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Kamil, Nazrol and Masih, Mansur

INCEIF, Malaysia, Business School, Universiti Kuala Lumpur,  
Kuala Lumpur, Malaysia

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# Shari'ah (islamic)compliant equity investments in Malaysia: influences of selected stock indices and their trend/cycle decomposition

Nazrol Kamil<sup>1</sup> and Mansur Masih<sup>2</sup>

## Abstract

We want to address three objectives: (i)for an investor in *Shari'ah* (Islamic) compliant equity investments in Malaysia, which stock has more bearing on returns: local market indices, regional or international? (ii) again, for Malaysian *Shari'ah* compliant equity investments, which stock is more influential in affecting returns : conventional or Islamic indices? (iii)what key observations can we make given the decomposition of index movements into permanent and cyclical (temporary) elements? Our corresponding findings are: (i) *Shari'ah* compliant equity investments in Malaysia, as measured by the FBMSHA index, is most influenced by local indices (namely KLCI and EMAS), and followed by international and regional indices. (ii) Between Islamic and conventional indices, the former exerts greater influence on *Shari'ah* compliant equity investments in Malaysia, albeit by marginal magnitudes. About 86% of stocks listed on Bursa Malaysia are pronounced as *Shari'ah* compliant (iii) Decomposing the stock indices into permanent and cyclical components produced some useful insights, namely (a)Malaysian *Shari'ah* compliant equities tend to underperform during bullish markets, while are generally “safer” when markets fall (b)In terms of diversifying *Shari'ah* compliant equity portfolios beyond Malaysian borders, there appears to be some benefit from cherry picking markets rather than investing in a regional based fund (c)For the risk averse *Shari'ah* compliant equity investor, a longer-termed investment horizon is advisable.

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<sup>1</sup> INCEIF, Lorong Universiti A, 59100 Kuala Lumpur, Malaysia.

<sup>2</sup> **Corresponding author**, Senior Professor, UniKL Business School, 50300, Kuala Lumpur, Malaysia.

Email: [mansurmasih@unikl.edu.my](mailto:mansurmasih@unikl.edu.my)

## 1. INTRODUCTION AND RESEARCH OBJECTIVES

The purpose of this study is to determine the influence of a number of indices on *Shari'ah* compliant equity investments in Malaysia. These aforesaid indices comprise both Islamic and conventional indices and capture local (Malaysian), regional and international markets (the US and the UK). The primary intended beneficiary of this endeavour would be investors currently or contemplating investing in *Shari'ah* compliant equities in Malaysia. Given the integrated nature of equity markets today, the astute investor may be interested to know how connected these equity markets are. More specifically, investors in *Shari'ah* compliant Malaysian equity assets may want to know to what extent other local, regional and international equity markets influence the former's returns. In addition, we decompose index returns into permanent and cyclical (transitory) components and make some rationalized comparisons. Such an empirical technique, we humbly submit, can provide insights on the dynamics of interaction between the indices. We believe the results of our empirical investigations have important implications in terms of benchmarking and diversification strategies.

We formalize our research objectives into the following:

- i. For an investor in *Shari'ah* compliant equity investments in Malaysia, which has more bearing on returns, local market indices, regional or international?
- ii. Again, for Malaysian *Shari'ah* compliant equity investments, which is more influential in affecting returns – conventional or Islamic indices?
- iii. What key observations can we make given the decomposition of index movements into permanent and cyclical (temporary) elements?

## 2. RESEARCH METHODOLOGY

The variable to represent *Shari'ah* compliant equity investments in Malaysia is the FTSE-Bursa Malaysia *Shari'ah* (FBMSHA) index. A number of other stock indices are used to capture the dimensions alluded to above and are shown in the figure below.

*Figure 1: Stock indices used for analytical comparison*

<b>Index</b>	<b>Abbrev.</b>	<b>Country</b>	<b>Area</b>	<b>Islamic/Conventional</b>
Kuala Lumpur Composite Index	KLCI	Malaysia	Local	Conventional
FTSE-Bursa Malaysia Emas	EMAS	Malaysia	Local	Conventional
Hang Seng	HSENG	Hong Kong	Regional	Conventional
Nikkei 225	NIKKEI	Japan	Regional	Conventional
Dow Jones Islamic Asia Pacific	DJIAP	Asia Pacific	Regional	Islamic
Dow Jones Industrial Average	DJIA	United States	International	Conventional
Standard & Poor's 500	SP	United States	International	Conventional
Dow Jones Islamic United States	DJIUS	United States	International	Islamic
FTSE 100	FTSE	United Kingdom	International	Conventional
Dow Jones Islamic United Kingdom	DJIUK	United Kingdom	International	Islamic
Dow Jones Islamic Markets	DJIM	World	International	Islamic

Our dataset is daily price indices for the period starting on 23 October 2006. The time period is limited given that the FBMSHA index was only introduced on 20 October 2006. The said data was sourced from DataStream.

We begin by conducting standard cointegration analysis. The variables are tested for unit root, and the appropriate VAR order is determined. Once we determine that the variables are cointegrated, we perform Long Run Structural Modelling (LRSM) to get some initial indications on variable significance. We decided to do away with vector error correction modelling as it was not highly pertinent to our research objectives. Variance decomposition allows us to address our first two research objectives. Finally, to tackle

our third research objective, we employed the multivariate Beveridge-Nelson (BN) trend/cycle decomposition to compute permanent and transitional components of the 12 stock indices we are examining.

Briefly, suppose  $z_t$  is the vector of stock indices, the aforementioned BN procedure extracts from our non-stationary series of data a permanent component and a transitional (or cycle) component.

$$z_t = z_t^P + z_t^C$$

The permanent component can be further sub-divided into a trend or deterministic part and a stochastic component.

$$z_t^P = z_{dt}^P + z_{st}^P$$

This multivariate BN decomposition differs from classical BN decomposition in that it incorporates the long-run relations between variables.

### **3. RESULTS AND INTERPRETATION**

We began our analysis with unit root testing, relying on the Augmented Dickey-Fuller (ADF) test and found that all variables were I(1). The table below summarizes the results.

Table 1: Results of ADF test

Variable	Test Statistic	Critical Value	Implication
<i>Variables in Level Form</i>			
FBMSHA	-1.4500	-3.4161	Variable is non-stationary
KLCI	-1.2409	-3.4161	Variable is non-stationary
EMAS	-1.2369	-3.4161	Variable is non-stationary
HSENG	-1.7199	-3.4161	Variable is non-stationary
NIKKEI	-1.7917	-3.4161	Variable is non-stationary
DJIAP	-1.0193	-3.4161	Variable is non-stationary
DJIA	-0.8154	-3.4161	Variable is non-stationary
SP	-0.7553	-3.4161	Variable is non-stationary
DJIUS	-1.0091	-3.4161	Variable is non-stationary
FTSE	-1.3452	-3.4161	Variable is non-stationary
DJIUK	-1.3183	-3.4161	Variable is non-stationary
DJIM	-1.0249	-3.4161	Variable is non-stationary
<i>Variables in Differenced Form</i>			
DFBMSHA	-17.4159	-2.8644	Variable is stationary
DKLCI	-17.7642	-2.8644	Variable is stationary
DEMAS	-17.4326	-2.8644	Variable is stationary
DHSENG	-24.7763	-2.8644	Variable is stationary
DNIKKEI	-17.7143	-2.8644	Variable is stationary
DDJIAP	-24.1840	-2.8644	Variable is stationary
DDJIA	-20.6477	-2.8644	Variable is stationary
DSP	-28.5646	-2.8644	Variable is stationary
DDJIUS	-20.8293	-2.8644	Variable is stationary
DFTSE	-15.3236	-2.8644	Variable is stationary
DDJIUK	-15.5362	-2.8644	Variable is stationary
DDJIM	-19.2436	-2.8644	Variable is stationary

Note: In selecting the test statistic for comparison with critical value, selection of ADF regression order was made using the SBC and AIC criteria. Where there is conflict, we selected the higher test statistic in the case of variables in level form, and the lower test statistic for variables in differenced form, as added assurance for the validity of our results.

In identifying the appropriate order of the VAR before proceeding to cointegration testing, the AIC and SBC criteria recommend 2 and 1 respectively<sup>1</sup>. Given that we are working with a relatively long time series (1,131 observations), the risk of over-parameterization is lower and thus we opted for the higher lag order of 2, which could help address any incidences of serial correlation.

<sup>1</sup> See Appendix 1.

Applying Johansen’s test of cointegration, the Maximal Eigenvalue and Trace tests indicate two and three cointegrating vectors, respectively, at the 95% confidence level. The results we obtained are by no means conclusive<sup>2</sup>. Notwithstanding the statistical results, we are inclined to believe that there exists only one cointegrating relationship among the indices. Market knowledge and intuition tells us that equity markets the world over tend to be highly integrated and connected. Over the long term, stock markets in various countries are likely to move in tandem, to varying degrees. This is mainly due to global information flows and to some extent, movement of capital among equity markets.

Assuming one cointegrating vector among the indices, we next modelled this long-run relationship using Microfit’s LRSM module. The table below summarizes some key results.

*Table 2: LRSM*

Variable	<i>Exact identification – normalize FBMSHA<sup>3</sup></i>				<i>Over identification</i>	
	Coeff.	Std. Error	t-ratio	Significant variable?	$\chi^2$ p-value	Significant variable?
KLCI	0.7130	0.5032	1.42		0.140	
EMAS	-1.9347	0.4819	-4.01	✓	0.004	✓
HSENG	-0.0508	0.0485	-1.05		0.280	
NIKKEI	-0.2345	0.0978	-2.40	✓	0.009	✓
DJIAP	0.9304	0.3268	2.85	✓	0.009	✓
DJIA	-0.3540	0.2185	-1.62		n/a <sup>a</sup>	n/a
SP	0.6751	0.3280	2.06	✓	0.128	
DJIUS	0.9341	0.6920	1.35		0.140	
FTSE	0.1929	0.1467	1.31		0.226	
DJIUK	0.3276	0.1568	2.09	✓	0.101	
DJIM	-2.1916	0.6436	-3.41	✓	n/a <sup>a</sup>	n/a

Note: <sup>a</sup> No convergent results were obtained thus we fall back to exact identification results and their implications

<sup>2</sup> While AIC, SBC and HQC criteria produce less intuitively acceptable results of 12, zero and zero cointegrating vectors, respectively. See Appendix 2.

<sup>3</sup> See Appendix 3.

At this juncture, based on the results thus far, we are able to make a number of observations. It appears that domestically, the broader-based EMAS index exerts greater influence on Malaysian *Shari'ah* compliant equity investments than the narrower 30-stock KLCI. This does not come as a surprise, given that 40% of the stocks that make up the KLCI are not *Shari'ah* compliant (12 out of 30). Regionally, again breadth of the index seems to be an important factor. The 225-stock Nikkei is significant while the 45-stock Hang Seng is not. Presumably, as is the case with the KLCI, a good percentage of stocks in the Hang Seng may not be *Shari'ah* compliant. Internationally, our results indicate that the US and UK equity markets do not have significant bearings on the Malaysian *Shari'ah* index. The World Dow Jones Islamic index however appears to be significant.

We move on to variance decomposition in order to investigate, among other things, relative endogeneity and exogeneity of the indices. The table below summarizes the results.

*Table 3: Variance Decomposition*

	FSHA	KLCI	EMAS	HSENG	NIKKEI	DJIAP	DJIA	SP	DJIUS	FTSE	DJIUK	DJIM
FSHA	14.88%	11.84%	12.00%	7.66%	2.24%	9.26%	5.87%	6.61%	6.75%	7.00%	6.59%	9.30%
KLCI	13.03%	12.08%	11.71%	7.44%	2.00%	9.12%	6.55%	7.28%	7.10%	7.16%	6.96%	9.59%
EMAS	12.85%	11.32%	11.49%	7.67%	2.11%	9.37%	6.52%	7.30%	7.10%	7.67%	7.01%	9.59%
HSNG	2.43%	2.03%	2.18%	17.79%	3.90%	11.83%	9.75%	10.37%	9.89%	8.16%	8.68%	13.00%
NIKK	0.90%	0.69%	0.67%	6.82%	12.50%	12.42%	11.55%	11.76%	11.18%	9.03%	8.77%	13.71%
DJIAP	1.67%	1.50%	1.36%	8.78%	5.99%	15.05%	10.09%	10.67%	10.97%	8.60%	10.18%	15.14%
DJIA	0.08%	0.05%	0.06%	2.34%	1.14%	3.45%	20.56%	19.85%	18.46%	9.14%	8.15%	16.72%
SP	0.07%	0.04%	0.05%	2.49%	1.04%	3.70%	19.42%	20.18%	18.71%	9.08%	8.20%	17.02%
DJIUS	0.08%	0.04%	0.05%	2.69%	1.19%	4.35%	18.03%	18.72%	19.00%	9.15%	9.03%	17.68%
FTSE	0.62%	0.58%	0.62%	3.62%	1.48%	4.71%	13.41%	13.77%	13.20%	17.87%	14.32%	15.80%
DJIUK	0.60%	0.39%	0.43%	4.18%	1.52%	6.33%	11.61%	12.54%	13.15%	13.37%	18.72%	17.17%
DJIM	0.35%	0.20%	0.20%	4.23%	1.95%	7.19%	14.67%	15.54%	16.00%	10.24%	11.62%	17.81%
Sum	47.55%	40.75%	40.80%	75.72%	37.06%	96.78%	148.04%	154.58%	151.50%	116.46%	118.22%	172.53%

Note: Generalized Variance Decomposition for time horizon = 100, computer-generated values have been adjusted so that rows add up to 100%



From the above table, we can make the following observations. Firstly, the Dow Jones Industrial Average (DJIA) appears to be the most exogenous stock index, followed by the Standard & Poor's 500 and the Dow Jones Islamic United States indices. This finding does not surprise us as the US equity market is the largest, most developed and highly active stock market in the world today. It would not be a stretch of imagination to concede that the mainstay indices of the US equity market would be the bellwether indices for the rest of the world.

Secondly, in terms of exerting influence on other indices, the top index is the DJIM. The measure for this is the sum of each column in the table above, denoting the total percentage causality, including that originating from its own. Being a world index, would expect DJIM to have a hand in effecting movements in other indices. Next in line are the 3 US-based indices, which reinforce our earlier point.

Thirdly, within the Asia Pacific region, the Hang Seng appears to be more influential than the Nikkei 225, both in terms of exogeneity and total percentage effect on other indices. We attribute this to the rise of China as the emerging economic superpower in recent times.

We are now in a position to address our research questions. The first research question was – which exerts more influence on *Shari'ah* compliant equity investments in Malaysia – local, regional or international indices? We furnish an answer with the help of the following table.

*Table 4: Influence on FBMSHA by geographic region*

<b>Area</b>	<b>Indices</b>	<b>% Influence</b>	<b>Average</b>	<b>Rank</b>
Local	KLCI	11.84%	11.92%	1
	EMAS	12.00%		
Regional	Hang Seng	7.66%	6.39%	3
	Nikkei 225	2.24%		
	DJIAP	9.26%		
International	DJIA	5.87%	6.56%	2
	S&P 500	6.61%		
	DJIUS	6.75%		
	FTSE	7.00%		
	DJIUK	6.59%		

Our results provide some evidence that local indices are more important influences on the *Shari'ah* index in Malaysia. This is followed by international indices which, on the average, exert marginally higher influence as compared to regional indices. We humbly attribute this to the fact that Malaysia is a small open economy. Her trading partners extend beyond regional neighbours and thus developments in farther parts of the world do have significant impact on the country's economic barometer. The implication of this finding is that investors of *Shari'ah* compliant equity in Malaysia are ill-advised to ignore regional and international economic and financial developments, given such empirically establishment connectivity, despite stronger impact from local indices.

The second research question posed was – between Islamic and conventional indices, which has a stronger influence on the *Shari'ah* equity index in Malaysia? Again, we construct a table to assist interpretation of results.

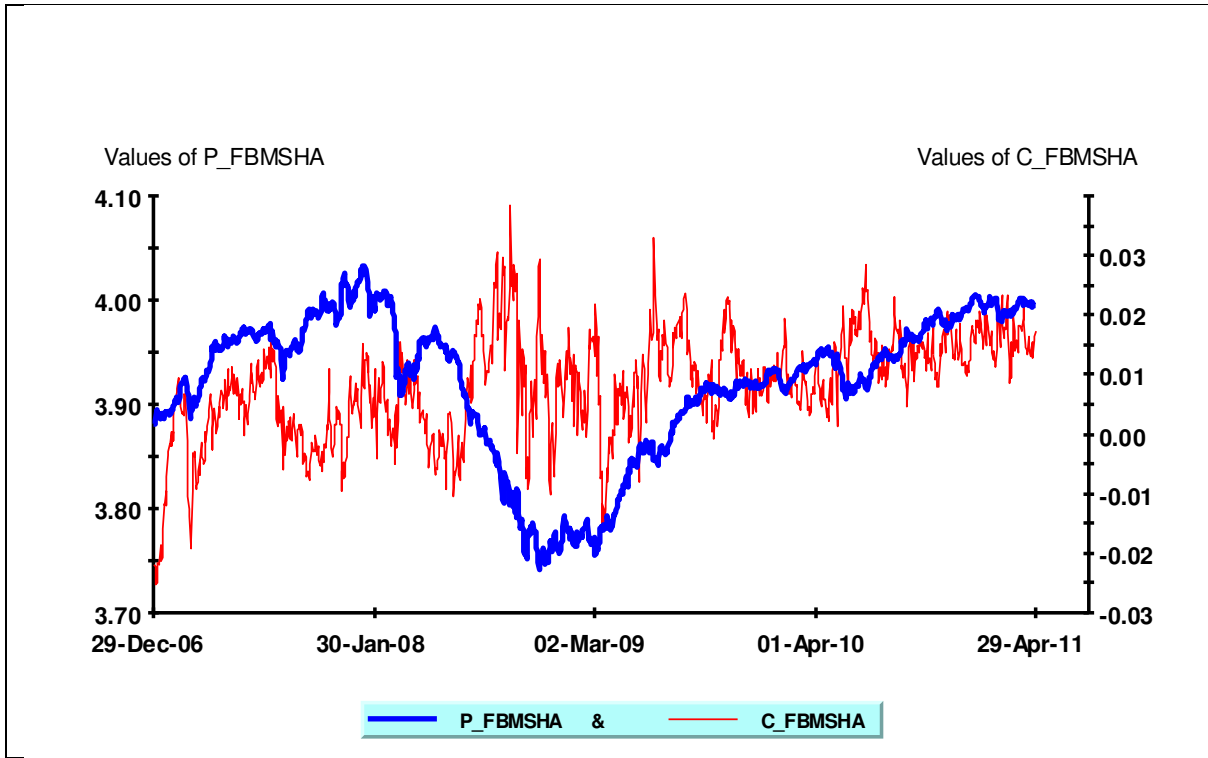
*Table 5: Influence on FBMSHA – conventional versus Islamic*

<b>Area</b>	<b>Indices</b>	<b>Conventional</b>	<b>Islamic</b>
Local	KLCI	11.84%	
	EMAS	12.00%	
Regional	Hang Seng	7.66%	
	Nikkei 225	2.24%	
U.S.	DJIAP		9.26%
	DJIA	5.87%	
	S&P 500	6.61%	
U.K.	DJIUS		6.75%
	FTSE	7.00%	
World	DJIUK		6.59%
	DJIM		9.30%
Average		<b>7.60%</b>	<b>7.98%</b>

From the table above, there is some empirical evidence that Islamic indices have stronger influence. This is the case on the average, as well as for regional markets and the U.S. This observation reflects common intuition that like should influence like. *Shari’ah* compliant equities around the world have many common grounds – avoidance of sectors like conventional finance and insurance, breweries, tobacco, gambling and gaming. Hence it makes sense that such indices influence each other to a greater extent vis-à-vis conventional stock indices. However, we find the gap in degree of influence somewhat marginal and this warrants some articulation. To do this as well as to address our third research objective, we indulge in the decomposition of indices movement into trend and cycle components.

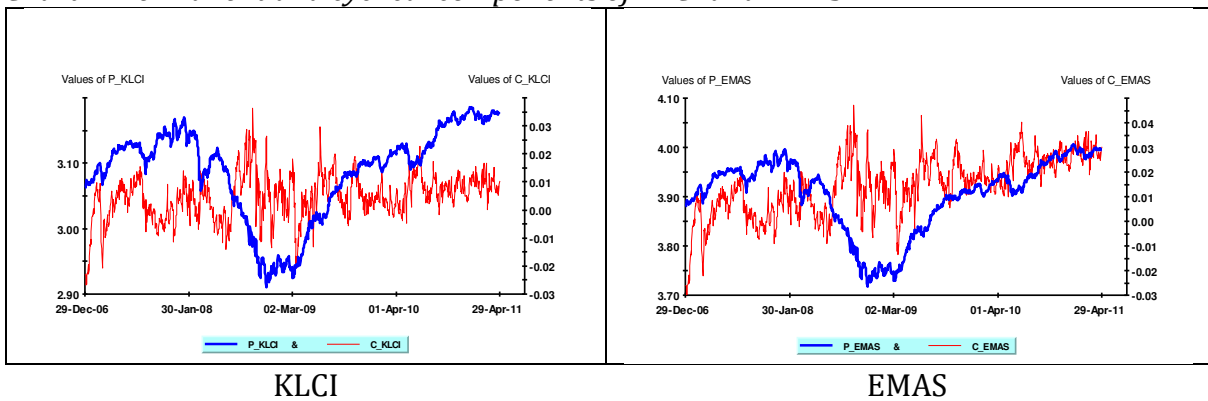
We first examine the FBMSHA index decomposed into its permanent and transitional elements.

*Chart 1: Permanent and cyclical components of FBMSHA*



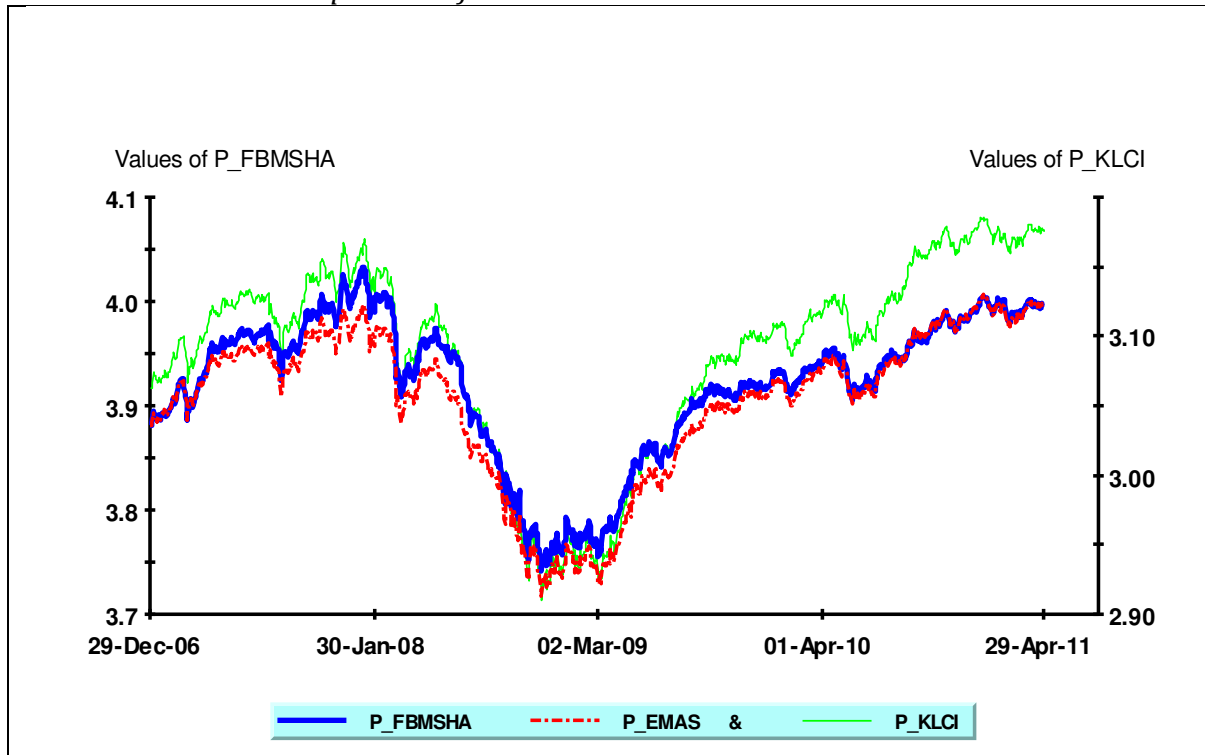
During the period of the global financial crisis (2008/09), the downtrend of the FBMSHA index is coupled with periods of highly volatile returns. The uncertainties that reigned during this time were evident in the cyclical (transitory) component. Post-recovery from the crisis, the cycle component was fluctuating within a noticeably narrower band. Performing similar decompositions of the KLCI and EMAS produce relatively consistent findings as above (see charts below).

*Chart 2: Permanent and cyclical components of KLCI and EMAS*



Next we analyze the permanent component of the three Malaysian stock indices (see chart below).

Chart 3: Permanent components of FBMSHA and KLCI

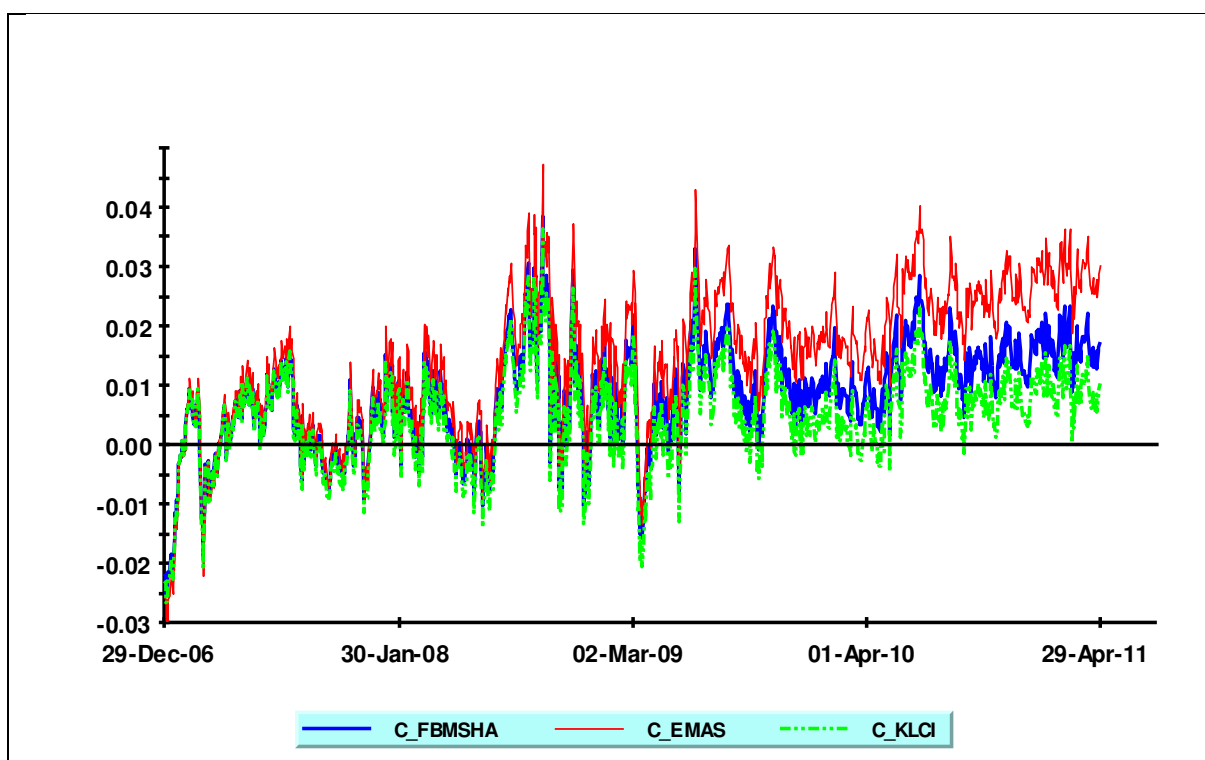


While the FBMSHA and EMAS indices tend to track one another, during times of equity uptrend, the escalation of the KLCI outstrip those of the FBMSHA and EMAS. Two factors can elucidate this phenomenon. Firstly, the KLCI is a narrow stock index, incorporating price changes of only 30 stocks, as compared to FBMSHA and EMAS which are both broad-based indices. Moreover, the KLCI is market-weighted with a handful of stocks contributing disproportionately higher to the eventual index. When the market is buoyant, these aforementioned stocks habitually absorb more than their fair share of the market exuberance. Secondly, when comparing the KLCI and FBMSHA, the difference in magnitude of permanent trend during bull markets can be attributed to *Shari'ah* non-

compliant stocks, especially finance stocks, that typically fare better than average, when market valuations are high.

The chart below illustrates the cycle component of the three Malaysian stock indices.

*Chart 4: Cyclical components of FBMSHA, EMAS and KLCI*

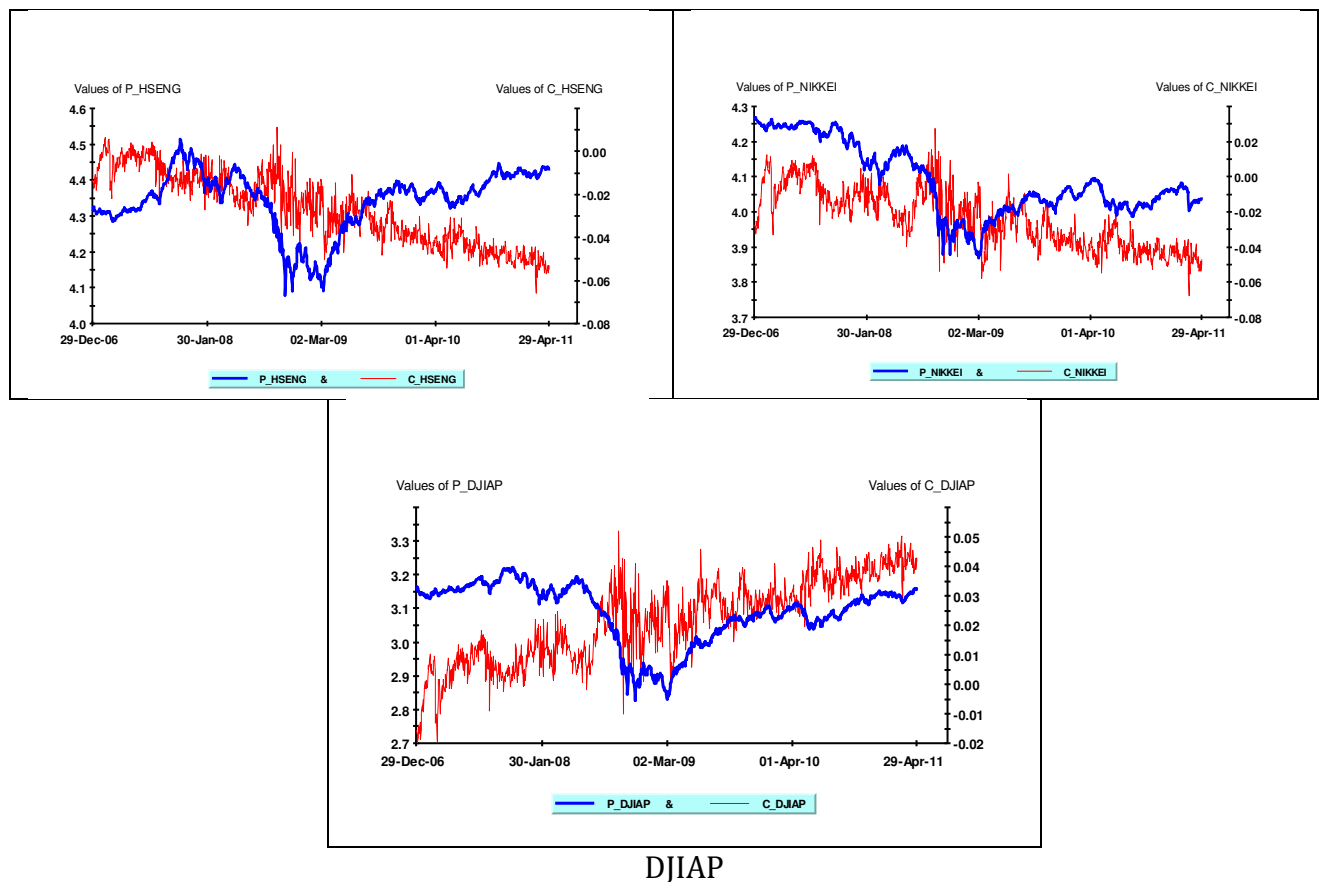


We can conclude from the chart above that generally, as far as short-term fluctuations are concerned, the EMAS index is the most volatile; the KLCI is the least volatile, while the FBMSHA takes middle ground. This is more pronounced in more recent times. This observation appears to apply when the market is on the uptrend. However, during a downtrend, the reverse is true. Taken together with previous observations, we can make the following supposition. When the market is bullish, the upward trending of the KLCI

tends to be more permanent and less cyclical in nature, compared to the FBMSHA. However, when markets are down, the KLCI absorbs a relatively larger brunt of the downtrend, at least in the short term. The implication of this apparent asymmetry in index behaviour for *Shari'ah* compliant equity investors is that investors should be aware of the inherent risk profile of *Shari'ah* compliant equity investment. *Shari'ah* equities tend to underperform during bouts of market exuberance while are generally more cushioned against impacts of downtrends. Investors need to have this in mind when benchmarking their *Shari'ah* compliant portfolios against conventional indices.

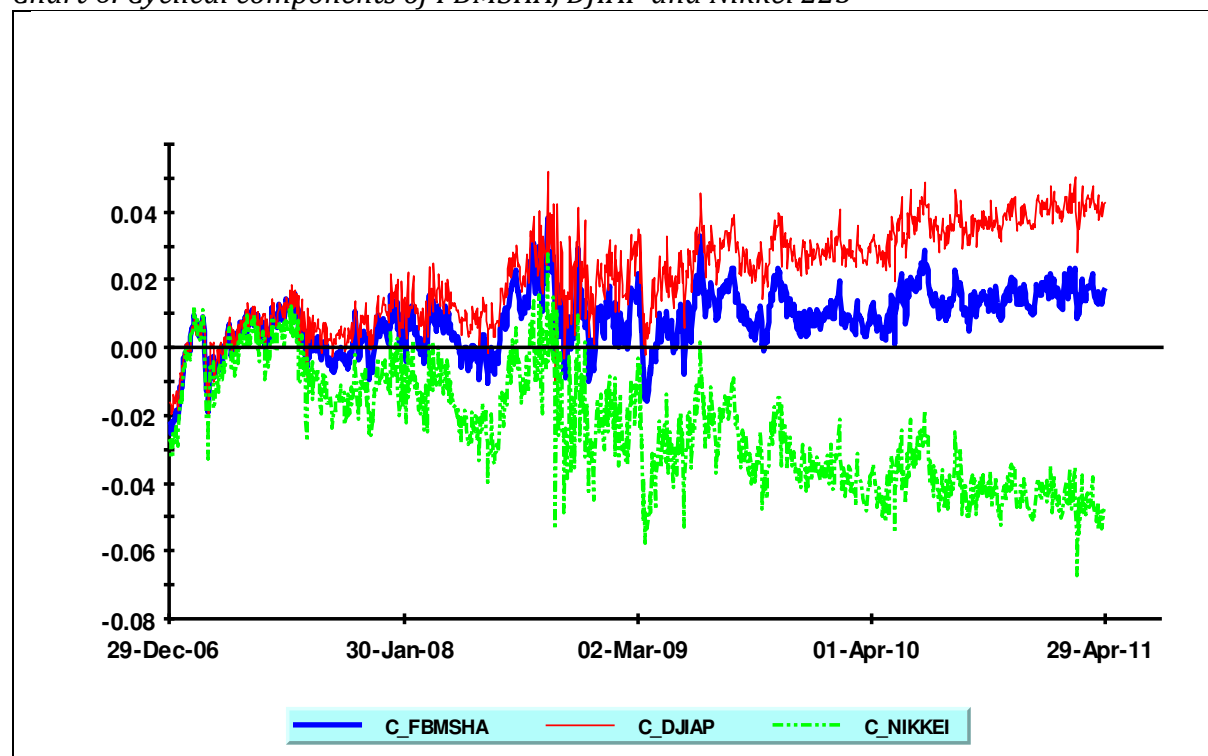
Moving on to regional markets, we chart permanent versus cyclical components for the three regional indices.

Chart 5: Permanent and cyclical components of Hang Seng, Nikkei 225 and DJIAP



Interestingly, while the permanent trend for all three regional indices is relatively similar to that of the Malaysian indices (sharp dip during the global financial crisis in 2008/09), short-term volatility witnessed a clear downtrend in our sample period in the case of the Hang Seng and Nikkei. In contrast, the short-term volatility of the DJIAP has been steadily increasing. From these we offer two elaborations. Firstly, the source of the uptrend in short-term volatility observed in DJIAP is either from *Shari'ah* compliant stocks or, from Asia-Pacific equity markets other than Hong Kong and Japan. Without deeper empirical analysis preferring one explication over the other would be pure conjecture. Secondly, as far as *Shari'ah* compliant equity investors in Malaysia are concerned, there is prima facie evidence of benefit in diversifying equity portfolio investment regionally. In this regard, the choice of market matters, as the chart below illustrates.

*Chart 6: Cyclical components of FBMSHA, DJIAP and Nikkei 225*

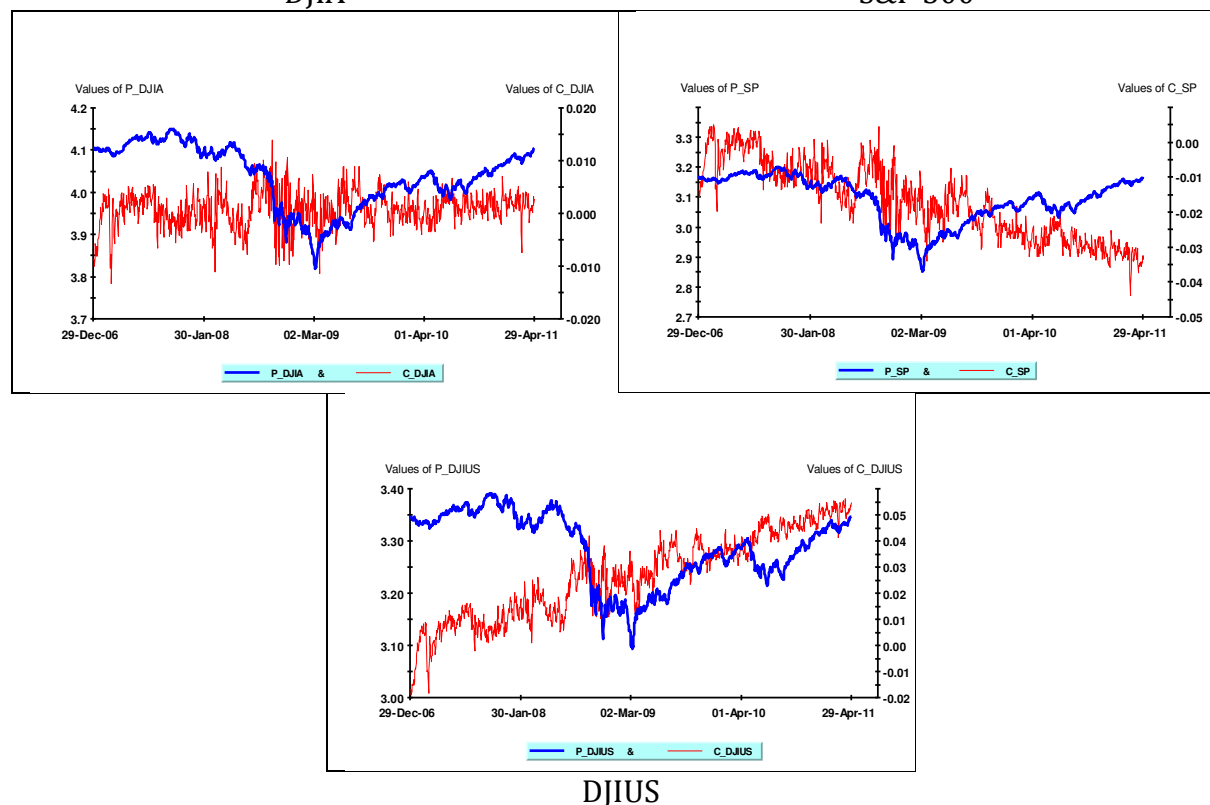




While short-term fluctuations of FBMSHA and DJIAP closely track one another, there is significant divergence between FBMSHA and the Nikkei. This means that other things held constant, Malaysian *Shari'ah* equity investors would benefit more in terms of portfolio diversification by investing in Japanese equities as compared to simply putting their investment monies in a regional fund.

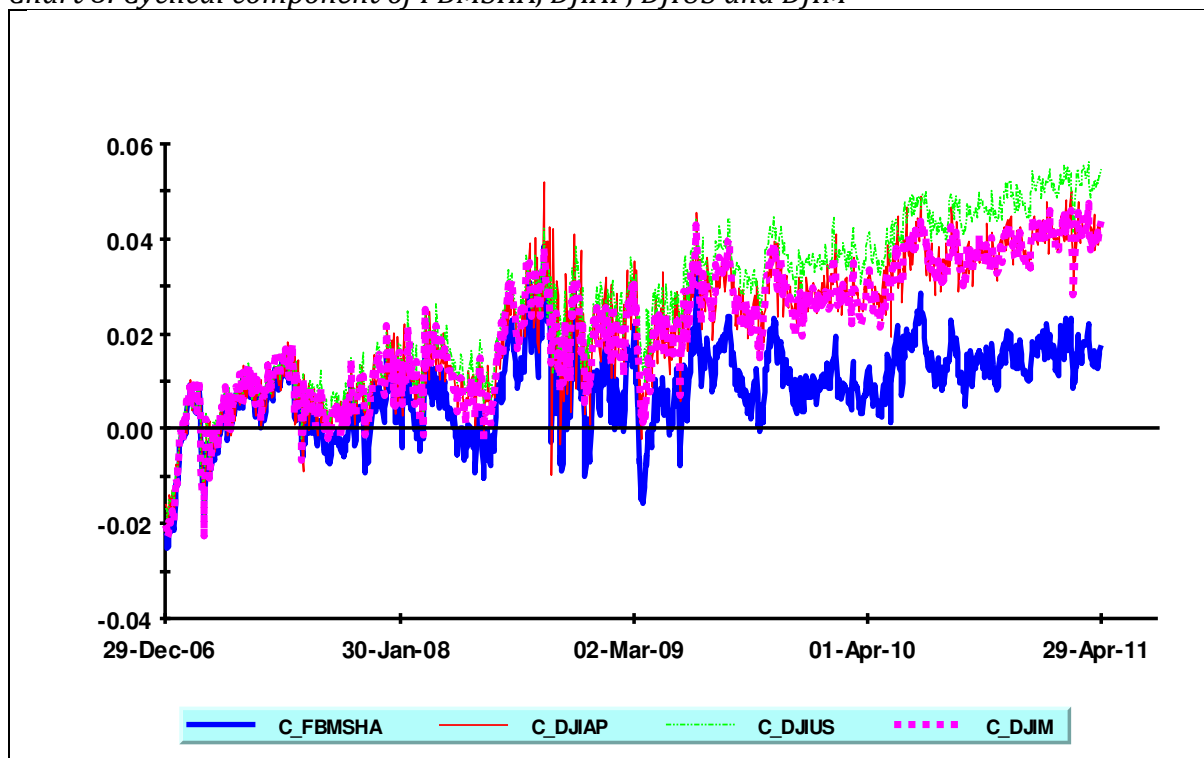
Turning our attention now to the U.S. equity market, as before, we plot permanent versus cyclical components of index movement for the three U.S.-based stock indices.

Chart 7: Permanent and cyclical components of DJIA, S&P 500 and DJIUS



As was the case with regional markets, we find a downward trend in short-term fluctuations in the S&P 500 while the DJIUS shows a clear upward trend. This appears to imply that *Shari'ah* compliant equity investing is becoming increasingly volatile, in the short-term. The implication to *Shari'ah* compliant equity investors (in the U.S.) is that a longer-termed investment horizon is called for if investors are risk averse. On the other hand, there are arguably greater market timing opportunities for *Shari'ah* complaint U.S. investors.

Chart 8: Cyclical component of FBMSHA, DJIAP, DJIUS and DJIM



The chart above illustrates the short-term variations in the *Shari'ah* indices for Malaysia, Asia-Pacific, the U.S. and the world. On one extreme is the DJIUS which appears to have the highest short-term volatility while at the other end of the spectrum, we have the FBMSHA, apparently with the lowest levels of volatility. In between are, understandably,

the DJIAP and DJIM indices, given that they represent an aggregate of a number of markets.

#### 4. CONCLUSIONS

We conclude our humble paper by revisiting our earlier established research questions.

One: *Shari'ah* compliant equity investments in Malaysia, as measured by the FBMSHA index, is most influenced by local indices (namely KLCI and EMAS), and followed by international and regional indices. This indicates that the Malaysian equity market has some distance to go in integrating with other world markets. This finding is understandable given that the Malaysian capital market is not as matured and developed as that of developed nations.

Two: Between Islamic and conventional indices, the former exerts greater influence on *Shari'ah* compliant equity investments in Malaysia, albeit by marginal magnitudes. The fact that the difference is not substantial suggests that market players do not make acute distinction between the two categories of equity investment. Often the differentiating factor is religious motivations. One must also bear in mind that Islamic equities is a subset of conventional equities and given highly liberal interpretations of *Shari'ah* compliance by Malaysian authorities, stock composition where the two do not overlap is relatively small (about 86% of stocks listed on Bursa Malaysia are pronounced as *Shari'ah* compliant).

Three: Decomposing the stock indices into permanent and cyclical components produced some useful insights, namely:

- a. Malaysian *Shari'ah* compliant equities tend to underperform during bullish markets while are generally "safer" when markets fall. This phenomenon should be incorporated when making performance benchmarking.
- b. In terms of diversifying *Shari'ah* compliant equity portfolios beyond Malaysian borders, there appears to be some benefit from cherry picking markets rather than investing in a regional based fund.
- c. For the risk averse *Shari'ah* compliant equity investor, a longer-termed investment horizon is advisable.

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# Appendices

## Appendix 1 – Selection of Order of the VAR

```
Test Statistics and Choice Criteria for Selecting the Order of the VAR Model
*****
Based on 1131 observations from 29-Dec-06 to 29-Apr-11. Order of VAR = 3
List of variables included in the unrestricted VAR:
DFBMSHA          DKLCI          DEMAS          DHSENG          DNIKKEI
DDJIAP           DDJIA          DSP            DDJIUS          DFTSE
DDJIUK           DDJIM
List of deterministic and/or exogenous variables:
INPT
*****
Order   LL          AIC          SBC          LR test          Adjusted LR test
3       64224.7     63780.7     62663.9     -----          -----
2       64083.4     63783.4     63028.8     CHSQ(144)= 282.6231[.000] 273.3773[.000]
1       63881.6     63725.6     63333.2     CHSQ(288)= 686.1034[.000] 663.6579[.000]
0       63127.1     63115.1     63084.9     CHSQ(432)= 2195.1[.000] 2123.3[.000]
*****
AIC=Akaike Information Criterion      SBC=Schwarz Bayesian Criterion
```

## Appendix 2 – Cointegration Test Results

```

Cointegration with unrestricted intercepts and restricted trends in the VAR
  Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix
*****
1131 observations from 29-Dec-06 to 29-Apr-11. Order of VAR = 2.
List of variables included in the cointegrating vector:
FBMSHA      KLCI      EMAS      HSENG      NIKKEI
DJIAP      DJIA      SP      DJIUS      FTSE
DJIUK      DJIM      Trend
List of eigenvalues in descending order:
.067264    .063533    .045953    .042616    .033347    .027649    .024034
.021264    .018031    .012133    .0087517   .0037130
*****
Null      Alternative      Statistic      95% Critical Value      90% Critical Value
r = 0      r = 1      78.7554      78.4200      75.0200
r<= 1      r = 2      74.2394      72.5000      69.4500
r<= 2      r = 3      53.2045      67.0500      63.6000
r<= 3      r = 4      49.2561      61.2700      58.0900
r<= 4      r = 5      38.3582      55.1400      52.0800
r<= 5      r = 6      31.7114      49.3200      46.5400
r<= 6      r = 7      27.5147      43.6100      40.7600
r<= 7      r = 8      24.3091      37.8600      35.0400
r<= 8      r = 9      20.5790      31.7900      29.1300
r<= 9      r =10      13.8065      25.4200      23.1000
r<=10      r =11      9.9418      19.2200      17.1800
r<=11      r =12      4.2072      12.3900      10.5500
*****
Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and restricted trends in the VAR
  Cointegration LR Test Based on Trace of the Stochastic Matrix
*****
1131 observations from 29-Dec-06 to 29-Apr-11. Order of VAR = 2.
List of variables included in the cointegrating vector:
FBMSHA      KLCI      EMAS      HSENG      NIKKEI
DJIAP      DJIA      SP      DJIUS      FTSE
DJIUK      DJIM      Trend
List of eigenvalues in descending order:
.067264    .063533    .045953    .042616    .033347    .027649    .024034
.021264    .018031    .012133    .0087517   .0037130
*****
Null      Alternative      Statistic      95% Critical Value      90% Critical Value
r = 0      r>= 1      425.8833      364.8400      355.9000
r<= 1      r>= 2      347.1279      314.1100      305.7500
r<= 2      r>= 3      272.8885      265.7700      258.0100
r<= 3      r>= 4      219.6840      222.6200      215.8700
r<= 4      r>= 5      170.4279      182.9900      176.9200
r<= 5      r>= 6      132.0697      147.2700      141.8200
r<= 6      r>= 7      100.3583      115.8500      110.6000
r<= 7      r>= 8      72.8436      87.1700      82.8800
r<= 8      r>= 9      48.5345      63.0000      59.1600
r<= 9      r>=10      27.9555      42.3400      39.3400
r<=10      r>=11      14.1490      25.7700      23.0800
r<=11      r =12      4.2072      12.3900      10.5500
*****
Use the above table to determine r (the number of cointegrating vectors).

```

Cointegration with unrestricted intercepts and restricted trends in the VAR  
 Choice of the Number of Cointegrating Relations Using Model Selection Criteria

\*\*\*\*\*

1131 observations from 29-Dec-06 to 29-Apr-11. Order of VAR = 2.

List of variables included in the cointegrating vector:

FBMSHA	KLCI	EMAS	HSENG	NIKKEI
DJIAP	DJIA	SP	DJIUS	FTSE
DJIUK	DJIM	Trend		

List of eigenvalues in descending order:

.067264	.063533	.045953	.042616	.033347	.027649	.024034
.021264	.018031	.012133	.0087517	.0037130		

\*\*\*\*\*

Rank	Maximized LL	AIC	SBC	HQC
r = 0	63881.6	63725.6	63333.2	63577.4
r = 1	63921.0	63741.0	63288.3	63570.0
r = 2	63958.1	63756.1	63248.0	63564.2
r = 3	63984.7	63762.7	63204.3	63551.8
r = 4	64009.4	63769.4	63165.7	63541.3
r = 5	64028.6	63772.6	63128.6	63529.3
r = 6	64044.4	63774.4	63095.2	63517.8
r = 7	64058.2	63776.2	63066.8	63508.2
r = 8	64070.3	63778.3	63043.8	63500.8
r = 9	64080.6	63780.6	63026.0	63495.5
r =10	64087.5	63781.5	63011.8	63490.7
r =11	64092.5	63782.5	63002.7	63487.9
r =12	64094.6	63782.6	62997.8	63486.1

\*\*\*\*\*

AIC = Akaike Information Criterion      SBC = Schwarz Bayesian Criterion  
 HQC = Hannan-Quinn Criterion



### Appendix 3 – LRSM – exact identification – normalized variable FBMSHA

```

      ML estimates subject to exactly identifying restriction(s)
      Estimates of Restricted Cointegrating Relations (SE's in Brackets)
      Converged after 1 iterations
      Cointegration with unrestricted intercepts and restricted trends in the VAR
      *****
      1131 observations from 29-Dec-06 to 29-Apr-11. Order of VAR = 2.
      List of variables included in the cointegrating vector:
      FBMSHA      KLCI      EMAS      HSENG      NIKKEI
      DJIAP      DJIA      SP      DJIUS      FTSE
      DJIUK      DJIM      Trend
      *****
      List of imposed restriction(s) on cointegrating vectors:
      A1=1
      *****
      Vector 1
      FBMSHA      1.0000
      ( *NONE*)
      KLCI      .71295
      ( .50320)
      EMAS      -1.9347
      ( .48190)
      HSENG      -.050816
      ( .048515)
      NIKKEI      -.23454
      ( .097818)
      DJIAP      .93044
      ( .32680)
      DJIA      -.35401
      ( .21849)
      SP      .67513
      ( .32800)
      DJIUS      .93406
      ( .69190)
      FTSE      .19286
      ( .14674)
      DJIUK      .32756
      ( .15679)
      DJIM      -2.1916
      ( .64356)

      ML estimates subject to exactly identifying restriction(s)
      Estimates of Restricted Cointegrating Relations (SE's in Brackets)
      Converged after 1 iterations
      Cointegration with unrestricted intercepts and restricted trends in the VAR
      *****
      1131 observations from 29-Dec-06 to 29-Apr-11. Order of VAR = 2.
      List of variables included in the cointegrating vector:
      FBMSHA      KLCI      EMAS      HSENG      NIKKEI
      DJIAP      DJIA      SP      DJIUS      FTSE
      DJIUK      DJIM      Trend
      *****
      List of imposed restriction(s) on cointegrating vectors:
      A1=1
      *****
      Vector 1
      Trend      .2655E-4
      ( .4176E-4)
      *****
      LL subject to exactly identifying restrictions= 64118.5
      *****
  
```