THE CASUAL RELATIONS BETWEEN THE ECONOMIC GROWTH AND FINANCIAL DEVELOPMENT IN GREECE: AN EMPIRICAL RESEARCH FOR THE CAUSALITY ANALYSIS

Spinthiropoulos Konstantinos  
PhD candidate, University of Macedonia

Garefalakis Alexandros  
PhD candidate, University of Portsmouth

Stiakakis Emmanouil  
Lecturer, University of Macedonia

Arvanitis Stavros  
Assistant Professor, Technological Education Institute of Crete

The main object of this research focuses on the empirical study of the causal relation among the degree of openness of the economy, the financial and economic growth using a multi-variate autoregressive model VAR. The long-term relation among GDP, the financial development and the degree of openness of the economy are based on the Cointegration test results. The Granger causality test, using the Vector Autoregression Estimate and the error correction model, suggests that there is a dynamic two-way causal link between the variables GDP and OPEN. In addition, there is an one way causal link between the variables GDP and FD and finally we observed an one way causal link between the variables OPEN and FD.

JEL Codes: C010, C100, C220.

Keywords: Financial development, economic growth, degree of openness of economy, model VAR, cointegration, Granger's Causality.

INTRODUCTION

Despite of their study object, an issue of extensive research is always the connection between two variables elements. Next to this, variables as the economic growth and financial development are significant motives for older and also younger researchers. Which of the variables has causality to the others has not been proved yet. Also, the analog time findings that are under study are not the same. The positive effect of the financial growth on the economic development is generally accepted. But there is a great difficulty in confirming the credibility of this view even nowadays. Following to this, a lot of researchers have suggested, we have already mentioned this, that the theoretical study and the empirical
tests are necessary for judging the credibility of a view. Schumpeter (1911) was one of the first researchers who tried to explain scientifically the relation between the financial development and economic growth. His main object of research was the financial services which are supplied by the intermediaries and he claimed that a necessary condition for the economic development is the promotion of innovations (Ghali, 1999; Floros, 2004).

Speaking about Mckinnon-Saw School, the impact of the state interaction to the financial development is a matter of discussion. This School clearly sets the fact that any state limitation to the Bank System leads to direct and negative results to the evolution of the Financial Sector. Specifically Mckinnon (1973) and Shaw (1973) believe that there is a parallel bad effect on the development of the financial sector and also on the economic growth because of the state limitations to the bank system. Greenwood and Jovanovic (1990), Bencivenga and Smith (1991), Shan, Morris and Sun (2001) agree as well on the same results. As far as the supporting or not of the Mckinnon school is concerned, several researchers such as Robinson (1952) and later Friedman and Schwartz (1963) support the theoretical view that the financial development has causality to the economic development coming from the increasing demand of financial-economic services regarding the fund demand.

Focusing on Greek market, we should pinpoint that, despite of the several attempts at analyzing the Athens Stock Exchange (Alexakis and Xanthakis, 1995; Mills et al., 2000; Sariannidis et al., 2006; Drimbetas et al., 2007) there is a limited number of studies that support the causal relation between the economic growth and the financial growth.

Next to this, all of these opinions are supported by the finding that the fund offer-GTP ratio, which is a typical measurement of financial growth, is the opposite of the velocity of money circulation speed. There is also a possible relation of the decline trend of the velocity of money circulation speed concerning the positive correlation between the standard of the financial development and the actual GTP. Accepting this condition as a fact, it would influence income elasticity demand of money, which is bigger than unit. Eventually, if we take this suggestion into account, the causality direction will lead from GTP to financial development.

A reference to the degree of openness of the economy concerns the import and export-gross domestic product rate. It is a matter of great importance the link between the economical development and the degree of openness of the economy. Apparently, an economy export oriented is mainly interested in export products.

Additionally, according to Solow (1957) who established the modern-classic models, one of the key factors that has an impact on the economic development is the technological progression. The commercial policy has a great influence on the long-term development through its effect to the technological progression which is a point of view that is claimed by the new theories of economic growth. In these models, the import of new technological products and at the same time the market’s capacity of enlargement through the production activity gaining bigger returns by the new products and also the effect to country’s production in research sector are some of the gains based on the degree of openness of the economy.

The interaction of trade might encourage the long-term economic development under
the condition that trade protection policy improves the investments on the sectors of research and technology for the countries with comparative advantage to these products according to Grossman and Helpman (1992).

It is also useful to define the problems that previous studies had to face because of two major limitations. The first one concerns the cointegration techniques that are used by the majority of the researchers and these are the residual-based cointegration test based on Engle and Granger (1987) or the maximum likelihood test associated with Johansen(1988) and Johansen and Juselius(1990). The main disadvantage of these tests is that they are not suitable for samples with too small size (Nerayan and Smyth, 2005; Odhiambo, 2009; Floros, 2008) and secondly these studies gave too much importance on the cross-sectional data, and the specific results might not be representative for country issues. So the cross sectional method puts the countries at the same group even though every country has a different financial development and this fact complicates the efficient study on the country specific impact of financial development on economic growth and vice versa (Odhiambo, 2009; Odhiambo, 2008; Ghirmay, 2004; Qnah, 1993; Casseli et al, 1996; Floros, 2007).

And the structure of the study is: Section 2 presents the data which was used for the analysis of the causal relation among the economic growth, the financial development and the degree of openness of Greek economy. Section 3 describes the regression results. Section 4 presents in summary the tests for unit roots. Cointegration is also the topic of Section 5. Section 6 concerns the findings of the research for the existence of short-term relation and the results of Granger Causality Test as well. Finally, some conclusive and final observations are provided in section 7.

DATA
Furthermore, we use the following triplex-variable VAR model in order to analyze the causal relation among the economic growth, the financial development and the degree of openness of economy:

\[ GDP = f(FD, OP) \] (1)

\( GDP \) is the Gross Domestic Product.

\( FD \) is the financial development\(^1\).

\( OP \) is opening degree of the economy\(^2\).

According to the economic theory, the financial development is measured by the money supply-GTP rate Jung (1986), while the degree of openness of economy is calculated by the export and import sum-GTP rate Liu et al (1997). The analysis of the study is associated with annual but not influenced by the inflation information referring to the period since 1960 and after: I until 2006: IV and are based on data by OECD Business Sector Data Base. All the data about the time table is symbolized with logarithms targeting to achieve their fluctuation stagnation and the letter L marks ahead every variable.

Attempting the cointegration of the model variables, the first factor we should take into account is that these variables should share common stochastic trend issues, and additionally the first differences should be stagnated and the residuals in the first type of equation of augmented Dickey-Fuller test as well. Relied on the economic theory, the
results might not be confirmed in every occasion, concerning the variables with stochastic trend.

The triplex-variable model Var will be under research and following to this the next step of the procedure will be the analysis of the time series about the stochastic trends applying the tests of unit root of augmented model Dickey-Fuller (1979) and Phillips-Perron’s for the calculation of the separate time series gaoling to collect the appropriate data regarding the time the variables are integrated.

**ALLOCATION OF TURNOVERS AND ANALYSIS OF REGRESSION**

In Table 1, the turnover allocation of the model variables is statistically addressed. The turnover allocation is thin-convex 2.15 and positively asymmetric right 0.35. In addition, the average of model allocation is positive and equal to 4.64E-13. Associating with the statistical function Jarque – Bera (JB) the allocation is not the regular one, but the use of Dickey-Fuller test (augmented test) and Phillips-Perron test about the existence of unit root shows that the course of turnovers for every variable leads successfully to stagnation for the first differences.

<table>
<thead>
<tr>
<th>Variables: FD-GDP-OPEN</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations</td>
<td>47</td>
</tr>
<tr>
<td>Average</td>
<td>4.64E-13</td>
</tr>
<tr>
<td>Median</td>
<td>-1207.336</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>13685.08</td>
</tr>
<tr>
<td>Asymmetry</td>
<td>0.358300</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>2.156975</td>
</tr>
<tr>
<td>Jarque-Bera</td>
<td>2.397404</td>
</tr>
<tr>
<td>Observations *R² (ARCH–LM Test)</td>
<td>36.81573</td>
</tr>
</tbody>
</table>

Obviously we observe that the function 1 has wrong prefix because one of the factors, apart from the derived, should have negative prefix. It is statistically significant at 1% (>0.0000) because the calculated price of the statistical element F is 21.25 and the p-value is 0.00. The only importance of FD variable is pinpointed by the testing of the single factors by t test. So the t test is equal to the evaluation of price p, for the variable FD the p value is 0.00 smaller than any importance standard and if we take (even only 10%) eventually we are able to reject the hypothesis that this variable factor is zero and so we come up with the conclusion about the statistically significance of the relation to the depended variable. As far as the variable OPEN is concerned, the price p – value is 0.62 higher than the highest standard of importance which we could examine (meaning 10%) and we reveal that its connection to the depended variable is not statistically important. It is necessary to examine the statistic Durbin-Watson statistic = 0.09 in order the autocorrelation of residuals to be researched. Following to this, there is a autocorrelation of 1st degree because the DW = 0.09 so DW< DU. So our model is not reliable if we take into account the autocorrelation issue which arises. Then, the presentation of the autocorrelation results by Breusch & Gottfrey, of
The Casual Relations Between the Economic Growth and Financial Development in Greece:

regularity by Jack-Bera, Heteroskedasticity by White and model ARCH is the following:

\[
\text{White Heteroskedasticity Test:}
\]
\[
\text{F-statistic } 12.97804 \quad \text{Probability } 0.000001
\]
\[
\text{Obs*R-squared } 25.98036 \quad \text{Probability } 0.000032
\]

\[
\text{Breusch-Godfrey Serial Correlation LM Test:}
\]
\[
\text{F-statistic } 208.5359 \quad \text{Probability } 0.000000
\]
\[
\text{Obs*R-squared } 42.70002 \quad \text{Probability } 0.000000
\]

\[
\text{ARCH Test:}
\]
\[
\text{F-statistic } 176.3769 \quad \text{Probability } 0.000000
\]
\[
\text{Obs*R-squared } 36.81573 \quad \text{Probability } 0.000000
\]

\[
\text{Chow Breakpoint Test: } 1967
\]
\[
\text{F-statistic } 1.986037 \quad \text{Probability } 0.131099
\]
\[
\text{Log likelihood ratio } 6.377146 \quad \text{Probability } 0.094635
\]

\[
\text{Chow Forecast Test: Forecast from 1987 to 2006}
\]
\[
\text{F-statistic } 2545316 \quad \text{Probability } 0.000000
\]
\[
\text{Log likelihood ratio } 801.4605 \quad \text{Probability } 0.000000
\]

In Table 3 the autocorrelation issue is noticed, regarding to the test Breusch & Godfrey because the Probability is 0,00 and this means that 0,00<0,05 or 5%.

Speaking about White test, the Probability is about 0,00 <0,05 or 5%. Next to this, an issue of Heteroskedasticity is set and also the fluctuations are not stable in different timing. Using the ARCH Lm test, the diagnostic test of above regression model can go further and at the same time the independence test of residuals and of square residuals to verify the
DW results. The model stability is evaluated examining the graphs of the stability test. The notification is the following: Prob=0.13>or 5%. This allows us to claim that the rates of the 2 models (because we separate the sample in 1974) are not stable.

Chow Forecast test makes us gather that the predictive capacity of the model is not credible because Prob=0.00<0.05 or 5% and the autocorrelation issue a & b degree of Durbin – Watson tests and Breusch & Godfrey tests are confirmed as well. Finally, the results of Ramsey test lead us to the conclusion that prob=0.026<0.05 or 5% which shows that model specialization is not appropriate.

Regarding the testing of trusting time of recursive estimate test (ols only), its increasing trend is underlined. At the end of 90’s the line begins to cline right and up, and in next decade the limits of dissuasion are defined by this track. Eventually, our analysis pinpoints that several problems come up. So the autocorrelation and the low predictive capacity of

![Figure 1: Cusum Test - Confidence Interval](image)

the model, which make logarithm or semi-logarithm types of models to be preceded by most of the researchers, are among them. The basic goal of every researcher is the successful prediction of the route of the variables in short-terms.

The examined model addresses the fake regression which limits its predictive capacity. This fact is clearly supported by the line type of regression where the ratio Durbin-Watson = 0.27< R-squared = 0.98. Our suggestion refers to the semi-logarithm type of regression with independent variable the GDP dependent variables the FD and the OPEN
AUGMENTED Dickey-Fuller Test (ADF Test)

The augmented ADF test makes reference to the t-statistics of \( \tilde{a}_2 \) coefficient and the regression is the following:

\[
\Delta X_t = \delta_0 + \delta_1 t + \delta_2 X_{t-1} + \sum_{i=1}^{k} \alpha_i \Delta X_{t-i} + u_t
\]  

(2)

The existence of unit root of \( X_t \) is the issue for testing by the ADF regression, namely in the logarithm of all model variables at time \( t \). The first differences with \( k \) lags are expressed by the variable \( \Delta X_{t-i} \) and finally the errors of autocorrelation are adjusted by variable \( u_t \).

Next, the coefficients \( \delta_0, \delta_1, \delta_2 \) and \( \alpha_i \) are being estimated. The null and the alternative hypothesis for the existence of unit root in variable \( u_t \) is:

\[ H_0 : \delta_2 = 0 \]
\[ H_1 : \delta_2 < 0. \]

We should mention that apart from Dritsakis and Adamopoulos (2004) we also use the Akaike information criterion (AIC) (1974), following to the proposal by Engle and Yoo (1987), to define the optimal specification of Equation (2). The computing of Equation 2 targets the ideal order of the model, over a selected grid of values of the number of lags \( k \) and gathering that the value of \( k \) at which the Akaike attains its minimum. Additionally, the distribution of the augmented Dickey-Fuller is non-regular and the critical values are suggested by Mackinnon (1991).

Results of Augmented Dickey-fuller Test and Phillips-perron

The Breusch – Godfrey test is used or the Lagrange (LM) multipliers for the autocorrelation test of residuals. The information criterion by Akaike (AIC, 1973) or Schwartz (SCH, 1978) is applied for the determination of the acceptable number of lags. We also observe that the variable GDP is not stable at the Levels and 1st differences, in any type of the equation of the augmented Dickey-Fuller test. According to the Phillips - Perron test, the variable GDP is unstable in any type of the equation levels, but it is stagnated at the 1st differences referring to the type of equation with Steady State and Trend where the stagnation is characterized as powerful. As far as the levels are concerned, the variable LFD is not stable in any type of the equation of the augmented Dickey-Fuller test. It becomes stagnated at the 1st differences and in particular at the 1st type of equation with zero (0) lags accounting the lowest possible prices Akaike & Schwarz. So if we take into account that the price Durbin-Watson is equal

<table>
<thead>
<tr>
<th>Tests for the Existence of Unit Root Using the Augmented Dickey-Fuller &amp; Phillips-Perron Test</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Augmented DF test</strong></td>
</tr>
<tr>
<td><strong>Phillips-Perron test</strong></td>
</tr>
<tr>
<td>Variables</td>
</tr>
<tr>
<td>LFd</td>
</tr>
<tr>
<td>Gdp</td>
</tr>
<tr>
<td>LOpen</td>
</tr>
</tbody>
</table>
to 1.89, the autocorrelation issue will not exist.

At the levels, we notice that there is no stagnation regarding the LOPEN variable in any type of equation of Dickey-Fuller test and Phillips-Perron. In the first differences the application of the Phillips-Perron test with the type of equation of Steady State allows the total stagnation, where the stagnation is called powerful (stable at 1%, 5%, 10%).

Furthermore, it is noticeable that the time series are stable at the first differences and this fact leads us to overcome the previous empirical research and go further but at the same time to test the existence of cointegration where the stagnation of the time series is considered as a necessary condition. Following to this, we will not be able to proceed successfully to the cointegration test of our variables, if the variables are not stagnated at the same standard.

**COINTEGRATION TEST**

The method of Engle-Granger (1987) examines the grade of integration of all the variables and the methodology of unit roots is applied so the cases are the following two: (a) The grade of integration of all the variables is at the same level so the procedure of cointegration is continued. (b) The grade of integration of the variables is not at the same level so we gather that there is no integration among the examined variables or the integration exists only for the variable being at the same level of integration and eventually we continue the procedure with the second ones. If all the variables are at the same level of integration, we will approach the equation of integration concerning the existence of long-term balanced relation, by applying the method of minimum squares,

\[ Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \ldots + \beta_k X_{kt} + U_t \]  

Additionally, the unit root test is used to the residuals of the previous equation and in particular to the following equation:

\[ \Delta U_t = \delta U_{t-1} + \sum_{i=1}^{n-1} \beta_i \Delta U_{t-1} + \epsilon_t \]

<table>
<thead>
<tr>
<th>Stagnation Test of the Residuals-Cointegration</th>
<th>( t )-statistic</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test</td>
<td>-2,013283</td>
<td>0,0433</td>
</tr>
<tr>
<td>Crucial values</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1%</td>
<td>-2,616203</td>
<td></td>
</tr>
<tr>
<td>5%</td>
<td>-1,948140</td>
<td></td>
</tr>
<tr>
<td>10%</td>
<td>-1,612320</td>
<td></td>
</tr>
</tbody>
</table>

In our research, the residuals are represented by the KOS variable. The augmented Dickey-Fuller test is applied targeting to study the existence of stagnation at KOS variable (which represents the connection of the residuals \( \Delta U_t = \delta U_{t-1} \)). Speaking about the stagnation of the residuals, we should notice that the \( t \)-statistic for \( p=0 \), is bigger than the
critical price at the grade of importance 1% and we conclude that the KOS variable is not stagnated. In the other hand, at the grade of importance 5% and 10% the critical prices are bigger than the t-statistic and obviously the KOS variable reaches stagnation at the grade 5% and 10%.

VECTOR AUTOREGATION ESTIMATES-ERROR CORRECTION AND GRANGER CAUSALITY-RESULTS

Using the Vector Autoregression Estimate and the Error correction model, the existence of short-term balanced relation is supported or not. The Table 6 shows the grade of Var model, with base LR, is 1 (meaning that the time postponement is 1).

<table>
<thead>
<tr>
<th>Table 6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lag Length Criteria</strong></td>
</tr>
<tr>
<td>Lag</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
</tbody>
</table>

VAR Lag Order Selection Criteria- Included observations: 43.

Following to the appropriate evaluation of the grade of Var model, we proceed to the test of the Vector Autoregression Estimate. The Table 7 makes clear that the exterior and interior variables does not give possible cointegrated vectors and we focus on the fact that the t-statistic is not statistically important to the turnover of the above test.

<table>
<thead>
<tr>
<th>Table 7</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vector Autoregression Estimate</strong></td>
</tr>
<tr>
<td>GDP</td>
</tr>
<tr>
<td>GDP(-1)</td>
</tr>
<tr>
<td>(0.15994)</td>
</tr>
<tr>
<td>[6.81637]</td>
</tr>
<tr>
<td>GDP(-2)</td>
</tr>
<tr>
<td>(0.16604)</td>
</tr>
<tr>
<td>[-0.44300]</td>
</tr>
<tr>
<td>LOPEN(-1)</td>
</tr>
<tr>
<td>(1849.93)</td>
</tr>
<tr>
<td>[-0.75442]</td>
</tr>
<tr>
<td>LOPEN(-2)</td>
</tr>
<tr>
<td>(1900.31)</td>
</tr>
<tr>
<td>[0.45777]</td>
</tr>
</tbody>
</table>

Taking into account the results of Table 7, we reject the case of the existence of cointegrated vector and as a result the existence of short-term balanced relation among the variables of the model. It is obvious that even if we proceed to the Error correction Model, the coefficient of the residuals Kos is not possible to be statistically important. The absence of short-term relation among the variables reveals that the coefficient $\lambda$ is not able to correct
the relation of disequilibrium during the examined period and the conversion will not be slow in economies like the Greek one. Dritsakis and Adamopoulos (2004) came up with the same findings researching about Greece in a different time period.

The Granger Causality Test represented the causal relations among the tested variables of the model. The Figure 2 shows that there is a causal relation of causality among the variables. Concerning the GDP and the LOPEN, there is a two-way causal relation of causality. Additionally the variables LFD and LOPEN have an one-way causal relation. Finally we observe an one-way causal relation between the variables GDP and LFD.

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>Observations</th>
<th>F-Statistic</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>LFD does not Granger Cause GDP</td>
<td>45</td>
<td>562.83</td>
<td>0.00702</td>
</tr>
<tr>
<td>GDP does not Granger Cause LFD</td>
<td>45</td>
<td>183.72</td>
<td>0.17245</td>
</tr>
<tr>
<td>LOPEN does not Granger Cause GDP</td>
<td>45</td>
<td>111.27</td>
<td>0.00014</td>
</tr>
<tr>
<td>GDP does not Granger Cause LOPEN</td>
<td>45</td>
<td>994.58</td>
<td>0.00031</td>
</tr>
<tr>
<td>LOPEN does not Granger Cause LFD</td>
<td>45</td>
<td>489.67</td>
<td>0.01252</td>
</tr>
<tr>
<td>LFD does not Granger Cause LOPEN</td>
<td>45</td>
<td>215.50</td>
<td>0.12917</td>
</tr>
</tbody>
</table>

In Table 8, we notice that the Probability of the variables in the total cases, using the Granger Causality Test, is lower than 5%. In this case, we conclude that there is a causal relation but there is no causal relation among the variables.

CONCLUSIONS
We gather that there is cointegration for the variables of the model we study because the time order is stagnated accounting the hypothesis $H_0$ (where $H: \rho \neq 1 \delta_2 < 0$) for KOS variable and concluding that the three variables of the model are stagnated at the 1st differences. That case makes obvious that the variables are moving together and to the same direction in long-terms, but this will not be possible in short-terms.

The results of Vector Autoregression Estimate lead us to support that short-term relation does not exist as there is no possible cointegrated vector which connects the variables of our model and it is a matter of great importance that the statistical $\lambda$ of the residuals is not able to reach prices much lower than 5% in order to be statistically significant. Next to this, in short-time level, the referred variables do not move to the same direction although they are connected by a long-term relation. In some economies, also in Greece, it is mentioned the existence of a long-term relation and at the same time the absence of a short-time relation among the variables which are examined by this study.

In long-terms, the movements of the sectors, that the variables belong to, are connected by a mathematic relation. We knew in advance that this study would lead us to these findings. The simultaneous investing actions of million of investors have a significant influence on the stock market. Additionally, several economic events, domestic or universal, effect to the investors’ behavior so that in future-terms the powers of supply and demand recreate an "hypothetical balance". So we argue that there is a two-way connection of influence between the financial development and the economic growth. Approaching a further study about the causal relation of the variables would reveal us rational findings regarding the connection among them.

Obviously, the financial development effects positively on the economic growth. It is well-known the impact of the bank sector on the route of market price. The route of bank sector is a determining factor for the positive or negative route of market price and the route of ratio, which estimates the economic development, is influenced as well.

NOTES

1. FD=M/GDP and m is the money offer.
2. OP=(Exports + Imports)/GDP.

REFERENCES


