FINANCIAL DEVELOPMENT AND ECONOMIC GROWTH: AN EMPIRICAL RESEARCH ABOUT GREECE - COINTEGRATION TEST

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Abstract

In this research we attempt to study empirically the casual relation among the degree of openness of the economy, the financial and economic growth using a multi-variate autoregressive model VAR. The Cointegration test results define the long-term relation among GDP, the financial development and the degree of openness of the economy.

JEL codes: C010, C100, C220

Key Words: financial development, economic growth, degree of openness of economy, model VAR.

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1. INTRODUCTION

The connection between two variables elements is always an issue of extensive research despite of their study object. Especially variables as the economic growth and financial development are motivating older and younger researchers. Nobody has proved yet which of the variables has causality to the others. Of course the analog time findings that are studied are different. In general, it is a common belief that the financial growth has a positive impact to the economic development. But the credibility of this view is very difficult to be confirmed even in our days. Next to this a number of researchers have mentioned, we have already mentioned this, that the credibility of a view should be studied theoretically and tested empirically. One of the first researchers who attempted to explain scientifically the relation between the financial development and economic growth was Schumpeter (1911). He focused on the financial services which are supplied by the intermediaries and supported that the promotion of innovations is a necessary condition for the economic development Ghali (1999).

As far as the impact of the state interaction to the financial development is concerned, it is a matter of discussion for Mckinnon-Saw School. It is a fact that this School believes that any state limitation to the Bank System will have direct and negative results to the evolution of the Financial Sector. Specifically Mckinnon (1973), and Shaw (1973) report that the state limitations to the bank system not only have a bad influence on the development of the financial sector but also on the economic growth. Greenwood and Jovanovic (1990), Bencivenga and Smith (1991), Shan, Morris and Sun (2001) have as well the same opinion. Concerning the supporting or not of the Mckinnon school, there are several researchers such as Robinson (1952) and later Friedman and Schwartz (1963) who believe in the theoretical aspect that the financial development has causality to the economic development as a result of the increasing demand of financial-economic services concerning the fund demand. As far as the Greek market is concerned, although many studies analyze 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 dealt with the causal relation between the economic growth and the financial growth.

All of these views are based on the conclusion that the fund offer-GTP ratio, which is a typical measurement of financial growth, is the opposite of the velocity of money circulation speed. The positive correlation between the standard of the financial development and the actual GTP is probably related to the decline trend of the velocity of money circulation speed. If we took this into account as a fact, it would have impact to income elasticity demand of money, which is bigger than unit. Eventually, according to this opinion the causality direction will lead from GTP to financial development.

Speaking about the degree of openness of the economy we actually mean the import and export-gross domestic product rate. It is very interesting the connection between the economical development and the degree of openness of the economy. It is obvious that an economy export oriented focuses on export products.

In addition one of the key factors that influences the economic development is the technological progression according to Solow (1957) who established the modern-classic models. The new theories of economic growth shows that the commercial policy has a great impact on the long-term development through its influence to the technological progression. At these models, the degree of openness of the economy grants access to the import of new technological products, when at the same time the market capacity is enlarged by the production activity gaining bigger returns by the new products and the country’s production in research sector is influenced.

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

The structure of the study is the following: Section 2 describes the data which was taken into account for the analysis of the casual relation among the economic growth, the financial development and the degree of openness of Greek economy. Section 3 shows the regression findings. Section 4 describes in summary the tests for unit roots. Section 5 is about the cointegration. Finally section 6 provides some conclusive and final observations.

2. DATA

For the analysis of the casual relation among the economic growth, the financial development and the degree of openness of economy we use the following triplex-variable VAR model:
GDP = f (FD, OP)  \textit{(equation 1)}

GDP is the Gross Domestic Product
FD is the financial development $^1$
OP is opening degree of the economy $^2$

The financial development, according to the economic theory, is calculated by the money supply-GDP rate Jung (1986) while the degree of openness of economy is accounted by the export and import sum-GDP rate Liu et al (1997). We used a data in order to analyse the research which is annual but not influenced by the inflation covering the period since 1960 and after: I until 2006:IV and are based on data by OECD Business Sector Data Base. All the information about the time table is given as logarithms so as to achieve their fluctuation stagnation and they are marked with an L ahead of every variable.

Targeting the model variables to be cointegrated, they should be under common stochastic trend, the first differences should be stagnated and also the residuals in the first type of equation of augmented Dickey-Fuller test. If we take into account the economic theory it will not be possible in every occasion to come to safe results concerning the variables with stochastic trend.

Concerning the triplex-variable model Var we will proceed to the analysis of the time series about the stochastic trends using the tests of unit root of augmented model Dickey-Fuller (1979) and Phillips-Perron’s for the calculation of the separate time series targeting to collect information about the time the variables are integrated.

3. ALLOCATION OF TURNOVERS AND ANALYSIS OF REGRESSION

Table 1: Statistics of the performances of the Graphic Regression Model

<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>

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

Table 2: Graphic Regression Model

<table>
<thead>
<tr>
<th>Period</th>
<th>1960 2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations</td>
<td>47</td>
</tr>
<tr>
<td>Dependent Variable</td>
<td>Gross Domestic Product GDP</td>
</tr>
<tr>
<td>Other Variables</td>
<td>Stable C</td>
</tr>
<tr>
<td>Degree of Openness of Economy OPEN</td>
<td>Financial Development FD</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.491365</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.468245</td>
</tr>
</tbody>
</table>

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$^1$ FD=M/GDP and m is the money offer
$^2$ OP=(Exports + Imports)/GDP
S.E. of regression 13992.65  
Sum squared resid 8.61E+09  
Log likelihood -513.8156  
Durbin-Watson stat 21.99215  
Akaike info criterion 22.11025  
Schwarz criterion 21.25298  
Prob(F-statistic) 0.000000

GDP= 89957.36-562531.3*FD-89486.81*OPEN (from equation 1)

We notice that the function 1 has wrong prefix because one of the factors, apart from the derived, should have negative prefix. The calculated price of the statistical element F is 21.25 and the p-value is 0.00 so it is statistically important at 1% (>0,0000). The testing of the single factors by t test shows the only importance of FD variable. Specifically, this is equivalent to the testing of the zero hypothesis H0:bj=0, so the observed variance of \( \hat{b}_j \) zero should be performed according to the sampling fluctuation. 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 conclude that the relation to the depended variable is statistically important. For the variable OPEN the price p-value is 0.62 higher than the highest standard of importance which we could examine (meaning 10%) and we come to the conclusion that its connection to the depended variable is not statistically important. In order to study the autocorrelation of residuals, we examine the statistic Durbin-Watson statistic = 0.092995. The DW = 0.09 so DW< DU, and there is a autocorrelation of a degree. Because of autocorrelation issue which is pinpointed, our model is not credible. Next to this, we will make the presentation of the autocorrelation results by Breusch & Godfrey, of regularity by Jack-Bera, Heteroskedasticity by White and model ARCH.

Table 3: Initial Model Tests

<table>
<thead>
<tr>
<th>Test</th>
<th>F-statistic</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>White Heteroskedasticity Test:</td>
<td>12.97804</td>
<td>0.000001</td>
</tr>
<tr>
<td>Breusch-Godfrey Serial Correlation LM Test:</td>
<td>208.5359</td>
<td>0.000000</td>
</tr>
<tr>
<td>ARCH Test:</td>
<td>176.3769</td>
<td>0.000000</td>
</tr>
<tr>
<td>Chow Breakpoint Test: 1967</td>
<td>1.986037</td>
<td>0.131099</td>
</tr>
<tr>
<td>Chow Forecast Test: Forecast from 1987 to 2006</td>
<td>6.377146</td>
<td>0.094635</td>
</tr>
</tbody>
</table>

In table 3 we observe the autocorrelation issue, according to the test Breusch & Godfrey because the Probability is 0.00 and this leads to 0.00<0.05 or 5%. As far as the White test is concerned, the Probability is about 0.00 <0.05 or 5%. So we have an issue of Heteroskedasticity and the fluctuations are not stable in different timing. Applying the ARCH Lm test, the diagnostic test of above regression model can be continued and also and also the DW results to be confirmed by the independence test of residuals and of square residuals. We evaluate the model stability looking through the graphs of the stability test. We present the following: Prob=0.13 or 5% . Following to this, the rates of the 2 models (because we separate the sample in 1974) are not stable.

Chow Forecast test leads us to claim that the predictive capacity of the model is not appropriate because Prob=0.00<0.05 or 5% confirming the autocorrelation issue a & b degree of Durbin – Watson tests and Breusch & Godfrey tests as well. Finally, according to the results of Ramsey test we realize that prob=0.026<0.05 or 5% which means that model specialization is not right.
As far as the testing of trusting time of recursive estimate test (ols only) is concerned, we mention that it is increased. At the end of 90’s the line begins to cline right and up, a track which in next decade sets the limits of dissuasion. Our analysis provides us the information to claim that several problems come up. Some of these are the autocorrelation and the low predictive capacity of the model which makes most of the researchers to proceed logarithm or semi-logarithm types of models. The right prediction of the route of the variables in the near future is the main target of every researcher.

In this research, the same problems are presented that we have already referred before. The fake regression that is presented by the examined model reduces the predictive capacity of the model. It is clearly defined by the line type of regression where the ratio Durbin-Watson=0.27< R-squared=0.98.

We suggest the semi-logarithm type of regression with independent variable the GDP dependent variables the FD and the OPEN in logarithm type.

### 4. AUGMENTED DICKEY-FULLER TEST (ADF TEST)

The augmented ADF test refers to the t-statistics of 2 coefficient on the following regression:

\[ Δ^2 X_t = δ_0 + δ_1 X_{t-1} + δ_2 X_{t-2} + \sum_{i=1}^{δ} α_i Δ X_{t-i} + u_t \]  

(equation 2)

The ADF regression tests for the existence of unit root of \( X_t \), namely in the logarithm of all model variables at time t. The variable \( Δ X_{t-1} \) expresses the first differences with k lags and finally variable \( u_t \) adjusts the errors of autocorrelation. The coefficients \( δ_0, δ_1, δ_2 \) and \( α_i \) are being estimated. The null and the alternative hypothesis for the existence of unit root in variable \( X_t \) is:

\[ H_0 : δ_1 = 0 \quad H_1 : δ_1 < 0 \]

Dritsakis and Adamopoulos (2004) and we as well follow the proposal by Engle and Yoo (1987) using Akaike information criterion (AIC) (1974), to determine the optimal specification of Equation (2). The appropriate order of the model is determined by calculating Equation 2, over a selected grid of values of the number of lags k and finding that value of k at which the Akaike attains its minimum. The distribution of the augmented Dickey-Fuller is non-regular and the critical values suggested by Mackinnon (1991) are used.
4.1. RESULTS OF AUGMENTED DICKEY-FULLER TEST AND PHILLIPS-PERRON

Table 4: Tests for the existence of unit root using the augmented Dickey-Fuller & Phillips-Perron test.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Augmented DF test</th>
<th>Phillips-Perron test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Levels</td>
<td>1st Differences</td>
</tr>
<tr>
<td>LFd</td>
<td>---</td>
<td>Type Equation</td>
</tr>
<tr>
<td>Gdp</td>
<td>---</td>
<td>1/0</td>
</tr>
<tr>
<td>LOpen</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

For the autocorrelation test of residuals the Breusch – Godfrey test is applied or the Lagrange (LM) multipliers. The information criterion by Akaike (AIC, 1973) or Schwartz (SCH, 1978) are used for the definition of the appropriate number of lags. At the Levels and 1st differences, the variable GDP is not stable in any type of the equation of the augmented Dickey-Fuller test. The Phillips - Perron test clarifies that the variable GDP is not stable in any type of the equation concerning levels, but there is stagnation at the 1st differences concerning the type of equation with Steady State and Trend where the stagnation is powerful. At the levels, the variable LFD is not stable in any type of the equation of the augmented Dickey-Fuller test. It becomes stable at the 1st differences and specifically at the 1st type of equation with zero (0) lags taking into account the lowest possible prices Akaike & Schwarz. There is no autocorrelation issue because the price Durbin-Watson is equal to 1.89.

At the levels, the LOPEN variable is not stable in any type of equation of Dickey-Fuller test and Phillips-Perron. The stagnation is succeeded in the first differences using the Phillips-Perron test with the type of equation of Steady State where the stagnation is powerful (stable at 1%, 5%, 10%). In addition, the observation that the time series are stable at the first differences, it allows us to go further to the empirical research and examine the existence of cointegration where the stagnation of the time series is a necessary condition. If the variables are not stable at the same grade, we will not be able to proceed to the cointegration test of our variables.

5. COINTEGRATION TEST

The method of Engle-Granger (1987) approaches the grade of integration of all the variables using the methodology of unit roots and the cases are the following two:  a) The grade of integration of all the variables is at the same standard so we continue the procedure of cointegration.  b) The grade of integration of the variables is not at the same standard for all of them so we conclude that there is no integration among the examined variables or there is integration just for the variable which have the same grade of integration and next to this we go on the procedure with these ones. In case that all the variables are at the same grade of integration, we evaluate, using the method of minimum squares, the equation of integration about the existence of long-term balanced relation.

\[ Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \cdots + \beta_n X_{nt} + \epsilon_t \]  (equation 3)  The unit root test is applied to the residuals of the previous equation and more specifically to the following equation:

\[ \Delta u_t = \delta \Delta u_{t-1} + \sum_{j=1}^{p} \beta_j \Delta u_{t-j-1} + \epsilon_t . \]
Table 5: Stagnation test of the residuals-Cointegration

<table>
<thead>
<tr>
<th>Augmented Dickey-Fuller test</th>
<th>t-statistic</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-2.013283</td>
<td>0.0433</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Crucial values</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1%</td>
<td>-2.616203</td>
</tr>
<tr>
<td>5%</td>
<td>-1.948140</td>
</tr>
<tr>
<td>10%</td>
<td>-1.612320</td>
</tr>
</tbody>
</table>

In this paper the KOS variable represents the residuals. The augmented Dickey-Fuller test is used in order to examine the existence of stagnation at KOS variable (which expresses the connection of the residuals $\Delta \tilde{u}_t = \delta \tilde{u}_{t-1}$). Concerning the stagnation of the residuals we underline that the t-statistic for $\rho=0$, is bigger than the crucial price at the level of importance 1% and obviously the KOS variable is not stagnated. In the contrary, at the level of importance 5% and 10% the critical values are bigger than the t-statistic so the KOS variable is stagnated at the level 5% and 10% as well.

6. CONCLUSIONS

The time order is stagnated accepting the hypothesis $H_0$ (where $H_0: \rho \neq 1 \not\implies \delta_0 < 0$) KOS variable and having the proof that the three variables of the model are stagnated at the 1st differences, we conclude that there is cointegration for the variables of the model we study. Following to this, in long-terms, that means that the variables are moving together and to the same direction but this will not happen in short-terms.

Eventually, there is a mathematic relation, which in long-terms connects the movements of the sectors that the variables belong to. The results which came up from this study were expected. The stock market is an area which is effect ed by the simultaneous investing actions of million of investors. Also the investors are influenced by the several economic events, domestic or universal, so that in long-terms the powers of supply and demand to act in such a way that everything to be restored in an "hypothetical balance". So we claim that the financial development effects and at the same time is effected by the economic growth. A further research regarding the causal relation of the variables would lead us to rational conclusions about the linking among them.

It is a common belief that the financial development has a positive influence on the economic growth. Definitely the bank sector plays a determined role to the route of market price. The route of bank sector is a factor which determines the positive or negative route of market price and also effects the route of ratio which evaluating the economic development.

REFERENCES


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