Is gold a hedge against equity risk? Malaysian experience based on NARDL approach

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Abstract

The chain of financial crises that had been occurring raised a serious concern among the investors regarding its equity risk. There is a need to rethink about gold as a hedge against its equity risk in the long run. Hence, the question is whether gold is a good hedge against equity risk? We use a recently developed time series technique namely, nonlinear ARDL (NARDL) to test the long term asymmetric relationship between gold price and Kuala Lumpur Composite Index. To the best of our knowledge, this would be the first attempt to use NARDL to look into the long run asymmetric relationship between these variables. Our results tend to suggest that gold price in the Malaysian context is determined by external factors, specifically cultural preferences. Also, it has a negative relationship making gold a good hedge against equity risk. This finding would be important for the investors to consider to have gold in their portfolio to hedge against equity risk in Malaysia.

Keywords: Malaysia, Emerging markets, Gold, Investments, Stock markets, Gold investment, NARDL

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Introduction

Over the last few decades, the world had witnessed a number recurring financial crises in different geographies, though the effect was not limited to that particular geography. Following is a list of such occurrences, i) The Japanese asset price bubble and its bursting (1986 onwards), ii) Black Monday, where the DJIA crashes by about 20% (1987) iii) The saving and loan crisis (late 1980's to 1990's), iv) The Mexican peso crisis (1994),v) The East Asian currency crisis (1997/1998), vi) The Russian crisis (1998), vii) The Brazilian crisis in 1999, viii) The Dot com bubble and burst (2002) where the Nasdaq index took a steep of 75%, ix) The Argentine financial crisis in 2001/2002 and in very recent years x) the US subprime mortgage crisis 2007/2008 and xi) the Greece financial crisis in 2009. It seems that financial crisis has become a phenomenon that greatly affects the stock markets over and over again. These series of recurring crises elucidate the excessive risk involved in stock market and brings back the interest in gold as an alternative investment asset. However, according to some researchers gold may not be attractive as an investment asset and especially as safe heaven during financial instability. However, others disagree on this. Thus the issue remains unresolved bringing mixed conclusions.

A significant amount of literature has addressed this issue in the past. Jaffe (1989) recommends holding up to 10% of gold in the portfolio in its real form rather than adding gold stocks. Chua, Sick and woodward (1990) confirmed that gold has a low Beta, as per CAPM, and find that it is consistently different from zero across different time periods. On the other hand, Faff and Chan (1998) concluded that gold stock relatively does not really help in diversifying the portfolio as gold has a time varying beta in contrast to gold's stable beta. Recent studies have been done using GARCH technique to measure the lead lad relationship. Cohen and Qadan (2010) used GARCH to discern causal effect between gold and VIX (S&P 500 volatility index) specifically during 2008 global financial crisis. The results confirmed that during the crisis period gold leads or drives the VIX, thus gold being a better safe haven asset. Finally, Ibrahim (2012) found that returns from the Malaysian stock market have been shown to have a low correlation with domestically priced gold returns. Thus, to conclude that there are not much correlations present between gold and stock return, making it a weak version of safe haven in Malaysia. Thus, the empirical results suggest mixed findings and hence remains unresolved.

Hence the big question is whether gold is really a hedge against equity risk or not? As from the above researches, there seems to be mixed findings on this issue. Thus, the researcher would like to make an humble attempt to find whether the gold is really a hedge against equity risk in the long run, specifically.

The researcher has extended the work of Ibrahim (2012) in terms of the method and the sample size. Ibrahim (2012) has used the GARCH technique to look at the lead lag relationship between gold price and KLCI. However, the researcher would like to look at whether the variables are conintegrating in the long run, using recently developed technique, namely Nonlinear ARDL (NARDL). To the best of our knowledge, this is the first time NARDL is used to test the cointegration between gold price and KLCI in the Malaysian context.

The research finding tends to indicate that the domestic gold price of Malaysia and KLCI are conintegrated in the long run and has a negative relationship when gold price increases. However, the decrease in the long run is insignificant. In the long run, the relationship is asymmetric. Thus, the results suggest that gold still has a potential to act as a hedge against equity risk at least in the Malaysian context.

The rest of the paper is organized in the following ways. Section ii would provide theoretical underpinnings. Section iii would provide a brief literature review, followed by the data and methodology in section iv. Then the results and findings in section v. Finally, conclusions and policy implications.

Theoretical Foundations

A Brief History of Gold and its Usage

"*Old is Gold*" as they say. Historically, gold was considered as an important precious metal for trading for many millennia's. It was considered as one of the best way to store wealth. According to the historians, the usage of gold can be traced back to 3000 BC, where goldsmiths in Sumeria were already working gold into the various forms of jewellery which are even used up to today. Its impact on economic activities and trade were evident at least in the Egyptian civilization which can be dated up to 1400 BC (O'Connor et al., 2015).

In modern business environment the usage of gold can be seen manly in the form of jewelleries, whereas for industrial purposes gold is used in technology, specifically on

computers and mobile phones, dentistry and even in airplanes among others. On the other hand, market players such as central banks, investors and speculators use gold as means of managing their portfolio's and as a store of value. Gold has been used as a currency by many civilizations and it was used as basis for monetary system for a long time. This means that currencies were linked to the gold at a fixed price. In terms of International trade, gold is being traded in seven market mainly which includes the London OTC market, COMEX (New York), the three Shanghai Exchanges, TOCOM (Tokyo), MCX (India), Dubai and Istanbul.

Supply and Demand of Physical Gold

There seems to be few researchers that have particularly studied the demand for physical gold, rather than 'paper' gold; where owners merely have a claim on gold which resides in the safe vaults of large banks. According to Batchelor and Gulley (1995) the relationship between jewellery demand in a number of countries which include USA, Japan, Germany, France, Italy, and UK, the price elasticity of demand of gold jewellery was found to be between – 0.5 to -1, with an average of, -0.65. In these western markets gold seems to be a discretionary good, thus displaying a negative price elasticity. However, in countries like China and specially India the demand for physical demand for gold is more cultural than to profit.

On the contrary, the supply very limited to compared to other storable commodities such as copper. The reason being new gold supply is very small relative to its existing stock at about 1% annually. New supplies of gold come to the market in a very different way compared to other financial asset, such as equities and bonds. Former represents presents what can be referred to as a real asset and the latter is essentially derivative claims on future cash flows or assets. As gold is considered to have in infinite life span unless destroyed at an atomic level, while equity and bond values can lose its value overnight at become worthless overnight due to financial crisis nightmare.

Gold as an Investment

Thanks to its inherent qualities, it has earned its place. Among financial assets, gold is considered as an asset class of its own. On the other hand, in reason years' gold has been replaced by other precious metals such as silver, platinum and palladium. One possible reason is that its usefulness as an industrial metal is small and declining when compared with its investment and jewellery uses. This is manly due its high cost

and scarcity. However, other precious metals still have significant uses in industry. Platinum is commonly used in catalysts, palladium is now mixed into many of the alloys that are replacing gold in dentistry and silver is increasingly being used in the production of solar panels for which the global demand is in the rise.

In 1971, Richard Nixon, 37th President of United States decided to totally delinking the dollar from gold with the so called agenda of stabilizing the economy. Ever since the gold price per ounce rise from $35 per ounce to $1246 per ounce today, that's more than 3,460% within 47 years. Prior to the closure of the gold window much of the discussion on gold prices understandably focused on gold's role as a monetary asset. Machlup (1969), just prior to Nixon's announcement to delink the dollar from gold, published his work discussing the speculative and investment aspect of gold. He emphasised the merits of other assets over gold, and concluded that the then price of gold per ounce which was $35 per ounce would not hold without government intervention and would fall significantly if governments moved out of the market. However, the market proved after 3 years by rising the gold price from $35 per ounce to $200 per ounce that Machlup's findings proved to falls.

The next big question is, how useful is gold as part of an investment portfolio? Is it a hedge against equity risk? Is it a hedge for all times or specific times periods? These are few of the question that an investor would consider answering before he would capitalize on Gold. To say that gold is a good hedge against a particular asset would mean that the correlation between gold and that asset is negative or there is no correlation. In simple terms, it would mean that if the return of that particular asset decreases the return on gold would increase and vice-versa when it is negatively correlated. When there is no correlation, when that particular assets return change the gold's return would not correspondingly increase or decrease necessarily when there is no correlation. Placing, negatively correlated asset in a portfolio is crucial since it would balance out the negative returns of the negatively correlated assets during adverse market conditions.

As most of the findings confirms that gold is a good hedge, the next question would be whether gold is a good hedge in times of extreme stress? The attractiveness of gold during the distressful economic conditions has been widely spoken in financial press. The study of Ariovich (1983) includes the impact of political instability on the

gold price, and separate them based on the effect to international financial markets, inflation expectations, and the value of the US Dollar. They use data from 1972 to 1981 and they find that using a measure of political instability in an explanatory model of the gold price does not increase the power of the model, but there is a positive relationship between the two.

Gold, stock markets and the financial crisis

The most recent global financial crisis in 2007/2008 is considered to be one of the worst only after great depression of 1929-33. It all started in Mid-2007. The collapse of Lehman Brothers, 4th largest Investment bank in the US, was the straw that broke the camel's back. The stock plunged 77% in the first week of September 2008. Then followed a chain of events and the crisis spread like a wild fire across the globe. Some were greatly affected, and others relatively saw less affect. On Monday the 15th of September, 2008 Lehman declared bankruptcy resulting in a staggering steep in stock by 93% from its previous close on September 12th. During this period, the interbank markets across advanced economies became dysfunctional and there was clear evidence of a run for 'quality asset' by investors.

For instance, the price of gold during that distressful period, which was regarded as a storage of value in the time of extreme economic conditions, went up from $660 per ounce in August 2007 to $1000 around the time when Bear Stearns was rescued by JP Morgan. Then the Federal Reserve made the Primary Credit Dealer Facility announcement on 16th of March 2008, which resulted in a drop in the gold price by 10% for a short period of time. Then again it saw a rise up to $1000 per ounce in March 2008, its record high (Chan et al., 2011). Nevertheless, the global financial crisis wiped out the equity market capitalization by almost $30 trillion, from $59 trillion in October 2007 to $29 trillion in November 2008 (World Federation of Exchange, 2014). The ripple effect continued to reflect in many exchanges around the globe. However, the disaster was evident particularly over 31 trading days (September to October 2008) as almost all indices collapsed by 30-40%. Specifically, FSE 1000, S&P 500 and Nikkei 225 indices dropped by 48%, 57% and 60% respectively between October 2007 and March 2009. The posed serious concerns among the investors regarding the equity risk especially during financial turmoil's. As mentioned earlier, these recurring

crisis highlights the excessive risk involved in stock market and brings back the interest in gold as an alternative investment asset.

Literature Review

There are large number of literatures that have discussed the role of gold as an investment asset in portfolios and how far it can help to mitigate equity risk. Gold is considered to be a volatile asset when it stands alone from the rest of the assets. Jaffe (1989) recommends holding up to 10% of gold in the portfolio in its real form rather than adding gold stocks. The latter would increase the risk, and does not provide the double benefit that gold provides. In their research, Chua, Sick and woodward (1990) confirmed that gold has a low Beta, as per CAPM, and find that it is consistently different from zero across different time period. This indicates the non-existence of correlation between gold price and stock prices from 1971 to 1988. This study clearly shows the role of gold being able to act as a hedge against equity risk. On the contrary, Faff and Chan (1998) concluded that gold stock relatively does not really help in diversifying the portfolio as gold and have a time varying beta in contrast to gold's stable beta.

In a more recent study, Bruno and Chincarini (2010) studied the optimal weightage of gold in a portfolio that should be present to maximize their risk-return profile. The weightage varied from 0.1% to 12% depending on the geography. Another important characteristic that contributes towards the ability to diversify is examining the skewness and return distribution of gold. Lucey, Tully, and Poti (2006) discuss the importance of examining the distribution over merely focusing on the mean and variance, as emphasized in the original portfolio theory. The results pertaining to the period of 1988-2003 showed that when the positive skew of gold is taken into consideration in a multi-moment asset allocation the optimal portfolio weights for gold are lower than under a simple mean-variance analysis. In terms of implication, the study indicated that investors should hold between 4-6% under traditional optimisation and 2-4% when skewness is account for.

The work of Emmrich and McGroarty (2013) who expanded the work of Jaffe (1989) using monthly data from 1981 to 2011. Their study results concluded that adding gold into a portfolio will reduce the volatility of the overall portfolio. Thus, the authors suggest that switching into and out of gold when the timing was correct can be

beneficial. On the contrary, Hiller et al. (2006) concluded that such switch would bring no benefits, even with hindsight.

Cohen and Qadan (2010) used GARCH to causal effect between gold and VIX (S&P 500 volatility index) specifically during 2008 global financial crisis. The results confirmed that during the crisis period gold leads or drives the VIX, thus gold being a better safe haven asset. In other periods when the market conditions were normal, the results showed that there was bi-directional causality between gold and VIX. Then again the work of Hood and Malik (2013) found that although gold is a hedge, but it is not necessarily a safe haven. The used much shorter data than Baur and McDermott (2010) which goes from 1979 to 2009. This conclusion was derived because gold is uncorrelated with the market crash, but not negatively correlated. On the other hand, VIX seem to be a strong safe haven. This results were in congruent with the findings of Ghazali, Hooi Lean, and Bahari (2014) for Sharia compliant stocks in Malaysia. Conversely, Gurgun and Unalmis (2014) found that gold to be a safe haven across the emerging markets, many of the countries which had strong Islamic financial characteristics. Ibrahim (2012), found that return from the Malaysian stock market haven been shown to have a low correlation with domestically priced gold returns. Thus, to conclude that there are not much correlations present between gold and stock return, making it a weak version of safe haven in Malaysia.

Data and Methodology

Data

We employ 4,105 daily observations spanning from August 1, 2001 to 31 May 2018. The begging and the ending date is dictated by data availability of gold bullion price. The focus variables of this study is gold price and Kuala Lumpur composite index, whereas the control variables are oil price and exchange rate. The selling price of one troy ounce domestic gold bullion are used to represent domestic gold prices while the Kuala Lumpur composite index is used to represent aggregate prices of stock market investment. The data on the two prices of the focus variables are sourced respectively, from Malaysia's central bank, Bank Negara Malaysia, and Data Stream International. Both of the control variable data were sourced from Data Stream International. We compute gold and stock market returns as the first difference of the natural log of the respective series. Table 1 summarizes the variables used in this study and detailed

descriptive statistics of the focus variables. We also plot these series in level and first-differenced forms in Figure 1.

Variable	Symbol	Proxy
Gold Price	ES	One troy ounce domestic gold bullion
Stock price	KI	Kuala Lumpur composite index
Exchange rate	EX	MYR/USD
Oil Price	OL	Tapis FOB Malaysia U$/BBL

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. summarize ES KI, detail
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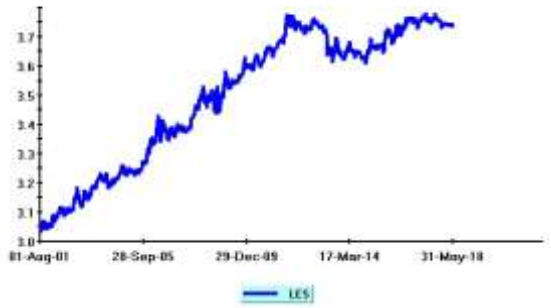
ES

	Percentiles	Smallest		
1%	1113	1077		
5%	1255	1077		
10%	1409	1079	Obs	4,105
25%	1846	1081	Sum of Wgt.	4,105
50%	3912		Mean	3579.568
		Largest	Std. Dev.	1593.907
75%	5071	6039		
90%	5611	6045	Variance	2540541
95%	5745	6047	Skewness	-.116942
99%	5907	6055	Kurtosis	1.526674

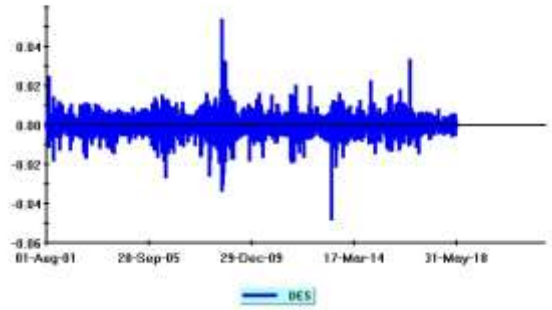
KI

	Percentiles	Smallest		
1%	619.22	592.26		
5%	657.65	592.75		
10%	730.4	592.85	Obs	4,105
25%	902.54	596.02	Sum of Wgt.	4,105
50%	1353.55		Mean	1300.314
		Largest	Std. Dev.	407.3984
75%	1672.72	1892.5		
90%	1798.61	1892.62	Variance	165973.5
95%	1843.92	1892.65	Skewness	-.1877035
99%	1876.61	1895.18	Kurtosis	1.549094

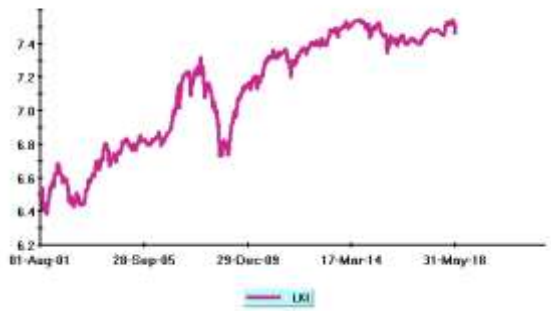
Table 1



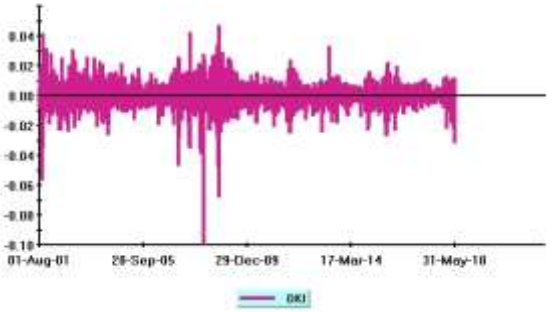
(ii) Natural log of Gold Price



(i) Gold Return



(iv) Natural log of Kuala Lumpur Composite Index



(iii) Stock Market Return

Figure 1

Methodology

A combination of standard time series techniques coupled with autoregressive distributed lags model (ARDL) and nonlinear ARDL are employed in this study. The reason of using time series techniques over regression approach is that time series techniques test the long term theoretical relationship between variables and the Granger causality of variables, who leads (exogenous/independent) or who lags (endogenous/dependent). On the contrary, the regression approach assumes a theoretical relationship between the variables rather than determining them and assumes the exogenous and endogenous variables in the beginning of the study. Thus, time series technique has an edge over conventional regression techniques.

To elucidate more on the above matter, understanding the evolution of econometrics techniques is quite crucial. For almost 60 years, 1930's-1990's econometricians lived in the illusion of using non-stationary data in a technique which prohibited the use of non-stationary data. In other words, the equations did not have delta (short term information) and thus, were non-stationary. However, the Ordinary Least Squares (OLS) model forbade estimating variables that were non-stationary. Thanks to the Noble laureate Clive Granger and Robert Engle who emphasized the flawed approach that could produce spurious correlation due to using non-stationary time series data in linear regressions. In 1987 Clive Granger and Robert Engle (Engle-Granger) formalized the cointegrating vector approach and coined the term in a publication they made. In essence, the time series approach emphasizes that any regression approach should not just start off mechanically, but rather by testing the stationarity and cointegrating properties of the time series involved. The reason being that most of the economic times series are non-stationary in their original level form. If the variables are non-stationary, which is the case for most variables, the conventional statistical tests such as R2, 't' test, etc. would not hold true.

Primarily in the time series data technique approach, we begin with testing whether the data are stationary or non-stationary. For this, we would run the unit root test both in level form and differenced form of the variable. This step is crucial since cointegration test in the standard times series technique requires all variables to be non-stationary. If a variable has a constant mean, variance and a covariance, then the

variable is called stationary. This differentiation between stationary and non-stationary data is essential in the inception since if the variable is made first-difference stationary, then it would imply that the data does not contain any long term information or theoretical information. Thus, cointegration test cannot be performed.

To test the stationarity, the following three tests would be conducted, namely Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and KPSS tests. ADF test (Dickey and Fuller, 1979) takes care of autocorrelation only whilst PP test (Phillips and Perron, 1988) takes care of both autocorrelation and heteroscedasticity. The null hypothesis of both tests assumes that the variables are non-stationary. In contrast, the null hypothesis of KPSS test is that the variable is stationary (Kwiatkowski et al., 1992). Once it is confirmed that variables are non-stationary, VAR order selection will be performed to determine the optimum number of lag for variables to be used in the study. The importance of this step is that this information will be used in Johansen co-integration test in determining the lag to be used. As we have determined the lag order, now we will be testing the presence of cointegration using different techniques. The oldest of it is the Engle-Granger co-integration. This test will be performed, to determine whether variables in this study are theoretically related or not (Engle and Granger, 1987). This is essential to ensure any relations between the variables are not in fact spurious. However, Engle-Granger has its own limitations in testing the presence of cointegration. It can only identify one cointegration and It cannot identify the number of co-integrating vectors. Due to this limitation, we would next test the presence of cointegration using Johansen. This method can identify the presence of more than one cointegration. It can also identify the exact number of cointegrating vectors between the variables and it is based on maximum likelihood (Johansen, 1991).

Although Johansen method is considered better than the Engel-Granger method, it has its own weaknesses. To be precise, Johansen requires all variables to be non-stationary. Additionally, in Johansen the result of co-integration tests depends on the number of lags chosen and whether or not trend is included in the test. It would mean that, changing the number of lags will yield different result. Another issue with Johansen test is, it is biased towards accepting the null hypothesis of no co-integration. Since p-value of 10% is used, i.e.the error that is acceptable if null

hypothesis is rejected is only 10%, this means 90% of the time the null hypothesis will be accepted. This is a major limitation of the Johansen method.

Due to the limitations present in the previous methods we would be using ARDL technique that was brought into light by Pesaran et al. (2001). This method is superior compared to the previous ones due to the following reasons. ARDL does not require all variables to be stationary and it also does not suffer from the pre-test biases of the Johansen test. ARDL is a bound testing approach that can be used even for small sample size, and this is a major strength for studies which have small sample size. This test contains two main steps. In the first step F-test is used to determine whether there is long run relationship between the variables. The calculated F-statistic will be compared against the upper and lower critical values as determined by Pesaran et al. (2001). If the computed F-statistics fall above the upper boundary, the null hypothesis of no cointegration can be rejected and will be concluded that the variables move together in the long run. Conversely, if it falls below the lower boundary, the null hypothesis cannot be rejected and there for we would conclude that there is no cointegration between the variables. The third possibility is that the F-statistics may fall between the two asymptotic critical values, and this would imply that non conclusive result can be made. In other words, this means that there might or might not be cointegration between the variables.

After the discovery of co-movement between the variables, the next step in ARDL would be to estimate the long-run coefficients of the variable. This is done through Vector Error Correction Model (VECM). At this stage we have already found cointegration and would be examining the Granger causality between the variables, which variable would be leading (exogenous/Independent) and which variable would be lagging (endogenous/dependent). In this stage the error correction term is estimated to determine the lead-lag variables. If the error correction term is significant the dependent variable would be identified as an endogenous/dependent variable, if it is insignificant the dependent variable would be exogenous/Independent. The computed coefficient indicates the time that would take to return to the equilibrium. For instance, a coefficient of -0.2535 would mean that in a particular period the adjustment is only 25%. Thus, this would mean that it would take four periods to return to the equilibrium. On the other hand, a positive coefficient would imply that the variable will

move away from the equilibrium, and the a negative one would imply that it would return to the equilibrium.

Noticeably, VECM does have one major limitation. It is only able to determine the absolute exogenous variable and the absolute endogenous variable. However, it would be more beneficial for the policy makers if we could know the most exogenous variable to least endogenous variable. This can be done by Variance decompositions (VDC) analysis. Specifically, the lead-lag ranking can be determined via VDC through two methods. The orthogonalised and the generalized VDC. In the former method the placing of the variables order matters, as the results would reflect it. On the contrary, in the latter method the order of variable does not matter. In the former method when one variable is shocked, other variable switches off. Where as in the latter method, when one variable is shocked, other variables are not switched off. Next on the list of step is Impulse response function (IRF). This indicates the graphical representation of VDC results.

Finally, we should bear in mind that at the cointegration tests, although the ARDL has managed to overcome the weaknesses of its predecessors, it still has its own weakness. One of the major weakness of ARDL technique is that it assumes linearity and symmetry. Assuming 'linearity' would mean that a certain percentage change in the independent variable would result in proportionate change in the dependent variable. Assuming 'Symmetric', on the other hand, would mean the speed of adjustment of a variable to get back to the equilibrium is the same. These two assumptions are far away from real life economic and financial environments. Thus, to have a more realistic approach we use nonlinear ARDL (NARDL) where the above two assumptions are relaxed, introduced by Shin et al. (2014).

The biggest strength of NARDL, among others, is that it can differentiate the short run and long run effects of regressors to the dependent variable. Also, it can test both linear and non-linear cointegration. If the results in NARDL is symmetric it would be in congruent with ARDL. The next section would discuss the results of each tests discussed in this section.

Empirical results and Discussions

Unit Root Tests

Following are the results of ADF, PP and KPSS tests in log form and differenced form.

ADF (Augmented Dikcy- Fuller)							
LOG FORM	VARIABLE	ADF	VALUE	T-STAT.	C.V.	RESULT
	LES	ADF(3)=SBC	10,457.4	- 1.843	- 3.510	Non-Stationary
		ADF(3)=AIC	10,476.4	- 1.843	- 3.510	Non-Stationary
	LKI	ADF(3)=AIC	14,253.9	- 1.979	- 3.510	Non-Stationary
		ADF(1)=SBC	14,241.0	- 1.925	- 3.489	Non-Stationary
	LOL	ADF(2)=AIC	10,071.7	- 1.963	- 3.487	Non-Stationary
		ADF(1)=SBC	10,059.7	- 1.943	- 3.489	Non-Stationary
	LEX	ADF(3)=AIC	16,985.8	- 1.102	- 3.510	Non-Stationary
		ADF(1)=SBC	16,972.3	- 1.038	- 3.489	Non-Stationary
1ST DIFF. FORM	VARIABLE	ADF	VALUE	T-STAT.	C.V.	RESULT
	DES	ADF(2)=SBC	10,460.8	-47.496	- 2.880	Stationary
		ADF(2)=AIC	10,473.5	-47.496	- 2.880	Stationary
	DKI	ADF(1)=SBC	14,239.3	-42.692	- 2.872	Stationary
		ADF(2)=AIC	14,249.9	-34.388	- 2.880	Stationary
	DOL	ADF(1)=SBC	10,059.2	-45.839	- 2.872	Stationary
		ADF(4)=AIC	10,069.4	-29.708	- 2.832	Stationary
	DEX	ADF(1)=SBC	16,970.8	-44.346	- 2.872	Stationary
		ADF(2)=AIC	16,981.9	-35.179	- 2.880	Stationary

Table 2.1 ADF Results

PP (Phillip- Perron)					
LOG FORM	VARIABLE	T-STAT.	C.V.	RESULT
	LES	-2.5942	-3.4529	Non-Stationary
	LKI	-2.3745	-3.4529	Non-Stationary
	LOL	-2.1581	-2.8551	Non-Stationary
	LEX	-1.3148	-3.4529	Non-Stationary
1ST DIFF. FORM	VARIABLE	T-STAT.	C.V.	RESULT
	DES	-125.956	-2.8551	Stationary
	DKI	-58.2694	-2.8551	Stationary
	DOL	-67.4217	-2.8551	Stationary
	DEX	-64.386	-2.8551	Stationary

Table 2.2 PP Results

All three tests; ADF, PP and KPSS, are non-stationary in its level form while they become stationary in the differenced form. In the level form the variables are only logged, thus does not lose any theoretical long term information and remains non-

stationary. Whereas, when you differentiate once the long term theoretical information is lost and only the short term remains. Thus, the variables becomes stationary.

KPSS		VARIABLE	T-STAT.	C.V.	RESULT
	LOG FORM	LES	3.0322	0.37804	Non-Stationary
		LKI	2.9761	0.37804	Non-Stationary
		LOL	1.4929	0.37804	Non-Stationary
		LEX	0.60685	0.37804	Non-Stationary
	1ST DIFF. FORM	VARIABLE	T-STAT.	C.V.	RESULT
		DES	0.050099	0.18246	Stationary
		DKI	0.030516	0.18246	Stationary
		DOL	0.041369	0.18246	Stationary
		DEX	0.074239	0.18246	Stationary

Table 2.3 KPSS Results

VAR order selection

Order	AIC	SBC	p-Value	C.V.
2	52006.6	51892.9	[.015]	5%

In order to find the cointegration we would require the order of vector auto-regression (VAR). We base our decision of chosen VAR order on the above table. We used stata to obtain the above results. Based on the above table, the more recommended lag would be 2. Since Akaike Information Criterion (AIC) and adjusted R is significant at lag 2 and the Schwarz Bayesian information criterion (SBC) is also significant at lag 2. Also, the data of this study is daily data, therefore would be more recommended to choose a lower lag. Thus, we select lag 2.

Cointegration tests

Engle-Granger

VARIABLE	ADF	VALUE	T-STAT.	C.V.	RESULT	CONCLUSION
LKI	ADF(2)=AIC	9839.7	-2.7971	-4.1026	NON-STATIONARY	NO COINTEGRATION
	ADF(2)=SBC	9827.3	-2.9238	-4.1026	NON-STATIONARY	NO COINTEGRATION

Noticeably, Engle-Granger cointegration test did not find any cointegration between the variables.

Johansen

Lag order 2, Unrestricted intercept and trend

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix					95%
Null	**Alternative**	**Statistic**	**95% Critical Value**	**90% Critical Value**	**Result**
r = 0	r = 1	31.843	31.790	29.130	Cointegration
r<= 1	r = 2	13.103	25.420	23.100	No cointegration

Lag order 2, Unrestricted intercept but restricted trend

Cointegration LR Test Based on Trace of the Stochastic Matrix					95%
Null	**Alternative**	**Statistic**	**95% Critical Value**	**90% Critical Value**	**Result**
r = 0	r>= 1	59.280	63.000	59.160	No cointegration
r<= 1	r>= 2	27.437	42.340	39.340	No cointegration

Cointegration LR Test Based on Trace of the Stochastic Matrix					90%
Null	**Alternative**	**Statistic**	**95% Critical Value**	**90% Critical Value**	**Result**
r = 0	r>= 1	59.280	63.000	59.160	Cointegration
r<= 1	r>= 2	27.437	42.340	39.340	No cointegration

The results of Johansen were contradictory to the results of Engle-Granger test. Johansen results confirmed the presents of one cointegration at 5% significance under unrestricted intercept and trend and confirmed cointegration under unrestricted intercept but restricted trend at 10% significance. At 5% significance there was no cointegration in unrestricted intercept but restricted trend. Next would be to test the cointegration using ARDL.

ARDL

Variables	F-statistics	p-value	Critical Lower Bound	Critical Upper bound	Conclusion
DES	3.8646	[.004]	3.539	4.667	Inconclusive
DEX	2.0150	[.090]	3.539	4.667	No cointegration
DKI	2.7655	[.026]	3.539	4.667	No cointegration
DOL	3.2166	[.012]	3.539	4.667	No cointegration

According to the bound test with null hypothesis of no cointegration, the result show that F-statistics for gold price; 3.8646 is between the lower and the upper bound. This implies that the present of cointegration is inconclusive. Thus, there is still a possibility that cointegration may exist. Since our results are inconclusive we may look at the p value and decide whether there is cointegration or not. If the p value is less than 5% then there is cointegration and vice versa. As the p value of DES is less than 5%, we conclude that there is cointegration. In other words, there is long run relationship between the two variables.

Non-linear ARDL

Variables	F-statistics	Critical Lower Bound (90%)	Critical Upper bound (90%)	Conclusion
ES	4.4103	3.063	4.084	Cointegration

As mentioned earlier, NARDL is superior to ARDL as this method does not assume linearity and symmetry which is far from reality. Interestingly, NARDL results tell us that there is cointegration in the long run. Thus, we confirm the doubt raised by the ARDL model results, by giving us inconclusive results.

Asymmetry statistics:

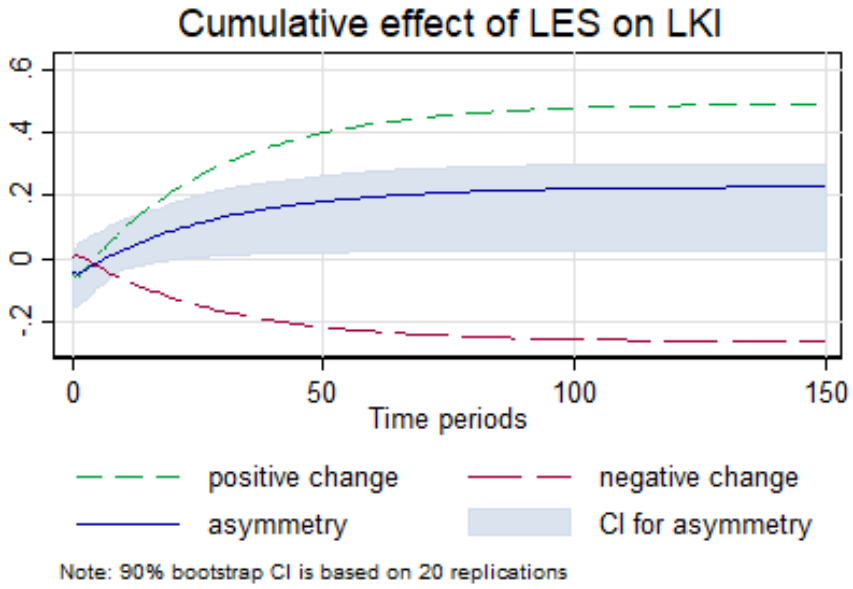
	Long-run effect [+]			Long-run effect [-]		
Exog. var.	coef.	F-stat	P>F	coef.	F-stat	P>F
LES	0.494	6.867	0.009	-0.265	3.279	0.070
LOL	0.038	1.49	0.223	-0.044	.6782	0.410
LEX	-0.456	17.52	0.000	0.038	.07758	0.781
	Long-run asymmetry			Short-run asymmetry		
	F-stat	P>F		F-stat	P>F	
LES	4.013	0.045		.6294	0.428	
LOL	.02166	0.883		2.08	0.150	
LEX	13.76	0.000		2.583	0.108	

Note: Long-run effect [-] refers to a permanent change in exog. var. by -1

Above table shows the long run increase and decrease effect of independent variables on the dependent variable. For instance, when Kuala Lumpur Composite Index (KLCI) decreases it decreases gold price by 49.4%. However, this results sound a bit too good to be through from reality. Since long run negative effect is insignificant we may

not certainly say that an increase in KLCI would decrease gold price by 26.5%. However, the relationship seems asymmetric. Regarding the second part of the table, there is asymmetry in the long run but there is no asymmetry in the short run since it is not significant.

Below is the graphical representation generated via bootstrap and level option. In the below figure we can see that decrease in KLCI has a positive effect on Gold price shown by red line. While increase in KLCI has a negative effect on gold price shown by the green line. And the blue line showing he increasing trend of asymmetry with time.



Since it has been established and confirmed that there is theoretical link between the variables, now we move on to test the granger causality between the variables. In other words, the lead lag relationship.

LRSM

As we have find out the number of cointegrating vectors, the Long-Run Structural Modelling intends to estimate theoretically meaningful long-run relations by imposing on those long-run relations, in other words, the cointegration. And then testing both identifying and over-identifying restrictions based on theories.

Below are the results obtain from microfit. Panel A data represents the exact identification data and Panel B represents over identification data. In the first step we

perform exact identification, assuming that our dependent variable is LKI (KLCI). In microfit command we would say A3=1. Then we obtain the results in panel A. However, we found out that t stat for LOL is less than two. Then we perform over identification by giving the command in microfit as A3=1; A4=0. Then we obtain the results in Panel B. Since the Chai squire's corresponding p value is more than 5% we accept Panel B and proceed with it.

	Panel A	**Panel B**
VRBL	**LKI**	**LKI**
LES	.90987	.97237
	(.31188)	(-.3894)
LEX	1.6375	2.2149
	(.48648)	(-.57552)
LKI	1.0000	1.0000
	(*NONE*)	(*NONE*)
LOL	-.19065	0.00
	(.11667)	(*NONE*)
Trend	-.6269E-3	-.6938E-3
	(.1304E-3)	(-1.68E-04)
CHSQ(1)	NONE	2.430[.120]

After performing exact and over identification we move to test the granger causality via VECM and VDC.

Vector Error Correction Model (VECM)

ecm1(-1)	**Coefficient**	**Standard Error**	**T-Ratio [Prob.]**	**C.V.**	**Result**
dLES	.3611E-5	.1613E-5	2.2382[.025]	5%	**Endogenous**
dLEX	.1136E-5	.3228E-6	3.5206[.000]	5%	**Endogenous**
dLKI	-.3379E-6	.6341E-6	-.53287[.594]	5%	**Exogenous**
dLOL	-.6111E-5	.1756E-5	-3.4796[.001]	5%	**Endogenous**

In VECM test, obtaining a p-value of less than 10% would mean that the null hypothesis will be rejected, and the variable will be endogenous. The above table

indicates that 3 of the variables are endogenous, namely gold price, exchange rate and oil price. Whereas, the KLCI seems to be exogenous. Noticeably, the result on KLCI was opposite from what we were expecting. However, this means that KLCI is determined by external factors. Whereas, the gold price, exchange rate, and Oil price can be controlled by the government. Now we move on to VDC.

Variance Decomposition

The biggest limitation of VECM as mentioned earlier is that it only gives the absolute endogeneity and exogeneity. Thus, may not be able to give the lead lag chain. To overcome this, VDC looks at the relative exogeneity and endogeneity. Below are the results obtain from 4 random periods.

	HORIZON	LES	LEX	LKI	LOL	TOTAL	SELF-DEP	RANKING
LES	3	98.76%	0.26%	0.05%	0.93%	**100.00%**	98.76%	1
LEX	3	0.01%	89.13%	10.39%	0.47%	**100.00%**	89.13%	4
LKI	3	0.01%	7.95%	90.58%	1.46%	**100.00%**	90.58%	3
LOL	3	0.53%	0.04%	1.51%	97.92%	**100.00%**	97.92%	2

	HORIZON	LES	LEX	LKI	LOL	TOTAL		
LES	5	98.67%	0.27%	0.06%	0.99%	**100.00%**	98.67%	1
LEX	5	0.01%	88.56%	10.92%	0.50%	**100.00%**	88.56%	4
LKI	5	0.01%	7.97%	90.50%	1.53%	**100.00%**	90.50%	3
LOL	5	0.61%	0.04%	1.65%	97.70%	**100.00%**	97.70%	2

	HORIZON	LES	LEX	LKI	LOL	TOTAL		
LES	7	98.62%	0.27%	0.08%	1.04%	**100.00%**	98.62%	1
LEX	7	0.03%	88.17%	11.29%	0.51%	**100.00%**	88.17%	4
LKI	7	0.01%	7.96%	90.48%	1.55%	**100.00%**	90.48%	3
LOL	7	0.71%	0.05%	1.75%	97.49%	**100.00%**	97.49%	2

	HORIZON	LES	LEX	LKI	LOL	TOTAL		
LES	9	98.58%	0.27%	0.09%	1.07%	**100.00%**	98.58%	1
LEX	9	0.06%	87.84%	11.59%	0.51%	**100.00%**	87.84%	4
LKI	9	0.00%	7.95%	90.48%	1.57%	**100.00%**	90.48%	3
LOL	9	0.82%	0.06%	1.84%	97.28%	**100.00%**	97.28%	2

This study uses generalized VDC given its strength over orthogonazied approach. A variable becomes the most exogenous when the forecast error variance is mostly explained by its own shock. The finding indicates that the ranking is consistent for forecast horizon of 3rd, 5th, 7th and 9th day as it is daily data. According to VDC Gold price is the most exogenous, followed by oil price, then KLCI and finally exchange rate the most endogenous variable. Interestingly this is in line with what we assumed for exact identification and contrary to VECM results where KLCI was the most exogenous variable.

From the above results we may obtain the below chain of granger causality in a decreasing strength from the most exogenous towards the direction of the arrow.

This results confirms that changers in the Kuala Lumpur Composite Index does not really effect the gold price. Rather the changers in gold price effect the stock index. A possible reason could be that in Malaysia since we have a considerable population of Tamil people, for whom gold is a cultural norm, where they use it as jewellery rather than investment not to say that even the Malays and the Chinese and other ethnics too use it as jewellery to a lesser degree. Thus, it makes gold an exogenous variable.

Oil price comes next in the chain, suggesting that this is also to a certain degree determined by external factors although to a lesser degree than gold price. Oil price, as a matter of fact, is determined globally. Although Malaysia is an oil producing country, the market cap of global oil market for Malaysia is relatively in significant. Thus, it has a less say in determining the oil price.

Third in the chain is our focus dependent variable. This is intuitively true in a sense that oil price has a direct effect on the stock index. Since most of the companies listed, if not all, use crude oil in its different form in their businesses. An increase in oil price will surely have a negative effect on the stock price and vice versa. Similarly, since gold and KLCI has a negative relationship when the investors anticipate that gold price would increase, they would switch their investment to gold from stock and vice versa.

Finally, the weakest or the most endogenous variable in the chain is exchange rate. This can be explain intuitively as the exchange rate depends highly on export and import among others. Similary, Central bank of Malaysia may have control the exchange rate to certain degree by government intervention just to maintain a stable economy. In the past it was evident that Dr Mahathi, the then Prime Minister of Malaysia decided to peg the Ringgit against Dollar at RM 3.80 when the region was hit by the Asian currency crisis 1997/1998. It was only unpegged on 21st of July 2005.

Conclusion and Policy Implications

To conclude, a series of financial crises that occurred in the past in different parts of the world affected the stock markets around the world in an unprecedented way. This has made the investors rethink about the equity risk involved in the stock market and reconsider gold as an investment. Although past researchers suggest mixed findings on whether gold is a good hedge against equity risk, most of recent studies particularly Ibrahim (2012) suggests that gold can be considered as a good hedge against equity risk. We have used a more recent technique namely NARDL to test the long term asymmetric relationship between the two variables. The results of this research is also in line with that. The results of this research suggest that gold price and the KLCI has long run relationship and are negatively correlated, and there is asymmetric relationship in the long run, although there is symmetry in the short run. Thus, we may conclude that gold still can be considered as a hedge against equity risk at least in the Malaysian context. However, our findings our limited to the data availability and other constrains. If a better method and more data and time were given, our results may change considerably.

In terms of policy implications, this findings may be useful for the investors who may think of investing in gold in Malaysia. However, it should be taken into account that gold is also being used as a cultural symbol and jewellery to a certain degree in the Malaysian context due the large Tamil/Hindu community residing in Malaysia. Thus, a change in the KLCI will not necessarily affect the price of gold in the Malaysian context. In short, gold at least provides a diversification benefit to investors in the Malaysian Market. Thus, gold may be considered as an investment to hedge against the equity risk.

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