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# Financial Development and Economic Growth: An Empirical Analysis for the UK

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***Abstract:***

*This paper investigates the relationship between financial development and economic growth for UK for the period 1965-2007 using a vector error correction model (VECM). The purpose of this paper is to examine the long-run relationship between these variables applying the Johansen cointegration analysis. Granger causality tests indicated that there is a causal relationship between financial development and economic growth for UK.*

***Key Words:*** *Financial Development, Economic Growth, Granger Causality*

***JEL Classification**: O11, C22*

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## 1. Introduction

The theoretical relationship between financial development and economic growth goes back to the study of Schumpeter (1911) who focuses on the services provided by financial intermediaries and argues that these are essential for innovation and development.

Schumpeter's (1911) view is that a well functioning financial system would induce technological innovation by identifying, selecting and funding those entrepreneurs who would be expected to successfully implement their products and productive processes.

Robinson (1952, p.86) claims that "where enterprise leads, finance follows"- it is the economic development which creates the demand for financial services and not vice versa. Financial development follows economic growth as a result of increased demand for financial services. This explanation was originally advanced by Friedman and Schwarz (1963).

Theory provides conflicting aspects for the impact of financial development on economic growth. The most empirical studies are based on those theoretical approaches proposed by some different economic school of thoughts which can be divided into three categories: (i) structuralists, (ii) the repressionists, (iii) endogenous growth theory supporters.

The structuralists contend that the quantity and composition of financial variables induces economic growth by directly increasing saving in the form of financial assets, thereby, encouraging capital formation and hence, economic growth (Patrick, 1966; Berthelemy and Varoudakis, 1998).

Patrick (1966) identified two possible causal relationships between financial development and economic growth. The first causal relationship - called 'demand following' - views the demand for financial services as dependent upon the growth of real output and upon the commercialization and modernization of agriculture and other subsistence sectors. Thus, the creation of modern financial institutions, their financial assets and liabilities and related financial services are a response to the demand for these services by investors and savers in the real economy.

The second causal relationship between financial development and economic growth is termed 'supply leading' by Patrick (1966). 'Supply leading' has two functions: to transfer resources from the traditional, low-growth sectors to the modern high-growth sectors and to promote and stimulate an entrepreneurial response in these modern sectors.

This implies that the creation of financial institutions and their services occurs in advance of demand for them. Thus, the availability of financial services stimulates the demand for these services by the entrepreneurs in the modern, growth-inducing sectors. Therefore, the supply- leading hypothesis contends that financial development causes real economic growth, while in contrary to the demand-following hypothesis argues for a reverse causality from real economic growth to financial development.

The financial repressionists, led by, McKinnon (1973) and Shaw (1973) – often referred to as the "McKinnon-Shaw" hypothesis contend that financial liberalization in the form of an appropriate rate of return on real cash balances is a vehicle of promoting economic growth. The essential tenet of this hypothesis is that a low or negative real interest rate will discourage saving. This will reduce the availability of loanable funds for investment which in turn, will lower the rate of economic growth. Thus, the "McKinnon - Shaw" model posits that a more liberalized financial system will induce an increase in saving and investment and therefore, promote economic growth.

The Mckinnon - Shaw school examines the impact of government intervention on the development of the financial system. Their main proposition is that government restrictions on the banking system such as interest rate ceilings and direct credit programs have negative effects on the development of the financial sector and, consequently, reduce economic growth.

The two different schools of thought are agreed to the transmission channels effect on the relationship between financial development and economic growth. Most of the theoretical models followed the emergence of endogenous growth theory.

The endogenous growth theory has reached to similar conclusions with the McKinnon-Shaw hypothesis by explicitly modelling the services provided by financial intermediaries such as risk-sharing and liquidity provision.

King and Levine (1993b) employ an endogenous growth model in which the financial intermediaries obtain information about the quality of individual projects that is not readily available to private investors and public markets. Levine (1997) proposed that financial development promotes economic growth through the two 'channels' of capital accumulation and technological innovation. Financial markets evaluate the potential innovative projects, and finance the most promising ones through efficient resource allocation.

The remainder of the paper proceeds as follows: Section 2 describes the specification of the model, while section 3 presents the results of unit root tests. Section 4 develops the Johansen cointegration analysis and section 5 analyses the vector error correction models. Finally, section 6 presents Granger causality tests and section 7 provides the conclusions of this paper.

## 2. Data and Specification Model

In this study the method of vector autoregressive model (VAR) is adopted to estimate the effects of stock and credit market development on economic growth through the effect of industrial production. The use of this methodology predicts the cumulative effects taking into account the dynamic response among economic growth and the other examined variables (Pereira and Hu, 2000).

In order to test the causal relationships, the following multivariate model is to be estimated:

$$GDP = f(SM, BC, IND) \qquad (1)$$

where:

GDP is the gross domestic product
SM is the general stock market index
BC are the domestic bank credits to private sector
IND is the industrial production index

Following the empirical studies of King and Levine (1993a), Vazakidis and Adamopoulos, 2010, the variable of economic growth (GDP) is measured by the rate of change of real, GDP, while the credit market development is expressed by the domestic bank credits to private sector (BC) as a percentage of GDP.

This measure has a basic advantage from any other monetary aggregate as a proxy for credit market development. Although it excludes bank credits to the public sector, it represents more accurately the role of financial intermediaries in channeling funds to private market participants (Levine et al, 2000, Vazakidis and Adamopoulos, 2009, Adamopoulos, 2010).

The general stock market index is used as a proxy for the stock market development The general stock market index (SM) expresses better the stock exchange market, while the industrial production index (IND) measures the growth of industrial sector and its effect on economic growth (Katsouli, 2003; Nieuwerburgh et al, 2005; Shan, 2005; Thalassinos and Thalassinos, 2006; Vazakidis, 2006).

The data that are used in this analysis are annual covering the period 1978-2007 for UK, regarding 2000 as a base year. All time series data are expressed in their levels and are obtained from International Financial Statistics (International Monetary Fund, IMF, 2007).

## 3. Unit Root Test

Economic theory does not often provide guidance in determining which variables have stochastic trends, and when such trends are common among variables. If these variables share a common stochastic trend, their first differences are stationary and the variables may be jointly cointegrated. For univariate time series analysis involving stochastic trends, Augmented Dickey- Fuller unit root tests are calculated for individual series to provide evidence as to whether the variables are integrated. This is followed by a multivariate cointegration analysis.

Following the studies of Seddighi et al (2000), Chang (2002), Chang and Caudill (2005), Augmented Dickey-Fuller (ADF) test involves the estimation one of the following equations respectively:

$$\Delta X_t = \beta X_{t-1} + \sum_{j=1}^{p} \delta_j \Delta X_{t-j} + \varepsilon_t \qquad (2)$$

$$\Delta X_t = a_o + \beta X_{t-1} + \sum_{j=1}^{p} \delta_j \Delta X_{t-j} + \varepsilon_t \qquad (3)$$

$$\Delta X_t = a_o + a_{1t} + \beta X_{t-1} + \sum_{j=1}^{p} \delta_j \Delta X_{t-j} + \varepsilon_t \qquad (4)$$

The additional lagged terms are included to ensure that the errors are uncorrelated. The maximum lag length begins with 3 lags and proceeds down to the appropriate lag by examining the AIC and SC information criteria.

The null hypothesis is that the variable $X_t$ is a non-stationary series ($H_0$: β=0) and is rejected when β is significantly negative ($H_a$: β<0). If the calculated ADF statistic is higher than McKinnon's critical values, then the null hypothesis (H0) is not rejected and the series is non-stationary or not integrated of order zero I(0).Alternatively, rejection of the null hypothesis implies stationarity. Failure to reject the null hypothesis leads to conducting the test on the difference of the series, so further differencing is conducted until stationarity is reached and the null hypothesis is rejected (Dickey and Fuller, 1979).

In order to find the proper structure of the ADF equations, in terms of the inclusion in the equations of an intercept ($\alpha_0$) and a trend (t) and in terms of how many extra augmented lagged terms to include in the ADF equations, for eliminating possible autocorrelation in the disturbances, the minimum values of Akaike's (1973) information criterion (AIC) and Schwarz's (1978) criterion (SC) based on the usual Lagrange multiplier LM(1) test were employed.

The Eviews 4.1 (2000) software package which is used to conduct the ADF tests, reports the simulated critical values based on response surfaces. The results of the Dickey-Fuller (DF) and Augmented' Dickey-Fuller (ADF) tests for each variable appear in Table 1.

**Table 1. DF/ADF unit root tests**

| **Variables** | **In levels** | | | | | **In first differences** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | lag<br>eq_f | adf_test<br>stat | cr_val<br>1%<br>5%<br>10% | SBC<br>AIC | LM<br>[prob] | lag<br>eq_f | adf_test<br>stat | cr_val<br>1%<br>5%<br>10% | SBC<br>AIC | LM<br>[prob] |
| GDPUK | (p=0)<br>(2) | 6.38<br>[1.00] | -2.62<br>-1.94<br>-1.61 | -3.92<br>-3.97 | 0.37<br>[0.68] | (p=0)<br>(4) | -5.61<br>[0.00] | -4.19<br>-3.52<br>-3.19 | -3.82<br>-3.95 | 0.01<br>[0.98] |
| BCUK | (p=1)<br>(2) | 2.07<br>[0.98] | -2.62<br>-1.94<br>-1.61 | -2.96<br>-3.05 | 0.65<br>[0.52] | (p=0)<br>(2) | -3.06<br>[0.00] | -2.62<br>-1.94<br>-1.61 | -2.95<br>-2.99 | 0.85<br>[0.43] |
| SMUK | (p=1)<br>(4) | -3.44<br>[0.05] | -4.19<br>-3.62<br>-3.49 | -3.30<br>-3.46 | 4.50<br>[0.01] | (p=2)<br>(3) | -5.77<br>[0.00] | -3.61<br>-2.93<br>-2.60 | -3.43<br>-3.61 | 0.34<br>[0.71] |
| INDUK | (p=0)<br>(2) | 1.85<br>[0.98] | -2.62<br>-1.94<br>-1.61 | -6.07<br>-6.11 | 1.42<br>[0.25] | (p=0)<br>(2) | -4.29<br>[0.00] | -2.62<br>-1.94<br>-1.61 | -4.61<br>-4.65 | 1.48<br>[0.23] |

Notes: Eq_f = equation form
Cr_val = critical values
AIC = Akaike criterion, SBC = Schwarz Bayesian criterion,
LM = Langrage Multiplier test

If the time series (variables) are non-stationary in their levels, they can be integrated with integration of order 1, when their first differences are stationary.

The observed t-statistics in the table 1 fail to reject the null hypothesis of the presence of a unit root for all variables in their levels confirming that they are non-stationary at 1% and 5% levels of significance. However, the results of the DF and ADF tests show that the null hypothesis of the presence of a unit root is rejected for all variables when they are transformed into their first differences.

Therefore, all series that are used for the estimation of ADF equations are non-stationary in their levels, but stationary and integrated of order one I(1), in their first differences. Moreover, the LM(1) test shows that there is no correlation in the disturbance terms for all variables in their first differences. These variables can be cointegrated as well, if there are one or more linear combinations among the variables that are stationary.

## 4. Cointegration Test

If these variables are being cointegrated, then there is a stable long-run linear relationship among them. Granger (1986) argued that a test for cointegration can thus be thought of as a pre-test to avoid "spurious regression" situations.

Following the studies of Chang (2002), Chang and Caudill (2005), Vazakidis and Adamopoulos (2010), since it has been determined that the variables under examination are integrated of order 1, then the cointegration test is performed. The testing hypothesis is the null of non-cointegration against the alternative that is the existence of cointegration using the Johansen maximum likelihood procedure, (Johansen and Juselious, 1992).

Once a unit root has been confirmed for a data series, the question is whether there exists a long-run equilibrium relationship among variables. According to Engle and Granger (1987), a set of variables, $Y_t$ is said to be cointegrated of order (d, b) - denoted CI(d, b) - if $Y_t$ is integrated of order d and there exists a vector, β, such that $\beta' Y_t$ is integrated of order (d-b). Cointegration tests in this paper are conducted using the method developed by Johansen (1988) and Johansen and Juselius (1990).

The multivariate cointegration techniques developed by Johansen (1988) and Johansen and Juselius (1992) using a maximum likelihood estimation procedure allows researchers to estimate simultaneously models involving two or more variables to circumvent the problems associated with the traditional regression methods used in previous studies on this issue. Therefore, the Johansen method applies the maximum likelihood procedure to determine the presence of cointegrated vectors in nonstationary time series.

Following the study of Chang and Caudill (2005), Johansen (1988) and Johansen and Juselius (1990) propose two test statistics for testing the number of cointegrated vectors (or the rank of Π): the trace ($\lambda_{trace}$) and the maximum eigenvalue ($\lambda_{max}$) statistics.

The likelihood ratio statistic (LR) for the trace test ($\lambda_{trace}$) as suggested by Johansen (1988) is:

$$\lambda_{trace} = -T \sum_{i=r+1}^{p} \ln(1-\hat{\lambda}_i) \qquad (5)$$

where $\hat{\lambda}_i =$ is the largest estimated value of i$^{th}$ characteristic root (eigenvalue) obtained from the estimated Π matrix, r = 0, 1, 2,…….p-1, and T is the number of usable observations.

The $\lambda_{trace}$ statistic tests the null hypothesis that the number of distinct characteristic roots is less than or equal to r, (where r is 0, 1, or 2,) against the general alternative. In this statistic $\lambda_{trace}$ will be small when the values of the characteristic roots are closer to zero (and its value will be large in relation to the values of the characteristic roots which are further from zero)

Alternatively, the maximum eigenvalue ($\lambda_{max}$) statistic as suggested by Johansen is:

$$\lambda_{\max}(r, r+1) = -T \ln(1-\hat{\lambda}_{r+1}) \qquad (6)$$

The $\lambda_{max}$ statistic tests the null hypothesis that the number of r cointegrated vectors is r against the alternative of (r+1) cointegrated vectors. Thus, the null hypothesis r=0 is tested against the alternative that r=1, r=1 against the alternative r=2, and so forth. If the estimated value of the characteristic root is close to zero, then the $\lambda_{max}$ will be small.

It is well known that Johansen's cointegration tests are very sensitive to the choice of lag length. Firstly, a VAR model is fitted to the time series data in order to find an appropriate lag structure. The Schwarz Criterion (SC) and the likelihood ratio (LR) test are used to select the number of lags required in the cointegration test. The Schwarz Criterion (SC) and the likelihood ratio (LR) test suggested that the value p=3 is the appropriate specification for the order of VAR model for UK. Table 2 presents the results from the Johansen (1988) and Johansen and Juselius (1992) cointegration test.

**Table 2. Johansen and Juselious Cointegration Tests (GDP, BC, SM, IND)**

| Country | United Kingdom | | | |
|---|---|---|---|---|
| | Johansen Test Statistics | | | |
| Testing Hypothesis | $\lambda_{trace}$ | Cr_v 5% 1% | $\lambda_{max}$ | Cr_v 5% 1% |
| $H_0$: r = 0 and r=1 | 69.07 | 39.89 45.58 | 40.50 | 23.80 28.82 |
| $H_0$: r ≤ 1 and r=2 | 28.56 | 24.31 29.75 | 20.70 | 17.89 22.99 |
| $H_0$: r ≤ 2 and r=3 | 7.85 | 12.53 16.31 | 7.31 | 11.44 15.69 |
| **Cointegrated vectors** | 1 (only for 1%) | | 1 (only for 1%) | |

Notes: Cr_v = critical values

The cointegration vector of the model of UK presented in table 2 has rank r<n (n=3). The process of estimating the rank r is related with the assessment of eigenvalues, which are the following: $\widehat{\lambda}_1 = 0{,}63$, $\widehat{\lambda}_2 = 0{,}40$, $\widehat{\lambda}_3 = 0{,}16$, $\widehat{\lambda}_4 = 0{,}01$ .

For UK, critical values for the trace statistic defined by equation (6) are 39.89 and 45.58 for Ho: r = 0 and 24.31 and 29.75 for Ho: r ≤ 1, 12.53 and 16.31 for Ho: r ≤ 2 at the significance level 5% and 1% respectively as reported by Osterwald-Lenum (1992), while critical values for the maximum eigenvalue test statistic defined by equation (7) are 23.80 and 28.82 for Ho: r = 0, 17.89 and 22.99 for Ho: r ≤ 1, 11.44 and 15.69 for Ho: r ≤ 2.

The results that appear in Table 2 suggest that the number of statistically significant cointegration vectors for UK is equal to 1 and is the following one:

$$GDP = 0.71 *SM + 0.24 *BC + 0.11 *IND \qquad (7)$$

It is obvious from the above cointegrated vector that stock market and credit market development have a positive effect on economic growth in the long-run. According to the signs of the vector cointegration components and based on the basis of economic theory the above relationships can be used as an error correction mechanism in a VAR model for UK respectively.

## 5. Vector Error Correction Model

Following the study of Chang and Caudill (2005), since the variables included in the VAR model are found to be cointegrated, the next step is to specify and estimate a vector error correction model (VECM) including the error correction term to investigate dynamic behaviour of the model.

Once the equilibrium conditions are imposed, the VEC model describes how the examined model is adjusting in each time period towards its long-run equilibrium state. Since the variables are supposed to be cointegrated, then in the short run, deviations from this long-run equilibrium will feed back on the changes in the dependent variables in order to force their movements towards the long-run equilibrium state. Hence, the cointegrated vectors from which the error correction terms are derived are each indicating an independent direction where a stable meaningful long-run equilibrium state exists.

The VEC specification forces the long-run behaviour of the endogenous variables to converge to their cointegrated relationships, while accommodates short-run dynamics. The dynamic specification of the model allows the deletion of the insignificant variables, while the error correction term is retained. The size of the error correction term indicates the speed of adjustment of any disequilibrium towards a long-run equilibrium state (Engle and Granger, 1987). The error-correction model with the computed t-values of the regression coefficients in parentheses is reported in Table 3.

The final form of the Error-Correction Model (ECM) was selected according to the approach suggested by Hendry (Maddala, 1992). The general form of the vector error correction model (VECM) is the following one:

$$\Delta LGDP_t = \beta_0 + \sum_i^n \beta_1 \Delta LGDP_{t-i} + \sum_i^n \beta_2 \Delta LBC_{t-i} + \sum_i^n \beta_3 \Delta LSM_{t-i} + \sum_i^n \beta_4 \Delta LIND_{t-i} + \lambda EC_{t-i} + \varepsilon_t \quad (8)$$

Where:

$\Delta$ is the first difference operator,

$EC_{t-1}$ is the error correction term lagged one period,

$\lambda$ is the short-run coefficient of the error correction term ($-1<\lambda<0$),

$\varepsilon_t$ is the white noise term.

The dynamic specification of the model allows the deletion of the insignificant variables, while the error correction term is retained. The error-correction model with the computed t-values of the regression coefficients in parentheses is reported in Table 3.

**Table 3. Vector Error Correction Model**

| **Independent Variable** | **Estimated coefficients** |
|---|---|
| Constant | 0.006[0.52] |
| $\Delta SM_{t-2}$ | 0.19[0.07] |
| $\Delta BC_{t-1}$ | 0.09[0.39] |
| $\Delta BC_{t-2}$ | -0.04[0.66] |
| $\Delta IND_{t-1}$ | -0.13[0.60] |
| $\Delta IND_{t-2}$ | 0.15[0.51] |
| $ECT_{t-1}$ | -0.01[0.04] |
| $R^2$ | 0.90 |
| DW | 2.03 |
| **Diagnostics tests** | |
| Serial Correlation | 2.29[0.05] |
| Functional Form | 0.01[0.89] |
| Normality | 0.97[0.32] |
| Heteroscedasticity | 24.10[0.00] |

[ ]= denote the probability levels,
Δ = Denotes the first differences of the variables.
$R^2$ = Coefficient of multiple determinations adjusted for the degrees of freedom (d.f),
DW= Durbin-Watson statistic

From the results of Table 3 we can see that a short-run increase of stock market index per 1% induces an increase of economic growth per 0.19% in UK, an increase of bank lending per 1% induces an increase of economic growth per 0.05% in UK, while an increase of productivity per 1% induces an increase of economic growth per 0.02% in UK. The estimated coefficient of $EC_{t-1}$ is statistically significant and has a negative sign, which confirms that there is not any a problem in the long-run equilibrium relation between the independent and dependent variables in 5% level of significance, but its relatively value (-0.02) for UK shows a satisfactory rate of convergence to the equilibrium state per period.

## 6. Granger Causality Tests

Granger causality is used for testing the long-run relationship between financial development and economic growth. The Granger procedure is selected because it consists the more powerful and simpler way of testing causal relationship (Granger, 1986).

The following bivariate model is estimated:

$$Y_t = a_{10} + \sum_{j=1}^{k} a_{1j} Y_{t-j} + \sum_{j=1}^{k} b_{1j} X_{t-j} + u_t \qquad (9)$$

$$X_t = a_{20} + \sum_{j=1}^{k} a_{2j} X_{t-j} + \sum_{j=1}^{k} b_{2j} Y_{t-j} + u_t \quad (10)$$

where: $Y_t$ is the dependent and $X_t$ is the explanatory variable and $u_t$ is a zero mean white noise error term in Eq (9), while $X_t$ is the dependent and $Y_t$ is the explanatory variable in Eq (10).

In order to test the above hypotheses the usual Wald F-statistic test is utilised, which has the following form:

$$F = \frac{(RSS_R - RSS_U)/q}{RSS_U/(T-2q-1)}$$

where:

RSSU= is the sum of squared residuals from the complete (unrestricted) equation

RSSR= the sum of squared residuals from the equation under the assumption that a set of variables is redundant, when the restrictions are imposed, (restricted equation)

T= the sample size and q = is the lag length.

The hypotheses in this test are the following:

$H_0$: X does not Granger cause Y, i.e. $\{\alpha_{11}, \alpha_{12},..\alpha_{1k}\}=0$, if $F_c <$ critical value of F.
$H_a$: X does Granger cause Y, i.e. $\{\alpha 11, \alpha_{12},....\alpha_{1k}\}\neq 0$, if $F_c >$ critical value of F (11)

and

$H_0$: Y does not Granger cause X, i.e. $\{\beta_{21}, \beta_{22},...\beta_{2k}\}=0$, if $F_c <$ critical value of F.
$H_a$: Y does Granger cause X, i.e. $\{\beta_{21}, \beta_{22},......\beta_{2k}\}\neq 0$, if $F_c >$ critical value of F (12)

(Katos, 2004).

The results related to the existence of Granger causal relationships among economic growth, stock market development, credit market development and productivity appear in table 4.

**Table 4. Granger causality tests**

| Countries | Dependent variable | Independent variable | F1 | F2 | Causal relations |
|---|---|---|---|---|---|
| | **GDP** | **SM** | 6,12 | 5,96 | GDP $\Leftrightarrow$ SM |
| | | **BC** | 0.40 | 4,75 | GDP $\Rightarrow$ BC |
| **UK** | | **IND** | 1,94 | 0,56 | No causality |
| | **SM** | **BC** | 8,75 | 1,30 | BC $\Rightarrow$ SM |
| | | **IND** | 3,05 | 3,22 | No causality |
| | **BC** | **IND** | 0,13 | 0,94 | No causality |

Critical values: 3.25 for UK

The results of Table 4 indicate that there is a bilateral causality between stock market development and economic growth, a unidirectional causal relationship between economic growth and credit market development with direction from economic growth to credit market development, and a unidirectional causal relationship between stock and credit market development with direction from credit market development to stock market development.

## 7. Conclusions

This paper employs with the relationship between financial development and economic growth for UK, using annually data for the period 1965-2007. The empirical analysis suggested that the variables that determine economic growth present a unit root. Once a cointegrated relationship among relevant economic variables is established, the next issue is how these variables adjust in response to a random shock. This is an issue of the short-run disequilibrium dynamics.

The short run dynamics of the model is studied by analysing how each variable in a cointegrated system responds or corrects itself to the residual or error from the cointegrating vector. This justifies the use of the term error correction mechanism. The error correction (EC) term, picks up the speed of adjustment of each variable in response to a deviation from the steady state equilibrium.

The VEC specification forces the long-run behaviour of the endogenous variables to converge to their cointegrating relationships, while accommodates the short-run dynamics. The dynamic specification of the model suggests deletion of the insignificant variables while the error correction term is retained.

The results of Granger causality tests indicated that there is a bilateral causal relationship between economic growth and stock market development and a unidirectional causal relationship between economic growth and credit market development with direction from economic growth to credit market development for UK. Therefore, it can be inferred that stock market development has larger effect on economic growth than credit market development in UK.

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