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Statistically Significant Relationships between Returns on FTSE 100, S&P 500 Market Indexes and Macroeconomic Variables with Emphasis on Unconventional Monetary Policy

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Abstract Establishing the nature of relationships between macroeconomic variables and stock market returns are imperative to investors and understanding the stock market dynamics in any country. These relationships have been extensively studied in both emerging and the developed stock markets. By employing vector error correction and cointegration techniques, this current study established the statistically significant long-run and short-run causal relationships between macroeconomic variables and the stock market returns of FTSE100 and S&P500 stock market indexes in the United Kingdom and United States respectively. The macroeconomic variables employed include industrial production index, short-term interest rates, exchange rates, consumer price index and unemployment rates in addition to broad money supply M3 that was included as an exogenous variable. Also global financial crisis was introduced, as a dummy variable to capture structural breaks inherent in the data. Empirical results showed that significant long-run relationship existed between stock market returns and industrial production index, interest rates, and consumer price index in the United Kingdom while stock market returns in the United States was influenced by all variables except industrial production index. Furthermore, results indicated that it takes longer for stock market returns to adjust to its long-run equilibrium in the UK than in the US. In the short-run, industrial production index, short-term interest rates, and unemployment rates have no significant causal link with returns on FTSE100. Similarly, industrial production index and exchange rates have no significant short-run causality with returns on S&P500. Unconventional monetary policies (Quantitative Easing or Large-Scale Assets Purchases) adopted by Federal Reserve have positive impact on the S&P500 stock market returns.

Keywords Vector Error Correction, Cointegration, FTSE100, S&P500, Long-run, Equilibrium, Quantitative Easing, Financial Crisis

1. Introduction

Financial market divided primarily into market for short-term funds (money market) and long-term financial assets (capital market) play an important role in the economy by linking individuals and firms, serving as a mechanism for mobilization and allocation of savings into investments. The capital market can be subdivided into primary market where new financial securities are issued and secondary market (otherwise referred to as stock market) for trading existing negotiable financial securities (stocks). Thus, the existence of a stock market makes trading of securities possible thereby making funds available for investment purposes in an economy. Macroeconomic variables such as money supply, interest rates (long-term and short-term), inflation rates, level of output (industrial production, employment level), exchange rates, alongside external forces, government structure and firms' profitability through demand and supply determine the price at which stocks are bought or sold on the stock exchange. Consequently, establishing the nature of the relationship between macroeconomic variables and stock market returns is imperative to investors and understanding the stock market dynamics in any country. These relationships have been extensively studied in both emerging and the developed stock markets.

Monetary policy interacts with the economy via transmission channel through the purchase and sale of bonds only. It can also influence the economy through the purchase of goods and services as well as financial assets such as treasury bills and common shares. Monetary policy is used by monetary authorities particularly the central banks to

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majorly achieve potential production through full employment, eliminate budget deficit (balance of payment deficit), realize economic growth and reduce the rate of inflation. According to the quantity theory of money, it is widely accepted that the money supply affects only the level of prices in an economy. However, its failure during the period of the great depression in the 1930s led to its abandonment. An alternative school of thought, Keynesian theory, proposed that the stock of money could be controlled by central banks such as the Bank of England and Federal Reserve. This theory also proposed that the demand for money is determined by gross national income and the rate of interest. And that the restoration of equilibrium between the demand for and supply of money is achieved through the financial assets markets. Contrary to quantity theory, Keynesian theory hypothesizes that change in the money supply cause changes in the rate of interest and not the inflation rate. Consequently, Milton Friedman in the 1950s introduced monetarism by modifying the quantity theory of money stating that economic systems have the inclination of moving towards full employment equilibrium. He claimed that in the long-run, the supply of money will have an effect on the inflation. Monetarism asserts that financial assets bear yield or return inform of interest payment (Hanson, 1983). This theory considers money as having a limited effect on demand for financial assets including bonds and stocks. According to Global Financial Stability Report (2012), "monetary policies play an important role in smoothing economic activity and influence the functioning of financial intermediation and financial structure". Under normal situation, expansionary policy (contractionary policy) leads to increase (decrease) in production and inflation rates resulting in higher (lower) interest rates. Higher (lower) interest rates leads to reduction (increase) in current consumption and investment. However, nominal interest rate may get close to zero during period of recession which results in the transmission channel becoming inexistent and making production shock greater due to continuous attempts by the central banks to further bring down nominal interest rate (Auerbach, 2012). Therefore, excess liquidity as a consequence of unconventional monetary policy such as quantitative easing (QE)[1] or Large-Scale Assets Purchase (LSAPs) by central banks result in increase in asset prices and lower interest rates which in turn lead to higher rate of return. LSAPs involve purchase of treasury and government sponsored enterprises (GSEs) to stimulate the economy through lower long-term interest rates. Bridges and Thomas (2012), iterated given the store of value function of money, the demand for broad money hinges on the nominal expenditure on goods and services, the value of asset transactions, value of overall asset portfolios and the relative rate of return on money. Stocks (financial asset) are good substitutes for money (for a great number of investors) especially when the rate of return is high. Theoretically, the marginal rate of substitution between money now and other forms of security (stocks inclusive) now equals the current price of the security (Hicks, 1968). With a close dependence of the demand for money upon the rate of interest rate, increased money supply may lead to higher inflation and thereby increased nominal interest rate. Higher interest rates lead to higher required rate of return and lower stock prices. Rapach (2002) argued that increase in inflation does not necessarily result in persistent depreciation of real value of stock in the industrialized countries. Many literatures criticise the claim that the existence of a negative relationship between inflation and stock returns is as a result of increase in rate of inflation which is accompanied by both lower expected earnings growth and higher required real return.

According to Fama (1981), significant relationship exists between macroeconomic variables such as industrial production index, GNP, money supply, inflation, interest rates and stock prices. He found strong positive correlations between common stock returns and these macroeconomic variables. Subsequently, several empirical studies have explored this area to ascertain the fundamentals of these relations in one country or in a group of countries. For example Chen *et al.* (1986) studied how some macroeconomic variables explain the US stock market movement using the Arbitrage Pricing Theory. Other researchers such as Cheung and Ng (1998), Mukherzee and Naka (1998) employed cointegration analysis to examine the relationships between stock returns and macroeconomic variables in developed economies such as Australia, Japan, US and Germany.

The industrial production index is used as a measure of real economic activity in a country. Theoretically, the industrial production increases during expansionary business cycle and decreases during a contraction. Therefore, a change in industrial production would indicate a change in economy. During economic growth, the productive capacity of firms to generate future cash flows is greatly influenced, hence a positive relationship between real economy and stock prices exist. Fama (1981) showed that the growth rate of industrial production have a strong long-run relation with stock returns. Forecasts in Industrial production, a major determinant of firms' cash flow account for significant parts of annual stock return changes (Fama, 1990). Whilst stock market prices can be used for forecast of economic growth, the reverse is not true (Foresti, 2006). Unlike stock market return, which is considered a leading economic indicator, unemployment rate is generally believed to be a lagging countercyclical economic indicator[2]. The unemployment rate is the percentage of country's labour force that is out of work. A low unemployment rate usually fuel inflation in addition to growing economy. When there is a possibility of inflation, the central banks through monetary policy will

[1] QE also called large-scale assets purchases (LSAPS) are effective alternative to conventional monetary policy when interest rates are close to zero

[2] Countercyclical economic indicators have an inverse movement with the economy i.e unemployment rates tends to get larger as the economy changes from expansion to recessionary business cycle.

raise short-term interest rates to discourage spending and increase savings. Normally, when the unemployment rate rises above the internationally accepted limit of 7 per cent, there will be concern and governments will try to stimulate the economy (through fiscal and monetary policies) to reduce the unemployment rate.

The relationship between stock return and exchange rates is still highly debated in literature. A school of thought postulated that the exchange rate is determined largely by a country's trade balance performance by developing a model of exchange rate determination that integrates the roles of relative prices, expectations and assets market and emphasized the relationship between the behaviour of exchange rate and the current account (Dornbusch and Fisher, 1980). Real economic variables such as real income and output are influenced by international competitiveness and trade balance, which is in turn function of changes in exchange, rates. Hence changes in exchange rates influence the competitiveness of a firm, which also influences the firm's earnings, or cost of funds (credit rating) and hence the stock returns.

Aims of study

By employing vector error correction and cointegration with restrictive dynamic techniques to justify the presence of contemporaneous relationships, this paper intend to contribute to existing literatures on the relationships between the aforementioned macroeconomic variables and the stock market returns of FTSE100 and S&P500 stock markets in the United Kingdom and United States respectively. Unlike most studies mentioned above, this current research introduces unemployment rates, broad money supply M3 (as an exogenous variable) and also establishes a dummy variable to capture the structural breaks caused by global financial crisis currently witnessed across the globe. The justification for the inclusion of unemployment rate is that governments become concern when unemployment rate rises above certain level and try to stimulate the economy through various fiscal and monetary policies, which have transmission effects on the stock market activities.

The data employed are monthly observations of industrial production index (IPI), consumer price index (CPI), short-term interest rates (INR), exchange rates (EXR), and stock market returns (S&P500, FTSE100) for United States and United Kingdom. The stock market returns are represented as SMI_US and SMI_UK respectively. The source of all macroeconomic data is the Organization for Economic Cooperation and Development (OECD). Data on stock market returns was collected from *Yahoo! Finance Database*. Monthly data of the two stock market returns from 2002 to 2012 to build two models, one for each market were used. All data were transformed to log so that they have same magnitude and to improve the quality of data analysis.

2. Data Analysis and Results

The variables included in the analysis are short-term interest rates (INR), exchange rates (EXR), unemployment rates (UE), money supply M3, industrial production index (IPI) and consumer price index (CPI), the returns of FTSE100 (SMI_UK) and S&P500 (SMI_US). Money supply M3 served as exogenous variable in all the models to ascertain the effect of changes in government monetary policies. Also financial crisis was introduced as a dummy variable to capture structural breaks in the models especially due to the current global recession. All macroeconomic and stock returns variables were converted to log. Stock market returns were computed using the formula; y_t= Log (y_t/y_{t-1}). Based on the time plots (appendix I and II), one can assume random walks for all endogenous and exogenous variables except the stock market returns, which seem to be stationary. The most frequently asked question in economic time series analysis is whether macroeconomic time series return to some long-run trend following a shock or whether they follow random walks. For example, if FTSE100 follows a random walk, the effects of a temporary shock such as increase in interest rates or drop in consumer price index will not dissolve after several months but instead will be permanent. If these variables do follow random walks, a regression of one against another can lead to spurious (non-sense) results because a random walk does not have a finite variance. Therefore Ordinary Least Squares (OLS) will not yield a consistent parameter estimator.

Unit root tests – Augmented Dickey-Fuller (ADF) and Phillips Perron (PP) Tests

To check the stationarity of these series, this study carried out Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests (Table 1.0) on the macroeconomic variables and the stock market returns. Dickey and Fuller (1979) postulated a test popularly referred to as the Dickey-Fuller test which uses a t-ratio test statistic. In summary, the test statistic is based on the least square (LS) estimate of the parameter $ø_1$ in the simple models:

$$y_t = ø_1 y_{t-1} + e_t \quad (1.1)$$

$$y_t = ø_0 + ø_1 y_{t-1} + e_t \quad (1.2)$$

Where the LS estimates of mean and variance of $ø_1$ under equation (1.1) are given as

$$\hat{ø}_1 = (\sum^T_{t=1} y_{t-1} y_t) / (\sum^T_{t=1} y^2_{t-1}) \quad (1.3)$$

$$\hat{\sigma}_e = \surd(\sum^T_{t=1} y_t - \hat{ø}_1 \; y_{t-1})/T-1 \quad (1.4)$$

where $y_0 = 0$ and T is the sample size. The t-ratio statistics is

$$DF_t \equiv (\hat{ø}_1 - 1)/ \; \hat{\sigma}_{(ø1)}$$

$$= (\sum^T_{t=1} y_{t-1} e_t)/ \; \hat{\sigma}_e \surd(\sum^T_{t=1} y^2_{t-1}) \quad (1.5)$$

If e_t has a finite mean and variance (white noise) with finite moments of order slightly greater than 2, then DF statistic in equation (1.5) converges to a function of Weiner process (Ruey, 2005).

Table 1. Unit root tests - ADF and PP tests

UNIT ROOT TEST RESULTS				
	Level		First Difference	
	No trend	Trend	No trend	Trend
UNITED STATES				
LSMI_US	*-5.10	*-4.78	*-10.85	*-10.81
LIPI_US	-1.06	-2.14	(*-12.12)	(*-12.28)
LINR_US	-0.87	-1.68	*-6.62	*-6.61
LEXR_US	-2.3	-2.63	*-5.33	*-7.84
LCPI_US	-0.75	-2.67	*-7.02	*-7.00
LUE_US	-1.42	-2.38	*-9.85	*-9.86
UNITED KINGDOM				
LSMI_UK	*-4.27	*-4.25	*-12.71	*-12.76
LIPI_UK	-0.48	-2.01	(*-13.40)	(*-13.41)
LINR_UK	-0.77	-6.12	*-6.73	*-6.76
LEXR_UK	-2.28	-2.53	*-7.70	*-7.85
LCPI_UK	1.49	-1.19	(*-12.29)	(*-13.93)
LUE_UK	-0.51	-2.63	**-3.4	**-3.49

Test significant at * 1 per cent, ** 5 per cent, *** 10 per cent, values in () are from PP tests
Source: Personal Computation using data from OECD and Yahoo! Finance Databases

However, if $\hat{\varnothing}_0 = 0$ under equation (1.2), the DF for the test above follows a nonstandard asymptotic distribution which invalidates the critical values of the test statistics other than derived through simulation (Fuller, 1976). Said and Dickey (1984) augmented the DF test to accommodate ARMA (p, q) models with unknown orders. To ascertain the presence of unit roots, the following test of hypothesis was performed.

$$H_0: \varnothing_1 = 1$$
$$H_1: \varnothing_1 < 1$$

That is y_t is I(1) against the alternate hypothesis y_t is I(0) using the regression

$$y_t = \theta_t + \Phi y_{t-1} + \sum_{j=1}^{p} \Psi_j \Delta y_{t-j} + e_t \qquad (1.6)$$

θ_t is a deterministic function of the time index t and $\Delta y_j = y_j - y_{j-1}$ is the differenced series of y_t. It can assume zero, a constant or $\omega_0 + \omega_1 t$ in practice. Then the t-ratio of $\hat{\theta} - 1$,

$$ADF = (\hat{\theta} - 1)/S.E(\hat{\theta}) \qquad (1.7)$$

Where $\hat{\theta}$ is the LS estimates of θ (generally referred to as the Augmented Dickey-Fuller unit root test). Sometimes the result of a regular ADF test may indicate that a series is of higher order i.e. I(2) when infact it is I(1). An alternative unit root test developed by Phillips and Perron (1988) is flexible in dealing with serial correlation and heteroskedasticity in the error terms by ignoring any serial correlation that may be existent in the test regression. The test regression is

$$y_t = \theta t + \rho y_{t-1} + u_t \qquad (1.8)$$

This approach requires no assumption that the error term u_t is stationary or uncorrelated and that the initial LS fit is nonparametric (Leybourne *et al*, 1999). Phillips and Perron demonstrated that the test statistics in (1.9) and (2.0) below have similar asymptotic null distribution as (1.7)

$$PP = T(\hat{\rho} - 1) - 1/2T^2(\hat{\lambda}^2 - \hat{v}_0)/\{\textstyle\sum_{t=2}^{T}(y_{t-1} - \bar{y}_{-1})^2\} \qquad (1.9)$$

And

$$PP_t = (\hat{v}_0/\hat{\lambda}^2)^{1/2}\{(\hat{\rho} - 1)/\hat{\sigma}_\rho\}$$
$$- 1/2T\{(\hat{\lambda}^2 - \hat{v}_0)\hat{\lambda}\}/\{\textstyle\sum_{t=2}^{T}(y_{t-1} - \bar{y}_{-1})^2\} \qquad (2.0)$$

That is under the null hypothesis that ρ=0, the PP and PP_t statistics have the same asymptotic distributions as the ADF t-statistics and normalized bias statistic (see Leybourne *et al*, 1999 for the full methodology appropriation). One advantage of PP tests over the ADF test is that the PP tests are robust to general forms of heteroskedasticity in the error term u_t. Another advantage is that the user does not have to specify a lag length for the test regression.

After considering with and without trend, the unit root tests accepted the null hypothesis of unit autoregressive root for all macroeconomic variables but rejected the null hypothesis in the case of the stock market returns. Therefore, a further ADF and PP tests on the first differences concluded that all macroeconomic variables are integrated of order one i.e. I (1) while the stock market returns are of order zero I (0).

Accounting for the structural breaks in the series

An exogenous variable referred to as financial crisis was included in the analysis to capture the structural breaks observed in the series majorly due to the collapse of many financial institutions in 2008 (see appendix I & II). This is essential because when there are breaks in the data, the regular ADF test tends to discover unit roots (non-stationarity) that are inexistent (Aweda *et al*, 2014). Structural change may occur for many reasons ranging from market globalization to the outcome of financial instability when markets suffer from a high degree of inefficiencies (IMF World Economic outlook, 1998). These inefficiencies could be loss of confidence in banking system, sharp decline in assets and failure of financial institutions and financial corporations and so on (Aweda *et al*, 2014). Quandt -Andrews Breakpoint tests[3] (tables 1.1 and 1.2) were carried out on US and UK stock market return models to ascertain where impacts of the global financial crisis were initially felt. After which an appropriate dummy variable was set up in each model reflecting these dates.

Table 1.1. Quandt-Andrews unknown breakpoint test –**FTSE100**

H_o: No breakpoints within data

Statistic	Date	Value	*p-value*
LR *F-statistic*	Jun-08	1.31	1.00
Wald *F-statistic*	Jun-08	19.79	0.56

Source: Personal Computation using data from OECD and Yahoo! Finance Database

Table 1.2. Quandt-Andrews unknown breakpoint test- **S&P500**

H_o: No breakpoints within data

Statistic	Date	Value	*p-value*
LR *F-statistic*	Dec-12	1.23	1.00
Wald *F-statistic*	Dec-12	18.51	0.46

Source: Personal Computation using data from OECD and Yahoo! Finance Database

Relations between FTSE 100 Stock Market Return and other Macroeconomic variables

Vector error correction models (*VECM*) were developed for each of the two stock market returns using global financial crisis and log of M3 as exogenous variables. The results of cointegration rank tests are based on trace and maximum eigenvalue, which selected two cointegration equations for United Kingdom and one cointegrating equation for US.

Lag order Selection

Before estimation of VECM model and its cointegrating vector, optimal lag length of initial VAR was established. Different information criteria were calculated for various lag length. After calculations based on different criteria, two lags was selected by the Likelihood Ratio (LR), Final Prediction Error (FPE), Akaike Information Criterion (AIC) and Hannan-Quinn (HQ) methods (table 1.3).

Causality amongst Endogenous variables

Toda-Yamamoto (1995) procedure was carried out to ascertain the causal relationship amongst the endogenous variables. Engle (1984) showed that under null hypothesis, the use of popular Wald test statistic of linear restrictions on parameters of a VAR model where some of the series are non-stationary would not follow the usual asymptotic chi-square distribution due to the presence of "nuisance parameter[4]". This method involves testing for the absence of Granger causality by estimating the following VAR model:

$$Y_t = \omega_0 + \omega_1 Y_{t-1} +..+ \omega_p Y_{t-p} + \tau_1 X_{t-1} +...+ \tau_p X_{tp} + u_t \quad (2.1)$$

$$X_t = \lambda_0 + \lambda_1 X_{t-1} +..+ \lambda_p X_{t-p} + \theta_1 Y_{t-1} +...+ \theta_p Y_{t-p} + v_t \quad (2.2)$$

The test hypotheses are

$$H_0: \tau_1 = \tau_2 =..... = \tau_p = 0$$

$$H_1: \tau_1 \neq \tau_2 \neq..... \neq \tau_p \neq 0$$

This is a test that *X* does not Granger-cause *Y*.

Also, testing

$$H_0: \theta_1 = \theta_2 =..... = \theta_p = 0$$

$$H_1: \theta_1 \neq \theta_2 \neq..... \neq \theta_p \neq 0,$$

Is a test that *Y* does not Granger-cause *X*.

If H_0 is rejected in both cases, this implies that there exists Granger causality. Granger non-causality test results show that there exist unidirectional causality from LSMI_UK to LINR_UK, LEXR_UK, LCPI_UK, LUE_UK and not vice versa (appendix III).

Test of Cointegration on FTSE 100 and other Macroeconomic variables

An equilibrium relationship inform of a linear combination may exist between two or more non-stationary time series following the result of a Granger Causality test. Since the series are non-stationary, running a regression analysis using conventional tests will lead to nonsense results. Also, if the non-stationary series are cointegrated of the same order, regression with first difference will lose long-run information because the first difference regression outputs represent the short run dynamics. Therefore, a VECM is necessary. This research work was based on test of cointegration proposed by Johansen (1988), Johansen and Juselius (1990) even though there are mixture of I(0) and I(1) time series. Harris (1995) showed that in the presence of a mixture of I(0) and I(1) series, the two tests, LR trace and maximum eigenvalue tests which Johansen test of cointegration was based can produce a nonsense cointegration relations. Contrarily, Pesaran *et al* (2001) in their paper on autoregressive distributed lag (ARDL) bound testing approaches to the analysis of level relationships reiterated that the system approach proposed by Johansen can be applied to mixtures of I(0) and I(1) regressors. Here, we considered a vector autoregressive process with white

[3] Quandt-Andrews breakpoint test is a modified version of Chow Test that uses Likelihood Ratio Test. QA breakpoint test follows a non-standard distribution and it automatically computes the usual Chow F-test repeatedly with differing break dates. The Break date with the largest F-statistic is chosen.

[4] A parameter is nuisance parameter if its value influences the distribution of observations even though one is not interested in its values.

noise and deterministic term (which comprise a linear trend and a constant) as below:

$$\Delta y_t = \alpha\beta' y_{t-1} + \sum_{i=1}^{p-1} \Phi_i * \Delta y_{t-i} + D_t + \varepsilon_t. \quad (2.3)$$

where Δy_t and Δy_{t-1} represent the vectors of first difference of the endogenous variables at time index t and t-1 respectively. The parameters α represents the adjustment coefficient restoring the disequilibrium error $\beta' y_t - c$ assuming $\beta' y_t = c$ defines the underlying economic relations. Furthermore, β is the cointegrating vector of long-run parameters. The matrix αβ' is of full rank if r = k and all variables in the vector y_t are I(0). If r is less than k, there are k-r linear combinations that are random walk and r stationary cointegrating relations. Johansen (1988), Johansen and Juselius (1990) proposed the cointegration rank test based on the reduced rank regression (*see Johansen and Juselius* (*1990*) *for full literature on Johansen test of cointegration*). Summarily, two test statistics for testing the null hypothesis that there are at most r cointegrating vectors were discussed. One of them involves likelihood ratio trace test statistic:

$$\lambda_{trace} = -(T-p) \sum_{i=r+1}^{k} \ln(1-\lambda_i) \quad (2.4)$$

which tests the null hypothesis of at most r cointegration vector against the alternative hypothesis of full rank cointegration vector.

The second test is the maximum eigenvalue test given in equation (2.5) which tests the null hypothesis of r cointegrating vectors against the alternative hypothesis of at least 1 cointegrating vectors;

$$\lambda_{max} = -(T-p) \ln(1-\lambda_{r+1}) \quad (2.5)$$

n is the sample size, λ_i is the i^{th} largest canonical correlation between disturbances from the n-dimensional processes and disturbance from the n-dimensional differentiated processes. Studies such as Toda (1994) and Lutkepohl *et al* (2000) showed that the results of both tests are similar. However, differences exist under null hypothesis if r = 0 and the power of the test with small sample sizes. Furthermore, Wen (1995) showed that Johansen test of cointegration find cointegration more often in finite sample than in asymptotic distribution and it is highly sensitive to lag length misspecification than the non normality of errors.

After carrying out Johansen Test of cointegration on the six endogenous variables, two long-run relations were generated. The test of cointegration was done including an intercept and linear trend in the terms but no exogenous variables. The two error corrections terms (or long-run relations) were computed based on the maximum eigenvalue as depicted in the table 1.4. One could not reject the hypothesis that the rank (αβ') is at most two.

Table 1.3. VAR Lag Order Selection-FTSE 100 VECM

Lag	LogL	LR	FPE	AIC	SC	HQ
0	962.5675	NA	$2.40*10^{-15}$	-16.63596	-16.49274	-16.57783
1	1896.448	1754.071	$3.97*10^{-22}$	-32.25126	-31.24877*	-31.84435
2	**1953.907**	**101.9278***	**$2.75*10^{-22}$***	**-32.62447***	**-30.76269**	**-31.86878***
3	1975.519	36.08250	$3.57*10^{-22}$	-32.37424	-29.65318	-31.26977

Source: Personal computation using data from OECD and Yahoo! Finance Databases

Table 1.4. Cointegration Rank Test (Maximum Eigenvalue)-FTSE100 VECM

No. of C.R (r)	Eigenvalue	$\hat{\lambda}_{max}$	α = 1%	*p-value*
r = 0 *	0.435831	68.68827	45.86900	* 0.0000
r ≤ 1 *	0.318274	45.97534	39.37013	* 0.0012
r ≤ 2	**0.199300**	**26.67226**	**32.71527**	**0.06510**

Source: Personal Computation using data from OECD and Yahoo! Finance Database

Table 1.5. Restricted Normalized Cointegrating Equations-FTSE100 VECM

	LSMI_UK(-1)	LIPI_UK(-1)	LINR_UK(-1)	LEXR_UK(-1)	LCPI_UK(-1)	LUE_UK(-1)	@TREND(02M01)
CointEq1	1	-0.568009	0.037776	0	1.285922	0	-0.005306
SE		-0.30301	-0.01244		-0.37013		-0.00107
t-statistics		[-1.87453]	[3.03683]		[3.47424]		[-4.95462]
CointEq2	-0.267857	-1	0.031822	0.153593	-0.84925	-0.191935	0.001828
SE	-0.08316		-0.00647	-0.0416	-0.33634	-0.04765	-0.00097
t-statistics	[-3.22083]		[4.91992]	[3.69171]	[-2.52496]	[-4.02835]	[1.89254]

Source: Personal Computation using data from OECD and Yahoo! Finance Database

Table 1.6. Restricted Speed of Adjustments to Long-run Equilibrium-FTSE100 VECM

	Δ(LSMI_UK)	Δ(LIPI_UK)	Δ (LINR_UK)	Δ (LEXR_UK)	Δ(LCPI_UK)	Δ (LUE_UK)
CointEq1	-1.180837	0.092452	-0.674967	0	0	0
SE	(0.19138)	(0.04593)	(0.21964)	(0)	(0)	(0)
t-statistics	[-6.17012]	[2.01284]	[-3.07306]	-	-	-
CointEq2	0.798189	0	-1.383169	0	0	0.591790
SE	(0.34370)	(0)	(0.36501)	(0)	(0)	(0.11761)
t-statistics	[2.32231]	-	[-3.78945]	-	-	[5.03181]

Source: Personal Computation using data from OECD and Yahoo! Finance Database

The long-run analysis shows that the two error correction terms with coefficients or speed of adjustment to equilibrium represented by common factors $\hat{\alpha}_1$ = -1.18 and $\hat{\alpha}_2$ = 0.79 are significant at 1 per cent. This is an indication that one can expect the LSMI_UK to converge to its long-run equilibrium at a fairly fast rate so as to allow the short-run dynamics. Specifically the adjustment will take about two and half months. For the equilibrium to be stable, it is necessary that a slight movement away from equilibrium position should set up forces tending to restore the equilibrium. Consequently, to uniquely determine the two cointegrating vectors, exchange rates and unemployment rates were removed from the first vector and restricted industrial production index to -1(additive inverse velocity relation [5]) in the second cointegrating vector by imposing restrictions on long-run coefficients $\hat{\beta}_{(1,4)}=0$, $\hat{\beta}_{(1,6)}=0$, $\hat{\beta}_{(2,2)}=-1$. Furthermore, restrictions were placed on the speed of adjustments in the second, fourth, fifth and sixth error correction equations i.e $\hat{\alpha}_{(4,1)}=0$, $\hat{\alpha}_{(5,1)}=0$, $\hat{\alpha}_{(6,1)}=0$, $\hat{\alpha}_{(2,2)}=0$, $\hat{\alpha}_{(4,2)}=0$, $\hat{\alpha}_{(5,2)}=0$. The test of restrictions yielded a χ^2 (6) value of 5.82 with *p-value* = 0.4429. This implies that exchange rate and consumer price index are weakly exogenous variables[6]. The normalized cointegrating vectors are as shown in Table 1.5 and Table 1.6. The VECM allows for the findings that the other endogenous variables Granger-Causes LSMI_UK or vice-versa as long as the error correction terms are statistically significant irrespective of the joint significance of the estimated coefficients (Aweda *et al*, 2014). In order to evaluate the long-run relations, we normalized first cointegrating vector on LSMI_UK. Surprisingly negative and significant relationship exists between stock market return and industrial production index. We also normalized the second cointegrating vector on industrial production index LIPI_UK and found a significant negative relationship with unemployment rates LUE_UK. Also, stock market return has a negative and significant relationship with industrial production index. A reason could be that this variable might not be the best proxy for measuring the real economy probably due to increased dependency on services innovation (tertiarisation). However, Sezgin *et al.* (2008) using GDP as the proxy for real output found significant negative short-run relationship between stock return of Istanbul Stock Exchange Index (ISE) and Turkey GDP. The positive relationship between interest rates and stock market return is in line with Fama (1981) who found strong positive correlation between common stock and real economic variable such as interest rates.

A global test value of 9.54 is significant at 1 per cent, which is high and implies that all the endogenous variables are important in forecasting LSMI_UK when considered together. However, a partial test on individual endogenous variable reveals that LSMI_UK(-1), LEXR_UK(-2), LCPI_UK(-1) are the only significant variables in the short-run. Specifically, a unit increase in the lagged variable LSMI_UK (-1) resulted in 0.33 per cent increments in LSMI_UK. While LSMI_UK decreased by 0.36 per cent due to unit increase in LEXR_UK (-2). It decreased by 0.33 per cent in the case of the exogenous variable LM3_UK (table 1.7). Between 2009 and 2010, the BoE loosened monetary policy through large-scale purchase of assets (quantitative easing), which lead to increase in broad money by about 8 per cent (Bridges and Thomas, 2012). The direct implication (through transmission/multiplier effect) on the VECM dynamics is that it resulted in higher inflation rate by more than 0.02 per cent translating to higher expected rate of return and lower stock prices because supply outstripped demand of stocks. Simultaneously, this translated into 2.6 per cent and 1.68 per cent decrease in stock returns and short-term interest rates respectively. Furthermore, exchange rates was impacted negatively which dropped by 0.25 per cent while industrial production index rose marginally by 0.26 per cent during the same period. The effects of increase in money supply M3 was statistically insignificant on short-term interest rates, exchange rates, consumer price index and unemployment rate using all statistical criteria. Unemployment rate rose slightly and inflation rate remains above target of 2 per cent which suggested that the purpose of the original quantitative easing was not fully realised at the time. Bridges and Thomas (2012) showed that equity issuance (up by more than 139 per cent from £2.3 billion in

[5] AIVR is a negative relationship between industrial production index and stock market return on FTSE 100 resulting in the opposite directional speed adjustment to long-run equilibrium.

[6] The parameters of weakly exogenous variables have marginal density function bearing no relation to the parameters that determine the conditional density function of a dependent variable.

Q1 2010 to £5.5 billion in Q2 2010) and increased debt in the banking sector (£135 billion up by 70 per cent in Nov. 2010) among other factors offset the early shock of QE (£200 billion large-scale assets purchases) on broad money supply. Unsurprisingly, industrial production index, short-term interest rates, and unemployment rates do not have statistically significant short-run relationships with the returns on FTSE100.

The global financial crisis has an insignificant positive impact on the LSMI_UK. The positive coefficient is attributable to the use of zero bound and unconventional monetary policy in 2009 to tackle rising unemployment rate which provoked an inflationary economic situation in 2012 prompting the BoE to backtrack. This paper asserts that the discretionary use of monetary policy which was targeted at level of inflation was relaxed to prevent further escalation of inflation rate which by 2012 rose by more than 0.12 per cent. This is in line with the monetarist theory which suggested that monetary policy should be aimed at achieving long-term stable growth of money supply. Also, the above-target inflation rate (approximately 2.8 per cent) resulted in steady decline in the exchange rate of pounds sterling although statistically insignificant. But, if left unchecked may have undesirable effects on wages (wage freeze or slow growth of earnings) and prices of goods and services in the economy (devaluation). It may also indicate stability in fiscal policies targeted at reduction of government spending (which increases due to frozen conventional monetary policy responses during recession) and budget deficit. Other important concerns relating to housing policies, mortgage market and so on were efficiently addressed to prevent the UK economy from breakdown.

$$\Delta(\mathrm{LSMI\_UK}) = \begin{pmatrix} -1.18 \\ 0.79 \end{pmatrix} * \begin{pmatrix} 1 & -0.2678 \\ -0.5680 & -1 \\ 0.03777 & 0.03182 \\ 0 & 0.1536 \\ 1.2859 & -0.8493 \\ 0 & -0.1919 \\ -0.0053 & 0.00183 \\ -3.0991 & 8.800 \end{pmatrix}^{|} \begin{pmatrix} \mathrm{LSMI\_UK}(-1) \\ \mathrm{LIPI\_UK}(-1) \\ \mathrm{LINR\_UK}(-1) \\ \mathrm{LEXR\_UK}(-1) \\ \mathrm{LCPI\_UK}(-1) \\ \mathrm{LUE\_UK}(-1) \\ \mathrm{@TREND} \\ \mathrm{c} \end{pmatrix} + \begin{pmatrix} 0.3277 \\ 0.1274 \\ -0.1651 \\ 0.7485 \\ 0.0850 \\ -0.1056 \\ -0.1213 \\ -0.3541 \\ 2.0112 \\ -1.6649 \\ -0.0743 \\ 0.2663 \\ 1.5831 \\ -0.3310 \\ 0.0134 \end{pmatrix}^{|} * \begin{pmatrix} \Delta(\mathrm{L}(\mathrm{SMI\_UK}(-1))) \\ \Delta(\mathrm{L}(\mathrm{SMI\_UK}(-2))) \\ \Delta(\mathrm{L}(\mathrm{IPI\_UK}(-1))) \\ \Delta(\mathrm{L}(\mathrm{IPI\_UK}(-2))) \\ \Delta(\mathrm{L}(\mathrm{INR\_UK}(-1))) \\ \Delta(\mathrm{L}(\mathrm{INR\_UK}(-2))) \\ \Delta(\mathrm{L}(\mathrm{EXR\_UK}(-1))) \\ \Delta(\mathrm{L}(\mathrm{EXR\_UK}(-2))) \\ \Delta(\mathrm{L}(\mathrm{CPI\_UK}(-1))) \\ \Delta(\mathrm{L}(\mathrm{CPI\_UK}(-2))) \\ \Delta(\mathrm{L}(\mathrm{UE\_UK}(-1))) \\ \Delta(\mathrm{L}(\mathrm{UE\_UK}(-2))) \\ \mathrm{constant} \\ \mathrm{L}(\mathrm{M3\_UK}) \\ \mathrm{FINANCIALCRISIS} \end{pmatrix}$$

Table 1.7. ECM Coefficients for FTSE100 stock market returns ECM

	Coefficient	Std. Error	t-Statistic	*p-value*
α 1	-1.180837	0.191380	-6.17010	*0.0000
α 2	0.798189	0.343700	2.322300	**0.0136
$\Delta(L(SMI\_UK(-1)))$	0.327757	0.161318	2.031742	**0.0447
$\Delta(L(SMI\_UK(-2)))$	0.127495	0.110671	1.152015	0.2520
$\Delta(L(IPI\_UK(-1)))$	-0.165116	0.536587	-0.307715	0.7589
$\Delta(L(IPI\_UK(-2)))$	0.748563	0.474254	1.578402	0.1175
$\Delta(L(INR\_UK(-1)))$	0.085046	0.089972	0.945250	0.3467
$\Delta(L(INR\_UK(-2)))$	-0.105678	0.081207	-1.301335	0.1960
$\Delta(L(EXR\_UK(-1)))$	-0.121392	0.189838	-0.639447	0.5239
$\Delta(L(EXR\_UK(-2)))$	-0.354164	0.178807	-1.980703	***0.0503
$\Delta(L(CPI\_UK(-1)))$	2.011271	1.249075	1.610208	0.1104
$\Delta(L(CPI\_UK(-2)))$	-1.664922	1.249800	-1.332151	0.1857
$\Delta(L(UE\_UK(-1)))$	-0.074365	0.267852	-0.277635	0.7818
$\Delta(L(UE\_UKnm(-2)))$	0.266323	0.265239	1.004087	0.3177
constant	1.583152	0.338767	4.673280	*0.0000
$L(M3\_UK)$	-0.331078	0.071272	-4.645249	*0.0000
$FINANCIALCRISIS$	0.013432	0.015179	0.884935	0.3782
R-squared	0.5949			
Adjusted R-squared	0.5325			
F-statistic	9.54	Durbin-Watson stat		1.967250
Prob(F-statistic)	*0.000000	Risk		4.3%

Null hypothesis that estimated coefficient is equal to 0 can rejected at *1%, **5%, or ***10% level of significant
Source: Personal Computation using data from OECD and Yahoo! Finance Databases

Residual Diagnostic Tests on FTSE100 Error Correction Model

A Durbin-Watson value of 1.96 indicates no serial correction in the VECM system error term and confirms long-run relationships that exist between the endogenous variables. One of the major problems associated with the Johansen test of cointegration is the insensitivity to the non-normality of residuals/innovations (Aweda *et al*, 2014). Therefore in order to ensure the avoidance of over-acceptance of cointegration, residual diagnostics were conducted for serial correlations, normality, ARCH [7] (Autoregressive Conditional Heteroskedasticity) effect and Heteroskedasticity on the system equation $\Delta(LSMI\_UK)$. Jarcque-Berra value of 3.89 (p-value of 0.1429) indicates the residuals are multivariate normal N_p (0, ∑), ARCH effect ($n{*}R^2 = 2.58$, p-value = 0.2754) are insignificant at 10 per cent level. After conducting the Breusch-Godfrey Lagrange Multiplier test of serial correlation ($n{*}R^2 = 3.34$, p-value = 0.1879) on the residuals one could not reject the null hypothesis of no serial correlation. The evaluation of the historical simulations or *ex post* forecasts using Theil inequality coefficient produced a value of 0.5788.

Furthermore, covariance accounted for 72.47 per cent, variance 27.52 per cent while bias proportion is $5.6\text{x}10^{-5}$ per cent. Usually the best model has a Theil Inequality value close to zero and the covariance portion very high (> 60 per cent) indicating a strong correlation between the actual and forecasted values.

Forecast errors reflect external shocks on the VECM model. These errors are mostly episodic in nature such as highlighted below. Others are completely chance variations which are completely isolated. In the case of LSMI_UK, these shocks were observed in:

- August and September 2002 - speculation over the invasion of Iraq.
- December 2007 to November 2010 - tight market liquidity.
- August and September 2008 - global financial crisis, collapse of Lehmann Brothers, Bank of America agreed to purchase investment bank Merrill Lynch, and insurance giant AIG sought an abridged loan from Federal Reserve Bank of America and the biggest bank failure in history occurred when JP Morgan Chase agreed to purchase the banking assets of Washington Mutual. Northern rock was nationalised after unsuccessful take-over bids.
- December 2009 - increased activities in the properties sector; house prices rose by 2.9 per cent.
- July 2011 to April 2012 - persistent sovereign debt crisis in the euro zone.

[7] ARCH assumes that all pairwise autocorrelations are zero. In stock market returns large and small errors tends to occur in clusters hence according to Engle, the recent past gives information about the conditional disturbance variance σ^2_t.

Relations between S&P500 Stock Market Return and Macroeconomic Variables

Test of Granger non-causality among the variables indicate reasonable evidence of causal relationships amongst them (appendix IV). A unidirectional causal relationship exists from stock market return to exchange rates and not vice versa. Similarly, a unidirectional causal relationship exists between consumer price index and exchange rate to interest rates but not vice versa. In the case of the remaining endogenous variables the reason for some granger non-causality could be that the sample sizes are insufficient to satisfy the asymptotic conditions that the cointegration and causality tests rely on. These causal relationships indicate there could be long run relationships amongst the variables. Therefore, a further test of cointegration was carried out using two lags which was selected based on the results of lag order selection (see table 1.8).

Johansen test of cointegration carried out on the stock market returns, the other endogenous and exogenous variables produced one cointegrating vector (table 1.9) with $\alpha = -1.15$, the speed of adjustment to equilibrium. This is an indication that one can expect the VECM to converge to its long-run equilibrium in less than a month so as to allow the short-run underlying dynamics.

Initial cointegrating relations amongst the variables produced some insignificant long-run coefficient in the cointegrating vector and speed of adjustments therefore restrictions were placed on some of the coefficients of α in the overall Vector Error Correction Model (VECM). Specifically, $\hat{\beta}_{(1,1)}=1$, $\hat{\beta}_{(1,2)}=0$, $\hat{\alpha}_{(2,1)}= \hat{\alpha}_{(3,1)}= \hat{\alpha}_{(5,1)}= \hat{\alpha}_{(6,1)}=0$. The restriction test yielded a χ^2 (5) value of 6.34 (*p-value* = 0.2745). Hence, industrial production index, short-term interest rate, consumer price index and unemployment rate were reconsidered to be weakly exogenous in this model. The cointegrating vectors are as shown in table 2.0 and Table 2.1 below.

One normalized the cointegrating vector to observe the long-run dynamics of this vector autoregressive model. After normalizing on stock market return (LSMI_US), consumer price index LCPI_US have positive and significant relationship with the stock market returns. Interest rate LINR_US, exchange rates LEXR_US and unemployment rates LUE_US are all negative and statistically significant. Theoretically, a rise in interest rates tends to diminish the demand for stocks. The positive relationship between consumer price index and stock market return was rather surprising. Rapach (2002) argued that the increase in inflation does not necessarily lead to persistent decline in real stock value in highly industrialized countries like United States. He concluded that there was little reasonable evidence of a negative long-run real stock price response to a permanent shock in inflation for 16 industrialized countries. Hence, all the long-run results are in support of existing macroeconomic theory and evidences.

Table 1.8. VAR Lag Order Selection- S&P500 VECM

Lag	LogL	LR	FPE	AIC	SC	HQ
0	573.2786	NA	$2.48*10^{-12}$	-9.697071	-9.555421	-9.639563
1	1578.643	1890.428	$1.58*10^{-19}$	-26.2674	-25.27585*	-25.86484
2	**1636.180**	**102.2892**	**$1.10*10^{-19}$***	**-26.63556***	**-24.79411**	**-25.88796***

Source: Excerpt from table from Appendix V

Table 1.9. Cointegration Rank Test (Maximum Eigenvalue) - S&P500 VECM

No. of C.R (r)	Eigenvalue	$\hat{\lambda}_{max}$	α = 1 %	*p-value*
r = 0 *	0.378720	58.06868	45.86900	0.0002
r ≤ 1	**0.264530**	**37.48396**	**39.37013**	**0.0177**
r ≤ 2	0.221392	30.53022	32.71527	0.0203

Source: Personal Computation using data from OECD and Yahoo! Finance Database

Table 2. Restricted Normalized Cointegrating Equation-S&P500 VECM

Cointegration Eq:	LSMI_US(-1)	LSPI_US(-1)	LSNR_US(-1)	LEXR_US(-1)	LCPI_US(-1)	LUE_US(-1)	@TREND(02M01)
CointEq1	1	0	-0.041467	-0.174603	1.41188	-0.190437	0.000308
SE			-0.01399	-0.05141	-0.53296	-0.06446	-0.00178
t-statistics			[-2.96470]	[-3.39636]	[2.64915]	[-2.95439]	[0.17319]

Source: Personal Computation using data from OECD and Yahoo! Finance Database

Table 2.1. Restricted Speed of Adjustment to Long-run Equilibrium-S&P500 VECM

	Δ(LSMI_US)	Δ(LIPI_US)	Δ(LINR_US)	Δ(LEXR_US)	Δ(LCPI_US)	Δ(LUE_US)
CointEq1	-1.1515	0	0	0.205627	0	0
SE	(0.16146)	(0)	(0)	(0.08149)	(0)	(0)
t-statistics	[-7.13174]	-	-	[2.52337]	-	-

Source: Personal Computation using data from OECD and Yahoo! Finance Database

The VECM System equation on $\Delta(L(SMI\_US))$ indicates that though the model is highly significant at 1 per cent level with *F-value* = 8.63 and *p*-value = 0, the endogenous variables accounted for more than 54 per cent of the total variation in LSMI_US. The Durbin-Watson value of 1.97 lies within the interval 2 < DW< 4-d_u, where d_u = 1.65 is the upper limit of the Durbin Watson table of critical values at 1 per cent level of significance. This signifies the co-movement of the endogenous variables in the long-run. The Vector Error Correction Model system equation is as shown in the equation below:

$$\Delta(\text{LSMI\_US}) = (-1.16) * \begin{pmatrix} 1 \\ 0 \\ -0.0415 \\ -0.1746 \\ 1.4119 \\ -0.1904 \\ 0.0003 \\ -6.1754 \end{pmatrix}^{|} * \begin{pmatrix} \text{LSMI\_US}(-1) \\ \text{LIPI\_US}(-1) \\ \text{LINR\_US}(-1) \\ \text{LEXR\_US}(-1) \\ \text{LCPI\_US}(-1) \\ \text{LUE\_US}(-1) \\ \text{@TREND} \\ \text{c} \end{pmatrix} + \begin{pmatrix} 0.1527 \\ -0.0676 \\ -0.1056 \\ -0.1227 \\ -0.0619 \\ -0.0128 \\ -0.1164 \\ -0.0394 \\ 2.07618 \\ 2.3690 \\ -0.3768 \\ -0.4566 \\ -3.6053 \\ 0.7679 \\ -0.5600 \end{pmatrix}^{|} * \begin{pmatrix} \Delta(\text{L}(\text{SMI\_US}(-1))) \\ \Delta(\text{L}(\text{SMI\_US}(-2))) \\ \Delta(\text{L}(\text{IPI\_US}(-1))) \\ \Delta(\text{L}(\text{IPI\_US}(-2))) \\ \Delta(\text{L}(\text{INR\_US}(-1))) \\ \Delta(\text{L}(\text{INR\_US}(-2))) \\ \Delta(\text{L}(\text{EXR\_US}(-1))) \\ \Delta(\text{L}(\text{EXR\_US}(-2))) \\ \Delta(\text{L}(\text{CPI\_US}(-1))) \\ \Delta(\text{L}(\text{CPI\_US}(-2))) \\ \Delta(\text{L}(\text{UE\_US}(-1))) \\ \Delta(\text{L}(\text{UE\_US}(-2))) \\ \text{constant} \\ \text{L(M3 \_ US)} \\ \text{FINANCIALCRISIS} \end{pmatrix}$$

Table 2.2. ECM Coefficient for S&P500 stock market returns ECM

	Coefficient	Std. Error	t-Statistic	*p-value*
α	-1.158459	0.164260	-7.052610	*0.0000
$\Delta(LOG(SMI\_US(-1)))$	0.152687	0.127687	1.195791	0.2344
$\Delta(LOG(SMI\_US(-2)))$	-0.067572	0.093308	-0.724183	0.4705
$\Delta(LOG(IPI\_US(-1)))$	-0.105565	0.120448	-0.876433	0.3828
$\Delta(LOG(IPI\_US(-2)))$	-0.122709	0.117045	-1.048398	0.2968
$\Delta(LOG(INR\_US(-1)))$	-0.061892	0.036256	-1.707102	***0.0907
$\Delta(LOG(INR\_US(-2)))$	-0.012832	0.035292	-0.363587	0.7169
$\Delta(LOG(EXR\_US(-1)))$	-0.116439	0.184281	-0.631859	0.5288
$\Delta(LOG(EXR\_US(-2)))$	-0.039372	0.182020	-0.216304	0.8292
$\Delta(LOG(CPI\_US(-1)))$	2.076179	1.131844	1.834334	***0.0694
$\Delta(LOG(CPI\_US(-2)))$	2.368991	1.235412	1.917572	***0.0579
$\Delta(LOG(UE\_US(-1)))$	-0.376751	0.181659	-2.073946	**0.0405
$\Delta(LOG(UE\_US(-2)))$	-0.456628	0.182586	-2.500888	**0.0139
constant	-3.605335	0.582813	-6.186093	*0.0000
$LOG(M3\_US)$	0.767848	0.124561	6.164409	*0.0000
$FINANCIALCRISIS$	-0.056017	0.019381	-2.890281	*0.0047
R-squared	0.549887			
Adjusted R-squared	0.486191			
F-statistic	8.633080	Durbin-Watson stat		1.969775
Prob(F-statistic)	*0.000000	Risk		4.5%

Null hypothesis that estimated coefficient is equal to 0 can rejected at *1%, **5%, or ***10% level of significant
Source: Personal Computation using data from OECD and Yahoo! Finance Databases

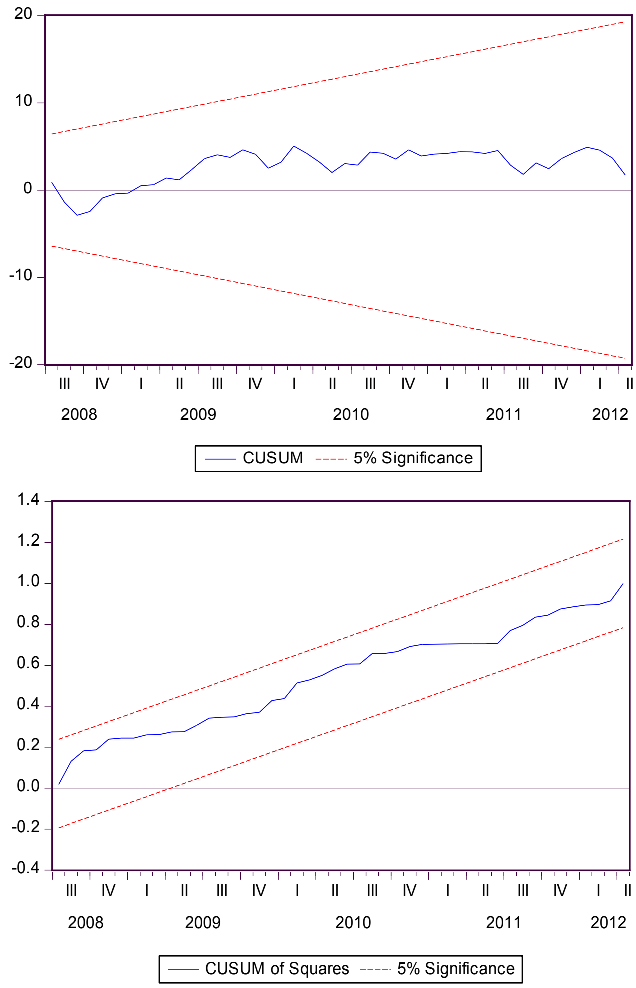
The short-run dynamics shows that lagged variables LINR_US(-1), LCPI_US(-1), LCPI_US(-2), LUE_US(-1), and LUE_US(-2) are statistically significant (table 2.1). For example, unit increases in the lagged variable LUE_US (-2) will result in a 0.4566 per cent decrease in the stock market return LSMI_US in the short-run. Exchange rates and industrial production index have no statistically significant short-run relationships with the returns on S&P500. Also, the exogenous variable LM3_US statistically significantly causes a 0.7678 per cent increase in LSMI_US for every unit increase. These had effect on VECM dynamics by transmission effect; unemployment rate dropped from 10 per cent in 2009 to 8.3 per cent in July 2012. This drop accounted for about 0.7 per cent increase in stock market return. At the same time broad money supply M3 was up by more than 7 per cent, but short-term interest rate was below 1 per cent. It should be noted that rise in money supply M3 is only statistically significant on exchange rates, industrial production index and stock market return. According to Keynesian theory, increase in money supply will first be felt in short-term asset markets, which will result in the fall of short-term interest rates. Whilst the rise in broad money supply induced by LSAPS or QE resulted in more than 5 per cent increase in S&P500 index stock return, it had a negative impact on interest rates in the long-run by lowering government bond yields as well as government sponsored enterprises (GSE) securities interest rates (Federal Reserve & Global Financial Stability Report, 2012) which in turn lead to increased demand in the stock markets. Under normal situation, expansionary policy leads to increase in production and inflation rates resulting in higher interest rates. Higher interest rates lead to reduction in current consumption and investment. However, towards the dawn of 2008 financial crisis, nominal interest rate got close to zero, hence the transmission channel became inexistent making the production shock greater due to continuous attempts by the Federal Reserve to further bring down nominal interest rate. Furthermore, price stability through low inflation was achieved with particular avoidance of deflation especially during QE2 implementation. Also, US tend to benefit from huge capital flights (so-called safe-haven) from the euro area, which resulted in reduced government interest payments (down by 20.82 per cent in 2012, www.treasurydirect.gov). Although excess liquidity caused by implementation of various large-scale assets purchases programmes between 2009 and 2010 resulted in higher rate of return, unemployment rate figure (8.3 per cent in July 2012) was above the internationally accepted level of 7 per cent. Therefore, the primary aim of the QE1 and QE2 to bring the economy to full employment was not fulfilled. Nevertheless, inflation rate which has been above-target level has steadily declined since the beginning of 2012 partly due to introduction of QE2. These are indications that the economy move towards slow recovery. In September 2012, the Federal Reserve announced new round of large-scale assets purchases to further bring down unemployment rate from 8.3 per cent which resulted in 0.4 per cent decline in January 2013 and to keep inflation rate below the target level of 2 per cent. The exogenous variable, 'financial crisis' was negative and statistically significant using 5 per cent statistical criterion despite the positive impact of QE2 on unemployment rates and inflation rates. This is an indication of volatile financial system particularly with the Federal Reserve focusing on extensive lower interest rates (in a bid to stimulate demand, make credit more readily available and keep unemployment rate as low as possible), which have a drawback of encouraging excessive risk taking by financial institutions. Furthermore, it suggests that there are inherent structural problems in the housing market, mortgage market, large budget deficit (debt ceiling issue), government bond bubbles, rising government spending and the persistent sovereign debt crisis in most European countries.

Residual Diagnostic Tests on S&P500 Error Correction Model

The model was carefully examined to check for possible inadequacies. If the specified VECM system equation $\Delta LSMI\_US$ is adequate, the residuals should behave as a white noise or simply stationary. Firstly, the Breusch-Godfrey Lagrange Multiplier (LM) test of serial correlation with $n*R^2 = 0.2174$, p-value = 0.8970 could not reject the null hypothesis of no serial correlation. Secondly, the Jarcque-Berra test of Normality with value 1.3671 is insignificant at 10 per cent signifying that the residuals are multivariate normally distributed. Finally, there are no traces of ARCH effect in the system equation since $n*R^2$ value of 6.45 is significant with a p-value of 0.0397 at 5 per cent level. The forecast errors were also checked for model misspecifications. Theil Inequality coefficient with a value of 0.5827 is reasonable. Out of which covariance accounted for more than 66 per cent, bias 0.0 per cent and variance more than 33.1 per cent. Forecast error also indicates that external shocks were observed in

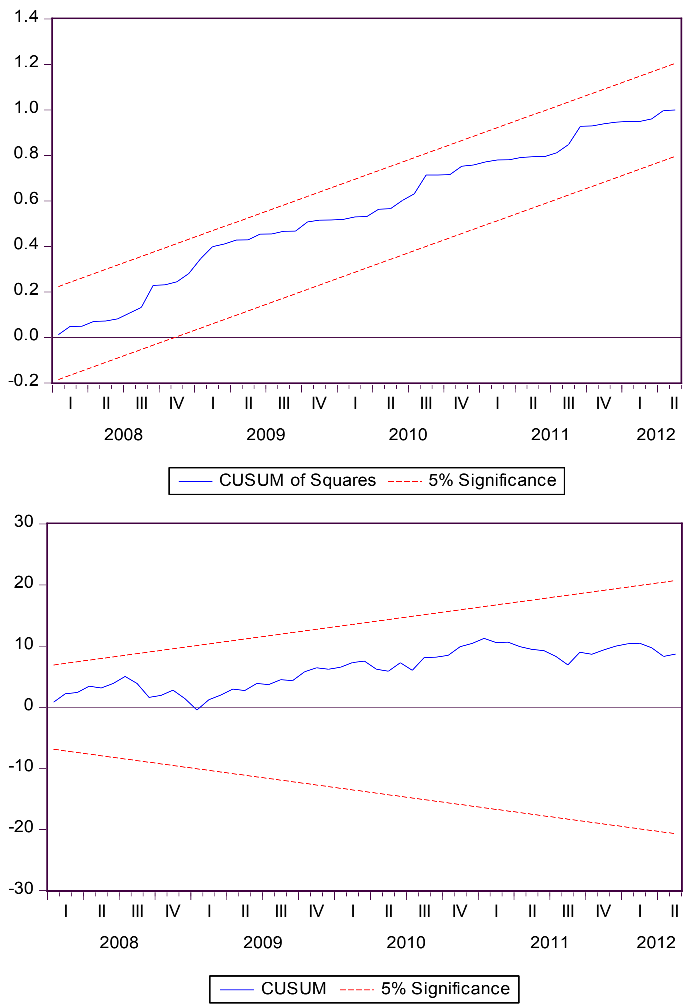
- May, August and September 2002 - speculations over invasion of Iraq.
- February to April 2005 - market volatility in the Euro zone.
- October and December 2007 - US growing debt and housing bubble, rising foreclosures. Car sales were down by 2.4 per cent which was a strong indication of looming recession.
- May 2008- there was strong liquidity crisis as a result of anticipation of recession in addition to high energy prices.
- September 2008 - Lehmann Brothers declared bankruptcy.
- January 2009 - rising unemployment rates.
- August 2011 - US lost its coveted AAA credit rating by Standard & Poor, European debt crisis continue to persist. There was also rising fear of a new US recession (GDP dropped to 1.3 per cent in Q1 2011 from 2.5 per cent in 2010 second time in a row).
- April 2012 - Sovereign debt crisis in the euro zone persists.

Models Stability Diagnostics



Source: Personal Computation using data from OECD and Yahoo! Databases

Figure 3. CUSUM and CUSUM Square Plots for returns on FTSE100



Source: Personal Computation using data from OECD and Yahoo! Databases

Figure 4. CUSUM and CUSUM Square Plots for returns on S&P500

The CUSUM and CUSUM of square tests as suggested by Brown *et al.* (1975) were employed to evaluate the cumulative sum of recursive residuals. The formal employs the test statistic $V_t = \sum^{t}_{p=k+1} v_p/\sigma_v$ to ascertain parameter instability arising from cumulative sum falling outside areas between [k, ± -0.948(T-k)$^{1/2}$] and [T, ± 3*0.948(T-k)$^{1/2}$] of 5 per cent critical areas. The range is dependent on time t. The $E(V_t) = 0$ if the vector of parameters β remains regular. The CUSUM square test on the other hand is based on calculating the test statistics $S_p = (\sum^{t}_{p=k+1} v^2_p)/ (\sum^{T}_{p=k+1} v^2_p)$ with an expected value $E(S_p) = (t\text{-}k)/ (T\text{-}k)$ which takes value zero if $t = k$ and 1 if $t = T$ under parameter constancy. Refer to Brown *et al* (1975) for details of table of significance lines for CUSUM of squares test. The necessary condition for recursive tests is that the disturbances or residuals must be multivariate normally distributed (Brown *et al.*, 1975).

The stability check carried out on the two models using graphical examination of recursive tests are displayed in Figure 3 and 4. It can be seen that there is little evidence of structural instability in the estimated model. Likewise, the cumulative sum of forecast errors does not cross the 5% critical lines in the recursive tests and, consequently, the null hypothesis of model stability cannot be rejected.

3. Conclusions and Economic Implications of Results

Sequel to the dynamic rate of stock market returns common to the two markets analysed in this research work, one can conclude that the efficient market hypothesis is essentially valid in the sense that the monthly rate of returns are stationary over pre- and post-financial crisis periods. Although the average rate of return in S&P500 is marginally higher than the FTSE100, the relative risk of return of 4.5 per cent in US is higher than UK (4.3 per cent). For the entire period, the global test of the combined effects of all the endogenous and exogenous variables in each market turned out to be significant in forecasting the respective stock market returns. More than 50 per cent of the total variation in stock market returns was accounted for by all the endogenous and exogenous variables in each market.

Long-run co-movement amongst the endogenous variables was established in each of the market though with varying speed of adjustment from disequilibrium caused by shocks on the stock market returns. The adjustment to equilibrium in the long-run is expected to take about one month in the United States and 2.5 months in the United Kingdom so as to allow short-run dynamics. The slower speed of adjustment to equilibrium in the United Kingdom was attributable to the additive inverse velocity relationship between industrial production and the return on FTSE100. In the FTSE100 model, the stock market return depended in the long-run on industrial production index, interest rates and consumer price index while relationship existed between stock market return, exchange rates and unemployment rates only through industrial production index. On the other hand, return on S&P500 was influenced in the long-run by interest rates, exchange rates, unemployment rates and consumer price index (CPI). However, increase in industrial production index resulted in a rather surprising decline in stock market return in UK in the long-run. The industrial production lags general economic activity. As a result of this negative relationship, industrial production index was considered inappropriate proxy for measuring real economic activities in the UK, which may be linked to the fast service innovations or tertiarisation of the economy.

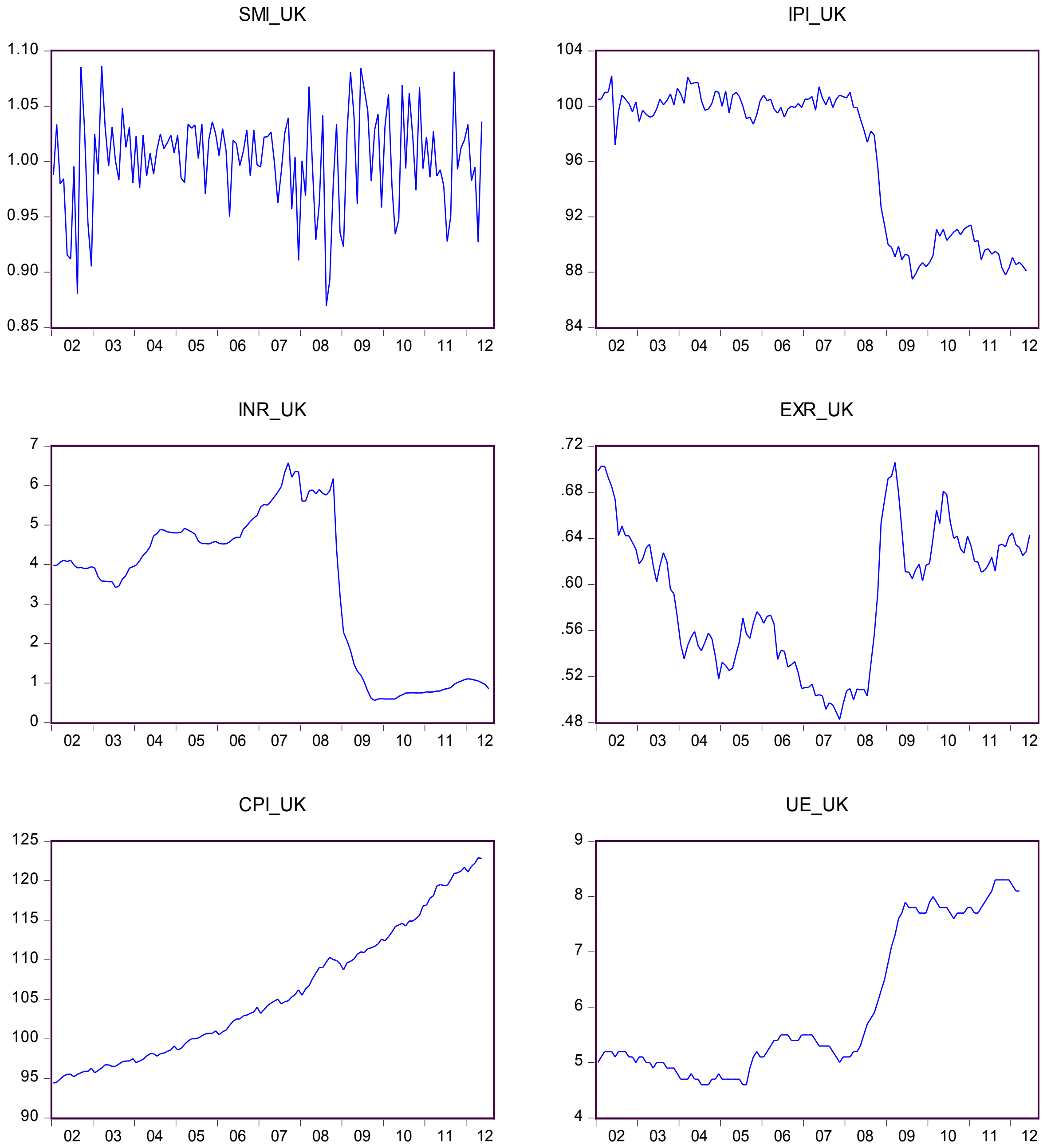
The short-run dynamics reveal exchange rates, consumer price index are significant in United Kingdom. However, industrial production index, interest rates and unemployment rates have no significant short-run relationships with return on FTSE100. Similarly, industrial production index in addition to exchange rates have no significant short-run causality with S&P500, which is rather surprising. In both markets the economic theory plays a much stronger role in determining the models' long-run properties than the short-run dynamics, which is largely data-determined.

Whilst increase in BoE monetary policy measured by broad money supply M3 lead to a significant decline in the stock market return on FTSE100, the return on S&P500 increased significantly due to the intervention of Federal Reserve. This was largely due to increased inflation in the short-run in United Kingdom and excess liquidity in the United States which is a direct impact of series of quantitative easing QE programmes especially QE2 in 2010 by the Federal Reserve. QE2 had a significant positive impact on industrial production or output through lower interest rates, which translated into higher stock prices in the long-run. Other factor associated with this was the fact that United States profits from the capital flights from European countries as a result of the persistent sovereign debt crisis. The impact of the 2007 – 2012 global financial crises was evaluated in each of the market. Although the effect of this dummy variable was negative and significant in the US signalling potentially insecure financial system, the crisis was positive but statistically insignificant in United Kingdom probably due to stable fiscal policy and other structural issues such as spending cuts, budget deficit reduction and housing policies adopted by the government. This further explains the higher risk of investing in the United States. This exogenous variable was introduced to evaluate the effect of inherent structural breaks in the markets.

Analysis of forecast error signified the impact of important shocks from external forces on stock market returns. The speculation about Iraq war of 2002 was observed in the two models, which lead to significant drop in returns at start of the war but stabilized during the war. Also the global financial crisis, which began in November of 2007, was revealed in the forecast errors of the models. Similarly, current financial crisis in the Euro zone was also accounted for in the forecast errors. However, each market has peculiar shocks from external forces distorting the forecast errors at various points. These include but not limited to tight market liquidity caused by the collapse of many banks resulting in significant outflows of cross-border interbank deposits, increased activities in the property sector in the United Kingdom, US losing its AAA credit rating by Standard & Poor and lingering sovereign debt crisis in the euro zone. There was also rising fear of a new US recession after the GDP dropped two quarters in a row between 2010 and 2011. Stock market return on S&P500 reacts quicker to shocks on macroeconomic variables, which were also reflected in the speed of adjustment to equilibrium in the long run. While the effect of unemployment rates will be negative on FTSE100, it is expected to have rather surprising positive effects on the S&P500 stock market index. The steady drop in unemployment rate since 2012, largely attributable to QE3 introduced by the Federal Reserve in September 2012 in continuation of its unconventional monetary policy was expected to have positive impact on overall output and keep inflation rate below 2 per cent target. This in turn is good news for stock prices and returns. Conversely, the rising inflation rate is an indication of imminent economic instability particularly in the United Kingdom. Above-target inflation rates will continue to have negative effects on the exchange rates, which in turn may result in fall in output in the short- to medium-term in United Kingdom. Therefore, interest rates may have to be increased in the future to check the growth of inflation rate which can have positive effects on aggregate output.

In conclusion, this research work has shown that stock market returns are important leading economic indicators for predicting the direction of economic activities in both United Kingdom and United States. Hence, the presence of a well-specified and stable relationship between stock market returns and macroeconomic variables can be seen as imperative for investors' confidence and sustainable long-term economic growth. Stability can be achieved by efficiently controlling changes in these macroeconomic fundamentals, which limit the variations of the economy without preventing it from fluctuating in general. Also, a stable monetary policy (either conventional or unconventional) is not enough. It can be complemented by a secure fiscal policy through the tax system or efficient government spending which affects aggregate expenditure rapidly and directly will change the level of employment and output without necessarily resulting in high inflation.

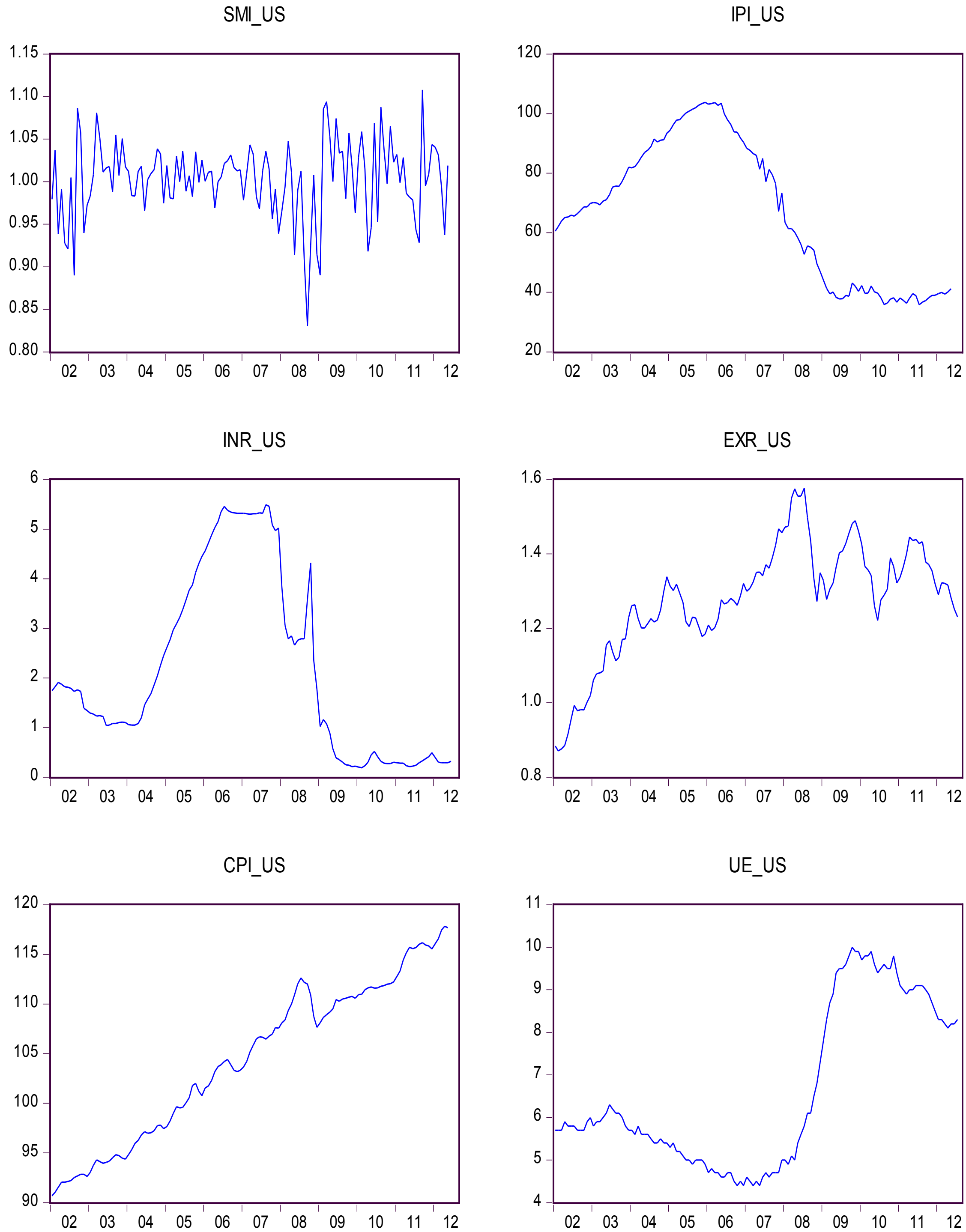
Appendix I



Source: Personal Computation using data from OECD and Yahoo! Finance Databases

Figure 1. Time Plots on FTSE100 stock returns and Macroeconomic variables

Appendix II



Source: Personal Computation using data from OECD and Yahoo! Finance Databases

Figure 2. Time Plots on S&P500 stock returns and Macroeconomic variables

Appendix III

Table 2.3. Granger Non-causality test for VECM of UNITED KINGDOM

Dependent variable: L(SMI_UK)			
Excluded	Chi-sq	df	*p-value*
L(IPI_UK)	1.860615	2	0.3944
L(INR_UK)	1.203200	2	0.5479
L(EXR_UK)	3.794903	2	0.1500
L(CPI_UK)	4.594928	2	0.1005
L(UE_UK)	1.045469	2	0.5929
All	13.95226	10	0.1752
Dependent variable: L(IPI_UK)			
Excluded	Chi-sq	df	Prob.
L(SMI_UK)	0.738466	2	0.6913
L(INR_UK)	3.207138	2	0.2012
L(EXR_UK)	6.664720	2	0.0357
L(CPI_UK)	4.933904	2	0.0848
L(UE_UK)	2.998418	2	0.2233
All	17.05279	10	0.0732
Dependent variable: L(INR_UK)			
Excluded	Chi-sq	df	Prob.
L(SMI_UK)	6.591381	2	0.0370
L(IPI_UK)	17.83176	2	0.0001
L(EXR_UK)	3.381744	2	0.1844
L(CPI_UK)	1.560624	2	0.4583
L(UE_UK)	2.363419	2	0.3068
All	32.24844	10	0.0004
Dependent variable: L(EXR_UK)			
Excluded	Chi-sq	df	Prob.
L(SMI_UK)	6.993199	2	0.0303
L(IPI_UK)	0.780942	2	0.6767
L(INR_UK)	0.211466	2	0.8997
L(CPI_UK)	1.289025	2	0.5249
L(UE_UK)	10.79596	2	0.0045
All	27.98211	10	0.0018
Dependent variable: L(CPI_UK)			
Excluded	Chi-sq	df	Prob.
L(SMI_UK)	6.055531	2	0.0484
L(IPI_UK)	3.468780	2	0.1765
L(INR_UK)	1.946328	2	0.3779
L(EXR_UK)	0.659848	2	0.7190
L(UE_UK)	5.827013	2	0.0543
All	16.06358	10	0.0978
Dependent variable: L(UE_UK)			
Excluded	Chi-sq	df	Prob.
L(SMI_UK)	10.56719	2	0.0051
L(IPI_UK)	9.174985	2	0.0102
L(INR_UK)	0.437910	2	0.8034
L(EXR_UK)	0.644904	2	0.7244
All	23.17159	10	0.0101

Source: Personal Computation using data from OECD and Yahoo! Finance Databases

Appendix IV

Table 2.4. Granger Non-causality test for VECM of United States

Dependent variable: L(SMI_US)			
Excluded	Chi-sq	df	*p-value*
L(IPI_US)	1.948487	2	0.3775
L(INR_US)	1.273760	2	0.5289
L(EXR_US)	0.650703	2	0.7223
L(CPI_US)	1.048692	2	0.5919
L(UE_US)	1.315723	2	0.5180
All	5.796645	10	0.8320
Dependent variable: L(IPI_US)			
Excluded	Chi-sq	df	Prob.
L(SMI_US)	2.594918	2	0.2732
L(INR_US)	0.987096	2	0.6105
L(EXR_US)	0.039256	2	0.9806
L(CPI_US)	1.686031	2	0.4304
L(UE_US)	4.728922	2	0.0940
All	13.60305	10	0.1919
Dependent variable: L(INR_US)			
Excluded	Chi-sq	df	Prob.
L(SMI_US)	3.140158	2	0.2080
L(IPI_US)	0.532808	2	0.7661
L(EXR_US)	5.019862	2	0.0813
L(CPI_US)	7.075267	2	0.0291
L(UE_US)	2.956090	2	0.2281
All	17.40129	10	0.0659
Dependent variable: L(EXR_US)			
Excluded	Chi-sq	df	Prob.
L(SMI_US)	15.13804	2	0.0005
L(IPI_US)	3.620874	2	0.1636
L(INR_US)	4.123563	2	0.1272
L(CPI_US)	0.644771	2	0.7244
L(UE_US)	3.096826	2	0.2126
All	32.63848	10	0.0003
Dependent variable: L(CPI_US)			
Excluded	Chi-sq	df	Prob.
L(SMI_US)	4.068821	2	0.1308
L(IPI_US)	1.277793	2	0.5279
L(INR_US)	1.565108	2	0.4572
L(EXR_US)	0.259774	2	0.8782
L(UE_US)	4.593464	2	0.1006
All	16.14346	10	0.0956
Dependent variable: L(UE_US)			
Excluded	Chi-sq	df	Prob.
L(SMI_US)	1.457072	2	0.4826
L(IPI_US)	4.434209	2	0.1089
L(INR_US)	0.303227	2	0.8593
L(EXR_US)	0.074624	2	0.9634
L(CPI_US)	0.819655	2	0.6638
All	7.801077	10	0.6483

Source: Personal Computation using data from OECD and Yahoo! Finance Databases

Appendix V

Table 1.8. VAR Lag Order Selection- S&P500 stock market returns and US Macroeconomic variables VECM

Lag	LogL	LR	FPE	AIC	SC	HQ
0	573.2786	NA	2.48e-12	-9.697071	-9.555421	-9.639563
1	1578.643	1890.428	1.58e-19	-26.26740	-25.27585*	-25.86484
2	**1636.180**	**102.2892**	**1.10e-19***	**-26.63556***	**-24.79411**	**-25.88796***
3	1660.986	41.55520	1.34e-19	-26.44421	-23.75286	-25.35156
4	1688.590	43.41042	1.59e-19	-26.30068	-22.75943	-24.86298
5	1715.403	39.41804	1.93e-19	-26.14364	-21.75250	-24.36089
6	1740.071	33.73409	2.48e-19	-25.94994	-20.70889	-23.82213
7	1780.805	51.52607*	2.48e-19	-26.03085	-19.93990	-23.55800
8	1811.969	36.22522	3.01e-19	-25.94819	-19.00734	-23.13029

Source: Personal Computation using data from OECD and Yahoo! Finance Databases

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