

Analyzing Integration between Stock Market of Turkey and G8 Nations with Maki Cointegration Test

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Abstract

In this study, long-term relationship between Turkey and G8 countries which represent 65% of the world economy is examined by Kapetanios (2002) unit root test and Maki (2012) cointegration test that allow more than two breaks and structural breaks can be determined as endogenous. Furthermore, before unit root and cointegration tests, all series are concluded as linear by Harvey et al. (2008) linearity test. As a conclusion, while each stock market of US, UK, Japan, and France are cointegrated in long-term with BIST (Istanbul Stock Market), stock markets of Germany and Canada are not cointegrated with BIST for this study, in the interval period from Nov 1990 to Dec 2012. So, an investor deciding to make portfolio diversification, can both decrease risk and increase income by investing on Germany or Canada stock markets together with BIST.

JEL classification numbers: G11, G15, F36

Keywords: International Portfolio Diversification, Financial Integration, Linearity Test, Unit Root Test, Cointegration Test

1 Introduction

The most significant innovation which is brought by the modern portfolio theory revealed by Harry Markowitz in 1952 is the correlation between the assets in portfolio as the most important factor affecting the portfolio risk, which means that the returns change together. It can be possible by considering correlation and choosing highly negatively correlated assets (Brealey et al., 2003: 245) rather than positively correlated ones (Saraç, 2013: 81). The existence of strong integration between capital markets triggers spillover effect among countries. Any economic shocks occurred in a country can easily spread in markets cointegrated with each other (Bozoklu and Saydam, 2010: 417).

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As the possibility to make portfolio diversification is increasing by developing technology and computer age (Korhonen and Peresetsky, 2013: 5), integration between markets is also increased (Lafuente and Ordonezi 2007: 3). Following these effects, in the last 20 years, the importance of integrated economic structures like EU, OECD, NAFTA, EMU has risen. (Canarella et al, 2009: 2). For example; Negative effects of this integration were observed on spreading with domino effect of mortgage crisis through all around the world in 2008.

Within the scope of our study, the integration between Turkey and G8 countries which are leading world economy will be investigated. At the first step, the literature study has been carried out, then results of linearity, unit root and cointegration tests are presented in this study.

2 Literature Review

In his study, Fahami (2011) made Johansen cointegration test in order to analyze the relationship among BRIC countries, Japan, US and UK stock markets by splitting the data set into two periods: before and after global financial crisis in 2008. As a result of the study, despite of the developing BRIC countries, US stock market was leading the world economy. Babecky et al. (2012), investigated Russia and China which are among G8 countries, and they found cointegration relationship between these two countries by the study spanning from Sep 1995 till Nov 2010. In order to determine the cointegrating degree of US and BRIC stock markets, An and Brown (2010) made Johansen cointegration test and found significant relationship between stock markets of US and China.

In their study, Canarella et al. (2009) investigated Germany, France, Holland, Ireland and UK between Jan 1992 and Dec 2007, and they observed long-term cointegration between US and Mexico. Chang and Tzeng (2009) examined the stock markets of US and its four major trade partners with nonparametric Bierens cointegration test and found US stock market was not cointegrated with these stock markets in the long-run.

Caporale et al. (2009) analyzed Germany, France, Holland, Ireland and UK with the data set spanning the years between 1973 and 2008, and determined long-term cointegration among these five countries. Fadhlouli et al. (2008) investigated G7 countries through the period between Oct 2000 and Oct 2006. There was no relationship observed as a conclusion. Lafuente and Ordonez (2007) made time varying cointegration test into their study investigating Germany, Spain, Italy and UK. In the study cointegration relationship was occurred in specific periods between the years 1993 and 2004.

In the literature on BIST; Sarıkamış and Düzakın (2013) researched the long-run relationship between Turkey and Eurasian countries in their study. While Turkey and Egypt stock markets were concluded as cointegrated in the long-run, each of United Arab Emirates, Bahrain, Bulgaria, Croatia, Kazakhstan, Pakistan, Romania and Jordan stock markets were not cointegrated with Turkey. Armeanu et al. (2013) in their study considered that Turkey remained unaffected from 2008 crisis and in parallel had a successful stock market. Within this scope, they analyzed long-term relationship between Turkey and Romania stock markets. According to study spanning daily data from Oct 2011 to Oct 2012, two country stock markets were not cointegrated. However, Bozoklu and Saydam (2010) examined relationship between Turkey and BRIC countries with the help of Johansen and Bierens cointegration tests which show linear and nonlinear

cointegration, respectively. In order to determine the integration between stock markets of Turkey and European countries, Boztosun and Çelik (2011) used Johansen cointegration test. As a result of the research, while Norway, the Netherlands, Belgium, Germany and UK were cointegrated with BIST; where France, Austria, Switzerland, Sweden and Spain were not.

Guidi (2012) investigated the long-term relationship between India and developed countries of Asia owing to Gregory-Hansen's cointegration test with one break in his study. According to Gregory-Hansen cointegration test, long-term relationship was identified between these countries, while there was no cointegration according to Johansen cointegration test. Yılcı and Öztürk (2010) analyzed cointegration between stock markets of BIST100 and each FTSE100, SP500 and AEX by Hatemi-J cointegration test. In their study, model with two breaks was exploited and financial crises in 1997 and 2008 were taken into account. As a result, no cointegration was observed.

In his study, Onour (2009) analyzed the long-term relationship between Egypt, Morocco and Tunisia which were North African countries, by the aid of nonlinear cointegration test. As a result of the study spanning years between 2002 and 2006, stock markets of these three countries were cointegrated. Huang et al. (2000) used Gregory-Hansen (1996) cointegration test with one break in their study spanning the period Jan 1992 - Jun 1997. As a result, China and Hong Kong stock markets were seen integrated in the long-run. Chang and Lu (2006) researched stock markets of Shanghai and Shenzhen according to Phillips-Quliaris (1990) and nonparametric Bierens (1997) cointegration approaches. Contrary to Johansen test, there was no cointegration between these two markets.

3 Model

Due to using predetermined structural break number, Maki (2012) criticized Gregory-Hansen (1996) with one break and Hatemi-J (2008) with two breaks cointegration tests, and put forward cointegration test whose structural breaks can be determined internally. According to this model, main hypothesis is non-existence of cointegration between variables, the alternative hypothesis is existence of cointegration with structural break whose number is determined by the model. One of the following four models must be selected;

$$y_t = \mu + \sum^k \mu_i D_{i,t} + \beta' x_t + u_t \quad (1)$$

$$y_t = \mu + \sum_{i=1}^k \mu_i D_{i,t} + \beta' x_t + \sum_{i=1}^k \beta' x_t D_{i,t} + u_t \quad (2)$$

$$y_t = \mu + \sum_{i=1}^k \mu_i D_{i,t} + \gamma t + \beta' x_t + \sum_{i=1}^k \beta' x_t D_{i,t} + u_t \quad (3)$$

$$y_t = \mu + \sum_{i=1}^k \mu_i D_{i,t} + \gamma t + \sum_{i=1}^k \gamma_i t D_{i,t} + \beta' x_t + \sum_{i=1}^k \beta' x_t D_{i,t} + u_t \quad (4)$$

We will use model 4 which lets us change in level, trend and independent variables. Maki cointegration test which shows similar features in Kapetanios test is as follows; first, the chosen model is estimated for all possible structural breaks, and the test statistics of unit root test applied to residuals are reached. Secondly, model having the smallest sum of squares of residuals inside the chosen models is determined as the first break point. After addition of first structural break into the model, examination continues for second, third and larger number of structural breaks with the permission of investigator. The number of

structural breaks which has the smallest T statistics between predicted models is chosen suitable number of structural breaks. (Yılancı, 2013)

4 Data

In our study, six of G8 countries which represent 65% of the world economy are investigated. The data of US Stock Market (S&P), Germany Stock Market (DAX), France Stock Market (CAC), Japan Stock market (NIKKEI), UK Stock Market (FTSE), Canada Stock Market (TSX) and Turkey Stock Market (BIST) are provided from www.ukfinance.yahoo.com The analysis period spans from Nov 1990 till Dec 2012.

During the calculation of stock returns, logarithmic differences are taken. The most important feature of stock returns calculation by this way is that the volatility of calculated returns are quiet small. (Assogbavi, 2007). This calculation is made by following formula:

$$\Delta Ft = \ln(Ft / Ft - 1)$$

5 Empirical Results

In order to decide which unit root test must be benefited, we will investigate linearity of series by Harvey et al. (2008) linearity test. As shown in Table.1 main hypothesis is accepted in series of all countries. So, all series are linear and this situation shows that they are at weak-form efficient markets. Moreover, Linear unit root and cointegration tests must be used.

Table 1: Harvey Linearity Test Results

Market	W-Lam	W %10	W % 5	W % 1
Turkey	0.96	5.06	5.07	5.09
Germany	4.96	7.26	7.27	7.29
US	1.52	6.19	6.20	6.22
France	5.59	8.66	8.69	8.73
UK	4.81	5.96	5.97	5.98
Japan	1.13	5.63	5.64	5.66
Canada	2.28	16.41	16.43	16.47

In investigation of the cointegration relationship between variables used in study, determining stability degree of variables is important for model choosing. Because in this study, Kapetanios (2002) unit root test which removes the internally determination of break number is used instead of Augmented Dickey and Fuller (1979) (ADF), Phillips and Perron (1988) (PP) and Kwiatkowski et al. (1992) (KPSS) which do not take into account structural breaks, Zivot Andrews (1992) with one break, Lumsdaine-Papell (1997) and Lee & Strazicich (2003) with two breaks unit root tests.

According to Kapetanios (2002) unit root test, after calculation of T values for all breaks, series are determined whether they have unit root by the break with the smallest T value. Results of Kapetanios unit roots test are shown below. According to these results, model

with one break is suitable for all countries except Canada. For Canada, model with five breaks for nonstationary level values is suitable. For their first differences model with one structural break is suitable for all countries. Turkey, US, UK, Japan and France stock markets are stationary at level, whereas Germany and Canada stock markets are first difference stationary. The structural breaks in Turkey are coincided with the period May 2000 when twin crises happened. Breaks of US, UK and France happened after financial crisis of Asia and in the period of Nov 1999, Feb 2000 and Dec 2000, respectively. Structural breaks belong to US and Canada are also coincided with similar period and happened in Jul 1991 and Oct 1992. The break of Japan is occurred in May 2007 before 2008 global financial crisis. As a result of Kapetanios Unit root test results, We can't say that Germany and Canada's series satisfy the necessary conditions for cointegration.

Table 2: Kapetanios Unit Root Test Results

Breaks	Turkey	Germany (Level)	Germany (1st dif.)	US	UK	Japan	France	Canada (Level)	Canada (1st dif.)
5	-8.52*	-16.2*	-7.4*	-17.2*	-13.6*	-9.3*	-15,7*	-1.16	-10.3*
4	-7.92*	-8.6*	-7.2*	-17.0*	-13.3*	-9,0*	-15,6*	-1,45	-10.0*
3	-7.22*	-6.2	-6.9*	-16.6*	-13.0*	-8.4*	-15,5*	-1,45	-9,8*
2	-6.73*	-5.1	-6.8*	-15.8*	-12,7*	-8.0*	-15,3*	-14.0*	-9,34*
1	-5,96*	-3.9	-6.6*	-15.1*	-7,63*	-7,5*	-5,1*	-13,7*	-9,2*

Note: Critical Values: 5 Breaks: -8.34; 4: Breaks: -7.73; 3 Breaks: -7.00; 2 Breaks: -6.11; 1 Break: -5.08, taking from study named Kapetanios (2002) "Unit-Root Testing Against The Alternative Hypothesis Of Up To M Structural Breaks"; * indicates at 5% level of significance.

In our study, same as with Kapetanios (2002) unit root test, in order to search for the long term integration between stock markets, Maki (2012) cointegration test which asserts that structural breaks cannot be determined previously, is used rather than Johansen (1992) cointegration test which does not take structural breaks into account, Gregory-Hansen (1996) with one break and Hatemi-J (2008) with two breaks. By this test, number of structural breaks is determined according to structure of series endogenously by the model.

Table 3: Maki Cointegration Test Results

	Test Statistic	Critical Value	Result	Break Dates
Turkey-US	-9.68	-6.52	Cointegration exists	Dec-1993; Jun-1998; Dec-1999
Turkey-UK	-10.12	-7.41	Cointegration exists	Dec-1993; Mar-1995; Sep 1997; Nov 1999; Mar-2001
Turkey-Japan	-9.67	-7.00	Cointegration exists	Dec-1993; Feb-1995; Feb-1998; Dec 1999
Turkey-France	-9.39	-7.00	Cointegration exists	Dec-1993; Mar-1995; Sep 1997; Nov-1999

Note: Critical Values are taken from study named Maki, D. (2012) "Tests for cointegration allowing for an unknown number of breaks".

According to Maki cointegration test results which allows more than 2 structural breaks, while Istanbul Stock Market has long-run integrated structure with US, UK, Japan and France stock markets and with this respect an investor makes an investment in Turkey, should invest on Germany or Canada stock markets in order to do portfolio diversification. Through Maki cointegration test, reflection of endogenously determined

structural breaks upon 94 Economic Crisis and 2000 twin crises is seen in Turkey. Besides, model with 3 structural breaks between Istanbul Stock Market and US, 4 structural breaks with Japan and France stock markets, 5 structural breaks with UK is considered suitable while doing cointegration tests.

6 Conclusions

In this study spanning the period Nov-1990 till Dec-2012, six of G8 countries consisting US, UK, Japan, France, Germany and Canada are investigated whether they are integrated with Istanbul Stock Market in the long-run.

Compared with the studies in literature; by Johansen (1992) cointegration test with no structural breaks, Boztosun and Çelik (2011) have not found long-run cointegration between Turkey and France. Yet, they observed integration between Turkey and Germany stock markets. Yılcıncı and Öztürk (2010) have concluded their study as no relationship between Istanbul Stock Market and both US and UK by using Hatemi J (2008) cointegration test. Besides, Fadhlouli et al. (2008) researched G7 countries in their study and result of Johansen (1992) cointegration test, they found no cointegration between stock markets of G7 countries.

In our study, Maki cointegration test which does not allow predetermined breaks and do allow more than two breaks in studies investigating long-terms, is used and compared with aforementioned studies cointegration between Turkey and these countries stock markets has been found. Maki (2012) cointegration test which has advantages like allowance much more breaks and determination of break internally by model, has different results.

A professional investor, who wants to invest on different stock markets at international level, will definitely examine the integration between these markets and will want to invest different markets whose has no cointegration in long-run. By this way, one will do portfolio diversification, decrease investment risk and increase its income. According to the results of this study, a person who invests in Istanbul Stock Market, can do portfolio diversification by investing in Germany and Canada Stock Markets in order to decrease the risk.

References

- [1] Armenau, D.; Doia, C.A.; Hancila, M.; Cioaca, S., , The Analysis of the Correlation Intensity Between Emerging Market During Economic Crisis, *Romanian Statistical Review Supplement*, **61**(2), pp. 307-318 (2013)
- [2] An, L., Brown, Dean, Equity Market Integration between the US and BRIC Countries: Evidence from Unit Root and Cointegration Test, *Research Journal of International Studies* – (16), (2010)
- [3] Assogbavi, T., , Equity Price-Volume Relationship on the Russian Stock Exchange, *International Business & Economic Research Journal*, **6**, pp. 107-116 (2007)
- [4] Babecký, J. ;Komárek, L.; Komárková, Z. Integration of Chinese and Russian Stock Markets with World Markets: National and Sectoral Perspectives, *BOFIT- Institute for Economies in Transition Bank of Finland Discussion Papers* **4**, (2012)

- [5] Ben-David, D.; Lumsdaine, R.L.; Papell; D.H., Unit Roots, Postwar Slowdowns and Long-Run Growth: Evidence from Two Structural Breaks, *Empirical Economics*, **28**(2), pp. 303- 319. (2003)
- [6] Berben, R.P.; Jansen, W.J., Bond Market and Stock Market Integration in Europe: A Smooth Transition Approach, *Applied Economics*, **41**:24, pp. 3067-3080,
- [7] Bierens, H. J. 1997, Nonparametric Cointegration Analysis, *Journal of Econometrics*, **77**, pp. 379-404, (2009)
- [8] Brealey, R.A.; Myers, S.T.; Marcus, A.J.; İşletme Finansının Temelleri, Çeviri: Ünal Bozkurt, Türkan Arıkan, Hatice Doğukanlı, *Literatür Yayıncılık*, (1997)
- [9] Bozoklu, Ş.; Saydam, İ.M., BRIC Ülkeleri ve Türkiye Arasındaki Sermaye Piyasaları Entegrasyonunun Parametrik ve Parametrik Olmayan Eşbütünlüşme Testleri ile Analizi”, *Maliye Dergisi*, Sayı: **159**, Temmuz-Aralık, (2010)
- [10] Boztosun, D., Çelik, T., Cointegration Analysis of Turkish Stock Exchange With European Stock Exchanges, *Süleyman Demirel University The Journal of Faculty of Economics and Administrative Sciences*, **16**(1) pp.147-162 (2011)
- [11] Canarella, G.; Miller, S.P.; Pollard, S.K., Dynamic Stock Market Interactions between the Canadian, Mexican, and the United States Markets: The NAFTA Experience, *Nova Science Publishers* (2009)
- [12] Caporale, G.M.; Erdogan, B., Kuzin, V., Testing for Convergence in Stock Markets: A Non-Linear Factor Approach, *Cesifo Working Paper* No. 2845 Category 7: Monetary Policy and International Finance (2009)
- [13] Chang, T. ve Lu; Y.C., Equity Diversification in Two Chinese Share Markets: Old Wine and New Bottle, *Economics Bulletin*, **7**(4), pp. 1-7 (2006)
- [14] Chang, T.; Tzeng, H.W., International Equity Diversification Between the United States and its Major Trading Partners: Nonparametric Cointegration Test, *International Research Journal of Finance and Economics*, **32**, pp. 139-147 (2009)
- [15] Dickey, D.A., Fuller, W.A., , Distribution of the estimators for autoregressive time series with a unit root, *Journal of the American Statistical Society*, **75**, pp. 427–431 (1979)
- [16] Fadhlouia, K.; Bellalahb, M.; Dherry, A.; Zouaouil, M., An Empirical Examination of International Diversification Benefits in Central European Emerging Equity Markets, *International Journal of Business*, **13**(4) (2008)
- [17] Fahami, N.A., The Structure of Linkages and Causal Relationships Between BRIC and Developed Equity Markets, *International Conference on Information and Finance*, Singapoure, (2011)
- [18] Gregory, A. W.; Hansen, B. E., Residual-Based Tests for Cointegration in Models with Regime Shifts, *Journal of Econometrics*, **70**, pp. 99-126, (1996)
- [19] Guidi, F., Cointegration Relationship and Time Varying Co-Movements among Indian and Asian Developed Stock Markets, *International Review of Financial Analysis*, **21**, pp. 10–22 (2012)
- [20] Harvey, D.I.; Leybourne, S.J.; Xiao, B.; , A Powerful Test for Linearity When the Order of Integration is Unknown, *Regime-Switching Models In Economics and Finance*, **12**(3) (2008).
- [21] Hatemi-J, A., , Tests for Cointegration with Two Unknown Regime Shifts with an Application to Financial Market Integration”, *Empirical Economics*, **35**(3), pp. 497-505 (2008)

- [22] Huang, B.N.; Yang, C.W.; Hu, J.W., Causality and cointegration of stock markets among the United States, Japan, and the South China Growth Triangle, *International Review of Financial Analysis* **9**:3, pp. 281-297 (2000)
- [23] Kapetanios, G., Unit-Root Testing Against The Alternative Hypothesis Of Up To M Structural Breaks, *U of London Queen Mary Economics Working Paper* No. 469 (2002)
- [24] Korhonen, I.; Peretesky, A., What Determines Stock Market Behavior in Russia Aand Other Emerging Countries?, *BOFIT- Institute for Economies in Transition Bank of Finland Discussion* **4** (2013)
- [25] Kwiatkowski, D., Phillips, P.C.B., Schmidt, P., Shin, Y., Testing The Null Hypothesis of Stationary Against The Alternative of a Unit Root, *Journal of Econometrics* **54**, pp. 159–178 (1992)
- [26] Lafuente, J.A.; Ordóñez, J., The Effect Of The Emu On Short And Long-Run Stock Market Dynamics: New Evidence On Financial Integration, *International Journal of Financial Markets and Derivatives*, **1**(1), pp. 75-95 (2007)
- [27] Lee, J.; Strazicich, M.C., Minimum Lagrange Multiplier Unit Root Test With Two Structural Breaks, *The Review of Economics and Statistics*, **85**(4), pp. 1082-1089 (2003)
- [28] Maki, D., “Tests for Cointegration Allowing for an Unknown Number of Breaks”, *Economic Modelling*, **29**, pp. 2011–2015 (2012)
- [29] Onour, I., Financial Integration of North Africa Stock Markets, *API-Working Paper Series 0908*, Arab Planning Institute - Kuwait, Information Center, 2009
- [30] Phillips, P. C. B.; Ouliaris, S., Asymptotic Properties of Residual Based Tests for Cointegration, *Econometrica* **58**, pp. 165–193 (1990)
- [31] Phillips, P.C.B., Perron, P., Testing for a unit root in time series regressions, *Biometrika*, **75**, pp. 335–346. (1988)
- [32] Saraç, M., Finansal Yönetim, **1**. Baskı, *Sakarya Kitabevi*, (2013)
- [33] Sarıkamış, M.C., Düzakın, H., İstanbul Menkul Kıymetler Borsasının Avrasya Borsaları ile Entegrasyonu, *Akademik Bakış Dergisi* Sayı: **35** Mart – Nisan, (2013)
- [34] Yılcı, V.; Öztürk, Z.A., Türkiye ile En Büyük Beş Büyük Ticaret Ortağının Hisse Senedi Piyasaları Arasındaki Entegrasyon İlişkisinin Analizi: Yapısal Kırılmalı Birim Kök ve Eşbütünleşme Analizi, *Erciyes Üniversitesi İİBF Dergisi*, **36**, sf.. 261 - 279 ,Issn:1301–3688 , (2010)
- [35] Yılcı, V., “Financial Econometrics Education is given by Associate Professor Veli Yılcı in 1-5 June 2013 in Sakarya University” (2013)
- [36] Zivot, Eric ve Andrews, D. W. K., “Further Evidence on the Great Crash, the Oil-Price Shock, and the Unit-Root Hypothesis”, *Journal of Business & Economic Statistics*, **10**(3), pp. 251-270. (1992)
- [37] www.ukfinance.yahoo.com