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EXCHANGE RATE AND GOLD PRICE: EVIDENCE FROM MALAYSIA

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Abstract

This study examines the relationship of exchange rate and gold price in Malaysia. The autoregressive distributed lag (ARDL) approach shows that there is long-run relationship between exchange rate and its determinants, includes gold price. An increase in gold price will lead to a depreciation of the US dollar. There is a negative relationship between exchange rate and gold price. Gold price is found to have a significant impact on exchange rate in the short run. The generalized forecast error variance decompositions demonstrate that changes of gold price influence the forecast error variance of changes of exchange rate. There is a link between the gold market and the exchange rate market.

JEL Classification: *F31, G11, G15*
Keywords: *Exchange rate, gold price, cointegration*

1. Introduction

Gold is a precious medal, which has intrinsic value. Gold is used widely as a store of wealth. Gold can be used as against inflation or depreciation of the United States (US) dollar. This is because gold is priced in the US dollar. When the US dollar falls, the nominal price of gold in the US dollar will rise to preserve the gold value. Gold can be as against the US dollar exchange rate risk (Adibe and Fei, 2009: 3; Baur and McDermott, 2010). However, the role of gold as against the US dollar varies from time to time (Capie, Mills and Wood, 2005: 352). Gold can be as against currency as it is a homogeneous commodity and easily traded in the well-organised spot and future markets. Gold cannot be produced by the authorities that produce currencies. Thus those who can increase the money supply and therefore weaken its value cannot do

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so to weaken the gold value (Capie, Mills and Wood, 2005: 351; Sjaastad, 2008: 119).

Since the breakdown of the Bretton Woods in the year 1973, gold can be publicly traded with little government intervention in many countries. Gold is not directly linked with the value of currency and also the monetary policy (Adibe and Fei, 2009: 5). The world witnesses an aggressive growth in gold price in recent years (Figure 1). For the period, quarter 1, 1976-quarter 1, 2012, the mean of the gold price in the US dollar was 466.10 per troy ounce. The standard deviation was 305.86. The skewness and kurtosis were 2.3545 and 5.7634, respectively. The world gold price was volatile. The role of gold as an investment has drawn more attention during global economic crisis in the year 2008 (Adibe and Fei, 2009: 3). In the time of uncertainty, when the values of financial assets become ambiguous due to unwillingness of investors to trade, the attractiveness of gold increase due to the relative simplicity of the gold market (Baur and McDermott, 2010).

This study examines the relationship of exchange rate and gold price in Malaysia. Gold tends to hold its value with the depreciation of exchange rate. Hence the relationship between exchange rate and gold price is negative (Adibe and Fei, 2009: 10). The Central Bank of Malaysia does not regulate strictly the transaction of the gold in Malaysia. Malaysia adopts a managed floating with no pre-determined path for exchange rate most of the time (IMF, 2009). The time series evidence of exchange rate and gold price is relatively limited. The previous studies mainly focus the link such as between gold price and oil price (Narayan, Narayan and Zheng, 2010; Zhang and Wei, 2010), between gold price and inflation (Sjaastad, 2008), between gold price and stock price (Baur and McDermott, 2010; Basher, Haug and Sadorsky, 2012) and between gold price and the exchange rate volatility (Capie, Mills and Wood, 2005). Moreover, the previous studies mostly examine the link for developed countries (Capie, Mills and Wood, 2005; Baur and McDermott, 2010; Wang and Lee, 2011). Joy (2011) examines the dynamic conditional correlation between gold price and the US dollar exchange rate, that is, an increase in gold price tends to be lead to a decrease in the value of the US dollar. Wang and Lee (2011) investigate the causality between exchange rate and gold price in a non-linear threshold vector autoregressive model for Japan with the assumption the market is imperfectly competitive. On the other hand, this study examines the relationship between exchange rate and gold price in a linear framework for a small and a relatively fast developing economy in Asia, namely Malaysia. Moreover, the relative importance of exchange rate and gold price in this study is examined using the generalized forecast error variance decomposition (Koop, Pesaran and Potter, 1996; Pesaran and Shin, 1998), which solves the orthogonalised problem of the forecast error variance decompositions of Sims (1980). Thus the result obtained is invariant with the position of the variables in the estimation. Pukthuanthong and Roll (2011) investigate the causality between the gold return and the exchange rate change in a multi-currency framework. However, the study did not examine the relative importance of the variables. The autoregressive distributed lag (ARDL) approach of Pesaran, Shin and Smith (2001) is used. The approach is suitable regardless all variables examined are I(1), I(0) or the mixture of I(1) and I(0) variables. On the other hand, the Johansen cointegration method is more relevant for all variables integrated in the same order, namely I(1). Furthermore, this study includes the impact of the Asian financial crisis, 1997-1998 in investigating the relationship between exchange rate and gold price.

This study is structured as follows. Section 2 provides a literature review of exchange rate and gold price. Section 3 illustrates the data and methodology and section 4 provides empirical results and discussions. The last section is concluding remarks.

2. Literature review

Gold can be used as against the value of currency. Capie, Mills and Wood (2005) investigate the role of gold as against the US dollar. The finding amongst others is that gold serves as against changes in the value of the US dollar. However, its role varies depending on unpredictable political attitudes and events. Reboredo (2013) investigates the link between the price of gold and exchange rates using different copula functions. The study uses weekly data for the period from January 2000 to September 2012. The results show significant positive relationship between gold and the US dollar depreciation against different currencies. This implies that gold can be used as against the US dollar movements. The study concludes the usefulness of gold in the risk-management of a currency portfolio. Ciner, Gurdgiev and Lucey (2013) examine the correlations between oil, gold, currency, the bond and stock markets in the US and the United Kingdom (UK) using the quantile regression methods. Gold acts as a safe haven when exchange rates drop significantly in both the US and the UK cases.

Currency depreciation would lead an increase in the gold return. Pukthuanthong and Roll (2011) test the relationship between the gold return and exchange rates of the US dollar against euro, Japanese yen and the UK pounds sterling, respectively. The period of study is from 2 January 1971 to 10 December 2009. The results of Granger causality show that lagged values of exchange rate changes influence the future gold returns. Moreover, exchange rates of the US dollar against euro, Japanese yen and the UK pounds sterling, respectively exhibit the negative relationship with the gold return. An increase in the gold return can be linked with currency depreciation.

Conversely, Sjaastad (2008) examines the theoretical and empirical relationships between exchange rates and gold price using the forecast error data. The period of study is from 1991 to 2004. Floating exchange rates is a main source of price instability in the world gold market and the world gold market is dominated by the US dollar bloc. Appreciations or depreciations of the US dollar would have significant impacts on gold price in other currencies. Gold is no longer to be a store of value against world inflation. Joy (2011) assesses the role of gold as a safe haven with respect to the US dollar using a multivariate generalized autoregressive conditional heteroskedasticity (GARCH) model of dynamic conditional correlations for 16 dollar-paired exchange rates (euro, Japanese yen, Indian rupee, Taiwan dollar, Australian dollar, Canadian dollar, Danish krone, Israeli shekel, Maltese lira, New Zealand dollar, Norwegian krone, Singapore dollar, South African, Swedish krona, Swiss franc and the UK pounds sterling). The data are weekly from 10 January 1986 to 29 August 2008. The results show that changes in the price of gold and changes in exchange rates are negatives. The negative relationships are increasingly in the year 2008. Quantile correlations show gold does not act as an effective safe haven from market stress. Gold has acted against the US dollar. However, gold has been a poor safe haven.

Gold is a safe haven for some stock markets but not for others. Baur and McDermott (2010) analyse the role of gold as a safe haven against stocks in emerging and developing countries using daily, weekly and monthly data for the period from 2 March 1979 to 2 March 2009. The results show that gold is a safe haven for major European stock markets and the US but not for Australia, Canada, Japan and large emerging markets such as Brazil, Russia, India and China. Moreover, the study reports that gold can be as a stabilising force for the financial system by reducing losses in the extreme negative market shocks. Gold is a weak safe haven for some emerging markets. However, gold is a safe haven for most developed markets during the financial crisis.

Gold moves against currency but depends on the degree of the exchange rate change. Wang and Lee (2011) investigate the causality between the gold return and Japanese yen depreciation rate in a non-linear threshold vector autoregressive model. The data are monthly for the period from April 1986 to March 2007. The results show that different levels of Japanese yen fluctuation have different effects on the effectiveness of gold against the exchange rate depreciation. The effectiveness of gold as against Japanese yen depends on the depreciation rate of Japanese yen. More specifically, the result shows that holding gold can avoid lose when Japanese yen depreciates against the US dollar by more than the 2.62 percent else gold does not have a role against the depreciation of Japanese yen. Wang and Chueh (2013) examine the short-run and long-run dynamic relationships among interest rates, oil prices, gold prices and the US dollar using daily data from 2 January 1989 to 20 December 2007. Gold prices, crude oil prices and interest rates influence each other in the short run. In some long-run ranges, interest rates lead gold prices. Changes in interest rates can affect investors' expectations of the US dollar, which will be translated into exchange rate. The US dollar will depreciate. Investors will move their capital to the gold market for speculation or capital preservation, resulting in fluctuations in gold prices. Gold prices went up because gold preserve values and provides hedging effects.

Generally, there is a negative relationship between exchange rate and gold price (Capie, Mills and Wood, 2005; Joy, 2011). However, the role of gold as against exchange rate varies across countries and time (Baur and McDermott, 2010). There are studies indicate that there is a weak relationship between exchange rate and gold price. The empirical findings of the relationship between exchange rate and gold price are mixed.

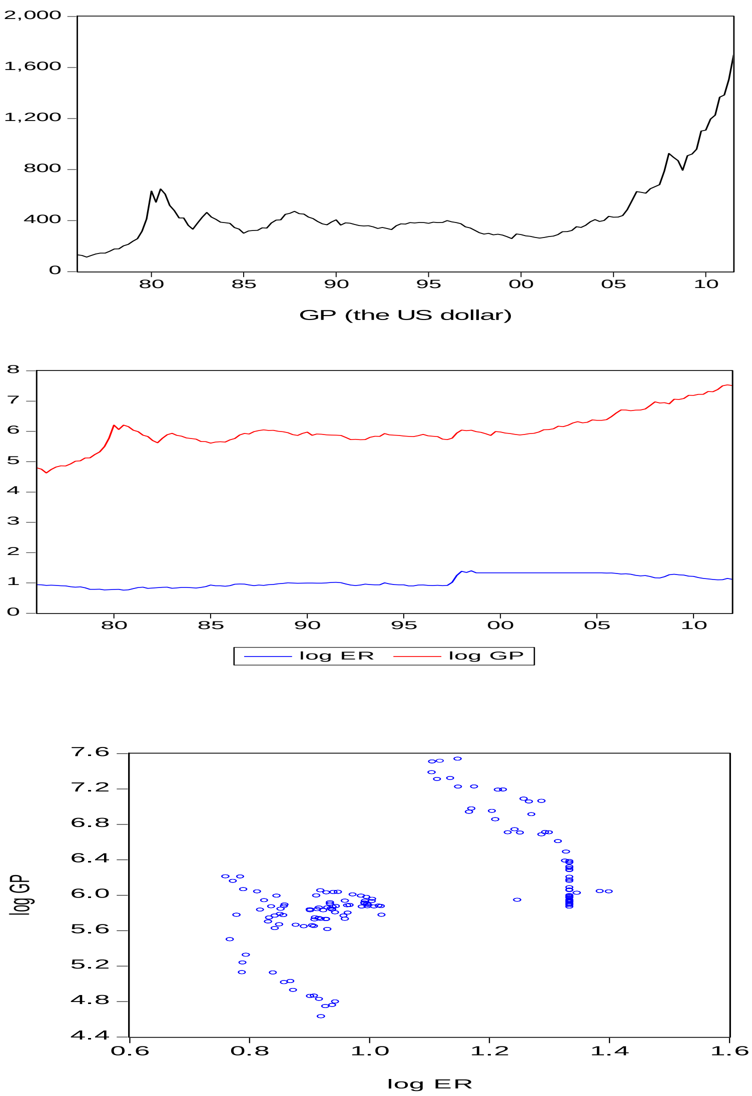
3. Data and Methodology

Exchange rate is Malaysian ringgit against the US dollar exchange rate. Thus an increase in exchange rate implies depreciation of Malaysian ringgit. The relative money supply (RMS_t) is expressed as $RMS_t = \left(\frac{MS_{m,t}}{MS_{us,t}} \right)$, where MS_t is the money supply M2 (Malaysian ringgit in million and the US dollar in million, respectively), the subscript *m* denotes Malaysia and the subscript *us* denotes the US. The relative demand (RD_t) is expressed as $RD_t = \left(\frac{IPI_{m,t}}{IPI_{us,t}} \right)$, where IPI_t is the industrial production index (2000 = 100). The interest rate differential (ID_t) is expressed as $ID_t = i_{m,t} - i_{us,t}$, where i_t is the treasury bills rate. Gold price (GP_t) is expressed as $GP_t = GP_{w,t} \times ER_t$, where $GP_{w,t}$ is the world gold price in the US dollar per troy ounce (2000 = 100) and ER_t is Malaysian ringgit against the US dollar. The sample period is from quarter 1, 1976 to quarter 1, 2012. All data were seasonal unadjusted.[2] Also, all data were transformed into the natural logarithms before estimation, except the interest rate differential. All the data were obtained from *International Financial Statistics*, the International Monetary Fund (IFS, IMF).

[2]This study has tried to include the seasonal dummy variables to capture the influence of seasonality in the estimations, which results are not reported. However, the conclusions with the seasonal dummy variables are the same as the estimations without including the seasonal dummy variables.

Figure 1 displays the plots of the natural logarithms of exchange rate and gold price. Generally, there is no specific pattern between exchange rate and gold price. The correlation between the natural logarithms of exchange rate and gold price is 0.51***, which is significance at 1 percent level. The descriptive statistics of the data in this study are given in Table 1. The Jarque-Bera test statistics are found to be statistically significant.

Figure 1
The Plots of exchange rate and gold price, 1976:Q1-2012:Q1



Source: IFS, IMF.
Notes: *ER* denotes exchange rate and *GP* denotes gold price.

Table 1
Descriptive Statistics, 1976:Q1-2012:Q1

	log ER_t	log GP_t	log RMS_t	log RD_t	ID_t
Mean	1.0577	6.0267	-3.2390	-0.3956	-1.0725
Median	0.9872	5.9201	-3.1404	-0.2378	-0.9000
Maximum	1.4005	7.5368	-2.0606	0.3396	4.5833
Minimum	0.7608	4.6292	-4.5897	-1.4285	-10.624
SD	0.1972	0.5854	0.7674	0.5271	3.2398
JB	15.2341***	7.8512**	12.0403***	14.913***	15.1636***

Correlation Matrices, 1976:Q1-2012:Q1

	log ER_t	log GP_t	log RMS_t	log RD_t
log ER_t	1	-	-	-
log GP_t	0.51***	1	-	-
log RMS_t	0.8***	0.8***	1	-
log RD_t	0.79***	0.71***	0.94***	1
ID_t	0.49***	0.33***	0.6***	0.65***

Source: IFS, IMF.
Note: SD denotes standard deviation. JB denotes the Jarque-Bera test statistic. *** (**) denotes significance at the 1% (5%) level. The tests of correlation are a 2-tailed test.

The Zivot and Andrews (1992) (ZA), Lee and Strazicich (2004) (LS) and Perron (1997) (P) unit root test statistics are used to examine the stationary of the data. The power to reject the unit root null hypothesis declines if there is a structural break in data that is ignored. The ZA unit root test statistics are an augmented Dickey-Fuller type endogenous break unit root test. The LS unit root test statistics are an endogenous unit root test for one or two structural breaks that is unaffected by structural breaks under the null and alternative hypotheses and thus spurious rejection will not occur. The LS unit root test statistics are based on Lagrange Multiplier test. The P unit root test statistics consider the date of possible change is not fixed a priori but is considered as unknown.

The Pesaran, Shin and Smith (2001) (PSS) bounds testing approach is used to examine the long-run relationship of the variables. The PSS bounds testing approach does not impose restrictive assumption that all the variables are to be integrated of the same order. The PSS bounds testing approach is said to be robust for finite samples even in the presence of regime shifts. The regime shifts can be modelled by using the dummy variables. The PSS bounds testing approach allows conclusion about cointegration among variables even with the dummy variables, that is, the asymptotic theory developed in the PSS bounds testing approach is not influenced by the inclusion of the dummy variables. Moreover, the PSS bounds testing approach allows a different number of optimal lags to be handled (Fuinhas and Marques, 2012).

The unrestricted error correction model for exchange rate is specified as follows:[3]

$$\Delta \log ER_t = \beta_{10} + \beta_{11} Trend + \beta_{12} D_t + \sum_{i=0}^{p} \beta_{13i} \Delta \log RMS_{t-i} + \sum_{i=0}^{q} \beta_{14i} \Delta \log RD_{t-i} + \sum_{i=0}^{r} \beta_{15i} \Delta ID_{t-i} + \sum_{i=0}^{s} \beta_{16i} \Delta \log GP_{t-i} + \sum_{i=1}^{v} \beta_{17i} \Delta \log ER_{t-i} + \beta_{18} \log RMS_{t-1} + \beta_{19} \log RD_{t-1} + \beta_{110} ID_{t-1} + \beta_{111} \log GP_{t-1} + \beta_{112} \log ER_{t-1} + u_{1,t} \quad (1)$$

where Δ is the first difference operator, log is the natural logarithm, ER_t is exchange rate, Trend is the time trend, D_t is the dummy variable to capture the influence of the Asian financial crisis, 1997-1998, RMS_t is the relative money supply, RD_t is the relative demand, ID_t is the interest rate differential, GP_t is gold price and $u_{1,t}$ is a disturbance term. The Wald or F-statistic is computed to test the null hypothesis, H_0: $\beta_{18} = \beta_{19} = \beta_{110} = \beta_{111} = \beta_{112} = 0$ against the alternative hypothesis, H_a: $\beta_{18} \neq \beta_{19} \neq \beta_{110} \neq \beta_{111} \neq \beta_{112} \neq 0$. If the Wald or F-statistic falls outside the upper bound, the null hypothesis of no cointegration is rejected or log ER_t and its determinants are said to be cointegrated. However, no conclusive inference can be made for the Wald or F-statistic falls inside the critical bounds. If the Wald or F-statistic falls below the lower bound, the null hypothesis of no cointegration cannot be rejected.

If there is evidence of cointegration, the long-run model of the ARDL approach for exchange rate can be estimated as follows:[4]

$$\log ER_t = \beta_{20} Trend + \beta_{21} D_t + \sum_{i=0}^{p} \beta_{22i} \log RMS_{t-i} + \sum_{i=0}^{q} \beta_{23i} \log RD_{t-i} + \sum_{i=0}^{r} \beta_{24i} ID_{t-i} + \sum_{i=0}^{s} \beta_{25i} \log GP_{t-i} + \sum_{i=1}^{v} \beta_{26i} \log ER_{t-i} + u_{2,t} \quad (2)$$

where $u_{2,t}$ is a disturbance term. The orders of the lags in the ARDL model can be selected by the Akaike Information Criterion (AIC). The model is estimated by using the ordinary least squares (OLS) estimator.

[3]The estimated model is based on a model of the monetary approach of the exchange rate determination and adding the gold price variable (Rapach and Wohar, 2002).
[4]Pukthuanthong and Roll (2011: 2071-2073) provide an explanation of the correlation between exchange rate and gold price.

The error correction model of the ARDL approach can be estimated as follows:

$$\Delta \log ER_t = \beta_{30} + \sum_{i=0}^{p} \beta_{31i} \Delta \log RMS_{t-i} + \sum_{i=0}^{q} \beta_{32i} \Delta \log RD_{t-i} + \sum_{i=0}^{r} \beta_{33i} \Delta ID_{t-i} + \sum_{i=0}^{s} \beta_{34i} \Delta \log GP_{t-i} + \sum_{i=1}^{v} \beta_{35i} \Delta \log ER_{t-i} + \beta_{36} EC_{t-1} + u_{3,t} \quad (3)$$

where EC_{t-1} is the one period lag of the error correction term and $u_{3,t}$ is a disturbance term. The error correction term is obtained from the error term of equation (2). The general-to-specific modelling strategy is used to estimate the error correction model.

Consider the vector autoregressive (VAR) as follows:

$$x_t = \sum_{i=1}^{p} \Phi_i x_{t-i} + \Psi w_t + \varepsilon_i \,,\ t = 1, 2, ..., T \quad (4)$$

where x_t is a $(m \times 1)$ vector of jointly determined dependent variables, w_t is a $(q \times 1)$ vector of deterministic and or exogenous variables, Φ is a $(m \times m)$ coefficient matrix, Ψ is a $(m \times q)$ coefficient matrix, ε_i is a vector of $(p \times 1)$ vector of disturbance terms and T is the sample size.

The equation (4) can be rewritten as the infinite moving average representation as follows:

$$x_t = \sum_{i=0}^{\infty} A_i \varepsilon_{t-i} + \sum_{i=0}^{\infty} G_i w_{t-i} \,,\ t = 1, 2, ..., T \quad (5)$$

where $A_i = \Phi_1 A_{i-1} + \Phi_2 A_{i-1} + \ldots + \Phi_p A_{i-p}$ and $G_i = A\,\Psi$. An impulse response function measures the time profile of the effect of shocks at a time on the future values of variables in a dynamic system. The generalized impulse response function of x_t at horizon n is defined as follows:

$$GI_x(n, \delta, \Omega_{t-1}) = E(x_{t+n} \mid \varepsilon_t = \delta, \Omega_{t-1} - E(x_{t+n} \mid \Omega_{t-1}) \quad (6)$$

Using equation (6) in equation (2), $GI_x(n, \delta, \Omega_{t-1}) = A_n \delta$, which is independence of Ω_{t-1} but depends on the shocks defined as δ.

The scaled generalized impulse response function can be rewritten as follows:

$$\Psi_j(n) = \delta_{jj}^{-\frac{1}{2}} A_n \sum e_j \text{, } n = 0, 1, 2, \ldots \tag{7}$$

where e_j is an $(m \times 1)$ vector with unity as its j-th element and zeros elsewhere. Finally, the generalized forecast error variance decomposition can be written as follows (Pesaran and Shin, 1998; Lee and Chien, 2010: 570):

$$\theta_{ij}(n) = \frac{\sigma_{ii}^{-1} \sum_{l=0}^{n} (e_i' A_l \sum e_j)^2}{\sum_{l=0}^{n} e_i' A_l \sum A_l' e_i} \text{, } i, j = 1, \ldots, m \tag{8}$$

The generalized forecast error variance decomposition examines the proportion of forecast error variance in one variable caused by the innovations in the other variables. Thus the generalized forecast error variance decomposition assesses which variables are the most endogenous and also assesses the relative importance of its own shock and shocks of other variable. The main advantage of the generalized forecast error variance decomposition is that the estimated result is invariant to the position of the variables entered in the VAR (Koop, Pesaran and Potter, 1996; Pesaran and Shin, 1998). Therefore it does not pre-assume any ordering that has theoretical implication. On the other hand, the approach of Sims (1980) is sensitive to the position of the variables in the VAR.

4. Empirical Results and Discussions

The ZA, LS and P unit root test statistics are reported in Table 2. The lag lengths used to estimate the ZA and LS unit root test statistics are based on the t-statistic, that is, the number of lags for which the last included lag has a marginal significance level less than the cutoff given by the 10 percent level. The fraction of entries on each end of data to exclude as the breaks and minimum gap between breaks is the 10 percent level. For the P unit root test statistics, the lag lengths used are based on the minimum of the t-statistic among the maximum of twelve lags. The results of the ZA, LS and P unit root test statistics show that the variables are mostly not rejected in their levels and also after taking the first differences, except the ZA unit root test statistics (crash and break) show exchange rate is a stationary variable and the relative money supply is a non-stationary variable, the LS unit root test statistic (crash) shows that the relative demand is a non-stationary variable, the P unit root test statistic (crash) shows that interest rate differential is a stationary variable and the P unit root test statistics (break) show that exchange rate, interest rate differential and gold price is a stationary variable. Thus the variables examined are the mixture of I(1) and I(0) variables and the use of the ARDL approach of PSS is suitable for the estimation in this study.

Table 2
The Results of the Zivot and Andrews (1992) (ZA), Lee and Strazicich (2004) (LS) and Perron (1997) (P) Unit Root Test Statistics

	ZA - Crash	ZA - Break	LS - Crash	LS - Break	P - Crash	P - Break
log ER_t	-4.85**	-7.83***	-2.11	-3.86	-4.79	-7.84***
	(1997:3)	(1997:3)	(1998:4)	(1998:4)	(1997:1)	(1997:1)
Δ log ER_t	-8.48***	-8.62***	-7.81***	-7.90***	-10.96***	-11.00***
	(1998:4)	(1997:2)	(1997:1)	(1996:2)	(1997:3)	(1997:3)
log RMS_t	-3.27	-3.23	-3.55	-3.90	-4.79	-4.72
	(1992:2)	(1991:4)	(2007:1)	(1993:2)	(1993:1)	(1993:1)
Δ log RMS_t	-4.73	-4.72	-8.71***	-8.70***	-9.32***	-9.32***
	(1998:1)	(1998:1)	(1989:2)	(1988:3)	(1997:3)	(1997:3)
log RD_t	-4.05	-4.82	-2.34	-4.18	-4.50	-5.17
	(1987:3)	(1988:1)	(1984:1)	(1997:2)	(1987:1)	(1987:3)
Δ log RD_t	-10.65***	-11.25***	-2.39	-7.83***	-5.81***	-5.44*
	(1990:1)	(2008:1)	(1982:4)	(2008:3)	(2011:2)	(2011:2)
ID_t	-4.71	-4.67	-2.76	-3.24	-5.46**	-5.59**
	(1998:3)	(1998:3)	(1983:4)	(1991:3)	(1998:1)	(1998:1)
Δ ID_t	-6.40***	-6.46***	-5.47**	-5.62**	-5.84***	-5.84**
	(1980:2)	(1980:2)	(1991:4)	(2008:4)	(1981:2)	(1981:2)
log GP_t	-3.46	-3.84	-1.68	-2.81	-4.01	6.57***
	(2005:4)	(1998:2)	(1982:2)	(1995:3)	(2006:4)	(1999:4)
Δ log GP_t	-10.52***	-12.89***	-8.99***	-9.02***	-10.40***	-10.60***
	(1980:2)	(1980:2)	(2000:2)	(1992:1)	(1980:4)	(1979:3)

Notes: Crash denotes the ZA, LS or P unit root test statistic for testing an abrupt change in level but no change in the trend rate. Break denotes the ZA, LS or P unit root test statistic for testing an abrupt change in level and a change in the trend rate. Values in parentheses are the breaks. The critical values for the ZA, LS or P unit root test statistics can be obtained from Zivot and Andrews (1992), Lee and Strazicich (2004) and Perron (1997), respectively. *** (**) denotes significance at the 1% (5%) level.

The PSS bounds testing approach is reported in Table 3. The Wald-statistic is found to be statistically significance at the 1 percent level. Hence there is a long-run relationship between exchange rate and its determinants. In other words, those variables are moving together and would not move too far from each other in the long run.

Table 3
The Results of Bounds Testing Approach for Cointegration

Wald-Statistic	16.3074***

Note: *** denotes significance at the 1% level.

The long run coefficients of the ARDL approach are given in Table 4. The model fulfils the conditions of homoscedasticity of error term and no-functional form but it does not fulfil the conditions of normality of error term and no-autocorrelation. The condition of no-autocorrelation is found only to be significant at the 10 percent level. The coefficients of all the variables are found to be statistically significant at the 1 percent level, except the relative demand. One possible explanation for the insignificant of the variable is that exchange rate could be actively managed rather than mainly reflected by the fundamentals. In the long run, an increase in the relative money supply, the interest rate differential and gold price will lead to an appreciation of the Malaysia ringgit. The negative coefficient of the relative money supply could be the results of heavily used of the monetary policy to achieve the targeted value of Malaysian ringgit. The positive coefficient of the dummy variable which is used to capture the Asian financial crisis is found to be positive. This implies that the crisis had led to depreciation of Malaysian ringgit. In the crisis, Malaysian ringgit was fixed to RM3.80 per one US dollar with the aim to stabilise Malaysian ringgit and the economy as well. The fixed currency policy lasted until 2005.

Table 4
The Long Run Coefficients of the ARDL Approach (4,0,4,0,0)

$\log ER_t = 0.0157\ Trend^{***} + 1.0509\ D_t^{***} - 0.4361 \log RMS_t^{***}$
$+ 0.1188 \log RD_t - 0.0518\ ID_t^{***} - 0.2884 \log GP_t^{***} + u_{2,t}$

Diagnostic tests:
Adj. R^2 = 0.9851. Equation Log-likelihood = 331.8. AIC = 317.8009.
LM = 8.8797*. Reset = 0.3187. Normality = 76.3568***. Hetero = 0.5193.

Notes: Adj. R^2 is the adjusted R^2. LM is the Lagrange Multiplier test of disturbance serial correlation. Reset is the test of functional form. Normal is the test of the normality of disturbance. Hetero is the test of heteroscedasticity.***(*) denotes significance at the 1% (10%) level.

The error correction model is reported in Table 5. The adjusted coefficient of determination (R^2) is 0.3981. The model fulfils the condition of no-autocorrelation but does not fulfill the conditions of homoscedasticity of error term, no-functional form and normality of error term. Thus the model is estimated by using the OLS with the White's Heteroscedasticity adjusted standard errors. The plots of cumulative sum of recursive residuals and cumulative sum of squares of recursive residuals indicate that the model is relatively stable at the 5 percent level (Figure 2). The one-lagged error correction term is found to have the expected negative sign and statistically significant at the 1 percent level. This implies the validity of an equilibrium relationship among the variables in the estimated model. There is some evidence that gold price is found to have a significant impact on exchange rate.

The interest rate differential is also found to have a significant impact on exchange rate in the short run.

Table 5
The Error Correction Model

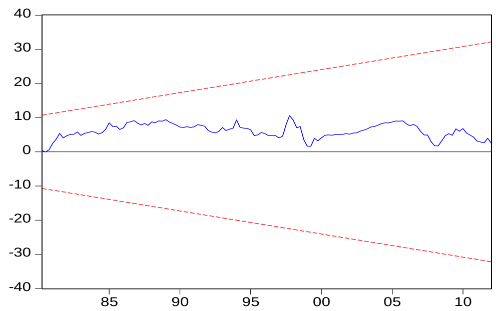
$$\begin{aligned}\Delta \log ER_t = {} & 0.0209^{***} - 0.0246\,\Delta \log RMS_{t-1} + 0.0983\,\Delta \log RMS_{t-2} + 0.0432\,\Delta \log RD_t \\ & - 0.0099\,\Delta ID_t^{***} + 0.0058\,\Delta ID_{t-1}^{**} - 0.0028\,\Delta ID_{t-2} + 0.0081\,\Delta ID_{t-3}^{***} \\ & + 0.0226\,\Delta \log GP_{t-1} - 0.0496\,\Delta \log GP_{t-2}^{*} + 0.3222\,\Delta \log ER_{t-1}^{***} \\ & - 0.2482\,\Delta \log ER_{t-2}^{**} - 0.2666\,\Delta \log ER_{t-4} - 0.1067\,EC_{t-1}^{***} + u_{3,t}\end{aligned}$$

Diagnostic tests:
Adj. R^2 = 0.3981. Equation Log-likelihood = 326.3766. AIC = 313.3766.
LM = 7.4993. Reset = 24.9574***. Normality = 39.8013***. Hetero = 23.4784***.

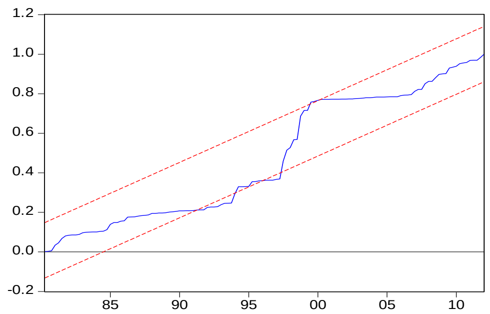
Notes: The estimation is based on White's Heteroscedasticity adjusted standard errors. *** (**, *) denotes significance at the 1% (5%, 10%) level.

Figure 2
The Plots of Cumulative Sum of Recursive Residuals (a) and Cumulative Sum of Squares of Recursive Residuals (b)

(a)



(b)



Note: The straight lines represent critical bounds at 5% significance level.

The generalized forecast error variance decompositions are reported in Table 6.[5] The choice of the lag length used in the estimations of the generalized forecast error variance decompositions are based on the AIC. The results of the generalized forecast error variance decompositions, which are reported, are based on the 1-5, 10, 15 and 20 horizon periods. On the whole, changes of exchange rate contribute to the forecast error variance of changes of gold price. Gold price accounts for about 1.1 percent of the forecast error variances of exchange rate. Conversely, exchange rate accounts for about 2.6 percent of the forecast error variances of gold price. This provides some evidence that the two markets are linked together.

[5]All variables are in the first difference of the natural logarithm.

Table 6
The Generalized Forecast Error Variance Decompositions

Δ log ER_t

Horizon	Δ log ER_t	Δ log RMS_t	Δ ID_t	Δ log RD_t	Δ log GP_t
0	1.0000	0.0025	0.1079	0.0029	0.0002
1	0.9701	0.0050	0.0992	0.0028	0.0038
2	0.9634	0.0059	0.1002	0.0027	0.0106
3	0.9412	0.0185	0.1122	0.0027	0.0108
4	0.9299	0.0208	0.1195	0.0032	0.0137
5	0.9285	0.0217	0.1196	0.0035	0.0139
10	0.9264	0.0226	0.1197	0.0036	0.0150
15	0.9264	0.0226	0.1197	0.0036	0.0150
20	0.9264	0.0226	0.1197	0.0036	0.0150

Δ log RMS_t

Horizon	Δ log ER_t	Δ log RMS_t	Δ ID_t	Δ log RD_t	Δ log GP_t
0	0.0025	1.0000	0.0102	0.0009	0.0316
1	0.0446	0.9317	0.0091	0.0042	0.0526
2	0.0904	0.8592	0.0081	0.0184	0.0503
3	0.0888	0.8577	0.0107	0.0181	0.0488
4	0.0875	0.8538	0.0157	0.0182	0.0515
5	0.0876	0.8467	0.0225	0.0193	0.0523
10	0.0873	0.8431	0.0248	0.0198	0.0547
15	0.0872	0.8428	0.0250	0.0198	0.0551
20	0.0872	0.8427	0.0250	0.0198	0.0551

Δ ID_t

Horizon	Δ log ER_t	Δ log RMS_t	Δ ID_t	Δ log RD_t	Δ log GP_t
0	0.1079	0.0102	1.0000	0.0214	0.0298
1	0.1000	0.0142	0.9706	0.0281	0.0343
2	0.1212	0.0183	0.9161	0.0276	0.0628
3	0.1336	0.0600	0.8384	0.0276	0.1081
4	0.1454	0.0620	0.8087	0.0268	0.1250
5	0.1437	0.0656	0.7991	0.0270	0.1274
10	0.1478	0.0701	0.7852	0.0277	0.1301
15	0.1477	0.0702	0.7849	0.0277	0.1303
20	0.1477	0.0702	0.7849	0.0277	0.1304

Δ log RD_t

Horizon	Δ log ER_t	Δ log RMS_t	Δ ID_t	Δ log RD_t	Δ log GP_t
0	0.0029	0.0009	0.0214	1.0000	0.0118
1	0.0034	0.0187	0.0284	0.9727	0.0114
2	0.0051	0.0205	0.0345	0.9652	0.0143
3	0.0053	0.0218	0.0407	0.9531	0.0155
4	0.0061	0.0219	0.0412	0.9506	0.0155
5	0.0071	0.0219	0.0411	0.9492	0.0155
10	0.0090	0.0220	0.0419	0.9445	0.0179
15	0.0090	0.0220	0.0419	0.9445	0.0179
20	0.0090	0.0220	0.0419	0.9445	0.0179

Table 6
The Generalized Forecast Error Variance Decompositions (continued)

Δ log GP_t

Horizon	Δ log ER_t	Δ log RMS_t	Δ ID_t	Δ log RD_t	Δ log GP_t
0	0.0002	0.0316	0.0298	0.0118	1.0000
1	0.0008	0.0353	0.0350	0.0109	0.9650
2	0.0070	0.0614	0.0327	0.0101	0.9173
3	0.0212	0.0657	0.0322	0.0261	0.8879
4	0.0383	0.0647	0.0323	0.0283	0.8708
5	0.0408	0.0644	0.0323	0.0286	0.8670
10	0.0421	0.0645	0.0339	0.0286	0.8649
15	0.0421	0.0645	0.0339	0.0286	0.8649
20	0.0421	0.0645	0.0339	0.0286	0.8649

Note: The VAR = 3 is used in the estimation.

The relationship between exchange rate and gold price is found to be negative. This implies that increase in gold price will lead to depreciation of the US dollar. This study finds that the negative relationship between exchange rate and gold price in a linear approach whereas Wang and Lee (2011) report the negative relationship between exchange rate and gold price in a non-linear model. Therefore the negative relationship between exchange rate and gold price can happen in the linear fashion. Malaysian ringgit seems to be relatively appreciated against the US dollar. This does not imply that Malaysian ringgit appreciate against gold price. Malaysian ringgit and the US dollar could be both depreciated but relatively the US dollar depreciated more than Malaysian ringgit. Pukthuanthong and Roll (2011) show that increase in gold price is linked with currency depreciation in every country. It is not true that only the US dollar depreciated and the other currency appreciated. Thus gold can be used as against for the US dollar or currency in general. In other words, gold can be as against inflation or purchasing power of currency.

The negative relationship between exchange rate and gold price also implies that exchange rate depreciation will increase gold demand and therefore will increase gold price. Investors can consider gold as part of their portfolios in investment. Gold has the function of money. Gold is a good preserving value asset and thus inflation resistance. The gold value is relative stable compared with many other financial assets such as stocks and bonds especially in the time of uncertainty. In such as way holding gold means that one has certain level of purchasing power. A good portfolio can reduce risk and retain a better rate of return. Moreover, the intensity of gold holding gold is strongly correlated with global power (Aizenman and Inoue, 2013).

The Asian financial crisis, 1997-1998 is found to have a significant negative impact on Malaysian ringgit. Under financial crisis or uncertainty, holding commodities such as gold can reduce the risk of lower purchasing power of currency. Thus gold as an alternative to currency becomes more important. Capie, Mills and Wood (2005) amongst others show gold serves as against the value of the US dollar. Conversely, Sjaastad (2008) demonstrates gold is no longer to be a store of value against world inflation. Baur and McDermott (2010) also document that gold is a safe haven for most developed markets during the financial crisis. Joy (2011) finds that changes in the price of gold and changes in exchange rate is negative and the negative relationship is increasingly during the global economic crisis in the year of 2008. Gold can be an alternative of holding the US dollar especially when the US dollar turns to be weak. Wang and Lee (2011) demonstrate that gold acts as against exchange rate depreciation. However, the effectiveness of gold as against Japanese yen depends on the depreciation rate of Japanese yen.

There is a significant impact of gold price to exchange rate in the short run. This means that the information in the gold market can be used to predict the exchange rate market. Nonetheless, the power of the prediction of the gold market on the exchange rate market could be small. One possible explanation of the low power of the prediction is that Malaysia adopts a managed floating exchange rate regime and the Central Bank of Malaysia could be actively intervene Malaysian ringgit in the market and thus the value of Malaysian ringgit might not closely reflected with the fundamentals. The exchange rate and gold markets are linked. In other words, there is a link between the financial market and the real sector. Any shock occurred in the real sector can be reflected in the financial market. Pukthuanthong and Roll (2011) report that lagged values of exchange rate changes are influential for future gold returns.

5. Concluding Remarks

This study has examined exchange rate and gold price in Malaysia. The results of the ARDL approach show that there is long-run relationship between exchange rate and gold price. Moreover, there is a significant impact from gold price to exchange rate in the short run. The negative relationship between exchange rate and gold price implies that gold can be an alternative to holding currency. This can be more important especially during the financial crisis as the value of currency depreciated greatly. The exchange rate market and the gold market are connected. Consequently information in the gold market can be used to predict the exchange rate market. There is still a link between exchange rate and gold price even after the breakdown of the Bretton Woods system.

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