also analyzed how the Vietnamese gold price was affected by the epidemic waves through the GARCH model.

Before the Covid pandemic, the relationship between world gold price, exchange rate and gold price in Vietnam are positive. The relationship between interest rate, CPI and Vietnamese gold price are negative. During period of covid-19, the relationship between world gold price and gold price in Vietnam is positive. The relationship between exchange rate, interest rate, CPI and Vietnamese gold price are negative. The epidemic also has the dynamics of increasing the price of gold during this period.

In general, in the two periods before and during Covid-19, macro factors such as CPI, bank interest rates, and exchange rates have had a negligible impact on Vietnam's gold price. This is appropriate when supply from imports, state policies and speculation heavily influence Vietnam's gold price. From the analysis results, we can see that the Vietnamese gold price is more sensitive to these indicators when compared to the pre-epidemic period, especially bank interest rates and foreign exchange rates. The epidemic waves also significantly impacted the gold price in Vietnam, especially in the preliminary stages of the epidemic, when the people and the government were still cautious in responding to the epidemic. After that, the impact of the epidemic wave on the gold price also gradually decreases as people adapted to it.

The problem is how to stabilize the volatility of the gold market. First, the Government needs to control the Covid-19 pandemic well to return to normal economic activities. Second, the Government's management of the gold market needs to avoid sudden policy changes that cause gold prices to fluctuate erratically, which will have a substantial and lasting impact on the macro stability of the economy. Besides, what needs to be done right away is to reduce the difference between domestic and foreign gold prices to an acceptable level to limit speculation that causes gold price fluctuations.

However, the study also has limitations as the independent variables in the model are simple. We can also include other variables such as crude oil price, silver price, VN INDEX stock index, GDP, or real estate price index. Furthermore, the study data for the duration of the pandemic were only two years, so the results only reflect the short-term impact. Other studies when the pandemic is over are needed to have a more holistic view.

# **Chapter 6: References**

Beckmann, J., Berger, T. and Czudaj, R. (2015). Does gold act as a hedge or a safe haven for stocks? A smooth transition approach. *Economic Modelling*, 48, pp.16–24.

Bollerslev, T. (1986). Generalized autoregressive conditional heteroskedasticity. *Journal of Econometrics*, 31(3), pp.307–327.

Cai, J., Cheung, Y.-L. and Wong, M.C.S. (2001). What moves the gold market? *Journal of Futures Markets*, [online] 21(3), pp.257–278.

Dickey, D.A. and Fuller, W.A. (1981). Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root. *Econometrica*, 49(4), pp.1057–1072.

Engle, R.F. (1982). A general approach to lagrange multiplier model diagnostics. *Journal of Econometrics*, 20(1), pp.83–104.

Giordano, R., Momigliano, S., Neri, S. and Perotti, R. (2007). The effects of fiscal policy in Italy: Evidence from a VAR model. *European Journal of Political Economy*, 23(3), pp.707–733.

Jones, A.T. and Sackley, W.H. (2014). An uncertain suggestion for gold-pricing models: the effect of economic policy uncertainty on gold prices. *Journal of Economics and Finance*, 40(2), pp.367–379.

Maital, S. and Barzani, E. (2020). The global economic impact of COVID-19: A summary of research. *Samuel Neaman Institute for National Policy Research*, *2020*, pp.1-12.

Neill, J.F. (1987). The inflation rate of the price of gold, expected prices and interest rates. *Journal of Macroeconomics*, 9(1), pp.71–82.

Oloko, T.F., Ogbonna, A.E., Adedeji, A.A. and Lakhani, N. (2021). Fractional cointegration between gold price and inflation rate: Implication for inflation rate persistence. *Resources Policy*, *2021*

Phan, D.H.B. and Narayan, P.K. (2020). Country Responses and the Reaction of the Stock Market to COVID-19—a Preliminary Exposition. *Emerging Markets Finance and Trade*, 56(10), pp.2138–2150.

Pierdzioch, C., Risse, M. and Rohloff, S. (2014). The international business cycle and gold-price fluctuations. *The Quarterly Review of Economics and Finance*, 54(2), pp.292–305.

Sadorsky, P. (2006). Modeling and forecasting petroleum futures volatility. *Energy Economics*, 28(4), pp.467–488.

Salisu, A.A., Vo, X.V. and Lucey, B. (2021). Gold and US sectoral stocks during COVID-19 pandemic. *Research in International Business and Finance*, 57.

Shafiee, S. and Topal, E. (2010). An overview of global gold market and gold price forecasting. *Resources Policy*, 35(3), pp.178–189.

Spanos, A., Andreou, E., Syrichas, G.L. and Panepistēmio Kypru (1997). *A VAR model for the monetary sector of the Cyprus economy*. Nicosia.

Spanos, P.D., Bergman, L.A., Shinozuka, M., Bucher, C.G. and Schuëller, G.I. (1997). A state-of-the-art report on computational stochastic mechanics. *Probabilistic Engineering Mechanics*, 12(4), pp.197–321.

Tanin, T.I., Sarker, A. and Brooks, R. (2021). Do currency exchange rates impact gold prices? New evidence from the ongoing COVID-19 period. *International Review of Financial Analysis*.

Wang, Y.S. and Chueh, Y.L. (2013). Dynamic transmission effects between the interest rate, the US dollar, and gold and crude oil prices. *Economic Modelling*, 30, pp.792–798.

Fang, S., Fan, W. and Lu, T. (2012). *Gold Pricing Model During the Financial Crisis*. [online] papers.ssrn.com. Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract\_id=2055266 [Accessed 22 Apr. 2022].

Ji, Q., Zhang, D. and Zhao, Y. (2020). Searching for safe-haven assets during the COVID-19 pandemic. *International Review of Financial Analysis*, [online]. Available at: <https://www.sciencedirect.com/science/article/pii/S1057521920301708> [Accessed 22 Apr. 2022].

State Audit Office of Vietnam (2021). [online] www.sav.gov.vn. Available at: <https://sav.gov.vn/SMPT_Publishing_UC/TinTuc/PrintTL.aspx?idb=2&ItemID=31834&l=/noidung/tintuc/Lists/TinTucSuKien> [Accessed 22 Apr. 2022].

Vuyyuri, S. and Mani, G.S. (2005). *Gold Pricing in India: An Econometric Analysis*. [online] papers.ssrn.com. Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract\_id=715841 [Accessed 22 Apr. 2022].

World Gold Council. (2021). *World Gold Council | The Authority on Gold*. [online] Available at: <https://www.gold.org/>[Accessed 2 Jan. 2022].

Yen, B.K. and Hoang, N.K. (2014). *Quản lý giá vàng nhìn từ góc độ kinh tế vĩ mô*. [online] Available at: <https://user-cdn.uef.edu.vn/newsimg/tap-chi-uef/2014-11-12-19/9.pdf>[Accessed 2 Jan. 2022].

# **Chapter 7: Appendix**

The principle is to compare the obtained p-values with 0.05 in turn: If p-value < 0.05, that variable has an impact on the mentioned variable, and vice versa if p-value > 0.05, that variable has no impact to the mentioned variable.

|  |
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| Result of Granger causality Wald tests 2017-2019 |
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| --- |
| Result of Granger causality Wald test 2020-2021 |
| Table  Description automatically generated |

|  |
| --- |
| Multicollinearity test 2017-2019 |
|  |
| Multicollinearity test 2020-2021 |
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| Serial corelation test 2017-2019 |
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| Serial corelation test 2020-2021 |
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| Lagrage-miltiplier test 2017-2019 |
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| Lagrage-miltiplier test 2020-2021 |
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Record of meetings with project supervisor

|  |
| --- |
| Supervisor’s name: Bui Duong Hai |
| Project title: **Determinants of the Vietnamese Gold Price in the Period of Covid-19** |

Record of meetings

|  |  |  |
| --- | --- | --- |
| **Date** | **Time** | **Supervisor’s signature** |
| Semester 1 | | |
| 8/11/2021 | 17:00-18:00 |  |
| 24/11/2021 | 17:00-18:00 |  |
| 13/12/2021 | 17:00-18:00 |  |
| Semester 2 | | |
| 08/03/2022 | 15:30-17:00 |  |
| 12/04/2022 | 15:30-17:00 |  |
| 25/04/2022 | 15:30-17:00 |  |

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Faculty: Business and Law

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Award: BA (HONS) Banking and Finance

Project/dissertation title: Factors determining the price of gold in Vietnam in the period of Covid-19.

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1. https://covid19.gov.vn/ [↑](#footnote-ref-1)