Is gold good for hedging? lessons from the Malaysian sectoral stock indices

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Abstract

Econometricians had been blamed for the financial crises that occurred due to their giving a 'false hope' to investors and policy makers using untested theoretical assumptions. Therefore, econometricians had been challenged to reform their studies by grounding them more solidly on reality. The theory of Markowitz 1952 in the context of investment portfolio urged the investor 'not to put all eggs in one basket' implying to diversify their investment portfolio as a mechanism to minimize the risk. Controversies pertaining to the role of gold and its stability to diversify the investment portfolio had been raised and had been puzzling the investors till to date. Normally, the variable used to represent the stock index of a country is in terms of indices and very limited research is found to apply sectoral indices. Therefore, this research is an humble attempt to examine the correlation and causality between the Malaysian sectoral stock indices and gold applying multivariate standard time series techniques using monthly observations ranging from January 2007 until September 2014. We found that gold was the most independent (exogenous) variable compared to the sectoral stock indices even during the 2008 financial crisis period and the most dependent sectors were construction and financial. Therefore, we believe that gold could be a hedging instrument against these sectors. Hence, we humbly suggest to the investors and investment portfolio managers to include gold as part of their investment portfolios.

Key words: sectoral stock indices, gold, Granger-causality, time series techniques

JEL classifications: C22, C58, E44, G11

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Introduction

Colander, Goldberg, Haas, Juselius, Kirman, Lux & Sloth (2009) blamed econometricians for failing to play their role which finally led to system failure, hence, financial crises. The authors further claimed that econometricians encouraged policy makers and market participants to see the stability of the market based on untested theoretical assumptions. These statements and financial crises challenged the econometricians to reform their studies by grounding them more solidly on realistic assumptions.

The theory given by Markowitz in 1952 in the context of investment portfolio suggests not to 'put all your eggs in one basket'. Markowitz further explains that investment portfolio must be a combination of assets which were imperfectly correlated with one another. He demonstrated that the risk inherent in the portfolio would be reduced in the event that successive assets were added to it, until eventually the volatility of the portfolio would equate to the average covariance of the assets composing the portfolio.

The work of Evans and Archer (1968) concluded that the most diversifiable risk could be eliminated by forming a portfolio which consists of eight to ten randomly selected stocks. Statman (1987) later suggested that the number should be closer to thirty to forty stocks**.** Clare and Motson (2008) further confirmed that the increase in diversification significantly decreases the time series standard deviation of the portfolio and proved that investor should hold a portfolio which consists of different eight to ten stocks subject to the only concern of risk elements.

This theory was further developed and later on suggested that the diversification is important not only across different global markets, but also within the various assets classes. For example, some investor invested in gold due to this asset being good as hedge or safe heaven against stock market movements. Jaffe (1989) analysed the benefits of diversifying investment portfolios with gold stocks and found that gold presented a diversification benefit. Research was conducted by Lawrence (2003) using the data ranging from 1975 to 2001 to examine the behaviour of returns on U.S. stocks, bonds and gold. He found lack of correlation between the returns on gold and other financial assets and the lack of relationship with the economic variables, whereas returns on stocks and bonds are correlated with economic variables. Therefore, he had an evidence to suggest that gold would make a good portfolio diversifier. Baur and Lucey (2009) extended the work

of Lawrence (2003) using the data of U.S. , United Kingdom and Germany ranging from November 1995 until November 2005 and confirmed that gold could act as a hedge and/or safe haven for stocks and bonds in extreme stock market conditions, however only for very short periods. Contradiction was found by Johnson and Soenon (1995) who extended Jaffe's (1989) work by investigating the role of gold in investment portfolios from global perspectives and found that during the period of 1984-1995, stocks and bonds dominated the performance of gold as an investment.

Therefore, this research is conducted humbly as an attempt to see whether gold can be a hedge against Malaysian stock indices based on sectors, in contrast to other works which normally take the main stock indices of a country to represent the stock of the country and the comparison between those country indices only.

This research is adopting monthly data ranging from January 2007 until September 2014 of gold price extracted from www.kitco.com and of seven out of ten sectoral indices from Bursa Malaysia Index Series namely KLSE Industrial Price Index (IND), KLSE Construction Price Index (CON), KLSE Finance Price Index, KLSE Tin and Mining Price Index (TIN), KLSE Plantation Price Index (PLN), KLSE Property Price Index (PRP) and KLSE Technology Price Index (TEC) duly extracted from Datastream using the multivariate time series techniques, hence, could see the correlations and causality between those variables.

Using this data and applying these techniques, we found that gold is the most (exogenous) variable that depends mostly on itself consistently even during 2008 financial crisis period as compared to other indices, while the most dependent variable is construction and next to it is the financial sector. Thus, we may humbly suggest to investor or investment portfolio manager to add some percentage of gold as it may act as hedging in investment portfolio especially for an investment portfolio which consists of construction and financial sector, as we had recognised these sectors as the most follower (endogenous) variables.

Research methodology, results and interpretations

In the analysis, monthly data of seven out of ten sectoral indices from Bursa Malaysia Index Series namely KLSE Industrial Price Index (IND), KLSE Construction Price Index (CON), KLSE Finance Price Index, KLSE Tin and Mining Price Index (TIN), KLSE Plantation Price Index (PLN), KLSE Property Price Index (PRP) and KLSE Technology Price Index (TEC) were extracted from Datastream. Monthly gold price was extracted from www.kitco.com and their prices are measured in US Dollars per ounce. The data consists of totalling 92 observations ranging from February 2007 until September 2014.

The econometric approach in this paper is based on multivariate standard time series techniques, whose assumptions are believed to be more realistic compared to the traditional regression techniques. The stationary (or non-stationary) of the variable in level and difference form is not assumed in time series technique but is tested using the unit root test. The differenced form was created via taking the difference of their log form.

In this research, unit root testing applied to all variables via Augmented Dickey Fuller (ADF) test and Phillips-Perron (PP) test. The PP test tends to be more significant as it allows for corrections of possible autocorrelation and heteroscedasticity in the residuals of the regression on which test is based, which is normally found in time series technique. While ADF test only can correct the autocorrelation problem by removing the effect of autocorrelation. ADF test revealed Akaike Information Criteria (AIC) and Schwarz Bayesian Criterion (SBC) which assist in the prediction of the best order of lags. AIC tends to choose higher order of lags as it is less concerned on over-parameter, while SBC is likely to choose lower order of lags.

Assuming the variable to be stationary (as per the traditional regression methods), whereas actually the variable is non-stationary will lead to misleading results. Thus, conducting ADF test and PP test will determine whether the variable can be applied in the cointegration or re-specification of the model should be done. The cointegration methods further only applied in the event of selected variable are non-stationary at level form and stationary at differenced form. Test conducted on non stationary variable is important because non stationary variable will keep the variable's theoretical part or long term information for testing cointegration. Therefore, in this technique, plotted graph between variables in original and after log the variable shall be observed and compared. Gold price and sectoral indices from Bursa Malaysia Index Series selected in this research were found to be non-stationary at level form, and becoming stationary after first differenced. Table 1 to 4 summarizes the result of both tests.

	VARIABLE	ADF	VALUE	T-STAT.	C.V.	IMPLICATION
LOG FORM	LCON	ADF(3)=AIC	130.3115	- 2.9020	-3.4614	Variable is non-Stationary
		ADF(1)=SBC	123.1652	- 2.2094	-3.4614	Variable is non-Stationary
	LFIN	ADF(5)=AIC	147.3154	- 3.4609	-3.4614	Variable is non-Stationary
		ADF(1)=SBC	138.1724	- 2.2835	-3.4614	Variable is non-Stationary
	LPLN	ADF(1)=AIC	114.4807	- 2.5786	-3.4614	Variable is non-Stationary
		ADF(1)=SBC	109.5489	- 2.5786	-3.4614	Variable is non-Stationary
	LIND	ADF(1)=AIC	160.7211	- 2.4815	-3.4614	Variable is non-Stationary
		ADF(1)=SBC	155.7893	- 2.4815	-3.4614	Variable is non-Stationary
	LPRP	ADF(5)=AIC	121.5709	- 3.7390	-3.4614	Variable is Stationary

		ADF(1)=SBC	114.1123	- 2.3620	-3.4614	Variable is non-Stationary
	LTEC	ADF(3)=AIC	102.8907	- 2.8078	-3.4614	Variable is non-Stationary
		ADF(3)=SBC	95.4930	- 2.8078	-3.4614	Variable is non-Stationary
	LTIN	ADF(1)=AIC	75.0745	- 2.3795	-3.4614	Variable is non-Stationary
		ADF(1)=SBC	70.1427	- 2.3795	-3.4614	Variable is non-Stationary
	LGLD	ADF(1)=AIC	155.9312	- 0.9875	-3.4614	Variable is non-Stationary
		ADF(1)=SBC	150.9993	- 0.9875	-3.4614	Variable is non-Stationary

Table 1: The result of Augmented Dickey Fuller (ADF) test conducted to level form of variables

	VARIABLE	ADF	VALUE	T-STAT.	C.V.	IMPLICATION
1ST DIFF. FORM	DCON	ADF(2)=AIC	125.2494	-4.0832	-2.8951	Variable is Stationary
		ADF(2)=SBC	120.3407	-4.0832	-2.8951	Variable is Stationary
	DFIN	ADF(3)=AIC	141.1154	-3.4061	-2.8951	Variable is Stationary
		ADF(1)=SBC	136.2048	-6.8397	-2.8951	Variable is Stationary
	DPLN	ADF(1)=AIC	110.9730	-5.6538	-2.8951	Variable is Stationary
		ADF(1)=SBC	107.2915	-5.6538	-2.8951	Variable is Stationary
	DIND	ADF(1)=AIC	156.0574	-6.4533	-2.8951	Variable is Stationary
		ADF(1)=SBC	152.3758	-6.4533	-2.8951	Variable is Stationary
	DPRP	ADF(5)=AIC	118.2919	-4.4126	-2.8951	Variable is Stationary
		ADF(1)=SBC	111.1269	-5.8843	-2.8951	Variable is Stationary
	DTEC	ADF(2)=AIC	98.4046	-3.5773	-2.8951	Variable is Stationary
		ADF(2)=SBC	93.4960	-3.5773	-2.8951	Variable is Stationary
	DTIN	ADF(2)=AIC	71.3489	-4.5966	-2.8951	Variable is Stationary
		ADF(1)=SBC	67.4193	-6.8383	-2.8951	Variable is Stationary
	DGLD	ADF(1)=AIC	151.8251	-5.5206	-2.8951	Variable is Stationary
		ADF(1)=SBC	148.1436	-5.5206	-2.8951	Variable is Stationary

Table 2: The result of Augmented Dickey Fuller (ADF) test conducted to variable after first differenced.

	VARIABLE	T-STAT.	C.V.	IMPLICATION
LOG FORM	LCON	-2.1856	-3.4586	Variable is Non-Stationary
	LFIN	-1.9105	-3.4586	Variable is Non-Stationary
	LPLN	-2.3692	-3.4586	Variable is Non-Stationary
	LIND	-2.3393	-3.4586	Variable is Non-Stationary
	LPRP	-1.7200	-3.4586	Variable is Non-Stationary
	LTEC	-1.4546	-3.4586	Variable is Non-Stationary
	LTIN	-2.4399	-3.4586	Variable is Non-Stationary
	LGLD	-.41308	-3.4586	Variable is Non-Stationary

Table 3: The result of Phillips-Perron (PP) test conducted to level form of variables

	VARIABLE	T-STAT.	C.V.	IMPLICATION
1ST DIFF. FORM	DCON	-10.2683	-2.8932	Variable is Stationary
	DFIN	-9.4276	-2.8932	Variable is Stationary
	DPLN	-7.9291	-2.8932	Variable is Stationary
	DIND	-10.5535	-2.8932	Variable is Stationary
	DPRP	-8.0493	-2.8932	Variable is Stationary
	DTEC	-9.3155	-2.8932	Variable is Stationary
	DTIN	-10.8182	-2.8932	Variable is Stationary
	DGLD	-7.5326	-2.8932	Variable is Stationary

Table 4: The result of Phillips-Perron (PP) test conducted to variable after first differenced.

However, to enable the test for cointegration, the order of Vector Auto Regression (VAR) of the model, in other words, the number of lags to be used shall be determined. Table 5 indicates the significant order of one since no contradiction occurs in the highest value of AIC and SBC. Furthermore it is significant at 5 percent of critical value.

Order	AIC	SBC	p-Value	Critical Value
1	1188.2	1099.8	[.980]	5%

Table 5: Determination of order of the VAR model

The requirement for cointegration test had been met since the selected variables for this research are non-stationary at level form and stationary after first difference. Number of cointegrating vectors of this model is consistently read as one cointegration referring to Maximal Eigenvalue and Trace of Stochastic Matrix as shown in Table 6 and 7. The seven indices representing the sectors and the gold price have a long run or theoretical relationship, hence, undeniable to state that these variables are moving together in the long run. This is a surprising finding as research conducted indicates that gold can be a good hedging for stocks, which means, it has negative correlations with stocks. Hence, this information is important to the portfolio manager and investor for investment portfolio management. In the event that the investment portfolio is cointegrated, investing even in different sector in Malaysia will limit the potential of investor to earn abnormal profits. However, based on relative endogeneity, we may see that the gold price may assist in hedging the position of the most endogenous variable. In other words, the investment basket shall be more diversified and to add another assets to allow minimization of risks faced by the investors.

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix					
Null	**Alternative**	**Statistic**	**95% Critical Value**	**90% Critical Value**	**Implication**
r = 0	r = 1	78.721	55.140	52.080	**1 cointegration**
r<= 1	r = 2	42.047	49.320	46.540	

Table 6: The result of Cointegration based on Maximal Eigenvalue of the stochastic matric

Cointegration LR Test Based on Trace of the Stochastic Matrix					
Null	**Alternative**	**Statistic**	**95% Critical Value**	**90% Critical Value**	**Implication**
r = 0	r>= 1	201.158	182.990	176.920	**1 cointegration**
r<= 1	r>= 2	122.437	147.270	141.820	

Table 7: The result of Cointegration based on Trace of the stochastic matric

After the number of cointegrating vector had been determined mathematically, the Long Run Structural Modelling is conducted in regards to our attempt to quantify the theoretical (or intuitive) relationship which is actually derived from economic theories under review between the variables. In addition, this step allows us to normalise our interested variable which is the gold price. Calculating the t-ratios of each variable manually, as coefficient and standard error given by microfit, all variables had been proven to be statistically significant against the focused variable, in other words, the indices has an effect on the gold price. Summarizes of the result is given in table 8.

Variable	Coefficient	Standard Error	t-ratio	Implication
LCON	-3.4118	-0.93074	3.6656	Variable is significant
LFIN	-1.0548	-0.36901	2.8584	Variable is significant
LGLD	-	-	-	-
LIND	1.9042	-0.91227	-2.0873	Variable is significant
LPLN	-1.1423	-0.27976	4.0831	Variable is significant
LPRP	1.9453	-0.38027	-5.1155	Variable is significant
LTEC	.66903	-0.17978	-3.7213	Variable is significant
LTIN	.99150	-0.30825	-3.2165	Variable is significant

Table 8: The result of Long Run Structuring Model

From the result, the cointegrating relation may be written as follows (number in parentheses are standard deviation):

GLD – 3.41CON – 1.05FIN + 1.90IND – 1.14PLN + 1.95PRP + 0.67TEC + 0.99TIN → I(0)
(-0.93) (-0.37) (-0.91) (-0.27) (-0.38) (-3.72) (-3.21)

Unlike traditional regression technique, a time series technique does not make an assumption on the independency or endogeneity of the variable. Time series technique enables the data to 'tell the story' in regards to independency in Vector Error Correction Model. Prior to this step, cointegrating

equations does not reveal anything pertaining to causality, in this case, the leading index(es) or the gold and the lagged variables.

Exogenous (leader or the stronger) variable received exogenous shocks resulting in deviation from the equilibrium, thus, may transmit to other weaker variables. Thus, endogenous (weaker) variable bears the brunt of short run adjustment to bring about long term equilibrium. The variable is endogenous in the event that the error term lagged is significant and this error term actually originates from the error term in the cointegrating equation from Long Run Structural Model as it captures the effect from all variables.

In addition to that, coefficient of e_{t-1} can tell the speed of adjustment or the time horizon that it will take to reach long term equilibrium in the event that the variables had been shocked. However, it fails to 'tell' the relative endogeneity between the variables.

This step is very important to the investor or investment portfolio manager as it tells either gold or specific sector are the leader and which is the lagged variables. Therefore, investors can better forecast or predict the expected results of their investment. Specifically in this research, either adding the gold in their investment portfolio which is only diversified according of different sectors may act as 'safe heaven' in the case of financial crisis. By examining the error correction term, each of the variables in table 9 shows whether the variable is endogenous or exogenous based on 5 percent of critical value. Three variables proven to be endogenous (or follower) are Construction, Technology and Tin and Mining sector. While the rest of the sectors: Gold, Financial, Industries, Plantation and Property are found to be exogenous or the leader in this research. The coefficient also tells the speed of adjustment if there is a shock applied to the index or gold.

ecm1(-1)	Coefficient	Standard Error	T-Ratio [Prob.]	C.V.	Implication
dLCON	.088913	.033158	2.6815**[.009]**	5%	Variable is endogenous
dLFIN	.010189	.027365	.37233**[.711]**	5%	Variable is exogenous
dLGLD	-.020048	.022307	-.89873**[.371]**	5%	Variable is exogenous
dLIND	.8301E-3	.022221	.037357**[.970]**	5%	Variable is exogenous
dLPLN	.0095943	.038165	.25139**[.802]**	5%	Variable is exogenous
dLPRP	.029462	.036303	.81157**[.419]**	5%	Variable is exogenous
dLTEC	-.10852	.040298	-2.6928**[.008]**	5%	Variable is endogenous
dLTIN	-.15390	.054614	-2.8180**[.006]**	5%	Variable is endogenous

Table 9: The summarizes of results of the Vector Error Correction Model

The ranking or relative endogeneity between the variables can only be detected in the following step: Variance Decomposition (VDC). Exogeneity is determined by the variation which is explained by itself. The variable will be recognised as the most exogenous if the variation is explained mostly by itself. The information in regards to relative endogeneity/exogeneity is important for investor, investment portfolio manager or even to policy maker. The most exogenous variable should always be in their focus as it has an impact on other followers or weaker variables. VDC decomposes the variance of forecast error of a particular variable into proportions attributable to shocks from each variable in the system including on its own.

In this case, we attempt to apply the orthogonalized VDCs and obtained the following result:

Forecast at Horizon: 12 (months)

	LCON	LFIN	LGLD	LIND	LPLN	LPRP	LTEC	LTIN
LCON	87.93%	0.39%	0.01%	0.32%	0.92%	5.30%	0.54%	4.59%
LFIN	75.26%	24.53%	0.00%	0.01%	0.02%	0.10%	0.01%	0.09%
LGLD	2.40%	0.01%	96.38%	0.03%	0.10%	0.55%	0.06%	0.47%
LIND	63.66%	0.50%	0.13%	35.71%	0.00%	0.00%	0.00%	0.00%
LPLN	37.01%	0.49%	4.34%	13.35%	44.72%	0.04%	0.00%	0.04%
LPRP	65.53%	0.89%	0.63%	0.99%	0.04%	31.50%	0.05%	0.38%
LTEC	58.71%	0.32%	1.45%	0.89%	0.45%	0.71%	33.53%	3.94%
LTIN	44.90%	0.35%	0.79%	1.36%	5.85%	1.38%	1.91%	43.48%

Forecast at Horizon: 24 (months)

	LCON	LFIN	LGLD	LIND	LPLN	LPRP	LTEC	LTIN
LCON	86.47%	0.44%	0.01%	0.35%	1.03%	5.95%	0.61%	5.14%
LFIN	75.24%	24.52%	0.00%	0.01%	0.02%	0.11%	0.01%	0.10%
LGLD	2.47%	0.02%	96.16%	0.04%	0.11%	0.61%	0.06%	0.53%
LIND	63.65%	0.49%	0.13%	35.72%	0.00%	0.00%	0.00%	0.00%
LPLN	36.98%	0.49%	4.35%	13.40%	44.69%	0.05%	0.01%	0.04%
LPRP	64.99%	0.86%	0.63%	1.01%	0.03%	32.01%	0.05%	0.43%
LTEC	59.16%	0.36%	1.45%	0.95%	0.51%	0.72%	32.50%	4.36%
LTIN	46.43%	0.27%	0.81%	1.47%	6.27%	1.53%	2.08%	41.14%

Forecast at Horizon: 36 (months)

	LCON	LFIN	LGLD	LIND	LPLN	LPRP	LTEC	LTIN
LCON	85.95%	0.46%	0.01%	0.37%	1.07%	6.17%	0.63%	5.34%
LFIN	75.24%	24.51%	0.00%	0.01%	0.02%	0.11%	0.01%	0.10%
LGLD	2.50%	0.02%	96.09%	0.04%	0.11%	0.64%	0.07%	0.55%
LIND	63.64%	0.49%	0.13%	35.73%	0.00%	0.00%	0.00%	0.00%
LPLN	36.97%	0.49%	4.35%	13.41%	44.68%	0.05%	0.01%	0.04%
LPRP	64.80%	0.85%	0.63%	1.02%	0.02%	32.19%	0.05%	0.44%
LTEC	59.31%	0.37%	1.45%	0.97%	0.53%	0.73%	32.14%	4.50%
LTIN	46.97%	0.25%	0.81%	1.51%	6.42%	1.59%	2.14%	40.31%

Forecast at Horizon: 48 (months)

	LCON	LFIN	LGLD	LIND	LPLN	LPRP	LTEC	LTIN
LCON	85.69%	0.46%	0.01%	0.37%	1.09%	6.29%	0.65%	5.44%
LFIN	75.23%	24.51%	0.00%	0.01%	0.02%	0.12%	0.01%	0.10%
LGLD	2.51%	0.02%	96.05%	0.04%	0.11%	0.65%	0.07%	0.56%
LIND	63.64%	0.49%	0.13%	35.73%	0.00%	0.00%	0.00%	0.00%
LPLN	36.96%	0.48%	4.35%	13.42%	44.68%	0.05%	0.01%	0.05%
LPRP	64.70%	0.84%	0.63%	1.02%	0.02%	32.28%	0.05%	0.45%
LTEC	59.39%	0.38%	1.45%	0.98%	0.54%	0.73%	31.96%	4.58%
LTIN	47.25%	0.23%	0.82%	1.53%	6.49%	1.62%	2.17%	39.89%

The rows in the tables read as the percentage of variance of forecast error for each variables into proportions attributable to shocks from other variables (in columns), including its own. While the columns read as the percentage in which that variable contributes to other variables in explaining the changes. The most interesting parts are highlighted as it represents the relative exogeneity of the variables. Therefore, the ranking of the variables can be consistently summarized as per in table 10.

No.	**Variables' Relative Exogeneity for Orthogonalised**
	At horizon: 12, 24, 36, 48
1	GLD
2	CON
3	PLN
4	TIN
5	IND
6	TEC
7	PRP
8	FIN

Table 10: Variables' Relative Exogeneity for Orthogonalised for time horizon 12, 24, 36 and 48

Therefore, from this result, gold is found to be the most exogenous, thus, it depends mostly on its own as compared to other sectors (representing by their indices accordingly). We also can see that the most follower or most endogenous is the Finance sector. Therefore, gold price is not affected by financial sector, while, the dropping in gold price can be predicted as 'bad luck' to financial sector. From the perspective of investor, we might say that gold can be a hedging for finance sector as it is not affected by the financial sector. External factors, for example financial crisis may be harmful to financial sector, thus, adding some percentage of gold in the investment portfolio may assist to reduce the risk in the event of financial crisis.

However, the limitations of orthogonalised VDCs should also be taken into considerations. Firstly, orthogonalised assumed that when a particular variable had been shocked, the rest of the variables are assumed to be 'switched off'. Besides that, it is a little bit biased because the results depend on the particular ordering of the variables in the VAR.

Due to these limitations, Generalised VDCs which are invariant to ordering of variables can be more accurate and trusted. In order to obtain the ranking of the variables, additional computation is needed to allow the percentage to be added up to 100 percent. The results in generalised VDC showed differences compared to the results obtained in orthogonalised VDC.

Forecast at Horizon: 12(months)

	LCON	LFIN	LGLD	LIND	LPLN	LPRP	LTEC	LTIN
LCON	3.47%	0.09%	3.40%	1.58%	4.54%	3.13%	2.58%	23.74%
LFIN	6.79%	0.07%	3.65%	2.15%	4.42%	2.66%	1.22%	26.09%
LGLD	1.46%	74.18%	1.68%	7.27%	0.02%	0.09%	0.21%	86.72%
LIND	3.95%	0.14%	7.47%	3.80%	4.01%	2.14%	1.07%	27.32%
LPLN	3.77%	0.94%	6.10%	11.87%	3.95%	1.72%	1.72%	34.47%
LPRP	3.99%	0.00%	3.58%	2.02%	7.03%	3.29%	2.09%	26.65%
LTEC	5.60%	0.01%	3.61%	2.44%	4.69%	10.37%	0.61%	34.18%
LTIN	4.88%	0.00%	3.34%	4.09%	4.37%	2.27%	13.73%	39.80%

Forecast at Horizon: 24 (months)

	LCON	LFIN	LGLD	LIND	LPLN	LPRP	LTEC	LTIN
LCON	3.43%	0.09%	3.40%	1.54%	4.61%	3.18%	2.69%	23.87%
LFIN	6.77%	0.07%	3.65%	2.14%	4.42%	2.66%	1.23%	26.06%
LGLD	1.52%	73.79%	1.70%	7.36%	0.02%	0.09%	0.23%	86.56%
LIND	3.95%	0.14%	7.47%	3.80%	4.01%	2.14%	1.07%	27.32%
LPLN	3.76%	0.94%	6.10%	11.86%	3.95%	1.73%	1.73%	34.46%
LPRP	3.99%	0.00%	3.59%	2.01%	7.08%	3.32%	2.13%	26.77%
LTEC	5.71%	0.01%	3.64%	2.50%	4.64%	10.29%	0.54%	34.28%
LTIN	4.98%	0.00%	3.35%	4.17%	4.27%	2.23%	13.15%	39.34%

Forecast at Horizon: 36 (months)

	LCON	LFIN	LGLD	LIND	LPLN	LPRP	LTEC	LTIN
LCON	3.41%	0.09%	3.40%	1.53%	4.64%	3.19%	2.73%	23.91%
LFIN	6.77%	0.07%	3.64%	2.14%	4.42%	2.66%	1.23%	26.05%
LGLD	1.53%	73.65%	1.71%	7.39%	0.02%	0.09%	0.24%	86.50%
LIND	3.95%	0.14%	7.47%	3.80%	4.01%	2.14%	1.07%	27.32%
LPLN	3.75%	0.94%	6.09%	11.86%	3.96%	1.73%	1.73%	34.45%
LPRP	3.99%	0.00%	3.59%	2.01%	7.10%	3.33%	2.14%	26.81%
LTEC	5.74%	0.01%	3.65%	2.53%	4.62%	10.26%	0.52%	34.31%
LTIN	5.02%	0.00%	3.36%	4.20%	4.23%	2.21%	12.95%	39.18%

Forecast at Horizon: 48 (months)

	LCON	LFIN	LGLD	LIND	LPLN	LPRP	LTEC	LTIN
LCON	3.40%	0.09%	3.40%	1.52%	4.65%	3.20%	2.76%	23.94%
LFIN	6.76%	0.07%	3.64%	2.14%	4.42%	2.66%	1.23%	26.04%
LGLD	1.54%	73.58%	1.71%	7.41%	0.02%	0.09%	0.25%	86.47%
LIND	3.95%	0.14%	7.47%	3.80%	4.01%	2.14%	1.07%	27.32%
LPLN	3.75%	0.94%	6.09%	11.85%	3.96%	1.73%	1.74%	34.45%
LPRP	3.98%	0.00%	3.59%	2.01%	7.11%	3.33%	2.15%	26.83%
LTEC	5.76%	0.01%	3.65%	2.54%	4.61%	10.25%	0.51%	34.33%
LTIN	5.03%	0.00%	3.36%	4.22%	4.22%	2.20%	12.85%	39.09%

Therefore, it is more reliable to refer to the exogeneity ranking duly provided by generalised VDC , as summarized in the table below:

No.	**Variables' Relative Exogeneity for Generalised**			
	At horizon: 12	At horizon: 24	At horizon: 36	At horizon: 48
1	GLD	GLD	GLD	GLD
2	TIN	PLN	PLN	PLN
3	PLN	TIN	TIN	TIN
4	TEC	TEC	TEC	TEC
5	IND	IND	IND	IND
6	PRP	PRP	PRP	PRP
7	FIN	FIN	FIN	FIN
8	CON	CON	CON	CON

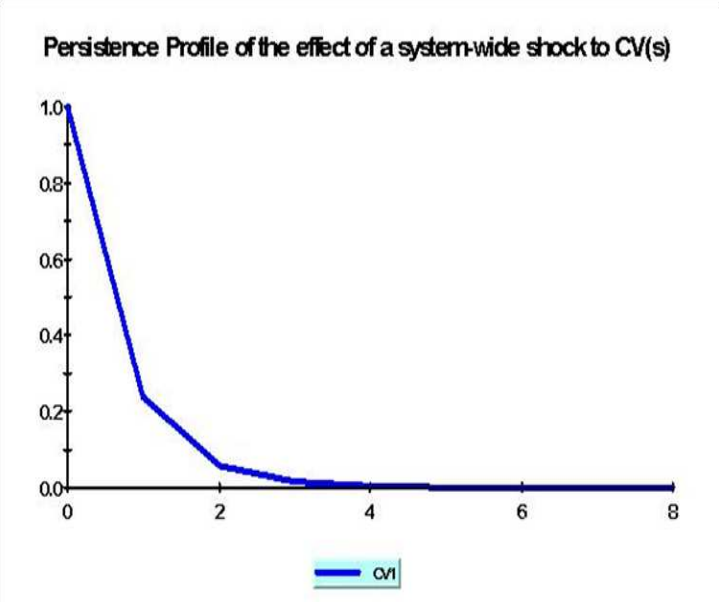
From the table, we may observe the following:

- The gold consistently remains to be the most exogenous variable along the time horizon as compared to the other variables (which are the indices of price index representing different sectors in Malaysia).
- The most endogenous is changing from financial sector to Construction sector. While the financial sector is recognised to be the second most endogenous as compared to other variables.

Therefore, from these results, we may infer that gold can be a good instrument to hedge the position of other sectors such as, the financial or construction sector in the event of financial crisis. This is statistically proven as the gold is consistently seen as the most exogenous variable applying both orthogonalised and generalised methods. Furthermore, this data set observed the performance of the variables on monthly basis since January 2007 until September 2014, which do not ignore the year 2008 of the financial crisis period.

The Impulse Response Functions (IRF) essentially produce the same information as per the VDCs, excepting that the results have been presented in graphical form. The graphs may be seen in the appendix which is available on demand.

The Persistence Profile illustrates the situation if the entire co-integrating equation is 'shocked', then the speed of adjustment or the time horizon required for the system to get back to equilibrium. Therefore, in this step, we allow the effects of system wide shock on the long run relations, instead of a variable specific shock in the case of IRF. In this case, the graph below shows the persistence profile of the cointegrating system.



The graph shows that the cointegration will come back to equilibrium after about three months, given external shocks to the cointegrating system.

Conclusion

In conclusion, the research question will be revisited. Applying standard multivariate time series techniques, we found statistically that gold is consistently the most independent variable even during the 2008 crisis period as compared to other stock indices used in this research to represent the sectoral stock indices. Gold is not affected by other variables, thus, we may humbly suggest to investors or investment portfolio managers to add some percentage of gold as it may act as hedging in investment portfolio especially for an investment portfolio which consists of construction and financial sector, as we had evidenced these sectors were the most dependent (endogenous) variables.

Limitations and suggestions for further research

There are actually ten sectors in accordance with the Bursa Malaysia Index Series. In this research, we only took seven sectors ignoring consumer product, industrial product and trading/services sector. Thus, ranking may be affected due to the absence of those variables. We humbly suggest that further research should be carried out including these sectors so that the exact ranking can be determined. Then only the investors and investment portfolio managers would fully benefit from the research in terms of selecting the sectors for their investment purpose. This is further to ensure that adding gold in their investment portfolio will be more significant, hence, answering the questions of whether gold may be used for hedging purpose.

We also humbly suggest that further research should be carried out to determine the portion or weightage of gold that should be included in the investment portfolio.

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