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Comovements of Stock Markets between Turkey and Global Countries

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Abstract

This paper presents empirical evidence on the dynamic structure of the correlations of the Turkish stock market with other national markets. Both conditional and unconditional correlations are analyzed. Linkages at the aggregate level are found to be time-varying, showing some transitional changes. In the analysis of the dynamics behind the transitional changes, the evidence indicates that the TED spread appears to be the most dominant factor contributing to the stock market comovements between Turkey and other global markets.

1. Introduction

The integration of global stock markets has grown rapidly over the past two decades, stimulated by deregulation and financial liberalization, especially in the emerging markets. This integration process brings out two issues addressed in the literature. The first issue is the measure of market integration. Literature suggest that an increase in integration leads to diminished benefits for investors who seek diversification through international investments. The second issue involves empirical studies of risk spillovers with financial contagion. It has been recognized that the convergence from market integration implies a higher possibility of volatility transmission since a shock in one country will lead investors to re-assess the risk of their portfolios in other countries. No matter which issue researchers focus on, the empirical evidence on the degree of integration is bound to provide a better understanding of the dynamic behavior across market/country investments.

In light of the above observations, this study conducts an empirical investigation to explore the dynamic correlations between Turkey and its trading countries. This research is parallel to the study by Chiang et al. (2016), who examine the dynamic correlations between Chinese stock returns and global markets. However, our study is unique compared with studies in the existing literature. First, focusing on the Turkish market allows us to highlight the time-varying correlations between an emerging market and the global markets. The estimated results will help us to gain more insights into Turkish investors' behavior when their trading interacts with a variety of countries characterized by conditions that are different in institutional structures and cultural backgrounds, rather than an arbitrary pairing of an emerging market with an advanced market (Uğur and Guidi 2014; Samarakoon 2011, Syriopoulos 2011, Çelik 2012).

The second special feature of this study is its insight concerning the reasons behind dynamic correlations. Although the evidence shows that the dynamic correlation coefficients of stock returns show structural changes and may possibly be fitted to a smooth transition model, it still lacks information pertinent to explain why the conditional correlation coefficients are time-varying. To determine what factors can be responsible for this time-varying relation we also repeat the analysis at sectoral level.[1] Looking at the sectoral level provides us with information on the microstructure of stock return linkages, which allows us to detect which channel appears to be more significant in explaining spillover risk across countries. Thus, the finding will help us to identify the key sector responsible for transmitting risk across markets, that is, the contagion effect. Since the results show that the finance-related sectors show the highest correlations with foreign countries, it is reasonable to focus on the factors that significantly measure the uncertainty of global financial markets.

Although numerous studies have been devoted to market integration, empirical studies on the Turkish market and its interactions with global markets have not received enough attention. This study will focus on the Turkish market for a number of reasons. First, Turkey began its liberalization in the 1980s, encouraging foreign trades and profit transfers. At the beginning of the 2000s, following a banking crisis, the Turkish government implemented a series of banking reforms, adopting risk management rules commonly used in the global banking system. It is of interest to investigate how the stock market’s behavior evolved over time in response to the ongoing shocks after connecting to the global markets.

Second, since Turkey is a prospective country for membership in the EU, and it has adopted several major reform policies, including macroeconomic stabilization and restructuring and privatizing state-owned corporations. Under this scenario, Turkey’s stock market has been structured to gradually connect not only with European countries but also with other nearby economies. The empirical evidence will provide more updated information about its dynamic adaptation to a more mature financial system.

Third, with its recent vigorous progress in economic and financial markets, Turkish stocks can be viewed as valuable assets to be absorbed into the portfolios of investors seeking international diversification. Figure 1 shows that prices in the Turkish stock market have increased substantially over time, and its performance has been more impressive compared with those of the other countries under consideration. The pattern of Turkish market prices suggests that combining Turkish stocks with the stock of other foreign countries can form a portfolio that achieves investment diversification in the post-financial-crisis period. Moreover, the Turkish market also shows a faster rate of price appreciation, so it offers an opportunity for investors to pursue higher stock returns. Therefore, estimating the dynamic relations of stock returns between Turkey and other national markets would provide significant insights into investment strategies for international investors.

The paper is organized as follows. Section 2 provides a literature review on the issue of the Turkish market’s connection to other national markets. Section 3 presents the methodology pertinent to the empirical studies. Section 4 discusses the data and empirical results. Section 5 examines the determinants of correlation dynamics. Section 6 contains concluding remarks.

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[1] The results of sectoral analysis are not provided in the article to keep the manuscript contact and short. However, the results can be presented upon request.

2. Literature review

Although many studies have been devoted to the investigation of the comovements of markets, only recently have studies started to focus on emerging markets (Syriopoulos, 2011). Most studies compare a leading country with countries in emerging markets, and Turkey, as one of the emerging markets, is analyzed against mature countries (Syriopoulos, 2011; Uğur and Guidi 2014, Samarakoon, 2011, Çelik, 2012). For example, Samarakoon (2011), using daily data from 2000 to 2009, finds that emerging markets, including Turkey, show strong evidence of interdependence due to normal linkages – not due to any crisis-induced contagion - to U.S. stock markets. Thus, portfolio diversification in emerging markets does not provide a hedge against U.S. stock markets. The study by Syriopoulos (2011), using weekly data from 1998 to 2007, examines Balkan equity market dynamics, including Turkey, with respect to the mature stock markets of Germany and the U.S. The results show that potential risk diversification may be limited due to the long-run comovements in the Balkan equity markets. On the other hand, it is possible to have short-run opportunities for diversification with the Balkan markets, especially with the Romanian and Turkish equity markets, which appear to have a smoother reaction to external shocks.

In the econometric analysis, several recent studies used the dynamic conditional correlation (DCC) method to analyze the dynamics of asset returns in financial markets (Engle 2002, 2009; Chiang et al. 2007a; Uğur and Guidi 2014; Çelik 2012; Saiti, et al. 2014; Roumpis and Syriopoulos 2009). In the study by Uğur and Guidi (2014), both static and dynamic integration between the SEE stock markets of Bulgaria, Croatia, Romania, Slovenia and Turkey and their developed counterparts in Germany, the UK, and the US are analyzed, and there is no clear-cut conclusion in favor of the diversification benefits, although diversification benefits exist from September 2007 to June 2013, when portfolios consisting of only one SEE market and one developed market were set up.

Saiti et al. (2014) examine daily data from 2007 to 2011 and compare the diversification benefits of conventional and Islamic stock indices. Their results show that purely Islamic stock indices do not provide more diversification benefits compared to their conventional counterparts, but there are regional diversification benefits. It follows that both the conventional and Islamic MSCI indices of Japan, GCC ex-Saudi, Indonesia, Malaysia and Taiwan provide better diversification benefits compared to Korea, Hong Kong, China, and Turkey. In their recent study, Roumpis and Syriopoulos (2009) apply weekly data from 1998 to 2007 to investigate the time-varying comovements for the Balkan countries, including Turkey, and advanced equity markets. Their evidence shows that the Balkan stock markets exhibit time-varying correlations as a peer group, although correlations with the mature markets remain relatively modest. Thus, there is some possibility for diversification with advanced markets. Çelik (2012) uses a DCC-GARCH model to test financial contagion between the foreign exchange markets of several emerging and developed countries and finds a contagion effect for some countries, including Turkey, during the global financial crisis. This implies that investors cannot gain too much from international diversification by holding a portfolio made up of diverse foreign currencies.

Much of the financial literature suggests that there are asymmetric effects on volatility resulting from shocks created by negative news (Serletis and King 1997; Egert and Kocenda 2011; Dajcman, 2012, Barunik et al, 2015 & 2016; Chiang et al, 2016). Thus, we prefer to adopt an asymmetric dynamic conditional correlation GARCH (ADCC-GARCH, Engle, 2009) model to trace out the dynamic path of the conditional correlations of stock market returns between Turkey and foreign countries. Using the ADCC-GARCH model allows us to incorporate the asymmetric effect into the model to investigate the convergence issue from a historical perspective.

Instead of investigating the comovements among a group of advanced markets, this study focuses on Turkey's market correlated with its trade-related, geographic nearby, and cultural similarity markets. This study also extends the aggregate market study to the analysis of sectoral markets, from which we can obtain information on the relative performance and correlations among different sectors, thereby facilitating our selection of factors in explaining the dynamic pattern of correlations.

3. Methodology

Forbes and Rigobon (2002) show that volatility tends to bias the test relation of conditional correlations if the impact of volatility cannot be neutralized. It has been suggested that the dynamic conditional correlation (DCC) GARCH model proposed by Engle (2002) is able to address the issue of heteroskedasticity and generate dynamic correlations for asset returns (Chiang et al. 2007a; Chiang et al. 2007b; Yu et al. 2010; Kenourgios et al. 2011; Lahrech and Sylwester 2011), since the error from the mean equation has been scaled by the conditional standard deviation from the GARCH process. Thus, in this study, we employ an ADCC-GARCH (Engle, 2009) model to analyze the stock returns between Turkey and a set of global markets.

It is easier to start with a bivariate return process as in Engle's (2002), which specify a vector return equation as:

$$R_t = \mu_t + \varepsilon_t \tag{1}$$

where $R_t = [\, R_{1,t}\; R_{2,t}]'$ is a 2x1 vector for the stock market return series, and $\varepsilon_t | F_{t-1} = [\varepsilon_{1,t}, \varepsilon_{2,t}]' \sim N(0, H_t)$, $F_{t\text{-}1}$ is the information set that includes all information up to and including time t-1. In the multivariate DCC-GARCH model, the conditional variance-covariance matrix can be written as

$$H_t = D_t P_t D_t \tag{2}$$

where $D_t = diag(\sqrt{h_{11,t}}, \sqrt{h_{22,t}})$ is the 2x2 diagonal matrix of the time-varying standard deviations from univariate GARCH models with $\sqrt{h_{it}}$ on the diagonal and P_t is the time-varying conditional correlation matrix. The conditional variance-covariance matrix of H_t can be estimated by using a two-stage approach in the DCC model. In the first stage, the univariate volatility models for each market will be estimated and the best one is selected according to the Akaike Information Criterion (AIC). In the second stage, market returns, transformed by their standard deviations in the first stage, are used to estimate the parameters of the conditional correlations. The conditional correlation matrix is assumed to vary as a GARCH process.

$$P_t = (Q_1^*)^{-1} Q_t (Q_t^*)^{-1} \tag{3}$$

$$Q_t = (1-a-b)\overline{Q} + a u_{t-1} u_{t-1}^{'} + b Q_{t-1} \tag{4}$$

where $Q_t^* = diag(\sqrt{q_{11,t}}, \sqrt{q_{22,t}})$, $\overline{Q} = E[u_t u_t^{'}]$, $Q_t = (q_{ij,t})$ is a positive matrix; thus, it guarantees that P_t is a correlation matrix with ones on the diagonal and off-diagonal elements less than one in absolute value. $\overline{Q}$ is the unconditional correlation matrix of the u_t where $u_{i,t} = \varepsilon_{i,t} / \sqrt{h_{ii,t}}$ for i=1 and 2. The non-negative scalar parameters a and b confine the effect of previous shocks and dynamic correlations. They satisfy the condition of (a+b) < 1. The typical element of P_t will be of the form:

$$\rho_{12,t} = \frac{q_{12,t}}{\sqrt{q_{11,t}}\sqrt{q_{22,t}}}. \tag{5}$$

A limitation of the standard DCC model is its failure to capture the notion of asymmetric effects in conditional return correlations. Many studies document that negative shocks to asset prices do have a greater impact on volatility than do positive shocks of the same magnitude, indicating an asymmetric effect of shocks on asset return volatility (Black, 1986; Christie, 1982; Campbell and Hentschel, 1992; Wu, 2001, Barunik et al. 2016). This paper thus uses the asymmetric dynamic conditional correlation GARCH (ADCC-GARCH) model developed by Cappiello, Engle, and Sheppard (2006) and Engle (2009). Thus, the correlation equation above is customized as:

$$\begin{aligned} Q_t &= (\overline{Q} - A^{'}\overline{Q}A - B^{'}\overline{Q}B - G^{'}\overline{N}G) \\ &+ A^{'}u_{t-1}u_{t-1}^{'}A + B^{'}Q_{t-1}B + G^{'}n_{t-1}n_{t-1}^{'}G \end{aligned} \tag{6}$$

where A, B, and G are kxk diagonal parameter matrices, $\overline{Q} = E\left[u_{t-1}u_{t-1}^{'}\right]$, $\overline{N} = E[n_{t-1}n_{t-1}^{'}]$, and n_t= I[u_t<0]ou_t, while "o" indicates a Hadamard product. For

Q_t to be positive, $(\overline{Q} - A^{'}\overline{Q}A - B^{'}\overline{Q}B - G^{'}\overline{N}G)$ must be positive semi-definite and the initial covariance matrix Q_0 must be positive.

4. Estimations of correlations

4.1 Data and unconditional correlations

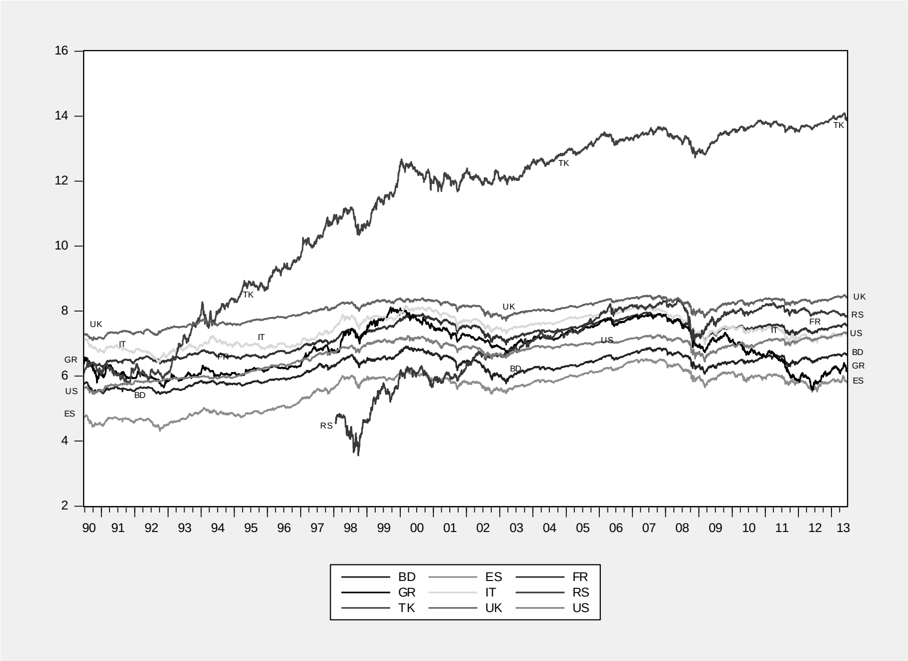
The data employed in this work are daily observations covering the period 6/21/1990 to 6/20/2013 and are taken from Datastream International. Nine market return indices are analyzed in the study: Turkey (TK), Germany (BD), Greece (GR), France (FR), Italy (IT), Russia (RS), Spain (ES), the United Kingdom (UK), and the United States (US). Considering the strengthening economic ties of Turkey with the EU through the adaptation of significant reforms, we have included France, Germany, and Italy - the main and founding partners of the EU - in our sample. Greece and Spain are countries of southern Europe that have characteristics similar to Turkey's. They have all experienced periods of strong growth and lengthy stagnation due to their political and economic circumstances. These countries, like Turkey, are energy-dependent economic unit, meaning that all of them are exposed to worldwide oil shocks. In addition, Greece and Spain are also members of the EU (Fuinhas and Marques, 2012). For these reasons, we add Greece and Spain to our sample. A number of studies show that a bilateral trade relationship is an important factor for cross-country linkages (Forbes and Chinn 2004; Bekaert and Harvey 1997; and Chen and Zhang 1997). Finally, the sample also includes the United Kingdom, Russia, and the United States because these countries are Turkey's main trading partners.

Time series plots of the log of international stock price indices for the daily sample are provided in Figure 1. Turkey shows much more country-specific variation in trend, although comovement of the stock price indices over the sample period is present. The summary statistics of the stock return indices of each market are reported in the upper panel of Table 1. Turkey (0.13) and Russia (0.08) have the highest average stock returns, accompanied by the highest standard deviations, 2.58 and 2.74, respectively. On the other hand, the data indicate that Greece has a negative average return over the sample period. The lower panel of Table 1 gives the unconditional correlations between Turkey and the stock returns of the other countries. All unconditional correlations present a positive relation. Russia has the lowest correlation with Turkey in the stock market (0.5%). The correlations with European countries are much higher: the United Kingdom (33.6%), France (33.4%), Germany (31.4%), Italy (32.5%), Spain (32.4%), and Greece (26.7%). The geographical connections and high trading volumes can partly explain the high correlations between Turkey and the European countries.

Table 1 Summary statistics of stock returns and correlations: 6/21/1990 6/20/2013

A. Returns	***R_BD_MARKET***	***R_ES_MARKET***	***R_FR_MARKET***	***R_GR_MARKET***	***R_IT_MARKET***	***R_RS_MARKET***	***R_TK_MARKET***	***R_UK_MARKET***	***R_US_MARKET***
Mean	0.014637	0.017815	0.016130	-0.003757	0.001224	0.080519	0.129181	0.018567	0.027549
Median	0.041275	0.026366	0.022650	0.000000	0.000000	0.013214	0.016255	0.022365	0.036215
Maximum	16.04614	11.74919	9.919869	12.76443	10.48222	27.54762	17.02575	8.861077	10.90192
Minimum	-9.293128	-8.491567	-8.428669	-9.970475	-8.636375	-19.85034	-19.46000	-8.714232	-9.408726
Std. Dev.	1.200834	1.281996	1.242485	1.728434	1.355502	2.736822	2.577373	1.066814	1.148149
Skewness	0.021367	-0.093253	-0.097979	0.047314	-0.133809	0.190249	-0.003897	-0.192349	-0.264727
Kurtosis	13.09548	8.076388	7.824616	7.590925	7.077156	15.32507	7.441628	9.566606	11.66165
Observations	6001	6001	6001	6001	6001	4018	6001	6001	6001

Figure 1 Time series plots of log of international stock price indices for the daily sample period: 6/21/1990 to 6/20/2013



4.2 Estimations of conditional correlations

The estimated correlations between Turkey and international stock markets using the ADCC-GARCH model (Cappiello et al, 2006) are depicted in Figure 2. Obviously, the correlation with Russia's market is the lowest and the variations fluctuate around zero. With the exception of the United States, the dynamic trajectories of Turkey's conditional correlations with all other countries have followed similar patterns since 1996. The evidence of comovements becomes more apparent during and after the 2008 crisis period.

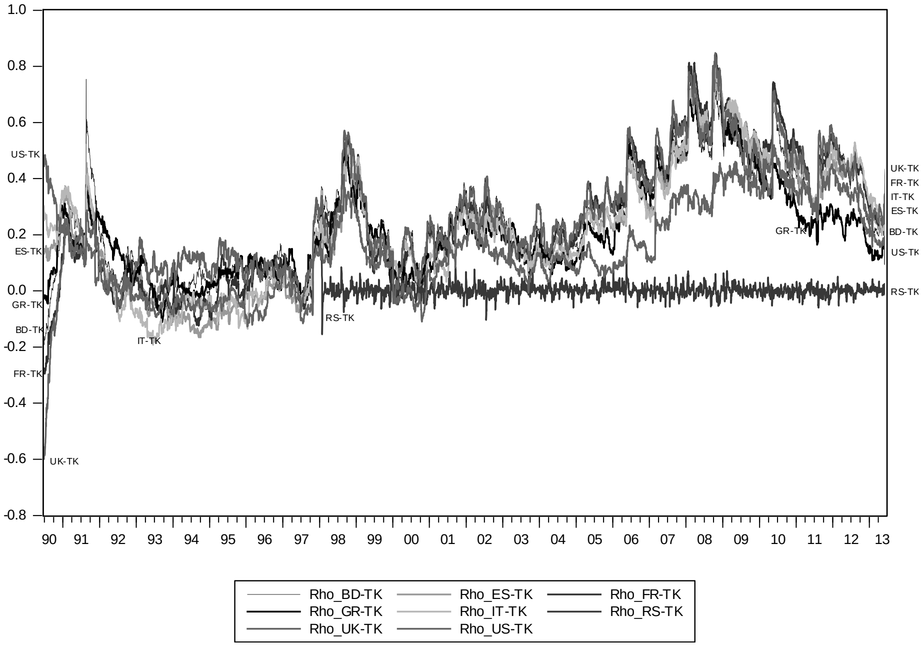
The summary statistics of conditional correlations derived from the ADCC procedure (Cappiello et al., 2006, Engle, 2009) are reported in Table 2. The results for the conditional correlations are quite consistent with those obtained from unconditional correlations. Average correlations range from 0.1% (Russia) to 35.7% (United Kingdom). The lowest average correlation still belongs to Russia, accompanied by the lowest standard deviation; the other lower correlation is with the US (20.8%). Turkey's market is seen to be highly correlated with the UK (35.7%), France (35.4%) and Germany (33.3%); the correlations with the other European countries are at least 28.2% (Greece).

Table 2 A summary statistics of dynamic correlation between Turkey and international markets

	Rho_BD-TK	*Rho_ES-TK*	*Rho_FR-TK*	*Rho_GR-TK*	*Rho_IT-TK*	*Rho_RS-TK*	*Rho_UK-TK*	*Rho_US-TK*
Mean	0.332604	0.325258	0.354127	0.281723	0.324806	0.001669	0.357030	0.208099
Median	0.302853	0.293304	0.315655	0.241840	0.277028	0.001425	0.331524	0.171288
Maximum	0.791286	0.776789	0.819297	0.845268	0.817827	0.119363	0.848029	0.519865
Minimum	0.011251	-0.023470	-0.048801	0.013913	-0.038574	-0.154732	-0.044527	-0.110098
Std. Dev.	0.150535	0.173338	0.190163	0.163453	0.184609	0.019267	0.169452	0.136516
Skewness	0.338953	0.432608	0.275983	0.827254	0.410623	0.069669	0.328091	0.162985
Kurtosis	2.395310	2.423380	2.209735	3.097961	2.206237	6.788791	2.446063	1.918605
Jarque-Bera	138.1532	180.9924	155.5612	459.8923	218.3958	2406.507	123.4566	213.5686
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	1336.402	1306.885	1422.883	1131.963	1305.069	6.705180	1434.547	836.1435
Sum Sq. Dev.	91.02828	120.6947	145.2619	107.3223	136.9020	1.491193	115.3437	74.86350
Observations	4018	4018	4018	4018	4018	4018	4018	4018

Notes: Sample covers the period 1/21/1998- 6/14/2013, including 4018 observations after adjustments.

Figure 2 Dynamic correlation of stock returns between Turkey and international markets



4.3 Transitional changes

The graphs of the dynamic correlations derived from the ADCC models indicate that some correlations exhibit nonstationary. Instead of simply fitting the correlation series to a deterministic time trend, or model it using an interventional model to capture a discrete shift after a certain event point, we follow the literature (Lahrech and Sylwester 2011; Chiang, et al. 2016) and fit the conditional correlation series to a smooth transition regression model as:

$$\hat{\rho}_{ij,t} = \alpha + \beta S_t(\gamma,\tau) + \varepsilon_t \tag{7}$$

$$S_t(\gamma,\tau) = \frac{1}{1+e^{-\gamma(t-\tau T)}}, \tau > 0 \tag{8}$$

where $\hat{\rho}_{ij,t}$ is the conditional correlations of stock returns between i and j derived from the ADCC model, ε_t is a zero mean stationary series, S_t is the logistic function, T is the sample size, and α, β, γ, and τ are estimated parameters. In this model, $\hat{\rho}_{ij,t}$ is assumed to have a transitional change from a first period value of α to a second period value of $\alpha + \beta$. The transition point is the midpoint from regime one to two. It is determined by the parameter τ. The speed of the transition between regimes is driven by the parameter γ. In fact, γ determines the slope and, hence, the shape of the transition curve. A positive value of β indicates a rise in the comovement of stock returns and a negative value of β shows a decline in the comovement of stock returns.

Table 3 summarizes the estimates of the smooth transition models for all countries at the market level[2]. It can be seen from these statistics that all of the markets exhibit transitional changes as evidenced by the positive value of β, which ranges from 0.26 (Greece) to 0.44 (Spain), indicating an upward shift from a lower correlation regime to a higher correlation regime. The statistics also show that the estimated coefficients of the speed of the transition (γ>0) for all of the markets have positive signs and are statistically significant. In particular, the value of γ for Greece (γ = 0.0438) is the highest. The speeds of transition for the other markets are in the range of 0.0015 to 0.0085. In particular, the statistics indicate that Germany = 0.0015, UK = 0.0016, Spain = 0.0017, France = 0.0053, Italy = 0.0059, and the US = 0.0085. The estimated τ values suggest that structural transitions occur around 2004-2006 for most markets. This period was stamped by the unwinding of carry trades owing to concerns about the tightening of US monetary policy (Pan and Singleton, 2008). It is also the period in which the Turkish banking sector went through a significant transformation by adopting Basel rules in the aftermath of the 2001 banking crisis (Bayraktar et al. 2014).

Interestingly, for the correlation between the United States and Turkey, the transition midpoint is the latest one compared with the other markets. It was around the time that the subprime crisis broke out when many headlines disclosed the decline in housing construction, and subprime lenders filed for Chapter 11.[3] It appears that the anticipation of bad news in stock markets or a deterioration in economic conditions causes investors to sell off stocks, leading to comovement. [4]

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[2] Since we have observed in the market dynamic correlations and the sectoral correlations that the Russia-Turkey dynamic correlation is not significantly different from zero, we drop Russia from further investigation. The figures consisting the corresponding fitted values and residuals will be provided upon request. This is not something unobserved in the literature. For example Horvath and Petrovski report that "the correlation of South Eastern European stock markets with developed markets is essentially zero."

[3] As of mid-August 2006, the US home construction index was down over 40% compared to a year earlier (reported by *MarketWatch*, Dow Jones US Home Construction Index). As of February 8, 2007, HSBC warned that bad debt provisions for 2006 would be 20% higher than expected: about $10 billion.

[4] The LSTR model suggests that a major break is found in most countries. We have also conducted Bai and Perron (1998, 2003a, 2003b) test to check possible multiple structural breaks. The Bai and Perron test indicates that more than one significant breaks occur. However, checking the t- statistics, we find that the most significant break date is almost the same for all the countries in 2006, only the US occurs in 2007. This is consistent with the major transition points determined by LSTR model. The transition midpoints by LSTR model is in the range of 12/2003 and 2/2007, while the date of 2/2007 is the transition midpoint for US in LSTR, which is exactly the same with what is determined by Bai and Perron. Thus, the evidence suggests that a single break for each country determined by LSTR model is appropriate in our study. The results will be available upon request.

Table 3 Estimates of the logistic smooth transition regression model

Markets	***α***	***β***	***γ***	***τ***	***Transition midpoint***	***Adjusted R^2***
Turkey-Germany	0.1078***	0.3589***	0.0015***	0.6015***	4/7/2004	0.51
	(27.96)	(39.59)	(17.17)	(88.72)		
Turkey-Spain	0.0532***	0.4372***	0.0017***	0.6071***	6/7/2004	0.62
	(15.62)	(57.11)	(21.90)	(129.96)		
Turkey-France	0.1034***	0.4189***	0.0053***	0.6568***	7/28/2005	0.67
	(45.76)	(98.31)	(18.61)	(337.42)		
Turkey-Greece	0.1358***	0.2594***	0.0438***	0.6833***	3/9/2006	0.49
	(71.57)	(76.11)	(4.72)	(746.10)		
Turkey-Italy	0.0985***	0.4047***	0.0059***	0.6829***	3/7/2006	0.63
	(43.44)	(90.57)	(16.49)	(348.18)		
Turkey-United Kingdom	0.0942***	0.4131***	0.0016***	0.5872***	12/23/2003	0.60
	(26.18)	(53.59)	(21.19)	(116.63)		
Turkey-United States	0.0677***	0.2871***	0.0085***	0.7240***	2/14/2007	0.60
	(12.01)	(30.80)	(9.32)	(254.75)		

Notes: This table presents the estimates of the logistic smooth transition regression model for the conditional correlation time series. The model is given by

$$\hat{\rho}_{ij,t} = \alpha + \beta S_t(\gamma,\tau) + \varepsilon_t \quad (7)$$

$$S_t(\gamma,\tau) = \frac{1}{1+e^{-\gamma(t-\tau T)}}, \tau > 0 \quad (8)$$

where ε_t is a zero mean stationary series; *St* is the logistic function; T is the sample size; and α, β, γ, and τ are estimated parameters. *t*-statistics are given in parentheses. The transition midpoint is obtained by τ × number of observations for each country.

5. Determinants of dynamic conditional correlation variations

5.1 Regression model

Although the evidence indicates that the dynamic correlation coefficients of stock returns show structural shift and may possibly well fit to a smooth transition model, it still lacks information to explain why the conditional correlation coefficients are time-varying. Since the results from finance-related sectors (provided upon request) show the highest correlations with that of foreign markets, it is reasonable to focus on the factors that significantly measure the uncertainty of global financial markets.

In the literature, the variations in option prices reflected in the implied volatility indices (VIX) are considered to have significant information content about future stock market volatility. Several studies show that the VIX can capture uncertainty arising from asset fundamentals in US stock markets (Whaley 2009; Hakkio and Keaton 2009; Bekaert and Hoerova 2013, Barunik et al. 2016). On the basis of the existing empirical evidence, we incorporate implied volatility into our analysis, including the volatility indices of the VDAX, VIX, and CACVOLI. In practice, not many countries, including Turkey, have a measure of implied volatility; therefore, we shall consider the closest variables to proxy for the financial market risk of particular countries.

Although changes in sovereign ratings have been used to explain stock market return volatility (Hooper et al. 2008; Li et al. 2008), the role of rating agencies has been criticized for behaving pro-cyclically, especially during the crisis. Thus, the question of whether the sovereign ratings carry new information that reveals true information about stock market uncertainty has been a controversial one. Alternatively, Chan, et al. (2009) introduce credit default swap (CDS) spreads as an argument to explain the dynamic relationship between sovereign CDS spreads and stock prices for seven Asian countries during the period January 2001 to February 2007. They find that there is a strong negative correlation between the CDS spread and the stock index for most Asian countries and that CDS markets play a leading role in five out of the seven countries. Basically, sovereign CDS are a kind of insurance contract that allows investors to buy protection against the event that a sovereign defaults on its obligations. Thus, CDS spreads directly reflect the market's assessment of the sovereign's credit risk. In addition, sovereign CDS markets are generally more liquid compared to corresponding sovereign bond markets. Owing to these properties, CDS spreads are considered to be a good candidate to represent at least a part of the financial risk of a particular country.

In facing financial market instability, market participants, however, pay particular attention to variations in the *TED* spread. When the *TED* spread widens, it sends a signal to the market that lenders perceive that the risk of default on interbank loans is rising. Interbank lenders, therefore, demand a higher rate of interest. In addition, this type of credit risk reflected in a rising *TED* spread is likely to generate liquidity risk, causing widespread uncertainty that impinges on financial markets.[5] A

[5] The *TED* spread exceeded 300 basis points in September and early October 2008, after the bankruptcies of several big banks and investment companies in the US market that constituted part of the global financial crisis. On October 10, 2008, the *TED* spread hit a record high of 458 basis points (the US 3-

general message emerging from market participants is that the *TED* spread can be viewed as a short-term indicator of perceived credit risk in financial markets. Aktuğ (2015) examines the prices of five major emerging markets, including Brazil, China, Indonesia, Mexico and Turkey, and reports that bond markets, along with foreign exchange markets, were very dominant in the price discovery process during a distressed period. He finds that the CDS market generally lags the other markets. In fact, Cheung et al.'s (2010) study shows that the TED spread has no significant causal relationship with respect to any of the stock market indices before the crisis; it becomes an important leading indicator during the crisis. Mina and Hwang (2012) analyze stock market comovements between four OECD countries and the US for the period 2006-2010 and show that the VIX is positively related to conditional correlations, but the TED spread and relative stock market capitalization are negatively related to conditional correlations of stock returns. Hwang et al. (2013) test the daily stock returns of 10 emerging economies with respect to the US for the period 2006–2010 and report that the CDS spread and the TED spread are negatively correlated with conditional correlations, while foreign institutional investment, exchange market volatility, and the VIX index of the S&P 500 are positively correlated. Min et al. (2013), on the other hand, analyze the dynamic relationship between stock markets and exchange rate markets. They find that the TED spread and VIX index strengthen the DCCs between stock returns and foreign exchange returns. But the CDS spread decreases conditional correlations. Finally, Kim et al. (2015) investigate the transmission of the recent US crisis to financial markets in five emerging Asian markets and find that the TED is insignificant. Thus, the evidence supporting the TED as a factor is somewhat mixed.

For all of these studies except the evidence by Min et al. (2013), the TED is defined as the difference between the three-month LIBOR and the three-month T-bill interest rate. The main purpose of these studies is to analyze the impact of the 2008 US financial crisis on the other countries; thus, it makes sense that they define the TED variable using the U.S. Treasury bill rate. But Min et al. prefer to use a country-specific definition of the TED; in their study, the TED spread is defined by the interest rate of each country less LIBOR. We also prefer to use a country-specific TED definition in order to measure country-specific liquidity risk, since our estimations of the DCC are based on return correlations between the Turkey's stock market and the other selected stock markets. Thus, the TED variable in our context incorporates Turkish - LIBOR rates; it is equal to Turkish Interbank three-month rate (TRLIBOR) minus the London Interbank 3-month rate (LIBOR). From a lender's perspective, the TRLIBOR rate represents sovereign credit risk only for Turkey, while the LIBOR contains the global credit risk that affects all of the global markets.

In addition to employing the VIX, CDS spreads, and the TED spread as indicators of uncertainty in financial markets,[6] we shall add two control variables: the

month Treasury bill was 0.24% and the corresponding LIBOR was 4.818%; the difference was 4.58%), signifying a severe default risk and credit crunch in interbank lending.

[6] It should be noted that a related study by Longstaff et al. (2007) analyzes whether the sovereign risk measured by CDS spreads is driven by regional and/or global economic forces external to the country. Their study covers the period 2000-2007 and finds that sovereign credit spreads are driven primarily by external factors, and that the country-specific component of sovereign credit risk is relatively modest. However, their study does not include the periods involving sovereign crises and credit events. One of the

volatility of oil price changes and the volatility of the exchange rate. The variance of the change in oil prices is added because of its significant impact on the costs of consumption and production. The volatility of changes in the exchange rate is included because of its influence on the volatility of the relative return on assets as implied in the international stock return parity condition as documented by Chiang (1991), Dumas and Solnik (1995), Santis and Gerard (1998), Phylaktis and Ravazzolo (2004), Antell and Vaihekoski (2007), and Saleem and Vaihekoski (2010), among others. Thus, the estimated equation for the conditional correlation coefficients is specified as follows:

$$\begin{aligned}\hat{\hat{\rho}}_{i,j,t} &= \varphi_0 + \varphi_1 \hat{\upsilon}^2_{Si,t} + \varphi_2 \hat{\upsilon}^2_{S,j,t} + \varphi_3 \hat{\upsilon}^2_{o,t} + \varphi_4 \hat{\upsilon}^2_{x_{ij},t} \\ &+ \varphi_5 TED_{i,t} + \varphi_6 VIX_{j,t} + \varphi_7 CDS_{i,t} + \varphi_8 CDS_{j,t} + \varepsilon_t\end{aligned} \tag{9}$$

where $\hat{\hat{\rho}}_{i,j,t}$ is the residual series of conditional correlations for i (Turkey) and j (non-Turkish markets) after fitting a logistic smooth transition regression (LSTR) model; $\hat{\upsilon}^2_{S,i,t}$ is the conditional variance of the national stock index return for Turkey; $\hat{\upsilon}^2_{S,j,t}$ is the conditional variance of the national stock index return for the j^{th} market (all countries other than Turkey); $\hat{\upsilon}^2_{o,t}$ is the conditional variance of changes in oil prices; $\hat{\upsilon}^2_{x_{ij},t}$ is the conditional variance of exchange rates between Turkey and the j markets. [7] These four conditional variances are generated by using a standard GARCH (1,1) process. The $TED_{i,t}$ spread is the difference between Turkey's 3-month interbank rate and LIBOR. $VIX_{j,t}$ is the implied volatility index by which market j measures its risk. It is available only for the US, the UK, France, and Germany. For other European countries, we use the volatility index of Germany, the VDAX, as a proxy variable. $CDS_{i,t}$ is the credit default swap spread for Turkey, and $CDS_{j,t}$ is the credit default swap spread for country j.

5.2. Modified regression models

The right-hand-side variables in equation (9) used for measuring risk may create a multicollinearity problem. Thus, we have also checked the correlation matrix of the independent variables for each market. From these analyses, we have observed that for all markets, the implied volatility and conditional variance of stock return markets have high correlations. This is also true for CDS of Turkey and the conditional variance of oil price changes.[8] To remove a potential multicollinearity

objectives of this study is to check whether their results hold for a crisis period by extending the period to 2013.

[7] Since the dependent variable is bound to interval [-1,+1], we apply a Fisher transformation given by $\hat{\hat{\rho}}_{i,j,t} = \frac{1}{2}\ln\left[\frac{1+\hat{\rho}_{ij,t}}{1-\hat{\rho}_{ij,t}}\right]$ on the correlation coefficient first and then conduct the regression estimation.

[8] The results of multicollinearity analysis are not provided in the article to keep the manuscript short. However, the results can be presented upon request.

problem resulting from their high correlations, we regress VIX_j on $\hat{\upsilon}^2_{S,i,t}$ and CDS_{TK} on $\hat{\upsilon}^2_{o,t}$ and obtain the residuals *VP_VIX* and *VP_CDSTK*, respectively.[9] VP_VIX serves as a variance premium, which is orthogonal to the conditional variance of stock returns. VP_CDSTK similarly captures the risk-neutralized from the conditional variance of oil price changes. Thus, equation 9 is modified as follows:

$$\begin{aligned}\hat{\hat{\rho}}_{i,j,t} &= \varphi_0 + \varphi_1 \hat{\upsilon}^2_{Si,t} + \varphi_2 \hat{\upsilon}^2_{S,j,t} + \varphi_3 \hat{\upsilon}^2_{o,t} + \varphi_4 \hat{\upsilon}^2_{x_{ij},t} \\ &+ \varphi_5 TED_{i,t} + \varphi_6 VP\_VIX_{j,t} + \varphi_7 VP\_CDSTK_{i,t} + \varphi_8 CDS_{j,t} + \varepsilon_t\end{aligned} \tag{10}$$

5.3 Estimated results

Equation (10) is estimated using the Newey-West consistent estimator and the results are reported in Table 4.1,4.2, and 4.3. For each country, we estimate three models due to the differences in the availability of data for the determinants. For example, the TED variable is available only for the period after 7/3/2006; on the other hand, CDS variables are available for all countries after 2/29/2008 except the UK, for which data are available after 11/6/2008.

[9] Since the VIX is an annualized rate of volatility, to be consistent with the conditional variance of stock returns on a daily basis, we rescale the VIX by dividing the VIX by the square root of the number of trading days (252) in a year.

Table 4.1 Estimates of ADCC correlations using Fisher transformation

Model I

Market	*C*	$\hat{\upsilon}^2_{S,i,t}$	$\hat{\upsilon}^2_{S,j,t}$	$\hat{\upsilon}^2_{o,t}$	$\hat{\upsilon}^2_{x_{ij},t}$	*VP_VIX*$_{j,t}$	*Observations*	*Adjusted* R^2
$\hat{\hat{\rho}}_{i,j,t}$ (Turkey-Germany)	-0.5449*** (-137.95)	0.0011*** (2.98)	0.0060** (2.47)	0.0036*** (4.87)	-0.0003** (-2.45)	0.0052*** (3.83)	5079	0.29
$\hat{\hat{\rho}}_{i,j,t}$ (Turkey-Spain)	-0.5575*** (-130.99)	0.0005 (1.51)	0.0056*** (2.70)	0.0057*** (7.12)	-0.0003* (-1.75)	0.0068*** (6.36)	5079	0.33
$\hat{\hat{\rho}}_{i,j,t}$ (Turkey-France)	-0.5313*** (-123.16)	0.0012*** (2.87)	0.0018 (0.89)	0.0030*** (3.60)	-1.12E-05 (-0.10)	0.0064*** (4.74)	3515	0.23
$\hat{\hat{\rho}}_{i,j,t}$ (Turkey-Greece)	-0.5436*** (-141.57)	0.0009*** (2.59)	-0.0018** (-2.24)	0.0054*** (6.21)	-0.0002** (-2.39)	0.0087*** (11.05)	5079	0.29
$\hat{\hat{\rho}}_{i,j,t}$ (Turkey-Italy)	-0.5478*** (-143.49)	0.0006 (1.45)	-0.0044*** (-3.07)	0.0051*** (5.70)	-0.0003* (-1.77)	0.0129*** (11.36)	5079	0.36
$\hat{\hat{\rho}}_{i,j,t}$ (Turkey-UK)	-0.5339*** (-125.16)	8.23E-05 (0.18)	0.0011*** (3.04)	0.0011 (1.29)	-0.0001 (-0.33)	0.0035 (1.37)	3514	0.27
$\hat{\hat{\rho}}_{i,j,t}$ (Turkey-US)	-0.5298*** (-155.25)	0.0002 (0.54)	-0.0111*** (-7.10)	0.0013*** (2.72)	-0.0004* (-1.84)	0.0194*** (7.84)	6000	0.23

Table 4.2 Estimates of ADCC correlations using Fisher transformation

Model II

Market	*C*	$\hat{\upsilon}^2_{S,i,t}$	$\hat{\upsilon}^2_{S,j,t}$	$\hat{\upsilon}^2_{o,t}$	$\hat{\upsilon}^2_{x_{ij},t}$	TED_t	$VP\_VIX_{j,t}$	*Observations*	*Adjusted* R^2
$\hat{\hat{\rho}}_{i,j,t}$ (Turkey-Germany)	-0.5936*** (-45.48)	0.0056** (2.15)	-0.0013 (-0.37)	-0.0021* (-1.92)	0.0013 (0.59)	0.0076*** (5.38)	0.0064* (2.26)	1820	0.41
$\hat{\hat{\rho}}_{i,j,t}$ (Turkey-Spain)	-0.5817*** (-41.22)	0.0032 (1.14)	0.0015 (0.55)	0.0052*** (3.05)	0.0019 (0.92)	0.0058*** (3.79)	0.0009 (0.41)	1820	0.35
$\hat{\hat{\rho}}_{i,j,t}$ (Turkey-France)	-0.6073*** (-42.96)	0.0060** (1.92)	-0.0059 (-1.62)	1.66E-05 (0.01)	0.0027 (1.37)	0.0073*** (4.89)	0.0087*** (3.22)	1820	0.37
$\hat{\hat{\rho}}_{i,j,t}$ (Turkey-Greece)	-0.6254*** (-45.25)	0.0081*** (3.67)	-0.0042*** (-3.67)	0.0041** (2.10)	0.0029** (1.92)	0.0091*** (6.51)	0.0028 (1.19)	1820	0.52
$\hat{\hat{\rho}}_{i,j,t}$ (Turkey-Italy)	-0.5729*** (-44.81)	0.0035* (1.41)	-0.0007 (0.31)	0.0037** (2.34)	0.0029 (1.39)	0.0037** (2.54)	0.0035 (1.51)	1820	0.35
$\hat{\hat{\rho}}_{i,j,t}$ (Turkey-UK)	-0.6311*** (-39.59)	0.0075*** (2.95)	-0.0058* (-1.81)	-0.0037*** (-2.86)	0.0169 (1.33)	0.0092*** (7.64)	0.0124*** (3.17)	1820	0.54
$\hat{\hat{\rho}}_{i,j,t}$ (Turkey-US)	-0.5371*** (-50.96)	-0.0006 (-0.32)	-0.0029 (-1.57)	-0.0019** (-2.41)	-0.0087* (-1.89)	0.0033*** (3.30)	0.0107*** (4.32)	1820	0.22

Table 4.3 Estimates of ADCC correlations using Fisher transformation

Model III

Market	*C*	$\hat{\upsilon}^2_{S,i,t}$	$\hat{\upsilon}^2_{S,j,t}$	$\hat{\upsilon}^2_{o,t}$	$\hat{\upsilon}^2_{x_{ij},t}$	TED_t	$VP\_VIX_{j,t}$	CDS_j	*VP_CDSTK*	*Observation*	*Adjusted* R^2
$\hat{\hat{\rho}}_{i,j,t}$ (Turkey-Germany)	-0.6614*** (-41.89)	0.0036* (1.76)	-0.0051** (-2.02)	-0.0069*** (-3.33)	0.0027 (1.50)	0.0178*** (9.59)	0.0051* (1.93)	0.0014*** (3.49)	-0.0001* (-1.75)	1386	0.55
$\hat{\hat{\rho}}_{i,j,t}$ (Turkey-Spain)	-0.6094*** (-34.97)	-0.0023 (-1.07)	0.0065 (2.19)	0.0028 (1.66)	-0.0002 (-0.09)	0.0156*** (7.92)	-0.0014 (-0.53)	-0.0002*** (-5.48)	8.33E-05 (1.28)	1386	0.51
$\hat{\hat{\rho}}_{i,j,t}$ (Turkey-France)	-0.6535*** (-37.32)	0.0041 (1.39)	-0.0066* (-1.88)	-0.0019 (-1.13)	0.0024 (1.32)	0.0157*** (7.50)	0.0068** (2.39)	-4.18E-05 (-0.25)	-3.50E-05 (-0.29)	1386	0.45
$\hat{\hat{\rho}}_{i,j,t}$ (Turkey-Greece)	-0.6138*** (-54.40)	0.0046*** (3.45)	0.0002 (0.25)	0.0043** (2.47)	0.0022** (2.14)	0.0129*** (9.87)	-0.0045** (-2.08)	-2.01E-06*** (-13.39)	0.0001** (2.10)	1386	0.75
$\hat{\hat{\rho}}_{i,j,t}$ (Turkey-Italy)	-0.6222*** (-42.21)	-0.0006 (-0.32)	0.0036* (1.66)	0.0007 (0.58)	0.0003 (0.20)	0.0152*** (8.02)	0.0002 (0.10)	-0.0002*** (-7.06)	9.68E-05* (1.92)	1386	0.53
$\hat{\hat{\rho}}_{i,j,t}$ (Turkey-UK))	-0.6973*** (-32.60)	0.0048*** (3.44)	0.0001 (0.04)	-0.0195*** (-6.19)	-0.0017 (-0.10)	0.0188*** (7.95)	0.0104*** (2.95)	0.0021*** (9.31)	-0.0006*** (-5.83)	1207	0.63
$\hat{\hat{\rho}}_{i,j,t}$ (Turkey-US)	-0.5381*** (-32.75)	-0.0020 (-0.91)	-0.0019 (-0.90)	-0.0021 (-0.91)	-0.0132*** (-2.60)	0.0046** (2.49)	0.0116*** (3.16)	-0.0002 (-0.80)	-6.00E-05 (-1.01)	1386	0.25

(i) The *estimates of Model I* are reported in Table 4.1. This model regresses the residuals of the ADCC series after fitting the logistic smooth transition regression (LSTR) model ($\hat{\hat{\rho}}_{i,j,t}$) on the following risk variables: conditional variances of stock returns for Turkey ($\hat{\upsilon}^2_{S,i,t}$) and the corresponding country ($\hat{\upsilon}^2_{S,j,t}$), the conditional variance of changes in the exchange rate ($\hat{\upsilon}^2_{x_{ij},t}$), the conditional variance of changes in oil prices ($\hat{\upsilon}^2_{o,t}$), and the variance premium of the VIX over the conditional variance of stock returns *(VP_VIX)*. Table 4.1 refers to estimations based on the sample period before the transition has taken place according to the LSTR model. For most of the cases, all variables are statistically significant. However, the results show that conditional variances of stock returns do have significant negative signs for 3 out of 9 cases: the $\hat{\upsilon}^2_{S,j,t}$ for Greece, Italy, and the US. The coefficient of *VP_VIX* and the conditional variance of oil price changes are positive and statistically significant at the 1% level for all cases except the UK. The conditional variance of the exchange rate is significant and negative for all cases except France and the UK.

(ii) *The estimates of Model II* are presented in Table 4.2, where we add the TED to the test equation. TED is one of the core variables that reflect the changes in financial market risk, and it is a variable that has longer observations available relative to the CDS variable. The results show that TED is significant and exhibits a positive sign for all cases which indicates a positive relation between the TED and pairwise correlations. The t-statistic of the TED for each country is much greater compared with the other determinants. The evidence suggests that short-term liquidity is very significant. It also implies the impact of fear on the banking sector, since it is a proxy for credit risk in interbank lending.

Owing to a specific definition of the TED in this study — the $TED_{i,t}$ spread is the difference between LIBOR and Turkey's 3-month Interbank rate (TRLIBOR) — the interpretation should pay particular attention from the Turkish perspective. Implicitly, we view that market reactions are asymmetric from an international perspective vs. Turkey's position. Specifically, when the TED spread widens as LIBOR decreases, it shows that there is a general increase in confidence in the banking sector, which affects all countries' stock markets positively, leading to an increase in the pairwise correlations of stock returns. Likewise, we can explain the increase in the pairwise correlations of stock returns due to a narrowing of the TED spread as the LIBOR increases, since an increase in the LIBOR shows a general decrease in confidence in the banking sector. However, the process and market reaction in terms of the TRLIBOR can become more complicated, since the impact of the TRLIBOR may also run through the swap market. Interest rate swaps, which are used to hedge fixed-rate consumer loans, have a floating leg paying 3-month

TRLIBOR[10]. The TRLIBOR is not only a reference to confidence in the Turkish banking system but is also the rate that has a significant impact on the capital movements dictated by global swap conditions. Thus, the level of the TRLIBOR affects the flows of hot money brought by foreign banks. If the TED spread widens owing to an increase in the TRLIBOR, sending a signal to the market that lenders perceive that the risk of default on Turkey's interbank loans is rising, this negative signal may cause Turkey's stock prices to fall. However, owing to a more significant effect of the swap market, with increasing flow of hot money, Turkish stock markets would be affected positively.

The spread may get narrower owing to a decrease in the TRLIBOR. This change is likely to encourage the Turkish stock market by improving its liquidity position, thus stimulating Turkish stock prices. On the other hand, through the swap market, the effect may be negative. In short, it looks like the global liquidity position is directly linked to the Turkish liquidity position via the TRLIBOR variable. Indeed, we see that the TRLIBOR and LIBOR rates tend to move together over time. To summarize, any change in the TED spread increases stock market correlations in a time-varying fashion, depending on the relative position of the market forces between Turkey and the other countries. This is in connection to the issue that changes in the TED variable may cause changes in stock market volatility. However, with the addition of the TED variable to the test equation, some of the conditional variances of stock returns, the exchange rate, and the VIP_VIX coefficients become insignificant and even the signs of the exchange rate and oil price variables alter.

(iii) *The estimates of Model III* are contained in Table 4.3, where CDS and VP_CDSTK are included. With the addition of these variables, the sample period is restricted to the post-financial-crisis period (it is also the period after the transition time according to the LSTR model). For four out of seven cases, the CDS variable for Turkey is significant. However, the magnitude of the coefficient is quite small and the sign is not consistent for different countries. Out of seven countries, the estimated CDS for the respective country vis-a-vis Turkey are significant for five cases, but again with mixed signs. Thus, we conclude that even in crisis periods, *CDS* has only partial explanatory power over the other macro variables. This result offers additional support to the report documented by Longstaff et al. (2007). As in Model II, the conditional variances of stock returns and the exchange rate and oil price variables become insignificant and/or change their signs. With diverse characteristics and different degrees of market perfection, no unique model will ever fit every data series perfectly because there are structures that are outside of the scope of the model. The *TED* is the variable that consistently produces a statistically significant positive sign while controlling for other variables. The sign of the TED contradicts with those of Mina and Hwang (2012) and Hwang et al. (2013) due to different definitions of the TED variable being used in their studies. In these studies, an increased TED spread implies a worsened liquidity situation (Lashgari, 2000; Cheung et al., 2010) in the world capital markets, and this, in turn, decreases the

[10] An interest rate swap is an agreement between two parties where one stream of future interest payments is exchanged for another based on a specified principal amount. Basically, the swap usually involves the exchange of a fixed interest rate for a floating rate, or vice versa, to reduce or increase exposure to fluctuations in interest rates.

comovements of stock returns among the four OECD countries and the US. However, the results are consistent with that of Min et al.(2013), since that study like the current study also uses the country-specific definition of the TED. In the present study, the TED variable measures a liquidity situation from Turkey's perspective; an increase in the TED promotes the comovements of the Turkish stock market with those of other stock markets, leading to a rise in correlations.

The *VP_VIX*, on the other hand, is significant for five out of seven cases, but it also has mixed signs. This also contradicts previous studies, but this may be explained by the fact that the TED variable, a variable more related to Turkey's financial markets, becomes dominant with respect to variables that measure the general risk of financial markets. In terms of the explanatory power of the models, the evidence concludes that Model III is the best one in terms of a higher adjusted R^2.[11]

6. Conclusions

This study analyzes the dynamic correlations between the Turkish stock market and global markets, including France, Germany, Italy, Greece, Spain, United Kingdom, the United States and Russia. Conditional correlations are analyzed both at the market level and the sectoral level[12]. The evidence shows that correlations are time-varying at both levels[13]. Additionally, dynamic correlations are observed to be non-stationary and show transitional changes over time. For Turkey, these transitional changes occur between the years 2004 and 2006. This is a period characterized by the unwinding of carry trades owing to the reaction to the tightening of US monetary policy (Pan and Singleton, 2008). It is also the period in which the Turkish banking sector went through a significant transformation by adopting Basel rules in the aftermath of the 2001 banking crisis.

Sectoral data help us to identify the variables that explain the dynamics of the correlations. The evidence suggests that factors related to the financial sectors are the most important ones. We choose three variables, assumed to represent the global risk and uncertainty of financial markets, to be the explanatory variables, namely, the VIX, the TED spread and CDS spreads, in addition to the usual stock market variances. The volatilities of oil prices and exchange rates are also added as control variables. Because the data are available in different time lengths, we test different models with different combinations of the VIX, the TED and CDS spreads. The results show that the TED spread is consistently significant and indicates a positive relation between TED spread and the DCCs of equity markets. The VIX variable is significant and positive for most of the cases. The CDS spreads for Turkey and the CDS spreads for a respective country are significant for some cases, but their

[11] We estimate the three models by applying a Fisher transformation. However, the results without Fisher transformation are comparable and not reported here for the sake of saving space.

[12] The results of sectoral analysis are not provided in the article to keep the manuscript contact and short. However, the results can be presented upon request.

[13] However, the magnitudes of the sectoral correlations are relatively lower when compared to those at the market level. Some sectors, such as Health Care, Industrials, Telecommunications, Technology, and Utilities, have quite low correlations. This reveals the existence of various diversification opportunities for international investors by investing in Turkish markets.

coefficients have mixed signs. Thus, we conclude that the CDS spread has only partial explanatory power over the other macro variables.

REFERENCES

Aktuğ R (2015): Empirical Dynamics of emerging financial markets during the global mortgage crisis. *Borsa İstanbul Review,* 15 (1): 17-36.

Antell J, Vaihekoski M (2007): International asset pricing models and currency risk: evidence from Finland 1970-2004. *Journal of Banking and Finance,* 31: 2571-2590.

Apergis N, Christou C, Miller SM (2014): Country and Industry Convergence of Equity Markets: International Evidence from Club Convergence and Clustering. *The North American Journal of Economics and Finance*, 29: 36–58.

Bai J, Perron B (1998): Estimating and testing linear models with multiple structural changes. *Econometrica*, 66: 47–78.

Bai J, Perron B (2003a): Additional critical values for multiple structural changes tests. *Econometrics Journal*, 6, 72–78.

Bai J, Perron B (2003b): Computation and analysis of multiple structural change models. *Journal of Applied Econometrics*, 18: 1–22.

Barben R, Jansen WJ (2005): Comovement in international equity markets: a sectoral view. *Journal of International Money and Finance*, 24: 832-857.

Barunik J, Kočenda E, Vácha L (2015): Volatility spillovers across petroleum markets. *The Energy Journal*, 36 (3): 309-329.

Barunik J, Kočenda E,Vácha L (2016): Asymmetric connectedness of stocks: How does bad and good volatility spill over the U.S. stock market? *Journal of Financial Markets*, 27(1): 55-78.

Bayraktar S, Hoşgör E, Göztepe TE (2014): Perspectives of Turkish Banks on Basel II. *Journal of Applied Finance and Banking*, 4(6): 93-107.

Bekaert G, Harvey CR (1997): Emerging equity market volatility. *Journal of Financial Economics*, 43: 29-77.

Bekaert G, Hoerova M (2013): The VIX, the variance premium and stock market volatility. Retrieved from http://srn.com/abstract=2252209

Berumen H, Ince O (2005): Effect of S&P500's return on emerging markets: Turkish experience. *Applied Financial Economics Letters*, 1(1): 59–64.

Black F. (1986): Noise. *Journal of Finance,* 41: 529–543.

Campbell JY, Hentschel L (1992): No news is good news: An asymmetric model of changing volatility in stock returns. *Journal of Financial Economics*, 31(3): 281-318.

Caporale G, Ali FM, Spagnolo N (2014): Oil Price Uncertainty and Sectoral Stock Returns in China: A Time-Varying Approach. Paper provided by DIW Berlin, German Institute for Economic Research in its series Discussion Papers of DIW Berlin, 1394.

Caporale G, Erdoğan B, Kuzin V (2015): Testing stock market convergence:a non-linear factor approach. *Empirica*, 42 (3): 481-498.

Cappiello L, Engle RF, Sheppard K (2006): Asymmetric dynamics in the correlations of global equity and bond returns. *Journal of Financial Econometrics*, 4: 537-572.

Chan K, Fung H, Zhang G (2009): On the Relationship Between Asian Credit Default Swap and Equity Markets. *Journal of Asia Business Studies*, 4(1): 3-12.

Chelley-Steely P. (2005): Modelling equity market integration using smooth transition analysis: a study of Eastern European stock markets. *Journal of International Money and Finance*, 24: 818-831.

Chen N, Zhang F (1997): Correlations, trade and stock returns of the Pacific-Basin markets. *Pacific-Basin Finance Journal*, 5: 559-577.

Cheung W, Fung S, Tsaic SC (2010): Global capital market interdependence and spillover effect of credit risk: evidence from the 2007–2009 global financial crisis. *Applied Financial Economics*, Special Issue: The Global Financial Crisis, 20(1-2): 85-103.

Chiang T, Jeon BN, Li H (2007a): Dynamic Correlation Analysis of Financial Contagion: Evidence from Asian Markets. *Journal of International Money and Finance*, 26: 1206-1228.

Chiang T, Lao L, Xue Q (2016): Comovements between Chinese and global stock markets: evidence from aggregate and sectoral data. *Review of Quantitative Finance and Accounting*, 47(4): 1003–1042.

Chiang T, Tan L, Li H (2007b): Empirical Analysis of Dynamic Correlations of Stock Returns: Evidence from Chinese A-Share and B-Share Markets. *Quantitative Finance*, 7(6): 651 – 667.

Christie A (1982): The stochastic behavior of common stock variances. *Journal of Financial Economics*, 10: 407–432.

Çelik S (2012): The more contagion effect on emerging markets: The evidence of DCC-GARCH model. *Economic Modelling*, 29: 1946-1959.

Dajcman S (2012): The Dynamics of Return Comovement and Spillovers Between the Czech and European Stock Markets in the Period 1997-2010. *Finance a úvěr-Czech Journal of Economics and Finance*, 62(4): 368-390.

Dumas B, Solnik B. (1995): The world price of foreign exchange risk. *Journal of Finance*, 50: 445-479.

Egert B, Kocenda E. (2011): Time-varying Synchronization of European Stock Markets. *Empirical Economics*, 40: 393-407.

Engle R. (2002): Dynamic Conditional Correlation: A Simple Class of Multivariate Generalized Autoregressive Conditional Heteroskedasticity Models. *Journal of Business & Economic Statistics* 20: 339-350.

Engle R. (2009): *Anticipating Correlations: A New Paradigm for Risk Management*. Princeton University Press, Princeton.

Forbes KJ, Menzie DC (2004): A Decomposition of Global Linkages in Financial Markets Over Time. *The Review of Economics and Statistics*, 86(3): 705-722.

Forbes K, Rigobon R (2002): No Contagion, Only Interdependence: Measuring Stock Market Co-movements. *Journal of Finance*, 57: 2223-2262.

Fuinhas JA, Marques A (2012): Energy consumption and economic growth nexus in Portugal, Italy, Greece, Spain, and Turkey: An ARDL bounds test approach (1965–2009). *Energy Economics*, 34: 511–517.

Hakkio C, Keeton WR (2009): Financial Stress: What is it, how can it be measured, and why does it matter? *Economic Review*, 2: 5-50.

Hooper V, Hume T, Kim SJ (2008): Sovereign rating changes- Do they provide new information for stock markets? *Economic Systems*, 32: 142-166.

Horvath R, Petrovski D (2013): International stock market integration: Central and South Eastern Europe compared. *Economic Systems*, 37: 81-91.

Hwang E, Mina HG, Kim BH, Kim H (2013): Determinants of stock market comovements among the US and emerging economies during the US financial crisis. *Economic Modelling*, 35: 338-348.

Kenourgios D, Samitas A, Paltalidis N (2011): Financial crises and stock market contagion in a multivariate time-varying asymmetric framework. *Journal of International Financial Markets, Institutions and Money*, 21(1): 92–106.

Kim BH, Kima H, Lee BS (2015): Spillover Effects of the U.S. Financial Crisis on Financial Markets in Emerging Asian Countries. Retrieved from Auburn University Department of Economics Working Paper Series: http://cla.auburn.edu/econwp/Archives/2015/2015-01.pdf

Krugman P (2009): The TIPS spread. Retrieved September 9, 2014, from The New York Times: http://krugman.blogs.nytimes.com/2009/01/16/the-tips-spread/?_php=true&_type=blogs&_r=0

Lahrech A, Sylwester K (2011): U.S. and Latin American stock market linkages. *Journal of International Money and Finance*, 30: 1341-1357.

Lashgari, M. (2000): The Role of Ted Spread and Confidence Index in Explaining the Behavior of Stock Prices. American Business review, 18(2): 9-11.

Li H, Jeon BN, Cho SY, Chiang TC. (2008): The impact of sovereign rating changes and financial contagion on stock market returns: Evidence from five Asian countries. *Global Finance Journal*, 19: 46-55.

Longstaff F, Pan J, Pedersen LH, Singleton KJ (2007): How Sovereign is Sovereign Credit Risk? NBER Working Paper No.13658. Retrieved from http://www.nber.org/papers/w13658

Mandelbrot BB (1963): The variation of certain speculative prices. *Journal of Business*, 36: 392–417.

Min HG, Shin SO, Jo Y (2013): Dynamic Interactions of Stock Market and Foreign Exchange Market for Six OECD Countries during the US Financial Crisis. Retrieved September 3, 2015, from http://www.kmfa.or.kr/down/1C-1.pdf

Mina HG, Hwang YS (2012): Dynamic correlation analysis of US financial crisis and contagion: evidence from four OECD countries. *Applied Financial Economics*, 22: 2063-74.

Pan J, Singleton KJ (2008): Default and Recovery Implicit in the Term Structure of Sovereign CDS Spreads. *The Journal of Finance*, 63(5): 2345-2384.

Phillips P, Sul D (2007): Transition Modeling and Econometric Convergence Tests. *Econometrica*, 75: 1771-1855.

Phylaktis K, Ravazzolo F (2004): Currency risk in emerging equity markets. *Emerging Markets Review*, 5(3): 317-339.

Roumpis E, Syriopoulus T (2009): Dynamic correlations and volatility effects in the Balkan equity markets. *Journal of International Financial Markets, Institutions and Money*, 19: 565-587.

Saiti B, Bacha O, Masih M (2014): The diversification benefits from Islamic investment during the financial turmoil: The case for the US-based equity investors. *Borsa İstanbul Review*, 14 (4): 196-211.

Saleem K, Vaihekoski M (2010): Time-varying global and local sources of market and currency risks in Russian stock market. *International Review of Economics and Finance*, 19: 686-697.

Samarakoon L (2011): Stock market interdependence,contagion, and the U.S. financial crisis: The case of emerging and frontier markets. *Journal of International Financial Markets, Institutions&Money*, 21: 724-742.

Santis G, Gerard B (1998): How big is the premium for currency risk? *Journal of Financial Economics*, 49: 375-412.

Serletes A, King M (1997): Common Stochastic Trends and Convergence of European Union Stock Markets. 65(1): 44-57.

Syriopoulos T (2011): Financial Integration and portfolio investments to emerging Balkan equity markets. *Journal of Multinational Financial Management*, 21: 40-54.

Uğur M, Guidi F (2014): An analysis of South-Eastern European stock markets: Evidence on cointegration and portfolio diversification benefits. *Journal of International Financial Markets, Institutions and Money*, 30: 119-136.

Whaley R (2009): Understanding the VIX. *Journal of Portfolio Management*, 35: 98-105.

Wu G (2001): The determinants of asymmetric volatility. *Review of Financial Studies*, 14: 837–859.

Yu I, Fung KP, Tam, C. S. (2010): Assessing Financial Market Integration in Asia- Equity Markets. *Journal of Banking and Finance*, 34: 2874-2885.

Yüce A, Simga-Mugan C (2000): Linkages among Eastern European Stock Markets and the Major Stock Exchanges. *Russian and East European Finance and Trade*, 36(6): 54-69.