FOURIER CAUSALITY AND VOLATILITY SPILLOVER PERSPECTIVES TO ANALYZE THE EFFECT OF TERRORISM ON TURKISH AND EUROPEAN STOCK MARKETS

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ABSTRACT

Terrorism has become a curse for most of the underdeveloped economies. Even relatively developed regions like Europe and Turkey are struggling to combat it. Besides the economic and political consequences, terrorist activities also have psychological cost that may reflect in stock market. This study investigates the causal effects of systematic shocks on mean returns and volatility of the general and 14 sectoral indices in Europe and Turkey using contemporary causality tests like Fourier Toda-Yamamoto Causality test (Nazlioglu et al., 2016), Fourier Standard Granger Causality test (Enders and Jones, 2015), and Causality in Variance (Hafner and Herwartz, 2006). Tourism related sectors turn out to be fragile whereas financial sector have significant resilience to terrorist attacks. Moreover, the spillover analysis shows that the Turkish stock market turns out to be more fragile to terrorist attacks in Europe than the other way around.

Keywords: Terrorism; Turkish and European Stock Markets; Fourier Causality

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1. Introduction

Terrorism has become a curse for most of the underdeveloped economies. Even relatively developed regions are struggling to combat it. Besides the economic and political consequences, terrorist activities also have psychological cost that may reflect in stock market. It is increasingly becoming a serious threat to the world especially for Europe and Turkey. The recent emergence of so-called Islamic State (IS), a terrorist organization mainly operating in Iraq and Syria, has been constantly involved in international terrorist activities, mainly in Europe and Turkey, for the last couple of years, and continue to threaten for more severe terrorist attacks. According to a recent report of JTIC (Jane's Terrorism and Insurgency Center), 2018:

> "In the five- to 10-year outlook, European countries will face an elevated terrorism threat posed by radicalized convicts, returned foreign fighters and other returnees who have direct ties to the legacy of the Islamic State,"

Significant number of prisoners, who are convicted for having relations with terrorist organizations or somehow involved in terrorist activities, are likely to be released between 2019 and 2023 (IHS Markit, Henry Jackson Society). According to the report, international terrorist attacks would be the primary focus of IS in the upcoming years and Europe is the most probable target that would increase the terrorism risk in the region.

Turkey, being the EU's 5th largest export market and 4th largest provider of imports, is the one of worse victims of terrorism in the region. The recent wave of terrorism starting with IS has severely affected Turkey; and its geo-political policies has put it on the hit list of the terrorist organizations. Recent insurgence in Syria has increased the terrorism risk even further. It is in the eye of the storm. Many western governments are warning their citizens to avoid touristic visits to Turkey. Terrorist attacks not only effect the economic activities but also may have psychological effects on investors that may influences their behavior.

The purpose of this study is to understand the effect of this type of systematic shocks on stock market performance in Turkey and EU using recently developed Fourier Standard Granger Causality test (Enders and Jones, 2015), Fourier Toda-Yamamoto Causality test (Nazlioglu et al., 2016) and Causality in Variance (Hafner and Herwartz, 2006). This study focuses on answering the following questions: how terrorist attacks effect mean returns of general and sectoral indices in Turkey and EU stock markets? how terrorist attacks effect the volatility of general and sectoral indices in Turkey and EU stocks markets.

Turkey, also being the member of Euro-Mediterranean Partnership and a candidate for EU membership since 1999, has strong economic ties with EU (see Figure 1). EU is the Turkey's largest export market with 41% of its total exports. Moreover, Turkey imports 26% of its imports from EU, that makes EU the largest provider of imports. On the other hand, Turkey hosts around 40% of its tourists from EU every year, that makes EU the largest market for tourism as well. Given the strong economic relations and geographical proximity, the likelihood of the systematic shocks in one market to spillover to the other is higher. Hence, the study also investigates how terrorist attacks in EU effect the mean returns and volatility of the overall and sectoral indices in Turkey and how terrorist attacks in Turkey effect the mean returns and volatility of the overall and sectoral indices in EU.

Figure 1. EU-Turkey Trade Relations

Source: European Commission[1]

Literature has some event specific studies that focus on analyzing spillover effects of terrorist attacks occurred in one country to the stock market performance of some other one. For example, Chen and Siems (2004) studies the effect of 14 terrorist attacks, Iraq's invasion in Kuwait and 9/11 attacks on global stock markets and finds banking and financial to be more resilient as compared to other ones. Chesney et al. (2011) analyzes the effect of 77 significant terrorist attacks in 25 countries on world markets and show that the US and European stock markets are more resistant, moreover, the airline and insurance sectors turn out to be the most

[1] https://policy.trade.ec.europa.eu/eu-trade-relationships-country-and-region/countries-and-regions/turkiye_en

vulnerable ones. In contrast, the banking sector has the highest immunity from the terrorist attacks. Kollias et al., (2011) also found the banking sector to be more resilient, and insurance, real estate and telecom sectors rebounds quickly in the European stock markets. Charles and Darne (2006) show that the international stock markets experience large shocks in response to 9/11 attacks. Moreover, many studies like Kolaric and Schiereck (2016), Raza and Jawaid (2013), Feridun (2011), Concepcion et al. (2003), Drakos and Kutan (2003), Fleischer and Buccola (2002), Arunatilake et al. (2001) and Enders et al. (1992) have consensus on vulnerability of tourism related sector to the terrorist activities.

A recent wave of studies like Suleman (2012), Bashir et al., (2013) and Balcilar et al., (2016) focus on the impact of overall terrorist activities in a country to not only on the mean returns but also on the volatility of the stock market in the respective countries. We have not come across any study that analyzes the impact of overall terrorist activities on the mean returns and volatility of the respective stock markets of Turkey and Europe, the closely connected regions and, currently, on the hit list of the international terrorist organizations, as well as the spillover effect of terrorist activities occurred in one region to other one. Also, this study uses contemporary causality tests like Fourier Standard Granger Causality test (Enders and Jones, 2015), Fourier Toda-Yamamoto Causality test (Nazlioglu et al., 2016) and Causality in Variance (Hafner and Herwartz, 2006).

Though terrorism is a well-studied topic in literature, many researchers are still trying to decipher the various aspects of its economic consequences in different markets (e.g. Narayan et al. (2018), El Ouadghiri & Peillex (2018), Javaid et al. (2018)). The salient features of this study are: analyzing overall and sectoral impact of terrorism on the stock markets of two of the most important NATO allies, using modern techniques that can capture even the smooth transitions, discovering the cross-causality of terrorist activities in both regions, and identifying relatively safe sectors for investment in the face of high security risk.

After the brief introduction, the rest of the paper is organized as follows. The next section contains data used followed by the empirical methodology. Later part gives findings and discussion. Lastly, a brief conclusion of study is provided.

2. Data

The study uses daily stock market data for general and 14 sectoral indices from Turkey and Europe. The sectors include Financials, Banks, Insurance, Information Technologies, Telecommunication, Tourism, Transportation, Food Beverage, Industrials, Metal Products Machinery, Electricity, Real Estate Invest Trusts, Wholesale & Retail Trade, Services, Energy, Healthcare and Aerospace & Defense. The Turkish data contains Borsa Istanbul (BIST) indices, however, the European data includes popular indices provided by MSCI, STOXX and FTSE. Daily Terror Index (DTI), proposed by Eckstein and Tsiddon (2004) in Eq. (1), to gauge the terrorist activities in Turkey and Europe.

$$DTI = \log(e + c + i + t)\,; \qquad (1)$$

where, 'e' is the exponent, 'c' represents number of human causalities, 'i' shows number of people injured and 't' is number of terrorist attacks occurred each day.

The higher the index, the higher is the severity of the terrorist incident. Both Turkey and Europe have been victim of this plague. However, it is quite obvious that both severity and frequency of the attacks have increased in recent years.

3. Empirical Methodology

3.1. Causality Tests and Fourier Approximation

In order to investigate the causal links from terrorist attacks to stock market performance Fourier Standard Causality Test (Enders and Jones, 2015) and Fourier Toda-Yamamoto Causality Test (Nazlioglu et al., 2016) are used. These contemporary tests include Fourier approximations to the Standard Granger Causality test and Toda-Yamamoto (1995) Causality test and try to overcome the limitations of these tests. The following VAR (p) model is used to test the Granger causality:

$$r_t = \alpha_0 + \alpha_1 r_{t-1} + \cdots + \alpha_p r_{t-p} + \beta_0 DTI_t + \beta_1 DTI_{t-1} + \cdots + \beta_q DTI_{t-q} + \epsilon_t \qquad (2)$$

$$H_0: \beta_0 = \beta_1 = \cdots = \beta_q = 0; \qquad No\ Causality\ from\ DTI\ to\ 'r' \qquad (3)$$

Here, 'r' represents returns and 'DTI' shows daily terror index. Both F and Wald statistics can be used to test the above hypothesis.

$$W - stat = \frac{(Rb-r)'\left[R(X'X)^{-1}R'\right]^{-1}(Rb-r)}{\hat{\delta}^2} \sim \chi_p^2 \quad (4)$$

Here, 'b' is the number of parameters of unrestricted model, 'r' shows the number of restrictions, 'R' represents the restricted matrix and $\hat{\delta}^2$ is the error variance. However, there are three main assumptions of this test: both the variables should be level stationary, the stability condition and no autocorrelation among the residuals. To overcome the stationarity problem, VECM-based causality test was developed. However, this new version brought another assumption that the variables should be stationary at same degree and there must be cointegration relation between them.

Toda-Yamamoto (1995) developed a causality test that overcome the limitations of both the above tests by using the following Var (p+dmax) test equation, where 'dmax' is the maximum unit root degree of the variables.

$$r_t = \alpha_0 + \alpha_1 r_{t-1} + \cdots + \alpha_p r_{t-p} + \beta_p DTI_{t-p} + \alpha_{p+dmax}.r_{t-(p+dmax)} + \beta_{p+dmax} DTI_{t+dmax} + \epsilon_t \quad (5)$$

$$H_0: \beta_1 = \cdots = \beta_q = 0; \qquad No\ Causality\ from\ DTI\ to\ 'r' \quad (6)$$

$$H_1: \beta_j \neq 0; \qquad Causality\ is\ present\ from\ DTI\ to\ 'r' \quad (7)$$

$$W - stat = T.\frac{RSS_R - RSS_{UR}}{RSS_{UR}} \sim \chi_p^2 \quad (8)$$

Here, RSS_R shows sum of squared residuals of restricted model, RSS_{UR} represents the sum of squared residuals of unrestricted model and 'p' is the number of restrictions.

Stock markets are one of the most responsive market of an economy to the systematic shocks like terrorist attacks. Therefore, the likelihood of having structural shifts in the data is significant. The tests discussed above do not consider the structural breaks while testing causality. A common approach for modeling structural shifts is to use dummy variables in the test equation, that can handle sharp shifts only. Later, smooth transition approaches, mostly used in

ARCH-type models for modeling volatility like STAR (Smooth Transitions Autoregressive) models (Kung-sik Chan and Howell Tong, 1986), was developed. However, both types require identifying number of structural shifts and their approximate timing. Enders and Jones (2015) developed Fourier version of the standard Granger causality test. It uses Fourier approximation (Gallant, 1981), which helps to model even smooth structural shifts without any prior knowledge about the structural shifts by employing few low frequency components, to take into account the structural shifts in data while testing causality linkages. The Fourier version modifies the VAR(p) test equation of the standard Granger causality test as follows:

$$r_t = \alpha_0 + Z'_t\delta + \sum_{j=1}^{p}\alpha_j r_{t-j} + \sum_{j=1}^{p}\beta_j DTI_{t-j} + \varepsilon_t; \quad (9)$$

$$Z_t = [d_{1t}, d_{2t}]; \quad (10)$$

where d_{1t} and d_{2t} denotes the structural shifts in $r_t$and DTI_t. To capture structural breaks as a steady process with unknown date, number and form of breaks, the Fourier approximation is applied to the above as given below:

$$Z_t = \left[\sin\left(\frac{2\pi kt}{T}\right), \cos\left(\frac{2\pi kt}{T}\right)\right] \quad (11)$$

Substituting the $Z_t$into the Eq.10 takes the following form having single Fourier frequency:

$$r_t = \alpha_0 + \gamma_1 \sin\left(\frac{2\pi kt}{T}\right) + \gamma_2 \cos\left(\frac{2\pi kt}{T}\right) + \sum_{j=1}^{p}\alpha_j r_{t-j} + \sum_{j=1}^{p}\beta_j DTI_{t-j} + \varepsilon_t \quad (12)$$

where 'k' is the frequency for the approximation, γ_1 denotes the amplitude and γ_2 shows the displacement of the frequency. Single Fourier frequencey is preferred as using larger frequencies decrease degree of freedom due to stochastic parameter variation that ultimately leads to over-fitting problem (Becker et al., 2006). The null hypothesis of standard Granger Causality of no causality, given in Eq. 3, is tested using Wald statistic.

Fourier version of Toda-Yamamoto causality test, developed by Nazlioglu et al., (2016), is also used. It modifies the VAR(p+d) test equation of Toda-Yamamoto (1995) test as follows:

$$r_t = \alpha_0 + \gamma_1 \sin\left(\frac{2\pi kt}{T}\right) + \gamma_2 \cos\left(\frac{2\pi kt}{T}\right) + \alpha_1 r_{t-1} + \cdots + \alpha_{p+d} r_{t-(p+d)} + \beta_1 DTI_{t-1} + \cdots + \beta_{p+d} DTI_{t-(p+d)} \quad (13)$$

where ‘p’ shows the lag length and ‘d’ denotes the maximum integration degree of the variables. The lag length is measured using Akaike information criterion.

3.2. Causality in Variance

Causality in variance test (Hafner and Herwartz, 2006), also known as volatility spillover, is used to test causality in variance from terrorist attacks to stock markets’ sectoral and overall indices. The test uses Lagrange Multiplier (LM) statistic to identify the existence and direction of dynamic volatility spillover. The null hypothesis of no causality in variance is tested by estimating a GARCH (p,q) model for the series and obtaining standardized residuals and the conditional variance.

$$\varepsilon_{it} = \xi_{rt}\sqrt{\sigma_{rt}^2}(1 + z'_{DTI}\pi), \quad z_{(DTI)t} = (\varepsilon_{DTI\,(t-1)}^2, \sigma_{DTI(t-1)}^2) \quad (14)$$

where ξ_{rt} and σ_{rt}^2 denote the standardized residuals and the conditional variance for the series ‘r’, respectively; $\varepsilon_{DTI\,(t-1)}^2$ and $\sigma_{DTI(t-1)}^2$ show squared residuals and the volatility for the series DTI.

$$H_0: \pi = 0; \ \ no\ causality\ in\ variance \quad (15)$$

$$H_1: \pi \neq 0; \ \ causality\ in\ variance$$

The hypothesis is test using the following LM test statistic:

$$\lambda_{LM} = \frac{1}{4T}\left(\sum_{t=1}^{T}(\xi_{it}^2 - 1)z'_{jt}\right) V(\theta_i)^{-1}\left(\sum_{t=1}^{T}(\xi_{it}^2 - 1)z_{jt}\right) \sim \chi_p^2 \quad (16)$$

$$V(\theta_i) = \frac{K}{4T}\left(\sum_{t=1}^{T} z_{jt}\, z'_{jt} - \sum_{t=1}^{T} z_{jt}\, x'_{it}\left(\sum_{t=1}^{T} x_{it}\, x'_{it}\right)^{-1}\sum_{t=1}^{T} x_{it}\, z'_{jt}\right), \ K = \frac{1}{T}\sum_{t=1}^{T}(\xi_{it}^2 - 1)^2 \quad (17)$$

4. Findings & Discussion

Table 1 shows the results for causality in mean and variance from terrorist attacks occurred in Turkey and Europe on the overall and sectoral indices of the respective stock markets. In Turkey, there is no significant causality found from terrorist incidents to the mean returns of any of the sectoral and overall indices. However, significant causality in variance is found in overall and tourism, transportation and food & beverages sectors in Turkey. This finding is in line with Balcilar et al. (2016) and Feridun (2011). Moreover, there is causality in variance in some other sectors like IT, industrials, metal products, electricity, real estate and services. In contrast, no significant causality is found both in mean and variance in insurance and banking sector indices. This implies that the Turkish financial sector is more immune to terrorist activities as compared to the other one. Besides financial, there are other sectors like telecom and wholesale & retail trade that are not affected by the terrorist activities.

Table 1a. Causality in Mean and Variance from Daily Terror Index (DTI) to Overall and Sectoral Indices

Turkey					Europe				
	Causality in Mean		Causality in Variance			Causality in Mean		Causality in Variance	
	Wald stat	p - value	LM stat.	p - value		Wald stat	p - value	LM stat.	p -value
DTI to BIST 100			27.662	0.000	**DTI to MSCI Europe**			4.206	0.122
Standard Granger Causality	9.494	0.66			Standard Granger Causality	6.759	0.873		
Toda & Yamamoto	9.428	0.666			Toda & Yamamoto	5.865	0.556		
Fourier Standard GC Single Freq.	9.717	0.641			Fourier Standard GC Single Freq.	6.592	0.883		
Fourier Toda & Yamamoto Single Freq.	9.424	0.666			Fourier Toda & Yamamoto Single Freq.	5.203	0.635		
Fourier Standard GC Cumulative Freq.	9.353	0.672			Fourier Standard GC Cumulative Freq.	6.206	0.905		
Fourier Toda & Yamamoto Cum. Freq.	9.395	0.669			Fourier Toda & Yamamoto Cum. Freq.	5.057	0.653		
DTI to BIST 30			24.182	0.000	**DTI to MSCI Europe Financials**			3.442	0.179
Standard Granger Causality	9.515	0.658			Standard Granger Causality	7.555	0.819		
Toda & Yamamoto	9.51	0.659			Toda & Yamamoto	4.159	0.761		
Fourier Standard GC Single Freq.	9.632	0.648			Fourier Standard GC Single Freq.	6.572	0.885		
Fourier Toda & Yamamoto Single Freq.	9.512	0.659			Fourier Toda & Yamamoto Single Freq.	3.423	0.843		
Fourier Standard GC Cumulative Freq.	9.428	0.666			Fourier Standard GC Cumulative Freq.	6.26	0.902		
Fourier Toda & Yamamoto Cum. Freq.	9.513	0.659			Fourier Toda & Yamamoto Cum. Freq.	2.606	0.919		
DTI to BIST Banks			2.405	0.300	**DTI to Stoxx Banks**			0.355	0.838
Standard Granger Causality	7.064	0.853			Standard Granger Causality	13.937	0.305		
Toda & Yamamoto	7.102	0.851			Toda & Yamamoto	7.004	0.136		
Fourier Standard GC Single Freq.	7.137	0.848			Fourier Standard GC Single Freq.	14.706	0.258		
Fourier Toda & Yamamoto Single Freq.	7.187	0.845			Fourier Toda & Yamamoto Single Freq.	9.192	0.102		
Fourier Standard GC Cumulative Freq.	7.141	0.848			Fourier Standard GC Cumulative Freq.	14.418	0.275		
Fourier Toda & Yamamoto Cum. Freq.	7.336	0.835			Fourier Toda & Yamamoto Cum. Freq.	8.721	0.121		
DTI to BIST Insurance			0.978	0.613	**DTI to Stoxx Insurance**			2.211	0.331
Standard Granger Causality	9.413	0.667			Standard Granger Causality	11.845	0.375		
Toda & Yamamoto	9.368	0.671			Toda & Yamamoto	3.299	0.192		
Fourier Standard GC Single Freq.	9.539	0.656			Fourier Standard GC Single Freq.	11.613	0.393		
Fourier Toda & Yamamoto Single Freq.	9.369	0.671			Fourier Toda & Yamamoto Single Freq.	3.183	0.204		
Fourier Standard GC Cumulative Freq.	9.363	0.672			Fourier Standard GC Cumulative Freq.	12.827	0.305		
Fourier Toda & Yamamoto Cum. Freq.	9.341	0.674			Fourier Toda & Yamamoto Cum. Freq.	3.507	0.173		
DTI to BIST Tourism			33.304	0.000	**DTI to MSCI Europe IT**			16.277	0.000
Standard Granger Causality	8.903	0.711			Standard Granger Causality	10.885	0.539		
Toda & Yamamoto	8.631	0.734			Toda & Yamamoto	5.506	0.598		
Fourier Standard GC Single Freq.	9.321	0.675			Fourier Standard GC Single Freq.	10.778	0.548		
Fourier Toda & Yamamoto Single Freq.	8.932	0.709			Fourier Toda & Yamamoto Single Freq.	5.562	0.592		
Fourier Standard GC Cumulative Freq.	8.819	0.718			Fourier Standard GC Cumulative Freq.	12.331	0.419		
Fourier Toda & Yamamoto Cum. Freq.	8.669	0.731			Fourier Toda & Yamamoto Cum. Freq.	5.737	0.571		
DTI to BIST IT			29.759	0.000	**DTI to MSCI Europe Telecom**			6.111	0.047
Standard Granger Causality	11.368	0.498			Standard Granger Causality	10.885	0.539		
Toda & Yamamoto	11.128	0.518			Toda & Yamamoto	5.506	0.598		
Fourier Standard GC Single Freq.	11.886	0.455			Fourier Standard GC Single Freq.	10.778	0.548		
Fourier Toda & Yamamoto Single Freq.	10.992	0.53			Fourier Toda & Yamamoto Single Freq.	5.562	0.592		
Fourier Standard GC Cumulative Freq.	12.046	0.442			Fourier Standard GC Cumulative Freq.	12.331	0.419		
Fourier Toda & Yamamoto Cum. Freq.	11.099	0.52			Fourier Toda & Yamamoto Cum. Freq.	5.737	0.571		
DTI to BIST Telecom			1.16	0.560	**DTI to Stoxx 600 Travel & Leisure**			5.556	0.062
Standard Granger Causality	1.977	0.99			Standard Granger Causality	28.004	0.006		
Toda & Yamamoto	3.663	0.989			Toda & Yamamoto	14.022	0.001		
Fourier Standard GC Single Freq.	1.919	0.99			Fourier Standard GC Single Freq.	27.056	0.008		
Fourier Toda & Yamamoto Single Freq.	3.248	0.994			Fourier Toda & Yamamoto Single Freq.	13.652	0.001		
Fourier Standard GC Cumulative Freq.	1.88	0.99			Fourier Standard GC Cumulative Freq.	28.236	0.005		
Fourier Toda & Yamamoto Cum. Freq.	2.18	0.99			Fourier Toda & Yamamoto Cum. Freq.	14.087	0.001		

On the other hand, in Europe, the situation is different. The terrorist incidents do not affect general indices; however, the terrorist attacks significantly affect the mean returns and volatility of travel & leisure, food & beverages, industrial and health care sectors. This finding supports the results of Arin et al., (2008). Here, Toda-Yamamoto (1995) causality test and its more advanced version Fourier Toda-Yamamoto (2016) turns out to be more useful in capturing the causality as compared to the Standard Granger causality tests especially in food & beverages and health-care sectors. Furthermore, significance causality in variance is found in IT, telecom, materials, utilities and energy sector indices.

Table 1b. Causality in Mean and Variance from Daily Terror Index (DTI) to Overall and Sectoral Indices

	Turkey					Europe			
	Causality in Mean		Causality in Variance			Causality in Mean		Causality in Variance	
	Wald stat	p - value	LM stat.	p - value		Wald stat	p - value	LM stat.	p -value
DTI to BIST Transportation			24.374	0.000	**DTI to Stoxx 600 Food & Beverages**			15.43	0.000
Standard Granger Causality	14.855	0.249			Standard Granger Causality	15.899	0.196		
Toda & Yamamoto	13.994	0.301			Toda & Yamamoto	8.499	0.014		
Fourier Standard GC Single Freq.	14.446	0.273			Fourier Standard GC Single Freq.	15.358	0.222		
Fourier Toda & Yamamoto Single Freq.	13.907	0.307			Fourier Toda & Yamamoto Single Freq.	8.329	0.016		
Fourier Standard GC Cumulative Freq.	13.797	0.314			Fourier Standard GC Cumulative Freq.	16.556	0.167		
Fourier Toda & Yamamoto Cum. Freq.	13.619	0.326			Fourier Toda & Yamamoto Cum. Freq.	8.604	0.014		
DTI to BIST Food&Beverages			7.906	0.019	**DTI to MSCI Europe Industrials**			10.908	0.004
Standard Granger Causality	13.797	0.314			Standard Granger Causality	21.244	0.047		
Toda & Yamamoto	13.783	0.315			Toda & Yamamoto	10.312	0.067		
Fourier Standard GC Single Freq.	14.533	0.268			Fourier Standard GC Single Freq.	20.876	0.052		
Fourier Toda & Yamamoto Single Freq.	13.642	0.324			Fourier Toda & Yamamoto Single Freq.	10.432	0.064		
Fourier Standard GC Cumulative Freq.	13.293	0.348			Fourier Standard GC Cumulative Freq.	21.581	0.042		
Fourier Toda & Yamamoto Cum. Freq.	13.428	0.339			Fourier Toda & Yamamoto Cum. Freq.	10.09	0.073		
DTI to BIST Industrials			18.774	0.000	**DTI to MSCI Europe Materials**			10.243	0.006
Standard Granger Causality	10.597	0.564			Standard Granger Causality	10.885	0.539		
Toda & Yamamoto	10.483	0.574			Toda & Yamamoto	5.506	0.598		
Fourier Standard GC Single Freq.	11.169	0.515			Fourier Standard GC Single Freq.	10.778	0.548		
Fourier Toda & Yamamoto Single Freq.	10.625	0.561			Fourier Toda & Yamamoto Single Freq.	5.562	0.592		
Fourier Standard GC Cumulative Freq.	10.842	0.542			Fourier Standard GC Cumulative Freq.	12.331	0.419		
Fourier Toda & Yamamoto Cum. Freq.	10.718	0.553			Fourier Toda & Yamamoto Cum. Freq.	5.737	0.571		
DTI to BIST Metal Products Machinery			7.566	0.023	**DTI to MSCI Europe Utilities**			9.339	0.009
Standard Granger Causality	7.874	0.795			Standard Granger Causality	5.728	0.929		
Toda & Yamamoto	7.804	0.8			Toda & Yamamoto	5.845	0.924		
Fourier Standard GC Single Freq.	7.988	0.786			Fourier Standard GC Single Freq.	5.788	0.926		
Fourier Toda & Yamamoto Single Freq.	8.038	0.782			Fourier Toda & Yamamoto Single Freq.	5.425	0.942		
Fourier Standard GC Cumulative Freq.	8.105	0.777			Fourier Standard GC Cumulative Freq.	5.339	0.946		
Fourier Toda & Yamamoto Cum. Freq.	7.996	0.785			Fourier Toda & Yamamoto Cum. Freq.	5.419	0.943		
DTI to BIST Electricity			31.88	0.000	**DTI to MSCI Europe Energy**			12.089	0.002
Standard Granger Causality	11.994	0.446			Standard Granger Causality	6.77	0.872		
Toda & Yamamoto	11.901	0.454			Toda & Yamamoto	3.095	0.213		
Fourier Standard GC Single Freq.	11.983	0.447			Fourier Standard GC Single Freq.	6.811	0.87		
Fourier Toda & Yamamoto Single Freq.	11.898	0.454			Fourier Toda & Yamamoto Single Freq.	3.27	0.195		
Fourier Standard GC Cumulative Freq.	12.287	0.423			Fourier Standard GC Cumulative Freq.	7.182	0.845		
Fourier Toda & Yamamoto Cum. Freq.	12.074	0.44			Fourier Toda & Yamamoto Cum. Freq.	3.595	0.166		
DTI to BIST Real Estate Invest. Trust			33.002	0.000	**DTI to MSCI Europe Health Care**			8.8	0.012
Standard Granger Causality	14.19	0.289			Standard Granger Causality	14.888	0.248		
Toda & Yamamoto	14.149	0.291			Toda & Yamamoto	7.954	0.019		
Fourier Standard GC Single Freq.	14.415	0.275			Fourier Standard GC Single Freq.	15.219	0.23		
Fourier Toda & Yamamoto Single Freq.	14.282	0.283			Fourier Toda & Yamamoto Single Freq.	8.184	0.017		
Fourier Standard GC Cumulative Freq.	14.188	0.289			Fourier Standard GC Cumulative Freq.	19.05	0.087		
Fourier Toda & Yamamoto Cum. Freq.	14.153	0.291			Fourier Toda & Yamamoto Cum. Freq.	9.49	0.009		
DTI to BIST Wholesale&Retail Trade			3.19	0.203	**DTI to STOXX Europe Real Estate**			3.824	0.148
Standard Granger Causality	5.893	0.921			Standard Granger Causality	8.747	0.724		
Toda & Yamamoto	5.7	0.93			Toda & Yamamoto	2.385	0.303		
Fourier Standard GC Single Freq.	6.427	0.893			Fourier Standard GC Single Freq.	8.49	0.746		
Fourier Toda & Yamamoto Single Freq.	5.469	0.94			Fourier Toda & Yamamoto Single Freq.	2.459	0.293		
Fourier Standard GC Cumulative Freq.	5.587	0.935			Fourier Standard GC Cumulative Freq.	8.88	0.713		
Fourier Toda & Yamamoto Cum. Freq.	5.519	0.938			Fourier Toda & Yamamoto Cum. Freq.	2.211	0.331		
DTI to BIST Services			24.711	0.000	**DTI to FTSE Aerospace & Defense**			2.238	0.327
Standard Granger Causality	9.655	0.646			Standard Granger Causality	10.687	0.556		
Toda & Yamamoto	9.459	0.663			Toda & Yamamoto	3.371	0.185		
Fourier Standard GC Single Freq.	9.904	0.624			Fourier Standard GC Single Freq.	10.45	0.577		
Fourier Toda & Yamamoto Single Freq.	9.19	0.687			Fourier Toda & Yamamoto Single Freq.	3.686	0.158		
Fourier Standard GC Cumulative Freq.	8.912	0.71			Fourier Standard GC Cumulative Freq.	11.016	0.528		
Fourier Toda & Yamamoto Cum. Freq.	9.025	0.701			Fourier Toda & Yamamoto Cum. Freq.	3.45	0.178		

Moreover, no significance causality, both in mean and variance, is present in financial sector indices like banks and insurance. Hence, financial sectors both in Turkey and Europe turns out to be more immune to terrorist activities as compared to other ones. The sectors are strong enough to combat this type of systematic shocks. This finding is partly in line with event specific studies of Chen and Siems (2004) that finds US financial sector less effected by 9/11 attacks and

Christofis (2010) that shows no effect of Istanbul 1999 bombings on banking sector. Other sectors that are resilient to terrorist incidents are real estate and aerospace & defense.

In order to see the effect of terrorism on individual markets in Europe, the overall and sectoral indices of five of the major European markets, Germany, France, UK, Spain and Norway, are also analyzed. The results show, the terrorist incidents effect the overall market volatilities in Germany, France, UK and Norway; however, in Spain, no significant effect is found in overall market. (see A1, A2 & A3 in appendix). The sectoral analysis proves the immunity of the banking sector from terrorist attacks in all of the markets. Moreover, the overall financial sectors also show resilience in all the markets except Germany and Norway. In Germany, significance causality in variance is also found in Transportation & Logistics and Healthcare sectors. In France, Consumer Service, Healthcare and Industrials sectors and, in UK, Travel & Leisure and Food Producers sectors seem to be among the fragile sectors. In Norway, along with Banks, Transportation and Healthcare sectors are also not affected by terrorist activities. Spanish stock market turns out be different than others as the overall and sectoral indices show resilience to terrorist attacks.

Table 2 show the results of cross causality from terrorist incidents occurred in Europe to Turkish stock market and from terrorist attacks happened in Turkey to European stock markets. In Turkey, except a minor causality to electricity sector, there is no significance effect on mean returns of general and sectoral indices. However, there is significance causality in variance of general and sectoral indices like tourism, IT, transportation, food & beverages, industrials, metal products, electricity, real estate and services. The sectors that are immune from terrorist attacks in Europe are Banks, insurance, telecom and wholesale & retail trade. Here, again the Turkish financial sector turns out to be resilient to the systematic shocks originating from Europe.

Table 2a. Causality from DTI Turkey to European Stock Markets and DTI Europe to Turkish Stock Market

Turkey (Cross)					Europe (Cross)				
	Causality in Mean		Causality in Variance			Causality in Mean		Causality in Variance	
	Wald stat	p -value	LM stat.	p -value		Wald stat	p -value	LM stat.	p -value
DTI to BIST 100			24.304	0.000	**DTI to MSCI Europe**			5.263	0.072
Standard Granger Causality	9.205	0.685			Standard Granger Causality	10.196	0.599		
Toda & Yamamoto	8.531	0.742			Toda & Yamamoto	8.805	0.551		
Fourier Standard GC Single Freq.	8.52	0.743			Fourier Standard GC Single Freq.	10.17	0.601		
Fourier Toda & Yamamoto Single Freq.	8.57	0.739			Fourier Toda & Yamamoto Single Freq.	8.897	0.542		
Fourier Standard GC Cumulative Freq.	8.58	0.715			Fourier Standard GC Cumulative Freq.	10.08	0.609		
Fourier Toda & Yamamoto Cum. Freq.	8.476	0.747			Fourier Toda & Yamamoto Cum. Freq.	8.788	0.552		
DTI to BIST 30			17.722	0.000	**DTI to MSCI Europe Financials**			8.613	0.014
Standard Granger Causality	9.532	0.657			Standard Granger Causality	13.417	0.339		
Toda & Yamamoto	8.846	0.716			Toda & Yamamoto	10.81	0.545		
Fourier Standard GC Single Freq.	8.85	0.716			Fourier Standard GC Single Freq.	13.645	0.324		
Fourier Toda & Yamamoto Single Freq.	8.921	0.71			Fourier Toda & Yamamoto Single Freq.	7.305	0.398		
Fourier Standard GC Cumulative Freq.	9.209	0.685			Fourier Standard GC Cumulative Freq.	11.8	0.462		
Fourier Toda & Yamamoto Cum. Freq.	8.833	0.717			Fourier Toda & Yamamoto Cum. Freq.	6.593	0.36		
DTI to BIST Banks			1.48	0.477	**DTI to Stoxx Banks**			4.642	0.098
Standard Granger Causality	7.967	0.788			Standard Granger Causality	12.988	0.37		
Toda & Yamamoto	7.289	0.838			Toda & Yamamoto	11.57	0.481		
Fourier Standard GC Single Freq.	7.101	0.851			Fourier Standard GC Single Freq.	11.161	0.515		
Fourier Toda & Yamamoto Single Freq.	7.182	0.845			Fourier Toda & Yamamoto Single Freq.	7.544	0.375		
Fourier Standard GC Cumulative Freq.	7.233	0.842			Fourier Standard GC Cumulative Freq.	11.006	0.528		
Fourier Toda & Yamamoto Cum. Freq.	6.906	0.864			Fourier Toda & Yamamoto Cum. Freq.	6.827	0.337		
DTI to BIST Insurance			0.768	0.681	**DTI to Stoxx Insurance**			6.257	0.044
Standard Granger Causality	9.243	0.682			Standard Granger Causality	8.672	0.731		
Toda & Yamamoto	9.097	0.695			Toda & Yamamoto	4.587	0.71		
Fourier Standard GC Single Freq.	8.74	0.725			Fourier Standard GC Single Freq.	7.494	0.823		
Fourier Toda & Yamamoto Single Freq.	9.066	0.697			Fourier Toda & Yamamoto Single Freq.	4.281	0.639		
Fourier Standard GC Cumulative Freq.	8.824	0.718			Fourier Standard GC Cumulative Freq.	5.99	0.917		
Fourier Toda & Yamamoto Cum. Freq.	8.71	0.727			Fourier Toda & Yamamoto Cum. Freq.	3.224	0.78		
DTI to BIST Tourism			23.368	0.000	**DTI to MSCI Europe IT**			14.213	0.001
Standard Granger Causality	14.056	0.297			Standard Granger Causality	9.764	0.637		
Toda & Yamamoto	13.453	0.337			Toda & Yamamoto	7.703	0.658		
Fourier Standard GC Single Freq.	13.268	0.35			Fourier Standard GC Single Freq.	12.21	0.429		
Fourier Toda & Yamamoto Single Freq.	13.648	0.324			Fourier Toda & Yamamoto Single Freq.	9.989	0.441		
Fourier Standard GC Cumulative Freq.	14.871	0.249			Fourier Standard GC Cumulative Freq.	10.947	0.534		
Fourier Toda & Yamamoto Cum. Freq.	14.435	0.274			Fourier Toda & Yamamoto Cum. Freq.	9.248	0.509		
DTI to BIST IT			25.138	0.000	**DTI to MSCI Europe Telecom**			8.157	0.017
Standard Granger Causality	9.303	0.677			Standard Granger Causality	16.895	0.154		
Toda & Yamamoto	9.292	0.678			Toda & Yamamoto	13.049	0.365		
Fourier Standard GC Single Freq.	9.291	0.678			Fourier Standard GC Single Freq.	13.829	0.312		
Fourier Toda & Yamamoto Single Freq.	9.323	0.675			Fourier Toda & Yamamoto Single Freq.	12.167	0.432		
Fourier Standard GC Cumulative Freq.	9.585	0.652			Fourier Standard GC Cumulative Freq.	12.954	0.372		
Fourier Toda & Yamamoto Cum. Freq.	9.604	0.651			Fourier Toda & Yamamoto Cum. Freq.	4.702	0.696		
DTI to BIST Telecom			0.505	0.777	**DTI to Stoxx 600 Travel & Leisure**			7.595	0.022
Standard Granger Causality	7.728	0.806			Standard Granger Causality	16.073	0.188		
Toda & Yamamoto	5.06	0.928			Toda & Yamamoto	13.458	0.062		
Fourier Standard GC Single Freq.	8.181	0.771			Fourier Standard GC Single Freq.	13.725	0.319		
Fourier Toda & Yamamoto Single Freq.	5.157	0.923			Fourier Toda & Yamamoto Single Freq.	10.849	0.093		
Fourier Standard GC Cumulative Freq.	8.829	0.717			Fourier Standard GC Cumulative Freq.	11.802	0.462		
Fourier Toda & Yamamoto Cum. Freq.	5.491	0.905			Fourier Toda & Yamamoto Cum. Freq.	9.787	0.134		

In Europe, there is no significant causality to the mean returns of general index and all the other sectoral indices except materials sector where a little evidence is found. As far as the causality in variance is concerned, no significance causality is found in the general index. However, significance causality is found in all the sectors except banks and aerospace & defense.

Table 2b. Causality from DTI Turkey to European Stock Markets and DTI Europe to Turkish Stock Market

Turkey (Cross)					Europe (Cross)				
	Causality in Mean		Causality in Variance			Causality in Mean		Causality in Variance	
	Wald stat	p -value	LM stat.	p -value		Wald stat	p -value	LM stat.	p -value
DTI to BIST Transportation			41.659	0.000	**DTI to Stoxx 600 Food & Beverages**			15.093	0.001
Standard Granger Causality	9.424	0.666			Standard Granger Causality	5.841	0.924		
Toda & Yamamoto	7.931	0.243			Toda & Yamamoto	5.152	0.924		
Fourier Standard GC Single Freq.	9.17	0.688			Fourier Standard GC Single Freq.	5.578	0.936		
Fourier Toda & Yamamoto Single Freq.	7.831	0.251			Fourier Toda & Yamamoto Single Freq.	3.825	0.7		
Fourier Standard GC Cumulative Freq.	9.072	0.672			Fourier Standard GC Cumulative Freq.	5.661	0.932		
Fourier Toda & Yamamoto Cum. Freq.	7.726	0.259			Fourier Toda & Yamamoto Cum. Freq.	3.807	0.703		
DTI to BIST Food&Beverages			12.077	0.002	**DTI to MSCI Europe Industrials**			10.678	0.005
Standard Granger Causality	18.064	0.114			Standard Granger Causality	7.072	0.853		
Toda & Yamamoto	17.53	0.131			Toda & Yamamoto	3.757	0.807		
Fourier Standard GC Single Freq.	17.286	0.139			Fourier Standard GC Single Freq.	7.352	0.833		
Fourier Toda & Yamamoto Single Freq.	17.34	0.137			Fourier Toda & Yamamoto Single Freq.	4.53	0.605		
Fourier Standard GC Cumulative Freq.	17.271	0.14			Fourier Standard GC Cumulative Freq.	6.896	0.864		
Fourier Toda & Yamamoto Cum. Freq.	16.937	0.152			Fourier Toda & Yamamoto Cum. Freq.	4.265	0.641		
DTI to BIST Industrials			17.51	0.000	**DTI to MSCI Europe Materials**			10.871	0.004
Standard Granger Causality	7.057	0.854			Standard Granger Causality	17.224	0.101		
Toda & Yamamoto	6.66	0.879			Toda & Yamamoto	17.223	0.07		
Fourier Standard GC Single Freq.	6.528	0.887			Fourier Standard GC Single Freq.	18.358	0.074		
Fourier Toda & Yamamoto Single Freq.	7.003	0.857			Fourier Toda & Yamamoto Single Freq.	18.346	0.049		
Fourier Standard GC Cumulative Freq.	7.207	0.844			Fourier Standard GC Cumulative Freq.	20.143	0.043		
Fourier Toda & Yamamoto Cum. Freq.	6.937	0.862			Fourier Toda & Yamamoto Cum. Freq.	20.06	0.029		
DTI to BIST Metal Products Machinery			6.456	0.040	**DTI to MSCI Europe Utilities**			12.785	0.002
Standard Granger Causality	3.495	0.991			Standard Granger Causality	14.456	0.273		
Toda & Yamamoto	3.447	0.991			Toda & Yamamoto	12.487	0.407		
Fourier Standard GC Single Freq.	3.23	0.994			Fourier Standard GC Single Freq.	12.015	0.444		
Fourier Toda & Yamamoto Single Freq.	4.191	0.98			Fourier Toda & Yamamoto Single Freq.	11.26	0.507		
Fourier Standard GC Cumulative Freq.	4.194	0.98			Fourier Standard GC Cumulative Freq.	13.196	0.355		
Fourier Toda & Yamamoto Cum. Freq.	4.178	0.98			Fourier Toda & Yamamoto Cum. Freq.	12.246	0.426		
DTI to BIST Electricity			25.717	0.000	**DTI to MSCI Europe Energy**			13.502	0.001
Standard Granger Causality	20.017	0.067			Standard Granger Causality	15.566	0.212		
Toda & Yamamoto	19.994	0.067			Toda & Yamamoto	13.757	0.247		
Fourier Standard GC Single Freq.	20.459	0.059			Fourier Standard GC Single Freq.	15.645	0.208		
Fourier Toda & Yamamoto Single Freq.	14.578	0.024			Fourier Toda & Yamamoto Single Freq.	10.061	0.185		
Fourier Standard GC Cumulative Freq.	20.547	0.057			Fourier Standard GC Cumulative Freq.	15.419	0.219		
Fourier Toda & Yamamoto Cum. Freq.	15.28	0.018			Fourier Toda & Yamamoto Cum. Freq.	9.955	0.191		
DTI to BIST Real Estate Invest. Trust			53.175	0.000	**DTI to MSCI Europe Health Care**			9.812	0.007
Standard Granger Causality	12.557	0.402			Standard Granger Causality	9.566	0.654		
Toda & Yamamoto	12.646	0.395			Toda & Yamamoto	11.019	0.527		
Fourier Standard GC Single Freq.	12.399	0.414			Fourier Standard GC Single Freq.	6.296	0.9		
Fourier Toda & Yamamoto Single Freq.	12.66	0.394			Fourier Toda & Yamamoto Single Freq.	2.2	0.9		
Fourier Standard GC Cumulative Freq.	12.54	0.403			Fourier Standard GC Cumulative Freq.	6.187	0.906		
Fourier Toda & Yamamoto Cum. Freq.	12.656	0.395			Fourier Toda & Yamamoto Cum. Freq.	1.99	0.921		
DTI to BIST Wholesale&Retail Trade			1.403	0.496	**DTI to STOXX Europe Real Estate**			7.486	0.024
Standard Granger Causality	9.084	0.696			Standard Granger Causality	8.227	0.607		
Toda & Yamamoto	8.378	0.755			Toda & Yamamoto	6.758	0.455		
Fourier Standard GC Single Freq.	8.651	0.732			Fourier Standard GC Single Freq.	7.389	0.688		
Fourier Toda & Yamamoto Single Freq.	7.775	0.802			Fourier Toda & Yamamoto Single Freq.	5.129	0.527		
Fourier Standard GC Cumulative Freq.	8.283	0.763			Fourier Standard GC Cumulative Freq.	6.599	0.763		
Fourier Toda & Yamamoto Cum. Freq.	7.907	0.792			Fourier Toda & Yamamoto Cum. Freq.	5.095	0.532		
DTI to BIST Services			19.669	0.000	**DTI to FTSE Aerospace & Defense**			3.509	0.173
Standard Granger Causality	11.399	0.495			Standard Granger Causality	9.127	0.692		
Toda & Yamamoto	10.453	0.576			Toda & Yamamoto	6.679	0.463		
Fourier Standard GC Single Freq.	10.641	0.56			Fourier Standard GC Single Freq.	8.603	0.736		
Fourier Toda & Yamamoto Single Freq.	10.04	0.612			Fourier Toda & Yamamoto Single Freq.	4.052	0.67		
Fourier Standard GC Cumulative Freq.	10.147	0.603			Fourier Standard GC Cumulative Freq.	8.274	0.763		
Fourier Toda & Yamamoto Cum. Freq.	9.698	0.642			Fourier Toda & Yamamoto Cum. Freq.	3.211	0.782		

The cross-causality analysis shows that terrorist activities have contagious effect on volatility in both Turkey and Europe. This is an evidence of financial globalization. The systematic shocks in one market, somehow, have the tendency to affect the volatility in the others. However, the shocks in Europe effect the volatility of general index but the shocks in Turkey do not affect the general index in Europe.

The evidence shows, the Turkish market is more fragile to external shocks as compared to Europe that shows resilience to external shocks. Another interesting finding is, the financial sector both in Turkey and Europe seem to have resistance to both local and external shocks. Moreover, the sectors that are more vulnerable as compared to the others are tourism related sectors. Hence, in face of high security threats, the investors would be better off if they avoid investing in tourism related sectors and prefer financial sector stocks especially banks and insurance companies.

5. Conclusion

The study analyses the psychological effects of terrorist attacks on investors' sentiments in Turkey and its close trading partner, the Europe.

The results show, in Turkey, these systematic shocks do not affect the mean returns of general and sectoral indices, however, they significantly effect the volatility of the general indices and most of the sectoral indices like tourism, IT, transportation, food & beverages, industrials, metal products, electricity, real estate and services. On the other hand, in Europe, the terrorist activities do not affect the mean returns of general and other sectoral indices, except travel & leisure, food & beverages and health care sectors. However, significant causality is found in the volatility of IT, telecom, travel & leisure, food & beverages, industrials, materials, utilities, energy and healthcare sectors but no causality in variance in the general, financials, banking, insurance, real estate, and aerospace & defense sectoral indices. The cross-causality analysis shows no significant causality from terrorist attacks in Europe to the mean returns of overall and sectoral indices in Turkey, however, significance causality in variance is found in general indices and sectoral indices except banking, insurance, telecom and trading sectors. On the other hand, no significant causality is found from the terrorist activities in Turkey to overall and sectoral indices in Europe except materials, however, significant causality in volatility is found in all the sectors except general, banking and aerospace & defense sectoral indices. Furthermore, individual analysis of the European markets also indicates a resilient banking sector and fragile tourism related sectors. The Spanish market turns out to be the most resilient one to the terrorist attacks.

In nutshell, the terrorist incidents do not affect the general and sectoral indices in Turkey but do affect the mean returns as well as the volatility of tourism related sectors in Europe. This shows that the that any kind of potential terrorist activities is already priced in Turkey; and investment in Turkish tourism sector is more attractive. The people there are more cautious in their touristic activities in the face of security threats. Another interesting finding is, financial sector, especially the banking sector, in both Turkey and Europe is strong enough to combat these types of internal and external shocks. The Turkish stock market is more fragile to terrorist attacks in Europe than the other way around. Hence, in face of high security threats, the investors would be better off if they avoid investing in tourism related sectors and prefer financial sector stocks especially banks and insurance companies.

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Appendix

A1. Causality in Mean and Variance from Daily Terror Index (DTI) to Overall and Sectoral Indices in Germany and France

Germany

	Causality in Mean		Causality in Variance	
	Wald stat	p - value	LM stat.	p -value
DTI to DAX 30			7.399	0.025
Standard Granger Causality	6.04	0.914		
Toda & Yamamoto	2.345	0.938		
Fourier Standard GC Single Freq.	6.93	0.862		
Fourier Toda & Yamamoto Single Freq.	6.253	0.794		
Fourier Standard GC Cumulative Freq.	7.857	0.796		
Fourier Toda & Yamamoto Cum. Freq.	6.975	0.728		
DTI to Financials			8.859	0.012
Standard Granger Causality	8.317	0.76		
Toda & Yamamoto	7.519	0.676		
Fourier Standard GC Single Freq.	9.771	0.636		
Fourier Toda & Yamamoto Single Freq.	8.323	0.597		
Fourier Standard GC Cumulative Freq.	10.42	0.579		
Fourier Toda & Yamamoto Cum. Freq.	9.142	0.519		
DTI to Transportation & Logistics			6.038	0.049
Standard Granger Causality	6.962	0.86		
Toda & Yamamoto	1.884	0.966		
Fourier Standard GC Single Freq.	6.761	0.873		
Fourier Toda & Yamamoto Single Freq.	1.64	0.977		
Fourier Standard GC Cumulative Freq.	8.096	0.778		
Fourier Toda & Yamamoto Cum. Freq.	1.628	0.978		
DTI to Food & Beverages			0.271	0.873
Standard Granger Causality	16.039	0.189		
Toda & Yamamoto	9.321	0.23		
Fourier Standard GC Single Freq.	16.453	0.171		
Fourier Toda & Yamamoto Single Freq.	9.289	0.233		
Fourier Standard GC Cumulative Freq.	15.089	0.237		
Fourier Toda & Yamamoto Cum. Freq.	9.245	0.236		
DTI to Healthcare			7.75	0.021
Standard Granger Causality	9.862	0.628		
Toda & Yamamoto	6.832	0.447		
Fourier Standard GC Single Freq.	9.203	0.686		
Fourier Toda & Yamamoto Single Freq.	7.719	0.358		
Fourier Standard GC Cumulative Freq.	14.034	0.299		
Fourier Toda & Yamamoto Cum. Freq.	8.81	0.267		
DTI to Banks			1.879	0.391
Standard Granger Causality	6.697	0.877		
Toda & Yamamoto	2.74	0.908		
Fourier Standard GC Single Freq.	5.574	0.936		
Fourier Toda & Yamamoto Single Freq.	2.291	0.942		
Fourier Standard GC Cumulative Freq.	5.194	0.951		
Fourier Toda & Yamamoto Cum. Freq.	4.82	0.903		

France

	Causality in Mean		Causality in Variance	
	Wald stat	p - value	LM stat.	p -value
DTI to CAC 40			6.53	0.038
Standard Granger Causality	5.663	0.932		
Toda & Yamamoto	3.039	0.881		
Fourier Standard GC Single Freq.	5.821	0.925		
Fourier Toda & Yamamoto Single Freq.	2.745	0.908		
Fourier Standard GC Cumulative Freq.	6.178	0.907		
Fourier Toda & Yamamoto Cum. Freq.	2.48	0.929		
DTI to Financials			0.843	0.656
Standard Granger Causality	6.432	0.893		
Toda & Yamamoto	6.225	0.796		
Fourier Standard GC Single Freq.	6.026	0.915		
Fourier Toda & Yamamoto Single Freq.	5.78	0.833		
Fourier Standard GC Cumulative Freq.	6.152	0.908		
Fourier Toda & Yamamoto Cum. Freq.	5.421	0.861		
DTI to Consumer Services			6.818	0.033
Standard Granger Causality	9.427	0.666		
Toda & Yamamoto	5.146	0.642		
Fourier Standard GC Single Freq.	9.543	0.656		
Fourier Toda & Yamamoto Single Freq.	4.528	0.717		
Fourier Standard GC Cumulative Freq.	10.309	0.589		
Fourier Toda & Yamamoto Cum. Freq.	4.186	0.758		
DTI to Health Care			5.738	0.057
Standard Granger Causality	5.313	0.947		
Toda & Yamamoto	3.106	0.875		
Fourier Standard GC Single Freq.	6.277	0.901		
Fourier Toda & Yamamoto Single Freq.	3.643	0.82		
Fourier Standard GC Cumulative Freq.	7.167	0.846		
Fourier Toda & Yamamoto Cum. Freq.	4.082	0.77		
DTI to Consumer Goods			3.795	0.150
Standard Granger Causality	6.879	0.866		
Toda & Yamamoto	3.918	0.789		
Fourier Standard GC Single Freq.	7.593	0.816		
Fourier Toda & Yamamoto Single Freq.	3.711	0.812		
Fourier Standard GC Cumulative Freq.	7.537	0.82		
Fourier Toda & Yamamoto Cum. Freq.	3.713	0.812		
DTI to Industrials			11.209	0.004
Standard Granger Causality	8.303	0.761		
Toda & Yamamoto	3.964	0.784		
Fourier Standard GC Single Freq.	8.758	0.723		
Fourier Toda & Yamamoto Single Freq.	8.663	0.564		
Fourier Standard GC Cumulative Freq.	9.594	0.651		
Fourier Toda & Yamamoto Cum. Freq.	9.339	0.5		

A2. Causality in Mean and Variance from Daily Terror Index (DTI) to Overall and Sectoral Indices in Spain and UK

Spain					UK				
	Causality in Mean		Causality in Variance			Causality in Mean		Causality in Variance	
	Wald stat	p - value	LM stat.	p -value		Wald stat	p - value	LM stat.	p -value
DTI to IBEX 35			0.608	0.738	**DTI to FTSE 100**			15.39	0.001
Standard Granger Causality	9.019	0.701			Standard Granger Causality	8.499	0.745		
Toda & Yamamoto	8.006	0.534			Toda & Yamamoto	2.513	0.926		
Fourier Standard GC Single Freq.	8.341	0.758			Fourier Standard GC Single Freq.	8.76	0.723		
Fourier Toda & Yamamoto Single Freq.	7.429	0.593			Fourier Toda & Yamamoto Single Freq.	2.407	0.934		
Fourier Standard GC Cumulative Freq.	7.571	0.818			Fourier Standard GC Cumulative Freq.	8.866	0.714		
Fourier Toda & Yamamoto Cum. Freq.	7.109	0.626			Fourier Toda & Yamamoto Cum. Freq.	2.401	0.934		
DTI to Financials & Real Estate			0.879	0.639	**DTI to Financials**			4.149	0.126
Standard Granger Causality	11.412	0.494			Standard Granger Causality	8.344	0.758		
Toda & Yamamoto	8.217	0.512			Toda & Yamamoto	4.396	0.733		
Fourier Standard GC Single Freq.	11.072	0.523			Fourier Standard GC Single Freq.	8.536	0.742		
Fourier Toda & Yamamoto Single Freq.	7.509	0.584			Fourier Toda & Yamamoto Single Freq.	3.941	0.786		
Fourier Standard GC Cumulative Freq.	9.16	0.689			Fourier Standard GC Cumulative Freq.	8.99	0.704		
Fourier Toda & Yamamoto Cum. Freq.	6.901	0.647			Fourier Toda & Yamamoto Cum. Freq.	3.578	0.827		
DTI to Banks			0.887	0.642	**DTI to Banks**			3.885	0.143
Standard Granger Causality	11.318	0.502			Standard Granger Causality	9.711	0.641		
Toda & Yamamoto	8.154	0.519			Toda & Yamamoto	3.623	0.822		
Fourier Standard GC Single Freq.	11.026	0.527			Fourier Standard GC Single Freq.	9.362	0.675		
Fourier Toda & Yamamoto Single Freq.	7.283	0.608			Fourier Toda & Yamamoto Single Freq.	3.553	0.83		
Fourier Standard GC Cumulative Freq.	8.964	0.706			Fourier Standard GC Cumulative Freq.	9.13	0.692		
Fourier Toda & Yamamoto Cum. Freq.	6.621	0.676			Fourier Toda & Yamamoto Cum. Freq.	2.432	0.932		
DTI to Consumer Services			0.911	0.634	**DTI to Travel & Leisure**			11.004	0.004
Standard Granger Causality	3.658	0.989			Standard Granger Causality	9.344	0.673		
Toda & Yamamoto	3.154	0.958			Toda & Yamamoto	6.924	0.545		
Fourier Standard GC Single Freq.	3.413	0.992			Fourier Standard GC Single Freq.	10.634	0.56		
Fourier Toda & Yamamoto Single Freq.	2.472	0.982			Fourier Toda & Yamamoto Single Freq.	7.089	0.527		
Fourier Standard GC Cumulative Freq.	3.447	0.991			Fourier Standard GC Cumulative Freq.	12.569	0.401		
Fourier Toda & Yamamoto Cum. Freq.	2.272	0.986			Fourier Toda & Yamamoto Cum. Freq.	11.225	0.34		
DTI to Consumer Goods			1.326	0.515	**DTI to Health Care**			3.355	0.187
Standard Granger Causality	9.511	0.659			Standard Granger Causality	9.855	0.453		
Toda & Yamamoto	2.74	0.908			Toda & Yamamoto	9.062	0.248		
Fourier Standard GC Single Freq.	9.5	0.66			Fourier Standard GC Single Freq.	9.838	0.455		
Fourier Toda & Yamamoto Single Freq.	2.732	0.909			Fourier Toda & Yamamoto Single Freq.	8.951	0.256		
Fourier Standard GC Cumulative Freq.	10.477	0.574			Fourier Standard GC Cumulative Freq.	9.808	0.458		
Fourier Toda & Yamamoto Cum. Freq.	2.762	0.906			Fourier Toda & Yamamoto Cum. Freq.	8.949	0.256		
DTI to Technology			2.046	0.360	**DTI to Food Producers**			8.557	0.014
Standard Granger Causality	15.419	0.219			Standard Granger Causality	11.792	0.462		
Toda & Yamamoto	15.798	0.201			Toda & Yamamoto	8.703	0.561		
Fourier Standard GC Single Freq.	15.339	0.223			Fourier Standard GC Single Freq.	12.253	0.426		
Fourier Toda & Yamamoto Single Freq.	15.738	0.204			Fourier Toda & Yamamoto Single Freq.	8.824	0.549		
Fourier Standard GC Cumulative Freq.	15.412	0.22			Fourier Standard GC Cumulative Freq.	13.948	0.304		
Fourier Toda & Yamamoto Cum. Freq.	15.834	0.199			Fourier Toda & Yamamoto Cum. Freq.	9.546	0.481		

A3. Causality in Mean and Variance from Daily Terror Index (DTI) to Overall and Sectoral Indices in Norway

Norway	Causality in Mean		Causality in Variance	
	Wald stat	p - value	LM stat.	p -value
DTI to OSE Benchmark			17.385	0.000
Standard Granger Causality	6.179	0.907		
Toda & Yamamoto	4.101	0.768		
Fourier Standard GC Single Freq.	6.064	0.913		
Fourier Toda & Yamamoto Single Freq.	3.644	0.82		
Fourier Standard GC Cumulative Freq.	5.836	0.924		
Fourier Toda & Yamamoto Cum. Freq.	3.65	0.819		
DTI to Financials			7.411	0.025
Standard Granger Causality	7.412	0.829		
Toda & Yamamoto	5.363	0.616		
Fourier Standard GC Single Freq.	7.28	0.839		
Fourier Toda & Yamamoto Single Freq.	4.719	0.694		
Fourier Standard GC Cumulative Freq.	7.198	0.844		
Fourier Toda & Yamamoto Cum. Freq.	4.511	0.719		
DTI to Banks			3.553	0.169
Standard Granger Causality	8.666	0.731		
Toda & Yamamoto	8.103	0.324		
Fourier Standard GC Single Freq.	8.076	0.779		
Fourier Toda & Yamamoto Single Freq.	7.313	0.397		
Fourier Standard GC Cumulative Freq.	7.808	0.8		
Fourier Toda & Yamamoto Cum. Freq.	6.832	0.447		
DTI to Transportation			0.52	0.771
Standard Granger Causality	10.99	0.529		
Toda & Yamamoto	6.995	0.429		
Fourier Standard GC Single Freq.	11.004	0.529		
Fourier Toda & Yamamoto Single Freq.	6.643	0.467		
Fourier Standard GC Cumulative Freq.	10.946	0.534		
Fourier Toda & Yamamoto Cum. Freq.	6.781	0.452		
DTI to Health Care			0.565	0.754
Standard Granger Causality	13.786	0.315		
Toda & Yamamoto	11.611	0.236		
Fourier Standard GC Single Freq.	13.627	0.325		
Fourier Toda & Yamamoto Single Freq.	11.344	0.253		
Fourier Standard GC Cumulative Freq.	13.48	0.335		
Fourier Toda & Yamamoto Cum. Freq.	11.249	0.259		
DTI to Banks			3.553	0.169
Standard Granger Causality	8.66	0.731		
Toda & Yamamoto	8.103	0.324		
Fourier Standard GC Single Freq.	8.076	0.779		
Fourier Toda & Yamamoto Single Freq.	7.313	0.397		
Fourier Standard GC Cumulative Freq.	7.808	0.8		
Fourier Toda & Yamamoto Cum. Freq.	6.832	0.447		