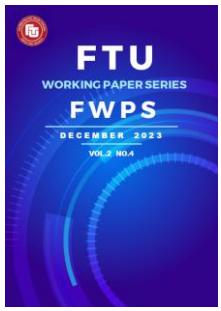

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CÁC YẾU TỐ QUYẾT ĐỊNH NHU CẦU VÀNG CỦA VIỆT NAM: PHÂN TÍCH DỮ LIỆU BẢNG CỦA CÁC NƯỚC ĐƯỢC LỰA CHỌN

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Tóm tắt

Từ trước đến nay, vàng luôn duy trì vị thế là một mặt hàng thiết yếu và là phương tiện đáng tin cậy để các cá nhân và chính phủ bảo vệ tài sản của họ. Để hiểu rõ hơn về các yếu tố tác động đến nhu cầu vàng ở Việt Nam, nhóm nghiên cứu đã tiến hành phân tích dữ liệu bảng từ các quốc gia được chọn từ đó chỉ ra mối liên hệ cùng chiều giữa nhu cầu vàng và giá vàng, cùng với tỷ giá hối đoái và tỷ lệ tín dụng cá nhân tính theo tổng sản phẩm quốc nội. Bên cạnh đó, cũng tồn tại mối tương quan ngược chiều giữa nhu cầu vàng và một số biến như dòng vốn đầu tư nước ngoài vào nước này, tỷ lệ lạm phát và tự do hóa thương mại. Trong quá trình nghiên cứu, nhóm nghiên cứu cũng phát hiện ra rằng tổng dự trữ vàng của Việt Nam có mối tương quan nghịch với cả giá vàng và tốc độ tăng trưởng GDP trong một thời gian dài. Mặt khác, các yếu tố như tỷ lệ lạm phát, tỷ giá hối đoái, độ mở thương mại có tương quan cùng chiều với tổng dự trữ của Việt Nam. Qua đó, nghiên cứu cũng khuyến nghị rằng chính phủ Việt Nam cần thực hiện một số bước chủ động để tăng cường và mở rộng tổng dự trữ cơ sở của nền kinh tế.

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GOLD DEMAND DETERMINANTS OF VIETNAM: INPUTS FROM A PANEL ANALYSIS OF SELECTED COUNTRIES

Abstract

Throughout history, gold has maintained its status as an essential commodity and reliable means for individuals and governments to safeguard their wealth. As such, many countries choose to allocate a portion of their reserves towards holding gold instead of relying solely on cash reserves. To further understand the factors that impact demand for gold in Vietnam, we conducted a panel analysis using data from selected nations. The findings indicated a correlation between the demand for gold and its price, taking into account various macroeconomic factors including inflation rates, exchange rates, and other related variables. Based on the research, there exists a notable positive association between gold demand and its price, along with its relation to foreign exchange rates, and individual credit ratios in terms of gross domestic product. Nevertheless, the study revealed an adverse correlation between the demand for gold and several variables such as foreign investment influx to the country, inflation rates, and trade liberalization. During the study, it was discovered that Vietnam's total reserves had a negative correlation with both the price of gold and GDP growth rate over an extended period. On the other hand, factors such as inflation rates, exchange rates, and trade openness positively influenced Vietnam's total reserves. Based on these findings, the study also recommends that the Vietnamese government should take some proactive steps to enhance and expand the economy's total reserve base.

Key words: Gold Reserves, Gold Demand

1. Introduction

Throughout human civilization, gold has been believed to be the symbol of wealth and has been used as the most valuable asset. Besides, gold also plays an important role as a store of value and a medium of exchange. Gold retains its value indefinitely because, unlike other commodities, it cannot be depleted or consumed. Many investors view gold as an alternative asset and a means of protecting their money since it acts as a hedge against the inflation-driven decline in the value of currencies.

To preserve their currencies and prevent being tethered to the US dollar, several nations hold substantial gold reserves, which results in enormous amounts of extremely liquid cash. A higher gold price typically compensates for a weaker currency. Nearly all central banks continue to use gold as their primary financial asset in addition to foreign currencies and government bonds. Also, as a safety measure, it is kept in central banks.

Gold was impacted by the Commodity Crisis in its last years (1980–2000), with prices rising above those that had been traded for 20 years. This reality has led to financial organizations once more employing gold to preserve the value of their currencies, albeit they have by no means gone

back to the gold standard. Contrarily, currently it is more difficult to maintain the gold standard the more expensive gold gets.

This study aims to use panel regression analysis to understand the determination of the relationship between demand of gold and some macroeconomics variables, with an emphasis on seven specific countries, and linking to Vietnam market from 2000 to 2021, as reported by the International Monetary Fund (IMF), International Financial Statistics (IFS), World Bank's World Development Indicators (WDI) and World Gold Council (WGC). Additionally, we provide information and proof to the government to enhance the role of gold as a reservation.

2. Literature review

2.1. Theoretical framework

2.1.1. Theory of Asset Demand

As a result of analyzing the variables affecting each nation's gold demand, the theory of Asset Demand developed by Frederic S. Mishkin (1983) stood out as particularly useful. The theory addresses the fundamental indicators to identify reasons behind the allocation of business or person's wealth to assets.

According to Mishkin (1983), when deciding whether to acquire and keep an asset or not, a person should take the four basic determinants of asset demand into account:

● Wealth: Wealth is the entire amount of assets and resources a person has. The ability to allocate resources to purchase additional assets increases with an individual's wealth. Therefore, as other things remain unchanged, wealth rises will lead to the increase in financial assets' demand.

● Expected return: Another important factor in determining the demand for an asset is its expected return in comparison to other assets during the coming time. The rise in expected return of an asset in comparison to other assets specifically causes the rise in the asset's demand.

● Risk: Risk refers to the level of uncertainty regarding the typical asset's return. Assuming all other factors remain the same, the demand for an asset will decrease as its risk level increases.

● Liquidity: Liquidity refers to the simplicity and speed that one asset could be converted into cash in comparison to other assets. Keeping all other factors constant, an asset will be more in demand if it is more liquid compared to other assets.

Summing up, according to the theory, an asset's quantity demanded is typically positively correlated with wealth, positively correlated with expected return compared to alternative assets, negatively correlated with return risk compared to alternative assets, and positively correlated with liquidity compared to alternative assets.

2.1.2. Modern Portfolio Theory

The Modern Portfolio Theory (MPT), developed by Harry Markowitz (1952), provides a further theoretical foundation for this approach.

The theory is an effective strategy for choosing investments that will optimize the total returns while maintaining a reasonable degree of risk. According to MPT by Harry Markowitz (1952), it is important to consider how an investment's risk and return characteristics relate to those of the entire portfolio rather than just looking at them separately. In other words, an investor will get larger returns without increasing risk if they build a portfolio of several assets.

Assumptions: Several presumptions have been made in order to verify the relationships between risk and return.

- Given their particular circumstances, investors strive to maximize portfolio returns.
- Returns on assets are often allocated.
- The volatility of returns from a portfolio determines its level of risk.
- Rational investors steer clear of needless risk (risk averse).
- Investors' utility functions are concave and growing.
- The same financial information is available to every investor.
- The expectations for returns are shared by all investors.

Equation:

- Portfolio Expected Return: The portfolio expected return is used to calculate the mean of the returns on investment probability distribution:

$$E(R_P) = \sum_{i=1}^{n} w_i E(R_i) \quad (1)$$

- Portfolio Risk: The portfolio standard deviation is used to calculate the portfolio risk.

First, we present the portfolio return variance by using the equation (2). The portfolio variance is determined by the correlation between the securities in the portfolio as well as the standard deviation of each security:

$$\sigma_P^2 = \sum_{i=1}^{n} w_i^2 \sigma_i^2 + \sum_{i} \sum_{j \neq 1} w_i w_j \sigma_i \sigma_j \rho_{ij} \quad (2)$$

Or it can be written as:

$$\sigma_P^2 = \sum_{i=1}^{n} \sum_{j=1}^{n} w_i w_j \sigma_{ij} \rho_{ij} \quad (3)$$

Thus, portfolio standard deviation is provided as:

$$\sigma_P = \sqrt{\sigma_P^2} \quad (4)$$

Where:

w_i: The proportion invested in security i

w_j: The proportion invested in security j

σ_{ij}: Covariance between securities i and j

ρ_{ij}: Correlation coefficient between the returns on securities i and j

n: Total portfolio's securities

$E(R_i)$: Expected return on security i

By owning combinations of products that are not fully positively linked, an investor can lower portfolio risk. This can be said that by having a diverse asset portfolio, investors may lessen their risk exposure associated with specific assets or in other words, may be provided with equal expected return but posing a lower risk.

2.2. Overview about Vietnam's gold market

2.2.1. Gold's prices in Vietnam

The price of gold in Vietnam is usually higher than the price of gold in the world. For example, On March 8th ,2022, the price of SJC gold bars rose to 74.4 million dong per tale, which is 20 million higher than the world price. There are two main reasons explaining this problem. Firstly, this is due to the incomplete correlation between domestic gold prices and the global ones. To illustrate, the rise in the global gold price would lead to the growth of Vietnam's gold price. However, according to the Government's Decree No. 24/2012/ND-CP on the management of gold business, only the Vietnamese government has the right to produce, export and import gold bars. If enterprises want to import the raw gold, they must have a permit license from the state. This situation results in the limitation of gold supply in the domestic market. Secondly, according to the World Gold Council, Vietnam's gold demand was very high, with 43 tons in 2021, a growth of 8% compared to the previous year. 72% of consumers believe gold is a safe investment asset and they tend to buy more gold for long-term reserving purposes.

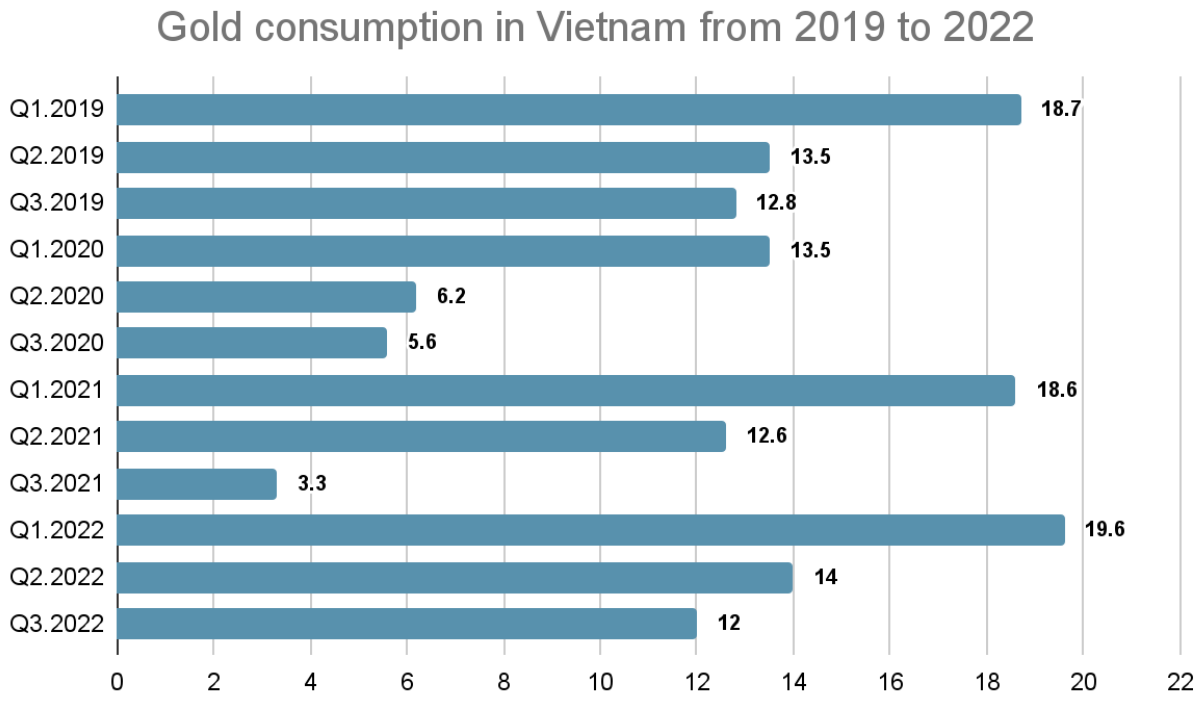
Figure 1: Gold prices in Vietnam from 2013 to now

Source: Gold Price

From 2013 up to now, Vietnam witnessed an upward trend in gold prices, from approximately 34 million per oz in 2013 to about 44 million per oz in the first half of 2023, with a peak of 48 million in the 2020 mid-year. Covid-19 is the main reason explaining why the price of gold was significantly high in recent years. In order to stimulate Vietnam economy's development during the outbreak of Covid-19 pandemic, Vietnamese government has loosed monetary policy, making the interest rate become significantly low. Therefore, investors decided to buy gold with the expectations of higher returns in the future; as a result, gold demand inclined rapidly during the time period.

2.2.2. The demand for gold in Vietnam

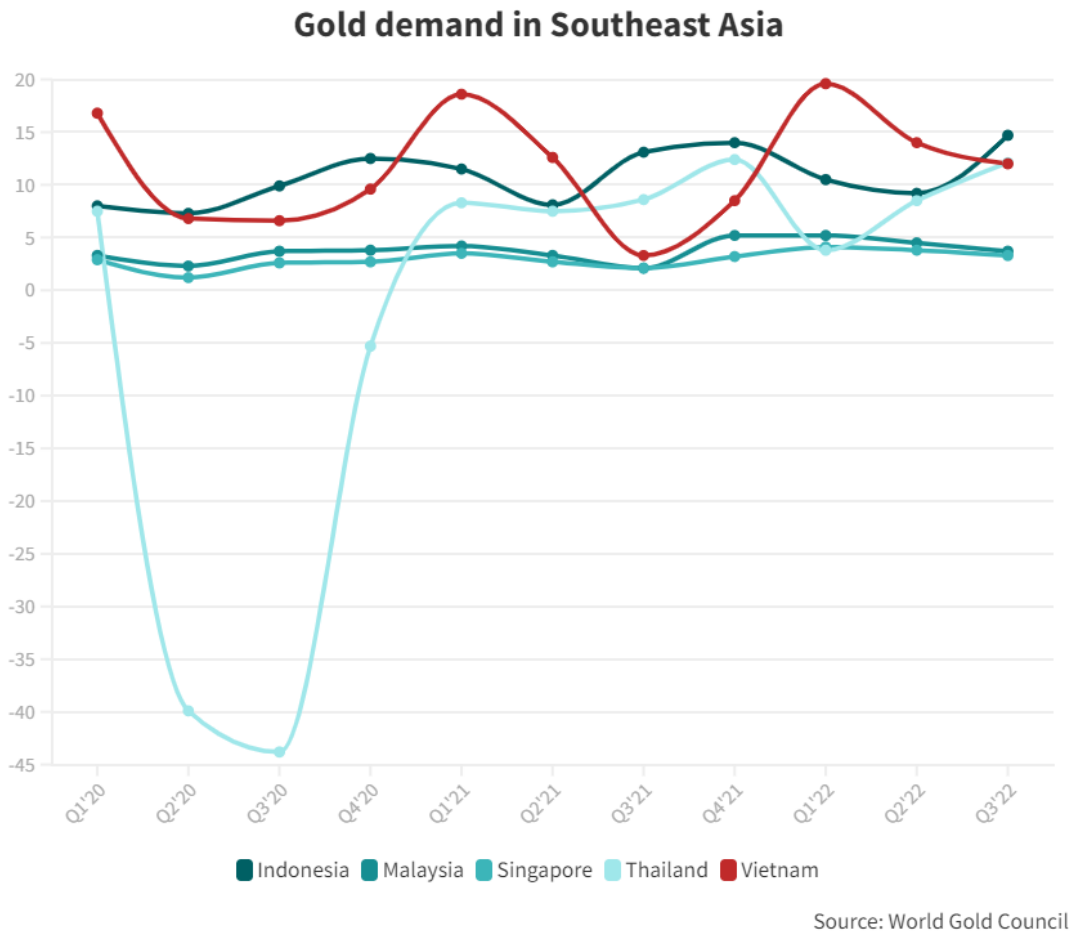
Figure 2: Gold consumption in Vietnam from 2019 to 2022



Source: World Gold Council

In 2022, 45.6 tons of gold was consumed in Vietnam, which was 0.6 tons higher than gold consumption in 2019. In the first quarter of 2022, because of the increasing inflation and the weakening of Vietnam dong, Vietnam saw an incline in the demand of gold, with 19.6 tons consumed. This number gradually dropped to 12 tons in the third quarter of 2022 which tripled the amount of gold consumed in one year earlier.

Figure 3: Gold demand in Southeast Asia



Source: World Gold Council

In the first quarter of 2022, Vietnam ranked first in gold demand in Southeast Asia with approximately 20 tons of gold consumed compared to about 10 tons in Indonesia and around 5 tons in Malaysia, Singapore and Thailand. However, after a slight decrease to 12 tons, Vietnam's gold demand has dropped to the second position, coming behind Indonesia with roughly 15 tons of gold consumed.

2.3. Empirical Review

Gold demand in developed countries has a favorable connection with the demand in the previous period and negative relation with gold price (Haugom, 1931). This means gold demand is driven by political and economic elements rather than by gold price. This study illustrates that the gold demand was influenced by several indicators of the global economy. Because the data for Haugom's analysis were for country groups rather than individual countries, it was not able to explore how national economic and financial situations influenced gold demand.

In an early study of gold demand in India, the rise in income would lead to the considerable incline in gold demand; in contrast, the growth in the price would result in the decrease in gold demand (Rao and Nagabhushanam, 1960). Meanwhile, gold prices did not respond significantly to consumer price index (CPI) announcements, indicating that it is not a viable inflation hedge (Tansu, 2004). This suggests that the demand for gold on the global market determines gold prices rather than the overall price level that prevails in a particular country.

In examining gold's ability to hedge against inflation in Vietnam, Hau Le Long, Marc J.K. De Ceuster, Jan Annaert, Dalina Amonhaemanon (2013) identified the case in which prices reached astounding rates throughout the 1980s and 1990s. The authors used the Fisher hypothesis to prove the concept that nominal gold returns shift in lockstep with respect to expected inflation. Along with the inflation factor, studies on how interest rates affect savings were also conducted by Bela Balassa (1993). While mostly focusing on developing nations, her work also discusses current research on the United States interest elasticity of savings, which is essential to comprehend the results from developing nations.

Gold price, sterling-dollar, and yen-dollar exchange rates were investigated using weekly statistics for 30 years to evaluate the degree to which gold has served as an exchange rate hedge (Forrest Capie, Terence C. Mills, Geoffrey Wood, 2005). Throughout the research, they reached the conclusion that the link between gold and the exchange rates is in fact negative and inelastic, but its correlation intensity has changed through time.

The elastic links between price, income, and gold demand over the long and short runs are examined by S. Maria Immanuvel and D.Lazar (2017). They discovered a long-term correlation between gold demand, price, and consumer income using the Cointegration and Error Correction model. The study recommends that new financial products may be created to monetize the gold sitting idle in families rather than trying to reduce demand.

The gold futures market operates in a certain way. News concerning central banks selling their gold stockpiles, political unrest in South Africa, and important macroeconomic factors including inflation, interest rates, and prices of oil all had a substantial impact on the gold futures market. But, in comparison to their influence on the Treasury bonds and foreign exchange markets, the responses of gold prices to articles concerning economic indicators were rather insignificant (Jun Cai, Yan-Leung Cheung, Michael C. S. Wong, 2001).

3. Methodologies & Data

3.1. Specifications of the model

In constructing the model, implications from Oktay, Ztunç, and Serin's study were utilized. Their research established a strong relationship between various macroeconomic variables, trade-related variables, financial indicators and gold reserves. Additionally, Starr and Tran's ideas were incorporated into the model as their analysis revealed that exchange rate volatility, inflation rate volatility and gold price are not systematic drivers of physical demand for gold.

3.1.1. The gold reserve model

The gold reserve model is brought out to indicate the relationship between the demand for gold by Vietnam as the dependent variable and the selected macroeconomic variables as the independent variable. It is specified as Equation 5 below:

$$LNGD = \beta_0 + \beta_1 IFR + \beta_2 ECR + \beta_3 FDIGR + \beta_4 TO + \beta_5 GP + \beta_6 PCTGDP + \mu \quad (5)$$

where,

GD = demand for gold represented by annual amount of gold reserves;

IFR = inflation rate;

ECR = exchange rate;

FDIGR = foreign direct investment growth rate;

TO = trade openness;

GP = price of gold;

PCTGDP = private credit to GDP ratio (proxy for the level of financial development).

3.1.2. The reserve without gold model

In contrast to the reserve gold model, this model demonstrates the relationship between the total reserve without gold in Vietnam and some selected macroeconomic variables. The model is shown in Equation 6 here in:

$$TRG = \beta_0 + \beta_1 IFR + \beta_2 ECR + \beta_3 GP + \beta_4 TO + \beta_5 GDPGR + \mu \quad (6)$$

where,

TRG = total reserves without gold;

IFR = inflation rate;

ECR = exchange rate;

GP = price of gold;

TO = trade openness;

GDPGR = GDP growth rate.

In this equation, a significant variable is GDP growth rate, which is calculated in constant VND using purchasing-power-parity exchange rates. One might expect gold to be a luxury item, with imports rising sharply as per-capita income rises. We include the GDP growth to see if recent income changes affect gold demand given the country's income level.

3.1.3. The panel model description

The panel data was analyzed using an econometric specification represented by Equation 7 below to investigate the demand for gold:

$$G_{it} = \alpha G_{it-1} + \beta X_{it} + \delta D_{it} + \mu_i + \varepsilon_{it} \quad (7)$$

As gold's perceived value is influenced by the esteem others place upon it, recent heightened demand may lead to increased demand in subsequent periods. This can be represented through variables G_{it} and G_{it-1}, which respectively capture gold reserves as a portion of international reserves and current period demand based on previous lagged levels. Additionally, X_{it} encompasses year dummies aimed at accounting for universal changes in global circumstances or geopolitical factors across countries; D_{it} comprises macroeconomic variables that are expected to prompt fluctuations in gold reserves among nations over time; μ_i represents country-specific intercepts while ε_{it} denotes the error term.

As a representation for some variable Y_{it}, Equation 8 is applicable to the fixed effects model:

$$Y_{it} = \alpha_i + \beta_1 X_{it} + \mu_i + v_{it} \quad (8)$$

Where: Y_{it} is a variable dependent on both entity (i) and time (t), with α_i serving as an intercept for each individual entity. Additionally, X_{it} denotes one independent variable, while β_1 represents its coefficient. Finally, v_{it} refers to the error term in the equation, whereas μ_i summarizes all cross-sectional variables affecting Y_{it} but remaining constant over time.

Therefore, by implementing a method that permits multiple intercepts for every individual cross-sectional unit, we can encompass the heterogeneity present in μ_i. According to Brooks, C. (2013), the employment of dummy variables in the estimation process can be utilized through the least squares dummy variable (LSDV) method to estimate this model.

As a representation for some variable Y_{it}, Equation 9 is applicable to the random effects model:

$$Y_{it} = \alpha + \beta X_{it} + u_{it} + \varepsilon_{it} \quad (9)$$

Whereas ε_{it} relates to intra-entity error, the term u_{it} denotes the inter-entity error component, which includes all factors affecting Y_{it} across sections and time periods.

In order to select between fixed and random effects models, a Hausman test needs to be conducted as part of the analysis. The null hypothesis assumes that the preferred model is based on random effects (Greene, W. H., 2008). Details regarding these results can be found in an appendix attached to this paper.

3.2. Data

The sources from which the data for this study were obtained include World Bank's World Development Indicators (WDI), International Monetary Fund (IMF), International Financial Statistics (IFS) and World Gold Council (WGC). It was decided to use an unbalanced panel of

154-observations, which included a mix of the selection of developed and developing countries that allocated only a relatively insignificant portion of their total reserves to gold holdings. The seven selected countries were composed of both high-income and emerging-market nations allocating portions of their overall reserves to gold, which were: the USA, Malaysia, Italy, Indonesia, Singapore, Australia and Ghana. This feature of the seven selected countries is similar to the total reserve allocation for gold holdings in Vietnam. Instead of keeping a lot of gold in total reserves, Vietnam often focuses on holding foreign currencies to ensure currency stability in the long run and support import-export activities and international payments.

4. Results & Discussion

Table 1 shows a summary of descriptive statistics of the data used for the panel regression that presents the descriptive property, or the nature of the data set used in the study, collected across the sampled countries.

Table 1: Descriptive Statistics for the Variables

	LNGD	GP	IFR	ECR	PCTGDP	TO	FDIGR
Mean	8.697987	1012.061	5.858052	97.20293	71.88	111.2944	440.9781
Median	8.48	1192.29	2.895	97.77	71.5	56.43	2.895
Maximum	10.69	1798.89	80.75	126.22	146	437.33	55862.27
Minimum	6.89	271.04	-5.99	67.57	1	22.15	-511.43
Std. Dev.	1.000653	503.3355	9.67884	11.0773	42.98883	113.2001	4559.919
Skewness	0.5007514	-0.1237373	4.308645	-0.3630291	0.0151775	1.575835	11.82149
Kurtosis	2.200823	1.688393	28.86146	3.655937	1.798747	4.112399	143.6521
Observation	154	154	154	150	150	154	154

Source: The authors' calculation

The mean of log linear gold reserves (LNDG) for the seven countries was found to be 8.7. The value of 1.000653 represents the deviation, while the skewness value of 0.5007514 indicated that the distribution of gold reserves among the seven countries is normal, and the kurtosis value of 2.200823 suggests that the distribution of gold reserves is platykurtic because 2.2 is less than 3 as the normal distribution threshold.

Next in the table is the variable PG, which is the price of gold, the determinant of gold demand. It can be concluded from the table that the price of gold is fairly symmetrical distributed among the seven countries as its skewness value is -0.1237373. The kurtosis value of 1.688393 implies that the price of gold distribution is platykurtic because 1.69 is less than 3.

Regarding the inflation rate (IFR), as the skewness value is 4.308645, which is much greater than 1.0, we can say that the distribution of inflation rates among the seven countries is positively skewed. Additionally, the kurtosis value of 28.86146 indicates that the distribution of inflation rates is leptokurtic.

ECR, from observing the results, the distribution of exchange rates among the seven countries can be said to be almost symmetrical. Moreover, the distribution of exchange rates is leptokurtic, as the value of kurtosis, 3.66, is slightly greater than 3.

Regarding the private credit to GDP ratio (PCTGDP), the distribution of gold reserves among the seven nations was shown to be normal by the skewness value of 0.0151775, and the platykurtic nature of the distribution of gold prices is suggested by the kurtosis value of 1.8, which is less than the normal distribution threshold of 3.

Trade openness (TO) has the skewness value of 1.575835 indicates that the trade openness is fairly symmetrical distributed among the seven countries, whereas the kurtosis value of 4.112399 implies that the price of gold distribution is leptokurtic because 4.11 is more than 3 as the normal distribution threshold.

The foreign direct investment growth rate (FDIGR) has the skewness value of 11.82149 reveals that the distribution of inflation rates among the seven countries is positively skewed, whereas the kurtosis value of 143.6521 indicates that the distribution of exchange rates is significantly leptokurtic, as 143.66 is sharply greater than 3 as the normal distribution threshold.

4.1. Relationship between Gold Demand and Macroeconomic Elements

Our research used the Fixed-Effect model to examine the link between global gold demand and some macroeconomic variables. The results of the Hausman test validated our choice to employ this model (Appendix 1). Table 2 displays the outcome of our model.

Table 2: Results of the Fixed-effects Model for the Factors Affecting Gold Demand

Independent variables	Coefficients	Prob. Value
GP	0.0004956	0.000
IFR	-0.0000819	0.876
ECR	0.0016261	0.212
PCTGDP	0.0004339	0.240
TO	-0.0001107	0.827
FDIGR	-0.000000814	0.406
Constant	8.042721	0.000
F-statistic	730.83	0.0000
Obs	147	
Adjusted R-squared	0.9938	

Source: The authors' calculation

The results of this examination reveal that Adjusted R-squared is 99.38%, which means our model accounted for about 99.38% of the systematic variation in the Demand for Gold. The error term or stochastic disturbances are blamed for the remaining 0.62% of the variation, which is inexplicable. This demonstrated that the model provides a very excellent fit, indicating that the explanatory variables as a whole and the explained variable exhibit a meaningful linear relationship.

The results indicated that there exists a positive link between the gold price (GP) and the exchange rate (ECR) and the gold demand (GD). According to coefficient figures, the positive relationship can also be seen between private credit to GDP ratio (PCTGDP) and gold demand (GD). In the case of negative relationships, the average decreases of gold demand (GD) are the result of one percentage increase in inflation rate (IFR), trade openness (TO), and foreign direct investment growth rate (FDIGR), holding other variables unchanged.

In terms of inflation rate, the structure of pricing in the research nations is shown by this factor. With regards to foreign direct investment growth rate, this may be the case because FDI is a highly unstable investment type. With respect to trade openness, this variable reveals how accessible an economy is to commerce, and in principle, greater trade openness provides more of foreign capital into a nation, therefore, leads to a rise in the productivity of that country. Lastly, the statistical insignificance of PCTGDP coefficient to gold demand can be explained by the rise in domestic

credit to the private sector, which served as a measure of financial growth, may have been overshadowed by the impact of other economic factors, for example, inflation.

4.2. Total Reserves Without Gold and Macroeconomic Determinants in Vietnam

4.2.1. Unit Root Test

This research examined the impact of macroeconomic factors on Vietnam's non-gold reserves. To avoid misleading results that may occur with time series data, we performed a stationarity test using the Augmented Dickey Fuller (ADF) test. The form shown in Equation 10 is an estimation of the generic form of this test:

$$\Delta Y_t = b_0 + \beta Y_{t-1} + \mu_1 \Delta Y_{t-1} + \mu_2 \Delta Y_{t-2} + \ldots + \mu_\rho \Delta Y_{t-\rho} + \varepsilon_t \quad (10)$$

In a unit root test for time series analysis, the variable to be tested is represented by Y_t, while b_0 stands for the intercept term. The coefficient of interest in this test is denoted as β, and μ represents the parameter used to account for the augmented lagged first difference of Y_t that denotes pth order autoregressive process. Finally, ε_t denotes any white noise error terms present in the data.

Table 3 presents the results of the unit root test, revealing that at first difference, exchange rate (ECR), trade openness (TO), gross domestic product growth rate (GDPGR) and interest rate (IFR) were stationary. This indicates that these series are I(1). The research findings also made clear that the Total Reserves without Gold (TRG) remained constant, indicating an I(0) series. Otherwise, it was observed that the price of gold (GP) remained stable at its second difference, suggesting an I(2) series.

Table 3: Unit Root Test Results.

Variables	Unit root test	Series: Level	Series: First/Second Diff.	Order of Integration	Prob.
TRG	ADF	3.221	_____	I(0)	0.08
GP	ADF	-0.525	-4.146	I(2)	0.0008
IFR	ADF	-3.024	-7.406	I(1)	0.0000
ECR	ADF	-1.871	-4.518	I(1)	0.0002
TO	ADF	-1.72	-4.482	I(1)	0.0002
GDPGR	ADF	-1.162	-4.001	I(1)	0.0014

Source: The authors' calculation

4.2.2. Error Correction Analysis

The table 4 below illustrates the result of the error correction model, showing the correlation between the short-run dynamic coefficients and the long-run relationships.

Table 4: Error Correction Representation for the Selected ARDL Model: TRG ARDL

Regressors	Coefficients	P-Value
D(DGP)	-2601795	0.008
D(IFR)	1.44E+08	0.004
D(ECR)	8.42E+08	0.006
D(TO)	1.22E+09	0.010
D(GDPGR)	-5.33E+09	0.008
R-squared = 0.9672		Durbin-Watson stat = 2.520161
Adj R-squared = 0.9508		

Source: The authors' calculation

Through this result, we can conclude that gold price, inflation rate, exchange rate, trade openness and GDP growth rate account for 95% variations in total reserves without gold while the error term explains the remaining 5%. Besides, according to the Durbin-Watson value, which equals to 2.520161, it can be concluded that there is no autocorrelation in the model.

In terms of coefficient values, inflation rate, exchange rate and trade openness witness positive values, which means that these variables have positive relationship with total reserves without gold in the short-run in Vietnam. In the short-run, inflation rate, exchange rate and trade openness increase will lead to an increase in total gold reserves. Meanwhile, the coefficients of gold price and GDP growth rate experience negative values.This means that gold price and GDP growth rate have negative relationships with total reserves without gold. In terms of volatility, an increase in gold price and GDP growth rate will result in a decrease in total reserves without gold in the short-run. Therefore, If Vietnam wants to increase the GDP growth rate, this country needs to reduce total reserves.

In terms of statistical significance, in Vietnam, gold price, inflation rate, exchange rate, trade openness and GDP growth rate were statistically significant because their P-values are all lower than 0.05. This suggests that stable and efficient policies regarding gold price, inflation rate, exchange rate, trade openness and GDP growth rate in Vietnam will result in a positive effect on total reserves of Vietnam.

4.2.3. Diagnostics Tests

To check the reliability of the model, we performed diagnostic tests for autocorrelation, heteroskedasticity and standardization. In this study, we used Breusch - Godfrey Serial Correlation LM Test, Breusch - Pagan - Godfrey Heteroskedasticity Test and normality tests. After testing, the results are obtained in Table 5 below:

Table 5: Serial Correlation LM Test, Heteroskedasticity and Normality Test Results

Test	Prob. Value
Breusch-Godfrey LM test for autocorrelation	0.1397
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity	0.6424
Normality Test	0.5969

Source: The authors' calculation.

In terms of autocorrelation testing, the Breusch-Godfrey F-Statistics p - value is higher than 0.05, indicating that there is no autocorrelation in this model or the residuals are serially uncorrelated. In terms of heteroskedasticity testing, the Breusch-Pagan-Godfrey F-Statistics p-value is higher than 0.05. This means that there is no phenomenon of heteroskedasticity in the model or the residuals are homoscedastic. Finally, the normality test results in a p-value is higher than 0.05 so we can conclude that the error term is normally distributed at the conventional level of significance.

5. Conclusion and recommendations

According to the result obtained from the first model that discusses the relationship between the gold demand and macroeconomic elements implemented according to the Panel OLS method, gold price is the determining factor in the gold demand. In addition, in the current context of accelerating trade liberalization in countries like today, the trade openness will affect the demand for gold or gold reserves. Meanwhile, the exchange rates also tend to be similar, which means that the more exchange rates, the more quantity of gold demand or gold reserves. In the case of Vietnam, there is great correlation between the factors of gold price, inflation rate, exchange rate, trade openness, GDP growth rate and total reserves without gold.

Based on this finding, some recommendations can be given as follows. Firstly, the fluctuation in exchange rates have an impact on the demand for gold and total national reserves. In Vietnam, it is necessary to maintain the goal of the national reserve size relative to GDP growth rate by breakthrough solutions in the direction of diversifying resources mobilized for the national reserve to increase the total national reserve level, consolidate the total base reserve and gradually reduce the burden on the state budget, especially the central budget. Secondly, because inflation reduces

the value of the Vietnamese currency, which is VND, and a decrease in the value of VND decreases the value of the total reserves. Therefore, it is necessary to take measures to minimize the domestic inflation rate. This will improve the Vietnamese performance of the reserve base and maintain its value even in the face of a deficit financing. Lastly, in terms of trade openness, due to the result above, we need to accelerate trade expansion and trade liberalization because trade openness has a positive relationship with the total reserves.

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Appendix

Appendix 1: The Hausman Test

Correlated Random Effects – Hausman Test:

Test cross-section random effects:

Test Summary	Chi-Sq. Statistic	Chi-Sq. Df.	Prob
Cross-section random	137.71	6	0.0000

Cross-section random effetcs test comparisions:

Variables	Fixed	Random	Var (Diff.)	Prob
GP	0.0011418	0.001145	-0.00000317	0.0001089
IFR	-0.0002381	-0.0851903	0.0849522	0.0125448
ECR	0.0037701	0.1003777	-0.0966076	0.0103126
PCTGDP	0.0010057	0.015585	-0.0145789	0.0025724
TO	-0.0002403	-0.0059687	0.0057284	0.0064785
FDIGR	-0.00000193	0.00000887	-0.0000108	0.00000437

Source: The authors' calculation.