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# INTERRELATIONSHIPS OF SECONDARY EQUITY MARKETS AT DOMESTIC AND INTERNATIONAL LEVEL

*This paper investigates the effects of stock markets on the process of secondary capital markets (parallel markets) growth in some European Union countries. If European secondary stock markets have become more integrated with one another and with world capital markets, we would expect to see them play a fundamental role in the development of the European financial sector and promote economic growth. More integrated and liquid European parallel equity markets make investment less risky and more easily accessible because they allow investors to acquire equity and sell it quickly and cheaply as soon as they need immediate access to their savings. At the same time companies enjoy permanent access to capital raised through equity issues. More liquid and deep European stock markets improve resource allocation by facilitating longer-term, more profitable investments and enhance prospects for growth in the wider region of Europe and in every member-country, including Greece.*
*JEL: C12, G15*

## 1. Introduction

As stock markets have gained a dominant role in equity funding and portfolio allocation decisions, research examining possible stock market linkages and interdependences has abounded in recent literature. Significant long-run relationships among different stock markets could be related to a range of reasons. The presence of strong economic ties and policy coordination in various markets can indirectly affect stock price behavior over time. With technological advances and financial innovations, advancement of international finance and trade, and regional and global cooperation, the geographical barriers among various national stock markets become less clear (Gelos and Sahay, 2000). The adoption of measures towards deregulation and market liberalization, rapid development in communication support and computerized trading systems, and increasing activities of multinational corporations are factors contributing to financial integration.

The secondary (parallel) stock markets function in certain world financial centers giving the opportunity to small and medium-sized enterprises to derive funds for financing their development. The term secondary markets indicates the financial markets of parallel negotiation that function concurrently with the primary ones in the framework of an integrated financial center in which the introduction of smaller enterprises is less difficult since the entry requirements are limited.

The secondary markets aim to make stock markets accessible to small to medium-sized enterprises, offering lower costs, availability of capital for investment plans

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and entrepreneurial development. This is achieved by loosening their introduction requirements and by reducing the cost of the introduction under that of the primary markets.
The significance of secondary capital markets, as a source of financing small to medium-sized enterprises, stems from the fact that in today's world small to medium-sized businesses are seen more than ever as a vehicle for entrepreneurship.
The criterion for choosing our sample of parallel markets (Greece, UK, France and Germany) is based on the fact that these markets operate in one stock exchange center with one representative stock index. Conversely, in countries like Spain, Portugal and Italy, parallel markets operate in several exchange centers with different stock indices[2].
The second section of this paper deals with secondary capital markets' contribution to entrepreneurial growth. The third section analyses the main methodological issues. The fourth section describes the data and presents the empirical results and finally, the paper ends with the provision of the basic conclusions as they came forth from the research.

## 2. The Contribution of Secondary Capital Markets to Entrepreneurial Growth

There is a heated discussion worldwide about the relation between secondary stock markets and the entrepreneurial growth of a country. It is very interesting to see in what way a stock market can help or even speed up the economic growth of a company. The main reasons for this phenomenon are that secondary stock exchanges:

- Increase liquidity and constitute a mechanism for the diversification of risk (a risk management device), therefore making market participants more prone to invest.
- Improve the flow of information about the activities of small companies, which results in the improvement of corporate control and eventually in better corporate governance. In other words, the organizational and managerial structure of the corporations become more effective.
- Provides the opportunity for society's savings to be directed to alternative ways of investment which are more productive. The existence of an exchange increases the stock of funding available for riskier investment projects - a prerequisite to economic growth. In general, it can be said that stock markets contribute to both capital accumulation and technological innovation.

In our globalized world secondary stock exchanges should be harmonized with international rules and regulations. The current trend is the globalization of stock exchanges either in terms of alliances or electronic links between them. The liberation of capital movement is also an important factor for the future development of financial markets. They should focus on a specific client target group of either institutional or retail investors. Thus it is very important to adopt the right strategy and formulate the appropriate rules in order to attract the target

[2] In Spain, the Segundo Mercado (parallel market) listed companies are traded in Madrid, Barcelona and Bilbao. In Portugal, Segundo Mercado operates in Lisbon and Porto. Finally, in Italy, Mercato Ristretto operates in six different cities (Rome, Milan, Turin, Genoa, Florence and Naples).

investors' group. Also, stock exchanges should establish sound supervisory structures, like, for example, clearness and transparency.

The theory of cointegration became the most sufficient method for testing the co-dependence between stock markets' indices. Cointegration examines the existence of a long-run common stochastic trend among stock prices. The cointegration between two stock markets implies that it is possible to use the price movements in one market in order to predict the price movements in the other market.

According to literature (Granger 1986, Chan, Gup, and Pan 1992, Arshanapalli and Doukas, 1993) if two markets are collectively efficient in the long run, then their stock prices cannot be cointegrated. In other words, if two markets are cointegrated, then it is not possible to explore profits from arbitrage.

The results of cointegration tests have important implications for portfolio diversification through investment strategy. Diversifying into stock markets cannot be effective if those markets are cointegrated (there are price co-movements). This is so because the systematic/country risk cannot be diversified away. Therefore it is not in the best interest of investors seeking diversified portfolios to invest in cointegrated markets.

The studies of developed and emerging markets are several, while studies that concern the secondary stock markets are few and mainly concern statistical comparisons and analyses[3]. In the past few years these markets have been characterized by high returns and constitute an interesting research endeavor.

Recent studies have found small correlation in the returns of developed stock markets (Wilkox, 1992), as well as among emerging and international markets (Hauser et al 1994, Errunza 1994). The results of these studies show the stock markets independence and support the international diversification of portfolios.

Some other studies, on the other hand, reinforce the view of co-dependence of international markets (Eun and Shim 1989). Therefore, the interpretation of high or low correlation and the consequences on international portfolio diversification is unclear. Speidell and Sappenfield (1992) suggest that international events, such as integration, liberalization of markets and crisis, affect the correlation of returns between markets in a positive manner. Blackman et al. (1994) draws the conclusion of the existence of long-term relationships for post international cointegration of markets for the period 1984-1989. Meric and Meric (1989), by analyzing the perennial stability of the correlation coefficients matrix for the 17 stock exchanges found that the larger the time period they used, the larger the level of stability, a result that is contrary to that of Maldonado and Saunders (1981). Eun, Shim, Arshanapalli and Doukas (1993) illustrated that many stock markets are non-stationary. The latter showed strong dependencies between the markets of U.S.A., Germany, England and France for the period after 1987. Finally, Chan, Gup and Pan (1997) show that there has been an increase in the significant cointegrating vectors in the 1980s before the stock market crash in 1987 for various samples of international stock markets, including the stock markets in the European Community.

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[3] Bannock, G. and Doran, A. (1987) Going Public, The Markets in Unlisted Securities. Harper & Row Publishers, London.
Bannock & Partners Ltd. (1994) European Second-tier Markets for NTBFs. A study carried out for the European Commission DGXIII-D4: SPRINT/EIMI.

*2.1 Secondary Capital Markets Quality Characteristics*

In order for a secondary stock exchange to be able to support the economic growth of a country, it is very important for it to possess certain quality characteristics. Therefore, the following issues must be addressed when we talk about a competitive parallel market:

- *Efficiency:* The extent to which information available each time to the public is adequate to current prices. It refers to the fairness of prices but to the extent to which investors have equal chances of forming the correct expectations. Efficient securities markets are vital in helping to raise competitiveness levels, through the efficient allocation of capital by mobilizing savings and by disciplining management. Access to low cost capital promotes the growth of new businesses.
- *Liquidity***:** The degree to which a market is liquid, meaning how easily trades are conducted in that market or, in other words, how easy it is to convert a security into cash. Liquidity components are the following:
    1. *Depth:* The size of a financial investment that can be traded at a given price.
    2. *Breadth:* The difference between the fair price and the actual traded price. It is usually measured by the width of the Bid/Offer spread that is the difference between the lowest sell price and the highest buy price. A high spread suggests an ineffective price discovery process because it implies that buyers have a very different opinion from sellers, therefore it is difficult to make trades.
    3. *Resilience:* The spread with which prices return to their initial "equilibrium" level after they change, in response to a trade by investors. This formulates a quality characteristic because investors can have the "fair" value of a security at any time.
- *Transparency:* The concept of transparency in a stock market includes the following elements.
    1. *Fairness:* Markets must be free from fraud and manipulation. Thus an adequate mechanism for promoting fidelity between buy and sell side must exist.
    2. *Information Dissemination:* A cornerstone prerequisite for the good functioning of the stock exchange.
    3. *Simplicity:* The rules and structures of the stock exchange must be as simple as possible in accordance with the targets aimed at.
    4. *Equal Treatment:* Different investors and companies, given their different features, must be treated equally with regard to access to the stock exchange and its markets.
    5. *Stock dispersion:* Adequate stock dispersion ensures a large number of trading parties and therefore, more effective price determination and a lower probability of manipulation.
    6. *Inside information:* Access and use of private (or inside) information is strictly prohibited in order to avoid price manipulations.
    7. *Protection:* The means through which investors are protected from market manipulations, inefficiencies and failures. Specifically, the kinds of services provided are important, both in terms of offering protection

for the less aware and offering facilities to encourage participation on the part of individuals.

- *Cost-Efficiency:* Transaction costs include all commissions, fees and operating costs which have to be paid by a customer involved in a deal. These costs increase with the number of parties involved and the inefficiency of procedures (e.g. the fax is more expensive and takes more time than e-mail), and with the costs of the trading systems involved.
- *Market Access:* Who can see the trading bids and asks and who can actually trade. Viewing is available to all market participants but access is limited to stock exchange members.
- *Orderly Markets:* Reduced price volatility is a prerequisite in order to boost confidence in stock market institutions and to avoid excessive levels of risk. The management of periods of turbulence and the protection of investors in periods of potential market disorder is a crucial point.
- *Innovation:* Innovation in products, rules and technology formulates a quality characteristic because it strengthens the competitive advantage of a stock exchange.
- *Effective use of technology:* A stock exchange should effectively use the advanced technology available in order to ensure high performance.

Even though the above difficulties exist, integration seems to be the future in the global financial sector. The major consequences of secondary capital markets integration will be the vast and inevitable rise of competitiveness at all levels (countries, financial institutions, stock exchanges), a new, common financial regulatory framework for all the countries in the European Union, mergers and co-operation between stock exchanges, 24-hour trading, the dominance of large stock exchanges against the smaller ones and finally, the possibility of lower levels of investor protection. It has recently been estimated[4] that the creation of a well-functioning single market in financial services - including banking, capital markets and insurance funds - would add around 43 billion euros annually to the EU economy. As a result, the EU could raise its underlying economic growth by up to 0.7 percentage points each year.

## 3. Methodological Issues

In order to test for cointegration, two econometric procedures are implemented: the Engle-Granger two-step methodology (Engle and Granger, 1987) and the Johansen's Maximum Likelihood approach (Johansen, 1988 and 1991).
According to Engle and Granger, two basic steps are followed:
1. Testing for the existence of unit roots (integration order) in each index, following Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) tests (1981) through the relationship:

$$ADF: \Delta S_t = a + \beta \Gamma + \rho S_{t-1} + \sum_{\iota=1}^{\kappa} \gamma_\iota \Delta S_{t-1} + u_t \qquad (1)$$

where $\Delta S_t = S_t - S_{t-1}$ , $S_t$ is the index of the examined market, and k is chosen so that the innovations $u_t$ be white noise. For the DF test, the $\gamma_l$'s are considered equal

[4] European Financial Services Round Table, FESE, 2002

to zero. The null hypothesis is $H_o$: ρ = 0. If the null hypothesis of only a unit root cannot be rejected, then the stock prices follow a random walk. Thus, the stock market is individually weak form efficient (Chan, Gup and Pan, 1997).

1. Cointegration testing among the stock market indices and their relevant secondary stock indices. Consider stock prices (in log) in countries i and j ( $S_t^i$ and $S_t^j$ ), and $P_t$ is the vector that consists of $S_t^i$ and $S_t^j$. According to Engle and Granger (1987), $S_t^i$ is said to be integrated of order d, denoted $S_t^i$ ~ I (d), if the dth difference of $S_t^i$ is stationary. The vector $P_t$ is said to be cointegrated of order d, b, denoted as $P_t$ ~ CI (d, b), if each component of $P_t$ is integrated of order d, and there exists a non-zero vector δ such that δ´ $P_t$ is integrated of order d-b, for b>0. If both $S_t^i$ and $S_t^j$ are I (1) and $P_t$ ~ CI (1,1)

[i.e. δ´ $P_t$ ~ I (0)], then there are error-correction equations in the following form:

$$\Delta S_t^i = \alpha_1 [S_{t-1}^i - \delta_1 S_{t-1}^j] + \text{lagged } (\Delta S_t^i \text{ and } \Delta S_t^j) + e_t^i \qquad (2)$$

$$\Delta S_t^j = \alpha_2 [S_{t-1}^j - \delta_2 S_{t-1}^i] + \text{lagged } (\Delta S_t^i \text{ and } \Delta S_t^j) + e_t^j$$

where $\alpha_1$ and $\alpha_2$ are non-zero coefficients and $e_t^i$ και $e_t^j$ are stationary, possibly autocorrelated error terms. As Granger (1986) and MacDonald and Taylor (1988 and 1989) have demonstrated, asset prices from two efficient markets cannot be cointegrated. The implication from the error-correction equations is that stock price changes in country i (country j) are predictable by $[S_t^i - \delta_1 S_t^j]$ $[S_t^j - \delta_2 S_t^i]$ if stock prices in countries i and j are cointegrated. On the other hand, if stock prices in country i and j are not cointegrated, then stock prices in country i have already incorporated all available information into the pricing process. Therefore, historical stock prices of country j contain no useful information in forecasting the stock price changes of country i. According to MacDonald and Taylor (1988 and 1989):

$$E\left(S_t^i / I_{t-1}^i\right) = E\left(S_t^j / I_{t-1}^{ij}\right), \qquad (3)$$

where E(./.)= the mathematical conditional expectation operator:

$$I_{t-1}^i = \left\{S_t^i, S_{t-1}^i, S_{t-2}^i, .....\right\} \qquad (4)$$

$$I_{t-1}^{ij} = \left\{S_t^i, S_{t-1}^i, S_{t-2}^i, ..., S_t^j, S_{t-1}^j, S_{t-2}^j, ..\right\}.$$

Condition (3) is clearly contradicted with the error-correction representation in condition (2), unless $\alpha_1$ and $\alpha_2$ and the coefficients associated with lagged $\Delta S_t^i$ and $\Delta S_t^j$ are all zero. Thus, cointegration implies collective inefficiency.

Engle and Granger proposed several cointegration tests; however, the most preferable is the ADF statistical test.

In order to test for cointegration between the two markets, the Johansen's Maximum Likelihood Procedure (Johansen, 1988) is implemented. This is a preferred method of testing for cointegration as it allows restrictions on the cointegrating vectors to be tested directly, with the test statistic being $\chi^2$ distributed. This specific procedure provides a unified framework of estimating and testing the

cointegration relationships in a VAR error correction mechanism, which incorporate different "short-run" and "long-run" dynamic relationships in a variable system.
Johansen extends Engle and Granger's cointegration to a multivariate framework considering a fairly general unrestricted error-correction model in the following form:

$$\Delta S_t = \Gamma_1 \Delta S_{t-1} + ... + \Gamma_{\kappa-1} \Delta S_{t-k+1} + rS_{t-k} + \mu + e_t, \quad (5)$$

where $S_t$ = (px1) vector of stock prices at time t;
r = (pxp) parameter matrix;
μ = (px1) intercept term.
The parameter matrix, r, indicates whether the (px1) vector of stock prices has long - run dynamic relationship or not. The rank of r equals the number of cointegrating vectors. If r has full rank, then all the stock price series are stationary in levels. If the rank of r is zero, eq. (5) reduces to a standard vector autoregression model. Cointegration is suggested if the rank of r is between zero and the number of stock series. The null hypothesis is that there is no cointegration among the stock prices.
Hall (1991) has demonstrated that in using the Johansen test for cointegration it is necessary to carry out tests to establish the appropriate order of VAR. These tests are the multivariate generalizations of the Akaike Information Criterion (AIC) and the Schwarz Bayesian Criterion (SBC):

$$AIC = T \log |\Sigma| + 2N \quad (6)$$

$$SBC = T \log |\Sigma| + N \log (T)$$

where T: number of observations;
N: total number of the forecasting parameters;
$|\Sigma|$: variance-covariance matrix of the residuals.

## 4. Data and Empirical Results

Daily price indices of primary and secondary stock markets in Greece (ASE GENERAL INDEX and ASE PARALLEL INDEX), United Kingdom (FTSE 100 and AIM INDEX), Germany (XETRA DAX and NEUER MARKET INDEX) and France (CAC 40 and SECOND MARCHE INDEX) were used in this study. Because dividends are not included, the indices simply represent prices. The data was converted to natural logs and covered the period from January 1998 to December 2000. It was drawn from the International Financial Statistics (IFS) and OECD Economic Indicators.
*Contemporaneous Correlations*
Regressing non-stationary variables on each other can lead to potentially misleading inferences about the estimated parameters resulting in the problem of spurious regressions. Before testing for cointegration, therefore, the order of integration of stock prices must be determined. As a preliminary step, the stock prices were transformed into natural logs, their integrated properties were investigated and their graphical representations were inspected. Most of the stock markets (indices) under study appear to possess some deterministic trend component or might even be characterized as trend-stationary processes. A range of descriptive statistics of the stock markets is analyzed (see table 1). The negative skewness apparent in some stock markets implies that the distribution of the series

(around the mean) has a long left tail, whereas the relevant Jarque-Bera statistics indicate rejection of the normality hypothesis.

Table 1

Stock Market Descriptive Statistics

| | ASE/GI | ASE/PI | FTSE 100 | AIM | CAC 40 | SECOND MARCHE | DAX | NEUER MARKET |
|---|---|---|---|---|---|---|---|---|
| Mean | 7.010 | 8.465 | 9.656 | 6.157 | 8.891 | 4.736 | 5.159 | 7.736 |
| Median | 7.018 | 8.518 | 9.646 | 6.167 | 8.917 | 4.709 | 5.197 | 4.756 |
| Maximum | 7.331 | 8.995 | 10.038 | 6.538 | 9.256 | 5.341 | 5.538 | 6.341 |
| Minimum | 6.603 | 7.698 | 9.257 | 5.756 | 8.236 | 4.251 | 4.753 | 4.251 |
| Std. Deviation | 0.186 | 0.287 | 0.139 | 0.148 | 0.167 | 0.299 | 0.158 | 1.332 |
| Skewness | -0.152 | -0.330 | 0.218 | -0.118 | -0.781 | 0.347 | -0.118 | 0.767 |
| Kurtosis | 1.957 | 2.266 | 2.940 | 2.706 | 4.009 | 1.883 | 1.706 | 1.654 |
| Jarque-Bera | 95.913 | 70.812 | 14.125 | 10.36 | 252.024 | 125.833 | 11.343 | 15.355 |
| Probability | 0.0000 | 0.0000 | 0.0009 | 0.0056 | 0.00000 | 0.00000 | 0.0052 | 0.0000 |
| Observations | 1,047 | 1,047 | 1,047 | 1,047 | 1,047 | 1,047 | 1,047 | 1,047 |

The indices correspond to the respective stock markets and secondary capital markets as mentioned above.

The contemporaneous correlations matrix of the eight stock indices is also studied (see table 2). The main markets stock indices of UK, France, Germany and Greece indicate relatively high and positive pair wise correlations. The secondary capital markets indices, however, show high negative correlation with the main markets and low correlation with most of the relative neighboring secondary markets. Overall, the correlation coefficients appear rather low, indicating weak (short-term) contemporaneous interactions between these markets. These findings may be associated with the relatively short active life of the secondary stock markets since their opening (early 1990s), and the absence of substantial market depth, in terms of number of listed companies, capitalization and turnover.

Table 2

Contemporaneous Correlations Matrix

| | ASE/GI | ASE/PI | FTSE 100 | AIM | CAC 40 | SECOND MARCHE | DAX | NEUER MARKET |
|---|---|---|---|---|---|---|---|---|
| ASE/GI | 1.000 | | | | | | | |
| ASE/PI | 0.908 | 1.000 | | | | | | |
| FTSE 100 | 0.369 | -0.405 | 1.000 | | | | | |
| AIM | -0.657 | -0.010 | 0.818 | 1.000 | | | | |
| CAC 40 | 0.331 | -0.318 | 0.629 | -0.521 | 1.000 | | | |
| SECOND MARCHE | -0.874 | -0.326 | -0.096 | -0.210 | 0.137 | 1.000 | | |
| DAX | 0.1 74 | -0.116 | 0.696 | -0.210 | 0.987 | -0.874 | 1.000 | |
| NEUER MARKET | -0.987 | -0.877 | -0.096 | -0.430 | -0.137 | -0.876 | 0.765 | 1.000 |

*Unit Roots*

In order to test for the presence of stochastic non-stationarity in the data, the integration order of the individual time series is investigated using the ADF and PP tests for the presence of unit roots. The selection of optimal lags is determined by minimizing AIC, and is set at four lags for the ADF test and at seven lags for the PP test. Both the ADF and PP tests are considered with and without trend. The null hypothesis in each test is that each of the price series contains a unit root (i.e., testing the series as *I(1)* against *I(0)*); it should be rejected if the test statistics are less than the critical value.

Table 3 reports the results of the unit roots tests on the levels of each price series. The results indicate that the null hypothesis of unit roots in stock index prices for all four countries should not be rejected. To determine the order of integration of each price series, the DF and the ADF tests on the first differences are also computed in the same table, which reports the results of the Unit roots tests. The PP tests lead exactly to the same results, therefore are not presented here.

Table 3

Unit Roots Tests between Primary and Parallel Markets

| Countries | ADF | Statistic | ADF Critical Value* |
|---|---|---|---|
| **Great Britain** | | | |
| FTSE 100 | Value | -3,0577 | -3,4201 |
| | ΔValue | -17,5729** | |
| AIM | Value | 1,9469 | |
| | ΔValue | -14,1502** | |
| **France** | | | |
| CAC 40 | Value | -1,7238 | -3,4209 |
| | ΔValue | -16,0463** | |
| Second Marché | Value | 1,6300 | |
| | ΔValue | -11,9487** | |
| **Germany** | | | |
| DAX XETRA | Value | -1,3799 | -3,4245 |
| | ΔValue | -13,0021** | |
| Neuer | Value | 0,51543 | |
| | ΔValue | -12,2541** | |
| **Greece** | | | |
| Primary market | Value | -2,5397 | -3,4164 |
| | ΔValue | -21,0531** | |
| Parallel Market | Value | -0,63780 | |
| | ΔValue | -17,4675** | |

Value = the logarithm of the market index

ΔValue = the first difference of the logarithms

* 5% critical value of the Augmented Dickey-Fuller test statistic.

** Statistically significant at 5% confidence interval.

The results indicate that unit roots on the first differences of the stock index prices are rejected at the 5% significance level, suggesting that the stock price changes are stationary. That is, the entire daily stock index prices are I (1) processes, indicating that stock prices follow a random walk. This result implies that all the stock markets examined are individually weak form efficient. Since the stock index price series are I (1), both the Engle-Granger's tests and the Johansen's procedure tests for cointegration are used. Engle-Granger's cointegration tests are implemented to the residuals of the regressions, only among the Secondary stock markets. Table 4 reports the results of DF and ADF tests.

Table 4

Engle-Granger Cointegration Test for the Secondary Markets

| System | DF | ADF |
|---|---|---|
| ASE PARALLEL MARKET INDEX–AIM INDEX | -0,2722 | -0,9147 (2)** |
| ASE PARALLEL MARKET INDEX–SECOND MARCE INDEX | -0,2834 | -1,3391 (2)** |
| ASE PARALLEL MARKET INDEX–NEUER MARKET INDEX | -0,6289 | -0,9445 (2)** |

* Critical value for 95% confidence level of the Augmented Dickey- Fuller test statistic is -3,3578.
** Statistically significant for 5% confidence level. The number in parentheses shows the least required lag order to have white noise innovations.

*Cointegration Vectors*

As the null hypothesis of unit roots cannot be rejected, multivariate models can be built to enable investigation of the presence or absence of cointegrating relationships in the data set. Departing from the bivariate cointegration regressions in the Engle-Granger framework, a vector error cointegration model (VECM) such as in Equation (4) is estimated to consider the eight series jointly, according to the procedure advanced by Johansen (1989, 1991). The four stock markets are modeled as in Equation (4) and the order the stock indices are entered into the VAR model is based on their market capitalization (all other orderings are also analyzed in supplementary models). The choice of optimal lags is given by consideration of minimizing the AIC and absence of autocorrelation in the VAR residuals; four lags for the levels of variables are included.

Furthermore, the Johansen cointegration test among secondary stock markets' relative indices is rejected for all countries (table 5). The results lead to findings similar to those of the Engle-Granger's methodology (table 4).

Table 5

Johansen Tests for Cointegration among Secondary Markets

| System | Null Hypothesis | Alternative Hypothesis | Tests for cointegration vectors based on | |
|---|---|---|---|---|
| | | | Maximal eigenvalue | Trace |
| ASE PARALLEL MARKET INDEX- AIM INDEX | r = 0<br>r ≤ 1 | r ≤ 1<br>r = 2 | 7.6208<br>4.0596 | 11.7904<br>4.0596 |
| ASE PARALLEL MARKET INDEX- SECOND MARCHE INDEX | r = 0<br>r ≤ 1 | r ≤ 1<br>r = 2 | 8.3283<br>2.0186 | 10.3469<br>2.0186 |
| ASE PARALLEL MARKET INDEX- NEUER MARKET INDEX | r = 0<br>r ≤ 1 | r ≤ 1<br>r = 2 | 4.5596<br>2.4138 | 6.9734<br>2.4138 |

Note: The 95% critical values of the test based on Maximal eigenvalue are 11.0300 (r = 0, r ≤ 1) and 4.1600 (r ≤ 1, r = 2), while the critical values of the test based on Trace are 12.3600 and 4.1600 respectively.

The rejection of cointegration among the Greek secondary stock market and the relative markets in UK, Germany, and France means that there are no linkages between them. This implies the existence of collective weak-form efficiency in the long run, and also the Greek parallel stock market is offered for European-oriented portfolio diversification.

Conversely, the hypothesis of cointegration between the primary and secondary markets and their relative indices in stock markets in Germany and France is

rejected, while it is accepted for the Greek and the British stock markets. The Johansen's multivariate cointegration test results are presented in Table 6.

Table 6

Johansen Tests for Cointegration among Primary and Secondary Markets

| System | Null Hypothesis | Alternative Hypothesis | Tests for cointegration vectors based on | |
|---|---|---|---|---|
| | | | Maximal eigenvalue | Trace |
| ASE GENERAL INDEX- PARALLEL MARKET INDEX | r = 0<br>r ≤ 1 | r ≤ 1<br>r = 2 | 16.6641<br>3.3010 | 19.9652<br>3.3010 |
| FTSE 100 INDEX- AIM INDEX | r = 0<br>r ≤ 1 | r ≤ 1<br>r = 2 | 22.3712<br>0.5392 | 22.9105<br>0.5392 |
| CAC 40- SECOND MARCHE INDEX | r = 0<br>r ≤ 1 | r ≤ 1<br>r = 2 | 8.1249<br>1.0944 | 9.2194<br>1,0944 |
| DAX XETRA- NEUER MARKET | r = 0<br>r ≤ 1 | r ≤ 1<br>r = 2 | 9.8377<br>0.0760 | 9.9138<br>0.0760 |

Note: The critical values of the test based on Maximal eigenvalue are 14.8800 (r = 0, r ≤ 1) and 8.0700 (r ≤ 1, r = 2), while the critical values of the test based on Trace are 17.8600 and 8.0700 respectively.

The existence of cointegration in the Greek and the British stock markets implies that it is possible to use the price movements in one market (primary) in order to predict the future price movements in the other market (secondary), and thus possible arbitrage profits can be explored in the long run. The long-run co-movements in Greek and British primary and secondary markets imply that they are improper for domestic diversification.

Table 7

Normalized Cointegrating Vector

| ASE/GI | ASE/PI | FTSE 100 | AIM | CAC 40 | SECOND MARCHE | DAX | NEUER MARKET | C |
|---|---|---|---|---|---|---|---|---|
| 1.000 | 0.939<br>(0.828) | 4.075<br>(0.574) | -3.163<br>(0.058) | -0.102<br>(0.278) | -0.817<br>(0.383) | -0.876<br>(0.767) | -4.675<br>(0.231) | 1.453<br>(0.955) |

*Asymptotic standard errors in parentheses.*

## 5. Conclusions

This paper uses cointegration tests to provide evidence on the relationship between the Greek secondary (parallel) capital market and the respective markets in the UK, France and Germany. Furthermore, it examines the existence of interdependence between primary and secondary markets in order to test the price behavior of secondary markets.

In more detail, the tests for the parallel markets showed absence of cointegration among them. Such a result, besides the non-existence of informational links, could be due to other factors, like different introduction requirements, number of index stock components, time required for the introduction, etc. The fact that the secondary markets do not show informational dependence implies collective weak form efficiency. This is favorable to portfolios with a significant percentage of small-to-medium capitalization stocks in order to achieve high levels of European-oriented diversification.

In Great Britain and Greece, the cointegration between primary and secondary markets shows the existence of a long-run common stochastic trend among their index prices, resulting from the information that is contained in the series. Conversely, the non-existence of cointegration between primary and parallel

markets in the two other countries makes it easier for domestic portfolio diversification and the restriction of risk. Their low level of systematic variation with the primary markets could be attributed to the distinct nature of the firms listed on secondary markets.

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