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The Integration of European Stock Markets and Market Timing

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Abstract

In this research, a European index and a world index were used to test the integration of the national stock markets of fourteen EU countries into the world stock market. A market timing procedure was used to detect differences of performance between the national indexes. The main conclusions drawn are that the European factor is important in explaining the returns of all the national indexes, but the world portfolio seems unnecessary in the cases of nine countries whose stock markets are embedded in the global European stock market. Differences of performance were also detected: the market timing effect being particularly evident in relation to the European market portfolio. Non-participation in the single currency does not seem to have a perceptible influence on the results.

Resumo

Neste estudo são utilizados um índice de acções europeu e um índice mundial para testar a integração dos mercados de acções de 14 países da União Europeia no mercado financeiro mundial. Um procedimento de "market timing" foi usado para detectar diferenças de desempenho entre os índices nacionais. As principais conclusões obtidas são que o factor europeu é importante para a explicação das rentabilidades de todos os índices nacionais, enquanto que o índice mundial parece desnecessário no caso de nove países cujos mercados de acções estão pouco abertos aos mercados financeiros não europeus. Foram igualmente detectadas diferenças de desempenho. O efeito de "market timing" é mais evidente em relação ao índice europeu. A não participação na moeda única não teve influência perceptível sobre os resultados.

I. Introduction

Since the seminal work of Solnik (1974), the central theme regarding financial markets integration has been to determine whether the same asset pricing model can be applied to a group of domestic financial markets. The main obstacles to perfect financial integration, apart from capital movement controls, are: the asymmetric information between domestic and foreign investors; the exchange rate risk and deviations from purchasing power parity and; hence, the difficulty that foreign assets have in conveniently hedging against domestic inflation. In the case of European Union countries who have already adopted the single currency, an analysis of financial integration has the following main aspects:

- the integration between EU domestic stock markets;
- the integration /segmentation of EU stock markets into the world stock market.

These are the objects of this research, in which both a European market portfolio and a world market portfolio were used in a pricing model for European Union assets. The tests conducted during this research are based on the tradition of integration vs segmentation of stock market analysis, developed earlier by Stehle(1977), Jorion and Schwartz (1986), Stulz (1981), Errunza and Losq (1985) and Errunza, Losq and Padmanabhan(1992). Unlike these pieces of research, however, where the risk premiums and coefficients were regarded as being constant, in this paper the risk premiums are represented by the excess returns observed in the market, and a market timing approach was used to evaluate the differences in performance between the different stock markets.

II. Presentation of the methodology and tests

In a world of perfectly integrated financial markets, the Capital Asset Pricing Model can be applied to all markets, by means of a world market portfolio, as was demonstrated by Solnik (1974). Thus, the equilibrium relationship between the excess expected return and the world portfolio is given by:

$$\mu_i - r_{f,i} = \beta_i \left(\mu_W - r_{f,W} \right) \qquad (1),$$

where μ_i is the expected return of an asset of country i, $r_{f,i}$ is the risk-free interest rate in that country, μ_W is the expected return of the world portfolio, and $r_{f,W}$ is a weighted average of the risk-free interest rates of all countries. Using this model as a reference to the definitions of financial integration, the subsequent empirical analysis presented in the literature has paid attention to the deviations from the international asset pricing tool proposed by Solnik. Although, during the eighties, the main causes of those deviations were still barriers to international capital movements, the elimination of most of those barriers has not, contrary to expectations, allowed a rapid integration of the financial markets. This shows that there are other causes of market segmentation, apart from controls on capital movements. The obstacles to market integration are commonly referred to under the portmanteau of *home bias*, but they reflect different causes of anomalous excessive preference for domestic assets by the investors, which contradicts the choices that would be expected in accordance with the Markowitz mean-variance model. The different causes of home bias have been the subject of a good number of articles. Transaction costs and the differences between fiscal systems are two of the explanations of home bias. These were analysed by French and Poterba (1991). The difficulty in hedging exchange rate risk also has a negative effect on the good portfolio choices in international investment, as Solnik and Noetzlin (1982) recognize. However, these authors showed that the diversification of investments by assets denominated in different currencies can improve the return/risk relationship. The deviations of exchange rate from purchasing power parity, and the difficulty in conveniently hedging against domestic inflation through investment in foreign assets, were made evident by Cooper and Kaplanis (1994) and by Glassment and Riddick (1996,2001). Finally, asymmetric information between domestic and foreign investors is another important cause of home bias, and this was the subject of analysis carried out previously by Kang and Stulz (1997) and by Brennan and Cao (1997). A certain degree of financial market segmentation, not as a result of barriers to capital movements but as a result of investor behaviour, is a phenomenon currently more likely to be observed between European Union and world markets. Hence it is the object of analysis in this research.

II.1 Previous empirical analysis of the integration and segmentation of stock markets

The conceptual tools on which the empirical analysis conducted here is based, are the same as those used in the relevant literature to explain market segmentation, even when the controls in capital movements were considered to be the most important cause of segmentation. The first empirical model proposed in the literature that estimates market segmentation is the one of Stehle (1977), which supposes that the domestic market portfolio plays a dominant role in asset pricing, and the world market portfolio is only a "secondary actor" in the model. This means that the model only accounts for the possibility of a country's financial market being partially integrated into the world market, but not perfectly integrated. The procedure used by Stehle in his empirical analysis, which is based on the Fama-Macbeth approach to CAPM, consists of two stages. In the first stage, the world index is isolated in a component that is not correlated with the domestic index, through the linear regression:

$$\tilde{R}_W = \alpha_{WD} + \beta_{WD}\tilde{R}_D + \tilde{\upsilon}_W \qquad (2),$$

where $\tilde{R}_W$ is the return of the world market portfolio, $\tilde{R}_D$ is the return of the domestic market portfolio and $\tilde{\upsilon}_W$ is the component of the return of the world portfolio not correlated with the domestic index. A second regression is carried out in the first stage with the objective of estimating the beta coefficients of each domestic individual asset i, relative to the domestic index and to $\tilde{\upsilon}_{\mathrm{W}}$:

$$\tilde{\mathrm{R}}_{\mathrm{i}} = \alpha_{\mathrm{i}} + \beta_{\mathrm{iD}}\tilde{\mathrm{R}}_{\mathrm{D}} + \beta_{\mathrm{i}\upsilon}\tilde{\upsilon}_{\mathrm{W}} + \tilde{\varepsilon}_{\mathrm{i}} \qquad (3).$$

The second stage consists of a regression of the expected excess returns of the individual assets over the two series of their beta coefficients, in order to estimate an equilibrium relation between return and systematic risk, represented by the following equation:

$$\mu_{\mathrm{i}} - \mathrm{r}_{\mathrm{f}} = \beta_{\mathrm{iD}}\lambda_{\mathrm{D}} + \beta_{\mathrm{i}\upsilon}\lambda_{\mathrm{W}} \qquad (4),$$

where λ_D and λ_W are the market prices of risk of the domestic market portfolio and of the world factor, respectively. The domestic stock market is partially integrated into the world market if $\lambda_W \neq 0$, and it is completely segmented if $\lambda_W = 0$.

Jorion and Schwartz (1986) proposed a model in which perfect integration and complete segmentation were the two extreme cases. The tests conducted by Jorion and Schwartz were of two types: the *tests on integration* and the *tests on segmentation*, both of which consisted of two stages. The first stage of the integration tests involves isolating the component of the return of the domestic market portfolio that is not dependent on the world portfolio, through the following regression:

$$\tilde{\mathrm{R}}_{\mathrm{D}} = \alpha_{\mathrm{DW}} + \beta_{\mathrm{DW}}\tilde{\mathrm{R}}_{\mathrm{W}} + \tilde{\gamma}_{\mathrm{D}} \qquad (5),$$

in order to obtain, in the following estimations, two different beta coefficients referring to each individual asset i, one beta relative to the world market portfolio, β_{iW}, and the other relative to the independent component of the domestic index, $\beta_{\mathrm{i}\gamma}$. The subsequent equilibrium equation then becomes:

$$\mu_i - r_f = \beta_{iW}\lambda_W + \beta_{i\gamma}\lambda_\gamma \qquad (6),$$

where λ_W and λ_γ are the market prices of risk of the world portfolio and of the domestic factor respectively. The domestic stock market is perfectly integrated into the world market when $\lambda_\gamma=0$, and this does not occur when $\lambda_\gamma\neq0$. The Jorion and Schwartz tests on segmentation are equally made up of two stages, the first being the isolation of the component of the return of the world portfolio that is not correlated with the domestic index, through the following regression, which is similar to the one used in Stehle's model:

$$\tilde{R}_W = \alpha_{WD} + \beta_{WD}\tilde{R}_D + \tilde{\upsilon}_W \qquad (7).$$

Again two beta coefficients are obtained for each individual asset, one referring to the domestic index, β_{iD}, and the other referring to the independent component of the world index, $\beta_{i\upsilon}$. The equilibrium equation that determines the final estimations is:

$$\mu_i - r_f = \beta_{iD}\lambda_D + \beta_{i\upsilon}\lambda_\upsilon \qquad (8).$$

The domestic market is completely segmented when the risk premium of the world factor, λ_υ, is equal to zero, but is not segmented when this risk premium is different from zero. In the second stage of both types of tests, Jorion and Schwartz use a maximum likelihood procedure that permits the error terms of both the dependent and independent variables to be taken into account in its estimations. Jorion and Schwartz's model was used by Ragunathan, Faff and Brooks (1999) to estimate the integration between the Australian and American stock markets. In their research, covering the period from January 1974 to December 1992, the authors included dummy variables to take account of the expansion and contraction phases of the business cycle.

Errunza and Losq (1985) proposed a model, which was tested by Errunza, Losq and Padmanabhan (1992) (albeit with some slight modifications), which considers the case where two types of assets exist in one domestic market, i.e. those which are available to all types of investors (both domestic and foreign), the so-called *eligible securities*, and those which are only available to domestic investors, and are thus *ineligible securities* for foreigners. To determine if this *mild segmentation* situation is observed, the authors propose, as a first step, the isolation of the components that do not depend on the world market portfolio, in both the portfolio of eligible assets and in the portfolio of ineligible assets, through the following regressions:

$$\tilde{R}_E = \alpha_{EW} + \beta_{EW}\tilde{R}_W + \tilde{\Phi}_E \qquad (9),$$

and

$$\tilde{R}_I = \alpha_{IW} + \beta_{IW}\tilde{R}_W + \tilde{\Upsilon}_I \qquad (10),$$

where $\tilde{R}_E$ and $\tilde{R}_I$ are the returns of the portfolio of eligible securities and of the portfolio of ineligible securities, respectively, and the independent components of the first and of the second of these portfolios are respectively $\tilde{\Phi}_E$ and Υ_I. The equilibrium relation between risk and return for each eligible individual security is then given by the following equation:

$$\mu_e - r_f = \beta_{eW}\lambda_{E,W} + \beta_{e\Phi}\delta_E \qquad (11)$$

where μ_e is the expected return of an eligible asset, β_{eW} and $\beta_{e\Phi}$ are its betas relative to the world portfolio and to the independent component of the return of the portfolio of eligible securities, and $\lambda_{E,W}$ and δ_E are the market prices of risk associated with each of these two factors. The equilibrium relationship between risk and return for each ineligible individual security is given by:

$$\mu_i - r_f = \beta_{iW}\lambda_{I,W} + \beta_{i\Upsilon}\delta_I \qquad (12)$$

where μ_i is the expected return of an ineligible asset, β_{iW} and $\beta_{i\Upsilon}$ are its betas relative to the world portfolio and to the independent component of the return of the portfolio of ineligible securities, and λ_{IW} and δ_I are the market prices of risk associated with each of these two factors. If the domestic financial market is integrated into the world market, the market price of risk δ_E will be equal to zero, while $\lambda_{E,W}$ λ_{IW} and δ_I will be different from zero The latter is a conditional market price of risk as it depends on the particular situation of the ineligible securities. In the case of imperfect integration of the portfolio of eligible securities into the world market, the risk price δ_{E} can also be different from zero.

II.2. The tests of integration and segmentation of the European sock markets relative to the world market used in the current research

In this paper, the integration of the European Union stock markets (represented by their domestic stock indexes) into the world market, since January 1999, has been tested, using, as the European market portfolio, and the EMUX index provided by MSCI[1] . The World MSCI index is used to represent the world portfolio. The risk free asset is represented by the Euribor interest rate with one week's maturity, and was obtained from the files of the ECB. The tests conducted in this study were of two types, both of which were inspired by Jorion and Schwartz's approach (and, to a lesser extent by that of Errunza and Losq, because two groups of national stock markets were formed) . Thefirst type are the tests on the integration of the European stock markets into the world market, which will also be called the *model of integration*, and the second type are the tests on the segmentation of European stock markets relative to the world market, which will be called the *model of segmentation*. In this study the market prices of risk are measured the excess returns of the European portfolio and the world portfolio relative to the risk free interest rate, and will be represented in the following discussion by $\tilde{\mathrm{R}}_{\mathrm{E}} - \tilde{\mathrm{r}}_{\mathrm{f}}$ and by $\tilde{\mathrm{R}}_{\mathrm{W}} - \tilde{\mathrm{r}}_{\mathrm{f}}$ respectively. In the tests on integration, the independent component of the excess return of the European portfolio is isolated through the following regression:

$$\tilde{\mathrm{R}}_{\mathrm{E}} - \tilde{\mathrm{r}}_{\mathrm{f}} = \alpha_{\mathrm{EW}} + \beta_{\mathrm{EW}} \left(\tilde{\mathrm{R}}_{\mathrm{W}} - \tilde{\mathrm{r}}_{\mathrm{f}} \right) + \tilde{\mathrm{E}} \qquad (13).$$

the residual $\tilde{\mathrm{E}}$ being a *pure European factor*. The following step involves estimating the following relationship for each EU national stock index:

[1] Morgan Stanley Capital International

$$\tilde{R}_i - \tilde{r}_f = \alpha_i + \beta_{iW}\left(\tilde{R}_W - \tilde{r}_f\right) + \beta_{iE}\tilde{E} + \tilde{\varepsilon}_i \quad (14),$$

where the constant α_i represents the deviation from a "normal" asset pricing model. If the constant is not statistically different from zero, the model becomes:

$$\tilde{R}_i - \tilde{r}_f = \beta_{iW}\left(\tilde{R}_W - \tilde{r}_f\right) + \beta_{iE}\tilde{E} + \tilde{\varepsilon}_i \quad (14').$$

A preliminary analysis of the coefficients estimated could indicate that an individual EU country's stock market is perfectly integrated into the world market if $\beta_{iE}=0$. However, the objective of these first tests is to create groups of countries for further analysis, in which *seemingly unrelated regressions* (SUR) will be used, and in which the possibility of the coefficients not being constant is taken into account. By using seemingly unrelated regressions, more robust conclusions can be obtained. These are based on the results of groups of countries, rather than considering them individually.

The possibility of time-varying integration was introduced by Bekaert and Harvey (1995) using a regime switching model. The variability of coefficients has been considered in the present research, by using the market timing hypothesis, introduced by Treynor and Mazuy (1966). According to market timing, each beta coefficient is composed of a constant term and another that is proportional to the market portfolio excess return. Using this tool, it is possible to determine if there are changes in the performance of the national index as a result of changes both in the European index and in the world index. The beta coefficient of a domestic index relative to the world index in the case of market timing can be represented by:

$$\beta_{iW} = \beta_{iW,0} + \beta_{iW,1}\left(\tilde{R}_W - \tilde{r}_f\right) \quad (15)$$

The beta coefficient of the domestic index relative to the pure European factor is then given by:

$$\beta_{iE} = \beta_{iE,0} + \beta_{iE,1}\tilde{E} \quad (16)$$

The differences in dimension and performance of the EU national stock markets suggest that, changes in their betas quite probably occur and depend on the situation of the market. The results, which are presented in the next section, demonstrate that the choice of market timing was a good one.

In the segmentation tests, the independent component of the excess return of the world portfolio is isolated through the following regression:

$$\tilde{R}_W - \tilde{r}_f = \alpha_{WE} + \beta_{WE}\left(\tilde{R}_E - \tilde{r}_f\right) + \tilde{W} \quad (17),$$

the residual $\tilde{W}$ being a *pure world factor*. The following step is also similar to the one used in the test of integration, and involves estimating the following relation for each EU national index:

$$\tilde{R}_i - \tilde{r}_f = \alpha_i + \beta_{iE}\left(\tilde{R}_E - \tilde{r}_f\right) + \beta_{IW}\tilde{W} + \tilde{\varepsilon}_i \quad (18),$$

or, if the constant is not statistically different from zero:

$$\tilde{R}_i - \tilde{r}_f = \beta_{iE}\left(\tilde{R}_E - \tilde{r}_f\right) + \beta_{iW}\tilde{W} + \tilde{\varepsilon}_i \quad (18').$$

The following procedures in this test include the use of seemingly unrelated relations, and the market timing for varying coefficients, as in the test of integration. The market timing hypothesis implies the following representations for the beta coefficient relative to the European index:

$$\beta_{iE} = \beta_{iE,0} + \beta_{iE,1}\left(\tilde{R}_E - \tilde{r}_f\right) \quad (19),$$

and relative to the pure world factor:

$$\beta_{iW} = \beta_{iW,0} + \beta_{iW,1}\tilde{W} \quad (20).$$

III. Presentation of the results

The data used was obtained from Morgan Stanley Capital International (MSCI) and consists of daily data regarding the following indexes between 4 January 1999 and 20 February 2003 (1079 observations for each variable):

- The national stock indexes of Austria, Belgium, Denmark, Finland, France, Germany, Great Britain, Greece, Holland, Ireland, Italy, Portugal, Spain and Sweden;
- The European index EMUX, and the World Index of MSCI, Worldx.

The risk-free asset is represented by the Euribor shortest-term interest rate (1 week) provided by the European Central Bank.

III.1 Tests on the stationarity of the series and the determination of the number of lags

The first tests that were carried out used the Dickey-Fuller procedure to check if the excess return series (of the 14 national indexes, the European portfolio and the world portfolio) were stationary. According to the results (Table A1 in the Annex) all series can be considered to be stationary, which means that in the regressions there is no need to distinguish between short-term and long-term relations.

Akaike Schwarz criteria were used to determine the number of lags of the dependent variable in all estimations, and there was found to be one lag in each case.

III.2. The distinction between integrated and non-integrated countries in the world market

In the initial tests, the market timing effect was neglected. Their objective was to determine whether or not the European stock markets presented the same pattern of integration in the world market. As this was not the case, two distinct groups of countries were formed according to the results of the tests. The European factor proved to be very significant in the estimations relative to all countries, both in the model of integration, based on equations (13), (14) and (14'), where it enters isolated from is correlation with the world index, and in the model of segmentation based on equations (16), (17) and (17'), where it enters fully as the global European index EMUX. According to these results, none of the European stock markets is perfectly integrated into the world market. The results of the tests of integration are presented in Table A2, in the Annex. The constants were not significantly different from zero in any of the regressions.

In the model of segmentation, however, the *pure world factor* (the world index isolated from its correlation with the European index), is not statistically different from zero in the cases of: Austria, Belgium, Denmark, Finland, Greece, Holland, Ireland, Italy and Portugal. The results for these nine countries can be interpreted as meaning that their stock markets are embedded in the global European stock Market. As for the other five countries (France, Germany, Great Britain, Spain and Sweden) the world factor has to be very significant in the tests of segmentation. Two peculiar results were observed in the cases of France and Spain, in which the beta coefficients of the pure world factor are negative. Furthermore, in all the tests of the model of segmentation, the constants were not significantly different from zero in any of the regressions.

The results of the tests of the model segmentation are given in Table A3, in the Annex and, based on these, two Groups of Countries were collated for further tests:

Group A (the world factor is **not significant** in the tests of segmentation)	**Group B** (the world factor is **significant** in the tests of segmentation)
Austria, Belgium, Denmark, Finland, Greece, Holland, Ireland, Italy and Portugal	France, Germany, Great Britain, Spain and Sweden

Group A, includes the countries which are embedded inside the European Financial system. They are those for which the pure world factor has revealed itself to be insignificant in the tests of segmentation. Group B includes the countries which are shown to be integrated into the world market, because of the perceptible significance of the world factor in both types of tests. With the exception of Italy, it can be said that the first group includes the countries whose financial markets are relatively small, while the second group includes, in general, the EU's larger stock markets.

III. 3. Correlation and Cross-Sectional Dispersion Analysis

If the correlation coefficients are low, they indicate that diversification of investments among the European countries can improve the return/risk relation. These coefficients, which are shown in Table A.4 in the Annex, have a maximum value equal to 0.871, which represents the correlation between France and Holland, and a minimum value of 0.112 between Greece and Austria. The average of the correlation coefficients of each country is also shown, with their values ranging from 0.227, in the case of Greece, to 0.634 in that of Holland. According to these values, gains from diversification within European stock markets, can be obtained in the post-euro era. The same kind of conclusions were drawn by Adjaoute and Dantine (2001), who found that the post-euro period is characterized by lower return correlations between Euroland countries, than those observed in the period of the same length running up to the introduction of the new currency.

The use of return correlation as a tool to evaluate the co-movement of markets is not suitable for taking into account the possibility that the correlations change over time. The *cross-sectional dispersion measure,* proposed by Solnik and Roullet (2000), varies inversely with instantaneous average correlation, and so provides information about dynamic correlation. This measure, represented by the standard deviation across the national index returns, has been calculated daily here for all countries taken individually as well as across the countries belonging to each of the two groups. The statistics of this measure, shown in Table A.5, and Graphs 1, 2 and 3, in the Annex, show that the cross-sectional dispersion measure was higher for Group A than for Group B, which means that gains from diversification are more easily obtained by investing in the first group of countries.

III. 3. Seemingly unrelated regressions with the market timing effect and likelihood ratio tests

The seemingly unrelated regressions (Hamilton(1994)) and the likelihood ratio tests proposed by Sims (1980) were carried out separately for each of the two groups (Tables A6 and A7, in the Annex, show the estimations while Tables A8 to A11, also in the Annex, show the likelihood ratio tests). The tests of integration and segmentation were conducted separately for each group of countries, and the market timing effect was considered. Again the constants were not significantly different from zero in any cases. All the likelihood ratio tests carried out for Group A were repeated but without Denmark. The same procedure was adopted in Group B, leaving out Great Britain and Sweden. The repetition of the tests excluding these countries served to detect whether their non-participation in the single currency had any influence in the global results. In most cases this distinction had no effect on the likelihood ratio tests.

In the model of integration, there are only two cases in which the T statistic shows that the market timing term is clearly different from zero. Both cases refer to the *pure European factor*, and represent Italy, which has a negative coefficient (meaning that it performs worse than the European average), and Spain with a positive coefficient (meaning that it performs better than the European average). These results are summarized in the following table:

Market timing effect in the model of integration (nº of cases in which the mark. timing coefficient is significantly different from zero)

World Index	**Pure European Factor**
Group A: 0 cases	Group A: 2 cases Italy (negative coefficient) Spain (positive coefficient)
Group B: 0 cases	Group B: 0 cases

The values of the chi-squared statistics in the likelihood ratio test, relative to the market timing effect, in the model of integration (Tables A.8 and A.9, in the Annex), lead to the non-rejection of the null hypothesis stating that these coefficients are zero in almost all cases, as their levels of significance are very high. The exception is the case of Group B without Great Britain and Sweden, in which the value of the chi-squared statistic has a level of significance of 7.7%.

The opposite occurs in the model of segmentation, in which there are eight cases of market timing terms statistically different from zero. In Group A these are the cases of Denmark and Ireland, each having negative market timing coefficients in the *pure world factor*, and Finland with a positive market timing coefficient in the European index. In Group B the cases are those of Germany with a negative market timing coefficient in the European index, and a positive market timing coefficient in the *pure world factor*; Great Britain with a negative market timing coefficient in the European index; and Spain and Sweden, with positive market timing coefficients in the European index. These results are summarized in the following table:

Market timing effect in the model of segmentation (nº of cases in which the market timing coefficient is significantly different from zero)

European Index	**Pure World Factor**
Group A: 1 case Finland (positive coefficient)	Group A: 2 cases Denmark (negative coefficient) Ireland (negative coefficient)
Group B: 4 cases Germany (negative coefficient) Great Britain (negative coefficient) Spain (positive coefficient) Sweden (positive coefficient)	Group B: 1 case Germany (positive coefficient)

As in the model of integration, a similar procedure was used with the model of segmentation. All the likelihood ratio tests (Tables A10 and A11) carried out for Group A on all countries, were repeated but with Denmark excluded. The same procedure was adopted in Group B, excluding Great Britain and Sweden. This distinction had a slightly different effect on the tests of segmentation, for Group A, than it had on the tests of integration. In fact, in the test that included Denmark, the chi-squared statistic of the likelihood ratio test on the market timing coefficients of the European index had a level of significance of 7%. However, when this country is excluded, the level of significance becomes 4,9%. In the case of Group B, the exclusion of Great Britain and Sweden had no impact on this or other likelihood ratio tests. In fact, whether these countries are included or excluded, the critical level of 5% is enough to allow the rejection of the null hypothesis of no market timing effect of the European index.

The values obtained for the chi-squared statistics in the likelihood ratio tests done on the constant term of the beta coefficient of the pure European factor, in the model of integration, lead to the rejection of the null hypothesis that this term is not different from zero. These results confirm those of the previous tests which also indicated the evident significance of the European factor. The value of the chi-squared statistic in the likelihood ratio tests carried out on the constant term of the beta coefficient of the pure world factor, in the model of segmentation, leads, in the case of Group A countries, to the non rejection of the null hypothesis stating that this term not is not different from zero. This result is also in accordance with the one, obtained in the preliminary tests, that indicated a strong segmentation relatively to the rest of the world, of this group of countries..

The values obtained for chi-squared statistics in the likelihood ratio tests referred to the one period lag of the dependent variable (suggested by the Akaike and Schwarz criteria) also confirmed the explanatory power of the lag.

Conclusions

The main conclusions obtained from the tests conducted in this research are, firstly, that a model using the World index as the single factor can hardly provide an asset pricing model for the European stock markets. Therefore, it can be concluded that none of the European stock market analysed is perfectly integrated into the world stock market. Therefore, a European factor is required to explain its returns. On the other hand, in the cases of the following countries: Austria, Belgium, Denmark, Finland, Greece, Holland, Ireland, Italy and Portugal the possibility of the returns of their stock market indexes being explained solely by the European factor can not be excluded. The stock indexes of the other group of countries under study: France, Germany, Great Britain, Spain and Sweden, are clearly related to the world index. However, even in these cases, the European factor is significant in explaining the returns of the national indexes. The fact that there are differences of performance between EU national stock indexes has been shown in this study, by using a market timing approach. Whether countries use the single currency or still use their own national currency, seems to have had no significant influence on the results.

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ANNEX

Table A.1) Augmented Dickey-Fuller tests on stationarity of the excess returns

Index excess return	Augmented Dickey-Fuller t statistic Value at the critical level of 5% = -1.95
Áustria	-8.2480
Belgium	-16.2178
Denmark	-32.4105
Finland	-33.3137
France	-15.6431
Germany	-33.4680
Great Britain	-13.4663
Greece	-28.8723
Holland	-8.4161
Ireland	-29.9162
Italy	-32.7475
Portugal	-23.2522
Spain	-33.3609
Sweden	-32.1643
EMUX	-11.3977
WorldX	-29.6931

Table A.2: Tests of integration of EU markets in the world market with constant coefficients

Country	Coefficient of the world index	Coefficient of the pure European factor	Lag of the dependent variable	R^2	DW Statist.
Austria	0.1978 (8.7414)	0.2518 (1.9958)	0.0573 (1.995)	0.153	2.010
Belgium	0.6231 (25.7164)	0.6209 (21.1217)	0.113 (5.275)	0.521	1.928
Denmark	0.4495 (17.124)	0.4536 (14.213)	0.0047 (1.878)	0.315	2.090
Finland	1.4769 (27.242)	1.4405 (21.856)	0.000 (-0.03)	0.532	2.039
France	0.9385 (88.2567)	0.9951 (77.0345)	0.008 (0.972)	0.927	2.238
Germany	1.0942 (62.424)	0.9559 44.9857	-0.074 (-6.174)	0.846	2.270
Great Britain	0.8486 (43.6478)	0.5390 (22.8219)	-0.038 (-2.306)	0.693	2.075
Greece	0.3364 (7.8712)	0.2608 (5.022)	0.125 (4.293	0.090	2.077
Holland	0.9147 (56.455)	0.9293 (47.171)	0.015 (1.253)	0.834	2.130
Ireland	0.4834 (18.0864)	0.4194 (12.922)	0.138 (5.495)	0.320	2.089
Italy	0.7690 (47.0019)	0.8056 (40.5688)	-0.009 (-0.641)	0.782	2.094
Portugal	0.4304 (19.7758)	0.4585 (17.334)	0.117 (4.952)	0.398	1.968
Spain	0.8259 (41.7967)	0.9036 (37.627)	-0.002 (-0.098)	0.746	1.931
Sweden	1.1028 (31.9290)	0.9313 (22.2015)	0.025 (0.019)	0.584	1.942

Table A.3 Tests on segmentation with constant coefficients

Country	Coefficient of the European index	Coefficient of the pure world factor	Lag of the dep. variable	R^2	DW Statist.
Austria	0.2208 (12.5622)	-0.0516 (-1.4572)	0.0573 (1.995)	0.152	2.010
Belgium	0.6254 (33.3314)	0.0077 (0.2030)	0.113 (5.275)	0.520	1.928
Denmark	0.4535 (22.2288)	-0.00009 (-0.0022)	0.0047 (1.878)	0.315	2.090
Finland	1.4699 (34.932)	0.0492 (0.5798)	0.000 (-0.03)	0.532	2.039
France	0.9665 (117.2119)	-0.0477 (-2.8650)	0.008 (0.972)	0.927	2.238
Germany	1.0436 (76.734)	0.1467 (5.3594)	-0.074 (-6.174)	0.846	2.270
Great Britain	0.7267 (48.186)	0.3144 (10.3276)	-0.038 (-2.306)	0.693	2.075
Greece	0.3073 (9.2656)	0.0779 (1.1650)	0.125 (4.293	0.087	2.077
Holland	0.9255 (73.583)	-0.0062 (0.2466)	0.015 (1.253)	0.834	2.130
Ireland	0.4598 (22.1343)	0.0677 (0.1050)	0.138 (5.495)	0.320	2.089
Italy	0.7880 (62.1807)	-0.0294 (-1.1487)	-0.009 (-0.641)	0.782	2.094
Portugal	0.4442 (26.291)	-0.0239 (-0.703)	0.117 (4.952)	0.398	1.968
Spain	0.862 (56.2133)	-0.0696 (-2.2512)	-0.002 (-0.098)	0.746	1.931
Sweden	1.0386 (38.747)	0.1798 (3.3266)	0.025 (0.019)	0.584	1.942

Table A.4: Correlation coefficients between index returns

	RAUT	RBEL	RGERM	RDNK	RFIN	RFRA	RGBR	RGRE	RIRL	RITA	RNDL	RPRT	RSPA	RSWE
RAUT	1.000													
RBEL	0.342	1.000												
RDEU	0.318	0.628	1.000											
RGERM	0.293	0.468	0.492	1.000										
RFIN	0.225	0.390	0.579	0.418	1.000									
RFRA	0.346	0.691	0.836	0.550	0.661	1.000								
RGBR	0.304	0.608	0.716	0.485	0.577	0.790	1.000							
RGRE	0.112	0.220	0.236	0.222	0.238	0.248	0.224	1.000						
RIRL	0.312	0.470	0.466	0.430	0.389	0.523	0.539	0.243	1.000					
RITA	0.299	0.618	0.779	0.464	0.564	0.839	0.720	0.236	0.464	1.000				
RNDL	0.340	0.729	0.789	0.540	0.595	0.871	0.795	0.262	0.550	0.796	1.000			
RPRT	0.247	0.431	0.553	0.397	0.479	0.591	0.497	0.209	0.369	0.535	0.531	1.000		
RSPA	0.348	0.617	0.740	0.488	0.589	0.818	0.692	0.247	0.466	0.789	0.773	0.591	1.000	
RSWE	0.307	0.488	0.658	0.522	0.724	0.729	0.637	0.245	0.459	0.643	0.667	0.517	0.643	1.000
AVER.	0.292	0.515	0.599	0.444	0.495	0.653	0.583	0.227	0.437	0.596	0.634	0.458	0.600	0.557

Table A.5. Statistics on the Cross-Sectional Dispersion Measure

The 14 EU Countries	Observations 1078 Sample Mean 0.00014917772 Variance 2.9545e-08 Standard Error 0.00017188734 SE of Sample Mean 5.235e-06 t-Statistic 28.49505 Signif Level (Mean=0) 0.0000000 Skewness 7.26068 Signif Level (Sk=0) 0.00000000 Kurtosis 88.65494 Signif Level (Ku=0) 0.0000000 Jarque-Bera 362503.010 Signif Level (JB=0) 0.00000000
Group A	Observations 1078 Sample Mean 0.00017237276 Variance 5.835427e-08 Standard Error 0.00024156629 SE of Sample Mean 7.3574e-06 t-Statistic 23.42835 Signif Level (Mean=0) 0.00000000 Skewness 8.90439 Signif Level (Sk=0) 0.00000000 Kurtosis 123.40228 Signif Level (Ku=0) 0.00000000 Jarque-Bera 698241.94809 Signif Level (JB=0) 0.00000000
Group B	Observations 1078 Sample Mean 0.00007468577 Variance 9.121752e-09 Standard Error 0.00009550786 SE of Sample Mean 2.908906e-06 t-Statistic 25.67486 Signif Level (Mean=0) 0.000000 Skewness 4.44557 Signif Level (Sk=0) 0.00000000 Kurtosis 28.95021 Signif Level (Ku=0) 0.00000000 Jarque-Bera 41196.09006 Signif Level (JB=0) 0.00000000

Table A6- a) . Tests on integration (with market timing): Group A

Country	Coefficient of the world index		Coefficient of the pure European factor		Lag of the dep. variable	**R^2**	**DW Statist.**
	Constant Term	M. Tim. term	Constant Term	M. Tim. term			
Austria	0.197 (8.762)	-1.643 (-1.780)	0.249 (9.074)	-0.268 (-0.209)	0.054 (1.961)	0.132	2.011
Belgium	0.624 (25.667)	1.192 (1.199)	0.616 (20.921)	-1.113 (-0.805)	0.096 (4.776)	0.512	1.884
Denmark	0.446 (17.000)	-0.044 (-0.041)	0.451 (14.191)	-2.422 (-1.630)	0.056 (2.280)	0.316	2.110
Finland	1.482 (27.310)	0.511 (0.230)	1.439 (21.864)	2.895 (0.943)	-0.021 (-1.071)	0.532	2.008
Greece	0.3348 (7.821)	-0.665 (-0.3802)	0.260 (5.012)	-0.952 (-0.391)	0.129 (4.458)	0.090	2.090
Holland	0.914 (56.354)	-0.186 (-0.281)	0.928 (47.164)	-0.2022 (-0.219)	0.012 (1.037)	0.834	2.125
Ireland	0.480 (17.995)	-2.028 (-1.859)	0.419 (12.948)	-0.800 (-0.529)	0.131 (5.385)	0.321	2.084
Italy	0.7656 (46.891)	-0.1746 (-0.261)	0.8041 (40.625)	-2.160 (-2.339)	-0.005 (-0.406)	0.784	2.108
Portugal	0.428 (19.664)	-1.137 (-1.275)	0.457 (17.323)	-1.533 (-1.245)	0.103 (4.409)	0.400	1.942

Table A.6- b) . Tests on integration (with market timing): Group B

Country	Coefficient of the world index		Coefficient of the pure European factor		Lag of the dep. variable	**R^2**	**DW Statist.**
	Constant Term	M. Tim. term	Constant Term	M. Tim. term			
France	0.938 (88.188)	-0.563 (-1.293)	0.996 (77.152)	0.033 (0.054)	0.011 (1.331)	0.927	2.234
Germany	1.091 (62.269)	0.892 (1.240)	0.953 (44.952)	-1.614 (-1.630)	-0.058 (-5.121)	0.846	2.310
Great Britain	0.847 (43.578)	-1.062 (-1.334)	0.539 (22.858)	-0.448 (-0.407)	-0.039 (-2.359)	0.694	2.071
Spain	0.829 (42.034)	-0.626 (-0.776)	0.908 (37.904)	2.889 (2.582)	0.014 (0.944)	0.748	1.955
Sweden	1.103 (31.889)	1.495 (1.055)	0.930 (22.190)	-0.708 (-0.362)	0.038 (1.198)	0.585	2.221

Table A.7-a) Tests on segmentation (with market timing): Group A

Country	Coefficient of the European index		Coefficient of the pure world factor		Lag of the dep. variable	**R^2**	**DW Statist.**
	Constant Term	M. Tim. term	Constant Term	M. Tim. term			
Austria	0.217 (12.387)	-1.176 (-2.139)	-0.0424 (-1.195)	0.580 (0.253)	0.054 (1.936)	0.133	2.019
Belgium	0.627 (33.185)	0.294 (0.496)	0.011 (0.278)	-0.359 (-0.145)	0.098 (4.892)	0.512	1.887
Denmark	0.454 (22.249)	0.212 (0.332)	-0.009 (-0.227)	-5.277 (-1.984)	0.058 (2.352)	0.317	2.106
Finland	1.475 (35.098)	2.914 (2.209)	0.034 (0.403)	-5.939 (-1.080)	-0.021 (-1.107)	0.534	2.013
Greece	0.307 (9.251)	0.157 (0.151)	0.071 (1.063)	-3.935 -0.904	0.129 (4.461)	0.090	2.090
Holland	0.924 (73.417)	-0.387 (-0.979)	-0.003 (-0.133)	0.830 (0.504)	0.0121 (1.030)	0.834	2.130
Ireland	0.459 (22.159)	0.388 (0.598)	0.054 (1.299)	-7.859 (-2.909)	0.132 (5.412)	0.325	2.076
Italy	0.786 (62.113)	-0.516 (-1.297)	-0.031 (-1.223)	-2.068 (-1.248)	-0.005 (-0.404)	0.783	2.111
Portugal	0.441 (26.156)	-0.810 (-1.526)	-0.024 (-0.694)	-2.004 (-0.907)	0.1033 (4.405)	0.398	1.942

Table A.7-b) Tests on segmentation (with market timing): Group B

Country	Coefficient of the European index		Coefficient of the pure world factor		Lag of the dep. variable	**R^2**	**DW Statist.**
	Constant Term	M. Tim. term	Constant Term	M. Tim. term			
France	0.966 (117.108)	-0.005 (-0.019)	-0.050 (-2.989)	-1.292 (-1.196)	0.011 (1.360)	0.927	2.237
Germany	1.040 (76.714)	-1.051 (-2.465)	0.1549 (5.640)	3.654 (2.060)	-0.059 (-5.237)	0.847	2.293
Great Britain	0.723 (48.078)	-1.277 (-2.699)	0.321 (10.537)	2.064 (1.048)	-0.040 (-2.383)	0.695	2.068
Spain	0.864 (56.427)	1.058 (2.193)	-0.075 (-2.435)	-0.813 (-0.406)	0.014 (0.950)	0.747	1.946
Sweden	1.043 (38.987)	2.090 (2.480)	0.163 (2.998)	-6.493 (-1.857)	0.040 (2.069)	0.587	2.217

Table A.8-a) Tests on integration: Group A Likelihood ratio tests

World index: constant term	Chi-Squared(9)= 2573.401062 with Significance Level 0.00000000
World index: mark. tim. term	Chi-Squared(9)= 9.044647 with Significance Level 0.43316315
Pure European factor: constant term	Chi-Squared(9)= 2238.254394 with Significance Level 0.00000000
Pure European factor: mark. tim. term	Chi-Squared(9)= 10.837199 with Significance Level 0.28703345
Lag of the dep. variable	Chi-Squared(9)= 89.520759 with Significance Level 0.00000000

Table A.8-b) Tests on integration: Group A Likelihood ratio tests (without Denmark)

World index: constant term	Chi-Squared(8)= 2567.730713 with Significance Level 0.00000000
World index: mark. tim. term	Chi-Squared(8)= 8.950450 with Significance Level 0.34649322
Pure European factor: constant term	Chi-Squared(8)= 2232.902611 with Significance Level 0.00000000
Pure European factor: mark. tim. term	Chi-Squared(8)= 8.384718 with Significance Level 0.39681973
Lag of the dep. variable	Chi-Squared(8)= 88.908833 with Significance Level 0.00000000

Table A.9-a) Tests on integration: Group B- Likelihood ratio tests

World index: constant term	Chi-Squared(5)= 4472.742696 with Significance Level 0.00000000
World index: mark. tim. term	Chi-Squared(5)= 5.404243 with Significance Level 0.36856025
Pure European factor: constant term	Chi-Squared(5)= 3253.229034 with Significance Level 0.00000000
Pure European factor: mark. tim. term	Chi-Squared(5)= 8.259823 with Significance Level 0.14248570
Lag of the dep. variable	Chi-Squared(5)= 37.041534 with Significance Level 0.00000059

Table A.9-b) Tests on integration: Group B- Likelihood ratio tests (without Great Britain and Sweden)

World index: constant term	Chi-Squared(3)= 3469.601728 with Significance Level 0.00000000
World index: mark. tim. term	Chi-Squared(3)= 2.729636 with Significance Level 0.43521436
Pure European factor: constant term	Chi-Squared(3)= 3079.702294 with Significance Level 0.00000000
Pure European factor: mark. tim. term	Chi-Squared(3)= 6.841092 with Significance Level 0.07713893
Lag of the dep. Variable	Chi-Squared(3)= 32.207505 with Significance Level 0.00000047

Table A.10-a) Tests on segmentation: Group A Likelihood ratio tests

Pure world factor: constant term	Chi-Squared(9)= 7.079993 with Significance Level 0.62879121
Pure world factor: mark. tim. term	Chi-Squared(9)= 16.075126 with Significance Level 0.06532923
EMUX: constant term	Chi-Squared(9)= 3102.786947 with Significance Level 0.00000000
EMUX: mark. tim. term	Chi-Squared(9)= 15.829582 with Significance Level 0.07052678
Lag of the dep. variable	Chi-Squared(9)= 90.930848 with Significance Level 0.00000000

Table A.10-b) Tests on segmentation: Group A Likelihood ratio tests (without Denmark)

Pure world factor: constant term	Chi-Squared(8)= 6.881223 with Significance Level 0.54950046
Pure world factor: mark. tim. term	Chi-Squared(8)= 13.368188 with Significance Level 0.09979372
EMUX: constant term	Chi-Squared(8)= 3097.158522 with Significance Level 0.00000000
EMUX: mark. tim. term	Chi-Squared(8)= 15.730715 with Significance Level 0.04640064
Lag of the dep. variable	Chi-Squared(8)= 90.210942 with Significance Level 0.00000000

Table A.11-a) Tests on segmentation: Group B Likelihood ratio tests

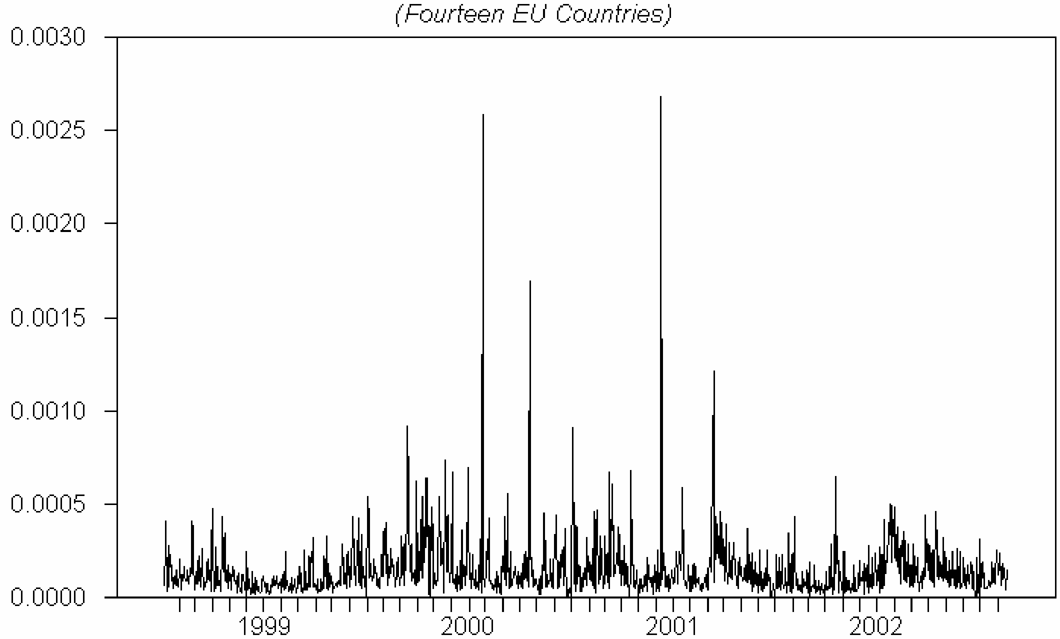
Pure world factor: constant term	Chi-Squared(5)= 171.415898 with Significance Level 0.00000000
Pure world factor: mark. tim. term	Chi-Squared(5)= 9.146924 with Significance Level 0.10334540
EMUX: constant term	Chi-Squared(5)= 4232.013347 with Significance Level 0.00000000
EMUX: mark. tim. term	Chi-Squared(5)= 23.686309 with Significance Level 0.00024941
Lag of the dep. Variable	Chi-Squared(5)= 38.810883 with Significance Level 0.00000026

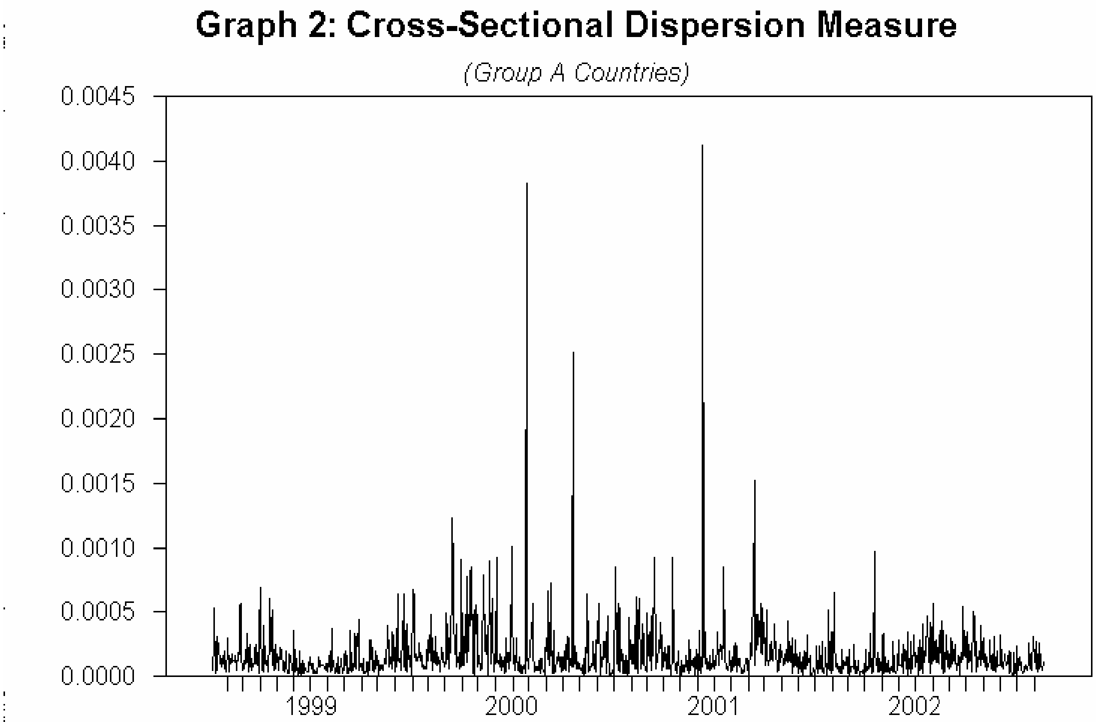
Table A.11-b) Tests on segmentation: Group B Likelihood ratio tests (without Great Britain and Sweden)

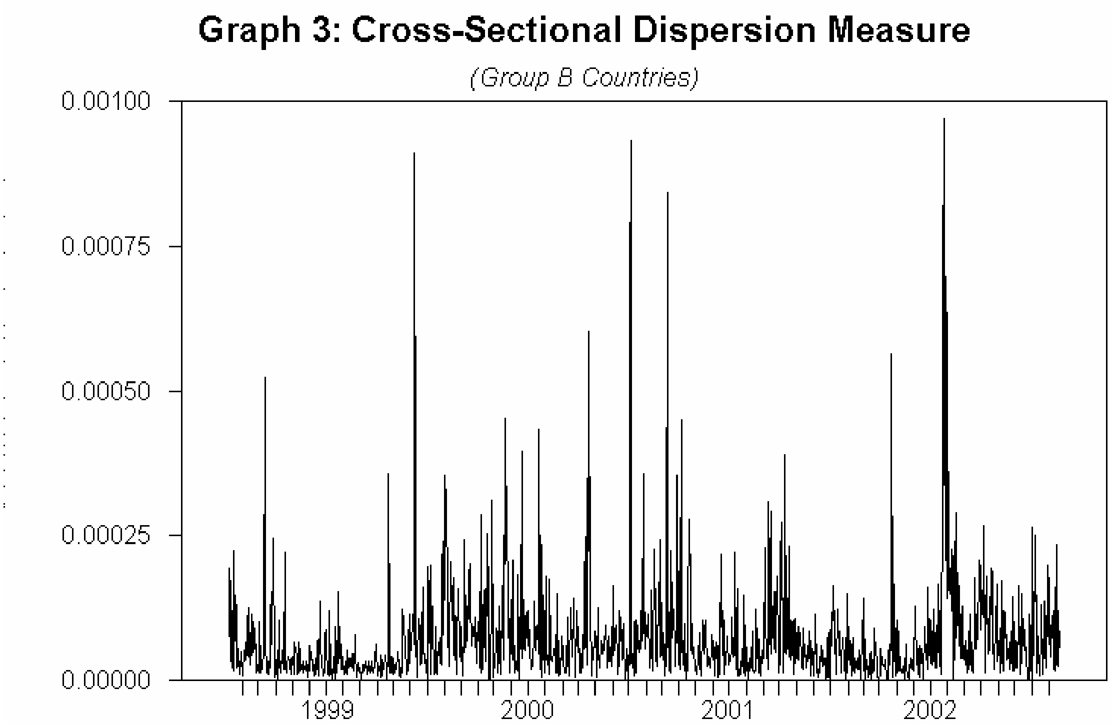
Pure world factor: constant term	Chi-Squared(3)= 33.720872 with Significance Level 0.00000023
Pure world factor: mark. tim. term	Chi-Squared(3)= 4.290245 with Significance Level 0.23178050
EMUX: constant term	Chi-Squared(3)= 4005.756199 with Significance Level 0.00000000
EMUX: mark. tim. term	Chi-Squared(3)= 9.343247 with Significance Level 0.02505877
Lag of the dep. Variable	Chi-Squared(3)= 32.978760 with Significance Level 0.00000033

Graph 1: Cross-Sectional Dispersion Measure

(Fourteen EU Countries)




Graph 2: Cross-Sectional Dispersion Measure
(Group A Countries)
0.0045
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
1999
2000
2001
2002


Graph 3: Cross-Sectional Dispersion Measure
(Group B Countries)
0.00100
0.00075
0.00050
0.00025
0.00000
1999
2000
2001
2002

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