Flight-to-quality or contagion effect? An analysis from the Turkish and the US financial markets

HATICE GAYE GENCER, Asst. Prof. Dr.*

Article**
JEL: G10, G11, G15
doi: 10.3326/fintp.39.3.4

* The author would like to thank two anonymous referees for their useful comments and suggestions.
** Received: June 3, 2015
Accepted: June 19, 2015

Hatice Gaye GENCER
Yeditepe University, İnönü Mah. Kayışdağı Cad. 26 Ağustos Yerleşimi 34755 Ataşehir – İstanbul, Turkey
e-mail: gaye70@yahoo.com

FINANCIAL THEORY AND PRACTICE
39 (3) 325-340 (2015)

Abstract

In this paper, we investigate the presence of flight-to-quality from stocks to bonds as they are the two alternative asset classes predominantly used for hedging investment risk. A negative correlation between stock and bond markets is taken as a prognostication of flight-to-quality, while a positive correlation can be taken as a sign of contagion between the markets. We analyze the Turkish and US stock and government bond markets between June 6, 2006 and November 29, 2013, to make a comparison between the diversification benefits in a developed and an emerging market economy. We further divide our sample into two sub-periods to compare the patterns in crisis and tranquil periods. Our results reveal the existence of flight-to-quality in Turkey, whereas we find significant positive correlations between stocks and bonds in the US, implying a contagion effect. Additionally, we design portfolios of bonds/stocks and compute optimal weights and hedge ratios of the assets.

Keywords: bonds, stocks, portfolio investments

1 INTRODUCTION AND RELATED LITERATURE

Investors redesign their portfolios towards less risky assets at times of financial distress, a phenomenon referred to as "flight-to-quality". Baur and Lucey (2006) give a comprehensive definition of flight-to-quality, as the presence of decreasing correlations between stocks and bonds in the case of stock market plunges, resulting in negative correlation coefficients. By contrast, the authors relate decreasing correlation coefficients between the two asset classes at times of stock market mounts, to the phenomenon of "flight-from-quality". Following their stimulating study, we analyze the existence of flight-to-quality from stocks to bonds in Turkey and the US for the period between June 2006 and November 2013. Other than flight-to-quality and flight-from-quality, contagion between these markets is also corroborated in various studies (Kodres and Pritsker, 2002; Baur and Lucey, 2006). Negative contagion is described as increasing correlations during simultaneous stock and bond market collapses, whereas, positive contagion is identified by the increase in the correlations in joint market upswings.

Keim and Stambaugh (1986), Schwert (1989), Campbell and Ammer (1993) and Fleming et al. (1998) are among the pioneers in the study of the relationship between stock and bond markets. They are followed by Hartmann et al. (2001), Li (2002), Gulko (2002), Dopfel (2003), Baker and Wurgler (2006), Chulia and Torro (2008). Campbell and Ammer (1993) vindicate a low positive correlation between stocks and bonds over a sample period of 35 years (1952-1987) measured in monthly returns. Upon their findings for G-5 countries, Hartmann et al. (2001) suggest that "flight-to-quality is about as frequent as simultaneous crashes of stock and bond markets". Chordia et al. (2001) assert increasing correlations between both the bid-ask spreads and trading volume changes in the stock and bond markets during crises, using data over the period from 1991 to 1998. Li (2002) argues that uncertainty about expected inflation is a major determinant of the correlation coefficient between stocks and bonds for a sample of G-7 countries. Gulko (2002) postulates that the correlation between stock and bond market returns is time-varying, dependent on the changes in the financial market dynamics and investor sentiments. He documents positive correlations between stock and bond markets in times of stock market crashes. Cappiello et al. (2006) find that at times of financial stress, the correlation between stocks and bonds tends to decrease. Goeij and Marquering (2004) investigate the asymmetric effects on the conditional covariances between the US stock and bond markets using weekly data over the period from 1987 to 1999. They provide evidence for asymmetric effects especially in the stock market, where bad news is followed by much higher conditional covariance between bonds and stocks than in the case of good news.

In their captivating study, Connolly et al. (2005) discuss the causes of positive and negative correlations between stocks and bonds, following the line of thought broached by Campbell and Ammer (1993). Under normal conditions, these two financial assets are positively correlated, since the variations in real interest rates affect their discount rates in the same direction. The expectations about future earnings will also have common influences on their returns. The only reason for a negative correlation between stocks and bonds is the differential response to inflation expectations. A change in the expected inflation leads to a certain change in bond prices, while the effect on stock prices is uncertain. An increase (decrease) in the inflation expectation will cause a decline (rise) in bond prices, but the impact on stock prices is ambiguous, as it is pertinent to industry and firm-specific conditions. The authors study the period from 1986 to 2000 in the US, when inflation was quite low and stable and yet they report time-varying and also sustained negative correlations between the two markets. Thus, they explain these results with cross-market hedging and flight-to-quality observed at times of increased volatility in stock markets. Their findings reveal that bond returns tend to be higher than stocks at times of higher uncertainty (measured by VIX, Chicago Board Options Exchange's Volatility Index). They also document a negative relation between uncertainty (VIX) and the future correlation between bonds and stocks. In an extension of their previous work, Connolly et al. (2007) study a sample of European countries (Belgium, Denmark, Germany, France, Italy, the Netherlands, Spain, Switzerland, the UK) along with the US between 1992 and 2002. They attest that increased stock market volatility leads to negative stock-bond correlations, in support of the findings of Kodres and Pritsker (2002) on cross-market hedging, with the argument that a shock in an asset market would be counteracted with price rebalancing in another market.

More recently, Dajcman (2012) investigates the co-movement between stock market returns and sovereign bond yields for Italy, Ireland, Portugal, Spain and Germany applying a DCC-GARCH model. He adduces time-varying correlations between stocks and bonds, and evinces the flight-to-quality phenomenon especially during 2008 crisis, with the exception of Germany, whereas the co-movement between stocks and bonds is positive. By contrast, Rösch and Kaserer (2013) depict the presence of flight-to-quality in German stock market in their study, where they use increasing liquidity costs in times of crises as an empirical evidence of default probability. Bianconi et al. (2013) investigate the BRIC (Brazil, Russia, India, China) countries and substantiate negative correlations between the bond and stock markets of both Russia and Brazil. However, the authors conclude that there are no significant correlations between Chinese and Indian stocks and bonds, a finding which they attribute to Chinese and Indian capital markets being relatively closed and state-controlled.

In this study, we investigate the presence of flight-to-quality in the US and Turkish financial markets. The US economy can be cited as one of the most developed economies in the world, while Turkey is described as an emerging market.[1] Applying Dynamic Conditional Correlation (DCC) – GARCH – GJR model, we find evidence of flight-to-quality and cross-market hedging in Turkey, whereas our results display contagion effects in the US, which may be a sign of market integration. Furthermore, we compute optimal weights and hedge ratios, and document that, in the Turkish financial markets, government bonds should outweigh stock investments in a hedged portfolio. On the contrary, ninety percent of the optimal portfolio should consist of stocks in the US, to minimize risk without lowering expected return. In this way, the empirical results of our study shed valuable insight on portfolio management and risk assessment.

The rest of the paper is organized as follows: part 2 describes the methodology. Part 3 presents the data analysis and the preliminary statistical tests. Parts 4 and 5 discusses the empirical findings and the results from optimal portfolio weight and hedge ratio computations, respectively. Finally, part 6 concludes.

2 METHODOLOGY

For analyzing shock and volatility spillovers between different time series, multivariate GARCH specifications are applied, such as the CCC-GARCH model of Bollerslev (1990) and the DCC-GARCH model of Engle (2002). In order to measure the time-varying correlations between bond and stock markets, we employ the dynamic conditional correlations (DCC) model proposed by Engle (2002). It

[1] The US economy has a pioneering role in global economic activity. Moreover, the US financial system is considered as the epicentre of the global financial crisis. That is the underlying reason for the selection of the US stock and bond markets as the crisis originating economy. Turkey is the 17th largest economy according to its GDP (IMF, 2014) and it is one of the members of the G20 countries. Among the emerging economies Turkey has a stock market (Borsa Istanbul) that is a potential alternative for the global investors with regard to its trading volume and possible benefits from portfolio diversification. The Turkish stock exchange market was established in 1985 and the market capitalization was $220 billion in 2014 (MKK, 2014). Foreign investors possess significant portfolio investments in the Turkish equity market, 62.3% and 64% of the total market capitalization in 2013 and 2014, respectively (MKK, 2014). The US investors constitute the largest group of foreign investors, controlling 33% of the equity investments in Borsa Istanbul (MKK, 2015). Hence, the comparative performance of the Turkish and the US financial markets has a significant importance for both the Turkish and the US investors and authorities, as well as for international portfolio managers.

provides two extra parameters, which are used to evaluate the effects of past innovations and past correlations on the current conditional correlations. The constant conditional correlation (CCC) model can be written as follows:

$$H_t = D_t R D_t \tag{1}$$

where R represents constant conditional correlation matrix and $D_t = diag(\sigma_{1t}, \sigma_{2t}, \ldots, \sigma_{Nt})$.

The dynamic conditional correlation (DCC) model can be described as follows:

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

where R_t is the time varying correlation matrix and D_t is the diagonal matrix of time varying standard deviations generated from the univariate GARCH model on each series.

The DCC framework consists of two stages. The first estimates the univariate GARCH model. In this paper, we consider Glosten, Jagannathan and Runkle's GJR (1993) model to account for possible leverage effects in the conditional volatility. Hence, the elements of matrix D_t are given by the GJR-GARCH(p,q) model as written below:

$$h_{it} = \omega_i + \alpha_i \varepsilon_{i,t-1}^2 + \gamma_i d\left({}_i\varepsilon_{i,t-1} < 0\right)\varepsilon_{i,t-1}^2 + \beta_i h_{i,t-1} \tag{3}$$

Where w_i, α_i and β_i are the model parameters, $d(\cdot)$ represents the indicator function (i.e. $d(\varepsilon_{t-1} < 0) = 1$ if $\varepsilon_{t-1} < 0$ and $d(\varepsilon_{t-1} < 0) = 0$, otherwise). Thus, the GJR-GARCH model permits good and bad news to have distinct effects on the conditional variance, known as "asymmetric" or "leverage" effect.

In the second stage estimation, the dynamic correlations are computed by the equations below:

$$Q_t = (1 - \sum_{m=1}^{M}\alpha_m - \sum_{n=1}^{N}\beta_n)\bar{Q} + \sum_{m=1}^{M}\alpha_m(\varepsilon_{t-m}\varepsilon'_{t-m}) + \sum_{n=1}^{N}\beta_n Q_{t-n} \tag{4}$$

$$R_t = Q_t^{*-1} Q_t Q_t^{*-1} \tag{5}$$

where M is the length of the innovation term in the DCC estimator, and N is the length of the lagged correlation matrices in the DCC estimator. $\bar{Q}$ is the unconditional covariance of the standardized residuals resulting from the first stage estimation and Q^*_t is a diagonal matrix composed of the square root of the diagonal elements of Q_t.

The log likelihood of the estimator is:

$$L = (-1/2)\sum_{t=1}^{T}(k\log(2\pi) + 2\log(|D_t|) + \log(|R_t|) + \varepsilon' R_t^{-1}\varepsilon_t) \tag{6}$$

where ε_t is the residual which is normally distributed with zero mean and a time varying variance and it is standardized by the conditional standard deviation.

In modelling the DCC-GARCH model, we assume conditional probability distribution density function of error terms which follow normal distribution, and the model is estimated with the quasi maximum likelihood (QMLE) method. In addition, we use the BHHH (Berndt, Hall, Hall and Hausman) iterative algorithm to obtain the optimal values of the parameters.

3 DATA ANALYSIS

In this study, we use daily data over the period from June 6, 2006 to November 29, 2013. The data set includes the 10-year government bond index of Turkey, the Borsa Istanbul composite index (BIST100), the 10-year government bond index of the US and Standard and Poor's 500 (S&P 500) index. All data are the closing prices of the relevant index. The prices are in US $ for S&P 500 and US bond index, whereas they are in Turkish Lira for BIST100 and Turkish bond index. We extract all relevant data from Bloomberg. The return series can be obtained as follows:

$$R_t = \ln\left(P_t / P_{t-1} \right) \tag{7}$$

where R_t denotes return, P_t and P_{t-1} represent price at time t and price at time $t-1$, respectively.

Table 1 gives the summary statistics of the return series. The mean values of the returns are -0.05% and 0.054% for Turkish bond and stock markets respectively and the standard deviations are 1.650 and 2.055 in the same order, while the mean values for US bond and stock markets are both 0, and the standard deviations are 0.023 and 0.014 respectively. In Turkey, bond returns are very slightly negative, and stock returns are considerably higher and both carry a much higher risk than US bonds and stocks. Moreover, excess kurtosis is computed for all the return variables, except the US bonds (greater than 3), implying a non-normal distribution. The rejection of the Jarque-Bera test statistics' null hypothesis also confirms the non-normality of the series. Typically, serial correlations on raw and squared data are found as the result of the Ljung-Box tests up to 10th lag. ARCH (10) tests indicate that the variables contain significant ARCH effects. Finally, the augmented-Dickey-Fuller (ADF) test applied to the return variables provide the rejection of unit-roots. Therefore, the return data are appropriate for GARCH-type modelling and further analysis.

Table 1
Descriptive statistics (%)

	BondTR	BIST100	BondUS	S&P500
Mean	-0.050	0.054	0.000	0.000
Minimum	-9.255	-14.65	-0.171	-0.094
Maximum	11.269	10.553	0.105	0.104
Std. dev.	1.650	2.055	0.023	0.014
Skew.	0.559	-0.780	-0.154	-0.391
Kurt.	7.322	7.112	2.968	8.908
J-B	3619.7[a]	3497[a]	694.39[a]	6235.2[a]
	(0.000)	(0.000)	(0.000)	(0.000)
ARCH (10)	21.699[a]	19.573[a]	15.160[a]	93.992[a]
	(0.000)	(0.000)	(0.000)	(0.000)
Q (10)	34.348[a]	38.707[a]	16.505[a]	62.435[a]
	(0.000)	(0.000)	(0.000)	(0.000)
Q2 (10)	387.000[a]	350.612[a]	293.339[a]	2018.40[a]
	(0.000)	(0.000)	(0.000)	(0.000)
ADF	-20.782[a]	-23.004[a]	-25.966[a]	-25.441[a]
	(0.000)	(0.000)	(0.000)	(0.000)

Robust standard errors are in parentheses.
[a]Denotes the statistical significance at the 1% level.

Source: Author's calculations.

Figure 1 displays the plots of our return series. As can be seen from the graphs, volatility increases in both the US and Turkish financial markets during the subprime mortgage crisis, and the trend dramatizes in the last quarter of 2008. The Eurozone crisis kindled by the Greek sovereign debt crisis paves the way to another high volatility episode in the second half of 2011 in both economies. Lastly, Turkish stock and bond markets witness another sheared interval in the second half of 2013, this time resulting from the political unrest in the country.

Figure 1
Return plots of the series

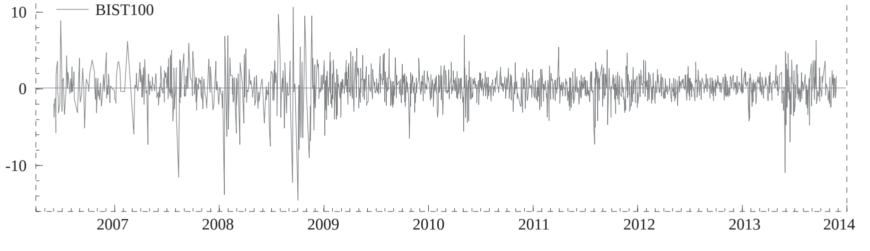
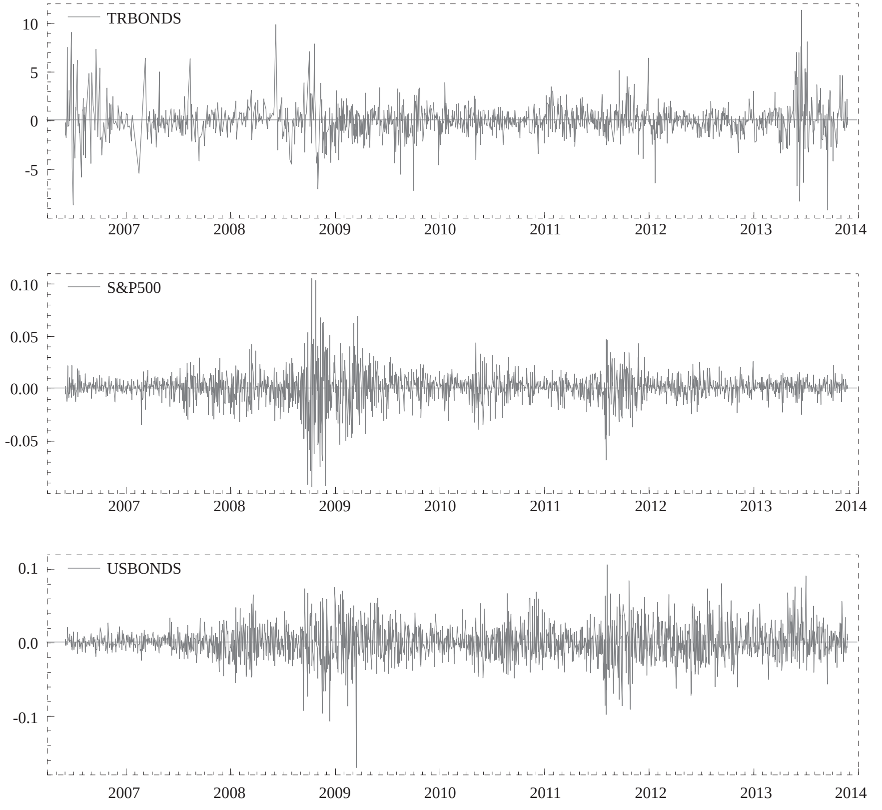


Figure 1 (continue)
Return plots of the series



Source: Author's calculations.

4 EMPIRICAL RESULTS

We give a thorough discussion of our empirical results in this section. In table 2a and 2b, we document the results of our DCC-GARCH-GJR (1, 1) models. The results for the full sample period are listed in table 2a, which denote that the parameters of the past shocks (α) and past volatilities (β) impact current conditional volatility in the univariate context. The asymmetry terms (γ) are all positive and significant, except for the Turkish bonds, indicating that the effect of the past negative shocks on the current conditional volatility is higher than that of the past positive shocks. The dynamic correlation coefficient between the Turkish bonds and stocks (ρ) is -0.494, and it is 0.430 between the US bonds and stocks, which are both significant at the 1% level. The parameters α and β of the DCC model are all significant and show that past shocks and one-lagged correlations impact the current conditional correlation. Our results reveal that, in the Turkish financial markets, flight-to-quality exists, while in the US, the contagion effect is prevalent during the period under investigation.

TABLE 2A
DCC (1, 1) Model results for the bonds-stocks pair

	Whole sample			
	BondTR	**BIST100**	**BondUS**	**S&P500**
C (M)	-0.091[a]	0.132[a]	0.000	0.000
	(0.006)	(0.000)	(0.219)	(0.246)
C (V)	0.044	0.147[b]	0.013	0.021[a]
	(0.359)	(0.024)	(0.128)	(0.000)
α	0.094[c]	0.073[a]	0.053[a]	-0.037[a]
	(0.085)	(0.000)	(0.000)	(0.000)
β	0.905[a]	0.820[a]	0.928[a]	0.916[a]
	(0.000)	(0.000)	(0.000)	(0.000)
γ	-0.027	0.155[c]	0.040[b]	0.202[a]
	(0.4304)	(0.057)	(0.024)	(0.000)
DCC parameters				
ρ	-0.494[a]		0.430[a]	
	(0.000)		(0.000)	
α	0.045[a]		0.0589[a]	
	(0.000)		(0.000)	
β	0.922[a]		0.911[a]	
	(0.000)		(0.000)	
Univariate diagnostic				
$Q^2(10)$	5.684	7.790	3.471	8.476
	(0.841)	(0.649)	(0.968)	(0.582)
Multivariate diagnostics				
Hosking (10)	41.153		37.802	
	(0.334)		(0.478)	
Li-McLeod (10)	41.124		37.833	
	(0.335)		(0.477)	

Robust standard errors are in parentheses.
[a] indicates 1% significance, [b] 5% significance, and [c] 10% significance levels.
Source: Author's calculations.

In order to buttress the above findings, we divide our whole sample into two sub-periods. The first sub-sample covers the period between March 13, 2007 and August 12, 2009, witnessing the sub-prime mortgage crisis. The second sub-sample is between January 4, 2010 and November 29, 2013 which coincides with the aftermath of the crisis. We use the reports of the Bank of International Settlements (BIS, 2009) for the specification of the crisis and post-crisis periods.[2] Table 2b exhibits the results of these further analyses. Interestingly, for the crisis sub-sample, the α parameters are all statistically insignificant (except for the US bonds) and β parameters are all significant. Hence, the empirical findings indicate that past own shocks do not affect the current conditional volatilities (except for the

[2] GFC lasts through four phases with the first one, the "initial financial turmoil" which continues from the third quarter of 2007 to mid-September 2008, followed by the second phase, "sharp financial deterioration", until the end of 2008; the third phase, "macroeconomic deterioration", ends in the first quarter of 2009 and the fourth phase, "stabilization and tentative signs of recovery" lasts by the end of 2009.

US bonds), while own past volatilities display a profound impact on the current conditional volatilities. The γ terms are all insignificant, except for US stocks. The dynamic conditional correlation between Turkish bonds and stocks is -0.603, significant at the 1% level, indicating the flight-to-quality phenomenon in times of market distress. As postulated by Baur and Lucey (2006), decreasing correlations between the two assets at times of stock market plunges is an indication of flight-to-quality. The flight from stocks to bond investments at times of market turmoil places bonds as quality assets in the Turkish financial markets. On the other hand, the dynamic conditional correlation between the US bonds and stocks is 0.458, significant at the 1% level. This result confirms the existence of contagion in the US financial markets. Our results evince negative contagion in the US, with increasing correlations between the assets when the stock market collapses.

Table 2b

DCC (1, 1) Model results for the bonds-stocks pair

	Crisis period				**Post-crisis period**			
	BondTR	**BIST100**	**BondUS**	**S&P500**	**BondTR**	**BIST100**	**BondUS**	**S&P500**
C (M)	-0.112	0.180[c]	0.000	0.000	-0.081[b]	0.080	0.000	0.000
	(0.100)	(0.081)	(0.548)	(0.449)	(0.021)	(0.062)	(0.517)	(0.132)
C (V)	0.091	0.906[b]	0.032	0.030[b]	0.022	0.147[b]	0.114[c]	0.037[a]
	(0.272)	(0.029)	(0.275)	(0.043)	(0.164)	(0.045)	(0.086)	(0.000)
α	0.057	0.054	0.104[b]	-0.011	0.091[a]	0.019	0.051[b]	-0.068[a]
	(0.172)	(0.319)	(0.026)	(0.513)	(0.000)	(0.441)	(0.012)	(0.000)
β	0.927[a]	0.674[a]	0.884[a]	0.902[a]	0.911[a]	0.827[a]	0.915[a]	0.892[a]
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
γ	-0.043	0.322	0.039	0.197[a]	-0.021	0.180[b]	0.034	0.274[a]
	(0.239)	(0.137)	(0.480)	(0.000)	(0.460)	(0.024)	(0.156)	(0.000)
DCC parameters								
ρ	-0.603[a]		0.458[a]		-0.419[a]		0.503[a]	
	(0.000)		(0.000)		(0.000)		(0.000)	
α	0.076[a]		0.100[a]		0.032[b]		0.057[a]	
	(0.004)		(0.009)		(0.011)		(0.000)	
β	0.851[a]		0.737[a]		0.928[a]		0.913[a]	
	(0.000)		(0.000)		(0.000)		(0.000)	
Univariate diagnostic								
Q^2(10)	2.682	2.696	3.872	15.805	3.176	5.042	2.944	10.300
	(0.987)	(0.987)	(0.952)	(0.105)	(0.976)	(0.888)	(0.982)	(0.414)
Multivariate diagnostics								
Hosking (10)	17.638		45.995		31.865		41.996	
	(0.998)		(0.174)		(0.747)		(0.301)	
Li-McLeod (10)	17.875		46.013		31.938		42.027	
	(0.997)		(0.174)		(0.744)		(0.300)	

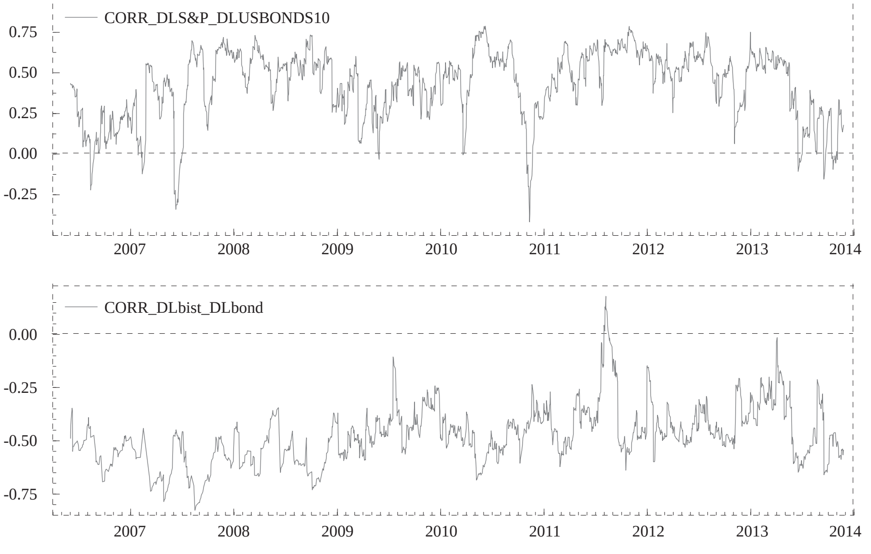
Robust standard errors are in parentheses.
[a] indicates 1% significance, [b] 5% significance, and [c] 10% significance levels.
Source: Author's calculations.

The results of the post-crisis period substantiate the above findings. During the post-crisis period the dynamic conditional correlations between bonds and stocks in both economies increase. Still, the coefficient is negative in the case of Turkey, showing that flight-to-quality continues to exist in the aftermath of the crisis. In the US, a higher positive correlation between the two markets signals positive contagion after the crisis episode. The β parameters indicate the significant effect of past own volatilities on current conditional volatilities. Apart from the Turkish stock market, the other variables are all affected by past own news. Both Turkish and the US stock markets exhibit asymmetry to past shocks in the post-crisis period.

In tables 2a and 2b, we also document the univariate and multivariate diagnostic test results applied to standardized squared residuals. The univariate tests of Ljung-Box Q (10) show no serial correlations in the squared residuals. Besides, the Hosking and Li-McLeod multivariate portmanteau tests, which are the extensions of the univariate Ljung-Box test, are applied to the squared residuals and the results posit that the fitted multivariate model is adequate to obtain the reliable parameters.

The above findings can be seen as visual representations in figure 2. The graphs represent the time varying evolution of conditional correlations between Turkish and the US bonds and stocks, respectively in the whole period. From the graphs, it can be seen that in the Turkish economy, negative correlations are prevalent during the sample period, while it is just the opposite in the US, where negative correlations are very rare.

Figure 2
Plots of time-varying correlations between bonds and stocks



Source: Author's calculations.

5 HEDGE RATIOS AND OPTIMAL PORTFOLIO WEIGHTS

In this section, we elaborate on the connotations of our DCC-GARCH-GJR model results by designing optimal portfolios of both US and Turkish bonds-stocks. We construct two hedged portfolios; the first consists of Turkish 10-year government bonds and BIST100 index, and the second of US 10-year government bonds and the S&P500 index. By constructing hedged portfolios, the objective of minimizing the risk at the same expected return is sustained. Kroner and Ng (1998) propose the optimal holding weight calculations:

$$w_t^{bs} = \frac{h_t^s - h_t^{bs}}{h_t^b - 2h_t^{bs} + h_t^s} \tag{8}$$

and

$$w_t^{bs} = \begin{cases} 0, & if \;\; w_t^{bs} < 0 \\ w_t^{bs}, & if \;\; 0 \le w_t^{bs} \le 1 \\ 1, & if \;\; w_t^{bs} > 1 \end{cases} \tag{9}$$

where the w_t^{bs}, denotes the weight of government bonds in a one-dollar portfolio of bonds/stocks index at time t; h_t^b, h_t^s and h_t^{bs} are the conditional volatility of government bond index, the conditional volatility of the stock index and the conditional covariance between bond and stock returns at time t.

Kroner and Sultan (1993) compute the optimal hedge ratios of a two-asset portfolio in the following way:

$$\beta_t^{bs} = \frac{h_t^{bs}}{h_t^s} \tag{10}$$

β_t^{bs} indicates the amount of short position required in the government bonds to hedge the one-dollar long position in the stock market.

Table 3 depicts the average values of optimal weights and hedge ratios for the portfolios. The results show that the optimal weight of government bonds in the bonds/stocks portfolio is 0.251 in the US and 0.571 in Turkey. This denouement implies that to minimize risk at a given level of return, investors should hold more government bonds than stocks in Turkish financial markets. On the other hand, in the US, investors should hold more stocks, and only one-tenth of the portfolio should be invested in government bonds. These results are in line with our DCC GJR-GARCH model results. As we report a negative correlation between Turkish government bonds and stocks, the weight of government bond investments is higher than that of stocks in a hedged portfolio. On the other hand, the hedge ratio for bonds/stocks portfolio is -0.397, which means that one-dollar short position in Turkish stock market, should be matched by a long position of 39.7 cents in the bond market. Overall, our findings corroborate the flight-to-quality phenomenon in Turkish markets, where government bonds are regarded as quality assets, to reduce the portfolio risk especially in times of adverse market conditions. Thus in

Turkish financial markets, adding bonds in stock portfolios increases efficiency by lowering risk at the same expected return.

TABLE 3
Optimal portfolio weights and hedge ratios

	US bonds/stocks	TR bonds/stocks
w_t^{bs}	0.118	0.571
β_t^{bs}	0.905	-0.397

Source: Author's calculations.

6 CONCLUSION

The bond and the stock markets are the two main financial markets and have some common features, yet the assets traded in these markets indicate significant discrepancies between them, which lead to them being regarded as alternative investments. Investors switch between these alternatives to reduce risk at times of market distress. This study investigates the flight-to-quality phenomenon from stocks to bonds in two distinct economies, the US and Turkey. The US is one of the most developed economies in the world with voluminous financial markets. On the other hand, Turkey is an emerging economy, with relatively shallow financial markets that were established by the mid 1980s.[3] Hence, the results of our study provide a comparison between a developed and an emerging market in the context of cross-market hedging.

Our data period embraces the most recent crisis, starting by June 2006 and ending by November 2013. We take two sub-samples to make a profound analysis, with the first one, between March 2007 and August 2009, labelled as the crisis period. The second matches the post-crisis period, between January 2010 and November 2013. Overall, we posit significant results confirming the existence of flight-to-quality in the case of Turkey. We document negative correlations between Turkish government bonds and stocks, with a lower negative value during the crisis period. In contrast, our empirical findings demonstrate the contagion effect in the US, where the correlation between US government bonds and stocks are positive. The coefficient increases during the crisis, signalling the negative contagion effect. At the post-crisis period, the DCC-GARCH-GJR model results indicate a positive contagion in the US.

In order to assess the implications of our findings for portfolio management and hedging, we also compute the optimal weights and hedge ratios for the designed portfolios of government bonds and stocks for both the economies. Turkish government bonds outweigh stocks in the optimal portfolio with a hedge ratio of -0.397, implying that a one-dollar short in Turkish stocks should be matched by

[3] The S&P 500 has a total market capitalization above $15 trillion, almost 68 times higher than the Turkish stock exchange market (S&P Dow Jones Indices). Therefore, we describe the Turkish equity market as a "shallow market" in comparison to the S&P 500 index.

39.7 cents of long position in bond investments. On the other hand, according to the hedge ratio for the US government bonds-stocks portfolio, one-dollar long in US government bonds should be matched by 90.5 cents of short position in the S&P500 index. The weight of the US government bonds is only about ten percent of the optimal portfolio, as implied by the positive correlation between the assets. In this study, we posit a comparison between a developed and an emerging market in the context of cross-market hedging during the most recent financial crisis. Hence, our results provide insights for investors and portfolio managers to effectively implement diversification and hedging strategies in the international financial markets.

REFERENCES

1. Baker, M. and Wurgler, J., 2006. Investor sentiment and the cross-section of stock returns. *The Journal of Finance*, 61 (4), pp. 1645-1680. doi: 10.1111/j.1540-6261.2006.00885.x
2. Baur, D. and Lucey, B. M., 2006. Flight-to-quality or Contagion? An Empirical Analysis of Stock-bond correlations. *Institute for International Integration Studies Discussion Paper.* Trinity College, Dublin.
3. Bianconi, M., Yoshino, J. A. and Machado de Sousa, M. O., 2013. BRIC and the US financial crisis: An empirical investigation of stock and bond markets. *Emerging Markets Review*, 14, pp. 76-109. doi: 10.1016/j.ememar.2012.11.002
4. BIS, 2009. *The international financial crisis: timeline, impact and policy responses in Asia and the Pacific*. Bank for International Settlements (August).
5. Bollerslev, T. (1990). Modelling the coherence in short-run nominal exchange rates: a multivariate generalized ARCH model. *The Review of Economics and Statistics*, pp. 498-505. doi: 10.2307/2109358
6. Campbell, J. Y. and Ammer, J., 1993. What Moves the Stock and Bond Markets? A Variance Decomposition for Long-Term Asset Returns. *The Journal of Finance*, 48 (1), pp. 3-37. doi: 10.1111/j.1540-6261.1993.tb04700.x
7. Cappiello, L., Engle, R. F. and Sheppard, K., 2006. Asymmetric dynamics in the correlations of global equity and bond returns. *Journal of Financial Econometrics*, 4 (4), pp. 537-572. doi: 10.1093/jjfinec/nbl005
8. Chordia, T., Sarkar, A. and Subrahmanyam, A., 2001. Common determinants of bond and stock market liquidity: the impact of financial crises, monetary policy, and mutual fund flows. *Staff Report, Federal Reserve Bank of New York*, No. 141.
9. Chulia, H. and Torro, H., 2008. The economic value of volatility transmission between the stock and bond markets. *Journal of Futures Markets*, 28 (11), pp. 1066-1094. doi: 10.1002/fut.20342
10. Connolly, R. A., Stivers, C. and Sun, L., 2007. Commonality in the time-variation of stock–stock and stock–bond return comovements. *Journal of Financial Markets*, 10 (2), pp. 192-218. doi: 10.1016/j.finmar.2006.09.005
11. Connolly, R., Stivers, C., & Sun, L. (2005). Stock market uncertainty and the stock-bond return relation. *Journal of Financial and Quantitative Analysis*, 40 (01), pp. 161-194. doi: 10.1017/S0022109000001782
12. Dajcman, S., 2012. Comovement between stock and bond markets and the ‘flight-to-quality’ during financial market turmoil–a case of the Eurozone countries most affected by the sovereign debt crisis of 2010–2011. *Applied Economics Letters*, 19 (17), pp. 1655-1662. doi: 10.1080/13504851.2011.652771
13. Dopfel, F. E., 2003. Asset allocation in a lower stock-bond correlation environment. *The Journal of Portfolio Management*, 30 (1), pp. 25-38. doi: 10.3905/jpm.2003.319917
14. Engle, R. F., 2002. Dynamic conditional correlation: a simple class of multivariate generalized autoregressive conditional heteroskedasticity models.

Journal of Business and Economic Statistics, 20, pp. 339-350. doi: 10.1198/073500102288618487

15. Fleming, J., Kirby, C. and Ostdiek, B., 1998. Information and volatility linkages in the stock, bond, and money markets. *Journal of Financial Economics*, 49 (1), pp. 111-137. doi: 10.1016/S0304-405X(98)00019-1
16. Glosten, L. R., Jagannathan, R. and Runkle, D. E., 1993. On the relation between the expected value and the volatility of the nominal excess return on stocks. *The Journal of Finance*, 48 (5), pp. 1779-1801. doi: /10.1111/j.1540-6261.1993.tb05128.x
17. Goeij, P. and Marquering, W., 2004. Modeling the conditional covariance between stock and bond returns: A multivariate GARCH approach. *Journal of Financial Econometrics*, 2 (4), pp. 531-564. doi: 10.1093/jjfinec/nbh021
18. Gulko, L., 2002. Decoupling. *The Journal of Portfolio Management*, 28 (3), pp. 59-66. doi: 10.3905/jpm.2002.319843
19. Hartmann, P., Straetmans, S. and Devries, C., 2001. Asset Market Linkages in Crisis Periods. *European Central Bank Working Paper*, No. 71.
20. Keim, D. B. and Stambaugh, R. F., 1986. Predicting returns in the stock and bond markets. *Journal of Financial Economics*, 17 (2), pp. 357-390. doi: 10.1016/0304-405X(86)90070-X
21. Kodres, L. and Pritsker, M., 2002. A Rational Expectations Model of Financial Contagion. *The Journal of Finance*, 57, pp. 769-799. doi: 10.1111/1540-6261.00441
22. Kroner, K. E. and Ng, V. K., 1998. Modeling asymmetric comovements of asset returns. *Review of Financial Studies*, 11 (4), pp. 817-844. doi: 10.1093/rfs/11.4.817
23. Kroner, K. F. and Sultan, J., 1993. Time-varying distributions and dynamic hedging with foreign currency futures. *Journal of Financial and Quantitative Analysis*, 28 (4), pp. 535-551. doi: 10.2307/2331164
24. Li, L., 2002. Correlation of Stock and Bond Returns. *Working Paper*, Yale University.
25. MKK, 2014. *Borsa Trendleri Raporu XI*. Available at: <https://www.mkk.com.tr/tr/content/Bilgi-Merkezi/Borsa-Trendleri-Raporu>.
26. MKK, 2015. *Borsa Trendleri Raporu XII*. Available at: <https://www.mkk.com.tr/tr/content/Bilgi-Merkezi/Borsa-Trendleri-Raporu>.
27. Rösch, C. G. and Kaserer, C., 2013. Market liquidity in the financial crisis: The role of liquidity commonality and flight-to-quality. *Journal of Banking & Finance*, 37 (7), pp. 2284-2302. doi: 10.1016/j.jbankfin.2013.01.009
28. S&P Dow Jones Indices. Available at: <https://us.spindices.com/indices/equity/sp-500>.
29. Schwert, G. W., 1989. Why does stock market volatility change over time? *The Journal of Finance*, 44 (5), pp. 1115-1153. doi: 10.1111/j.1540-6261.1989.tb02647.x