European Stock Market Integration *

Carmen Ansotegui
Department of Financial Management and Control.
ESADE. Ramon Llull University

María Victoria Esteban
Department of Econometrics and Statistics.
Universidad del País Vasco.

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Abstract

This paper analyses the variation in the degree of integration of European markets since the arrival of the euro, and whether or not this event has had an equal effect on the firms that form part of a benchmark and those outside it. The degree of integration is measured by the relevance of the industry factor with relation to the country factor in explaining return. We postulate a two factor model for returns, these factors being industry and country. Through the R^2 time series, and formal testing of individual and joint significance of coefficients, the degree of integration is inferred. Results indicate that the nationality of firms continues to be of fundamental importance. The industry sector to which a firm belongs is of greater relevance after the arrival of the euro, but it is not the only factor that explains return. Large firms included in the Stoxx index are more integrated than small firms. These results hold for both European and Euro samples.

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1 Introduction

The concept of integration of European Equity Markets may be considered from various angles, ranging from institutional integration to common return determination. The maximum degree of integration would be the creation of a single market, although this extreme has not occurred jet; however, there have been attempts at some operational and legislative unification. What is a reality is the possibility of an agent to operate in all the markets, and the possibility of cross- listing for firms. In this paper we consider integration in terms of determinants of asset returns. More precisely, European Equity Market Integration is interpreted in this paper as the loss of relevance of the country factor in the determination of equity return, the alternative explanatory factor being the sector.

In this paper we study whether the single currency has changed the level of Integration of European Stock Markets. We test whether the European Stock Markets are more integrated since the euro, and therefore the role of the country factor decreases in the determination of returns, while the explanatory power of the sector factor increases. One of the signals of this change in the determinants of assets returns is that the arrival of the euro in 1999 led to the reorganisation of international institutional investors, who closed their offices in the various European countries and centralised their operations, reorganising decision-making by sectors rather than countries. This change in the process of investment decision-making, from diversification by country to diversification by sector, may be viewed as the culmination of the integration process of European Stock Markets. In a fully integrated market the location of stocks is not relevant, and correlation between assets will be determined by international rather than national factors.

This approach to the integration of international markets has been studied, among others, by Grinold, Rudd and Stefeck (1989) and Beckers, Connor and Curds (1996), who analyse the influence of the country factor in comparison with alternative factors, such as the industry factor, in order to explain world asset returns. Their results confirm that the country factor determines the largest part of the return, - and the correlation between countries is lower than the correlation between sectors.[1] The results of Baca, Garbe and Weiss (2000) and Cavaglia, Brightman and Aked (2000) present diversification by sector as an alternative to diversification by country in developed markets[2] . Segmentation by country has also been accepted as a reality by European markets operators, as demonstrated by the work of Drummen and Zimmermann (1992), Heston and Rouwenhorst (1995), Freimann (1998) and Rouwenhorst

[1]Grinold, Rudd and Stefeck (1989) also test the explanatory power of other factors such as the beta of stocks, size, return and volatility.

[2]Cavaglia *et. al.* (2000) study 21 developed countries, including 14 European countries, whereas Baca et. al. (2000) only study 7 developed countries, these being France, Germany, the Netherlands, Switzerland and the U.K. in Europe, in addition to Japan and the U.S.A.

(1999), although these markets are more integrated than world markets.[3]

Our work contributes to the existing literature in several aspects. Firstly, it analyses the change in Stock Market Integration for Europe, making a clear differentiation between before and after the euro. Secondly, the sample selection concentrate on European countries, allowing us to analyse small countries such as Portugal, Luxembourg and Greece, which are not considered in previous studies. Previous studies focus on representative stocks, for big market value shares, whereas our study considers a wider sample of firms which allows us to study the possible existence of different degrees of integration for big firms that belong to international benchmarks, as well as small firms. Finally, the formal testing of all hypotheses, instead of graphical analyses, makes our study more rigorous.

The paper is organised as follows:Section 2 introduces the model and Section3 introduces the sample. Section 4 presents the results of estimation for European countries. Section 5 studies the difference between stocks belonging to the Stoxx and those outside it. Given that the behaviour of stocks in the Stoxx is quite different from those that are not, we analyse the individual coefficients for each set of assets in Section 6. In Section 7 we replicate the analysis for the euro countries alone. Finally, in Section 8 we present our conclusions and analyse future research.

2 The Model

The model presented in this section is consistent with the decission process followed by institutional investors. In this process the first stage in portfolio management is to group individual stocks according to risk groups. Traditionally, the criterion for grouping stocks in Europe has been the country. Economic integration and, above all, the arrival of the euro suggest that the country has ceased to be the criterion for diversification. An alternative and generally accepted diversification criterion in the European Market is the sector.

In accordance with Heston and Rouwenhorst (1995), we assume that the return of a stock in a given period, t, is explained by two factors: the industry to which the firm belongs and the country. For a firm i, which belongs to industry s and country c, the return in period t can be modelled as in equation (1)

$$R_{i,t} = \alpha_t + \beta_{s,t} + \gamma_{c,t} + \epsilon_{i,t} \tag{1}$$

In this paper, we consider that stock markets are fully integrated when the country component, $\gamma_{c,t}$ is irrelevant, and the Equity Market is Non-Integrated when the sector coefficient $\beta_{s,t}$ is not significant. Furthermore, we understand that the degree of Equity Market Integration increases when the country factor loses explanatory power with respect to the industry factor.

[3]See Grinold, Rudd and Stefeck (1989).

If we assume that the return of a stock is given by an industry and a country factor, we can generalise the model given by equation (1) for the firms in Europe. This general model is represented by equation (2) and we refer to it as the *Industry and Country Model.* The variables I_{si} and I_{ci} are dummy variables for the industry and the country of firm i. I_{si} is 1 if firm i belongs to industry s and 0 otherwise; I_{ci} is 1 if firm i belongs to country c and 0 otherwise.

$$R_{i,t} = \alpha_t + \sum_{s=1}^{10} \beta_{s,t} I_{si} + \sum_{c=1}^{17} \gamma_{c,t} I_{ci} + \epsilon_{i,t} \tag{2}$$

$i = 1, \ldots, N_t$; Number of firms in each period t, maximum 2145.
s = 1, ..., 10; Industries. See Table 1 for industry description.
c = 1, ..., 17; Countries in Europe. See Table 1 for country description.

The regressors matrix in equation (2) is singular. To overcome the singularity problem in the estimation, we impose as a restriction that the net effect of countries and industries is zero. Of all of the possible solutions available[4] to solve the singularity problem, this restriction allows a more economically convenient interpretation of the independent term as the return of the European Market.

In each period we estimate equation (2) restricting the average effect of country and industry to zero for all firms. In this case the independent term, α_t, represents the return of the European Market, and the returns are measured in relation to this Market. Therefore, $\beta_{s,t}$ and $\gamma_{s,t}$ represent the net effect of industry or country. These restrictions can be formalised as equations (3) and (4).

$$\sum_{i=1}^{N_t} \sum_{s=1}^{10} \beta_{st} I_{si} = 0 \tag{3}$$

$$\sum_{i=1}^{N_t} \sum_{c=1}^{17} \gamma_{ct} I_{ci} = 0 \tag{4}$$

In each period, $t = 1 \ldots 739$, we estimate equation (2) with cross-section data by Least Squared with White (1980) correction[5] subject to restrictions given by equations (3) and (4).

In order to reach our conclusions on Equity Market Integration in Europe, we will perform a number of analyses. First of all, we will study the evolution of the time series R_t^2, making a graphic analysis of the actual values of the time series and its moving average. This will allow us to gain some insights into the

[4]The easiest solution would be to drop one variable from any set.

[5]White (1980) corrects by heteroscedasticity and gives a consistent estimator of the variance covariance matrix that can be used for hypothesis testing. This correction is more general than correction by market value, used in other papers, because it permits estimation by GLS without explicitly imposing the cause of the eteroscedasticity.

Country	Industry										
	RESOR	BASIC	GENIN	CYCGD	NCYCG	CYSER	NCYCG	UTILS	TOTLF	ITECH	Total
Germany	1	24	45	29	22	30	9	10	49	29	**248**
Belgium	0	14	8	3	14	7	5	2	29	8	**90**
Spain	2	24	11	5	14	19	5	7	29	2	**118**
Finland	1	11	11	1	6	7	5	1	4	3	**50**
France	5	19	23	24	43	65	11	1	28	31	**250**
Ireland	6	9	0	2	11	8	1	0	9	4	**50**
Italy	4	18	18	19	8	17	7	9	53	6	**159**
Luxembourg	0	1	3	0	2	5	0	3	20	0	**34**
Netherlands	7	11	14	8	12	25	9	0	31	13	**130**
Austria	1	10	8	3	4	2	1	2	16	3	**50**
Portugal	0	11	3	1	2	12	7	1	10	3	**50**
Greece	3	11	0	0	3	11	3	2	14	3	**50**
Sweden	0	9	17	2	8	6	5	1	17	4	**69**
Switzerland	0	18	37	4	24	12	3	5	44	3	**150**
Denmark	0	7	6	3	12	9	1	1	8	3	**50**
Norway	9	2	6	2	3	8	1	2	7	8	**48**
U.K.	16	48	36	9	49	168	21	15	148	39	**549**
Total	**55**	**247**	**246**	**115**	**237**	**411**	**94**	**62**	**516**	**162**	**2145**

Industries	
Resources	RESOR
Basic Industries	BASIC
General industrials	GENIN
Cyclical Consumer goods	CYCGD
Non-Cyclical Consumer goods	NCYCG
Cyclical Services	CYSER
Non-Cyclical Services	NCYSR
Utilities	UTILS
Information Technology	ITECH
Financials	TOTLF

Table 1: *Classification of firms by industry and country*

tendency of the explanatory power of the model in the course of time. We will also calculate the average R^2 for the periods before and after the euro, which will allow us to consider the changes since the euro of country and industry. This analysis coincides with Beckers, Connor and Curds (1996), who study the significance of R^2. Secondly, we will formally test the hypothesis of Full Integration and Non-Integration, testing the null of $\beta_{s,t}$'s and $\gamma_{c,t}$'s equal zero. Finally, and with the same aim as Heston and Rouwenhorst (1995), who analyse the behaviour of estimated coefficients, we will test the individual significance of each coefficient, and consider their evolution in time. We will focus on the time series evolution of all these measures, and in particular on how they change before and after the euro.

3 Sample

The sample includes weekly prices for stocks in the Datastream TOTMK Index for 17 countries, which has a total of 2,145 firms. The sample period runs from January 1, 1988 to March 3, 2002, a time series of 739 weekly returns[6]. Each firm is classified by country and industry. We consider 10 different industries as defined by *Financial Times Actuaries*. The distribution by countries and industries is shown in Table 1.

Prices are given in euros for countries in the euro area. Prior to January 1999 prices are given in ecus, in accordance with DS calculations. For the non-

[6]Week 575 begins on January 1, 1999.

European Countries			
	All shares	Stoxx	No Stoxx
Total Sample			
Industry and Country	10.52	18.45	10.61
Industry	2.33	5.53	2.44
Country	8.46	13.67	8.45
Before Euro			
Industry and Country	10.74	18.91	10.82
Industry	1.69	4.40	1.95
Country	9.33	15.33	9.13
After Euro			
Industry and Country	9.75	16.86	9.88
Industry	4.57	9.45	4.14
Country	5.46	7.91	6.09

Table 2: *Average* $\{R^2\}_{t=1}^{739}$ *for different Model Specifications and period samples.*

euro countries we calculate returns in ecus prior to 1999 and euros thereafter.

4 Integration Before and After Euro for European Countries

In this section we analyse to what extent the structure in the determination of Stock Market Return has changed for European Markets since the arrival of the euro. The markets considered here are the twelve euro countries, plus Switzerland, Sweden, Norway, Denmark and the U.K.

We will study whether integration of the market has actually taken place, and therefore whether the nationality of the stocks has ceased to be relevant. Our alternative hypothesis is that sector has become the segmentation criterion.

On the basis of *Industry and Country*, represented by equation (2), we analyse the degree of integration. We define Full Integration as the non-relevance of the country factor in the determination of stock returns. In the model, Full Integration is tested as the null hypothesis $H_0 : \gamma_1 = \ldots = \gamma_C = 0$. By imposing the restriction in equation (2) we arrive at equation (5), which we will refer to as the *Industry Model.*

On the other hand, if there is Non-Integration between firms, the explanatory power of the industry factor would be zero, and all the explanatory power would be for the country factor in our model. We test the hypothesis of Non-Integration by imposing the restriction $H_0 : \beta_1 = \ldots = \beta_S = 0$ in equation (2) and we arrive at equation (6), which we will refer to as the *Country Model.*

$$R_{i,t} = \alpha_t + \sum_{s=1}^{10} \beta_{st} I_{si} + \epsilon_{it} \tag{5}$$

$$R_{i,t} = \alpha_t + \sum_{c=1}^{17} I_{ci}\gamma_{ct} + \epsilon_{it} \tag{6}$$

As a first measure of the degree of integration we study the series $\{R^2\}_{t=1}^{739}$ for the three alternative model specifications: the Industry Model, the Country Model, and the Industry and Country Model, given by equations (5), (6)and (2) respectively. Graphical representation of the R^2 time series is given in the first column of Figure 1.

Tendency is captured by Figure 2 represents the moving average for 52 weeks of the series $\{R^2\}_{t=1}^{739}$, and shows an increase in the explanatory power of the Industry Model after the euro and a decrease in the explanatory power of the Country Model.

The explanatory power of the model measured by R^2 has an average of 10.5% for the total period, which corresponds to 10.7% before 1999 and 9.8% after the euro. The increase in the relevance of industry can be measured by the average of R^2 of the Industry Model before and after the euro. This increases from 1.7% to 4.6%. In contrast, when the relevance of country before and after the euro is measured by the R^2 of the Country Model, it decreases from 9.3% to 5.5%, confirming the reduction in the relevance of country in the determination of return - see first column in Table 2.

We can conclude from the analysis of the R^2 that European Equity markets are more integrated after the euro, since the explanatory power of the country decreases, while at the same time the explanatory power of industry increases.

4.1 Formal Testing: Full Integration vs Non-Integration

We formally test the null hypothesis of Full Integration of European Equity Markets. The hypothesis can be tested by imposing the restriction $H_0 : \gamma_1 = \ldots = \gamma_{17} = 0$ in equation (2). According to this hypothesis, the country is not relevant in the determination of return, and the return would be fully explained by the Industry Model given by equation (5). Under the null hypothesis the test statistic follows a χ^2_{16} distribution [7]. We also test the hypothesis of Non-Integration, with all returns explained by the country factor. We test the hypothesis by imposing the null $H_0 : \beta_1 = \ldots = \beta_{10} = 0$ in the Industry and Country Model, and under this hypothesis the statistic follows a χ^2_9 distribution. Table 3 presents the summary of results of these tests. Before 1999 in 0.17% of the periods we cannot reject (accept) the null

[7] Given the R matrix of linear restrictions the test statistic is:

$$\left(R\hat{\beta}_{MCO} - r\right)' \left(R'\widehat{Var}(\hat{\beta})_{White}R\right)^{-1} \left(R\hat{\beta}_{MCO} - r\right)$$

In our case R is the matrix that imposes $\gamma_1 = \ldots = \gamma_{17} = 0$, r is the zero vector, $\hat{\beta}_{MCO}$ is the LS estimator and $\hat{Var}(\hat{\beta})_{White}$ is a White's consistent estimator of the variance covariance matrix of $\hat{\beta}_{MCO}$.

	Country	Industry
Total sample	0.14	38.97
Before euro	0.17	46.86
After euro	0.00	11.51

Table 3: *Percentage of periods in which the null is accepted*

hypothesis of the country coefficients equal zero, whereas we cannot reject it in any period after the euro.

On the other hand, we cannot reject the null hypothesis of industry coefficients equal zero in 47% of the periods before 1999, while this percentage falls dramatically to 11.51% after the euro.

On the basis of these results we cannot say that there is Full Integration, insofar as the country is even more relevant after the euro. However, it could be said that there is a considerable increase in the relevance of industry after the euro.

Results are consistent with previous works by Heston and Rouwenhorst (1995), Freiman (1998) and Rouwenhorst (1999), in which country still represents a relevant part of equity returns. However, the effect of the industry factor on return increases after 1999, but not to the extent that it represents an alternative to the country factor, in contrast with the results of Cavaglia et. all. (2000) and Baca et. all.(2000).

5 Shares in the Stoxx

In investment decision-making a generally accepted market index, the benchmark, is taken as a reference, with respect to which portfolio return and risk are measured. The benchmark is particularly relevant for the institutional investor, who in many cases replicates the index as a passive investment policy. The arrival of the euro has changed the benchmark for managers, since national indexes no longer have the relevance that they had in the past, and have been substituted by European indexes such as Stoxx50 or Eurotop. Passive portfolio management leads the investment community to focus on the benchmark companies, normally large and liquid companies.

Insofar as passive portfolio management is a dominant force in European investment, the behaviour of benchmark firms - those in the European league - can be very different from the behaviour of those in the national league.

The hypothesis that we would put forward is that if managers focus mainly on benchmark companies, these firms must be integrated in a Single European Market. Small companies, which do not belong to the benchmark, have a lower degree of integration; their return is analysed within the context of each country rather than at a European level. It should be noted, however, that if the large firms are integrated, the small firms may also be integrated through arbitrage possibilities in the national markets.

In this section we study whether there is a different degree of integration for companies in the benchmark and for those which are not. More specifically, we analyse whether the variance explained by the country and sector factor is different for companies which are in the benchmark and for those which are not. The benchmark that we consider is the Stoxx, a European Index composed of a total of 600 companies from developed European countries.

A first insight into the differences in behaviour of stocks that belong to the index and those that do not is provided by the differences in value of R^2 for the different model specifications. The second and third columns of the graphs in Figure 1 show that the variance explained by our model is greater for shares in the Stoxx than for shares outside it. Furthermore, in numerical terms, Table 2 shows that the average R^2 is higher for the subsample of shares that belong to the index than for the subsample of shares that do not for any model specification, and also before and after the euro. The average R^2 of the Industry and Country Model - equation (2)- and the total period sample is 18.45% of periods for shares belonging to the Stoxx as opposed to 10.61% for those which are not in the Stoxx.

We formally test the differences in behaviour for shares inside and outside the Stoxx. We test whether the two subsamples come from different data generating processes. If this is the case, the Industry and Country Model for a firm belonging to the Stoxx is:

$$R_{i,t} = \alpha_t^{\star} + \sum_{s=1}^{S} \beta_{st}^{\star} I_{si} + \sum_{c=1}^{C} \gamma_{ct}^{\star} I_{ci} + \epsilon_{it}^{\star} \tag{7}$$

and for a firm outside the Stoxx the data generating process is:

$$R_{i,t} = \alpha_t^{\star\star} + \sum_{s=1}^{S} \beta_{st}^{\star\star} I_{si} + \sum_{c=1}^{C} \gamma_{ct}^{\star\star} I_{ci} + \epsilon_{it}^{\star\star} \tag{8}$$

We test the null hypothesis that both groups come from the same population, $H_0 : \alpha_t^{\star} = \alpha_t^{\star\star}, \beta_s^{\star} = \beta_s^{\star\star}, \forall s, \gamma_c^{\star} = \gamma_c^{\star\star}, \forall c$

The statistic is

$$\left(R\hat{\beta}_{MCO} - r\right)' \left(R'\widehat{Var}(\hat{\beta})_{White}R\right)^{-1} \left(R\hat{\beta}_{MCO} - r\right) \overset{a}{\sim} \chi^2_{26}$$

in which the system given by equations (7) and (8) is estimated by LS with White's correction.

At the 5% significance level we cannot reject the null hypothesis of shares that come from the same population for 13.8% of the periods that run from 1988 to 2002. However, the percentages are very different before and after the euro (16.55% before and 4.24% after). Therefore, we may state that shares belonging to the index and those outside the index follow two different factor models, the explanatory power of the model being higher for shares in the Stoxx than for those outside it. This is especially true after 1999.

Europe						
	Country Coefficients			Industry Coefficients		
	Total Sample	Before Euro	After Euro	Total Sample	Before Euro	After Euro
All Shares	0.14	0.17	0.00	38.97	46.86	11.51
Stoxx	0.41	0.35	0.60	35.32	42.85	9.09
Non-Stoxx	0.68	0.70	0.60	53.32	60.27	29.09

Table 4: *Percentage of periods for which we reject the null hypotheses* $\gamma' c = 0$ *and* $\beta' s = 0$

5.1 Equity Market Integration for shares in Stoxx

As we have just observed, the two factor model explains more for firms in the benchmark than for firms outside it. Now it has to be asked what the degree of integration is for benchmark and non-benchmark firms. Figure 2 shows the moving average R^2 for the three alternative model specifications for firms in Stoxx and outside Stoxx. We can observe that the industry factor explains more and the country factor explains less for both types of firm after the euro.

We formally test the hypothesis of Full Integration ($\gamma' c = 0$) and Non-Integration($\beta' s = 0$) for both subsamples, firms belonging to the Stoxx and outside Stoxx. As in section 4.1 we test the null hypothesis of Full and Non-Integration by imposing restrictions in equation (7). For shares outside Stoxx we impose restrictions in equation (8). Table 4 shows the results of these tests. The null of Full Integration -$\gamma' c = 0$- cannot be rejected in 0.41% of periods for shares that belong to the Stoxx and in 0.68% of periods for non-Stoxx shares, when the total period sample is considered. Before the euro these percentages are 0.35% and 0.70% respectively, and after the euro 0.6% and 0.6%. From this we may conclude that the country was and is a relevant variable in the explanation of returns for all stocks, whether or not they belong to the Stoxx.

The null of Non-Integration - $\beta' s = 0$- yields the following results: we cannot reject the null in 35.32% of periods for the firms in Stoxx and in 53.32% of periods for the non-Stoxx firms, when the total sample period is considered. For firms in the Stoxx the null hypothesis is accepted in 42.85% of periods, a figure which falls drastically to 9.09% after the euro. For firms outside the Stoxx theses percentages are higher: 60.27% before the euro and 29.09% after the euro.

Given these results, we may conclude that country is relevant in the determination of equity returns, and in this respect Full Integration has not yet arrived in the European Market. However, the relevance of industry has changed dramatically since the euro. Although the Stock Market has not achieved Full Integration, it may be said to have increased considerably. This is especially true for firms belonging to the Stoxx.

6 Individual Relevance for Countries and Industries

In this section we analyse the relevance of each country and each industry in the determination of returns. We analyse individual significance rather than the actual value of the coefficients, which is not relevant for our purposes.

In the last section we accepted that the data generating process for firms in the Stoxx and outside the Stoxx was different, and therefore we analyse both subsamples separately.

Formally we test the individual significance of industries and countries and test the null hypothesis of non-relevance: $H_0 : \{\beta^{\star}_{s,t} = 0\}^{10}_{s=1}, \{\gamma^{\star}_{c,t} = 0\}^{17}_{c=1}$ Stoxx set, and $H_0 : \{\beta^{\star\star}_{s,t} = 0\}^{10}_{s=1}, \{\gamma^{\star\star}_{c,t} = 0\}^{17}_{c=1}$ for firms outside the Stoxx set of shares. We also test the significance for the market $H_0 : \{\alpha^{\star}_{s,t} = 0\}$ and $\{\alpha^{\star\star}_{s,t} = 0\}$, Table 5 presents the percentage of periods in which the coefficient is significant at the 5% confidence level for Shares in Stoxx and Outside Stoxx. We complement this formal testing with the 36 weeks moving average of the number of periods for which each industry is significant, which allows us to see the trend for each industry and country. Figures 3 and 4 show these trends with respect to industry and country for firms belonging to Stoxx. Figures 5 and 6 show these trends with respect to industry and country for firms outside the Stoxx.

The market is significant in a very high percentage of periods compared with any other individual coefficient for country or industry. For firms in Stoxx the percentage of periods for which the market is significant increases from 84.24% to 88.48% after the euro - see Table 5.

For firms in the Stoxx the percentage of periods for which the industry coefficients are significant is higher after the euro than in the previous period, and this is the case for all industries. This increase is particularly relevant in the Technology (ITECH) sector, which increases from 20.94% of periods before the euro to 68.48% after - See Table 5 under $\beta^{\star}$. Other sectors which show a notable increase in their significance are Non Consumer Services (NCSER), with 24.14% of periods before and 58.18% after, and Non Consumer Goods (NCGD), which increases from 26.85% to 55.76%. At the other extreme, General Industries (GENIN) is the sector that shows the smallest increase, moving from 17.24% to 20.61%.

The relevance of the country coefficients tends to diminish for firms in Stoxx when this coefficient is measured as the percentage of periods in which it is significant - See Figure 6 , but this behaviour is not homogeneous for all countries. Luxembourg is the most striking case, although Greece, Norway and Finland also show an increase here. As shown in Table 5 - under $\gamma^{\star}$ - Luxembourg increases from 77.34% of periods for which the coefficient is significant before the euro to 86.06% after the euro, Belgium increases from 40.15% to 43.64%, Greece from 51.23% to 64.24%, and the U.K. from 51.97% to 59.39%. It should be observed that these results are very similar to those obtained in section **??**, with decreases in the correlations of the national in-

Europe					
Sample	91 to 98	99 to 02		91 to 98	99 to 02
Shares in Stoxx					
	$\alpha^{\star}$			$\gamma^{\star}$	
INDP	84.24	88.48	Germany	47.78	32.12
	$\beta^{\star}$		Belgium	40.15	43.64
RES	30.05	51.52	Spain	49.26	43.64
BAS	32.51	52.73	Finland	34.98	27.27
GENIN	17.24	20.61	France	50.25	29.70
CGD	20.94	32.73	Ireland	39.66	27.27
NCGD	26.85	55.76	Italy	60.59	47.27
CSER	21.92	31.52	Luxembourg	77.34	86.06
NCSER	24.14	58.18	Netherlands	37.68	25.45
UTL	48.03	55.76	Austria	61.08	43.64
TOLF	38.42	58.18	Portugal	45.32	40.61
ITECH	20.94	68.48	Greece	51.23	64.24
			Sweden	53.20	40.00
			Switzerland	38.92	41.82
			Denmark	43.60	32.73
			Norway	33.50	30.91
			UK	51.97	59.39
Shares out Stoxx					
	$\alpha^{\star\star}$			$\gamma^{\star\star}$	
INDP	83.99	90.91	Germany	50.49	46.67
	$\beta^{\star\star}$		Belgium	42.61	51.52
RES	21.92	33.33	Spain	49.01	52.12
BAS	25.12	49.09	Finland	50.49	38.79
GENIN	21.67	17.58	France	37.93	42.42
CGD	20.20	30.30	Ireland	25.62	32.73
NCGD	17.98	37.58	Italy	67.98	55.15
CSER	18.23	18.79	Luxembourg	35.22	51.52
NCSER	15.02	35.76	Netherlands	41.13	46.06
UTL	24.38	35.76	Austria	46.31	57.58
TOLF	32.02	55.15	Portugal	35.47	49.70
ITECH	18.47	69.09	Greece	49.75	72.12
			Sweden	52.22	46.06
			Switzerland	51.97	44.24
			Denmark	39.41	32.12
			Norway	45.07	41.82
			UK	65.76	67.88

Table 5: *Percentage of periods in which individual coefficients are significant*

dexes of Luxembourg, Belgium, Greece and Switzerland.

As in the case of firms in the Stoxx, we may state that for firms outside the Stoxx the industry factor is more significant after the euro than before. Again, the Technology (ITECH) sector, which increases from 18.47% of periods before the euro to 69.09% after its arrival, is the sector that shows the highest increase - See Table 5 under $\beta^{\star\star}$ and Figure 5. Other relevant sectors are: Non Consumer Services (NCSER), which increases from 15.02% of periods before to 35.76% after; Non Consumer Goods (NCGD), with growth from 17.98% to 37.58%; and the Financial sector (TOLF), which increases from 32.02% to 55.15%. The sector General Industries (GENIN), which for shares in Stoxx was the sector with the lowest growth, decreases from 21.67% to 17.58%.

Broadly speaking, we may say that the relevance of the country factor decreases for firms in the Stoxx, but not for those outside the Stoxx. The graphical analysis in Figure 6 shows an increase for Greece and Luxembourg, and a slight decrease in the case of Finland. For firms in Stoxx the countries that do not show a decrease in the percentage of periods in which the coefficient is significant are Belgium, Luxembourg, Greece, Switzerland and the U.K. If we consider firms outside the Stoxx, we may add Spain, France, Ireland, the Netherlands, Austria and Portugal to the afore-mentioned group of countries, while Switzerland drops out of this group.

Results here are consistent with our previous results; the percentage of periods for which country is significant is higher for those shares outside the Stoxx, whereas the relevance of sector becomes less significant, see Figure 6. Therefore, we may state that shares in the Index are more integrated. The industry factor gains in importance, whereas the country factor loses importance for shares in the Stoxx after the euro. Thus we may conclude that the degree of integration has increased since the euro.

7 The Euro Countries

We have just observed that, in general, the individual significance of country shows a decrease, especially for shares in Stoxx. However, the U.K. reveals a different pattern, since its significance increases after the euro. The U.K. represents a considerable part of the European market, and therefore of our sample. The question must be asked to what extent this different pattern could be due to the fact that the U.K. does not form part of the single currency group of countries.

In this section we have therefore excluded the following countries from the previous sample: Switzerland, Sweden, Norway, the U.K. and Denmark. This leaves us with twelve countries and a maximum of 1,279 firms in the sample for the same period.

We study the integration of Euro Equity Markets by following exactly the same steps taken for European Equity Integration. Figures 7 to 12 provide a

Euro Countries			
	All shares	Stoxx	No Stoxx
Total Sample			
Industry and Country	11.18	22.22	11.40
Industry	2.83	7.7	3.12
Country	8.63	15.61	8.6
Before Euro			
Industry and Country	11.15	22.60	11.80
Industry	2.32	6.57	2.78
Country	9.49	17.20	9.33
After Euro			
Industry and Country	9.95	20.90	9.98
Industry	4.61	11.61	4.30
Country	5.66	10.10	6.08

Table 6: *Average R^2 for Euro Countries.*

graphical representation of all the variables used in our analysis.

7.1 Explained Variance: R^2

The variance explained by the model is higher for the Euro countries than for the European countries. We compare the average R^2 for both sets of countries, the different model specifications, and for the two relevant sample periods. That is to say, we compare the R^2 results for the Euro countries shown in Table 6 and the R^2 results for European countries shown in Table 2. It may be observed that the differences in results are not very relevant for all shares, with an average of 10.52 for Europe compared with 11.17 for Euro countries in the total sample period, or 10.74 compared with 11.15 and 9.75 compared with 9.95 if the sample period is divided in two, before and after the euro. The same results can be seen for the Industry Model and the Country Model.

The explanatory power of the two factor model - the Industry and Country Model, is much higher for the Euro countries than for the European countries, when the sample is divided into shares in and outside Stoxx. The explanatory power of the Industry and Country model for the total sample is 22.22 in the Euro Countries compared with 18.45 in the European Countries. Similar differences can be found both before the euro, with 22.60 for Euro countries compared with 18.91 for European countries, and after the euro, with 20.90 for Euro countries and 16.86 for European countries.

This result supports our basic initial hypothesis that portfolio managers focus mainly on shares in the benchmark.

7.2 Shares in the Benchmark

Since the explanatory power of the model is much higher for shares in the Stoxx that outside Stoxx, we test formally if we can accept that they belong

	Euro					
	Country Coefficients			Industry Coefficients		
	$H_0 : \gamma_1 = \ldots = \gamma_{12} = 0$			$H_0 : \beta_1 = \ldots = \beta_{10} = 0$		
	Total Sample	Before Euro	After Euro	Total Sample	Before Euro	After Euro
All Shares	2.44	2.79	1.20	50.20	58.53	21.21
Stoxx	3.11	2.79	4.22	49.26	58.01	18.78
No Stoxx	5.28	6.11	2.41	60.08	66.72	36.96

Table 7: *Percentage of periods in which the null is accepted.*

to different populations[8].

We can accept the null of equal model for shares in the Stoxx and outside the Stoxx - 25.61% periods before 1999, and only 7.27% periods after 1999[9]. As in the case of European countries we accept that shares in the Stoxx and outside Stoxx follow two different generating process.

7.3 Full Integration versus Non Integration

We test in here the relative relevance of industry and country in stock return determination. In the first place we test the existence of Full Integration, the country is not relevant, and Non-Integration, the industry is not relevant.

For Full Integration testing, as we did in section 4.1, we test the null $H_0 : \gamma_1^\star = \ldots = \gamma_{12}^\star = 0$ in equation (7) for shares in Stoxx and the null $H_0 : \gamma_1^{\star\star} = \ldots = \gamma_{12}^{\star\star} = 0$ in equation (8) for shares outside the Stoxx. The number of periods for which the null hypothesis is accepted at the 5% significance level is shown in Table **??**.

For firms in the Stoxx we can accept the null of Full Integration a 2.79% of periods before the euro and 4.22% after. The country is relevant for stock return determination period after period, and in this sense we cannot state that Euro Equity Market Integration. The big change after euro is the role of industry, we accept the null of Non-Integration a 58.01% of periods before euro and drops to 18.78% after. For stocks outside the index the country becomes even more relevant after the euro, we accept the null 6.11% of periods before and only 2.42% of periods after. The level of integration only increases for shares outside the Stoxx if we attend the increase in the relevance of industries

[8]We assume that shares in Stoxx follow the model given by equation (7) and No Stoxx by equation (8). We test the null hypothesis that both groups come from the same population, $H_0 : \alpha_t^\star = \alpha_t^{\star\star}, \beta_s^\star = \beta_s^{\star\star}, \forall s, \gamma_c^\star = \gamma_c^{\star\star}, \forall c$
The statistic is

$$\left(R\hat{\beta}_{MCO} - r\right)' \left(R'\widehat{Var}(\hat{\beta})_{White}R\right)^{-1} \left(R\hat{\beta}_{MCO} - r\right) \overset{a}{\sim} \chi^2_{21}$$

in which the system given by equations (7) and (8) is estimated by LS with White correction.

[9]Remember that for European countries these percentages were 16.55% and 4.24% respectively.

Euro					
Sample	91 to 98	99 to 02		91 to 98	99 to 02
Shares in Stoxx					
	$\alpha^{\star}$			$\gamma^{\star}$	
INDP	75.12	83.64	Germany	43.84	40.61
	$\beta^{\star}$		Belgium	37.68	44.24
RES	28.08	47.88	Spain	46.80	38.79
BAS	23.15	34.55	Finland	35.96	26.67
GN	13.79	10.30	France	43.84	33.33
CGD	20.44	36.36	Ireland	38.92	27.88
NCGD	18.97	50.30	Italy	58.37	49.09
CSER	16.50	24.85	Luxembourg	64.29	76.36
NCSER	19.21	49.70	Netherlands	34.24	24.85
UTL	23.15	35.15	Austria	54.19	36.36
TOLF	32.76	40.61	Portugal	44.58	40.61
ITECH	19.70	66.67	Greece	43.10	61.21
Shares out Stoxx					
	$\alpha^{\star\star}$			$\gamma^{\star\star}$	
INDP	74.38	87.88	Germany	46.06	43.64
	$\beta^{\star\star}$		Belgium	41.38	47.27
RES	19.95	27.88	Spain	47.54	52.73
BAS	23.15	35.15	Finland	51.72	35.15
GN	19.46	15.15	France	39.41	40.61
CGD	17.73	29.70	Ireland	29.06	35.15
NCGD	12.32	38.18	Italy	66.75	54.55
CSER	11.58	17.58	Luxembourg	29.56	43.64
NCSER	18.47	30.30	Netherlands	38.18	38.79
UTL	24.14	36.36	Austria	42.36	50.30
TOLF	26.35	46.67	Portugal	35.47	44.24
ITECH	16.50	58.79	Greece	48.03	71.52

Table 8: *Percentage periods for which coefficient is significant*

in the explanation of returns; the null of Non-Integration is accepted 66.72% of periods before the euro and 36.96% after.

As in the Europe case, we can say the degree of integration has increased after the euro to the extent that the industry plays a greater role than previously, no because the irrelevance of the country.

7.4 Significance of Coefficients

The behaviour of individual betas is not very different from the European case as we can see in Table 8. All industries are more relevant after the euro than previously, except General Industries (GENIN), and this for shares in Stoxx and outside.

In term of countries Belgium, Luxembourg and Greece are the ones more relevant after the euro for shares in Stoxx. For shares outside the Stoxx all countries are more relevant after the euro that before, except for Germany and Finland.

We can conclude that the integration of the Euro countries follow the same pattern than the full European set of countries. The Equity markets are more

integrated, but in the context of a two factor model for return explanation, the integration comes more for the increase in relevance of industries than because the country is irrelevant, though it has decrease the explanatory power respect.

8 Conclusions

The arrival of the euro was seen as the event that would definitively boost the integration of European markets. In this paper the integration of European markets is measured as the relative capacity of the country factor with respect to the industry factor in explaining stock market returns. The lesser the relevance of the country factor with relation to the relevance of the industry factor, the higher the degree of integration of the markets. According to this interpretation, the results presented in this paper show that industry is a much more significant explanatory factor after 1999 than it was before. However, the country factor continues to play an important role in explaining return and cannot be ignored. Therefore, there has been integration since the euro, but not full integration.

It could be considered that large firms, those that belong to the benchmark of institutional investors, are more integrated. Indeed, the results obtained in our study corroborate this. For firms in the Stoxx the Industry and Country model explains greater variance than for those firms outside the benchmark. However, the higher degree of integration does not imply full integration for firms in the Stoxx, since country continues to be a relevant factor.

The degree of integration varies from country to country. In Greece, Luxembourg, Austria, Portugal and the U.K. country coefficients are even more relevant in the determination of equity return after the euro. All sectors increase in relevance, in particular technology, banking and non consumer services.

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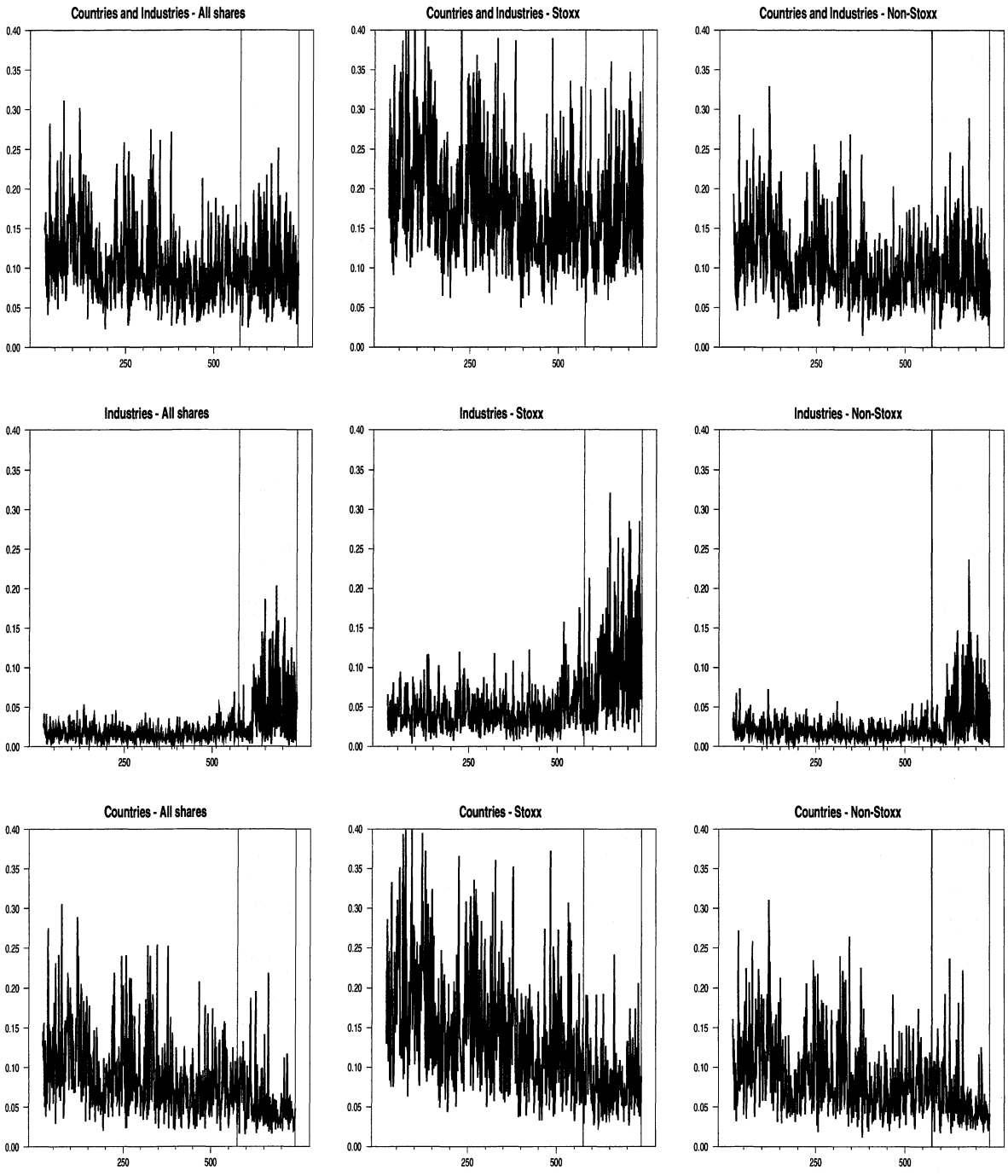

Figure 1: *Time series R^2 for Industry and Country Model, Industry Model and Country Model. Total sample, shares in Stoxx and outside Stoxx*

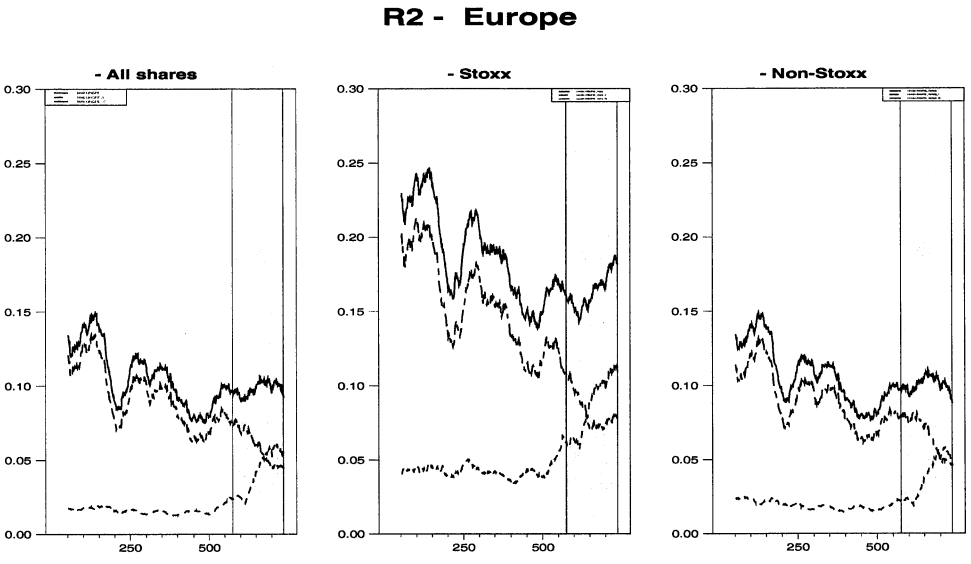

Figure 2: *Moving Average time series of R^2 for Industry and Country Model, Industry Model and Country Model. Total sample, Stoxx and outside Stoxx*

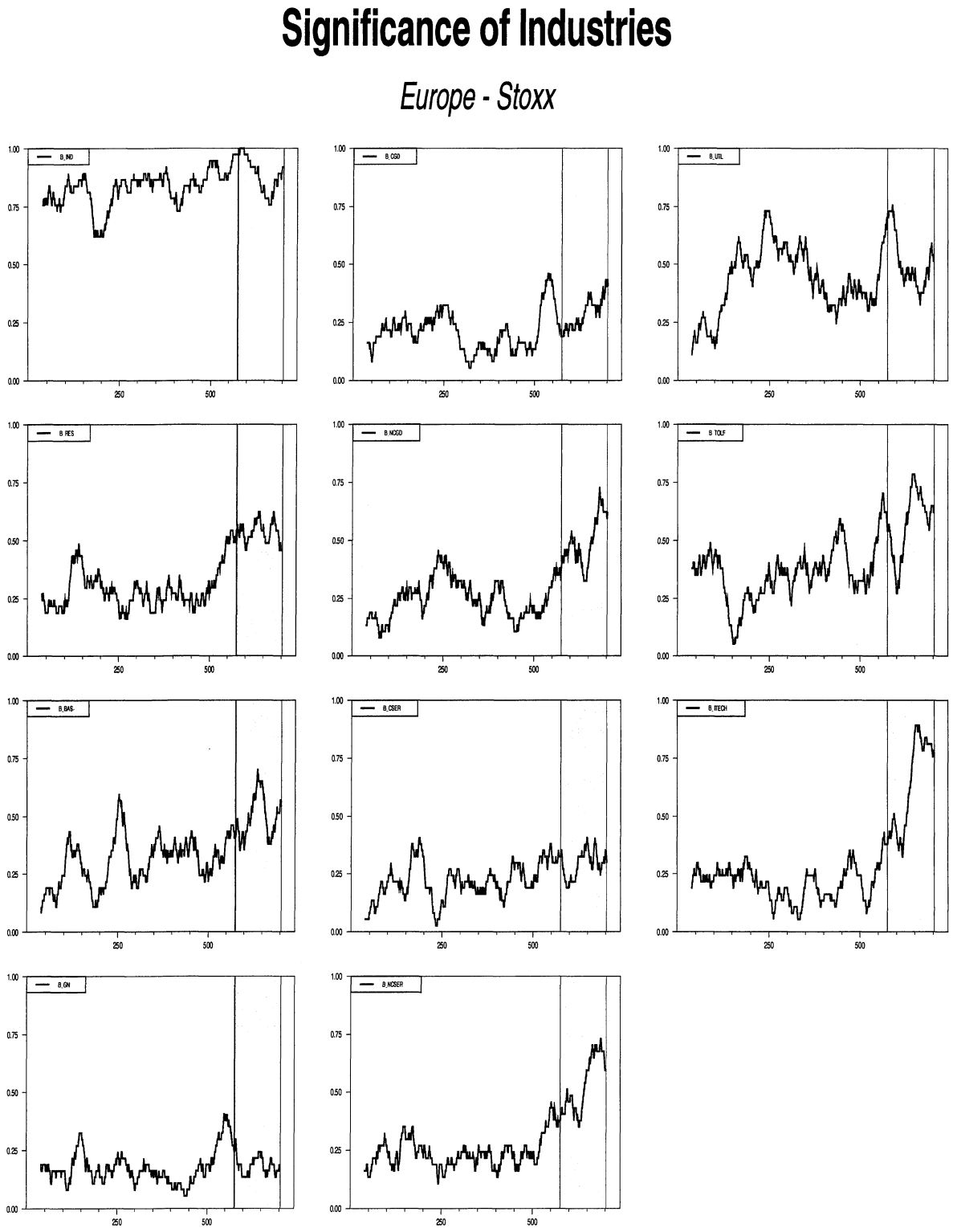

Figure 3: *36 week Moving Average of individual coefficient significance*

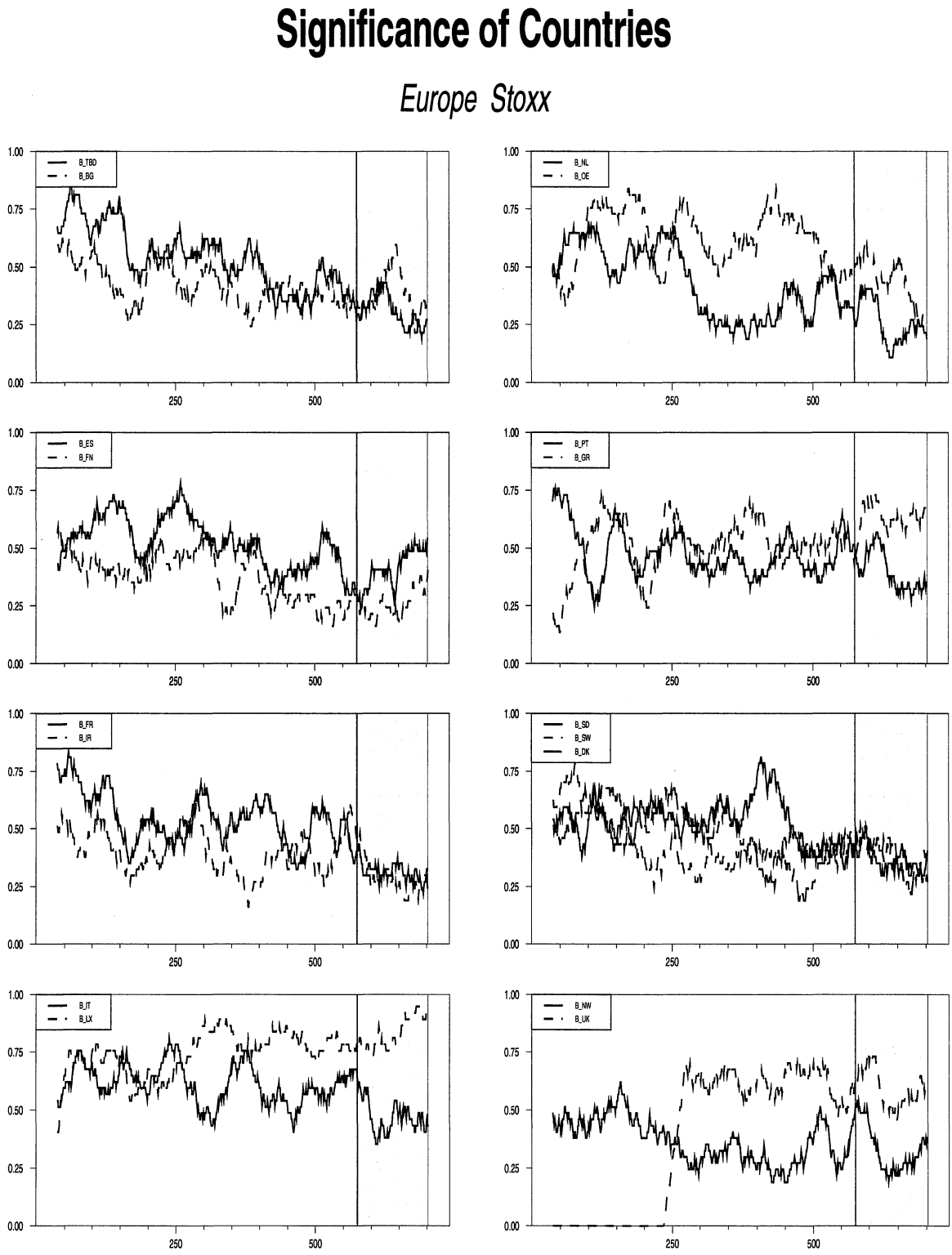

Figure 4: *36 week Moving Average of individual coefficient significance*

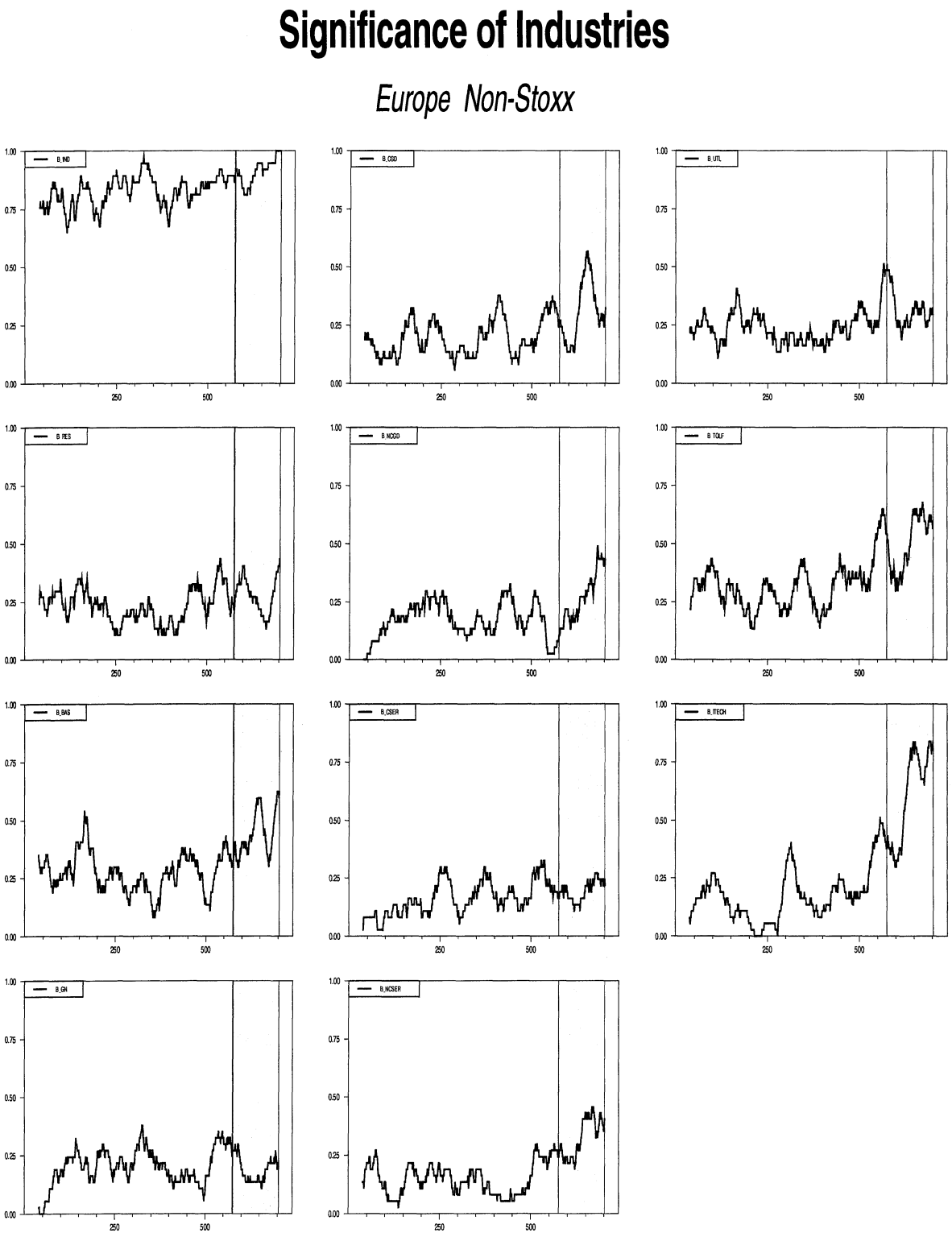

Figure 5: *36 week Moving Average of individual coefficient significance*

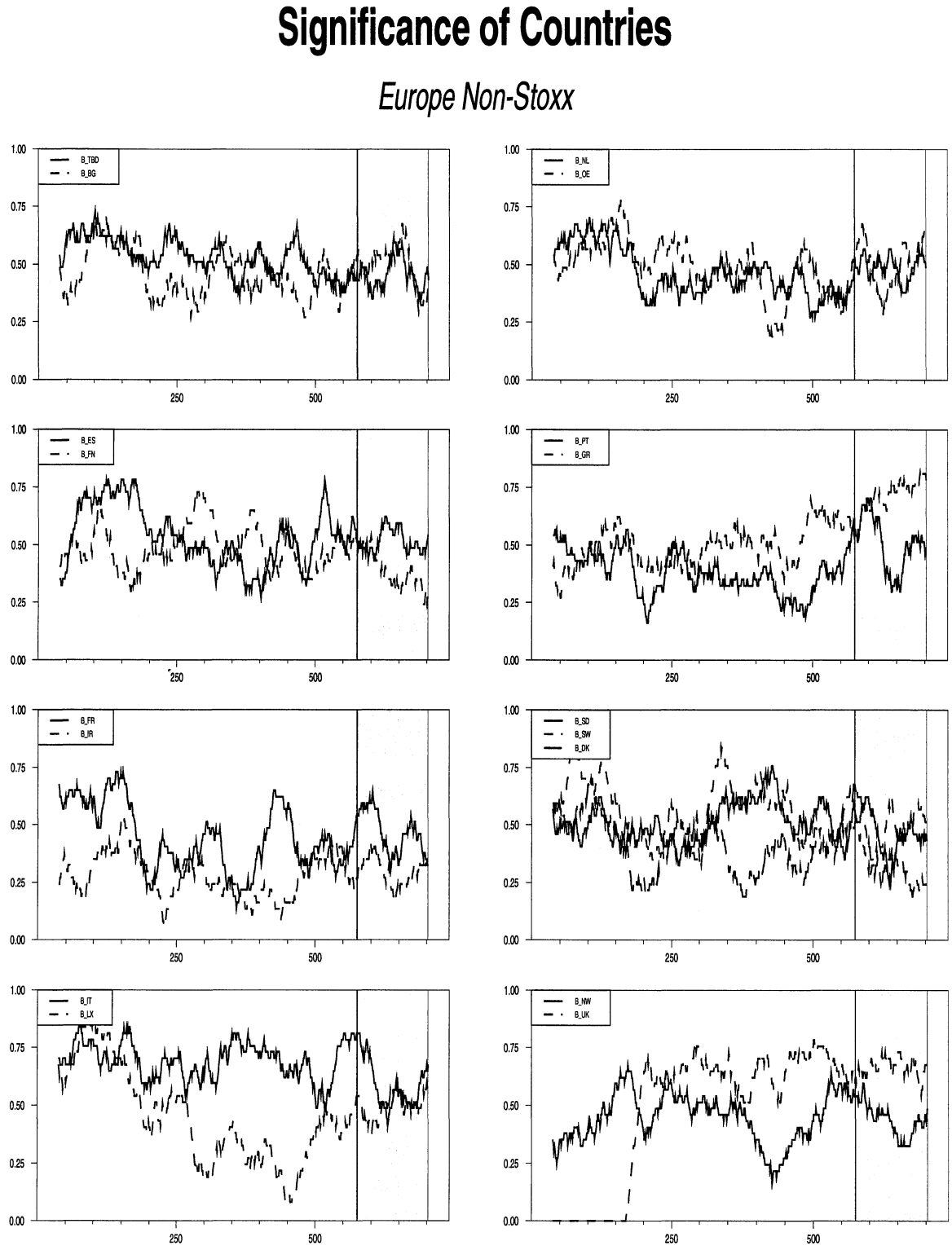

Figure 6: *36 week Moving Average of individual coefficient significance*

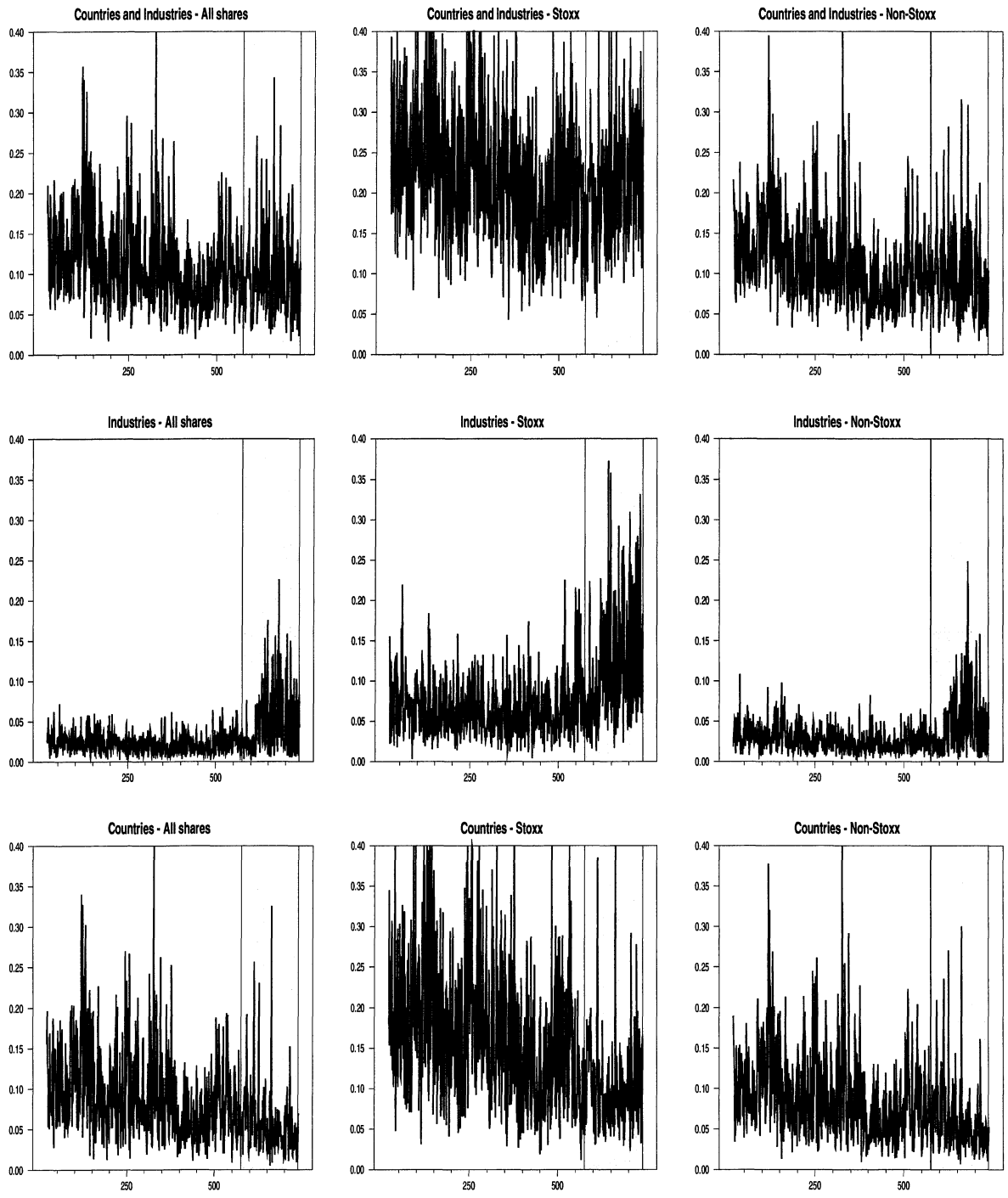

Figure 7: R^2 *for different model specifications in the Euro Countries*

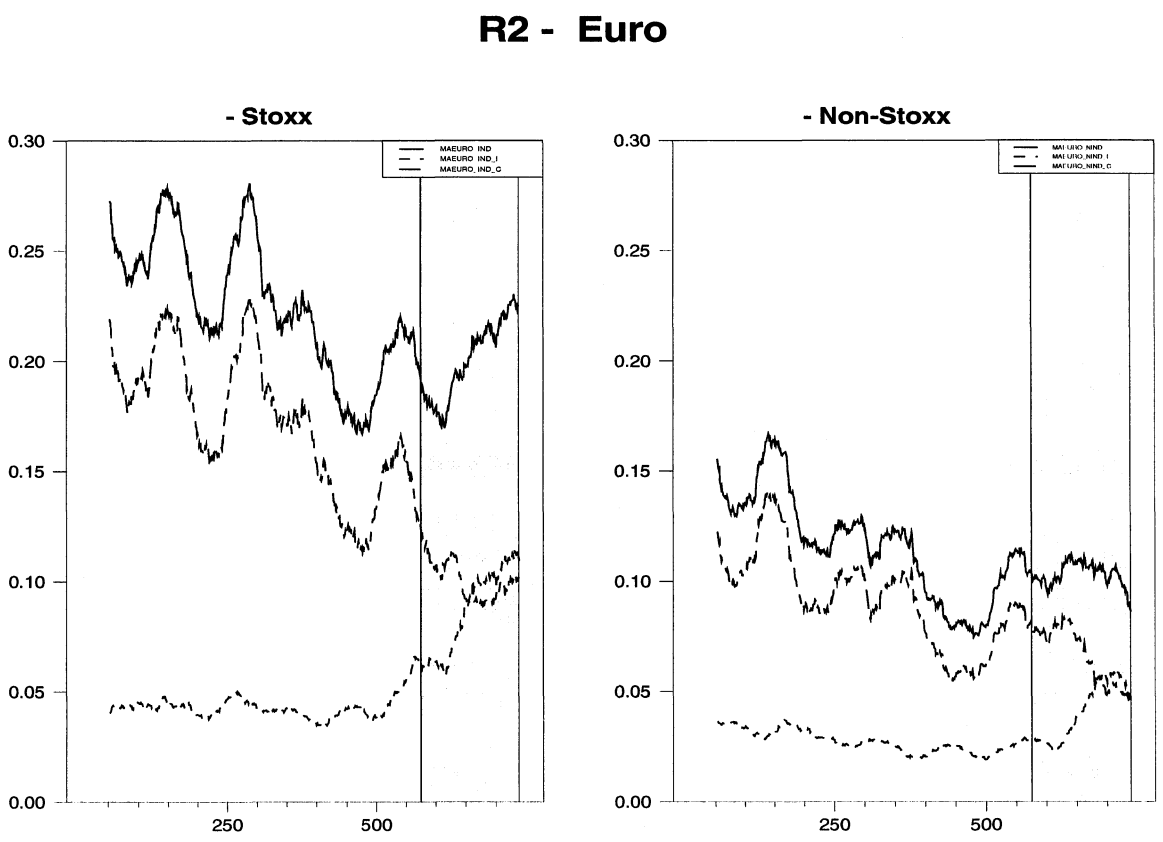

Figure 8: R^2 *for different model specifications in the Euro Countries*

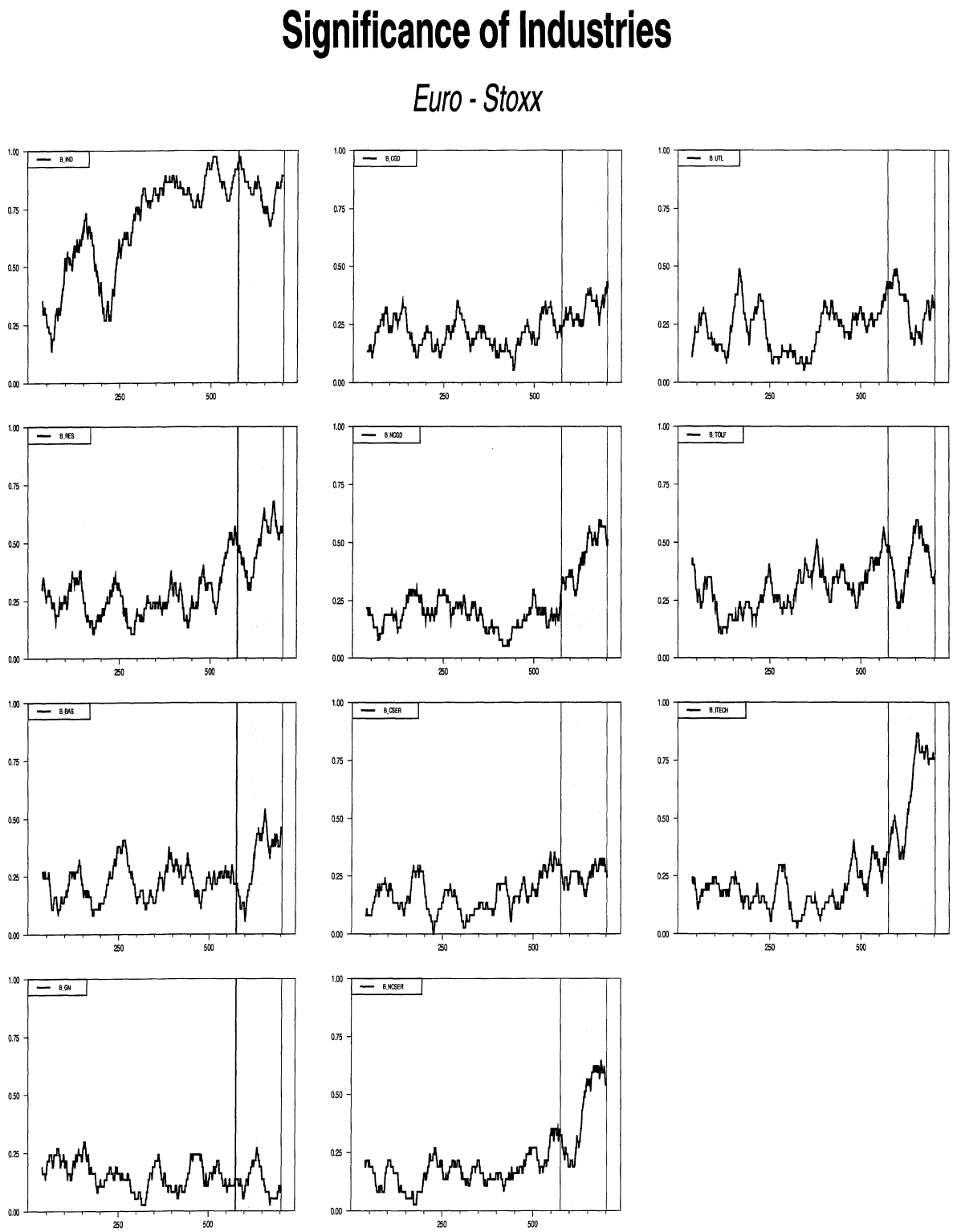

Figure 9: *36 week Moving Average of individual coefficient significance*

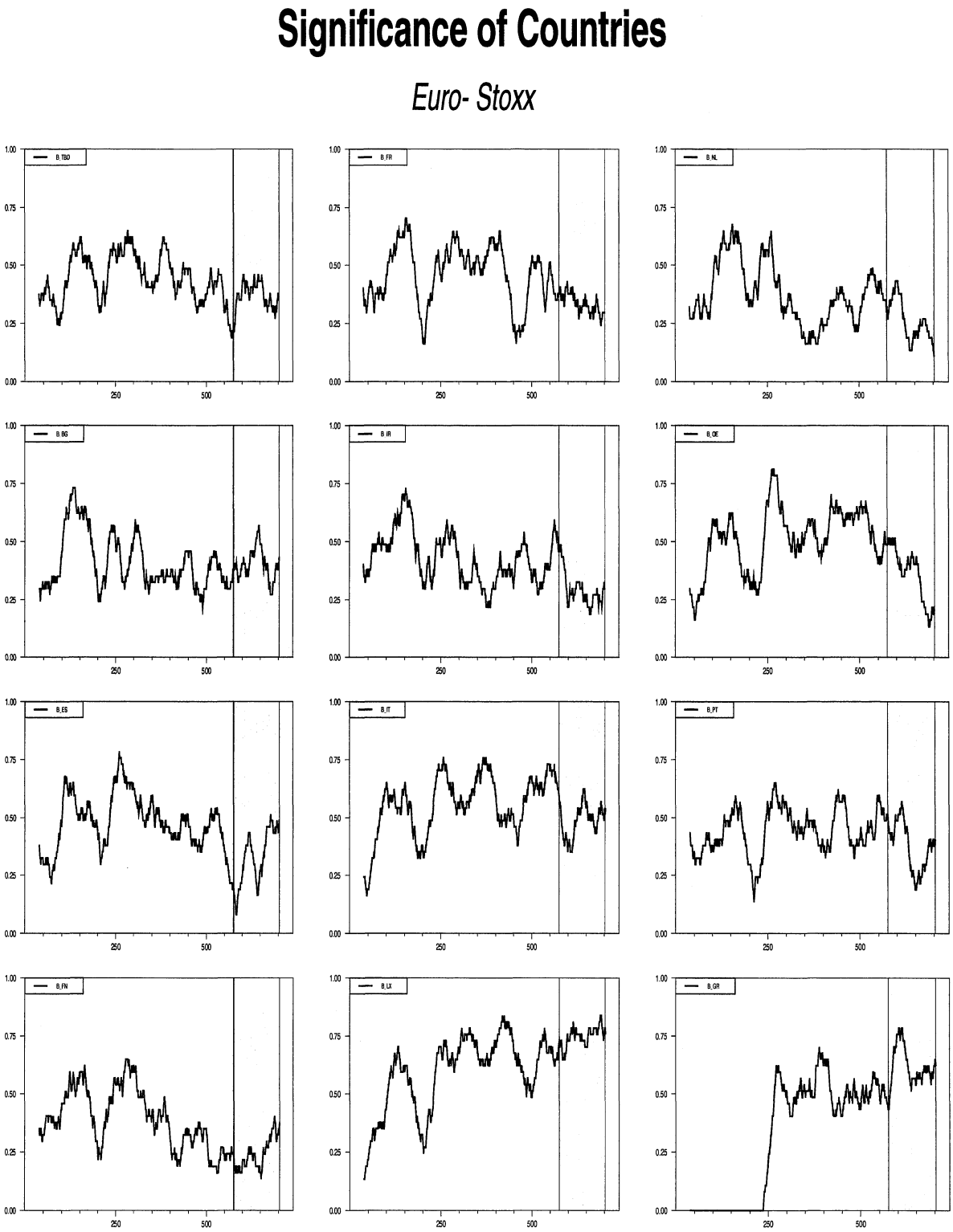

Figure 10: *36 week Moving Average of individual coefficient significance*

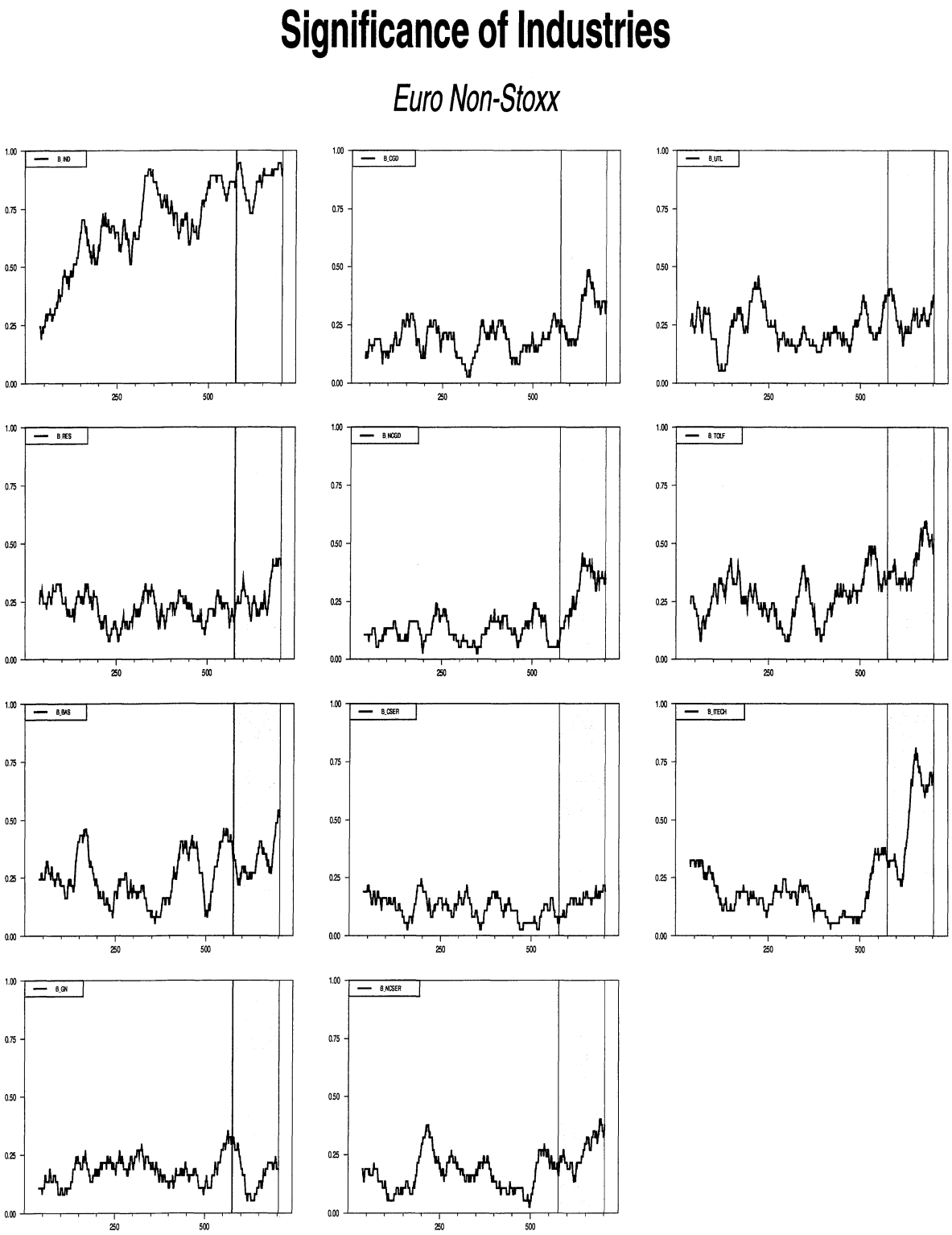

Figure 11: *36 week Moving Average of individual coefficient significance*

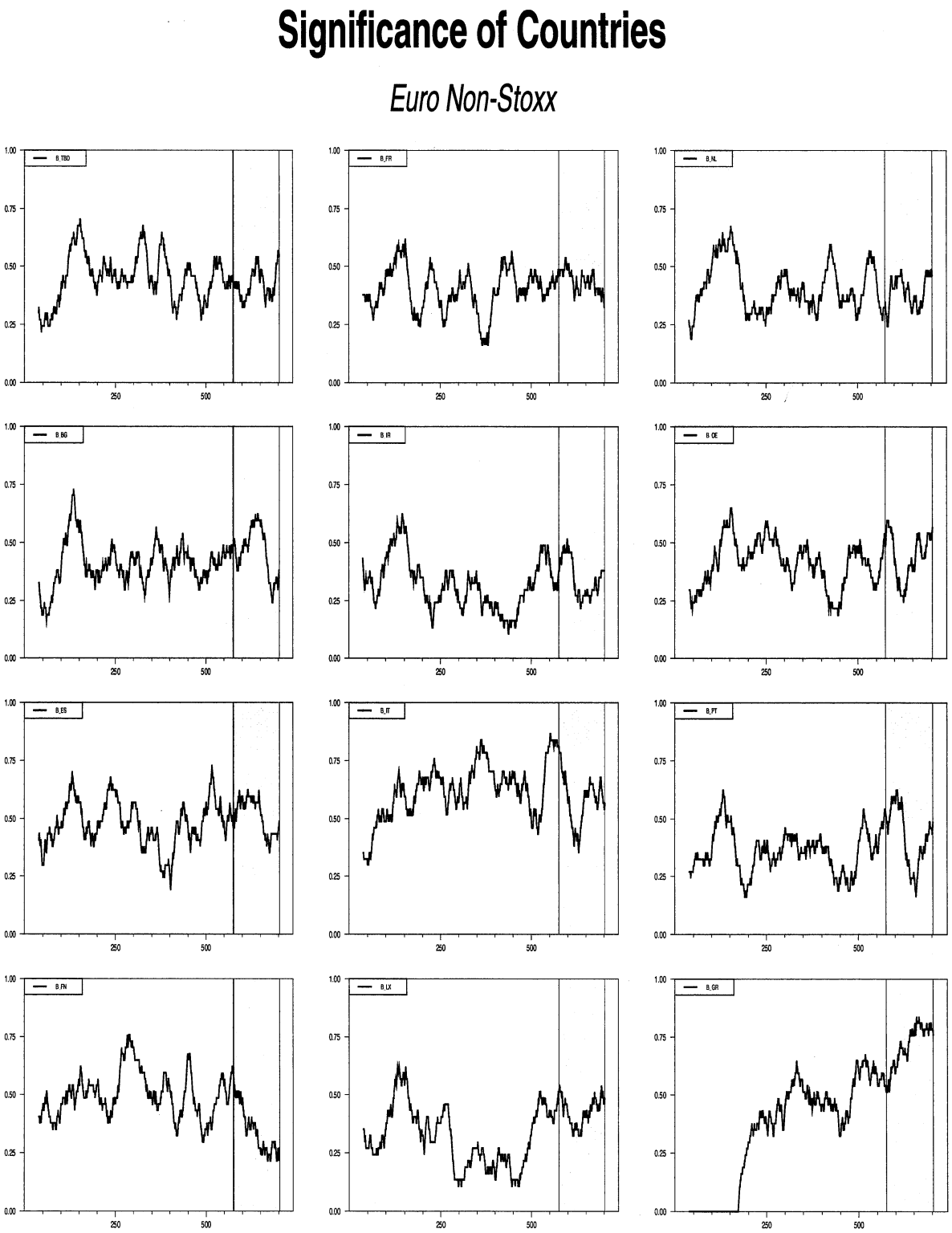

Figure 12: *36 week Moving Average of individual coefficient significance*