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Causality Relationship among the Changes of Stock Price, Exchange Rate, Crude Oil Price, and Gold Price: Evidence from Malaysian Market

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Abstract: Gold is a safe haven asset especially in times of uncertainties and can provide long-term capital gain. The objective of this study is to investigate the causality relationship among the changes of the Malaysia stock price index (KLCI), US stock price index (DOJ), Malaysian currency exchange rate (EXR) and crude oil price (COP) on the gold price (POG) in the Malaysian Market. This study employs vector error correction method with co-integration analysis, Granger causality test, and model evaluation. Based on the findings, COP and the lagged of the gold price (POG) only have a significant short-term relationship, however, the KLCI, DOJ, EXR and COP has also a significant long-term relationship with the gold price. Moreover, POG granger causes KLCI and COP also granger causes POG, both are uni-directional causality. Furthermore, EXR granger causes POG with bi-directional causality. Evidently, EXR and COP changes are importantly affecting the gold price changes. Otherwise, the gold price changes are affecting also the changes of KLCI and EXR in the study. These findings are important for investors who are opportunities for investment in gold in Malaysia.

Keywords: Gold Price, Malaysia Stock Price Index (KLCI), Dow Jones (DOJ), Exchange Rate, Crude Oil Price
JEL Classification: C12, C22, G00, Q00.

INTRODUCTION

Gold is no less popular than stocks and bonds as an investment alternative for the long term as well as short term. Traditionally, the public can invest in physical gold such as gold jewelry, gold coins and gold bullions. Recent years saw the development of more platforms to invest in gold such as Gold Accumulation Plans (GAP), Exchange Traded Funds (ETF), gold funds and E-gold. With the onset of more platforms to invest in gold, gold can be tracked and traded like common stocks, which makes gold more appealing to have in any investment portfolio.

Extant literature suggests that gold is a hedge as well as safe haven to a certain extent. More specifically, gold has been found to have little correlation with the US stock market, i.e. S&P 500 and Dow Jones Industrial Average, which makes gold an appealing investment alternative especially in periods of extreme stock market declines [1-3]. For instance, during the global financial crisis, while stock prices across a significant cross-section of the US stock market declined, gold price more than doubled from approximately $808.50 USD per ounce on 5th September 2008 to $1895 USD per ounce on 5th September 2011 (extracted from Market Business Insider).

Besides gold, crude oil is also among the most traded commodities in the world and prices of both commodities—gold and crude oil—provide indications of the directions of stock market indices [4]. While crude oil and gold enable investors to hedge against risks of investing in the stock markets, extant literature suggests that oil price and gold price move together in synchrony with each other and oil price can be used to predict gold price [5, 6].

While gold price is traditionally quoted in USD, gold price is also available in other denominations as the commodity is widely traded around the world. Changes in currency exchange rates confound the value of gold [7]. For example, consider the trend in world gold price quoted in USD in Figure 1 where gold price in USD decreased for the 10-year period 2008 Jan-2018 Jan especially during 2013 to now. In Figure 1, the current price of gold as of January 22, 2018 is USD 1,332.70 per ounce. On the other hand, in Figure 2, gold price quoted in MYR per ounce initially declined

but subsequently increased throughout the same 10-year period. The current price of gold as of January 22, 2018 is RM 5,250.72 per ounce. Much is to be learned about what contributes towards the rise and fall of gold price of the study.

Fig-1: World Gold Prices in USD/Oz since 2008- 2018
(Source: http://www.macrotrends.net/1333/historical-gold-prices-100-year-chart)

Fig-2: Gold Prices in Malaysia Ringgit (MYR) (oz) since 2008- 2018
(Source: https://goldprice.org/gold-price-malaysia.html)

Few studies have examined the relationship between gold price, oil price, stock market and exchange rate. Jain and Biswal's [8] study, which provides evidence of a dynamic relationship between oil price, gold price, exchange rate and the stock market in India, is among the few. While such dynamic relationship provides insights into how best policy makers can manage the effect of gold and crude oil trading on the currency exchange rate and stock market, much is still to be learned about the complexity of such dynamic relationship. Further, as an emerging market in an improving economy with strengthening currency, Malaysia attracts foreign capital [9]. Empirical evidence suggests that international diversification, cross-border capital flow and bilateral trade are not uncommon and as such emerging markets are subject to the influence of foreign markets [10]. This study aims at understanding the relationship among gold price, crude oil price, exchange rate, US stock price and Malaysia stock price. More specifically, the objective of this study is to investigate the causality relationship among the changes of the Malaysia stock price index (KLCI), US stock price index (DOJ), the Malaysian currency exchange rate (EXR) (RM/USD) and crude oil price (COP) on the gold price (POG) i.e. Kijiang Emas in the Malaysian Market.

This research fills the literature gaps. First, these studies primarily focused on physical gold such as gold coins [11, 12]. Second, prior studies are primarily international studies focusing on one or few factors such as consumer price index, oil price and stock price in determining gold price in their respective countries [13, 14]. This study contributes by examining factors affecting future gold price and the nature of short-term as well as long-term relationship between future gold prices with these factors. Understanding such short-term as well as long-term relationships in future gold price enables investors, regulators and portfolio managers to make more informed investment decisions.

The remainder of this paper is structured as follows. The next section provides a review of literature and the theoretical framework. The third section discusses the methodology. The fourth section describes the findings and analysis. The final section presents the overall conclusions.

LITERATURE REVIEW

The determinants of gold price and return on gold investment in Malaysia had been an ongoing area of research interest. A wide range of national as well as international macroeconomic factors ranging from crude oil price to currency exchange rate and inflation rate had been examined in extant literature using a variety of methods to determine their relationships with gold price and return on gold investment, but a conclusive result was yet to be reached. For example, Cengiz Toraman *et al.* [15] analysed the relationship between inflation rate, interest rate, return of US dollar and oil price with gold price using MGARCH data. The study had found a positive relationship between gold price and crude oil price and a negative relationship between return of gold and return on US dollar. No significant relationship was found between macroeconomic factors like inflation rate and interest rate with the return of gold.

Furthermore, Nurulhuda *et al.* [16] found a significant inverse relationship between macroeconomic factors like inflation rate and currency exchange rate with gold price. However, Nurul huda *et al.* [17] examined the price of 916 gold using Least Square Method. While the study provided further support to the positive relationship crude oil price and gold price, Nurulhuda's *et al.* [17] confessed concerns about reliability of their results due to the period of study from 2003 to 2012 and suggested inclusion of more macroeconomic factors like unemployment rate, political risk and gross domestic product to enhance the reliability of future studies. Much is to be learned about gold price and return on gold, which is evaluated to be in an inefficient market [18].

Fahmi *et al*. [19] examined the role of gold in the Malaysian market. Kijang Emas proxies for domestic gold while Kuala Lumpur Composite Index (KLCI) represents stock price. They found that gold plays a critical role as a hedge, but the character of its hedging properties is short-lived. Gold cannot protect its positive return a month consistent with particular crisis periods under investigation. They also found little evidence of gold as a safe haven in a few quartiles with the contemporaneous and slacked stock market investigation amidst the particular period [20].

Forrest Capie *et al.* [21] examined whether gold serves as a hedge against major currencies. Their study examined the relationship between gold price with currency exchange rates like sterling-to-USD and yen-to-USD to ascertain the extent to which gold acts as an exchange rate hedge based on 30 years of weekly data. The yen-to-USD and sterling-to-USD exchange rates were chosen for the study as the two exchange rates were deemed closest to gold price. The two exchange rates were also the most vital foreign exchange rates in the market. Gold served as a hedge against fluctuations in the foreign exchange value of the USD, but gold appeared to be highly dependent on unpredictable political states of mind and occasions. The study concluded that gold served as a hedge since the commodity was a standardized asset unlike property and was effectively traded in a continuously open market.

Ibrahim [22] examined the relationship between gold return and stock market return and whether such relationship changes in times of consecutive negative market returns for an emerging market like Malaysia. The study collected daily observations spanning from 1st August 2001 to 31st March 2010. Price of gold bullion is used as a proxy for domestic gold price while the Kuala Lumpur Composite Index is used as a proxy for stock market investment. The study applied GARCH-type models. The study sheds light on the favorable properties of gold as an investment asset for an emerging market like Malaysia. Gold market in Malaysia has been found to be unperturbed by the heightened risk of the stock market. More specifically, the negative relationship between gold return and stock market return despite four consecutive negative market returns suggests that gold possesses hedging properties in times of market declines. In other words, the study provides support to gold as a vehicle for preserving wealth in the midst of recurring financial turbulence.

In India, Amalendu Bhunia and Amit Das [23] found that the causal relationship between the sensitivity of gold price and stock market return using Vector Error Correction Model. In the aritcle, Johansen's co-integration test results suggested that there was a long-run equilibrium relationship between gold price and stock market return in India. Moreover [24], conducted a comparative study of risk and return in India for the gold versus the stock market. The study focused on the risk and return of National Stock Exchange (NSE) Index compared with the return of gold. The study gathered data from the official website of National Stock Exchange for the Index Value. Spot prices of gold were collected from the official website of Multi Commodity Exchange. Data were gathered for duration of 8 years from 2005/2006 to 2012/2013. Standard deviation was used to measure volatility while Compounded Annual Growth Rate sheds light on the annual growth in initial investment. Results suggested that investment in gold was very popular in India compared with stock market as return of gold was found to be relatively higher over the study period. The public's preference for gold as an investment was deemed to contribute to the positive return of gold over a long period. Results also found that risk of gold investment was 1/3 of the risk of the stock market investment. The study recommended

investing in gold via the Gold Mutual Fund of Exchange Traded Fund (ETF) as the return of ETF was directly related to return of gold.

CONCEPTURAL FRAMEWORK OF THE GOLD PRICE MODEL

As much is to be learned about in the gold price model, this study examines such relationships based on the following conceptual framework (in FIGURE 3).

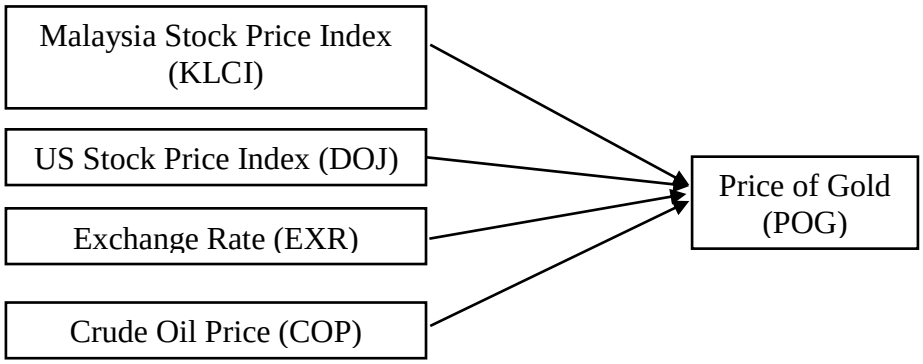

Fig-3: Conceptual Framework of the Gold Price Model

(Source: Development of the study)

$$\mathbf{POG_t = \beta_0 + \beta 1\ KLCI_{t-1} + \beta 2\ DOJ_{t-1} + \beta 3\ EXR_{t-1} + \beta 4\ COP_{t-1} + \varepsilon_t}$$

Where,

POG_t = Malaysian Gold Price (Kijang Emas) (USD per ounce)
$KLCI_{t-1}$= Malaysia Stock Price Index (Kuala Lumpur Composite Index)
DOJ_{t-1} = US Stock Price Index (Dow Jones Industrial Production index)
EXR_{t-1} = Real Effective Exchange rate (RM per USD)
COP_{t-1} = Crude Oil Price (USD per barrel)
β_s = Coefficients of Independent Variables
β_0 = Intercept term
ε_t = Error term
t = Time trend (daily data from 2011 Jan to 2015 Dec)

1. H_0: There is no positive relationship between KLCI and POG
   H_A: There is a positive relationship between KLCI and POG

2. H_0: There is no positive relationship between DOJ and POG
   H_A: There is a positive relationship between DOJ and POG

3. H_0: There is no positive relationship between EXR and POG
   H_A: There is a positive relationship between EXR and POG

4. H_0: There is no positive relationship between COP and POG
   H_A: There is a positive relationship between COP and POG

METHODOLOGY

Secondary data is collected from journals, articles, reports, newspapers, website such as, https://goldprice.org/gold-price-malaysia.html and so on. The sample includes daily time-series data for a period of 5 years from January 2011 to December 2015. Kijang Emas used as a proxy for traditional investment in gold in Malaysia and also currency exchange rate data were collected from Central Bank of Malaysia. As for the independent variables, Malaysia stock price Index (KLCI) is used as a proxy for stock price and data was gathered from Kuala Lumpur Stock Exchange. Dow Jones Industrial Production index, which is the proxy for US stock market return, and crude oil price were collected from websites, such as http://www.macrotrends.net/1369/crude-oil-price-history-chart and so on.

Firstly, this study used the unit root test for the stationary of the variables and explained by Gujarati and Porter [25]. The unit root (stationary) was tested by the Augmented Dickey-Fuller (ADF) and Phillip-Perron (P-P) test. Therefore, the variables were made by unit root test at the first differencing I(1) level to become stationary. Thus, the data were stationary at the first differences I(1) at the 0.01 level.

Secondly, a Vector Error Correction Model (VECM) is also known as a restricted Vector Autoregressive (VAR) is designed for non-stationary time series that are co-integrated. VECM determines short-term dynamics between variables by restricting the behaviour of variables in long run. It restricts the long run relationship through their co-integrating relations and error correction term (ECM) represents the deviation from long-run equilibrium. Thirdly, Granger causality is used to isolate clearly the direction of causality because VECM does not determine the direction of causality between the variables [26]. Granger [27] proposed Granger causality test to examine whether a causal relationship existed between two variables. This approach answers whether *x* caused *y* by how much of the current *y* can be explained by previous values of *x*. Results can be bi-directional, uni-directional or even no causality among variables. A simple restricted Granger causality can be modeled as below with assumption X_t and Y_t was two stationary time series with zero means and μ_{1t} μ_{2t} were uncorrelated disturbances.

If a variable *X* "Granger-causes" variable *Y*, the H_0 will be rejected and the causality direction between *X* and *Y* was *X*→*Y*. *X* was said to Granger-cause *Y* (*X*→*Y*) if the result was significant in F-tests of *X* to *Y* and this shows the variables are cointegrated and have long-run equilibrium relationship. Performance of the time series regression models is measured depending on the quality of its forecasting power [28]. Thus, the measurement of forecast accuracy would be taken as model selection criteria. The model evaluation used the model accuracy criteria such as root mean squared error (RMSE), mean absolute error (MAE), mean absolute percentage error (MAPE) and Theil's inequality coefficient (U-Theil). The model performance is considered satisfactory with an ideal value of significantly less than 1 and close to 0 for RMSE, MAE, and U-Stat.

Root mean squared error (RMSE) is more sensitive compared to other forecast statistics because it squares the forecasting errors and gives disproportionate weight to very large errors. Mean absolute error (MAE) is slightly lower than the root mean squared error and also less sensitive to the occasionally large error. Mean absolute percentage error (MAPE) expresses the error in term of percentage and able to be calculated only with positive data values. The absence of this statistic might probably imply that the data contains negative values. The scale of Theil's Inequality Coefficient (U- Stat) lies between 0 (perfect prediction) and 1 (perfect inequality).

RESULTS & DISCUSSION

Cointegration Equation

$$0.0244\ \Delta POG_{t-1} - 0.0189\ \Delta KLCI_{t-1} - 0.0239\ \Delta DOJ_{t-1} + 0.0255\ \Delta EXR_{t-1} - 0.0134\ \Delta COP_{t-1} = 0$$

[3.0788**] [-16.9759***] [-17.4057***] [11.4654***] [-7.0896***]

In the POG cointegration equation, the variables POG, KLCI, DOJ, EXR, and COP are cointegrated between the variables. Long run relationship between POG, KLCI, DOJ, EXR, and COP are statistically significant at 0.05 and 0.01 level, respectively. Therefore, for long-term investment in gold, KLCI, DOJ, EXR, and COP are the most important indicators for long-term prediction in the gold price of the study.

VECM Equation

$$\Delta POG = 0.0189 + 0.1515\ \Delta KLCI_{t-1} + 0.0097\ \Delta DOJ_{t-1} - 92.9459\ \Delta EXR_{t-1} + 5.7562\ \Delta COP_{t-1} - 0.4615\ \Delta POG_{t-1} + 1.8845\ e_t$$

[-0.9741] [0.8433] [-0.9471] [5.8705***] [-18.1454***]

$R^2 = 0.5352$ Adj $R^2 = 0.5344$

According to POG VECM equation, 53.52 percent of the variation in the Malaysian gold price model and is well explained by the explanatory variables in the model. The COP and the lagged variable of POG are statistically significant at α 0.01 level. Therefore, every 1 unit increase in the COP, on average, has a positive effect on increasing in POG by 5.7562 units with statistical significance at α 0.01 level, holding constant with other variables. Moreover, every 1 unit increase in the lagged variable of POG, on average, has a negative effect on decreasing in POG by 0.4615 units with statistical significance at α 0.01 level, holding constant with other variables. Based on the results, changes in crude oil price and the lagged of the gold price are most important affecting to the changes of the gold price. It is effected to the current price of gold may be increased or decreased of the Malaysian gold market (see it in Figure 2, gold price fluctuation within 10 years). The above results are consistent with findings in [17] and [29] study. For instance [29], highlighted a significant positive relationship between crude oil price and gold price and also a significant negative relationship between Malaysian ringgit currency exchange rate and the gold price.

Granger Causality Test

Table 1 shows the granger causality with lag 1between the two variables POG → KLCI is significance at α 0.05 level while KLCI → POG is not significant. Therefore, POG granger causes KLCI and they are having a unidirectional

relationship. So, POG and KLCI have a long-term equilibrium relationship and are cointegrated. In fact, the gold price POG's changes only affected to the KLCI stock price changes in the Malaysian market. Results also show that granger causality with lag 1 between the two variables EXR → POG is significance at α 0.01 level while POG → EXR is also significance at α 0.05 level. Therefore, EXR granger causes POG and they are having a bidirectional relationship. So, POG and EXR have a long-term equilibrium relationship and are cointegrated. It means that the gold price POG's changes affected to the EXR exchange rate volatility and also EXR's changes affected to the gold price POG changes in the Malaysian market.

Based on the result, granger causality with lag 1 between the two variables COP → POG is significance at α 0.01 level while POG → COP is not significant. Therefore, COP granger causes POG and both are having a unidirectional relationship. So, POG and COP have a long-term equilibrium relationship and are cointegrated. On the other hand, the crude oil price COP's changes only affected to the gold price POG changes in the market. Evidently, EXR and COP changes are importantly affecting the gold price changes. Therefore, EXR and COP are the most important factors of the changes of the gold price in the study. Alternatively, the gold price POG's changes affected to the KLCI stock price changes and also the EXR exchange rate volatility in the Malaysian market. Nevertheless, US Stock Market Return (DOJ) → the gold price (POG) and POG → DOJ are not significant. Therefore, US Stock Market Return is not significantly affecting the changes of the gold price in Malaysia. Amalendu Bhunia's *et al.* [23] found that gold price is also the bi-directional causality relationship between the stock price in India during the estimating period. They indicated that the co-movement of gold price and stock price even during the period global financial crisis and thereafter.

Table-1: Results of Granger Causality Test

KLCI causes POG (KLCI → POG) ^{ns}
POG causes KLCI (POG → KLCI)**
DOJ causes POG (DOJ → POG) ^{ns}
POG causes DOJ (POG → DOJ) ^{ns}
EXR causes POG (EXR → POG)***
POG causes EXR (POG → EXR)**
COP causes POG (COP → POG) ***
POG causes COP (POG → COP) ^{ns}

Notes: ***, ** is significant at α 0.01 and 0.05, respectively, as are not significant.

MODEL EVALUATION

FIGURE 4 shows that the gold price model ($lnPOG_t$) generated the lowest statistics of Root Mean Squared Error (RMSE), Mean Absolute Error (MAE), Mean Absolute Percent Error (MAPE) and Theil's inequality coefficient (U-Theil). RMSE, MAE, and U-Theil are significantly less than 1 and close to 0. Thus, the model is concluded with a satisfactory and valid forecasting performance.

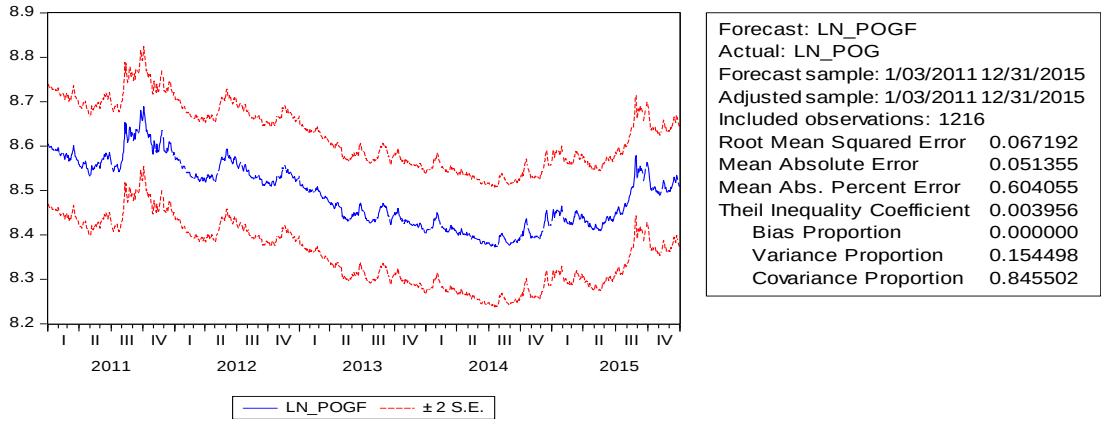

Fig-4: Model Evaluation of Gold Price Model

(Source: Development of the study)

CONCLUSION

This study investigates the relationship between KLCI, DOJ, EXR and COP on the effect on the gold price using a VECM model with the cointegration equation and Granger causality test. From the analysis, there is a long run relationship among KLCI, DOJ, EXR, COP, and POG. Interestingly, only COP and lagged variable of the POG demonstrated as the short term relationship. Furthermore, KLCI and COP are having a uni-directional relationship with POG. So, POG with KLCI & COP is having a long-term equilibrium relationship and cointegrated. However, only EXR

granger causes POG and they are having a bi-directional relationship. So, POG and EXR have a long-term equilibrium relationship and cointegrated also. Evidently, this study concludes that EXR and COP changes are importantly affecting the gold price changes. Otherwise, the gold price changes are affecting also the changes of KLCI and EXR in the study. Since the model is evaluated to be satisfactory and valid for forecasting performance. Future research can consider using univariate model with multivariate analysis for short-term and long-term forecasting performance of the commodity gold market.

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