Herd behaviour in Malaysian capital market: An empirical analysis

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HERD BEHAVIOR IN MALAYSIAN CAPITAL MARKET: AN EMPIRICAL ANALYSIS

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Abstract

This study examines the existence of herd behavior among foreign investors in the Malaysian capital market. In methodology, the study analyzes the herd behavior by estimating vector error correction (VECM) model of FPI inflows as well as FPI outflows from/to major investors such as the United States, United Kingdom, Singapore and Hong Kong using quarterly data covering the period of Q1:1991 to Q3:2007. Additionally, we adopt an innovation accounting by simulating variance decompositions (VDC) and impulse response functions (IRF) for further inferences. The findings support the belief that there is a strong herd instinct prevailing among foreign investors in the Malaysian capital market.

Keywords: *Foreign portfolio investment, herd behavior, VECM, Impulse Response, Variance Decomposition*

JEL classification: G15, C32, C12.

1. INTRODUCTION

In the wake of increased global capital mobility, the issue of ensuring stability of foreign capital flows has captured the research interests of many. Countries which are highly opened to capital flows are getting more concerned about its stability due to the unprecedented magnitude of financial crises resulting from the highly volatile nature of foreign capital flows. Studies on the causes of capital flows cite various reasons leading to the volatile nature of foreign portfolio investment.

Foreign portfolio investments are shown to be influenced by changes in economic and financial "fundamentals", (Corsetti et al., 1998; Kaminsky, 1998; Krugman, 1979) which can be categorized into the external and internal factors. The external factors include changes in macroeconomic and financial variables that are outside the host country that give impact on the volume of capital flows. Increased availability of financial capital coupled with sustained decline in the global interest rate and recessions in the industrialized economies have often been quoted as the major external factors that increase capital inflow into developing countries (Calvo et al., 1993, 1996; Chuhan et al.,

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1993; and Fernandez-Arias, 1996). Calvo et al. (1993) in particular, find evidence of lower foreign interest rates result in increased foreign capital flows into Latin America. Essentially, the external factors result in greater foreign capital inflow into the host economy as investors engage in "flight to quality" by shifting their funds to safer investment haven.

Internal factors are country-specific characteristics which have direct impact on the country's capital flow. This includes financial market-related factors such as improvement in investment infrastructure and macroeconomic-related variables relating to supply and demand shocks. Bachetta and Wincoop (1998) document positive relationship between capital inflow and favorable macroeconomic condition of a country bring about by successful macroeconomic stabilization policy and improvement in the financial market due to liberalization policies. Kim (2000) also highlighted successful resolution of debt problems among developing countries as well as advancement in transaction technologies as additional pull factors affecting the flow of capital.

Apart from the real or fundamental changes, there is a growing literature suggesting that capital flow, in particular, foreign portfolio investment are sensitive to the aggregate behavior in the financial market. In this context, investors react to financial market rumors even though the fundamentals are not deteriorating (Kaminsky and Schmuckler, 1999; Banerjee, 1992). The so-called "herding behavior" is based solely on "market sentiment" rather than objective assessment of market fundamentals partly because acquiring information can be costly in terms of time and money (see for example, Eichengreen and Mody, 1988; Kumar and Prasad, 2002). Herding behavior could result in massive outflow or inflow of funds and is purely contagion as investors react without undertaking careful assessment of the validity of the news that they are reacting to. In a related study, Baek (2006) finds that portfolio investment in Asia is caused by investors' appetite for risks, while portfolio investment in the Latin American is caused by real or fundamental factors in the domestic and global economy. Investment in Asia, therefore, is considered as more volatile in nature compared to that in Latin America since it is sensitive to market mood as opposed to true economic fundamentals.

In view of the importance of identifying factors affecting stability of portfolio investment particularly for a small open economy such as Malaysia, this study examines the causes of foreign portfolio investment flows for the case of Malaysia. In particular, this study examines the existence of herd behavior among foreign investors in the Malaysian capital market. In achieving this objective, the study analyzes the herd behavior of investments by major foreign investors in Malaysia, namely the United States, United Kingdom, Singapore and Hong Kong using the vector error correction (VECM) model. The study also undertakes the variance decompositions (VDC) analysis and impulse response functions (IRF) for further inferences.

An area of novelty of this study is that it analyzes portfolio investment behavior of the individual investing country rather than aggregated investment analysis in Malaysia. This country-by-country analysis enables detailed inferences to be made with respect to the investment behavior of the major investing countries. The rest of the paper is organized as follows: the next section provides some background information on foreign portfolio investment based on the Malaysian experience. In particular, this section highlights investment behavior of the top four major investing countries in Malaysia. Section 3 presents the empirical methods and preliminary analysis of the data. Section 4 highlights the empirical findings including the data preliminaries and the results based on the unrestricted VAR and VECM tests. Further inferences are then made based on the

VDC and IRF analysis. Finally, section 5 concludes and draws several policy recommendations from the major findings of the paper.

2. PATTERN OF FOREIGN PORTFOLIO INVESTMENT INFLOWS AND OUTFLOWS IN MALAYSIA

During the period 1991 to 2007, foreign portfolio investment (FPI) in Malaysia has been rather volatile. The amount of total FPI (comprising of both inflow and outflow) ranged from RM40.6 billion in 1991 to a historical high of RM729.1 billion in 2007. Foreign portfolio investment has been very volatile in the pre-1997 period but has become more stable in the post-1997/1998 Asian crisis period. Total foreign portfolio inflow and outflow also reached record highs in 2007 at RM376.4 billion and RM352.6 billion, respectively. In terms of net portfolio investment, the lowest net portfolio investment was recorded during the Asian financial crisis in 1997 at negative RM28.4 billion. Net foreign portfolio investment has shown encouraging trend in the post-2000 period by recording positive flows since 2003, except for 2005 which recorded a negative net FPI of RM6.8 billion.

Of total FPI into Malaysia, approximately 80 percent originated from four countries, namely the US, the UK, Singapore and Hong Kong. On average, in the 1991-2007 period, 11.5 percent of total FPI comes from the US, 17.1 percent from the UK, 36.6 percent from Singapore and 22.6 percent from Hong Kong. An interesting observation of FPI from these countries is that the share of FPI inflows from these countries has continued to decline. In particular, in 1991, around 94.4 percent of total FPI came from these countries, while in 2007, the share has dropped significantly to only 79.3 percent. The decline was contributed by lower FPI from Singapore (from 54.5 percent in 1991 to 23.2 percent in 2007) and Hong Kong (from 24.4 percent in 1991 to 17.4 percent in 2007). The contribution of FPI from the US has increased from 5.1 percent in 1991 to 20 percent in 2007, while that from the UK has also increased from around 15 percent in the 1990s to around 22 percent in the post-2000 period. On aggregate basis, the decline in the contribution of these countries to total FPI inflow also indicate the increasing importance of FPI from other sources such as from “other countries” which details are not being specified by the Malaysian central bank - Bank Negara Malaysia.

Table 1. Total Foreign Portfolio in Malaysia, 1991-2007

	Total Inflow	Total Outflow	Total FPI	Net
1991	19,346	21,274	40,620	-1,928
1992	60,935	53,043	113,978	7,892
1993	187,779	162,128	349,907	25,651
1994	238,454	224,425	462,879	14,029
1995	106,414	101,054	207,468	5,360
1996	144,933	136,090	281,023	8,843
1997	156,162	184,517	340,679	-28,355
1998	57,028	58,286	115,314	-1,258
1999	43,598	42,532	86,130	1,066
2000	54,529	63,274	117,803	-8,745
2001	37,910	39,891	77,801	-1,981
2002	54,383	59,381	113,764	-4,998
2003	76,013	65,164	141,177	10,849
2004	135,107	100,419	235,526	34,688
2005	127,298	134,137	261,435	-6,839
2006	172,661	161,579	334,240	11,082
2007	376,444	352,612	729,056	23,832
Average	120,529	115,283	235,812	5,246

Table 2. Inflow of Foreign Portfolio Investment in Malaysia by Major Investing Countries, 1991-2007

	US	UK	Singapore	Hong Kong	% of Total FPI Inflow
1991	995	2,174	10,359	4,731	94.38
1992	4,361	13,471	31,596	9,853	97.29
1993	9,135	26,100	113,307	31,343	95.80
1994	35,028	36,004	114,018	37,267	93.23
1995	13,778	12,304	52,154	24,109	96.18
1996	8,870	17,654	70,198	41,699	95.51
1997	9,878	20,646	75,373	42,229	94.85
1998	5,625	6,867	22,239	17,477	91.55
1999	2,871	5,856	18,157	8,474	81.10
2000	4,749	8,160	16,072	17,155	84.61
2001	7,353	7,578	7,530	8,703	82.21
2002	7,258	12,085	11,068	13,720	81.15
2003	9,171	19,621	15,192	20,279	84.54
2004	20,131	28,943	34,990	29,900	84.35
2005	20,116	27,331	31,737	25,904	82.55
2006	30,030	36,946	31,169	28,537	73.37
2007	74,758	71,077	87,177	65,441	79.28
Average	15,536	20,754	43,667	25,107	87.17

Table 3. Outflow of Foreign Portfolio Investment in Malaysia by Major Investing Countries, 1991-2007

	US	UK	Singapore	Hong Kong	% of Total FPI Outflow
1991	692	2,358	11,722	5,336	94.52
1992	4,168	13,608	27,009	6,792	97.24
1993	6,436	26,532	98,997	24,584	96.56
1994	31,576	31,045	101,809	44,399	93.05
1995	7,483	10,733	52,079	26,617	95.90
1996	5,832	16,012	67,591	41,386	96.13
1997	10,219	20,562	80,316	64,055	94.92
1998	5,479	5,675	24,636	18,915	93.86
1999	3,768	6,248	18,489	8,907	87.96
2000	4,338	10,262	20,478	19,120	85.66
2001	3,670	10,249	9,156	8,466	79.07
2002	7,075	13,089	12,921	13,803	78.96
2003	7,728	19,213	14,169	14,391	85.17
2004	17,213	22,361	21,251	25,531	86.00
2005	20,060	26,113	36,295	26,458	81.21
2006	24,148	31,928	41,537	22,162	74.13
2007	74,750	62,720	79,916	62,288	79.31
Average	13,802	19,336	42,257	25,483	87.50

Similar to inflow, around 80 percent of FPI outflow resulted from the US, the UK, Singapore and Hong Kong. In the period of 1991-2007, around 10 percent of total FPI outflow went to the US, 17.5 percent to the UK, 37.6 percent to Singapore and 23 percent to Hong Kong. Over the years, outflows of FPI to the US showed an increasing trend, while outflows to the UK, Singapore and Hong Kong seemed to be declining. As in the case of inflow, the total outflows to these countries have also been declining in view of the increased outflow to the "other countries".

Similar declining trends of FPI inflows from Singapore and Hong Kong as well as FPI outflows to UK, Singapore and Hong Kong give preliminary indication that there could be a strong common behavior among these foreign investors towards investing in the country and pulling out the investment out from the country. This behavior could be tested by proper empirical tests which will be conducted in this study.

3. METHODOLOGY

Data and Variables

Data of FPI inflows and outflows from/to the United States, United Kingdom, Singapore and Hong Kong as well as real GDP are quarterly, ranging from Q1:1991 to Q3:2007 and sourced from Bank Negara Malaysia's *Quarterly Bulletin* and International Monetary

Fund's *IMF Financial Statistics* of various issues. The raw data obtained for all variables are in RM million and the base year for real GDP is 1987. All variables are expressed in their logarithmic transformation, denoted by italic small letters. Δ denotes the first difference operator.

To evaluate the integration properties of the variables, we employ standard augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests (Dickey and Fuller, 1981; Phillips and Perron, 1988). A variable is said to be integrated of order d, written *I*(d) if it requires differencing d times to achieve stationarity. For cointegration, we employ the VAR based tests of Johansen (1988) and Johansen and Juselius (1990).

The Model

To test the herd behavior among foreign investors in Malaysian portfolio market, the vector autoregressive (VAR) model is adopted first on all FPI inflows (US, UK, Singapore and Hong Kong). In this analysis, there is a set of p=4 endogenous variables, *z = [fpiius, fpiiuk, fpiis, fpiihk]* where *fpiius, fpiiuk, fpiis* and *fpiihk* refer to the logarithm of US FPI inflow, UK FPI inflow, Singapore FPI inflow and Hong Kong FPI inflow, respectively. Following Johansen(1988,1991) and Johansen and Juselius(1990,1992), we consider a *p*-dimensional vector time series z_t and model it as an Unrestricted Vector Autoregression (VAR) involving up to *k*-lags of z_t.

$$z_t = A_1 z_{t-1} + ... + A_k z_{t-k} + \mu + \varepsilon_t, \quad \varepsilon_t \sim niid(0, \Sigma) \qquad (1)$$

where z_t is a *(px1)* matrix and each of the A_i is a *(pxp)* matrix of parameters. The Johansen approach is used with the consideration that it enables hypotheses tests concerning the matrix and the number of equilibrium relationships to be carried out.

Before test of cointegration could be done, we have to choose the maximum lag length, *k*, in the Unrestricted Vector Autoregression Model (VAR). Choosing the appropriate lag length is important since a *k* too small will invalidate the tests, whereas a *k* too large may result in a loss of power (Kanioura, 2001). The appropriate lag is chosen by checking the residuals of VAR model with one lag after another and the selection of lag is based on the one that has the absence of serial correlation in the residuals.

Being aware of the lag order, then we construct the long-run equations (Unrestricted VAR model) for the series. The analysis is carried out further by doing the Johansen cointegration test with *k-1* lag. The determination of the number of cointegrating vectors is based on the *maximal eigenvalue* and the *trace* tests.

The vector error correction model (VECM) restricts the long-run behaviour of the endogenous variables to converge to their cointegrating relationships while allowing for short-run adjustment dynamics. In this case, the cointegration terms are the correction terms since a series of partial short-run adjustments correct gradually the deviation from long-run equilibrium. The VECM corresponds to a restricted VAR of order *k-1* for the first differenced series, with the inclusion of error-correction terms for the cointegrating vectors.

We write a *p*-dimensional vector error correction model (VECM) as follows:

$$\Delta y_t = \sum_{i}^{k-1} \Gamma_i \Delta y_{t-i} + \Pi y_{t-1} + \mu + \varepsilon_t, \quad t = 1, \ldots T \tag{2}$$

where y_t is the set of $I(1)$ variables discuss above; $\varepsilon_t \sim niid(0,\sum)$; μ is a drift parameter, and Π is a (p x p) matrix of the form $\Pi = \alpha\beta'$ where α and β are both (p x r) matrices of full rank, with β containing the r cointegrating vectors and α carrying the corresponding loadings in each of the r vectors. The adjustment coefficients in matrix α refer to the coefficients of the Error Correction (ECM) terms.

Additionally, we adopt an innovation accounting by simulating variance decompositions (VDC) and impulse response functions (IRF) for further inferences. VDC and IRF serve as tools for evaluating the dynamic interactions and strength of causal relations among variables in the system. The VDC indicate the percentages of a variable's forecast error variance attributable to its own innovations and innovations in other variables. Thus, from the VDC, we can measure the relative importance of fluctuation of one country FPI inflow in accounting for fluctuation in FPI inflows from other countries. Moreover, the IRF trace the directional responses of a variable to a one standard deviation shock of another variable. This means that we can observe the direction, magnitude and persistence of FPI inflow of one country to variation in FPI inflows from other countries.

For similar objective, the above method is repeated for FPI outflows from Malaysia to the United States, United Kingdom, Singapore and Hong Kong. In this case, the VAR model is applied on FPI outflows to all these foreign countries (denoted as *fpious, fpiouk, fpios* and *fpiohk*).

4. EMPIRICAL FINDINGS

As a preliminary step, we first subject each variable to Augmented Dickey Fuller (ADF) and Phillip-Perron (P-P) unit root tests. The results of the tests are displayed on Table 4. The results generally suggest that most variables are integrated of order one as the null hypothesis that the series are not stationary is accepted at level but rejected at first difference. In other words, the variables are stationary at first difference or I(1).

Table 4: Unit Root Tests

Variable	**ADF test statistic (with trend and intercept)**		**P-P test statistic (with trend and intercept)**	
	Level	***First Difference***	***Level***	***First Difference***
rgdp	-2.44	-3.71**	-3.34*	-9.48***
fpiius	-3.40*	-10.52***	-3.33*	-10.77***
fpiiuk	-3.47*	-10.83***	-3.46*	-10.69***
fpiis	-2.71	-7.92***	-2.69	-7.87***
fpiihk	-2.97	-6.96***	-2.97	-6.83***
fpious	-3.28*	-6.55***	-3.16	-10.33***
fpiouk	-3.83**	-10.91***	-3.75**	-10.92***
fpios	-2.59	-7.69***	-2.66	-7.72***
fpiohk	-2.90	-5.88***	-2.49	-5.90***

Note: *** , ** and * denote significance at 1%, 5% and 10% level, respectively.

4.1 Analysis on FPI inflows into Malaysia

The first VAR model developed consists of 4 endogenous variables of capital inflows: *z = [fpiius, fpiiuk, fpiis, fpiihk]*. For this model, the maximum lag length, *k*, of 2 is chosen. Based on *Maximum Eigenvalue* and *Trace* tests of cointegration, there are two cointegrating vectors existed among the variables. Table 5 provides detail results of these cointegration tests.

Table 5: Johansen Cointegration Tests Results

Null Hypothesis about Rank (r)	*Max-Eigen* Statistic	5% Critical Value	*Trace* Statistic	5% Critical Value
r=0	29.18	27.58	69.94	47.86
r≤1	25.68	21.13	40.76	29.80
r≤2	12.18	14.26	15.08	15.49
r≤3	2.90	3.84	2.89	3.84

Normalising *fpiis* for cointegrating vector 1 and *fpiiuk* for cointegrating vector 2, following are the suggested vectors:

CV1 = *fpiis* + 1.55*fpiius* – 2.51*fpiihk* + 0.326
CV2 = *fpiiuk* – 0.64*fpiius* – 0.33*fpiihk* -0.455

We then proceed with an estimated error correction model using the 4 foreign portfolio inflow variables to illustrate how the cointegration results might be utilised. The vector error correction model (VECM) restricts the long-run behaviour of the endogenous variables to converge to their cointegrating relationships while allowing for short-run adjustment dynamics. Table 6 displays 4 short-run equations for Δ*fpiius,* Δ*fpiiuk,* Δ*fpiis* and Δ*fpiihk*, respectively. All coefficients of short-run equation are coefficients relating to the short run dynamics of the model's convergence to equilibrium and coefficients of lag CV (error correction term) represent the speed of adjustment. From all 4 short-run equations, equation 1 is selected to be used for further inferences as it has at least one lag error correction term ($CV1_{t-1}$) which is significant with negative sign. The negative sign of the ECM terms or cointegrating vectors is rather better results to be considered since it is the correct sign of the error correction. The significant of an error correction term shows the evidence of causality in at least one direction.

To support the selection of equation 1, we apply a number of diagnostic tests to the error correction model. We find no evidence of serial correlation, heteroskedasticity and ARCH (Autoregressive Conditional Heteroskedasticity) effect in the disturbances. The model also passes the Jarque-Bera normality test which suggesting that the errors are normally distributed.

Table 6: The Vector Error Correction Model

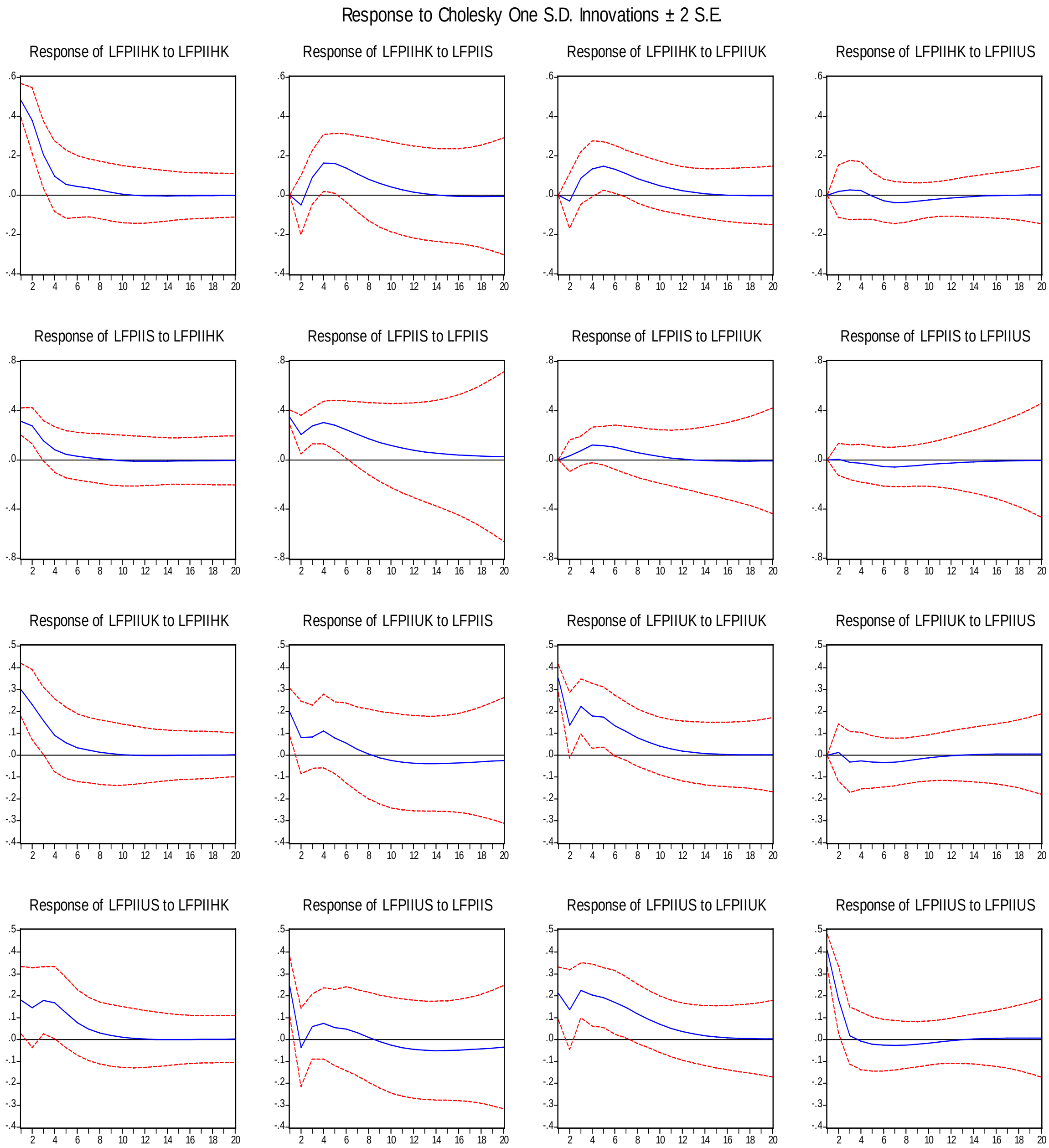
Ind. Variable \ Equation	Dependent Variable			
	(1) $\Delta fpiius$	(2) $\Delta fpiiuk$	(3) $\Delta fpiis$	(4) $\Delta fpiihk$
constant	0.06	0.03	-0.01	0.02
$\Delta fpiius_{t-1}$	0.27	0.32*	0.10	0.09
$\Delta fpiius_{t-2}$	0.13	0.25*	0.15	0.16
$\Delta fpiiuk_{t-1}$	-0.68**	-0.73***	-0.08	-0.39
$\Delta fpiiuk_{t-2}$	0.06	-0.05	0.23	0.05
$\Delta fpiis_{t-1}$	-0.41	0.10	-0.56**	-0.28
$\Delta fpiis_{t-2}$	-0.32	0.04	-0.42*	-0.02
$\Delta fpiihk_{t-1}$	0.34	0.18	0.49**	0.49**
$\Delta fpiihk_{t-2}$	-0.15	-0.38*	-0.15	-0.24
$CV1_{t-1}$	-0.17**	-0.11	0.04	0.12*
$CV2_{t-1}$	0.92***	0.17	0.36*	0.39
Included observation	64	64	64	64
Adjusted R^2	0.32	0.14	0.15	0.14
F-statistic	3.99***	2.03**	2.09**	2.02**
Diagnostic test:				
Far	0.63			
Farch	0.27			
JBnormal	1.41			
Fhet	0.68			

Notes: 1. *Far* is the F-statistic of Breusch-Godfrey Serial Correlation LM Test
Farch is the F-statistic of ARCH Test
JBnormal is the Jarque-Bera Statistic of Normality Test
Fhet is the F-statistic of White Heteroskedasticity Test
2. *** , ** and * denote significance at 1%, 5% and 10% level, respectively.

From an estimated VAR, we compute variance decompositions and impulse-response functions, which serve as tools for evaluating the dynamic interactions and strength of causal relations among variables in the system. The results of variance decomposition and impulse response functions are displayed in Table 7 and Figure 1, respectively.

From Figure 1, the IRF can produce the time path of dependent variables in the VAR, to shocks from all the explanatory variables. It could be seen that FPI inflow from Hong Kong does react significantly to FPI inflow innovations from Singapore and UK as it respond positively for the first 5 quarters and then subsides to zero afterwards. The figure also shows that the FPI inflow from UK responds positively to a shock in FPI inflows from Hong Kong and Singapore for about 9 quarters before it subsided to zero. Shock in FPI flow from the US, however, does not give significant impact on both FPI inflows from Hong Kong and UK. Interestingly, FPI inflow from the US reacts positively and significantly to shock in all other countries inflows with the longest period of reaction on shock is 16 quarters from UK inflow. These results imply that FPI inflow from the US is highly sensitive to shock in FPI inflows from other countries but shock in the US FPI inflow itself is rather insignificant to the other countries FPI inflows.

Figure 1: Impulse Response Functions, FPI inflows



As discussed earlier, the variance decomposition is an alternative method to IRF for examining the effects of shocks to the dependent variables. It determines how much of the forecast error variance for any variable in a system is explained by innovations to each explanatory variable, over a series of time horizons. Usually own series shocks explain most of the error variance, although the shock will also affect other variables in the system. From Table 7, looking along the main diagonal, the results reveal that the own shock is relatively high for FPI inflow from Hong Kong with 88% even at longer time horizon (20 quarters). This implies the exogeneity of FPI inflow from Hong Kong in variance decompositions, as after the first quarter after the shock, the variance appears to be less explained by innovations in other explanatory variables. On the other hand, the results shows that the percentage of variance explained by own shock for other countries

FPI inflows are relatively smaller especially from Singapore and the US. In fact, the own shock's contribution is declining in long run for US inflow from 56% in first quarter to 8% in 20 quarter period which indicates that the US inflow is highly endogenous.

The VDC substantiate the significant role played by UK, Singapore and Hong Kong FPI inflows in accounting for fluctuations in US FPI inflow. At 2 quarter horizon, the fraction of US inflow forecast error variance attributable to variations in UK, Singapore and Hong Kong inflows are 24%, 14% and 12% respectively. The explanatory power of all variables continuously increase at longer horizon and at 20-quarter horizon the contributions are 60%, 15% and 17%, respectively. Obviously, for FPI inflow from Singapore, percentage of forecast variance in it is largely explained by innovation in FPI inflow from Hong Kong, among other explanatory variables as it maintains higher percentage than the other. As for FPI from UK, its forecast error variance largely attributable to variations in Hong Kong and Singapore inflows. The results again strengthen the findings earlier that US FPI inflow has insignificant role in determining the variation of other countries FPI inflows but FPI inflow from the US is highly determined by FPI inflows from other countries.

Table 7: Variance Decompositions of FPI inflows

Period (Qtr)	S.E.	*fpiihk*	*fpiis*	*fpiiuk*	*fpiius*
Variance Decomposition of *fpiihk*					
2	0.801970	99.07307	0.427826	0.498983	0.000121
4	1.066667	96.83784	1.336718	1.510587	0.314858
6	1.304335	94.60676	1.391247	2.467931	1.534066
8	1.527872	92.69070	1.714459	3.174081	2.420762
10	1.721136	91.21406	1.949895	3.737675	3.098375
12	1.900109	90.11585	2.112914	4.140608	3.630627
14	2.064232	89.28512	2.242340	4.450299	4.022243
16	2.216725	88.65103	2.341633	4.681973	4.325364
18	2.359700	88.15509	2.418791	4.864376	4.561739
20	2.494569	87.75829	2.480639	5.009976	4.751094
Variance Decomposition of *fpiis:*					
Period (Qtr)	**S.E.**	***fpiihk***	***fpiis***	***fpiiuk***	***fpiius***
2	0.650984	64.30578	34.61180	0.792431	0.289991
4	0.859387	55.26631	37.54554	6.350516	0.837635
6	1.076842	52.39249	35.48135	8.787317	3.338839
8	1.274401	49.88800	35.53050	10.12215	4.459361
10	1.447493	48.15726	35.33862	11.11625	5.387863
12	1.607426	47.05021	35.11842	11.77309	6.058280
14	1.753464	46.20656	35.00983	12.24785	6.535765
16	1.888934	45.58988	34.91444	12.59610	6.899579
18	2.015627	45.11498	34.83902	12.86660	7.179398
20	2.134919	44.73902	34.78127	13.07857	7.401146
Variance Decomposition of *fpiiuk:*					
Period (Qtr)	**S.E.**	***fpiihk***	***fpiis***	***fpiiuk***	***fpiius***
2	0.637880	39.82943	15.71156	44.36944	0.089572
4	0.885342	30.65441	15.66059	52.87568	0.809318
6	1.118448	29.29182	15.36570	53.02401	2.318474
8	1.327698	27.88087	15.62400	53.31246	3.182666
10	1.514197	26.94234	15.73254	53.42858	3.896542
12	1.684422	26.35741	15.80449	53.44059	4.397511
14	1.840102	25.91303	15.86282	53.45919	4.764965
16	1.984306	25.59373	15.90677	53.45724	5.042263
18	2.119027	25.34697	15.93926	53.45836	5.255413
20	2.245808	25.15318	15.96543	53.45708	5.424304
Variance Decomposition of *fpiius:*					
Period (Qtr)	**S.E.**	***fpiihk***	***fpiis***	***fpiiuk***	***fpiius***
2	0.625642	11.93461	14.34689	23.93155	49.78695

4	0.828903	12.98024	13.84663	44.34451	28.82861
6	1.076470	16.77142	13.19045	52.25831	17.77983
8	1.300087	16.75827	13.76990	56.08722	13.38460
10	1.507020	16.97606	14.05466	57.71948	11.24980
12	1.696865	16.98888	14.19842	58.76756	10.04513
14	1.870058	16.98448	14.34045	59.36562	9.309452
16	2.029979	16.97555	14.43772	59.78161	8.805127
18	2.178859	16.96320	14.50759	60.08615	8.443052
20	2.318460	16.95379	14.56489	60.31331	8.168008
Cholesky Ordering: LFPIIHK LFPIIS LFPIIUK LFPIIUS					

4.1 Analysis on FPI outflows from Malaysia

In this second part of the analysis, we adopt similar VAR model using FPI outflows from Malaysia to all four foreign countries in study. Thus, the VAR model with 4 endogenous variables used is *z = [fpious, fpiouk, fpios, fpiohk]* where *fpious, fpiouk, fpios* and *fpiohk* refer to the logarithm of US FPI outflow, UK FPI outflow, Singapore FPI outflow and Hong Kong FPI outflow, respectively. Lag 3 is chosen as the optimal lag for the VAR model. However, we found no cointegration existed among the variables using *Maximum Eigenvalue* and *Trace* tests of cointegration as shown on Table 8.

Table 8: Johansen Cointegration Tests Results

Null Hypothesis about Rank (r)	*Max-Eigen* Statistic	5% Critical Value	*Trace* Statistic	5% Critical Value
r=0	19.54	27.58	44.71	47.86
r≤1	13.29	21.13	25.17	29.80
r≤2	10.17	14.26	11.88	15.49
r≤3	1.71	3.84	1.71	3.84

Since there is no cointegration traced, we conduct Toda and Yamamoto (1995) non-causality test to establish the direction of causation between the two variables. The main advantage of this test over Granger causality test is that it does not require pretests of stationarity or cointegration between series.[4]

The Toda and Yamamoto(1995) procedure essentially suggests the determination of the *d-max*, namely, the maximal order of integration of the series in the model, and to intentionally over-fit the causality test underlying model with additional *d-max* lags – so that the VAR order is now $p = k + d$, where k is the optimal lag order. This modified version of the Granger causality test is employed to establish a causal relationship between variables in this study. The test is done by estimating a two-equation system:

$$Y_t = \alpha_1 + \sum_{i=1}^{k+d\max} \beta_i Y_{t-i} + \sum_{i=1}^{k+d\max} \delta_i X_{t-i} + \mu_t \qquad (3)$$

[4] The unit root and cointegration tests are usually required before testing for causality. This might contribute to possible pretest biases due to the sensitivity of stationary or cointegration tests. The pretest biases might be severe as the power of unit root tests is known to be very low and tests for cointegrating rank in Johansen (1991) are not very reliable for finite samples (see Reimers(1992) and Toda and Yamamoto(1995)).

$$X_t = \alpha_2 + \sum_{i=1}^{k+d\max} \phi_i Y_{t-i} + \sum_{i=1}^{k+d\max} \theta_i X_{t-i} + \nu_t \qquad (4)$$

where d-max is the maximal order of integration of the series in the system and μ_t and ν_t are error correction terms that are assumed to be white noise. The Wald tests were then applied to the first k coefficient matrices using the standard χ^2-statistics. The null hypothesis set for equation (3) is $\delta_i = 0 \forall_i \leq k$ and for equation (4) is $\phi_i = 0 \forall_i \leq k$. From equation (3), X "Granger-causes" Y if its null hypothesis is rejected and from equation (4), Y "Granger-causes" X if its null hypothesis is rejected. Unidirectional causality will occur between two variables if either null hypothesis of equation (3) or (4) is rejected. Bidirectional causality existed if both null hypotheses are rejected and no causality existed if neither null hypothesis of equation (3) nor equation (4) is rejected.

Table 9 displays results obtained for Toda and Yamamoto non-causality tests. Obviously, there are bidirectional causality between FPI outflow to Singapore and FPI outflow to Hong Kong. In other words, capital outflow to Singapore causes capital outflow to Hong Kong, vice versa. In addition, significant Wald test coefficient of US capital outflow in UK outflow equation indicates that capital outflow to UK is caused by capital outflow to US.

Table 9: Toda-Yamamoto Non-causality test results

Equation	Wald test (χ^2)
fpiohk (in *fpiouk* equation)	3.26 (0.35)
fpios (in *fpiouk* equation)	4.24 (0.24)
fpious (in *fpiouk* equation)	**6.4 (0.09)**
fpiohk (in *fpious* equation)	0.54 (0.91)
fpios (in *fpious* equation)	2.29 (0.51)
fpiouk (in *fpious* equation)	4.90 (0.18)
fpiohk (in *fpios* equation)	**8.08 (0.04)**
fpiuk (in *fpios* equation)	5.12 (0.16)
fpious (in *fpios* equation)	5.77 (0.12)
fpios (in *fpiohk* equation)	**11.12 (0.01)**
fpious (in *fpiohk* equation)	4.82 (0.19)
fpiouk (in *fpiohk* equation)	1.29 (0.73)

Note: The figures in parentheses are the p-values.

Overall, results from the analyses of both FPI inflows and FPI outflow to/from Malaysia from/to 4 main trading partners clearly prevail the existence of herd behavior among foreign investors in the Malaysian short-term capital market. In particular, the study found that capital inflow from US is highly influenced by other countries' inflows especially from UK. As for outflows, capital outflow from UK is highly affected by capital outflow from US and both Singapore and Hong Kong capital outflows are influenced by each other. This clearly explains the reason why the country portfolio market was badly hit by the currency crash in 1997 which worsened the balance position of Malaysian capital market.

5. CONCLUSION

By employing the VECM model to analyze the behaviour of FPIs by major investing countries, the study finds evidence supporting the existence of herd behavior among the foreign investors in the Malaysian capital market. More importantly, the existence of herd behaviour among the foreign investors is not only evidence in the outflows of capital but the inflows of capital as well.

On a country-by-country analysis, the study finds that FPI inflows from the US is highly sensitive to changes in inflows from other major investing countries, pointing to the evidence of herd behaviour among the US foreign portfolio investors in the Malaysian capital market. On the other hand, shocks in the US FPI inflow itself are insignificant to the other countries FPI inflows, suggesting that the inflows from other investing countries are not based on merely following the behaviour of the US foreign portfolio investor. This finding is further supported by the VDC analysis since a significant proportion of the fluctuations in US FPI inflows are being explained by the innovations in the other major portfolio investing countries, namely the UK, Singapore and Hong Kong. There is also some evidence of herd behaviour among the UK foreign portfolio investors as shocks and variations in FPI from Hong Kong is significant in accounting for the variations in the UK FPI. As in the previous case, the results support that US FPI inflow has insignificant role in determining the variation of other countries FPI inflows but FPI inflow from the US is highly determined by FPI inflows from other countries. There is also evidence of herd behaviour in the FPI outflows among the major foreign investing countries. In particular, the study finds significant bi-directional causation running from Singapore to Hong Kong FPIs and uni-directional causation running from UK to US FPIs.

In general, the study finds clear evidence of the existence of herd behavior among the major foreign investors in the Malaysian capital market. This finding implies that, during the period under review, the Malaysian short-term capital market can be volatile and speculative as it is influenced more by market "mood". Being a small yet highly open economy, Malaysia could be highly susceptible to the swings in market mood. It is therefore imperative for Malaysia to take the necessary pre-cautionary steps to ensure that an aggregate reversal in portfolio investment flows would not impose a de-stabilising impact on the economy. Learning from the experience during the financial crisis 1997/1998, this study emphasizes the need to strengthen market supervision and improving the financial structure so as to reduce the impact of capital reversal on the Malaysian financial market.

REFERENCES

Bacchetta, Philippe and Wincoop, Eric V. (1998). "Capital Flows to Emerging Markets: Liberalization, Overshooting and Volatility," *CEPR Discussion Papers 1889*, C.E.P.R. Discussion Papers.

Baek, In-Mee. (2006). "Portfolio investment flows to Asia and Latin America: pull, push or market sentiment?" *Journal of Asian Economics*, 17:363-373.

Banerjee, Abhijit V. (1992), "A Simple Model of Herd Behavior," *Quarterly Journal of Economics*, Vol. CVII (3): 797-817.

Bank Negara Malaysia. *Monthly Statistical Bulletin*. Various issues.

Calvo, G., Leiderman, L., Reinhart, C. M. (1993). "Capital inflows and real exchange rate appreciation in Latin America". *IMF Staff Papers*, 40(1): 108-151.

Calvo, G., Leiderman, L., Reinhart, C. M. (1996). "Inflows of capital to developing countries in the 1990s," *Journal of Economic Perspectives*, 10(2): 123-139.

Chuhan, P., Classens, S., and Mamingi, N. (1993). "Equity and bond flows to Latin America and Asia: the role of global and country factors," *Journal of Development Economics*, 55: 439-463.

Corsetti, Giancarlo & Pesenti, Paolo and Roubini, Nouriel. (1999). "What caused the Asian currency and financial crisis?," *Japan and the World Economy*, Elsevier, 11(3): 305-373.

Dickey, D. A. and Fuller, W. F. (1979). "Distribution of the estimates for autoregressive time series with a unit root," *Journal of the American Statistical Association*, 74: 427-431.

Eichengreen, B. and Mody, A. (1988). "What explains changing spreads on emerging market debt: fundamentals or market sentiment?" *NBER Working Paper, No. 6408*, National Bureau of Economic Research.

Fernandez-Arias, E. (1996). "The new wave of private capital inflows: push or pull?" *Journal of Development Economics*, 48(2): 389-418.

Johansen, Søren. (1991). "Estimation and Hypothesis Testing of Cointegrating Vectors in Gaussian Vector Autoregressive Models". *Econometrica*, 59, no. 006: 1551-1580

Johansen, Søren. (1998). "Statistical analysis of cointegration vector," *Journal of Economics Dynamics and Control*. 12: 231-254.

Johansen, Søren. and Juselius, Katarina. (1990). Maximum likelihood estimation and inference on cointegration: with applications to the demand for money. *Oxford Bulletin of Economics and Statistics,* 52, 169-210.

Johansen, Søren & Juselius, Katarina (1992). "“Testing Structural Hypotheses in a Multivariate Cointegration Analysis of the PPP and the UIP for UK”. *Journal of Econometrics*, 53: 211-244.

Kaminsky, Graciela. (1998). "Currency and Banking Crises: The Early Warnings of Distress," *International Finance Discussion Papers 629*, Board of Governors of the Federal Reserve System, October.

Kaminsky, Graciela L. and Schmuckler, Sergio L. (1999). “What triggers market jitters?” *The World Bank Policy Research Working Paper No. 2094*.

Kanioura, Athina. (2005). "A Cointegration Analysis of US Interest Rates,” *Working Paper no. 3*. Department of Economics, University of Sheffield, 2001

Kim, Yoonbai. (2000). “Causes of capital flows in developing countries,” *Journal of International Money and Finance*, Elsevier, 19: 235-253.

Kumar, M. S. and Persaud, A. (2002). “Pure contagion and investors shifting risk appetite: Analytical issues and empirical evidence,” *International Finance*, 3(5): 401-436.

Krugman, Paul. (1979). "A Model of Balance-of-Payments Crises," *Journal of Money, Credit and Banking*, 11: 311-325.

Toda, H. Y. and Yamamoto. (1995). “Statistical inference in vestor autoregressions with possibly integrated processes,” *Journal of Econometrics*. 66: 225-250.