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Full Length Research Paper

Common stochastic trend and co-integration in the stock exchange markets: European countries and Turkey

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According to modern portfolio theory, there are some benefits from diversifying assets. In the literature, the possibility of this diversification is mostly investigated by analysing the correlation coefficients between the returns of the assets. However, this analysis can only give some ideas about short term decisions. For long term decisions, existence of common stochastic trends should be investigated. In this paper, for the fourteen European Union (EU) members and Turkey, this investigation is made by using the methodology of Johansen (1988) and Johansen and Juselius (1990). Since Turkey is in the negotiation process of EU, this analysis is important. Furthermore, 1996 is an important point in time where a customs union is formed between the EU member countries and Turkey. The paper also analyzes whether this formation had an effect on the number of common trends or not. The results show the existence of common trends and moreover, show that number of these trends increases after the formation of customs union. Therefore, there is no evidence of diversification.

Key words: Common stochastic trend, co-integration, stock exchange markets, Turkey, EU countries.

INTRODUCTION

In the literature, simple cross country correlations over short term horizons are usually used to determine gains to international portfolio diversification. These correlations may be misleading for the investors for making their decisions if they plan to stay in the markets for a long period and national equity markets share a common trend. For this aim, this study uses the modern portfolio theory which explains the benefits from diversifying assets, determined by investigating the integration, and interdependence of stock exchanges is used. Therefore, this study not only focuses on the correlations, but determines the common trends by using the methodology of Johansen (1988) and Johansen and Juselius (1990). Before these influential papers, more simple techniques of testing common trend were being used. A very good review of these studies can be seen in Arshanapalli and Doukas (1993). They state that there exists conflicting results in these previous studies about the existence of common trend. Solnik (1977), Kohlhagen (1983) and Khoury et al. (1987) give the reasons of these conflicting results in terms of methodological problems.

After Johansen (1988) and Johansen and Juselius (1990), most of the papers used their technique to test common trend. For example, Kasa (1992) investigated the U.S., Japan, England, Germany and Canada stock exchanges to find out whether there exists a common trend for both stock prices and dividends. Evidences of common trend in both of the series were observed in the paper. Garett and Spyrou (1997), Choudhry (1997) and Chen et al. (2002) use the same technique to test cointegration for Latin American and Asia Pacific regions. They all found evidences of common trend for these regions. Similar analysis is made by Masih and Masih (1997) for the Asian countries, also including four developed markets. They also reach common trend as well. Pan et al. (1999) also studied Asian-Pacific countries

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but the originality of the paper is that they used a modified cointegration test with GARCH effects to see whether stock price series share common time-varying volatility.

At this point, the study differs itself from studies elaborated by questioning whether forming blocks like European Union (EU) and North America Free Trade Agreement (NAFTA) has positive effects on the co-movements of markets or not. For EU, the number of studies[1] deals with whether economic and financial integration has created the co-movement in the countries of the EU.

Serletis and King (1997) supports cointegration relation among the EU countries. Laopodis (2005) considers the longrun relationship between EU countries and the US, and also investigates the possibilities of diversification both within EU and for US investors.

Surprisingly, no strong cointegration relationship is found in the article among EU countries, especially after the introduction of Euro in 1999. This means that it is possible to consider the stock exchange of each country as different asset opportunities and so, diversification is possible. In the paper, same kind of results are valid for US investors as well. Kim et al. (2005) also investigates the effect of the introduction of Euro but with a different approach by using EGARCH framework.

To NAFTA, Aggarwal and Kyaw (2005) and Darrat and Zhong (2005) examines the effect of passage to NAFTA in terms of financial integration and co-movement in NAFTA equity markets. Both find that in the pre-NAFTA period, there is no evidence of cointegration among the three NAFTA countries but cointegration exists for post-NAFTA period. Contrary to the study of Aggarwal and Kyaw (2005) and Darrat and Zhong (2005), Phengpis and Swanson (2006) find no cointegration relation for both pre- and post-NAFTA but by using rolling cointegration tests in the studies of Rangvid and Sorensen (2002) and Pascual (2003), they expose that NAFTA has a time-varying characteristics so that the results may change depending on the period studied. Among recent studies, López-Herrera and Ortiz (2010) examines integration between the NAFTA markets and the world capital market.

Results evidence a time-varying integration process among NAFTA equity markets. Integration of the NAFTA capital markets to the world capital market evidences a mild segmentation and a time-varying integration as well.Kasa (1992) and Garett and Spyrou (1997) argue that even though common trend exists for some regions, it may still be possible to diversify by entering the stock exchange markets of these regions (such as, UK, US, Germany, Japan, G-7 countries, emerging equity markets of the Latin American and Asian regions). Both papers claim that if the return response to common trend is limitted, then diversification is possible. Garett and Spyrou (1997) show that return reaction is limitted for some of the countries in the regions, and also for US and UK markets, so these countries can diversify.

Mavrakis and Alexakis (2008) examines whether the Greek stock market is integrated with the equity markets of three major economies. Empirical evidences indicate the existence of two long-run relations between the Greek stock market and the equity markets of Germany, United Kingdom, and the United States. Imposing restrictions on the resulting cointegrating vectors, their results indicate one common stochastic trend for each cointegrating relation as well as a high degree of integration between the examined European stock markets leading to a total absence of long-term diversification gains when investing across the national stock markets of Germany and Greece. Diamandis (2009) examines long-run relationships between four Latin America stock markets and a mature stock market, that of the US, and suggests that there is one long-run relationship among the five equity markets. It indicates that the examined stock markets are partially integrated, while there is also evidence that the four stock markets of Latin America (Argentina, Brazil, Chile and Mexico) together with the US stock market have four significant common permanent components, which drive this system of equity markets in the long run. Finally, it shows that although cointegration exists, there are small long-run benefits from international portfolio diversification since the stock prices adjust very slowly to these common trends.

Erdinc and Milla (2009) assess whether there is cointegration among stock exchange markets of a bloc of major EU countries of France, Germany, and, United Kingdom. Results indicate that there exists a long term relationship when we match the European countries with each other.
Assidenou (2011) investigates the cointegration properties of major capital markets indices during the September, 2008 to August, 2009 episode of the financial and banking crises that originated in U.S markets. Contrary to former studies that concluded on the independencies of Asian markets, this paper reveals that during the deeper financial crisis period, Asian major markets indices were cointegrated. This finding suggests that local investors in Asian capital markets cannot avoid any influence from outside capital markets even if some local markets are still entirely not opened to international investors. Demian (2011) investigates the impact of EU accession on financial markets in the Czech Republic, Estonia, Hungary, Poland, Romania and Slovakia and what effect, if any, EU entry had on the cointegration relationships between these markets and developed ones. The paper finds an increase in the number of cointegration relationships over time. However, it appears that EU accession plays a minor direct role in the development of these links, cointegration being driven more by financial and economic factors as opposed to explicit political actions.

Therefore, short review prompts us to use different

[1]Some examples are: for inflation Driffill and Miller (1993), for per capita output Serletis and Krichel (1992), for exchange rates Ardeni (1992) and for currency targets Frankel et al. (1992).

approach for the case and thus, the paper alternatively brings out that formation of blocks in the body of EU may have positive effects on the co-movements of markets. For this aim, in the paper, a comparision of the situation between the pre-costoms union and post-costoms union agreement (January 1, 1996) between EU and Turkey is made.

When the issue comes to explore how the assertion of the paper is valid for Turkey, to review related studies for Turkey provides us very good guidance for our study. Erdal and Gunduz (2001) investigate whether, and to what extent, the Istanbul Stock Exchange (ISE) is integrated globally with major developed markets in the world and regionally with the emerging markets of the Middle East and North Africa (MENA) Region by employing Johansen (1988) cointegration test procedure. The paper fills the gap in the literature because most of the studies on stock exchange interdependence relates to the European, US, Japan, Asian, Pacific and Latin American markets but neglects MENA countries. The paper provides an evidence of a strong cointegrating relationship between ISE and seven matured markets. It is also observed that especially US and Japanese markets are influential on Turkish stock exchange. On the other hand, the paper indicates that there is no cointagration among the equity markets of Turkey and MENA countries. Another study, Gunduz and Omran (2001), which also investigates the cointegration relation among five MENA countries including Turkey, could not find a long run relation. However, some studies provide opposite result of Erdal and Gunduz (2001) and Gunduz and Omran (2001) studies. Onay (2006) examines the long-term financial integration of second-round acceding and candidate countries' with the European Union and the US stock markets during the Accession Process. The results indicate that the completion of accession negotiations with Bulgaria and Romania and ongoing negotiations with Croatia and Turkey have not yet resulted in the complete financial integration of these markets with the European Union. They still offer significant long-term diversification opportunities for the European as well as the US investors. Aktar (2009) investigates whether there exists long run relationship and Granger Causality between Turkish, Russian and Hungarian stock indices for the period of January 5, 2000 and October 22, 2008. He also finds that Hungarian stock market does Granger cause to Turkish stock market but not vice versa.

Furthermore, Russian stock market does Granger cause to Hungarian stock market but not vice versa. Vuran (2010) states that there exists long run relationship between ISE-100 index with stock exchange indices of developed and developing countries, based up on the test results. Efendioglu and Yoruk (2005) study reaches a result that there is no long run or cointegration. Relationship between ISE index and the stok exchange indices of France, Germany, England, Holland and Italy and thus, portfolio diversification and arbitrage opportunities exist. Kucukkaya (2009) examines possible short and long term relationships between the US and the Turkish equity markets by employing correlation analysis, cointegration methodology and Granger causality. Results indicate that the two markets are not highly correlated, and there is no cointegrating relationship, pointing to possible diversification benefits by investing in the Turkish market. On the other hand, Korkmaz et al. (2008) investigates an existence of long run relationship between ISE and stock exchange of EU-17, and of ten countries who have high share in foreign trade of Turkey. According to the results of cointegration tests, they conclude that there is a long run relationship with 11 countries of EU-17 and 7 countries out of 10. Karagoz ve Ergun (2010) aim to investigate financial integration among four emerging (plus Greek) stock markets in the Balkans by using multivariate co-integration technique and examines that integration between these developing markets and developed markets represented by the US, UK and Japan. Results of the co-integration reveal that there is at least one co-integration equation between Balkan stock markets indices which verifies the stock market integration in the region.

A very recent study of Oztek and Ocal (2011) has a complemantary charectar to this study since it compares the integration process of Turkish stock markets with new member states of EU and this paper analysis the situation for the old member states of EU. Oztek and Ocal make the analysis by modelling co-movements among financial markets. The time-varying correlation between markets is modelled by Smooth Transition Conditional Correlations (STCC) .

METHODOLOGY

This study deals with the fourteen members of European Union (Austria, Belgium, Denmark, England, Finland, France, Germany, Greece, Holland, Ireland, Italy, Portagal, Spain and Sweden) along with Turkey. Considering the evaluation of the EU, four groups are formed. Group 1: Belgium, France, Germany, Holland and Italy, founders of the Union. Group 2: Denmark, England and Ireland, entered the Union in the 1972. Group 3: Greece, Portugal, and Spain, became members of the EU in 1981, 1986, and 1986 respectively. Group 4: Austria, Finland and Sweden entered the Union in 1995.

The paper uses the "Capital International" indices of Morgan Stanley. Although Luxembourg is one of the founders of the Union, the country is not included in the study because the data for the country do not exist in the database of Morgan Stanley. It is not prefered to get the data for Luxembourg from another source in order to provide consistency among data. The countries which became a member of the Union after 1995 do not exist in the study as well. There are two reasons for this: first, the data for these countries are not very healty and second, the stock exchanges of these countries are not as developed as the ones which are included in the study.

The time period of the analysis is from January, 1988 to August, 2008. Although the data go back to 1969 for most of the countries, for Finland, they are available since January, 1982 and for Greece, Ireland, Portugal and Turkey, they are available since January, 1988. Therefore, the period is limitted to January, 1988 to August, 2008. The data are the end of month value-weighted indices of a large sample of firms in each countries' markets in terms of dollars,

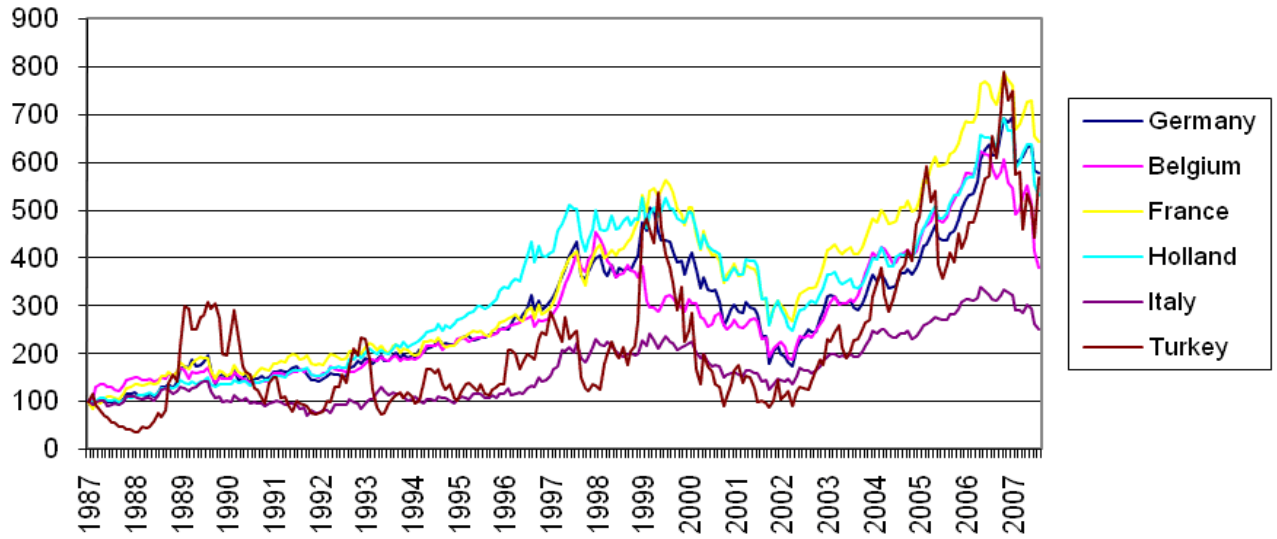

Figure 1. Group 1 stock price indices.

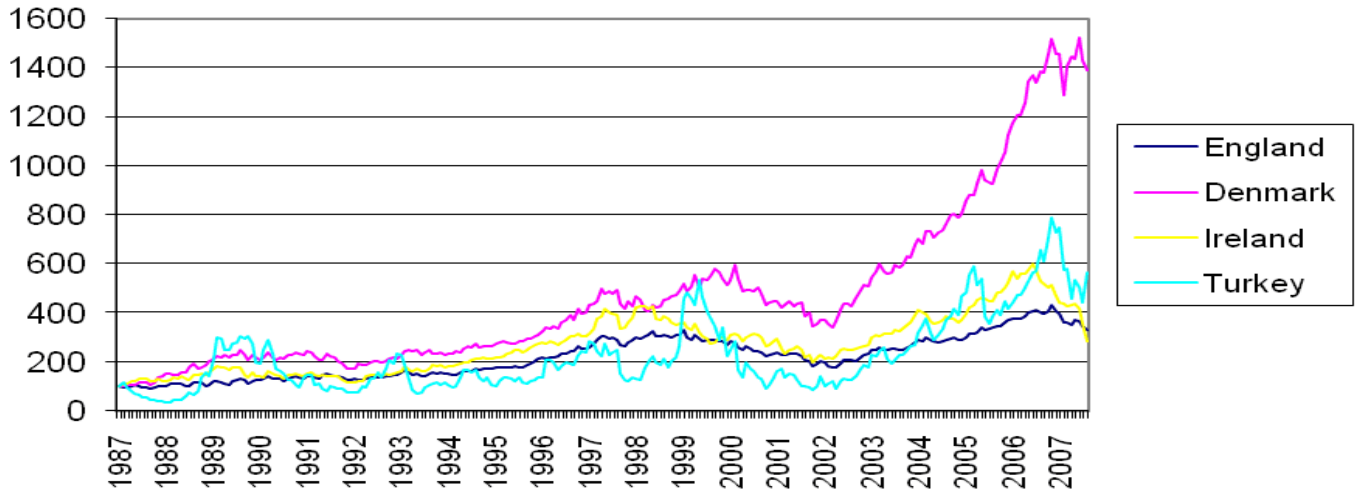

Figure 2. Group 2 stock price indices.

and their logarithmic values are downloaded from Morgan Stanley. The data are recalculated by taking December, 1987 as the basis month. Figures 1 to 4 contain plots of these indices for each group respectively. Turkey is inculuded in all of the figures for comparison purposes.

Figure 1 indicates that ISE index of Turkey does not move along with the indices of the countires, especially during crises period such as 1988, 1994 and 1997 to 1998 in Group 1 until 1999, but then, it follows almost a similar path. According to Figure 2, Turkey seems to follow a similar path with Denmark in Group 2. Figure 3 gives the impression that Turkey and Greece has a very close relatioship. Last Figure 4indicates that, in exception of Austria case, Turkey's path accordingly moves with the other two. All figures initially indicate that there are some common stochastic trends to analyze.

To shed some light on the picture, summary statistics for monthly returns are presented in Table 1. Some points are worth to mention about the values in Table 1. Initially, in terms of means of returns, the highest returns are observed for Denmark, Finland, Greece, Sweden and Turkey - the lowest among them is 0.0112 for Sweden and highest is 0.0208 for Turkey. Consistent with the modern portfolio theory, these countries have high standard deviations as well, except for Denmark. The country has a standard deviation of 0.0520 which is close to the standard deviations of other countries. Among the five countries, Turkey has considerably high standard deviation which is 0.1731. Secondly, lowest returns are observed for England, Ireland, Italy and Potugal - the lowest among them is 0.0036 for Portugal and highest is 0.0057 for Irland. Although Italy and Portugal have relatively higher standard deviations, consistent with the modern portfolio theory, England and Irland have low standard deviations. Secondly, skewness and kurtosis values reflect that returns show some unnormal charecteristics.

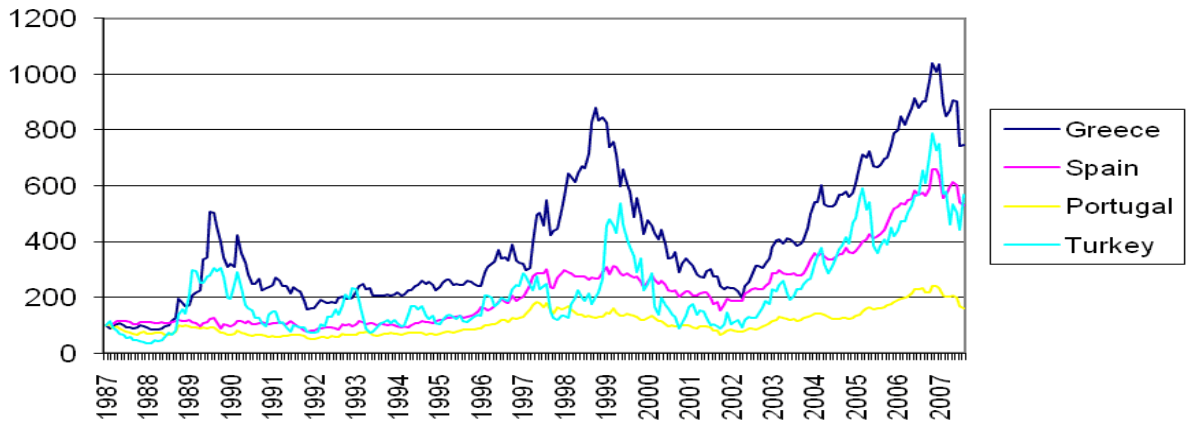

Figure 3. Group 3 stock price indices.

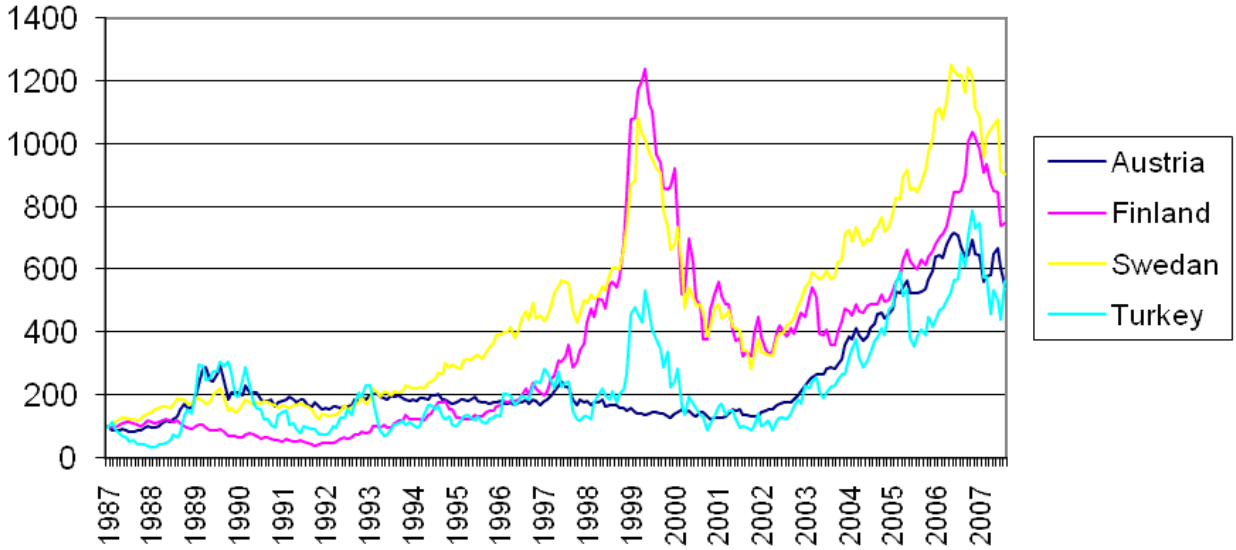

Figure 4. Group 4 stock price ındices.

It is also interesting to see the correlations between the returns of the markets. These correlations are reported in Table 2. Note that the correlation coefficients for Turkey are the lowest ones. Finland and Greece are the countries which are closest to the charecteristics of Turkey with relatively lower correlation coefficients compared to the other EU members. One other thing to note from Table 2 is that Groups 1 and 2 countries have higher correlation coefficients among themselves, only Italy and Ireland showing some exceptional cases.

These correlation results may give some ideas to the investors about the possibilities of diversification. For example, since Turkey, Greece and Finland have lower correlation coefficients, including these countries to portfolios may have a diversification effect. Moreover, a portfolio just consisting of Groups 1 and countries may not be considered as diversified. However, one should keep in mind that these correlation coefficents can give some idea only for short term decisions. They may be misleading if long term decisions are to be taken. Common trends should be analysied for the possibility of a long term diversification. Therefore, this study further analyses the fourteen EU members and Turkey by using the methodology of Johansen (1988) and Johansen and Juselius (1990).

EMPIRICAL RESULTS

While examining common trends in international stock exchanges, initially, unit root tests should be applied in the autoregressive representations of each country's stock price index. In this study, tests are applied to the logarithms of the price indices presented in Figures 1 to 4. Two cases are considered, where in the first one, there are fluctuations around a constant mean and in the second one, in addition to this, there exist fluctuations around a deterministic linear trend. There are four lags to account for serial correlation in the error terms. Results do not change very much depending on the lags chosen.

Table 1. Descriptive statistics of monthly percentage changes of stock exchange indices (January, 1988 to August, 2008).

Country	Mean	Median	Maximum	Minimum	Std. dev.	Skewness	Kurtosis
Austria	0.0087	0.0099	0.2527	-0.2340	0.0646	-0.0391	1.5823
Belgium	0.0067	0.0095	0.2475	-0.1900	0.0520	-0.2178	3.1496
Denmark	0.0118	0.0147	0.1472	-0.1347	0.0520	-0.1898	0.0227
England	0.0056	0.0039	0.1479	-0.1052	0.0443	0.1697	0.2891
Finland	0.0120	0.0052	0.3237	-0.3177	0.0908	0.1471	1.3295
France	0.0088	0.0093	0.2079	-0.1539	0.0544	-0.0819	0.9212
Germany	0.0087	0.0109	0.2238	-0.2435	0.0615	-0.3788	2.0898
Greece	0.0123	0.0095	0.5531	-0.2260	0.0997	1.5806	6.7434
Netharlands	0.0079	0.0099	0.1292	-0.1781	0.0481	-0.7752	1.6098
Irland	0.0057	0.0107	0.1816	-0.1956	0.0577	-0.2449	1.1856
Italy	0.0055	0.0026	0.2140	-0.1890	0.0642	0.1945	0.4753
Portugal	0.0036	0.0045	0.2841	-0.1935	0.0637	0.2937	1.5457
Spain	0.0082	0.0082	0.2139	-0.2174	0.0607	-0.1495	1.0907
Sweden	0.0112	0.0137	0.2281	-0.2247	0.0710	-0.2439	0.7858
Turkey	0.0208	0.0077	0.7230	-0.4124	0.1731	0.7167	1.7792

The results of the Augmented Dickey-Fuller (1979) tests of the null hypothesis that a single unit root exists in each country's stock price series are presented in Table 3 to 6 for Groups 1, 2, 3 and 4 for the whole period, pre-customs union period (that is, before January 1996) and post-customs union period (that is, after January 1996).

The tests cannot reject the null hypothesis of unit root for all of the countries and for all of the periods when the alternative is taken as stationary fluctuations around a constant mean except Denmark and Spain for the pre-customs union period. However, the rejection rate is at 10% and it is weak. For the case of fluctuations around a deterministic linear trend for England for the pre-customs union period and for Turkey for the whole period, null hypothesis can be rejected, but this rejection is weak for Turkey, at 10% level and more strong for England, at 5% level. Therefore, it can be concluded that the evidence mildly supports that there is a random walk component in each country's stock market. At this point, the question is; to what extent these random walk components are independent of eachother.

Johansen's common stochastic trends test can be applied. Kasa (1992) uses Johansen's approach to testing for common trends and cointegration, as well. The Johansen test is essentially a multivariate Dickey-Fuller test which determines the number of cointegrating equations, or cointegrating rank, by computing a likelihood ratio statistics for each added cointegrating equation. If we cannot reject the hypothesis that the number of cointegrating equations is none, the series are not cointegrated. If we cannot reject the hypothesis of one cointegrating equation, there is one cointegrating equation and the series share a stochastic trend (Ackert and Racine, 1999: 139). If *r* linearly independent cointegrating equations in a group of *n* stock markets can be found, then *n-r* common stochastic trends from the linear combinations of the markets lying in the orthogonal complement of the cointegration space can be defined.

The results for Groups 1, 2, 3 and 4, including Turkey in each case, are presented in the Tables 7 to 14. In each table, there are two specifications; VAR(2) and VAR(11), along with a constant mean, and with a constant mean and a deterministic linear trend.

From Table 7, it can be seen that for constant mean model when k=2, number of cointegrating equations is 1 for all of the periods that are considered. Since in Group 1 there are 6 countries including Turkey, this means that there are 5 common stochastic trends. On the other hand, when k=11, number of cointegrating equations is 2 for whole period, 4 for pre-costom union period and 6 for post-costom union period. This means that there are 4 common stochastic trends for the whole period, 2 for the pre-costom union period and non for the post costoms union period.

From Table 8, it can be seen that for constant mean and a deterministic linear trend model when k=2, number of cointegrating equations is 1 for the whole period and pre-costoms union period but there is no cointegrating equation for the post-union period. Since in Group 1 there are 6 countries including Turkey, this means that there are 5 common stochastic trends for the whole period and pre-costoms union period and 6 for post-costoms union period. On the other hand, when k=11, numbers of cointegrating equations are 2, 6 and 3 for whole period, pre-costom union period and post-costom union period, respectively. This means that there are 4 none and 3 common stochastic trends for the whole period, pre-costom union period and post costoms union period, respectively.

For the aforementioned two cases, note that when

Table 2. Correlation matrix (January, 1988 to August, 2008).

Country	Austria	Belgium	Denmark	England	Finland	France	Germany	Greece	Holland	Ireland	Italy	Portugal	Spain	Sweden	Turkey
Austria	1.000	0.486	0.454	0.506	0.239	0.496	0.592	0.412	0.541	0.457	0.424	0.461	0.451	0.362	0.290
Belgium		1.000	0.587	0.614	0.294	0.728	0.697	0.407	0.751	0.590	0.513	0.505	0.573	0.493	0.165
Denmark			1.000	0.589	0.391	0.615	0.666	0.310	0.658	0.535	0.523	0.492	0.591	0.602	0.208
England				1.000	0.479	0.687	0.660	0.302	0.756	0.676	0.476	0.491	0.649	0.619	0.239
Finland					1.000	0.466	0.495	0.236	0.491	0.400	0.459	0.366	0.478	0.638	0.296
France						1.000	0.831	0.417	0.792	0.526	0.592	0.528	0.677	0.663	0.280
Germany							1.000	0.409	0.815	0.563	0.611	0.518	0.657	0.703	0.324
Greece								1.000	0.376	0.352	0.382	0.505	0.453	0.355	0.349
Holland									1.000	0.639	0.575	0.583	0.667	0.699	0.287
Ireland										1.000	0.421	0.512	0.595	0.540	0.215
Italy											1.000	0.475	0.613	0.558	0.243
Portugal												1.000	0.658	0.544	0.331
Spain													1.000	0.705	0.242
Sweden														1.000	0.367
Turkey															1.000

Table 3. Univariate unit root tests - stock prices in logs, Group 1 [a,b].

	Germany			Belgium			France			Holland			Italy		
	Whole	Pre CU	Post CU	Whole	Pre CU	Post CU	Whole	Pre CU	Post CU	Whole	Pre CU	Post CU	Whole	Pre CU	Post CU
τμ(4)	-1.26	-1.39	-1.10	-1.24	-1.01	-1.51	-1.44	-2.50	-1.52	-1.46	0.13	-1.71	-1.00	-1.97	-2.07
ττ(4)	-2.06	-2.06	-1.38	-1.76	-2.66	-1.44	-2.28	-2.59	-1.65	-1.23	-2.05	-1.60	-2.27	-2.06	-1.83

[a] Numbers for τμ are t-statistics on β_0 in the regression $\Delta x_t = \alpha + \beta_0 x_{t-1} + \sum_{j=1}^{k} \beta_j \Delta x_{t-j}$. Numbers for ττ are t-statistics on β_0 in the regression $\Delta x_t = \alpha_0 + \alpha_1 t + \beta_0 x_{t-1} + \sum_{j=1}^{k} \beta_j \Delta x_{t-j}$; [b] MacKinnon critical values for rejection of hypothesis of a unit root at 1% for τμ is -3.46 and ττ is -4.00 at 5% for τμ is -2.87 and ττ is -3.43 at 10% for τμ is -2.57 and ττ is -3.14.

k=11 there is much stronger evidence against the null hypothesis. The numbers of cointegrating equations are higher when k=11. This result is consistent with Kasa (1992) which states that higher order VAR provides stronger evidence against the null hypothesis. Again from the above two cases one can note that there is some evidence that costoms union have an increasing effect on the number of common stochastic trends. When pre and post costoms union periods are compared, it can be seen that numbers of common stochastic trends either stay constant or increase except for the case of constant mean and a deterministic linear trend model when k=11. This result may indicate that customs union did not increase the possibility of diversification.

From Table 9, it can be seen that for constant mean model when k=2, there are no cointegrating equations for all of the periods that are considered. Since in Group 2 there are 4 countries including Turkey, this means that there are 4 common stochastic trends. On the other hand, when k=11, number of cointegrating equations is 1 for whole period, 2 for pre-costom union period and 1 for post-costom union period. This means that there are 3 common stochastic trends for the whole period, 2 for the pre-costom union period

Table 4. Univariate unit root tests - stock prices in logs for Group 2[a,b].

	England			Denmark			Ireland		
	Whole	**Pre CU**	**Post CU**	**Whole**	**Pre CU**	**Post CU**	**Whole**	**Pre CU**	**Post CU**
τμ(4)	-1.18	-1.10	-1.83	-0.53	-2.69	-0.04	-1.65	-1.46	-1.89
ττ(4)	-1.50	-3.75	-1.71	-1.78	-2.31	-1.08	-1.40	-2.01	-1.31

[a] Numbers for τμ are t-statistics on β_0 in the regression $\Delta x_t = \alpha + \beta_0 x_{t-1} + \sum_{j=1}^{t} \beta_j \Delta x_{t-j}$. Numbers for ττ are t-statistics on β_0 in the regression $\Delta x_t = \alpha_0 + \alpha_1 t + \beta_0 x_{t-1} + \sum_{j=1}^{t} \beta_j \Delta x_{t-j}$; [b] MacKinnon critical values for rejection of hypothesis of a unit root at 1% for τμ is -3.46 and ττ is -4.00 at 5% for τμ is -2.87 and ττ is -3.43 at 10% for τμ is -2.57 and ττ is -3.14.

Table 5. Univariate unit root tests - stock prices in logs for Group 3 [a,b].

	Greece			Spain			Portugal		
	Whole	**Pre CU**	**Post CU**	**Whole**	**Pre CU**	**Post CU**	**Whole**	**Pre CU**	**Post CU**
τμ(4)	-1.71	-2.10	-1.56	-0.24	-2.85	-1.28	-0.91	-2.54	-1.95
ττ(4)	-2.27	-1.94	-1.64	-1.92	-3.03	-1.60	-2.17	-2.63	-1.79

[a] Numbers for τμ are t-statistics on β_0 in the regression $\Delta x_t = \alpha + \beta_0 x_{t-1} + \sum_{j=1}^{t} \beta_j \Delta x_{t-j}$. Numbers for ττ are t-statistics on β_0 in the regression $\Delta x_t = \alpha_0 + \alpha_1 t + \beta_0 x_{t-1} + \sum_{j=1}^{t} \beta_j \Delta x_{t-j}$; [b] MacKinnon critical values for rejection of hypothesis of a unit root at 1% for τμ is -3.46 and ττ is -4.00 at 5% for τμ is -2.87 and ττ is -3.43 at 10% for τμ is -2.57 and ττ is -3.14.

Table 6. Univariate unit root tests - stock prices in logs for Group 4 [a,b].

	Austria			Finland			Sweden			Turkey		
	Whole	**Pre CU**	**Post CU**	**Whole**	**Pre CU**	**Post CU**	**Whole**	**Pre CU**	**Post CU**	**Whole**	**Pre CU**	**Post CU**
τμ(4)	-0.96	-2.21	0.06	-0.53	-0.38	-1.65	-1.10	-1.05	-1.64	-2.32	-1.99	-1.71
ττ(4)	-1.38	-1.59	-1.28	-1.84	-0.33	-1.63	-1.99	-1.74	-1.88	-3.31	-1.95	-2.27

[a] Numbers for τμ are t-statistics on β_0 in the regression $\Delta x_t = \alpha + \beta_0 x_{t-1} + \sum_{j=1}^{t} \beta_j \Delta x_{t-j}$. Numbers for ττ are t-statistics on β_0 in the regression $\Delta x_t = \alpha_0 + \alpha_1 t + \beta_0 x_{t-1} + \sum_{j=1}^{t} \beta_j \Delta x_{t-j}$; [b] MacKinnon critical values for rejection of hypothesis of a unit root at 1% for τμ is -3.46 and ττ is -4.00 at 5% for τμ is -2.87 and ττ is -3.43 at 10% for τμ is -2.57 and ττ is -3.14.

Table 7. Johansen tests for cointegration among stock exchanges of Group 1 countries and Turkey (January, 1988 to August, 2008) constant mean model [a-c].

H_0	Whole period		Pre-customs union		Post-costoms union		CV (5%)
	(k=2)	**(k=11)**	**(k=2)**	**(k=11)**	**(k=2)**	**(k=11)**	
r=0	101.72	119.02	110.00	376.60	93.49	113.98	94.15
r≤1	64.64	73.04	61.02	254.75	64.70	82.39	68.52
r≤2	36.37	45.78	36.12	143.76	39.28	57.04	47.21
r≤3	20.43	24.20	16.15	42.13	22.46	36.50	29.68
r≤4	6.62	10.86	6.33	12.96	11.58	19.59	15.41
r≤5	2.76	3.45	0.34	0.06	3.53	6.40	3.76

[a]Critical values are from Osterwald-Lenum (1992); [b]k refers to number of lags in the VAR; [c] Eigenvalues-Whole Period, k=2, (0.140, 0.109, 0.063, 0.055, 0.016, 0.011), Eigenvalues Whole Period, k=11, (0.176, 0.109, 0.087, 0.055, 0.031, 0.015). Eigenvalues-Pre-Customs Union, k=2 ,(0.406, 0.232, 0,191, 0.099, 0.062, 0,004), Eigenvalues-Pre-Customs Union, k=11, (0.762, 0.729, 0.698, 0.291, 0.141, 0.001); Eigenvalues-Post-Costoms Union k=2, (0.173, 0.154, 0.105, 0.069, 0.052, 0.023), Eigenvalues-Post-Customs Union, k=11, (0.188, 0.154, 0.126, 0.105, 0.083, 0.041).

and 3 for the post costoms union period.

From Table 10, it can be seen that for constant mean and a deterministic linear trend model when k=2, number of cointegrating equations is none for the whole period

Table 8. Johansen tests for cointegration among stock exchanges of Group 1 countries and Turkey (January, 1988 to August, 2008), constant mean and a deterministic linear trend model [a-c].

H_0	Whole period		Pre-customs union		Post-costoms union		CV (5%)
	(k=2)	(k=11)	(k=2)	(k=11)	(k=2)	(k=11)	
r=0	116.60	128.91	135.57	495.91	96.83	137.26	114.90
r≤1	77.67	82.93	80.49	359.56	67.80	97.96	87.31
r≤2	41.98	54.82	53.07	242.70	41.86	67.22	62.99
r≤3	24.64	33.23	31.44	133.72	24.31	41.93	42.44
r≤4	10.82	18.09	15.80	39.53	12.16	23.60	25.32
r≤5	2.85	6.40	5.99	12.88	4.02	6.77	12.25

[a]Critical values are from Osterwald-Lenum (1992); [b]k refers to number of lags in the VAR; [c]Eigenvalues-Whole Period, k=2, (0.146, 0.135, 0.068, 0,055, 0.032, 0.012), Eigenvalues Whole Period, k=11, (0.176, 0.112, 0.087, 0.062, 0.048, 0.027); Eigenvalues-Pre-Customs Union , k=2, (0.443, 0.253, 0.206, 0.153, 0.099, 0.062), Eigenvalues-Pre-Customs Union, k=11,(0.799, 0.747, 0.723, 0.670, 0.269, 0.141); Eigenvalues-Post-Costoms Union k=2, (0.174, 0.157, 0.109, 0.077, 0.052, 0.026), Eigenvalues-Post-Customs Union, k=11, (0.228, 0.183, 0.153, 0.114, 0.105, 0.044).

Table 9. Johansen tests for cointegration among stock changes of Group 2 countries and Turkey (January, 1988 to August, 2008), constant mean model [a-c].

H_0	Whole period		Pre-customs union		Post-costoms union		CV (5%)
	(k=2)	(k=11)	(k=2)	(k=11)	(k=2)	(k=11)	
r=0	38.75	48.63	43.98	70.16	44.74	57.57	47.21
r≤1	20.74	18.58	18.85	33.83	22.00	24.83	29.68
r≤2	5.30	4.72	7.54	13.67	6.59	10.99	15.41
r≤3	0.69	0.00	2.24	0.03	0.22	2.25	3.76

[a]Critical values are from Osterwald-Lenum (1992); [b]k refers to number of lags in the VAR; [c]Eigenvalues-Whole Period, k=2, (0.071, 0.061, 0.019, 0.003), Eigenvalues Whole Period, k=11, (0.119, 0.057, 0.020, 0.000); Eigenvalues-Pre-Customs Union k=2, (0.235, 0.113, 0.055, 0.024), Eigenvalues-Pre-Customs Union, k=11, (0.348, 0.211, 0.148, 0.000); Eigenvalues-Post-Costoms Union k=2, (0.139, 0.096, 0.041, 0.002), Eigenvalues-Post-Customs Union, k=11, (0.194, 0.087, 0.056, 0.015).

Table 10. Johansen tests for cointegration among stock changes of Group 2 countries and Turkey (January, 1988 to August, 2008), constant mean and a deterministic linear trend model [a-c].

H_0	Whole period		Pre-customs union		Post-costoms union		CV (5%)
	(k=2)	(k=11)	(k=2)	(k=11)	(k=2)	(k=11)	
r=0	52.56	69.11	73.34	96.72	53.51	76.44	63.00
r≤1	27.60	30.61	31.02	57.04	29.03	43.69	42.44
r≤2	11.77	16.03	14.94	22.15	10.97	16.11	25.32
r≤3	1.47	3.20	4.82	6.53	3.95	6.69	12.25

[a]Critical values are from Osterwald-Lenum (1992); [b]k refers to number of lags in the VAR; [c]Eigenvalues-Whole Period, k=2, (0.097, 0.062, 0.041, 0.006), Eigenvalues Whole Period, k=11, (0.150, 0.060, 0.053, 0.013); Eigenvalues-Pre-Customs Union k=2, (0.363, 0.157, 0.102, 0.050), Eigenvalues-Pre-Customs Union, k=11, (0.373, 0.337, 0.168, 0.074); Eigenvalues-Post-Costoms Union k=2, (0.149, 0.112, 0.045, 0.026), Eigenvalues-Post-Customs Union, k=11, (0.194, 0.166, 0.060, 0.043).

and post-costoms union period but it is 1 for the post-union period. Since in Group 2 there are 4 countries including Turkey, this means that there are 4 common stochastic trends for the whole period and post-costoms union period and 3 for pre-costoms union period. On the other hand, when k=11, numbers of cointegrating equations are 1, 2 and 2 for whole period, pre-costom union period and post-costom union period, respectively.

Table 11. Johansen tests for cointegration among stock exchanges of Group 3 countries and Turkey (January, 1988 to August, 2008), constant mean model [a-c].

H_0	Whole period		Pre-customs union		Post-costoms union		CV (5%)
	(k=2)	(k=11)	(k=2)	(k=11)	(k=2)	(k=11)	
r=0	55.75	52.00	68.13	62.78	47.69	40.31	47.21
r≤1	23.29	26.59	38.02	39.77	20.54	19.26	29.68
r≤2	5.91	10.47	18.19	20.95	3.86	7.29	15.41
r≤3	0.00	0.06	2.37	6.09	0.94	0.03	3.76

[a]Critical values are from Osterwald-Lenum (1992); [b]k refers to number of lags in the VAR; [c]Eigenvalues-Whole Period, k=2, (0.124, 0.068, 0.024, 0.000), Eigenvalues Whole Period, k=11, (0.102, 0.066, 0.043, 0.000); Eigenvalues-Pre-Customs Union k=2, (0.274, 0.190, 0.155, 0.025), Eigenvalues-Pre-Customs Union, k=11, (0.237, 0.199, 0.160, 0.069); Eigenvalues-Post-Costoms Union k=2, (0.164, 0.104, 0.019, 0.006), Eigenvalues-Post-Customs Union, k=11, (0.129, 0.076, 0.047, 0.000).

Table 12. Johansen tests for cointegration among stock exchanges of Group 3 countries and Turkey (January, 1988 to August, 2008), constant mean and a deterministic linear trend model [a-c].

H_0	Whole period		Pre-customs union		Post-costoms union		CV (5%)
	(k=2)	(k=11)	(k=2)	(k=11)	(k=2)	(k=11)	
r=0	69.57	69.50	68.66	84.92	85.70	62.79	62.99
r≤1	34.45	38.09	38.48	49.75	45.81	36.26	42.44
r≤2	17.01	21.69	18.31	30.16	18.98	18.21	25.32
r≤3	5.57	9.62	2.37	11.40	2.64	6.90	12.25

[a]Critical values are from Osterwald-Lenum (1992); [b]k refers to number of lags in the VAR; [c]Eigenvalues-Whole Period, k=2, (0.133, 0.068, 0.046, 0.022), Eigenvalues Whole Period, k=11, (0.124, 0.067, 0.050, 0.040); Eigenvalues-Pre-Customs Union k=2, (0.275, 0.193, 0.156, 0.025), Eigenvalues-Pre-Customs Union, k=11, (0.339, 0.206, 0.198, 0.126); Eigenvalues-Post-Costoms Union k=2, (0.231, 0.162, 0.102, 0.017), Eigenvalues-Post-Customs Union, k=11, (0.160, 0.112, 0.072, 0.044).

This means that there are 3, 2 and 2 common stochastic trends for the whole period, pre-costom union period and post costoms union period, respectively.For these two cases, again there is stronger evidence against the null hypothesis when k=11. The numbers of cointegrating equations are higher when k=11. Again from the above two cases one can note that there is some evidence that customs union have an increasing effect on the number of common stochastic trends. When pre and post costoms union periods are compared, it can be seen that numbers of common stochastic trends either stay constant or increase except for the case of constant mean model when k=11. This result may indicate that customs union did not increase the possibility of diversification.From Table 11, it can be seen that for constant mean model when k=2, numbers of cointegrating equations are 1 for whole period, 3 for pre-costom union period and 1 for post-costom union period. Since in Group 3 there are 4 countries including Turkey, this means that there are 3 common stochastic trends for the whole period, 1 for the pre-costom union period and 3 for the post costoms union period. On the other hand, when k=11, numbers of cointegrating equations are 1 for whole period, 4 for pre-costom union period and none for post-costom union period. This means that there are 3 common stochastic trends for the whole period, none for the pre-costom union period and 4 for the post costoms union period.From Table 12, it can be seen that for constant mean and a deterministic linear trend model when k=2, numbers of cointegrating equations are 1 for whole period and pre-costom union period and 2 for post-costom union period. Since in Group 3 there are 4 countries including Turkey, this means that there are 3 common stochastic trends for the whole period and the pre-costom union period and 2 for the post costoms union period.

On the other hand, when k=11, numbers of cointegrating equations are 1 for whole period, 2 for pre-costom union period and none for post-costom union period. This means that there are 3 common stochastic trends for the whole period, 2 for the pre-costom union period and 4 for the post costoms union period.For these two cases, this time, stronger evidence against the null hypothesis when k=11 can not be found.

The numbers of cointegrating equations are not absolutely higher when k=11. However, again from the above two cases one can note that there is some evidence that costoms union have an increasing effect on the number of common stochastic trends. When pre and post costoms union periods are compared, it can be seen that numbers of common stochastic trends either stay constant or increase except for the case of constant

Table 13. Johansen tests for cointegration among stock exchanges of Group 4 and Turkey (January, 1988 to August, 2008), constant mean model [a-c].

H_0	Whole period		Pre-customs union		Post-costoms union		CV (5%)
	(k=2)	(k=11)	(k=2)	(k=11)	(k=2)	(k=11)	
r=0	35.44	54.92	41.45	80.68	40.33	41.02	47.21
r≤1	14.10	20.36	15.40	36.68	13.17	14.99	29.68
r≤2	2.33	4.66	4.90	10.54	5.81	3.81	15.41
r≤3	0.55	0.02	0.81	0.13	0.04	0.08	3.76

[a]Critical values are from Osterwald-Lenum (1992); [b]k refers to number of lags in the VAR; [c]Eigenvalues-Whole Period, k=2, (0.083, 0.047, 0.007, 0.002), Eigenvalues Whole Period, k=11, (0.136, 0.064, 0.019, 0.000); Eigenvalues-Pre-Customs Union k=2, (0.242, 0.106, 0.043, 0.009), Eigenvalues-Pre-Customs Union, k=11, (0.404, 0.265, 0.115, 0.002); Eigenvalues-Post-Costoms Union k=2, (0.164, 0.047, 0.037, 0.000), Eigenvalues-Post-Customs Union, k=11, (0.157, 0.071, 0.024, 0.001).

Table 14. Johansen tests for cointegration among stock exchanges of Group 4 countries and Turkey (January, 1988 to August, 2008), constant mean and adeterministic linear trend model [a-c].

H_0	Whole period		Pre-customs union		Post-costoms union		CV (5%)
	(k=2)	(k=11)	(k=2)	(k=11)	(k=2)	(k=11)	
r=0	43.22	70.70	67.21	126.95	65.78	61.71	62.99
r≤1	19.18	31.16	39.68	59.11	35.20	35.64	42.44
r≤2	7.23	14.88	13.87	32.72	13.03	14.28	25.32
r≤3	1.78	4.48	4.02	10.30	5.77	3.54	12.25

[a]Critical values are from Osterwald-Lenum (1992); [b]k refers to number of lags in the VAR; [c]Eigenvalues-Whole Period, k=2, (0.093, 0.047, 0.022, 0.007), Eigenvalues Whole Period, k=11, (0.154, 0.066, 0.043, 0.019); Eigenvalues-Pre-Customs Union k=2, (0.254, 0.240, 0.099, 0.042), Eigenvalues-Pre-Customs Union, k=11, (0.550, 0.267, 0.232, 0.114); Eigenvalues-Post-Costoms Union k=2, (0.182, 0.136, 0.047, 0.037), Eigenvalues-Post-Customs Union, k=11, (0.158, 0.131, 0.068, 0.023).

mean and a deterministic linear trend model when k=2. This result may indicate that customs union did not increase the possibility of diversification.

From Table 13, it can be seen that for constant mean model when k=2, numbers of cointegrating equations are none for all of the periods. Since in Group 3 there are 4 countries including Turkey, this means that there are 4 common stochastic trends for all of the periods. On the other hand, when k=11, numbers of cointegrating equations are 1 for whole period, 2 for pre-costom union period and none for post-costom union period. This means that there are 3 common stochastic trends for the whole period, 2 for the pre-costom union period and 4 for the post costoms union period.

From Table 14, it can be seen that for constant mean and a deterministic linear trend model when k=2, numbers of cointegrating equations are none for whole period and 1 for both pre and post costom union period. Since in Group 3 there are 4 countries including Turkey, this means that there are 4 common stochastic trends for the whole period and 3 for the pre and post costom union periods. On the other hand, when k=11, numbers of cointegrating equations are 1 for whole period, 3 for pre-costom union period and none for post-costom union period. This means that there are 3 common stochastic trends for the whole period, 1 for the pre-costom union period and 4 for the post costoms union period.

For these two cases, again there is stronger evidence against the null hypothesis when k=11. The numbers of cointegrating equations are higher when k=11. Again from the afore two cases, one can note that there is some evidence that costoms union have an increasing effect on the number of common stochastic trends. When pre and post costoms union periods are compared, it can be seen that numbers of common stochastic trends either stay constant or increase. This result may indicate that customs union did not increase the possibility of diversification.

Conclusion

This paper initially presents the correlation coefficients between the returns of the fourteen EU member countries and Turkey which is a country on the way to be a member. The correlation coefficients of EU member countries are higher, compared to Turkey, except for Finland and Greece. This initial analysis may indicate that Turkish stock market may have a diversification effect. However, this is misleading if long term decisions are to

be taken. Correlation coefficients can give some ideas only for short term decisions. When long term decisions are the concern, existance of common trends should be investigated. For this reason, the paper continues to test for common trends by using the methodology of Johansen (1988) and Johansen and Juselius (1990). Test results show that although there are some few exceptional cases, mostly, common trends exists. These results imply that investors with long holding periods can not diversify their portfolios by including Turkish stock market. This result is consistent with the results of Oztek and Ocal (2011). However, one objection to this conclusion may be the possibility of deviation from the common trends for some period of time. Therefore, an extension of this paper can be to inspect the existence of such deviations from the common trends and if there are deviations, to measure the persistence of these deviations.

The formation of customs union between EU member countries and Turkey in 1996 is an important point in time. For this reason, the paper also analyses whether this formation increased the number of common trends or not. Results show that although there are a few exceptional cases most of the time formation of customs union had an incresing effect on the number of common trends.

Finally, the results show that there is stronger evidence against the null hypothesis of no common trend when the lag order is chosen higher while forming the model. This result is consistent with the results of Kasa (1992).

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