The impact of macroeconomic variables on Stock market in United Kingdom

NEIFAR, MALIKA and Dhouib, Salma and Bouhamed, Jihen and Ben Abdallah, Fatma and Arous, Islem and Ben Braiek, Fatma and Mrabet, Donia

IHEC SFAX UNIVERSITY, IHEC SFAX UNIVERSITY, IHEC SFAX UNIVERSITY, IHEC SFAX UNIVERSITY, IHEC SFAX UNIVERSITY, IHEC SFAX UNIVERSITY

23 February 2021

Online at https://mpra.ub.uni-muenchen.de/106246/
MPRA Paper No. 106246, posted 25 Feb 2021 07:53 UTC
The impact of macroeconomic variables on Stock market in United Kingdom\textsuperscript{1}

NEIFAR Malika,\textsuperscript{2} 

Dhouib Salma (salma.dhouib.97@gmail.com))
Bouhamed Jihen (jihenbouhamed2@gmail.com),
Ben Abdallah Fatma (fatmabenabdallah223@gmail.com),
Arous Islem (arousislem4@gmail.com),
Ben Braiek Fatma (benbraiekgatma@gmail.com), and
Mrabet Donia (mrabetdonia23@gmail.com)

Abstract

The key objective of this study is to shed light on the relationship between the stock market and macroeconomic factors (Interest rate, Consumer Price Index, Exchange rate) in United Kingdom for the period Pre Global Financial Crisis 2008 (GFC); from January 1999 to December 2007. The finding of \textit{Johansen} Cointegration, and \textit{Granger} and Toda Yamamoto (TY) Causality tests show respectively that there is no co-integration between variables, no causal relation is detected from macro factors to stock return, and a unidirectional causal relation is depicted from exchange rate to stock price. While from VAR Granger non Causality/Block Exogeneity Wald Tests results, both inflation (INF) and exchange rate growth (EXCG) Granger cause the UK stock market Return. Moreover, the ARDL specification show a stable \textit{long run} effect of all considered macroeconomic factors on the UK stock price. Precisely, the results of the ECM show that all considered macroeconomic factors drives UK stock price toward long-run equilibrium at a fast speed.

\textbf{Key words:} UK Stock market, Macroeconomic variables, Causality, ECM, Cointegration, ARDL model, \textit{F}\textsuperscript{PSS}Test.

\textbf{Jel classification:} C32; E44; G14.

We certify that we have the right to deposit the contribution with MPRA.

\textsuperscript{1} This is one of oral projects done within course “Formation doctorale” for MSc students (2MRF) at IHEC Sfax University under supervision of Pr NEIFAR Malika.
\textsuperscript{2} Associate Professor in Quantitative Methods at New Economic Department, \textbf{IHEC Sfax University}. Postal address: Road Sidi Mansour Km 10, B.P. 43, 3061. Sfax, Tunisia.

Email : malika.neifar@ihecs.usf.tn and mneifar68@gmail.com
# Table of content

I. Introduction .................................................................................................................. 3

II. A selected literature review ......................................................................................... 4

III. Econometric Models and Estimation ........................................................................... 5

  1. The data ......................................................................................................................... 5

  2. Econometric Methods .................................................................................................. 8

  3. Empirical Results ......................................................................................................... 11

IV. Conclusion .................................................................................................................. 16

Annex 1: Test Toda and Yamamoto (TY) results .............................................................. 17

Annex 2: VAR (1) for variables in 1st difference ............................................................... 18

Annex 3: ARDL .................................................................................................................. 19

References ....................................................................................................................... 20
I. Introduction

Economic theory suggests that stock prices should reflect expectations about future corporate performance while corporate profits generally reflect the level of economic activities. Then, if stock prices accurately reflect the underlying fundamentals, the stock prices should be employed as leading indicators of future economic activities.

On the other hand, the efficient market hypothesis (EMH), in particular semi-strong form efficiency, states that stock prices must contain all relevant information including publicly available information, (Fama, 1970). At an efficient capital market, security prices adjust rapidly to new information. Therefore, the current prices reflect all information about the security so that no investor is able to employ readily available information in order to predict stock price movements quickly enough so as to make a profit through trading shares.

Over the past few decades, numerous researchers, economists and practitioners have continually researched the relationship between macroeconomic factors and stock returns. It is often assumed that a variety of basic macroeconomic factors such as interest rate, industrial output, exchange rate, money supply, and inflation rate cause the stock return. And the impact of macroeconomic factors on stock returns for various countries has been captured and verified by a fair number of models and tests.

In fact, any country’s stock market must be treated as a benchmark of its own power in economic terms. There are many variables, including not only economic, but also social, and political variables, according to the literature, that can affect the working success of a stock market.

This research aims to identify the nature of the relationship between the stock market and three macroeconomic variables. The variable under investigation concern United Kingdom (UK) market stock price (SP) or return as proxy for the UK stock market. Macroeconomic variables are Consumer price index (CPI), Interest rate (INT), and exchange rate (EXC) for UK economy.

Three testable hypotheses are considered to represent the relationship between dependent variable (stock market price or return) and dependent / independent variables (inflation, interest rate, and exchange rate):

- **H1**: Interest rate does not affect stock market price.
- **H2**: Inflation does not affect stock market return.
- **H3**: Exchange rate does not affect stock market price.

In order to reach the objective of this article, different econometrics technics are applied such as unit root tests, Vector Auto Regression (VAR) for optimal lag length selection, VEC Model and (Johansen, 1988) test for co-integration, ARDL framework and F_{PSS} test procedure, VAR Granger non Causality/Block Exogeneity Wald Tests, and Toda and Yamamoto Wald causality test.
This paper investigates the nature of the causal static and dynamic relationships between the UK stock price (return) and the considered macroeconomic variables in UK economy for the period between January 1999 and December 2007 using UK data extracted from International Monetary Fund (IMF). All investigations are done by Eviews 10.

(Poon & Taylor, 1991) conducted a study on equity prices from UK stock markets and macroeconomic variables. Their results are dissimilar to (Chen, Roll, & Ross, 1986), concluding that macroeconomic indicators do not have significant effects on equity returns.

Based on more recent data (between January 1999 and December 2007), this paper results confirmed the influence of macroeconomic variables on the UK stock market prices. This paper provides then a basis and guidelines to investors and financial experts for making investment decisions in the UK share market. Also, it may be useful for the policy and decision makers of the UK economy.

This article is arranged as follows. Section I comprises the introduction. Section II give a selection literature review. Section III describes methodology (subsection 1) and the used data (subsection 2), and analyzes the estimation and tests results (subsection 3). Finally, section IV concludes the paper.

II. A selected literature review

The literature demonstrate the associations between equity returns and different macroeconomic indicators, but the debate continues regarding which indicator has a substantial effect on equity markets. Various Macroeconomic indicators have been considered such as Gross Domestic Product, Inflation, Oil Prices, Exchange rate, Interest rates, Gold prices, Money supply, Foreign Direct Investment, Imports, and Exports.

In the first systematic studies undertaken by (Fama, 1970) and (Roll & Ross, 1980), the effect of macroeconomic factors on financial markets was extensively researched. They studied different macroeconomic variables and their influence on volatility in stock prices and showed that some macroeconomic variables appear to have a very strong impact on stock prices, while others remain at best inconclusive.

Later, (Maysami, Howe, & Hamzah, 2004) examined empirical long run relationship between stock prices in Singapore and a set of economic variables including exchange rate, money supply, inflation, and industrial production. They found that the stock market index forms a co-integration relationship with considered variables. Similarly, (Ali, Rehman, Yilmaz, Khan, & Afzal, 2010) concluded that equity markets were co-integrated with macroeconomic indicators and stock prices in Pakistan. However, for other macroeconomic variables, no causal relationship is known. (Kutty, 2010) used the Granger causality test to investigate the connection between stock prices and exchange rates in Mexico. He documented that stock prices and exchange rates have no long-term association between them. In the same context, (Shawtari, Salem, Hussain, Hawariyuni, & Omer, 2015) using vector error-correction models,
found a long-term co-integration of macroeconomic variables including industrial production, inflation, money supply, and exchange rate with stock market prices. More recently, (Neifar M., 2021) examined the short run and long run relationship between stock prices at Suisse stock market and a set of macroeconomic variables including Suisse exchange rate, Interest rate, and inflation for the period from 1999:1 to 2018:4. She found that the stock market price forms a co-integration relationship with considered macroeconomic variables within an ARDL framework. “The impact of exchange rate changes on the economy depend to a large extent on the level of international trade and the trade balance. Hence the impact can be determined by the relative dominance of import and export sectors of the economy” (Maysami, Howe, & Hamzah, 2004).

According to experts, if the interest rate rises then equity returns diminish, and any negative news linked to interest rates badly affects the exchange rate and stock markets (Lobo, 2000).

An increase in inflation affects the stock markets’ performance in a negative manner, while a decrease in the rate of inflation exerts a positive effect on the equity markets and investors’ confidence will be reinstated (Omran & Pointon, 2001).

Unlike most of authors that widely theorized that stock prices are influenced by macroeconomic variables, (Lu, Metin IV, & Argac, 2010), in examining the long-term relationship between stock returns and monetary variables in an emerging market through time (for the whole research period (1988 to 1995)), by using the co-integration technique, show that there is no co-integrating relationship between stock prices and any of the variables or groups of variables of concern. This is consistent with the findings of (Neifar M., 2021) in the case of Canada for the period from January 1999 to April 2018.

III. Econometric Models and Estimation

1. The data

A. Sample and data Analysis

We collect monthly data on the UK's stock price (SP) that will serve as an indicator for the stock market and macroeconomics variables (Interest rate, Consumer Price Index, Exchange rate) from January 1999 to December 2007. The descriptive analysis begins with information about macroeconomic indicators and notation are shown in Table 1. Except for the inflation rate, we have converted monthly data into a natural log.

Figure 1 shows the trend of LCPI, LSP, LEXC and LINT in United Kingdom’s over a nine-year period (1999:1 – 2007:12). From figure 1 below, it is evident that during the whole period, CPI is characterized by a decreasing trend. It is almost the same case for the SP process. Interestingly, the SP trend decreased significantly by the end of 2002. However, it increased
during the remaining period. The downward trend in SP could be attributed to the fact that until the middle of the spring of 2003, the global economy lived in the shadow of geopolitical tensions, with the uncertainties related to the Iraqi conflict continuing to foster wait-and-see behavior by agents and to tighten prices in oil markets. In addition to these international tensions, the economic disparities between the major areas persisted and even increased. The United States and, more unexpectedly, Japan showed a resumption of growth in the spring, but the euro area remained very much in decline, and most major European countries even experienced a few quarters of contraction in their activity. Overall, this growth gap was explained by a number of factors, most notably the appreciation of the euro vis-à-vis the dollar and more expansive monetary and fiscal policies on the other side of the Atlantic. The global economy reaches its low point at the beginning of 2003 in a deteriorating context marked by the outbreak of the war in Iraq, including the United Kingdom economy. Furthermore, EXC’s graph showed a decline in the trend over the entire period. In addition, from 1999 to 2003, the INT trend decreased considerably. Nevertheless, and with the beginning of 2003, the INT trend took an upward until the end of the period.

Table 1: Description of variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSP</td>
<td>The market stock price (SP) in log: the price that it sells for on the open market at a given point in time.</td>
</tr>
<tr>
<td>LCPI</td>
<td>Consumer price index (CPI) in log, a measure that examines the weighted average of prices of a basket of consumer goods and services, such as transportation, food, and medical care.</td>
</tr>
<tr>
<td>LINT</td>
<td>Nominal interest rates (INT) in log.</td>
</tr>
<tr>
<td>LEXC</td>
<td>Nominal exchange rate (EXC) in log.</td>
</tr>
<tr>
<td>INF</td>
<td>Inflation rate.</td>
</tr>
</tbody>
</table>

Note: Monthly UK macroeconomic data are selected from International Monetary Fund (IMF). SP is selected from OCDE (Organisation de Cooperation et de Developpement Economique).

Figure 1: Stock price, consumer price index, Exchange rate in log, and interest rate evolution from January 1999 to December 2007.
B. Unit root test results

Prior to the testing of co-integration, we conducted a test of order of integration for each variable using Augmented Dickey-Fuller Test (ADF) and Phillips-Perron Test (PP). The results on variables at level and at 1$^{st}$ difference are given in Table 2, which on the whole shows that the variables under study can be considered integrated of order one, i.e., I(1) since they are not stationary in level but stationary at 1$^{st}$ difference. Hence, we can pass for co-integration (Johansen, 1988) test investigation.

<table>
<thead>
<tr>
<th>Variable</th>
<th>LSP</th>
<th>LCPI</th>
<th>LINT</th>
<th>LEXC</th>
<th>LSP</th>
<th>LCPI</th>
<th>LINT</th>
<th>LEXC</th>
</tr>
</thead>
<tbody>
<tr>
<td>With Constant (C)</td>
<td>t-Statistic</td>
<td>-0.8564</td>
<td>-2.2327</td>
<td>-1.1019</td>
<td>-0.2932</td>
<td>-0.7770</td>
<td>-1.9882</td>
<td>-0.5875</td>
</tr>
<tr>
<td></td>
<td>Prob.</td>
<td>0.7984</td>
<td>0.1961</td>
<td>0.7131</td>
<td>0.9212</td>
<td>0.8212</td>
<td>0.2917</td>
<td>0.8678</td>
</tr>
<tr>
<td>With C &amp; Trend</td>
<td>t-Statistic</td>
<td>-0.9932</td>
<td>-3.1922</td>
<td>-0.7387</td>
<td>-2.3018</td>
<td>-0.6377</td>
<td>-2.8557</td>
<td>-0.3924</td>
</tr>
<tr>
<td></td>
<td>Prob.</td>
<td>0.9706</td>
<td>0.0916</td>
<td>0.9671</td>
<td>0.4291</td>
<td>0.9745</td>
<td>0.1812</td>
<td>0.9867</td>
</tr>
<tr>
<td>Without C &amp; Trend</td>
<td>t-Statistic</td>
<td>0.1799</td>
<td>-0.3482</td>
<td>0.0689</td>
<td>-0.9230</td>
<td>0.1925</td>
<td>-0.3507</td>
<td>0.4798</td>
</tr>
<tr>
<td></td>
<td>Prob.</td>
<td>0.7365</td>
<td>0.5574</td>
<td>0.7026</td>
<td>0.3145</td>
<td>0.7403</td>
<td>0.5564</td>
<td>0.8170</td>
</tr>
</tbody>
</table>

The matrix of correlation shows the presence of a negative linear relationship between INF and R, while a positive linear relationship between EXCG and R is suggested (see Table 3).

<table>
<thead>
<tr>
<th>Correlation Matrix</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Correlation</strong></td>
</tr>
<tr>
<td>R</td>
</tr>
<tr>
<td>INF</td>
</tr>
<tr>
<td>INTG</td>
</tr>
<tr>
<td>EXCG</td>
</tr>
</tbody>
</table>

For the identification of the direction of causal association among considered variables, and to find out directional causality, we used in first stage the pairwise (Granger, 1969) causality test on stationary series (variables in first difference). Results are reported in Annex 1 Table A1.
Table A1 shows that none of the macro factors has an effect on UK Stock return. More investigations are needed to get a robust result.

2. Econometric Methods

A. The Johansen multivariate co-integration procedure

We use the (Johansen, 1988) co-integration approach. The following k-dimensional VAR process with p lags

\[ Y_t = \mu + \Phi_1 Y_{t-1} + \ldots + \Phi_p Y_{t-p} + \lambda D2003 + \varepsilon_t \]

can be rewritten in the VEC Model form:

\[ \Delta Y_t = \mu + \Pi Y_{t-1} + \Gamma_1 \Delta Y_{t-1} + \ldots + \Gamma_{p-1} \Delta Y_{t-p+1} + \lambda D2003 + \varepsilon_t \]

where \( Y_t \) is the vector of k = 4 considered endogenous variables

\[ Y_t = (LSP_t, LCPI_t, LINT_t, LEXC_t)' \]

\( \mu \) is a k×1 vector of real parameters; \( \mu_t = \mu + \delta t \) or \( \mu_t = \mu + \delta t + \gamma t^2 \), \( \delta, \gamma \) is a k×1 vector of trend coefficients, \( t \) is a linear time trend, \( t^2 \) is a quadratic time trend, and D2003 is a dummy variable,

\[ D2003 = 1 \text{ if } t \geq 2003 \text{ and zero if not,} \]

\[ \Pi = \sum_{i=1}^{p} \Phi_i - I \]

is the long-run matrix, and \( \Gamma_1, \ldots, \Gamma_{p-1} \) are k × k matrices of parameters

\[ \Gamma_i = -\sum_{j=i+1}^{p} \Phi_j. \]

If all variables in \( Y_t \) are I(1), the matrix \( \Pi \) has rank \( 0 \leq r < k \), where \( r \) is the number of linearly independent co-integrating vectors. If the variables are co-integrated \( (r > 0) \) the VAR in first differences is misspecified as it excludes the error correction term.

In the VEC model above, when the rank of \( \Pi \) is \( r > 0 \), it may be expressed as

\[ \Pi = \alpha \beta', \]

where \( \alpha \) and \( \beta \) are \((k \times r)\) matrices of parameters of rank \( r \). \( \alpha \) give the speed of adjustment to equilibrium. \( \beta \) is the matrix of long-run coefficients that represents up to \( k - 1 = 3 \) cointegration relationship and ensures that \( Y_t \) s converge to their long-run steady state.\(^3\)

The Johansen’s approach is aimed to test the number \( r \) of co-integrating relationships. The test for co-integration between the \( Y \)s is calculated by looking at the rank of the \( \Pi = \alpha \beta' \) matrix via its eigenvalues.

Two test statistics for cointegration under the Johansen approach are considered. The trace statistic takes the form

\[ \lambda_{\text{trace}} = -T \sum_{i=r+1}^{k} \ln(1 - \hat{\lambda}_i) \]

where \( \lambda_i \) are the ordered eigenvalues, and

\[ \lambda_{\text{max}} = -T \ln(1 - \hat{\lambda}_{r+1}). \]

\(^3\) A set of time-series variables are cointegrated if they are integrated of the same order and a linear combination of them is stationary.
The distributions of the test statistics are **non-standard**. (Johansen & Juselius, 1990) provide critical values for the two statistics.

If the **test statistic is greater than the critical value** from Johansen’s tables, we **reject the null hypothesis** that there are \( r \) co-integrating vectors in favor of the alternative that there are \( r + 1 \) (for \( \lambda_{\text{trace}} \)) or more than \( r \) (for \( \lambda_{\text{max}} \)).

Johansen’s testing procedure is sequential. It starts with the test for \( r = 0 \) co-integrating equations (a maximum rank of zero) and then accepts the first null hypothesis that is not rejected.\(^4\)

**B-Pairwise Granger causality test**

Prior to the Pairwise Granger causality tests, we first conduct unit root tests to determine if the variables are stationary and to detect their order of integration. Then, we capture the interrelationships among the variables with Pairwise Granger causality tests. In testing for Granger causality, two **stationary** variables \( Y_t \) and \( X_t \) are considered in the following VAR model

\[
Y_t = a + \sum_{j=1}^{p} C_{ji} Y_{t-j} + \sum_{j=1}^{p} D_{ji} X_{t-j} + \epsilon_{t1} \\
X_t = b_j + \sum_{j=1}^{p} F_{ji} X_{t-j} + \sum_{j=1}^{p} E_{ji} Y_{t-j} + \epsilon_{t2}
\]

\( Y_t \) and \( X_t \) are analyzed together while testing for their interaction. \( X \) does not granger cause \( Y \) if \( D_{ji} = 0 \) for all \( j \), while \( Y \) does not granger cause \( X \) if \( E_{ji} = 0 \) for all \( j \).

Four results of the analyses are possible:

1) Unidirectional Granger causality from variable \( Y_t \) to variable \( X_t \).

2) Unidirectional Granger causality from variable \( X_t \) to \( Y_t \).

3) Bi-directional causality.

4) No causality.

**C. Toda and Yamamoto Wald causality test**

Besides the **Granger causality**, an important procedure was developed by (Toda & Yamamoto, 1995) to investigate significant direction of causality. This approach could be used regardless of the integration order and whether the indicators are simply integrated of order zero \( I(0) \) and of order one \( I(1) \).

In order to investigate (Granger, 1969) causality, (Toda & Yamamoto, 1995) developed a method based on the estimation of augmented VAR model \( (p+d \text{ max}) \) where \( p \) is the optimal

\(^{4}\) In case of no cointegration, (Granger & Newbold, 1974) noted that the regression results from the VAR models with non-stationary variables are spurious.
time lag on the first VAR model and d max is the maximum integrated order. Toda and Yamamoto modified Wald test is then based on the pairwise equations:

\[ Y_t = a + (\sum_{j=1}^{p} C_j Y_{t-j} + \sum_{j=p+1}^{d_{\text{max}}} C_{j2} Y_{t-j}) + (\sum_{j=1}^{p} D_j X_{t-j} + \sum_{j=p+1}^{d_{\text{max}}} D_{j2} X_{t-j}) + \epsilon_{t1} \]
\[ X_t = b_j + (\sum_{j=1}^{p} F_j X_{t-j} + \sum_{j=p+1}^{d_{\text{max}}} F_{j2} X_{t-j}) + (\sum_{j=1}^{p} E_j Y_{t-j} + \sum_{j=p+1}^{d_{\text{max}}} E_{j2} Y_{t-j}) + \epsilon_{t2} \]

where \( \epsilon_{t1} \) and \( \epsilon_{t2} \) are the white-noise errors.

The modified Wald test (M Wald) follows asymptotically Chi-square \((\chi^2)\) distributions with the degrees of freedom are equal to the number of time lags \((p)\). Finally, rejection of null hypothesis entails the rejection of Granger non causality.

**D-ARDL specification**

To explore the long- and short-run linear relationships between stock market returns and macro-economic factors, the following equation in the ARDL form will be used:

\[ \Delta \text{LSP}_t = \mu(t) + \gamma_1 \text{LSP}_{t-1} + \gamma_2' \text{X}_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta \text{LSP}_{t-i} + \sum_{i=1}^{p} \beta_i' \Delta \text{X}_{t-i} + \epsilon_t, \] (1)

where

\[ \mu(t) = C_1 + C_2 t + \mu_1 \text{D2003} + \mu_2 \text{DT}, \]
\[ X = (\text{LCPI}, \text{LINT}, \text{LEXC})', \]
\[ \Delta X = (\Delta \text{LCPI}, \Delta \text{LINT}, \Delta \text{LEXC})' \equiv (\text{INF}, \text{INTG}, \text{EXCG})', \]
\[ \text{D2003} = 1 \text{ for year } \geq 2003 \text{ and zero if not,} \]
\[ \text{DT} = t \text{ if } t \geq 2003 \text{ and 0 if not,} \]

indicating significantly change of SP trend by the end of 2002, \( C_1 \) is the intercept of this equation, \( t \) is the trend, \( \alpha_i \) and \( \beta_i \) represent short-term relationship, \( \gamma_1 \), and \( \gamma_2 \) represent long-term relationship (all are real parameters), \( p \) is the maximum lag to be used, and \( \epsilon_t \sim WN(0, \sigma^2) \).

**F_{PSS} Test Procedure**

Another way to test for co-integration and causality is the Bounds Test for Co-integration within the ARDL framework developed by (Pesaran, Shin, & Smith, 2001). This test is based on F type statistic (noted by \( F_{PSS} \)) to resolves null hypothesis of no co-integration in the ARDL model. It is a bound test [with two sets of critical values (lower and upper)].

\( F_{PSS} \) test is based on the following steps:

---

5 The Toda and Yamamoto, 1995 approach follows the following steps: First, we find the integration order for each series (d). If the integration order is different we get the maximum (d max). Second, we create a VAR model on series levels regardless of integration order that we found. Then, we define the order of stable VAR model (p) from lag length taken from LR, final prediction error (FPE), AIC, SC, HQ criteria.
Step 1: Testing for the unit root of \( \text{LSP}_t \) and \( X_t \) (using either ADF or PP tests, or both).

Step 2: Testing for co-integration between \( \text{LSP}_t \) and \( X_t \) (using Bounds test approach).

The null hypothesis of no co-integration is:

\[
H_0: \gamma_1 = 0, \gamma_2' = 0
\]

And the alternative hypothesis of co-integration is:

\[
H_1: \gamma_1 \neq 0, \gamma_2' \neq 0.
\]

If the \( F_{\text{磐}} \) is greater than the upper critical bound, then the null hypothesis is rejected, suggesting that there is a co-integrating relationship between the variables under consideration. If the \( F_{\text{磐}} \) falls below the lower critical bounds value, it suggests that there is no co-integrating relationship.

3. Empirical Results

A. Co-integration test

To test for co-integration and before employing causation analysis, we must specify how many lags to include in the VAR models. Therefore, in order to find out the lag length, we followed a lag length selection criterion, the AIC information criterion which suggests 2 lags for the time series data as the least value of AIC, i.e. -20.57994 corresponds to 2 lags in the selected sample period as displayed in Table 4.

Table 4 : Optimum lag length for VAR specification

<table>
<thead>
<tr>
<th>Lag</th>
<th>LogL</th>
<th>LR</th>
<th>FPE</th>
<th>AIC</th>
<th>SC</th>
<th>HQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1002.602</td>
<td>988.8544</td>
<td>1.65e-14</td>
<td>-20.38753</td>
<td>-19.74645*</td>
<td>-20.12840</td>
</tr>
<tr>
<td>2</td>
<td>1027.837</td>
<td>45.21363*</td>
<td>1.36e-14</td>
<td>-20.57994*</td>
<td>-19.51146</td>
<td>-20.1480*</td>
</tr>
<tr>
<td>3</td>
<td>1039.090</td>
<td>19.22406</td>
<td>1.51e-14</td>
<td>-20.48105</td>
<td>-18.98518</td>
<td>-19.87639</td>
</tr>
<tr>
<td>4</td>
<td>1048.676</td>
<td>15.57702</td>
<td>1.74e-14</td>
<td>-20.34742</td>
<td>-18.42416</td>
<td>-19.57001</td>
</tr>
</tbody>
</table>

Note: * indicates lag order selected by the criterion, LR: sequential modified LR test statistic (each test at 5% level), AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion.

In order to test the co-integration between time series we applied the Johansen test for P-1 = 1, showed at Table 5. The test result shows that there is no co-integration depending on the five cases.

Now, two alternatives can be considered: a VAR (1) model for stationary variables (variables in 1st difference) or an ARDL model for non-stationary variables (in level and at first difference). Here after, we see which of these alternatives is more adequate for UK stock market price during this period of study.
Table 5: Johansen test results for P-1 = 1.

<table>
<thead>
<tr>
<th>Data Trend:</th>
<th>None</th>
<th>None</th>
<th>Linear</th>
<th>Linear</th>
<th>Quadratic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Type</td>
<td>No Intercept</td>
<td>No Intercept</td>
<td>No Intercept</td>
<td>No Intercept</td>
<td>No Intercept</td>
</tr>
<tr>
<td>Trace</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Max-Eig</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Note: Exogenous series: D2003. Series are LSP LCPI LINT LEXC. Lags interval is 1 to 1.

**B. VAR in First difference**

In one hand, we recruit the impulse response function with a view to more understand our analysis. In fact, the impulse response function analysis is illustrated in the figure 2. The first line of graphs shows the IRF of VAR (1) module respectively of R, and monetary indicators including the inflation, exchange rate growth, and interest rate growth (INF, EXCG and INTG). From the figure 2, it is evident that for Return (R) there was a sharp fall in the first two months. However, this is added to a positive impact from inflation, which lasts about four months and disappears afterwards, as compared to the interest rate, which does not show any noticeable effect. Nevertheless, the graphs displays that the exchange rate has the biggest positive effect, as the UK currency depreciates as the exchange rate rises. If the UK money is appreciated, the market attract investments. This rise in demand push up the stock market level, suggesting that stock market returns will be positively correlated to the changes in the exchange rates.

![Figure 2: Impulse response analysis from VAR (1) for variables in first difference.](image)

---

6 The results of studies by (Fama & Schwert, 1977) and (Nelson, 1976) pointed to a negative relation between inflation and stock prices (affirming that macroeconomic variables influence stock returns).

7 Alternatively, a depreciation of the UK currency lead to an increase in demand for UK’s exports and thereby increasing cash flows to the country.
In order to test the correlation between the residues of the model the Autocorrelation LM test was implied. The test ensures that the residues are uncorrelated and that they represent white noises (see Table 6 hereafter).

**Table 6: VAR Residual Serial Correlation LM Tests. Null hypothesis: No serial correlation at lag h**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>16.54385</td>
<td>16</td>
<td>0.4157</td>
<td>1.038344</td>
<td>(16, 284.8)</td>
<td>0.4160</td>
</tr>
<tr>
<td>2</td>
<td>9.923611</td>
<td>16</td>
<td>0.8706</td>
<td>0.615757</td>
<td>(16, 284.8)</td>
<td>0.8707</td>
</tr>
</tbody>
</table>

**A. Granger causality/Block Exogeneity Wald Tests**

For the identification of the direction of causal association among considered variables, and to find out directional causality, we used VAR Granger Causality/Block Exogeneity Wald Tests on stationary series (VAR(1) in first difference).

**Table 7** shows significant bidirectional causal relations: The first is between inflation and stock return. And the second one is between the exchange rate growth and the stock return. The table reveals the existence of a unique significant one-way unidirectional causal relation from inflation to exchange rate growth at 1% significance level (p < 0.01) at 1 lags. However, the other pairs of variables do not have any causation in either direction as demonstrated at Table 7.

Thus Granger causality results suggest that changes in **stock return in the United Kingdom stock market** has significant **short run effects** on the **exchange rate growth** and on the **inflation**.

**Table 7: VAR Granger Causality/Block Exogeneity Wald Tests from VAR (1) model in first difference variables (p = 2).**

<table>
<thead>
<tr>
<th>Dependent variables</th>
<th>test results</th>
<th>R</th>
<th>INF</th>
<th>INTG</th>
<th>EXCG</th>
<th>ALL</th>
<th>conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>Stat</td>
<td>_</td>
<td>5.174221</td>
<td>0.044329</td>
<td>12.50174</td>
<td>13.09507</td>
<td>INF, EXCG → R</td>
</tr>
<tr>
<td></td>
<td>P-value</td>
<td></td>
<td>0.0229</td>
<td>0.8332</td>
<td>0.0004</td>
<td>0.0044</td>
<td></td>
</tr>
<tr>
<td>INF</td>
<td>Stat</td>
<td>4.468413</td>
<td>_</td>
<td>0.002636</td>
<td>1.592258</td>
<td>5.263613</td>
<td>R → INF</td>
</tr>
<tr>
<td></td>
<td>P-value</td>
<td>0.0345</td>
<td>_</td>
<td>0.9590</td>
<td>0.2070</td>
<td>0.1535</td>
<td></td>
</tr>
<tr>
<td>INTG</td>
<td>Stat</td>
<td>4.023634</td>
<td>2.653359</td>
<td>_</td>
<td>0.681698</td>
<td>6.565712</td>
<td>R → INTG</td>
</tr>
<tr>
<td></td>
<td>P-value</td>
<td>0.0449</td>
<td>0.1033</td>
<td>_</td>
<td>0.4090</td>
<td>0.0871</td>
<td></td>
</tr>
<tr>
<td>EXCG</td>
<td>Stat</td>
<td>3.686390</td>
<td>13.51211</td>
<td>1.053974</td>
<td>_</td>
<td>18.54292</td>
<td>R, INF → EXCG</td>
</tr>
<tr>
<td></td>
<td>P-value</td>
<td>0.0549</td>
<td>0.0002</td>
<td>_</td>
<td>0.3046</td>
<td>0.0003</td>
<td></td>
</tr>
</tbody>
</table>
B. Toda and Yamamoto test

In the second stage, we employed (Toda & Yamamoto, 1995) Wald test. Table 8 shows a significant one-way unidirectional causal relation from exchange rate to stock price, from stock price to interest rate, and from consumer price index to exchange rate at 5% significance level (p < 0.05).

Table 8: Toda and Yamamoto (TY) Modified Wald non causality test analysis

<table>
<thead>
<tr>
<th>Dependent variables</th>
<th>Test</th>
<th>Stat</th>
<th>LSP</th>
<th>LCPI</th>
<th>LINT</th>
<th>LEXC</th>
<th>All</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSP</td>
<td>Stat</td>
<td>_</td>
<td>1.882091</td>
<td>0.445491</td>
<td>6.525639</td>
<td>7.415475</td>
<td>LEXC→LSP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P-value</td>
<td>0.3902</td>
<td>0.8003</td>
<td><strong>0.0383</strong></td>
<td>0.2841</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LCPI</td>
<td>Stat</td>
<td>1.201122</td>
<td>_</td>
<td>0.673941</td>
<td>1.873069</td>
<td>4.494840</td>
<td>LSP→LINT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P-value</td>
<td>0.5485</td>
<td>0.7139</td>
<td>0.3920</td>
<td>0.6100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LINT</td>
<td>Stat</td>
<td>8.338772</td>
<td>1.318868</td>
<td>_</td>
<td>0.964373</td>
<td>10.02974</td>
<td>LSP→LINT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P-value</td>
<td><strong>0.0155</strong></td>
<td>0.5171</td>
<td>_</td>
<td>0.6174</td>
<td>0.1234</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LEXC</td>
<td>Stat</td>
<td>1.908429</td>
<td>15.07854</td>
<td>2.041639</td>
<td>_</td>
<td>21.25692</td>
<td>LCPI→LECG</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P-value</td>
<td>0.3857</td>
<td><strong>0.0005</strong></td>
<td>0.3603</td>
<td>_</td>
<td>0.0016</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: The rejection of null hypothesis at 5% (p < 0.05) or at 10% (p < 0.1). All variables are in level. P+dmax=3.
Source: Authors’ calculations.

B. ARDL model results

In order to implement the ARDL model, we have to determine the appropriate lags length. To ensure comparability of results for different lag lengths, all estimations were computed over the same sample period and the selection of ARDL (11, 12, 11, 10) is based on the lowest value of the Akaike Information Criterion (see Figure 3). After deciding the optimal lags orders, the results of $F_{PSS}$ test-statistic is reported in the table below (Table 9).

The $F_{PSS}$-statistic for joint significance is above the upper bound critical value at 5% level of significance (5.07). This result confirm the existence of long-run equilibrium relationship between macroeconomic variables and UK Stock market Prices pre GFC (see Table 9).
Table 9: \( F_{PS} \) - Statistic of Cointegration between Macro Variables and Stock Prices

<table>
<thead>
<tr>
<th>Test Statistic</th>
<th>Value</th>
<th>Signif.</th>
<th>I(0)</th>
<th>I(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-statistic</td>
<td>12.125668</td>
<td>10%</td>
<td>3.47</td>
<td>4.45</td>
</tr>
<tr>
<td>K</td>
<td>3</td>
<td>5%</td>
<td>4.01</td>
<td>5.07</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.5%</td>
<td>4.52</td>
<td>5.62</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1%</td>
<td>5.17</td>
<td>6.36</td>
</tr>
</tbody>
</table>

We further go to the long run stability relation and the short run dynamics. The results of the long run coefficients are presented in Table 10. It implies that Consumer Price Index (CPI in log), interest rate (INT in log) and exchange rate (EXC in log) affect positively the UK stock price in the long run.

Table 10: Long run relationship results.

\[
ECT = \text{LSP} - \left(0.898776 \times \text{LCPI} + 0.171244 \times \text{LINT} + 1.053271 \times \text{LEXC}\right)
\]

Note: (.) and [.] are respectively the standard deviation and the p-value.

In order to capture the short-run dynamics of the model, error correction mechanism was applied and the results are reported in the Table 11. The results show that the ECM term, has negative sign \((-1.557087\) and is statistically significant at 5 percent level, ensuring that long-run equilibrium can be attained in the case of UK stock market.

Since the co-integration results show that stock prices are co-integrated with LCPI, LINT and LEXC, the following Error Correction Model (ECM) will be used in testing the long run causal relationship;

\[
\Delta \text{LSP}_t = \mu_1(t) + \delta_1 \text{ECT}_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta \text{LSP}_{t-i} + \sum_{i=1}^{d} \beta_i \Delta X_{t-i} + \epsilon_t
\]  

Then, there is a long-run causal relationship between LSP and \(X = (\text{LCPI}, \text{LINT}, \text{LEXC})'\). Precisely, \(\delta_1\) indicates a causality from \(X = (\text{LCPI}, \text{LINT}, \text{LEXC})'\) to LSP that implying that \(X = (\text{LCPI}, \text{LINT}, \text{LEXC})'\) drives LSP toward long-run equilibrium.

Table 11: Error Correction model of LSP for the UK Stock Market

<table>
<thead>
<tr>
<th>Variable</th>
<th>ECM(_{-1})</th>
<th>C(_1)</th>
<th>t</th>
<th>TD</th>
<th>D2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficient</td>
<td>(-1.557087)</td>
<td>1.101887</td>
<td>0.017267</td>
<td>-0.032140</td>
<td>-1.611587</td>
</tr>
<tr>
<td>Std. Error</td>
<td>0.216479</td>
<td>0.155528</td>
<td>0.002433</td>
<td>0.004509</td>
<td>0.230761</td>
</tr>
<tr>
<td>t-Statistic</td>
<td>-7.192791</td>
<td>7.084836</td>
<td>7.098104</td>
<td>-7.127912</td>
<td>-6.983782</td>
</tr>
<tr>
<td>Prob.</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

To ascertain the goodness of fit of the selected ARDL model, the stability and the diagnostic tests are conducted. Table 12 shows that, the selected ARDL model fulfils the conditions of no
specification errors. Considered Diagnostic test statistics are serial non correlation tests and homoskedasticity test at 5% level.

The structural stability test is conducted by employing the cumulative sum of recursive residuals (CUSUM).

**Figure 4** presents plot of the CUSUM test statistics that fall inside the critical bounds of 5% significance. The stability tests further confirm the stability of the estimated coefficients.

**Table 12: diagnostic of ARDL model (Breusch-Godfrey Serial Correlation LM Test)**

<table>
<thead>
<tr>
<th></th>
<th>F-statistic</th>
<th>F(2,43)</th>
<th>Prob. F(2,43)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obs*R-squared</td>
<td>1.406155</td>
<td>0.2561</td>
<td>0.2561</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Obs*R-squared</th>
<th>Prob. Chi-Square(2)</th>
<th>0.0525</th>
</tr>
</thead>
</table>

Heteroskedasticity Test: ARCH

<table>
<thead>
<tr>
<th></th>
<th>F-statistic</th>
<th>F(1,93)</th>
<th>Prob. F(1,93)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obs*R-squared</td>
<td>1.091755</td>
<td>0.2988</td>
<td>0.2988</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Obs*R-squared</th>
<th>Prob. Chi-Square(1)</th>
<th>0.2938</th>
</tr>
</thead>
</table>

**Figure 4 : Plot of cumulative sum of recursive residuals**

**IV. Conclusion**

The role of macroeconomic monetary variables in the relationship with the share prices of stocks has become a critical and fascinating subject for academics and financial economics practitioners. The **efficient** market hypothesis suggests that all the relevant information currently known about changes in macroeconomic variables (such as money supply and interest rate) are fully reflected in current stock prices, so that investors will not be able to earn **abnormal profit** through **prediction** of the future stock market movements.

This study examines the relationship between stock prices and a set of macroeconomic variables, which comprises interest rate, inflation, consumer price index and the exchange rate, using data from the United Kingdom stock market for the period **Pre 2008 GFC**; from January 1999 to December 2007. This study employs a time series technique comprised of VAR, cointegration, Error Correction Modelling, and Granger causality tests to reach empirical evidence of the nature of relations between stock prices and macroeconomic variables. **ARDL** findings revealed that the UK market formed significant relationships with all macroeconomic variables included in this study.

Following these successive steps, the study concludes:
First, the impulse response graphs from the VAR (1) model on stationary series (variables in first difference) show temporary effects on stock return.

Second, the VAR Granger non Causality/Block Exogeneity Wald Tests results show that both inflation (INF) and exchange rate growth (EXCG) Granger cause the stock market Return of the United Kingdom.

Third, from the (Toda & Yamamoto, 1995) Wald non causality test on non-stationary series (variable in level), Show that only exchange rate (EXC) as macroeconomic factor which has effect on UK stock market prices.

Fourth, the Johansen’s co-integration test reveals no co-integration between the macro economic factors and the United Kingdom stock market price.

And then, it’s the ARDL model which implies the existence of a stable long run equilibrium relationship between macroeconomic variables and the stock market price. The results of the ECM representation confirm that all considered macroeconomic factors X = (LCPI, LINT, LEXC) ′ drives UK stock price (LSP) toward long-run equilibrium at a fast speed.

This study would guide UK policy makers toward reassessing their policies regarding those macroeconomic variables and their influence on the stock market. They should be aware that any changes in their policies regarding the macroeconomic variables would have affect the stock market.

Finally, further analysis can considered to use a wider dataset, including the time from 2008 global financial crisis to nowadays, and more macroeconomic factors, which may lead to more significant results in the relationship between UK stock prices (returns) and UK economic environment.

Annex 1: Test Toda and Yamamoto (TY) results

<table>
<thead>
<tr>
<th>Null Hypothesis:</th>
<th>Obs</th>
<th>Conclusion</th>
<th>F-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>INF → R</td>
<td>105</td>
<td></td>
<td>0.41283</td>
<td>0.6629</td>
</tr>
<tr>
<td>R → INF</td>
<td></td>
<td></td>
<td>1.39199</td>
<td>0.2534</td>
</tr>
<tr>
<td>EXCG → R</td>
<td>105</td>
<td></td>
<td>1.84045</td>
<td>0.1641</td>
</tr>
<tr>
<td>R → EXCG</td>
<td></td>
<td></td>
<td>2.13843</td>
<td>0.1232</td>
</tr>
<tr>
<td>INTG → R</td>
<td>105</td>
<td></td>
<td>0.64080</td>
<td>0.5290</td>
</tr>
<tr>
<td>R → INTG</td>
<td></td>
<td>R→INTG</td>
<td>5.94337</td>
<td>0.0036</td>
</tr>
<tr>
<td>EXCG → INF</td>
<td>105</td>
<td></td>
<td>1.39358</td>
<td>0.2530</td>
</tr>
<tr>
<td>INF → EXCG</td>
<td></td>
<td></td>
<td>7.67881</td>
<td>0.0008</td>
</tr>
<tr>
<td>INTG → INF</td>
<td>105</td>
<td></td>
<td>0.06672</td>
<td>0.9355</td>
</tr>
<tr>
<td>INF → INTG</td>
<td></td>
<td></td>
<td>0.49165</td>
<td>0.6131</td>
</tr>
<tr>
<td>INTG → EXCG</td>
<td>105</td>
<td></td>
<td>0.84674</td>
<td>0.4319</td>
</tr>
<tr>
<td>EXCG → INTG</td>
<td></td>
<td></td>
<td>0.30055</td>
<td>0.7411</td>
</tr>
</tbody>
</table>

Note: →: does not Granger Cause. ——: Granger cause.
Table A2: Johansen test results.

<table>
<thead>
<tr>
<th>Lag</th>
<th>Log Likelihood by Rank (rows) and Model (columns)</th>
<th>Akaike Information Criteria by Rank (rows) and Model (columns)</th>
<th>Schwarz Criteria by Rank (rows) and Model (columns)</th>
</tr>
</thead>
</table>

Table A3: Model Residual Diagnostics

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>18.40812</td>
<td>16</td>
<td>0.3005</td>
<td>1.159085</td>
<td>(16, 284.8)</td>
<td>0.3008</td>
</tr>
<tr>
<td>2</td>
<td>29.32587</td>
<td>32</td>
<td>0.6026</td>
<td>0.914922</td>
<td>(32, 329.8)</td>
<td>0.6036</td>
</tr>
</tbody>
</table>

Annex 2: VAR (1) for variables in 1st difference

Figure B 1: VAR (1) stability condition of level variables
Figure B 2 : VAR (3) stability condition of level variables, application of TY test

Table A 4 : VAR (3) stability condition in application of LY test.

<table>
<thead>
<tr>
<th>Root</th>
<th>Modulus</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.967244 - 0.021558i</td>
<td>0.967484</td>
</tr>
<tr>
<td>0.967244 + 0.021558i</td>
<td>0.967484</td>
</tr>
<tr>
<td>0.862437</td>
<td>0.862437</td>
</tr>
<tr>
<td>0.510876</td>
<td>0.510876</td>
</tr>
<tr>
<td>0.402018</td>
<td>0.402018</td>
</tr>
<tr>
<td>0.088500 - 0.115411i</td>
<td>0.145437</td>
</tr>
</tbody>
</table>

No root lies outside the unit circle.
VAR satisfies the stability condition.

Annex 3: ARDL

Table A5: The rest of the ARDL results.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>D(LSP(-1))</td>
<td>1.029530</td>
<td>0.179575</td>
<td>5.733149</td>
<td>0.0000</td>
</tr>
<tr>
<td>D(LSP(-2))</td>
<td>0.913293</td>
<td>0.190470</td>
<td>4.291842</td>
<td>0.0000</td>
</tr>
<tr>
<td>D(LSP(-3))</td>
<td>1.020127</td>
<td>0.153869</td>
<td>5.817175</td>
<td>0.0000</td>
</tr>
<tr>
<td>D(LSP(-4))</td>
<td>0.678808</td>
<td>0.163381</td>
<td>4.072734</td>
<td>0.0000</td>
</tr>
<tr>
<td>D(LSP(-5))</td>
<td>0.779443</td>
<td>0.156360</td>
<td>5.477089</td>
<td>0.0000</td>
</tr>
<tr>
<td>D(LSP(-6))</td>
<td>0.649211</td>
<td>0.166157</td>
<td>4.898012</td>
<td>0.0000</td>
</tr>
<tr>
<td>D(LSP(-7))</td>
<td>0.379170</td>
<td>0.165426</td>
<td>3.445784</td>
<td>0.0018</td>
</tr>
<tr>
<td>D(LSP(-8))</td>
<td>0.332353</td>
<td>0.157248</td>
<td>2.968869</td>
<td>0.0066</td>
</tr>
<tr>
<td>D(LSP(-9))</td>
<td>0.320530</td>
<td>0.151887</td>
<td>2.695358</td>
<td>0.0099</td>
</tr>
<tr>
<td>D(LSP(-10))</td>
<td>0.314194</td>
<td>0.155853</td>
<td>2.515596</td>
<td>0.0155</td>
</tr>
<tr>
<td>D(LCPI)</td>
<td>-0.695262</td>
<td>0.483337</td>
<td>-0.438462</td>
<td>0.4572</td>
</tr>
<tr>
<td>D(LCPI(-1))</td>
<td>-1.572790</td>
<td>0.500371</td>
<td>-2.144731</td>
<td>0.0101</td>
</tr>
<tr>
<td>D(LCPI(-2))</td>
<td>-1.194359</td>
<td>0.499529</td>
<td>-2.389085</td>
<td>0.0059</td>
</tr>
<tr>
<td>D(LCPI(-3))</td>
<td>-0.392510</td>
<td>0.457007</td>
<td>-1.858870</td>
<td>0.1290</td>
</tr>
<tr>
<td>D(LCPI(-4))</td>
<td>0.921695</td>
<td>0.461454</td>
<td>1.997372</td>
<td>0.0519</td>
</tr>
<tr>
<td>D(LCPI(-5))</td>
<td>-0.025873</td>
<td>0.470584</td>
<td>0.034981</td>
<td>0.9564</td>
</tr>
<tr>
<td>D(LCPI(-6))</td>
<td>0.644562</td>
<td>0.452469</td>
<td>1.424544</td>
<td>0.1612</td>
</tr>
<tr>
<td>D(LCPI(-7))</td>
<td>0.846362</td>
<td>0.454736</td>
<td>1.861216</td>
<td>0.0693</td>
</tr>
<tr>
<td>D(LCPI(-8))</td>
<td>1.049598</td>
<td>0.428252</td>
<td>2.450888</td>
<td>0.0182</td>
</tr>
<tr>
<td>D(LCPI(-9))</td>
<td>0.539272</td>
<td>0.482646</td>
<td>1.117324</td>
<td>0.2698</td>
</tr>
<tr>
<td>D(LCPI(10))</td>
<td>-0.122227</td>
<td>0.367559</td>
<td>-0.332536</td>
<td>0.7410</td>
</tr>
<tr>
<td>D(LCPI(11))</td>
<td>0.242715</td>
<td>0.328941</td>
<td>0.737869</td>
<td>0.4644</td>
</tr>
<tr>
<td>D(LINT)</td>
<td>-0.069881</td>
<td>0.193412</td>
<td>-0.361304</td>
<td>0.7196</td>
</tr>
<tr>
<td>D(LINT(-1))</td>
<td>0.017256</td>
<td>0.196850</td>
<td>0.087661</td>
<td>0.9305</td>
</tr>
<tr>
<td>D(LINT(-2))</td>
<td>0.114213</td>
<td>0.204081</td>
<td>0.559645</td>
<td>0.5785</td>
</tr>
<tr>
<td>D(LINT(-3))</td>
<td>-0.105740</td>
<td>0.162589</td>
<td>-0.650351</td>
<td>0.5188</td>
</tr>
<tr>
<td>D(LINT(-4))</td>
<td>-0.190288</td>
<td>0.167473</td>
<td>-1.136229</td>
<td>0.2619</td>
</tr>
<tr>
<td>D(LINT(-5))</td>
<td>0.263049</td>
<td>0.176810</td>
<td>1.487746</td>
<td>0.1438</td>
</tr>
<tr>
<td>D(LINT(-6))</td>
<td>0.243755</td>
<td>0.167986</td>
<td>1.451043</td>
<td>0.1537</td>
</tr>
<tr>
<td>D(LINT(-7))</td>
<td>-0.196583</td>
<td>0.174128</td>
<td>-1.146184</td>
<td>0.2578</td>
</tr>
<tr>
<td>D(LINT(-8))</td>
<td>0.156505</td>
<td>0.175152</td>
<td>0.893540</td>
<td>0.3763</td>
</tr>
<tr>
<td>D(LINT(-9))</td>
<td>0.137257</td>
<td>0.170044</td>
<td>0.807183</td>
<td>0.4238</td>
</tr>
<tr>
<td>Variable</td>
<td>Coefficient</td>
<td>Std. Error</td>
<td>t-Statistic</td>
<td>Prob.</td>
</tr>
<tr>
<td>----------</td>
<td>-------------</td>
<td>------------</td>
<td>-------------</td>
<td>-------</td>
</tr>
<tr>
<td>D(LINT(10))</td>
<td>0.298772</td>
<td>0.168035</td>
<td>1.778030</td>
<td>0.0822</td>
</tr>
<tr>
<td>D(LEXC)</td>
<td>-0.155570</td>
<td>0.281069</td>
<td>0.153495</td>
<td>0.8589</td>
</tr>
<tr>
<td>D(LEXC(-1))</td>
<td>-0.644041</td>
<td>0.281995</td>
<td>-3.283874</td>
<td>0.0012</td>
</tr>
<tr>
<td>D(LEXC(-2))</td>
<td>-1.484706</td>
<td>0.284821</td>
<td>-3.701792</td>
<td>0.0007</td>
</tr>
<tr>
<td>D(LEXC(-3))</td>
<td>-0.000762</td>
<td>0.273794</td>
<td>-4.027833</td>
<td>0.0000</td>
</tr>
<tr>
<td>D(LEXC(-4))</td>
<td>-0.569111</td>
<td>0.287412</td>
<td>-1.980122</td>
<td>0.0538</td>
</tr>
<tr>
<td>D(LEXC(-5))</td>
<td>-0.018343</td>
<td>0.307786</td>
<td>-3.059595</td>
<td>0.0026</td>
</tr>
<tr>
<td>D(LEXC(-6))</td>
<td>-0.137006</td>
<td>0.296800</td>
<td>-1.461611</td>
<td>0.0959</td>
</tr>
<tr>
<td>D(LEXC(-7))</td>
<td>-0.131901</td>
<td>0.283702</td>
<td>-1.464929</td>
<td>0.2440</td>
</tr>
<tr>
<td>D(LEXC(-8))</td>
<td>0.249631</td>
<td>0.279565</td>
<td>1.608326</td>
<td>0.3189</td>
</tr>
<tr>
<td>D(LEXC(-9))</td>
<td>0.424058</td>
<td>0.294342</td>
<td>1.440702</td>
<td>0.0525</td>
</tr>
</tbody>
</table>

References


