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STOCK MARKET AND GROWTH IN GREECE: EVIDENCE FROM COINTEGRATION AND CAUSALITY TESTS*

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Abstract

Current wisdom suggests that stock-market development may affect economic growth by raising the proportion of savings funnelled to investment and/or increasing the social marginal productivity of capital and/or influencing the saving rate. Earlier empirical studies on the subject, however, have reported conflicting research findings, attributable to the use of cross-sectional data and differences in the samples chosen, time periods examined and data bases used. Moreover, the evidence suggests that the causal link between finance and growth is crucially determined by the nature and operation of the financial institutions and policies pursued in each country. These considerations point to the need for case specific studies using time-series data for individual countries. In this context, the present study seeks to contribute to current research in the area by investigating the relationship between economic growth and stock-market activity in the case of Greece over the period 1958-95. To this end, an endogenous growth model is specified providing a formal rationalization for the incorporation of stock-market activity in a sources — of — growth equation. Using cointegration and causality tests, the paper reports findings that provide empirical support to the hypothesis that stock-market development does not affect positively the output growth rate in Greece. (JEL Classification, G10, 052)

1. Introduction

Financial reforms in less developed and developed countries in the last decade have been characterized by an enormous growth of stock markets. World

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stock-market capitalization grew from $4.7 to $15.2 trillion between the mid-1980s and mid-1990s (Demirguc - Kunt and Levine, 1996). The total value of shares traded on developing countries' stock markets rose over twenty-fold between 1983 and 1992 (Singh, 1997) and that on emerging markets jumped from less than 3% of the $1.6 trillion world total in 1985 to 17% of the $9.6 trillion world total in 1994 (Demirguc - Kunt and Levine, 1996). These figures clearly suggest that the growth effects of stock markets could potentially be substantial.

The subject had been extensively studied nearly two decades earlier by Goldsmith (1969), Mckinnon (1973), Shaw (1973) and others, who showed that financial development (a broader notion of stock-market development comprising insurance and household credit as well as bank lending), correlates with growth. However, these early studies were based on traditional growth theory, according to which financial intermediation could be related to the level of the capital stock per worker or to the level of productivity, but not to their respective growth rates. The latter were ascribed to exogenous technical progress thus leaving no analytical foundation for the economic growth-financial development relationship.

Recent developments in endogenous growth theory have offered important insights into the ways stock-market development can affect growth. Endogenous growth models have shown that there can be self-sustaining growth without exogenous technical progress and that the growth rate can be related to preferences, technology, income distribution and institutional arrangements. Thus, stock-market development can be shown to have not only level effects, but also growth effects. The theoretical explanation of this process is intuitively appealing: stock-market development can raise the proportion of savings funnelled to investment; it may increase the social marginal productivity of capital; and it can influence the saving rate (Pagano, 1993).

During the last few years, endogenous growth models have been used by a number of authors in their attempt to assess empirically the relationship between stock-market development and economic growth. For instance, Atje and Jovanovic (1993) estimated a growth model using data for 40 countries over the period 1980-88. They found a large positive effect of stock markets on development. Similar results were reported by Levine and Zervos (1996) on the basis of data for 41 countries covering the period 1976-93. After controlling for initial conditions and various economic and political factors, they concluded that the measures of stock-market development were robustly correlated with current and future rates of economic growth, capital accumulation and productivity improvements. On the other hand, Harris (1997) using a similar approach and data for 49 countries over the period 1980-91 was led to conflicting findings. In the whole sample and in the sub-sample of less developed countries, stock-market activity was not found to offer much incremental explanatory power, whereas in the sub-sample of developed countries stock-market activity did have some impact, but its statistical significance was weak. Overall, they suggested that the stock-market effect is not as strong as previously suggested.

Clearly, the empirical evidence on the subject can be deemed inconclusive. The diversity in the conclusions drawn must be mainly attributed to sample variations and differences in time periods examined and data bases used. Furthermore, a notable shortcoming of the aforementioned and other relevant studies is the use of inter-country cross-section analysis, of the type popularized by Barro (1991). This approach involves averaging out variables over long time periods and using them in cross-section regressions aiming at explaining cross-country variations of growth rates. However, a great deal of scepticism in relation to cross-country regressions is shared by many investigators. Levine and Renelt (1992) and Levine and Zervos (1996) acknowledge the sensitivity of the results to the set of conditioning variables. Evans (1995) discusses econometric problems which stem from heterogeneity of slope coefficients across countries. Lee et al. (1996) show that convergence tests obtained from cross-country regressions are likely to be misleading because the estimated coefficient of the convergence term contains asymptotic bias. Quah (1993) points out that the technique is predicated on the existence of stable growth paths and shows, using data from 118 countries, that long-run growth patterns are unstable. Furthermore, cross-country regressions can only refer to the "average effect" of a variable across countries. In the context of causality testing this limitation is particularly severe as the possibility of differences in causality patterns across countries is likely. In fact, Arestis and Demetriades (1996), using data for 12 countries, provide evidence which suggests that the causal link between finance and growth is crucially determined by the nature and operation of the financial institutions and policies pursued in each country. The related study by Demetriades and Hussein (1996), where causality tests are carried out for 16 developing countries, suggests that causality between financial development and growth varies across countries. Thus, the evidence suggests that a time-series analysis may yield deeper insights into the relationship between financial development and real output than cross-section analysis (Arestis and Demetriades, 1997).

In this context, the present study seeks to contribute to current research in the area by investigating the relationship between economic growth and stock-market activity in the case of Greece during the period 1958-95. Greece is chosen for empirical work mainly for two reasons. First, the Greek economy is one of the weakest in Europe with persistent economic problems[1]. In 1995 Greek GDP per capita was equal to 57.3% of the European Union average, a figure considerably lower that that of 1981 (63.7%) or even 1971 (59.7%)[2]. Secondly, despite its undisputed importance, the question of the growth effects of stock-market activity in Greece has been almost completely neglected by economists. Therefore, an investigation of the impact of stock-market development on the output growth rates of the Greek economy would offer insights into the ways stock-market activity could support economic expansion in this country.

The rest of the paper is organized as follows. Section 2 identifies the major conduits through which stock-market activity affects growth. Section 3 deals with the specification of an endogenous growth model providing a formal rationalization for the incorporation of stock-market activity in a sources-of-growth equation. However, while economic theory suggests possible equilibrium relationships between variables of interest, it tends to inform us very little concerning the adjustment processes at work. In this paper we utilize the technique of cointegration and the related notion of error correction which allows for additional channels through which causality may emerge (Holden and Thompson, 1992). The specifics of the econometric technique deployed as well as the outcome of the empirical investigation are discussed in Section 4. Unlike previous studies, the results indicate that stock-market development has not affected positively economic growth in Greece. Section 5 deals with the interpretation of the non-positive growth effect of stock-market activity. It is argued and empirically shown that stock-market development does not increase savings and thereby growth in Greece. Section 6 summarizes and concludes.

2. Main Economic Effects of Stock — Market Development

Typical "AK" models, as specified by Lucas (1988) and Romer (1989), combined with the standard capital stock accounting identity and the condition for capital market equilibrium, reveal succinctly how stock-market development can affect growth: it can raise the proportion of savings funnelled to investment; it may increase the social marginal productivity of capital; and it can influence the saving rate (Pagano, 1993).

2.1. Funnelling Savings to Firms

In the process of transforming savings into investment, stock markets absorb resources, so that an amount saved by households generates less than it worth of investment. The remaining goes to dealers as commissions, fees and the like. This absorption of resources by the stock market is primarily a reward for services supplied, but it may also reflect the X — inefficiency of the intermediaries and their market power. In addition, as noted by Roubini and Sala-y-Martin (1991, 1992), their activity is often burdened by taxation and by restricting regulations, translating into higher unit margins. The implicit assumption here is that the quasi — rents earned by intermediaries and the tax revenue extracted from them are entirely spent on private and public consumption respectively. Their detrimental effect on growth is tempered if they are partly spent on investment. However, if stock-market development reduces this leakage of resources, it may increase the growth rate.

2.2. Increasing the Social Marginal Productivity of Capital

A second key function of stock markets is the allocation of funds to those projects where the marginal product of capital is highest. Stock markets may increase the productivity of capital, thereby promoting growth, in two ways: (i) collecting information to evaluate alternative investment projects and (ii) inducing individuals to invest in riskier but more productive technologies by providing risk sharing.

The informational role of stock markets has been related to productivity growth by Greenwood and Jovanovic (1990). In their model, capital may be invested in a safe, low-yield technology or a risky, high-yield one. The return to the risky technology contains two random terms: an aggregate and a project-specific shock. The authors have shown that stock markets, unlike individual investors, can perfectly unscramble any aggregate productivity shock and thus choose the technology that is most appropriate for the current realization of the shock. Thus, savings channelled through stock markets are allocated more efficiently, and the higher productivity of capital results in higher growth.

Stock markets also enable investors to share risks. This affects their investment choices and their saving behaviour. According to Levine (1991), individuals suffer idiosyncratic liquidity shocks by selling shares on the stock market rather than withdrawing money from the bank, while the stock market also allows agents to reduce rate — of — return risk by portfolio diversification. This twofold insurance function increases willingness to invest in less liquid, more productive projects and also avoids unnecessary terminations. As a result, setting up a stock market raises the productivity of investment and the growth rate.

2.3. Influencing the Saving Rate

The third way stock-market development can effect growth is by altering the saving rate. In this instance the sign of the relationship is ambiguous, in that stock-market development *may also reduce* savings, and thereby growth. As stock markets develop, households gain better insurance against endowment shocks and better diversification of rate — of — return risk. This factor affects saving behaviour, but the effect is ambiguous.

Stock markets enable people to share the rate — of — return risk, such as that due to the volatility of stock returns. With constant relative risk-aversion utility, the response of saving is negative if the risk-aversion coefficient is above 1, and positive otherwise. As a result, the response of growth to a reduction of rate-of-return risk is ambiguous as well (Devereux and Smith, 1991).

3. The Model

In this paper, the growth effects of stock-market development are examined in the context of an endogenous growth framework. Extending the Greenwood-Jovanovic (1990) model, which is of an "AK" structure, and following Parente and Prescott (1991) and Atje and Jovanovic (1993), we add to the economy's production function a labour term L and a capacity constraint L on employment, in order to preserve competition in the market. Thus, the aggregate production function can be written as

$$Y_t = K_t \min (L, \overline{L})_t^{\theta}, \ \theta > 0 \tag{1}$$

where Y is the output and K is the capital stock in the economy.

In the presence of a stock market, the standard capital stock accounting identity becomes

$$K_{t+1} = (1 - \delta) K_t + F(STM_t) I_t \tag{2}$$

where I stands for gross investment, δ for the rate of depreciation, STM for the level of stock-market intermediation, and F for an increasing function designed to capture the forces by which the development of the stock market might affect the rate of return on investment.

If $\lambda=\bar{L}^{\theta}$, then λ denotes the inverse of the economy's capital-output ration, since equation (1) becomes $Y_t = \lambda K_t$. This relationship implies that the growth rate of output is equal to the growth rate of capital stock, i.e.

$$g_Y = g_K \tag{3}$$

and using equation (2) the rate of growth of capital stock can be written as

$$g_k = (K_{t+1} - K_t) / K_t = -\delta + F(STM_t) I_t / K_t =$$

$$= -\delta + F(STM_t)(Y_t / K_t)(I_t / Y_t) = -\delta + \lambda F(STM_t) i_t \tag{4}$$

where i represents the investment-output ratio. Combining equations (3) and (4) one can get a formula for the rate of growth of per capita income:

$$g_{pc} = g_Y - g_L = -\delta + \lambda F(STM_t) i_t - g_L$$

where g_{pc} stands for per capita income and g_L for the growth rate of labour. A first-order Taylor expansion of F in STM gives

$$\lambda F(STM_t) i_t \approx \lambda [F(0) i_t + F'(0) i_t STM_t]$$

and the equation for per capita income becomes

$$g_{pc} = -\delta - g_L + \lambda F(0) i_t + \lambda F'(0) i_t STM_t \tag{5}$$

which is the regression equation to be estimated in the next section.

4. Methodology and Empirical Results

The main focus of this study is on obtaining the direction and strength of stock-market activity on the growth process of the Greek economy. Simplifying the notation in equation (5), the relationship between growth and stock-market activity takes the form

$$g_{pc,t} = a_o + a_1 g_{L,t} + a_2 i_t + a_3 i_t STM_t + u_t \tag{5a}$$

which is the equation to be used throughout the empirical work of this paper.

Data in constant prices on output and investment were compiled on an annual basis from 1958 to 1995 from various issues of the National Accounts of Greece. Rate of change of per capita GDP and gross domestic fixed capital formation were used to represent economic growth and aggregate real investment spending. Stock-market development was represented by three alternative variables: a) the ratio of annual value of all stock-market trades to GDP (smt), an index usually used to measure liquidity, which is an important indicator of stock-market development in that it may be inversely related to transactions costs, which impede the efficient functioning of stock markets (Arestis and Demetriades, 1997), b) the ratio of annual market value of listed in the Athens Stock Exchange securities to GDP (mvs), and c) the number of listed companies in the Athens Stock Exchange (nc). Data on the stock-market variables were taken from the Annual Report of the Athens Stock Exchange, 1997. Finally in the absence of data on the labour force for the whole period examined, the growth rate of this variable was proxied by the growth rate of population (g_p).

As Engle and Granger (1987) point out, if the concept of equilibrium is to have any meaning or relevance, the processes underlying the relationship between the output growth rate and its determinants in equation (5a) should be such that the "disequilibrium errors" u_t should tend to fluctuate around their mean value, or show some systematic tendency to become small over time. A minimal condition for equilibrium is that the variables in the equilibrium relationship should be cointegrated.

A prerequisite for testing a set of variables for cointegration is to establish the properties of the individual series. The relevant Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) tests for unit roots and stationarity indicate that all variables are integrated of order one (I (1)) and the classical least squares techniques are inapplicable in this case study[3].

In practice, the Engle and Granger (E - G) two-step procedure (Engle and Granger, 1987) consists of estimating by OLS the presumed equilibrium relationship (i.e. the cointegrating regression) and then testing the residuals for stationarity. If the residuals are I (0), i.e. stationary, the null hypothesis of noncointegration is rejected and the OLS estimators are "super-consistent" (Stock, 1987)[4]. Then, the cointegrating regression is indeed a long-term equilibrium relationship and we can then move to the second step, namely the OLS estimation of a dynamic short-run equation, in which the residuals of the cointegrating regression serve as an error correction mechanism which accounts for short-run disequilibrium. According to the "Granger Representation Theorem"

(Granger, 1983; Engle and Granger, 1987), such a dynamic short-run equation exists if the variables in question are cointegrated and its estimators are not only consistent, but are as efficient asymptotically as those that would be obtained if the true value of the cointegrating vector were known and used in the second stage.

4.1. The Long — Run Relationship

The OLS estimates from fitting equation (5a) to Greek data are reported in Table 1. The equations in this Table correspond to the alternative variables used to represent stock-market development in Greece. Strictly speaking, it is not possible to draw any statistical inferences from these results since, as the series are non-stationary, useful tests such as the F and t — statistics do not follow the standard distributions. Even the parameter estimates may not be unbiased, though they are consistent. However, the advantage of the E — G procedure is that we choose in advance one variable for the left-hand side of the equation, thus assuming that a given structural relationship among the variables involved exists. Consequently, though not strictly legitimate from the econometric point of view, we can interpret the coefficient estimates of the cointegrating regression as representing structural parameters (Engle and Granger, 1987).

The estimated equation is reasonably well defined in terms of the standard criteria as they are reported therein. The Lagrange Multiplier (AR), ARCH (Engle, 1982) and RESET (Ramsey, 1974) statistics do not provide evidence for rejecting the null hypotheses of no autocorrelation, homoskedasticity and no functional misspecification bias. The coefficient related to investment share is positive and significant at least at the 5% level, while the coefficients associated with population growth and the stock-market activity are negative, the former being marginally significant at the 10% level in one case. However, as mentioned above, these results cannot be used for statistical inference about the growth effects of the stock-market activity in Greece. The estimated long-run relationships are primarily used for cointegration testing purposes.

To test the null hypothesis of noncointegration of the variables involved in the long-run relationships of Table 1 two tests are used: the Cointegrating Regression Durbin-Watson (CRDW) statistic (Engle and Granger, 1987) and the ADF statistic (Davidson and Mackinnon, 1993). The CRDW statistics are 2.443, 2.053 and 2.161 indicating that the variables in question are cointegrated[5]. However, since Engle and Granger themselves suggest that the CRDW test might be used only for a quick approximate result, and DeJong et al. (1992) have shown that the ADF test outperforms most alternatives, we moved to the second test which is based on the residuals from fitting equation (5a). The regression equation run for each of the long-run relationships was of the form

$$\Delta\hat{u}_t = -\varphi\hat{u}_{t-1} + \sum_{i=1}^{K} n_i\, \Delta\hat{u}_{t-i}$$

where $\hat{u}_t$ stands for the estimated residuals of the long-run relationships, with K=3. Since the coefficient of $\hat{u}_{t-1}$ was significant at least at the 10% level, the null hypothesis of noncointegration should be rejected[6]. Therefore, the ADF statistics, along with the CRDW statistics, provide enough indications in favour of cointegration, so that we may assert that the long-run relationships of Table 1 do describe long-run equilibrium relationships.

4.2. The Short-Run Relationship

In the next step of the E-G cointegration methodology, the lagged values of the residuals of the long-run equations serve as an error correction mechanism in a short-run dynamic equation, where the explanatory variables are in first differences or lagged first differences. This equation only includes stationary variables, thus from the econometric point of view it is a standard single equation where all the classical diagnostic and misspecification tests are applicable.

Tables 2, 3 and 4 report the OLS estimates of the short-run equation for all the alternative variables representing stock-market development in Greece, with various combinations of the explanatory variables (equations 1-3). The RESET test does not indicate the existence of functional misspecification bias, thus suggesting that the equation is sufficiently enriched in dynamics. The explanatory power of the regressions is considerably higher compared to that of the corresponding long-run equations and the error correction term has the expected negative coefficient and is significant at the 1% level in all cases. The coefficient of the investment share term remains positive and significant at the 1% level in most of the cases while that of the population growth term turns out to be positive though non-significant. This result should not be surprising, since there is no reason to expect that a larger workforce will be necessarily more productive workforce. Presumably, in labour surplus economies, like Greece, the natural rate of growth is not a binding constraint. Besides, the non-significant growth effect of population is a fairly common result in production function studies of industrializing societies. Most impressing, however, is the coefficient of the stock-market activity variable, which appears negative but significant only when the variable smt is used to represent stock-market development. To reach a more parsimonious specification of the growth equation, a dummy variable (OIL) was included in the regressions that took a value of zero for the 1973-74 and 1979-80 periods and one elsewhere, to allow for the growth effects of the oil-price shocks of the seventies in the Greek economy. The OLS estimates of this augmented specification are reported in equations 4-6 in Tables 2, 3 and 4. The coefficient of the dummy variable is positive and significant at the 10% level in some cases, with no changes in the signs and significance of the coefficients of the other variables. Thus, the results of the short-term dynamics do not provide empirical support to the hypothesis that stock-market development affects positively the output growth rate in Greece.

5. Interpretation on the Non-positive Stock — Market Growth Effect

The somewhat impressing non-positive effect of stock-market development on Greek output growth rates led us to examine empirically the relationship between stock-market activity and saving rate in this country. As mentioned in Section 2, stock-market development can affect growth by altering the saving rate. In this instance the sign of the relationship is ambiguous, in that stock-market development may also reduce savings, and thereby growth. For the purposes of this paper, the causal relationship between stock-market activity and saving rate was tested on the grounds of the standard Granger causality test and the Engle anf Granger two-step procedure.

The standard Granger causality test used in order to test the presence and direction of a causal relationship between two variables X and Y is based on the estimation of the following vector autoregressive (VAR) specification:

$$X_t = b_0 + \sum_{i=1}^{n} b_{xi} X_{t-i} + \sum_{i=1}^{n} b_{Yi} Y_{t-i} + w_t \tag{6}$$

where n stands for the VAR lag length, provided that X_t and Y_t are covariance stationary time series. If J_t is a universe of information up to and including period t, then the Granger (1969) definition of causality states that Y_t causes X_t given J_t if X_t has a smaller forecast error variance when the information contained in past values of Y_t (i.e. Y_r, $r<t$) is used than if it is not used at all. Thus, if past Y_t contributes significantly to forecasting current X_t, that is the coefficients b_{Yi}, i= 1, 2, ..., n in (6) are jointly significant in terms of a standard Wald test, then Y_t is said to Granger cause X_t.

In the event of the variables involved being non-stationary, the form of non-stationarity should be clarified prior to the implementation of the Granger causality test, so that the danger of drawing misleading inferences can be averted. Specifically, if the series at issue are I(1) and share a common trend, that is if they are cointegrated in the sense of Engle and Granger (1987), then determining the causal ordering between X_t and Y_t in a Granger sense requires the reformulation of the VAR in the familiar error correction specification (ECM), that is

$$\Delta X_t = b_0^* + \sum_{i=1}^{n} b_{xi}^* \, \Delta X_{t-i} + \sum_{i=1}^{n} b_{Yi}^* \, \Delta Y_{t-i} + \rho \hat{\Psi}_{t-1} + Z_t \tag{7}$$

where $\hat{\Psi}$ are the estimated residuals from the cointegrating regression between X_t and Y_t, i.e.

$$X_t = c_0 + c_1 Y_t + \Psi_t \tag{8}$$

The relationship between stock-market activity and saving rate in Greece was tested for private savings. In the light of the preceding discussion, our primary concern was to determine the presence of non-stationary behaviour of the variables of interest. Consequently, the ratio of annual value of all stock-market trades to GDP (smt), the ratio of annual market value of listed securities to GDP (mvs) and the private saving-income ratio (PRS) were initially subjected to unit root testing by means of the DF and ADF tests. The results indicated that all these variables are I (1)[7].

The next step of the E-G cointegration methodology involved the OLS estimation of equation (8) with the addition of a trend term (t) as an explanatory variable. The results are reported in Table 5. Though non-significant, the coefficients of the stock-market activity variables appear negatively signed, while the CRDW is significantly non-zero and the ADF test is significant in both equations. The results indicate that the null hypothesis of non — cointegration of the variables of interest can be rejected in favour of cointegration in both equations. This suggests the presence of a long-term causal relationship between them. On the basis of this, the negative effects of stock-market activity on the private saving rate of the Greek economy was tested in the second stage of the E-G methodology through the estimation of equation (7) for both cases. The results of the Granger causality tests based on the error-correction model are shown in Table 6. The tests and the conclusions drawn are based on the significance of the coefficients of the error-correction terms, i.e. coefficient ρ in equation (7). The empirical findings of the causality between the saving rate and the stock-market activity suggest that the development of the Greek stock-market reduces savings in this country. In other words, more efficient risk sharing caused by stock-market development, reduces the saving rate so much as to offset the growth-enhancing effect of more productive investment.

Before concluding, some observations seem appropriate in regard to the advantages and limitations of the E-G procedure as well as to the time period used in the preceding analysis. First, combination of the two steps provides a complete model incorporating both the long-run static and the short-run dynamic models. It is claimed that this approach has the advantage that estimation of the two steps is quite separate, so that changes in the dynamic model do not enforce re-estimation of the static model obtained in the first step. In other words, the long-term estimates of the postulated relationship have good properties without the need to make any prior assumptions about the dynamics in the data-generating mechanisms. As such, the E-G approach offers a tractable modeling procedure. On the other hand it has been criticized on the grounds that the estimates of the cointegrating regression have rather poor finite sample characteristics, particularly in the case where the explanatory power of the model is substantially low.

Secondly, only the last four years of the time period used in the analysis coincide with the institutional deregulation of the Athens Stock Exchange. It would be interesting to split the sample into two periods and analyse the stock-market growth effects separately. However, such a procedure would lead to unreliable statistical results in this case study, due to the extremely limited number of observations and degrees of freedom in the second period. The point to be made is that, just any other estimation results, our estimates can at best be indicative and suggestive, but not conclusive and should therefore be treated as such.

6. Conclusions

The purpose of this paper has been to investigate the growth effects of stock-market development in Greece over the period 1958-95. Most researchers consider that stock-market development may affect economic growth by raising the proportion of savings funnelled to investment; by increasing the social marginal productivity of capital; and by influencing the saving rate. What matters, of course, is the net effect of stock-market activity on output growth rates.

Case specific studies using time-series data for individual countries can contribute to current research on the subject, supplementing the findings of cross-sectional studies. This paper has specified an endogenous growth model that provides a formal rationalization for the incorporation of stock-market activity in a sources — of — growth equation. Using the technique of cointegration and the related notion of error correction, the paper has reported findings that provide empirical support to the hypothesis that stock-market development does not affect positively the output growth rate in Greece. It seems that more efficient risk sharing caused by stock-market development, reduces the saving rate so much as to offset the growth-enhancing effect of more productive investment.

Footnotes

1. For a comprehensive discussion on Greek fiscal problems and economic performance, see Alogoskoufis (1995).

2. Source: European Economy, Annual Economic Report for 1995, no. 59, 1995.

3. To test the hypothesis of a unit root in a variable X the following OLS regression is run:

$$\Delta X_t = d_0 + d_1 X_{t-1} + \sum_{i=1}^{m} d_i \Delta X_{t-i} + \varepsilon_t$$

where m, the number of lags in the dependent variable, is chosen so as to induce a white noise disturbance term. The test statistic suggested is the standard t-ratio for the estimate of d_1 (critical values provided by Fuller, 1976, Table 8.5.2). The results of the relevant tests are avaialble on request from the authors.

4. Super-consistent are the estimates which converge on the true but unknown population parameters with an order of convergence of 1/n instead of the customary rate of $1/\sqrt{n}$, where n is the number of observations. This implies that the OLS estimators converge on the true values at a faster rate in the non-stationary than in the stationary case (Holden and Thompson, 1992).

5. The null hypothesis is DW=0. Critical values for three variables case are 0.488, 0.367 and 0.308 at 1% , 5% and 10% level, respectively (Hall, 1986, p. 233).

6. The null hypothesis is $\hat{u}_t \sim I(1)$. Critical values for three variable case are -3.89, -3.13 and -2.82 at 1%, 5% and 10% level, repsectively (Hall, 1986, p. 233).

7. The results are available on request from the authors.

TABLE 1

The Long — Run Economic Growth-Stock Market Development Relationship in Greece

Explanatory Variables:	Dependent Variable: $g_{pc,t}$ (1)	(2)	(3)
Constant	-7.307***	-8.136***	-3.206
	(-2.702)	(-3.485)	(-0.508)
$g_{p,t}$	-1.413	-1.095	-0.202
	(-1.150)	(-1.012)	(-0.140)
i_t	0.548***	0.539***	0.379**
	(4.972)	(5.662)	(2.155)
$i_t smt_t$	-17.320*		
	(-1.322)		
$i_t mvs_t$		-0.023	
		(-0.258)	
nc_t			-0.021
			(-0.674)
Statistics - Diagnostics:			
$\bar{R}^2$	0.411	0.515	0.263
SEE	2.689	2.248	2.451
CRDW	2.443	2.053	2.161
F	9.405	10.916	3.630
AR	2.400	1.200	7.091
ARCH	1.398	0.874	0.547
RESET	0.645	3.577	2.833

Notes:

(i) g_{pc} = the annual growth rate of real GDP per capita, g_p = the annual growth rate of population, i= real investment as a share of real GDP, smt= the ratio of annual value of all stock market trades to GDP, mvs= the ratio of annual market value of listed in the Athens Stock Exchange Securities to GDP, nc= the number of listed companies in the Athens Stock Exchange.

(ii) $\bar{R}^2$ = the coefficient of multiple determination adjusted for degrees of freedom, SEE= the standard error of the regression, CRDW= the Cointegrating Regression Durbin-Watson statistic, F= the regression F-statistic.

(iii) The diagnostics have the following meaning: AR is the X^2 test for residual autocorrelation, ARCH is the X^2 test for autoregressive conditional heteroskedasticity and RESET is the F test for functional misspecification.

(iv) t-values in parentheses; (*) denotes significance at the 10% level, (**) at the 5% level and (***) at the 1% level.

TABLE 2

The Short-Run Economic Growth-Stock Market Development Relationship in Greece
Case 1: Stock — Market Development Variable = smt

Explanatory Variables:	Dependent Variable: $\Delta g_{pc,\ t}$					
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	0.073	0.053	0.149	-1.412	-1.414	-1.542
	(0.180)	(0.125)	(0.385)	(-1.033)	(-1.000)	(-1.208)
$\Delta g_{p,\ t}$	1.070	1.035	1.648	0.657	0.628	1.129
	(0.755)	(0.703)	(1.188)	(0.451)	(0.415)	(0.798)
	***	***	***	***	***	***
Δi_t	1.092	1.094	1.186	0.965	0.968	1.040
	(4.450)	(4.303)	(5.130)	(3.594)	(3.480)	(4.155)
	**	**	**	**	**	***
$\Delta i_t smt_t$	-30.754	-30.895	-36.319	-31.877	-32.082	-37.575
	(-1.918)	(-1.849)	(-2.349)	(-1.994)	(-1.922)	(-2.467)
	***	***	***	***	***	***
$\hat{u}_{t-1}$	-1.340	-1.320	-1.481	-1.298	-1.272	-1.425
	(-7.966)	(-4.626)	(-8.757)	(-7.569)	(-4.420)	(-8.327)
$\Delta g_{pc,\ t-1}$		-0.017			-0.022	
		(-0.099)			(-0.123)	
$\Delta g_{p,\ t-1}$			0.585			0.422
			(0.420)			(0.307)
			***			***
Δi_{t-1}			0.678			0.679
			(2.885)			(2.938)
$\Delta i_{t-1} smt_{t-1}$			-10.616			-7.618
			(-0.606)			(-0.439)
						*
OIL				1.666	1.651	1.892
				(1.138)	(1.088)	(1.389)
Statistics - Diagnostics:						
$\overline{R}^2$	0.648	0.636	0.707	0.652	0.638	0.717
SEE	2.420	2.499	2.239	2.409	2.491	2.202
DW	2.232	2.205	1.861	2.295	2.275	1.970
F	17.167	12.902	12.774	14.124	11.018	11.804
LM	8.482	10.392	3.433	8.415	9.252	2.078
ARCH	1.911	12.514	1.523	2.001	11.809	0.850
RESET	1.506	1.442	0.519	1.509	1.448	0.654

Notes:

(i) $\hat{u}_t$ = the estimated residuals of the cointegrating regression (5a), OIL = dummy variable for oil-price shocks.

(ii) Remaining details as in Table 1.

TABLE 3

The Short-Run Economic Growth-Stock Market Development Relationship in Greece
Case 2: Stock — Market Development Variable = mvs

Explanatory Variables:	Dependent Variable: $\Delta g_{pc,\,t}$ (1)	(2)	(3)	(4)	(5)	(6)
Constant	0.196	0.232	0.204	-1.258	-1.087	-1.559
	(0.453)	(0.544)	(0.401)	(-1.072)	(-0.930)	(-1.259)
$\Delta g_{p,\,t}$	1.182	1.308	1.409	0.829	0.978	1.078
	(0.948)	(1.064)	(1.031)	(0.661)	(0.784)	(0.807)
	***	***	***	***	***	***
Δi_t	1.023	0.982	1.051	0.967	0.935	1.012
	(3.826)	(3.710)	(3.616)	(3.632)	(3.533)	(3.594)
$\Delta i_t\ mvs_t$	-0.105	-0.041	-0.173	-0.235	-0.164	-0.376
	(-0.393)	(-0.154)	(-0.588)	(-0.835)	(-0.579)	(-1.201)
	***	***	***	***	***	***
$\hat{u}_{t-1}$	-1.076	-1.352	-1.179	-1.002	-1.259	-1.095
	(-5.660)	(-4.850)	(-5.269)	(-5.136)	(-4.397)	(-4.921)
		*				
$\Delta g_{pc,\,t-1}$		0.235			0.213	
		(1.334)			(1.215)	
$\Delta g_{p,\,t-1}$			0.964			0.664
			(0.691)			(0.489)
Δi_{t-1}			0.102			0.181
			(0.334)			(0.604)
$\Delta i_{t-1}\ mvs_{t-1}$			0.212			0.218
			(0.744)			(0.794)
				*		*
OIL				1.755	1.589	2.199
				(1.329)	(1.210)	(1.552)
Statistics - Diagnostics:						
$\overline{R}^2$	0.614	0.627	0.594	0.627	0.634	0.622
SEE	2.037	2.003	2.124	2.004	1.983	2.050
DW	2.267	2.204	1.843	2.321	2.224	1.879
F	11.766	10.088	6.454	10.080	8.828	6.368
LM	2.303	1.291	4.759	3.014	1.181	3.307
ARCH	0.961	0.745	1.196	0.945	0.773	1.872
RESET	1.920	1.081	2.224	1.322	0.787	1.225

Notes:

As in Tables 1 and 2.

TABLE 4

The Short-Run Economic Growth-Stock Market Development Relationship in Greece
Case 3: Stock — Market Development Variable = nc

Explanatory Variables:	Dependent Variable: $\Delta g_{pc,\ t}$ (1)	(2)	(3)	(4)	(5)	(6)
Constant	0.205	0.231	0.776	-0.038	0.109	-0.549
	(0.380)	(0.424)	(0.979)	(-0.026)	(0.073)	(-0.315)
			*			*
$\Delta g_{p,\ t}$	1.510	1.545	3.974	1.429	1.504	4.097
	(0.824)	(0.838)	(1.358)	(0.738)	(0.768)	(1.384)
	***	***	**	***	***	*
Δi_t	0.949	0.904	0.743	0.922	0.891	0.596
	(3.577)	(3.326)	(2.028)	(2.950)	(2.807)	(1.459)
Δnc_t	-0.014	-0.011	-0.081	-0.012	-0.010	-0.089
	(-0.281)	(-0.226)	(-1.088)	(-0.237)	(-0.201)	(-1.173)
	***	***	***	***	***	***
$\hat{u}_{t-1}$	-1.159	-1.379	-1.272	-1.145	-1.369	-1.200
	(-5.490)	(-4.207)	(-4.986)	(-4.945)	(-3.854)	(-4.431)
$\Delta g_{pc,\ t-1}$		0.189			0.187	
		(0.880)			(0.838)	
$\Delta g_{p,\ t-1}$			1.112			0.676
			(0.484)			(0.284)
Δi_{t-1}			0.388			0.435
			(1.045)			(1.146)
Δnc_{t-1}			-0.116			-0.121
			(-0.922)			(-0.955)
OIL				0.271	0.135	1.540
				(0.181)	(0.088)	(0.858)
Statistics - Diagnostics:						
$\bar{R}^2$	0.638	0.633	0.625	0.616	0.608	0.617
SEE	2.154	2.168	2.245	2.218	2.239	2.268
DW	2.276	2.100	1.831	2.282	2.105	1.925
F	10.254	8.249	5.768	7.743	6.449	5.036
LM	1.988	1.651	4.640	2.423	2.126	3.128
ARCH	0.516	0.512	1.104	0.442	0.467	1.339
RESET	0.873	0.452	0.401	0.827	0.357	0.127

Notes:

As in Tables 1 and 2.

TABLE 5

Results of Cointegrating Regressions for Private Saving Rates

Explanatory Variables:	Dependent Variable: PRS	
	(1)	(2)
Constant	*** 10.614 (11.675)	*** 14.547 (10.978)
t	*** 0.324 (6.695)	*** 0.165 (2.461)
smt	-329.716 (-1.133)	
mvs		-0.970 (-0.419)
Statistics		
$\bar{R}^2$	0.582	0.173
SEE	2.694	2.407
CRDW	0.745	1.109
F	26.155	3.928
ADF	-2.755	-3.447

Notes:
(i) PRS = the private saving-income ratio.
(ii) Remaining details as in Table 1.

TABLE 6

Results of Causality Tests Based on Coefficient p.

	Coefficient ρ	$\bar{R}^2$	SEE	DW	ADF
Explanatory Variable: smt	** -0.342 (-1.716)	0.204	2.094	1.701	-2.755
Explanatory Variable: mvs	*** -0.946 (-3.450)	0.619	1.576	2.012	-3.447

Notes:
(i) ρ = the coefficient of the lagged estimated residuals from the cointegrating regression (8), as it appears in equation (7).
(ii) Remaining details as in Table 1.

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