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Investigating the Effect of Gold Leading and Lagging Relative to the Stock and Housing Market, Considering the Effect of Macroeconomic Variables

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Abstract:

Purpose: This research examines the existence of the lead-lag effect in the gold markets compared to the stock and housing markets, taking into account the effect of macroeconomic variables. In emerging and relatively inefficient markets, returns are not normally distributed and have a high sequential correlation with each other. Also, price changes are not independent and random and there is a certain trend and pattern in the behavior of prices that knowledge of these patterns is necessary to gain more benefits for capital. It helps investors. One of the patterns that can be investigated in addition to market inefficiency is to investigate the existence of the lead-lag effect.

Method: In this research, the Lead-Lag model was analyzed using the VAR test and the LRSM test for long-term data during the years 1390 to 1401 on a monthly basis.

Findings: Financial stress shows that the inflation rate is a weak shelter for shareholders. Meanwhile, regarding whether gold is a hedge instrument against inflation, our result was able to prove this feature, which means that investing in gold is a reliable hedge. Here, the inflation rate lags behind gold and is obviously a good hedge against inflation. This paper shows that inflation shocks lead to a negative reaction to gold prices in the long run. In the short run, only gold price fluctuations affect inflation, and this causality is one-way.

Conclusion: From these findings, it can be concluded that the most exogenous variable, gold, followed by oil and the dollar, can be interpreted as the primary receivers of exogenous shocks, while housing prices, stocks, and the inflation rate seem to bear the burden of short-term adjustment endogenously, rather than the system return to its long-term state. The results show that gold is the most exogenous variable, while the inflation rate is the least endogenous variable. According to the research, it shows that the inflation rate cannot protect against changes in the price of gold.

Keywords: Precedence effect, gold, stock market, housing market, dollar, inflation rate, oil

1. Introduction

Recent studies show that gold can act as a profitable investment in emerging or developed markets. According to research by Van Hong et al.¹(2016), gold can only protect against inflation in the short term in the United Kingdom, the United States, and India. The study also showed that gold is not an inflation hedge in all cases in the long run.

Then, according to Newberry²(1992), market participants tend to shift their investments from common stocks, bonds, or stocks to commodity markets to meet expected inflation. In addition, Hossein et al³ (2013) considered that gold often quickly adapts to the inflation rate and, therefore, has the ability to maintain value. While other than gold, other investment avenues, such as the stock market, can also be used as a hedging tool. Delhi has an equivalent feature because, according to Hossein and Burhan⁴(2009), the Islamic stock market can be a suitable place to prevent inflation and one of the vital indicators of economic development. For a country with these three investment instruments that have the same characteristic as a safe place to invest in times of inflation, we decided to analyze which of them are leading or lagging and whether they can be included under a portfolio. as the goal of diversity in the Iranian market. As far as we are concerned and based on our limited knowledge to justify, we find that very little amount of research and theory testing has been done on this topic. To name just a few, most studies emphasize gold price determinants (Turaman et al⁵2011; Ibrahim et al.⁶

¹ Van Hong et al.

² Newberry

³ Hessein et al.

⁴ Hessein and Borhan

⁵ Turaman et al.

⁶ Ibrahim et al.

2014). Gold as an inflation hedge (Artigas⁷ 2010; Shahbaz et al.⁸2014; Van Hoang et al⁹ 2014). The dynamic relationship between gold and other commodities and the stock market (Ahmad et al.¹⁰ 2017; Abdullah et al.¹¹ 2022) and other related studies on gold investment (Bawer and McDermott¹², 2010; Ibrahim,¹³ 2012). Therefore, this study tries to fill the gap by extracting the same feature as a tool for hedging against inflation, especially considering the stock market and oil prices as variables. Significant changes or shocks have been observed over time, especially in the last decade, among the mentioned macroeconomic variables. It is necessary to validate the relationship between them periodically and this study helps investors who want to diversify their investment in different asset classes, including financial assets and real assets. This study expands the way of future investment for rational investors who should invest not only in gold but also in other commodity markets such as stocks and housing. (Abdel Reza and Puasa,¹⁴ 2013). It is against stocks and a safe haven in stock market conditions. Portfolio analysis further shows that the asset is a short-term safe haven (Bavero Luci ¹⁵2010). According to the conducted studies and research, it was found that until now research has been conducted in connection with gold, the stock market and the housing market as a hedge tool against inflation. However, there is almost no research that is related to the analysis of precedence- Takhre gold has been done with other parallel markets of Iran. According to the efficient market hypothesis, the stock price reflects all available information, and price or return changes should be unpredictable. However, the lead-lag effect is a phenomenon that provides the ability to predict returns in the markets. Investigating the lead-lag relationship between stocks and markets, in addition to evaluating market efficiency, provides useful trading strategies to investors (Asgar Noorbakhsh et al.¹⁶2021). It shows Iran's finances. Therefore, different methods have been used to answer this issue. Therefore, the purpose of this research is to prioritize gold over the stock and housing market by considering the effect of macroeconomic variables using the LEAD-LAG model.

2. Background Research

Forecasting the price of assets and, consequently, their returns is one of the oldest questions of financial economics. Yaqub Reshnawadi et al. (2019) conducted investigations in relation to transactions between exchange rates and stock markets in Iran and concluded that in recent decades, the development of securities markets has contributed greatly to the prosperity and development of countries. Having a structured and dynamic capital market is one of the basic requirements of countries on the path of development, and the role of this market in creating economic balance is not hidden from anyone. Therefore, explaining the fluctuations of the stock market is of great importance. In the meantime, the relationship between the stock market and the exchange rate has been the subject of research by many researchers. The exchange rate is a key variable and neglecting it can create issues and problems for the economy of any country in various dimensions. The results of this research showed that the exchange rate has a positive and significant effect on the stock price index in Iran. Moreover, with the increase in the exchange rate, the stock price index will also increase. Also, the stock price index statistically has a significant effect on the exchange rate in Iran. The results of the estimation of the model show that the effect of the stock price index on the exchange rate is negative and significant, meaning that as the stock price index increases, the exchange rate decreases. Nasim Amin Khorazian et al. (1401) conducted investigations in relation to oil prices and the stock market index of Iran and concluded that the intensity of correlation between pairs of time series is increased with the increase of uncertain conditions such as the increase of sanctions, the withdrawal of the United States from the JCPOA, and the pandemic. Corona will increase in the medium and long term. Based on the results, investors can adjust their investment portfolio in the long and medium term based on the conditions prevailing in the country and their investment goals.

Leila Asiyabi Aghdam et al. (1401) concluded that causal relationships and dynamic interactions between macroeconomic variables and stock price index are very important in the theory of macroeconomic policies and political policies of a country. The results of the analysis using the econometric methods of the self-return pattern of TAR thresholds show that there is a significant relationship between the economic variables and the stock price index in the stock exchange. However, the behavior of the variables on the stock price index in the stock exchange is different. Mohammad Arbi Madani and Zaid Fatiti 2022 investigated the role of gold in the financial market, especially in the foreign exchange and oil markets. They found that by extending the analysis to the optimal risk hedging strategies between the gold, foreign exchange and oil markets, the evidence shows that to reduce the risk for different investment horizons, investors should add gold to their portfolio without reducing the expected return of their portfolio. Jeremy Gayne et al. 2022 regarding gold as an effective hedge against inflation, conducted research in the United States of America and concluded that when monthly inflation in the United States exceeds 0.55%, gold reacts significantly to changes in inflation and the ten-year treasury interest rate. However, gold is somewhat unresponsive when inflation is moderate or low. Therefore, they argued that such asymmetric and size-dependent responses are the main reasons for the lack of agreement in the literature on gold plating ability.

⁷ Artigas

⁸ Shahbaz et al.

⁹ Van Hoang et al.

¹⁰ Ahmad et al.

¹¹ Abdollah et al.

¹² Bawer and McDermott

¹³ Ebrahim

¹⁴ Abdul, R.Z. and A.F. Puasa

¹⁵ Baur, D.G. and B.M. Lucey

¹⁶ Asgar Noorbakhsh et al

Gold This precious metal offers a diversification feature with the stock market, which is, therefore, a must-have asset in an investment portfolio. Unlike other major investment avenues, such as the stock market, the price of gold market is more dependent on its supply and demand around the world (Abdol & Puasa, 2013). So, when more money is available to buy almost as much gold, the price of gold naturally goes up.

According to Yuk Sa O Chen (2022), due to stimulatory monetary and fiscal policies during the COVID-19 pandemic, interest rates in the United States have reached near zero and inflation has reached an all-time high of over seven percent in 2021. The result suggests that housing prices are falling, but probably not because, first, based on historical data, mortgage rates typically do not keep pace with Fed rate movements. In addition, there is a significant increase in housing prices and changes in interest rates gradually affect housing prices instead of affecting housing prices. Finally, unlike previous interest rate hikes, interest rate hikes do not solve the supply chain problem that is the main driver of inflation during the pandemic. Therefore, if inflation remains high, housing prices will remain high. A thorough analysis of housing prices during rate hikes enables investors to make better investment decisions and take action accordingly. For potential buyers who are unsure about the high prices of 2021 or looking for permanent residence, this article provides guidance on mortgage rate fluctuations and housing price forecasts.

3. Research Questions

- Is the price of gold suitable as a hedging tool against inflation according to the acceleration-delay analysis?
- Does the price of gold lead to the backwardness of the stock and housing market during inflation?
- Which of Iran's markets is leading compared to other markets?
- Which statistical model shows a more accurate prediction of the relationship between markets?

4. Research Methodology

The current research is practical in terms of its purpose and has investigated the effect of the lead-lag of gold on the stock and housing market, considering the effect of macroeconomic variables. In this research, the lead-lag method has been used to investigate the relationship between variables.

The Lead-Lag effect, particularly in economics, describes a situation where one (leading) variable is mutually correlated with the values of another (lagging) variable at later times. Economists have found that under certain conditions, there is a precedence effect between the prices of large-cap and small-cap stock portfolios.

Therefore, although our focus is on the lead-lag relationship between gold prices and other investment markets, these variables also interact with macroeconomic variables (i.e., inflation rate and real effective exchange rate). Therefore, we try to reveal the theory behind the interaction of these variables. Another theory that seems to be related to our study is the theory of Markowitz (1952) in the field of investment basket, which asks the investor not to put all the eggs in one. Steubinger (2019) developed an optimal causal path algorithm and designed statistical arbitrage strategies for high-frequency data based on the lead-lag phenomenon. However, designing an investment strategy based on high-frequency data still has its drawbacks.

The variables investigated in this research are coins, the stock market, the housing market, the inflation rate, the dollar, and crude oil.

4.1. Study Community and Statistical Sample

The statistical population of this research is all the information related to the data of Iran, which must have the following characteristics:

- All data should be related to the years 2010-2022
- The data has been reviewed on a monthly basis.

In this analysis, all the data will be expressed and Microfit 4.1 and EViews 12.0 software will be used. Based on our humble effort and limited knowledge to solve this problem about whether the gold price leads to the delay of the housing index and the stock market. Considering macro variables, we used the standard time series technique to solve this issue, which cannot be solved in theory and other experimental studies. This time series technique is unique in that it helps us to determine which variable is exogenous (i.e., independent) and which is endogenous (i.e., dependent) from the data, contrary to the pre-determined theoretical assumption in the classical regression model. The data analysis we used for our research is a combination of an 8-step method that is briefly stated.

According to Masih et al. (2009), the data analysis employed is unit root tests, VAR order and Johansen cointegration test, followed by long run structural modeling (LRSM) and vector error correction modeling (VECM), variance analysis (VDCs), impulse response functions (IRFs) and stability profiles (PP).

5. Data Analysis and Hypothesis Testing

5.1. Unit Root Test

The unit root test is a test that is used to check the normality (or stationarity) of a time series. Having a single root means invisibility. The first test to check the existence of a unit root in a series was presented by Dickey and Fuller (in papers in 1976 and 1979). It is essential and very important to avoid spurious regression. A variable is stationary if it always has a constant mean, variance, and covariance over time. The test can be performed using the Augmented Dickey-Fuller (ADF) test, which is corrected for residual autocorrelation. Based on the highest level of Akaike information criteria (AIC) and Schwarz Bayesian criterion (SBC), the corresponding test statistic (t statistic) of each variable is compared with

the critical value of 1%, 5%, 10% critical value of ADF statistic. The null hypothesis in the ADF test is that the variables are not stationary. Table 1 summarizes the results.

Variable	Test Statistic	Critical Value			Implication
Variables in the Level Form		1%	5%	10%	
Gold	-1.2048	-4.0239	-3.4417	-3.1454	I(1)
Housing market	-1.8565	-4.0244	-3.4420	-3.1456	I(1)
Stock market	-0.4577	-4.0244	-3.4420	-3.1456	I(1)
Dollar	-1.5665	-4.0235	-3.4415	-3.1453	I(1)
Inflation	0.5542	-4.0239	-3.4417	-3.1454	I(1)
Oil	-2.0979	-3.4771	-2.8819	-2.5777	I(1)
Variables in the Differenced Form					
Gold	-7.6856	-3.4768	-2.8818	-2.5776	I(1)
Housing market	-6.0706	-3.4771	-2.8819	-2.5777	I(1)
Stock market	-4.4024	-3.4771	-2.8819	-2.5777	I(1)
Dollar	-11.3631	-3.4768	-2.8818	-2.5776	I(1)
Inflation	-5.8514	-3.4768	-2.8818	-2.5776	I(1)
Oil	-9.8624	-3.4771	-2.8819	-2.5777	I(1)

Table 1: The Result of Augmented Dickey-Fuller (ADF) Test Conducted to Level Form and First Differenced Form of Variables

To proceed with the cointegration test later, the above variables must be of the I(1) form, which means that the variables are standardized by one order of difference. The result shows that at the initial level, we have failed to reject the null hypothesis, so the variables are not stationary. On the other hand, all the variables at the level of difference have a t statistic higher than the value of c, so we can reject the null value and conclude that the variables are constant at the level of difference. Therefore, we can conclude that all the variables of this analysis are I(1), and we can perform the cointegration test after identifying the delay sequence in the next step.

5.2. VAR (Lag) Order

Determining the lag order of the VAR model is a prerequisite for the cointegration test using Johansen's method. To determine the order of integration of variables in the research, we use our 6 variables for VAR. The test showed LR, FPE¹⁷, HQ¹⁸, AIC¹⁹ and SC²⁰ which are the best predictors for lag. AIC tends to choose higher order lags because it pays less attention to additional parameters and tries to solve autocorrelation and from SC probably chooses a lower order of lags because it tries to avoid over-parameterization and less loss in degrees of freedom, and HQ is related to the Akaike criterion. Table 2 shows the obtained result.

Choice Criteria	Optimal Order
SC	1
HQ	1

Table 2: Order of VAR Model

We choose the optimal interval corresponding to the highest value of SC and HQ as the appropriate criterion. From the above table, it can be concluded that there is no conflicting optimal order by the highest value of SC and HQ. Therefore, on this basis, we choose lag 1 as the optimal VAR lag order.

5.3. Cointegration Test

Cointegration shows that the relationship between the variables is not spurious. There is a theoretical relationship between the variables and they are in equilibrium in the long run, although they may move differently in the short run. It also means that each variable contains information for predicting other variables. In this analysis, we have done a test to identify the co-accumulation between the variables, which is Johansen's (1988) based VAR test. Johansen's method uses maximum likelihood, which is eigenvalue and trace, and is able to identify more than one (1) cointegration vector compared to other tests. Based on Johansen's method, we are able to identify a co-accumulation relationship between variables at a significance level of 95% based on the maximum eigenvalue and the t-test of the tracking test. The result of Johansen's test is shown in tables 3 and 4.

¹⁷ Final Prediction Error

¹⁸ Hannan_Quinn

¹⁹ Akaike Information Criterion

²⁰ Schwarz Information Criterion

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob
None*	0.336733	139.5380	117.7082	0.0010
At most 1	0.159717	81.23596	88.80380	0.1553
At most 2	0.146499	56.52560	63.87610	0.1778
At most 3	0.129185	34.03155	42.91525	0.2870
At most 4	0.062476	14.38928	25.87211	0.6254
At most 5	0.036151	5.228484	12.51798	0.5639

Table 3: Trace Statistic

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob
None*	0.336733	58.30206	44.49720	0.0009
At most 1	0.159717	24.71035	38.33101	0.6921
At most 2	0.146499	22.49405	32.11832	0.4556
At most 3	0.129185	19.64227	25.82321	0.2642
At most 4	0.062476	9.160794	19.38704	0.7078
At most 5	0.036151	5.228484	12.51798	0.5639

Table 4: Max-Eigen Statistic

Therefore, we come to the conclusion that in the long term, there is a common force between the variables and the relationship between them is not fake. At this point, it is possible to proceed to the next step due to the existence of a merger.

5.4. Long Run Structural Modelling (LRSM)

According to Masih et al. (2009), to match the coefficient of the covariate vector with the theoretical and a priori information of the economy, we must apply LRSM. In other words, once the number of co-accumulated vectors is determined in the previous step, LRSM is performed according to our attempt to quantify the theoretical (intuitive) relationship that is actually derived from the economic theories under investigation between the variables. This means that for cointegration analysis to be theoretically meaningful in the long run, the price of gold must make a significant contribution to the long-run relationship. Since our main focus is to identify the direction of causality between gold price, stock market price, housing market and macroeconomic variables (dollar, inflation rate and oil price), we first applied a normalization restriction. The unity on the gold variable in the identification stage is exactly as shown in table 5 (Panel A).

The output above shows the maximum likelihood estimate of the exact identification (panel A) and overidentification (panels B and C). The estimates in panel A show that none of the variables are significant in relation to gold. Therefore, we decided to further test all variables and apply the overidentification restriction on all variables with $A_2=0$, as shown in panel B. According to panel B, the dollar is significant compared to gold. With this limitation, the variables of housing, stock market, dollar, inflation rate and oil remain. In panel C, all variables except housing and inflation rate are significant compared to gold, so The squared statistics of the panels are rejected with (p-value less than 10 percent), which means that the restriction is not true.

Variable	Panel A	Panel B	Panel C
Gold	1.0000 (*NONE*)	1.0000 (*NONE*)	1.0000 (*NONE*)
Housing market	-1.5437 (0.19652)	-1.5090 (0.18986)	-1.1832 (0.14377)
Stock market	0.11432 (0.069938)	0.13227 (0.064781)	0.0000 (*NONE*)
Inflation	0.80018 (0.26470)	0.67424 (0.22569)	0.56860 (0.22969)
Dollar	0.041737 (0.047512)	0.00 (*NONE*)	0.00 (*NONE*)
Oil	0.10869 (0.058259)	0.10681 (0.056597)	0.00 (*NONE*)
Trend	-0.0027682 (.0011634)	-0.0020974 (0.8724E-3)	-0.0027337 (0.7861E-3)
Chi-Square		0.82950 [0.362]	5.9982 [0.112]

Table 5: Exact and Over-Identifying Restrictions on the Cointegrating Vector

Then, interestingly, when we performed the over-identification restriction, that is, testing the null hypothesis that the dollar was insignificant, and the null hypothesis was also rejected ($p > 0.10$). Consequently, considering a cointegration in the previous step, we continued panel A, so we kept all the variables as we wanted. There is a theoretical reason behind this. From the above analysis, we arrive at the following co-accumulation equation (numbers). Standard deviations are given in parentheses:

Gold+1.5447House-0.80018	Inflation+0.041737	Dollar+0.10869	Oil
(0.19)	(0.06)	(0.04)	(0.05)

Cointegration, however, cannot tell us the direction of Granger causality as to which variable is leading and which variable is lagging (which variable is exogenous and which variable is endogenous). In order to identify the endogeneity/exogeneity of the variable, we will apply the vector error correction model (VECM) in the next step.

5.5. Vector Error Correction Model (VECM)

In our study so far, we have proven that six variables, which are gold, housing market, stock market, dollar rate, inflation rate, and oil, are significantly combined. However, as mentioned in the previous step, the co-accumulation equation does not reveal anything about the causality of whether it is a leading variable or a lagged variable. Therefore, the information from this stage is useful for investors and fund managers to diversify their investment risk. Typically, investors and fund managers are interested in knowing which investment path or macroeconomic indicator is an exogenous variable because then they can closely monitor the performance of this variable and it has a significant effect on the expected movement of other variables in which they have invested. VECM allows us to determine which variables are actually exogenous and which are endogenous. Here, at least one of the ECM terms ($et-1$) must have a small error correction coefficient for the validity of the cointegration relationship between the variables in the long run, which means that the corresponding dependent variable is the exogenous equation. The selected variable does not depend on the deviation of other variables and becomes a leading variable that initially receives exogenous shocks, which leads to deviation from equilibrium and thus causes shocks to be transferred to other variables. However, if the coefficient is significant, it indicates that the relevant dependent variable is endogenous. Therefore, this variable depends on the deviation of other variables and bears the main burden of short-term adjustment to establish a long-term balance between co-accumulated variables. On the other hand, the size of the error coefficient also indicates the ratio with which the imbalance in the dependent variable is corrected in each short period. Therefore, with the beginning of this stage and beyond, the statistical result of these stages will be welcomed by the policy market, portfolio investment fund managers and potential/current investors.

Variable	ECM (-1) t-ratio [p-value]	Implication
Gold	0.13134[0.896]	exogenous
Housing market	5.7063 [0.000]	endogenous
Stock market	1.2096[0.228]	endogenous
Inflation	0.58040[0.563]	endogenous
Dollar	10.2526[0.000]	exogenous
Oil	0.20863[0.835]	exogenous

Table 6: Error Correction Model

This result means that as an exogenous variable, when coins, dollars, and oil receive market shocks, other variables such as the housing market, stock market, and inflation rate are affected by the shocks (because their prob is smaller than 5%). Clearly, the VECM results showed that the coin index, dollar and oil are the primary receivers of an exogenous shock. According to the long-term equilibrium relationship, while the housing market, stock market index and inflation rate should bear the burden of short-term adjustment endogenously in different proportions to restore the system to its long-term equilibrium, this coefficient shows that the imbalance in each is the period. Meanwhile, since VECM does not provide relative information/ranking of exogeneity and endogeneity, we need to do the next step to identify the ranking of the variables.

5.6. Variance Decompositions (VDCs)

After identifying the exogenous and endogenous variables, they are exposed to VDCs to determine which of the exogenous variables are the most exogenous and which of the endogenous variables are the most endogenous. The VDCs test helps us determine the relative degree/ranking of endogeneity among those variables. VDCs decompose the forecast error variance of each variable into the proportion attributable to shocks to each variable in the system, including its past changes. The more it depends on its own past, the more exogenous it is, or the less it depends on its own past; it is endogenous. The relative exogeneity and endogeneity of the variables are presented by the VDC results in the following tables in different horizons. We decided to use the generalized VDC compared to the other (orthogonal VDC) because the nature of the orthogonal VDC is not unique and depends on the specific order of the variable in the VAR and assumes that the other variables in the system are switched off. A particular variable is shocked. In contrast, generalized VDC does not have such restrictions.

RANKING	SELFDEP	TOTAL	Oil	Inflation	Dollar	Stock market	Housing market	Gold	Horizon	Variable
1	0.99988	100%	1.31E-05	2.41E-06	5.07E-06	9.41E-05	7.98E-06	0.99988	10	Gold
4	0.85965	100%	0.013104	0.07761	0.007926	0.00802	0.12604	0.85965	10	Housing
5	0.80428	100%	0.004799	0.028632	0.031498	0.80428	5.17E-04	0.13028	10	Stock
3	0.92511	100%	2.59E-05	0.92511	0.004919	1.59E-05	0.001869	0.67683	10	Inflation
6	0.65565	100%	0.015716	0.002899	0.20278	0.009619	0.11334	0.65565	10	Dollar
2	0.95572	100%	0.95572	0.003342	0.001528	1.94E-05	0.02984	0.00954	10	Oil

Table 7: Generalised Variance Decomposition (Horizon 10 Day)

RANKING	SELFDEP	TOTAL	Oil	Inflation	Dollar	Stock market	Housing market	Gold	Horizon	Variable
1	0.9997	100%	3.21E-05	1.25E-05	5.92E-06	1.96E-05	2.31E-04	0.9997	20	Gold
4	0.89737	100%	0.019678	0.010335	0.010306	0.012043	0.050272	0.89737	20	Housing market
5	0.8056	100%	3.98E-04	0.007632	0.004186	0.8056	0.0030002	0.17919	20	Stock market
3	0.93906	100%	6.40E-04	0.004321	0.93906	3.92E-04	0.0046182	0.05097	20	Inflation
6	0.68963	100%	0.020144	0.12891	0.003716	0.012329	0.14526	0.68963	20	Dollar
2	0.95527	100%	0.95527	0.001669	0.003471	4.65E-05	0.027016	0.01253	20	Oil

Table 8: Generalised Variance Decomposition (Horizon 20 Day)

RANKING	SELFDEP	TOTAL	Oil	Inflation	Dollar	Stock market	Housing market	Gold	Horizon	Variable
1	0.99944	100%	5.96E-05	2.32E-05	1.10E-05	3.65E-05	4.30E-04	0.99944	40	Gold
4	0.91861	100%	0.023505	0.011535	0.0099513	0.014386	0.022016	0.91861	40	Housing market
5	0.75305	100%	6.87E-04	0.008684	0.0046927	0.75305	0.004252	0.22864	40	Stock market
3	0.95042	100%	0.001191	0.003698	0.95042	7.29E-04	0.00859	0.035372	40	Inflation
6	0.70231	100%	0.022597	0.09413	0.0041687	0.01383	0.16296	0.70231	40	Dollar
2	0.95436	100%	0.95436	0.00182	0.003605	8.42E-05	0.024176	0.01596	40	Oil

Table 9: Generalised Variance Decomposition (Horizon 40 Day)

RANKING	SELFDEP	TOTAL	Oil	Inflation	Dollar	Stock market	Housing market	Gold	Horizon	Variable
1	0.9993	100%	7.45E-05	2.90E-05	1.38E-05	4.56E-05	5.37E-04	0.9993	60	Gold
4	0.92051	100%	0.02464	0.011861	0.0097902	0.015081	0.018116	0.92051	60	Housing market
5	0.72951	100%	8.93E-04	0.009124	0.0049029	0.72951	0.005399	0.25017	60	Stock market
3	0.95382	100%	0.001489	0.004275	0.95382	9.11E-04	0.010735	0.0285	60	Inflation
6	0.70537	100%	0.023334	0.084444	0.0043045	0.014281	0.16827	0.70537	60	Dollar
2	0.95469	100%	0.95469	0.001021	0.0036677	1.04E-04	0.022879	0.017636	60	Oil

Table 10: Generalised Variance Decomposition (Horizon 60 Day)

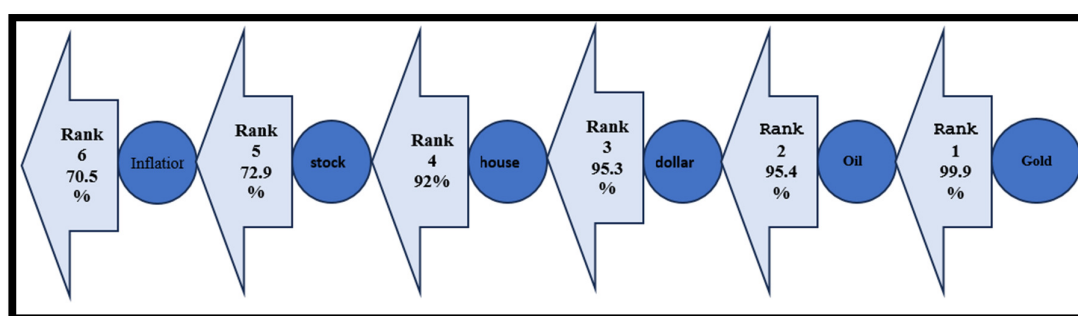


Figure 1: Direction of Causality from Right to Left

At first, our results from VDC do not seem to contradict those from the VECM approach. In general, the figure shows that for the gold variable, about 99.9% of the variance of the gold forecast error is explained by its own shock, followed by oil with 95.4%, the dollar with 95.3%, the housing market with 92%, the stock market 72.9% and finally the inflation rate with 70.5% are explained by their own shock. From these findings, it can be concluded that the most exogenous variable is gold, followed by oil and the dollar as the primary receivers of exogenous shocks, while it seems that the price of housing, stocks, and the inflation rate endogenously bear the burden of short-term adjustment to bring the system back to its long-term state. The results show that gold is the most exogenous variable while the inflation rate is the least endogenous variable. This result is supported by the research conducted by Rebordo (2013), which shows that the inflation rate cannot protect against changes in the price of gold. It should be noted that the gold variable is the most exogenous among the six (6) variables, which shows that Gold is self-reliant and others depend on gold. This result is consistent with our expectations of the result, as the global gold price has predictive power over other variables. Meanwhile, since Iran is one of the main oil producers in the world, we also expect that gold and oil prices are among the strongest exogenous variables in our study. Inflation seems to be led by spot prices of late, gold and oil prices and the

dollar. Financial stress suggests that inflation is a poor haven for shareholders. Meanwhile, regarding whether gold is a hedge instrument against inflation, our result was able to prove this feature, which means that investing in gold is a reliable hedge. Here, the inflation rate lags behind gold and is obviously a good hedge against inflation. Our result investigated the 2022 Hong Kong run cointegration between the domestic gold price and inflation in a distributed lag error correction framework. This paper shows that inflationary shocks lead to a negative reaction to the price of gold in the long run. In the short run, only gold price fluctuations affect inflation, and this causality is one-way. Gold is considered an important financial asset to protect wealth from inflationary pressure in the case of Iran. Moreover, their findings show that the price of gold (here, they used the Bahar Azadi coin as a proxy for Iranian gold) has a good hedge against inflation.

Therefore, we can conclude from here that housing prices, the stock market and the inflation rate are less exogenous, while gold, oil and dollar prices are more exogenous. This means that the inflation rate is late and mainly influenced by the stock market, housing prices, macroeconomic fundamentals and strategic commodities.

5.7. Impulse Response Functions (IRFs)

Impulse response functions (IRFs) produce essentially the same information as VDCs, except that the results are presented graphically. Here, we can see the effect of one variable on other variables, how much they respond, and how long they last. It takes time to become normal, to identify.

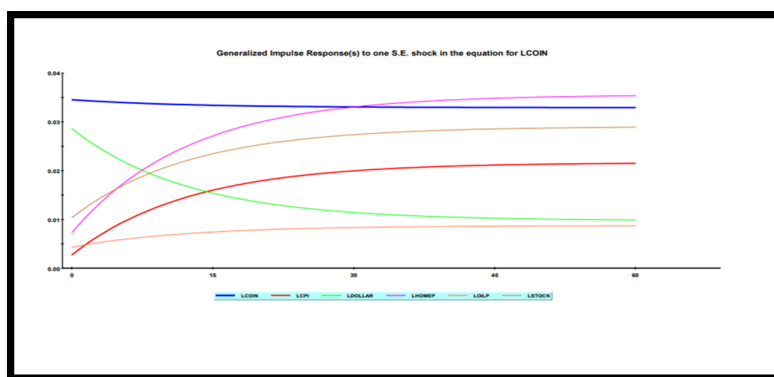


Figure 2

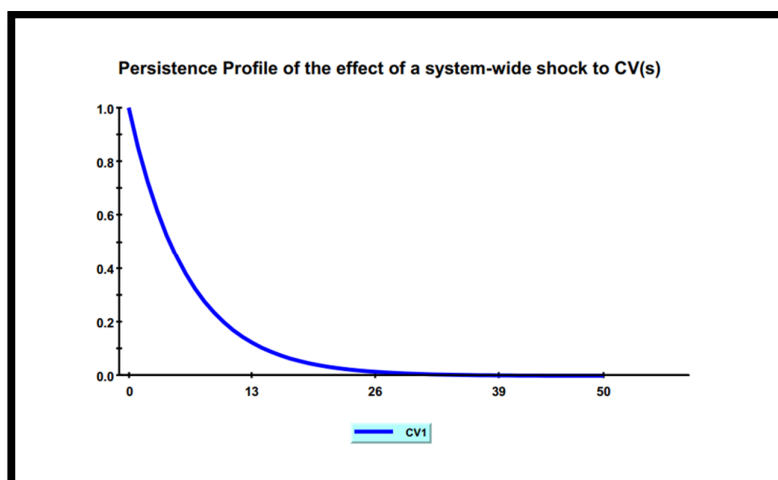


Figure 3

The graph indicates that the cointegration will return to equilibrium approximately after three months, given external shocks to the cointegrating system.

6. Conclusion

In the end, we came to the conclusion that about 99.9% of the variance of the gold forecast error is explained by its own shock, followed by oil at 95.4%, the dollar at 95.3%, the housing market at 92%, and the stock market at 72.9%. And finally, the inflation rate of 70.5% is explained by their own shock. From these findings, it can be concluded that the most exogenous variable is gold, followed by oil and the dollar as the primary receivers of exogenous shocks, while it seems that housing prices Stocks and the inflation rate endogenously bear the burden of short-run adjustment to bring the system back to its long-run state. The results show that gold is the most exogenous variable, while the inflation rate is the least endogenous variable. According to the research, it shows that the inflation rate cannot protect against changes in the price of gold.

7. Policy Implication

Considering the current conditions governing the country's economy, curbing inflation by gradually and continuously reducing the money supply rate in the long term can increase people's trust in the Rial and make people more willing to keep the national currency and save in the financial markets. By creating favorable conditions for investment and increasing domestic savings, the problem of unemployment will be significantly reduced.

It is suggested to use the necessary tools to make these markets as strong as possible to attract funds and prevent them from entering the gold market and keeping them stagnant. Also, since in Iran, gold is used as a hedge against inflation, governments can create more confidence in the people by adopting policies to reduce and control inflation, and with this condition, the flow of huge financial capital prevents the gold market.

It is suggested that policymakers and economic planners, especially in oil-exporting countries, should investigate the effects of the oil boom on domestic markets and its interrelationship with asset prices, such as stock prices in different conditions in their policy plans, and reduce the economy's dependence on oil. As a result, to reduce its vulnerability, the necessary currency and financial policies should be used.

Policies to control fluctuations in the housing market should include strengthening the supply of residential units and controlling construction costs while reducing bank interest rates, with the argument that reducing production costs cannot control housing prices. However, the effect of increasing low interest rates and the negative impact on housing prices prevails over its impact on reducing construction costs.

8. Limitation of the Study

In this research, the role of sanctions has not been considered, which has no effect on the investigated variables. The data is historical and its accuracy is the responsibility of the databases.

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