“The Time-Varying Currency Risk Exposure on Firms: Cross-Sectoral Evidence from Turkey on the EU Integration Process”

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The time-varying currency risk exposure on firms: cross-sectoral evidence from Turkey on the EU integration process

Abstract

Volatility in exchange rates has strong effects on the revenues and market values of firms.

The strength of these effects varies across sectors in which firms operate and time periods during which the firms are under investigation.

In general, financial firms are more sensitive to the volatility in the exchange rates than the industrial firms, due to their export driven facilities that calibrate their balance sheets in terms of open positioning.

This paper presents cross-sectoral evidence from Turkey before and after its acceptance to the EU as a candidate in December 2004.

By using daily returns of exchange rates and different sector indices of the Istanbul Stock Exchange, it is evident that the exchange rate volatility has strong effects on the daily stock returns of industrial and financial firms, and is statistically significant for the service sector firms.

Exchange rates, especially USD, are getting more effective in share prices of Turkish firms, which can be explained by foreign direct and portfolio investments in the last two years.

Turkey has become an open economy after its EU candidateship.

Keywords: floating exchange rate regime, banks, industrial firms, Turkish financial markets, European integration, GED parameterization.
JEL Classification: G10, G12, C10.

Introduction

As a market risk factor, exchange rates have crucial effects on financial firms. The change in exchange rates affects the market value of the investment positions and profit/loss of financial firms.
Industrial firms, especially if they have international facilities, whether export or import oriented, are also sensitive to the change in the exchange rates in an open economy.

Turkey has used a floating exchange rate regime since February 2001 in which the fixed exchange rate regime was attacked speculatively.

Since 2001, except for few extremes, such as the US penetration into Iraq in 2003 or global volatility increase in May/June of 2006, the exchange rates moved within a stable band changing 10% in both directions. Under the floating exchange rate regime, the financial firms followed an arbitrage strategy; banks and credit institutions borrowed in foreign currencies or collect deposits in foreign currencies and chose to lend in Turkish Lira with their borrowings.

Industrial firms, in a similar strategy tried to borrow in foreign currencies.

Though their strategies are similar, volatility of exchange rates on financial and industrial firms might have different financial results. An increase in exchange rates has negative effects on the profit/loss of a bank with an open position. While the industrial firms might expect similar results in the same position, they have the advantage of an increase in earnings from the export facilities. It is expected that though the industrial firms are also influenced negatively by an increase in the exchange rates due to parallel increase in the systemic market risk and their open positions, if any, the effects may be moderate because of their export oriented facilities, as compared to the banks and other credit institutions.

In this empirical research paper, we try to discover the effects of the exchange rate volatility on the stock returns of the Turkish firms since 2002.

By using both daily EUR/TRY and USD/TRY parity and returns of the Istanbul Stock Exchange Industrial Index, Financial Index and Service Sector Index, this paper examines the exchange rate risk exposure on the market values of the firms.

Most Turkish industrial firms listed on the Istanbul Stock Exchange have export facilities with remarkable volume. The service sector and especially tourism are open to currency risk due to the fact that their earnings are mostly in foreign currency. The originality of the paper is twofold.

First, it is one of the few empirical papers investigating the effects of exchange rates on the firms in Turkey since the use of the floating exchange rates regime. Second, it gives a cross-sectoral comparison of the effects, if any, between the financial, industrial and service firms.

The effect of the exchange rates volatility on the service sector is firstly examined empirically in Turkey.

On the methodological side, we chose to use the parametric model with relatively less assumptions, namely GARCH in Mean with Generalized Error Distribution to see the volatility effects of exchange rates on the stock returns of the firms.

Though some relatively complex volatility models are employed, we try to keep the methodology at a moderate level to clearly see the financial patterns rather than methodological effects on the empirical results.

The rest of the paper is organized as follows. Possible theoretical effects of exchange rate risk exposure on the firms are discussed with a current literature review. The parametric models to measure volatility are examined in the methodology part. After introducing data and unit root test results, empirical evidence is discussed in terms of financial theory and investment perspective. The conclusion covers some suggestions for future researches.

1. Theoretical framework and literature review

Firms may choose to hedge or alternatively manage the exchange rate risk. In general, conservative firms and industrial firms hedge their exchange rate risk to minimize the fluctuations of their financial statements. Firms try to save their domestic values of cash flows in foreign currency by derivative instruments.

On the other hand, financial firms, which have intense treasury facilities, manage rather than hedge their exchange rate risk exposure to provide earnings from the volatility in the F/X markets. The volumes of their trading book facilities depend on their risk appetite.

If the domestic currency gains value against foreign currency, the firms have trading books and an efficient market risk management process might choose arbitrage strategy rather than hedge strategy in their exchange risk management policy.

In terms of risk management process of industrial firms, the currency risk exposure arises especially if the firms are export-oriented and/or multinational ones. Madura (1989) and Papaioannou (2006) list three kinds of crucial risk sources:

1) Cash flow risk: Its source is the effect of exchange rate changes in transactional account exposure related to export contracts, import contracts or repatriation of dividends.

2) Translation risk: It is the F/X risk in balance sheets arising from the valuation of a foreign subsidiary.

3) Economic risk: It reflects the risk to the firm's present value of future operating cash flows from exchange rate movements. Economic risk is related to the effect of exchange rate movements on revenues and operating expenses.

Identification of the various types of currency risk, along with their measurement, is crucial to create a strategy for hedging or managing currency risk (Papaioannou, 2006).

Dumas (1978) and Adler and Dumas (1984) suggest that exchange rate risks of firms might be examined by the sensitivity of stock returns to exchange rate volatility. This method is labelled as the capital market approach, which measures exchange rate risk by regressing the stock returns of the firms and changes in the exchange rates. On the other hand, the risk exposure can also be measured by the sensitivity of cash flow to exchange rate volatility. Martin and Mauer (2005), for example, use the cash flow risk approach to examine the currency risk exposure on the firms. By assuming that the markets reflect all expectations and risks on the firms, we prefer to use the capital market approach in determining the exchange rate exposure for Turkish firms.

Firms face transaction exposure arising from gain/loss due to settlement of investment transactions stated in foreign currency terms. Dumas and Solnik (1995), by using a conditional international asset pricing model with exchange risk, show that the exchange risk is priced in the US, the UK, Japan and Germany. Allayannis and Ofek (2001) measure exchange rate exposure by using the domestic market index as a control variable.

Doukas, Hall and Lang (2001) examine the relation between Japanese stock returns and unanticipated exchange-rate changes for 1079 firms traded on the Tokyo stock exchange over the 1975-1995 period. They find that the exposure effect on multinationals and high-exporting firms is greater in comparison to low-exporting and domestic firms. What is more, lagged-exchange rate changes on firm value are statistically insignificant implying that investors assess the impact of exchange-rate changes on firm value with no significant delay.

Dominguez and Tesar (2004) estimate the exchange rate exposure of listed firms and eight industrialized and emerging markets and find that exchange rate movements do matter for a significant fraction of firms, although, which firms are affected and the direction of exposure depend on the specific exchange rate and vary over time. They argue that firms dynamically adjust their behavior in response to exchange rate risk and exposure is more prevalent in small- rather than large- and medium-sized firms. They also discover a link between a firm's exposure and its multinational status, foreign sales,

international assets, and degree of industry-level competitiveness and trade.

The stock prices of firms in the emerging markets might be affected by the exchange rate movements in a relatively stronger level as compared to those in advanced markets due to high volatility, low market volume and economic instability. An important distinction between firms operating in emerging and advanced economies is the weakness of the firms in emerging markets formerly to find finance from abroad in their local currency. Due to foreign currency debt, they are more sensitive to the exchange rate movements.

Calvo (2002) states that the intense of foreign-currency liabilities in emerging markets limits the flexible exchange rates management. Allayannis, Brown and Klapper (2002) find that the performance of East Asian non-financial firms around the Asian crisis is negatively affected by domestic-currency debt, foreign-currency debt, and foreign-currency debt converted into domestic-currency debt through hedging. They also find that the latter has the most negative impact on firm performance.

Chue and Cook (2003) find the impact of depreciations on emerging-market stock returns to be negative. They find a firm's foreign-currency debt outstanding to be an important determinant of its exchange-rate exposure.

More than 10% of firms in Brazil, Chile, Indonesia, Korea, Mexico, Morocco, South Africa, Taiwan, Thailand, and Turkey have both significant and negative exposure.

Aybar and Thirunavukkarasu (2005) examine the nature of the exchange rate exposure of 106 emerging market multinationals in 16 different countries in four regions. They find that more than 60% of the firms are significantly exposed to exchange rate fluctuations.

Chamberlain, Howe and Popper (1996) examine the foreign exchange exposure of a sample of US and Japanese banking firms.

Using daily data, they estimate the exchange rate sensitivity of the stock returns of the U.S. bank holding companies and compare them to those of Japanese banks.

They find that the stock returns of a significant fraction of the US companies move with the exchange rate, while few of the Japanese returns that they observe do so.

Bessler and Opfer (2006) examine the importance of various macroeconomic factors in explaining the return of a bank index and five German industrial indices for the period of 1974-2000. They find that while exchange rates are effective on industrial firms, banks are especially exposed to interest rate risk.

As observed, the empirical results vary on a sample period, model specification, form of proxies for exchange rate volatility and economy examined.
This paper gives empirical evidence by using Turkish market data from 2002 to 2007 and parametric models as described in the next part.

2. Generalized ARCH in mean model with generalized error distribution

2.1. GARCH in Mean Model. Due to the sensitivity of financial markets to the time dependent information, financial time series should be parameterized with the Autoregressive Conditional Heteroskedastic (ARCH) process, which is a time-varying conditional variance as a linear function of past squared residuals and of its past values. The ARCH model is constructed by Engle (1982) and extended as a GARCH (Generalized ARCH) process Bollerslev (1986).

The ARCH and GARCH processes model the changes in variance as a function of time. A GARCH (p, q) model is described as in equation 1.

$$Z_t = v\sqrt{ht}\,. \tag{1}$$

In the model, $\{v_t\}$ can be described as an independently distributed Gaussian random sequence with zero mean and unit variance. h_t, on the other hand, is the conditional variance of Z_t conditional on all the information up to time $t-1$, $I_t - 1$ as described in equation 2.

$$E(Z_t^2 | I_{t-1}) = h_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i z_{t-i}^2 + \sum_{i=1}^{p} \beta_i h_{t-1}\,. \tag{2}$$

In the equation, if p=0, we can argue the existence of an ARCH(q) process. A GARCH in mean model, on the other hand, is described by

$$Y_t = \delta\, f(h_t) + Z_t\,. \tag{3}$$

The process argues that the conditional mean is also a function of conditional variance h_t. In equation 3, $f(h)$ is, in general, equal to $\sqrt{h}$. In that framework, a GARCH regression model is written as in equation 4.

$$Y_t = x_t' b + \delta f(h_t) + Z_t\,. \tag{4}$$

2.2. Generalized Error Distribution. In order to use the GARCH process, we should choose assumptions on the conditional distribution of the error

term. In general, we can use three assumptions, namely, Gaussian, Student's t and the Generalized Error Distributions (GED).

By assuming that the returns are normally distributed, the Gaussian distribution has limitations in using the GARCH process, especially in emerging markets where non-linearity exists because of low volume, turbulences and thin trading.

Student's t-distribution, on the other hand, has limitations on log-likelihood contributions. By controlling the tail behaviors, it reaches normality in the end.

It is symmetric, as well. On the other hand, GED does not have any assumptions on the distribution of the errors. Instead, it examines the residuals and finds which assumptions should be made on the error distributions after checking the characteristics of the error terms. Since our data, especially in the second period, show negative skewness and relatively high kurtosis we choose to use GED.

The process is explicitly described by Krupinski and Purczynski (2006) as in the following[2]. Probability density function of the continuous random variable of Generalized Error Distribution or Generalized Gaussian Distribution takes the form in equation 5.

$$f(x) = \frac{\lambda \times \rho}{2 \times \Gamma(\frac{1}{\rho})} e - [\lambda \times |x|]^{\rho} \quad (5)$$

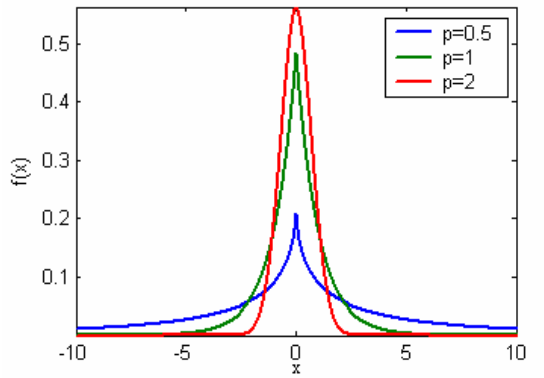
In the equation, p is the shape parameter and λ is relates to variance of the distribution, while

$$\Gamma(z) = \int_0^{\infty} t^{z-1} e^{-t} dt, z > 0 . \quad (6)$$

Following Krupinski and Purczynski (2006), the cumulative distribution can be reached by integrating equation 7.

$$F(x) = \int_{-\infty}^{x} f(z) dz \quad (7)$$

Figure 1, we can see the probability density function of GED for the shape parameters $p = 0.5$, $p = 1$, $p = 2$ and $\lambda = 1$. GED with the exponent equal 1 shows that the distribution is double exponential (Laplacian). On the other hand, GED with the exponent equal 2 is normally distributed. In general, we can argue that if the tail parameter equals 2, the GED is a normal distribution, on the other hand, if it is smaller than 1, it is fat-tailed.



Source: http://www.rkrupinski.ps.pl/langEn/GGD.php

Fig. 1. Generalized Gaussian Distribution

3. Data and empirical findings

3.1. Data. For the empirical analysis, daily values of the USD/TRY and EUR/TRY parities are used as the independent variables.

The daily values of the Istanbul Stock Exchange National 100 Index as the main index, and Industrial Sector Index, Financial Sector Index, Services Sector Index as sub-indices are used. The logarithmic values of the first difference (return) are used to decrease volatility in the data.

In addition, the analysis period is divided into two sub-time periods in order to see the conjectural changes in the relationship after and before Turkey's candidateship into the EU.

One period starts from 03.01.2002 to 29.12.2004 in which Turkey used floating exchange rates, on 21.02.2001, the country started to use floating exchange rates after speculative attacks. In December of 2004, Turkey became an official candidate of the EU.

The second sub-time period starts from 02.01.2005 to 17.07.2007 in which Turkey was seen as an EU candidate, and many structural changes occurred in that period.

A floating but stable exchange rate regime except from certain global minor turbulences is used with sharply decreasing interest rates. Additionally, the volumes of foreign direct and portfolio investments increased dramatically. In the banking sector, the share of foreign banks reached to two thirds of the sector.

In the industrial sector, the stable exchange rates created an easily planned cost, production and sales linkage. Overall, for all sectors in Turkey, effectiveness in production increased sharply. From that perspective, we can expect a change in the relationship between exchange rates and stock returns in Turkey, especially for the banking and industrial sectors. The descriptive statistics and Jarque-Bera test results of logarithmic differences of all financial time series are presented in Table 1.

[2] A web-based detailed explanation of the model can be found on http://www.rkrupinski.ps.pl/langEn/GGD.php

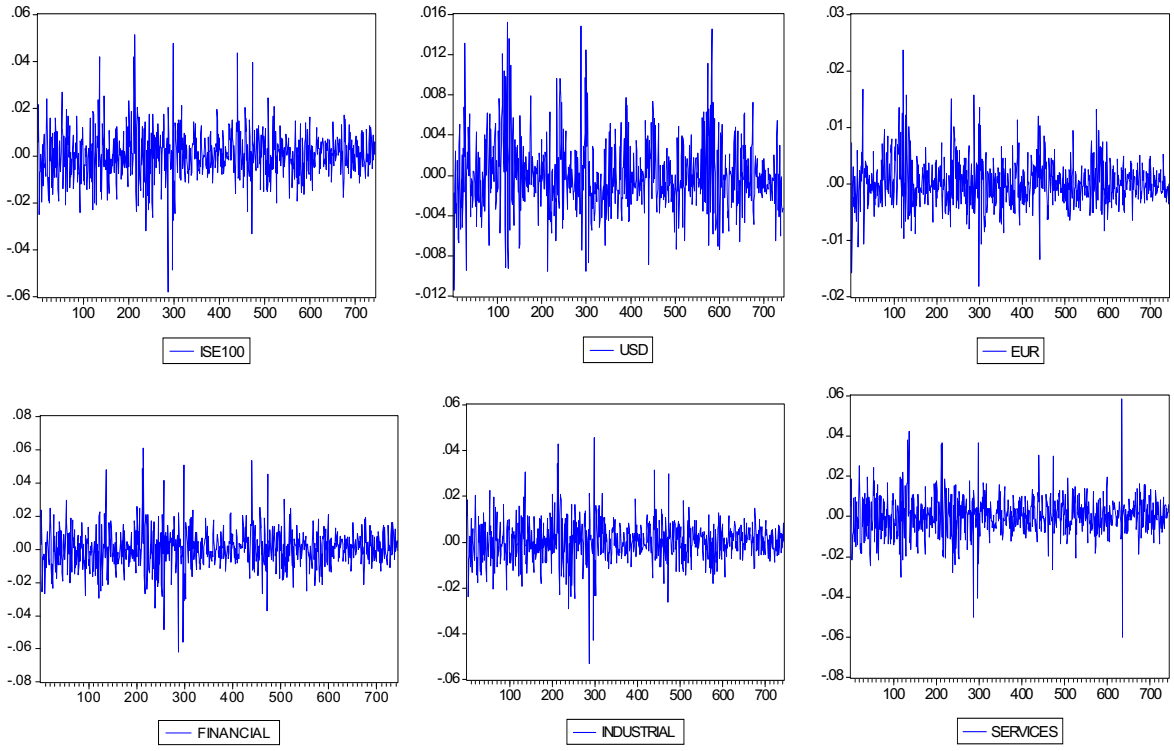


Fig. 2. Log-returns of time series for period 1 (03.01.2002-29.12.2004)

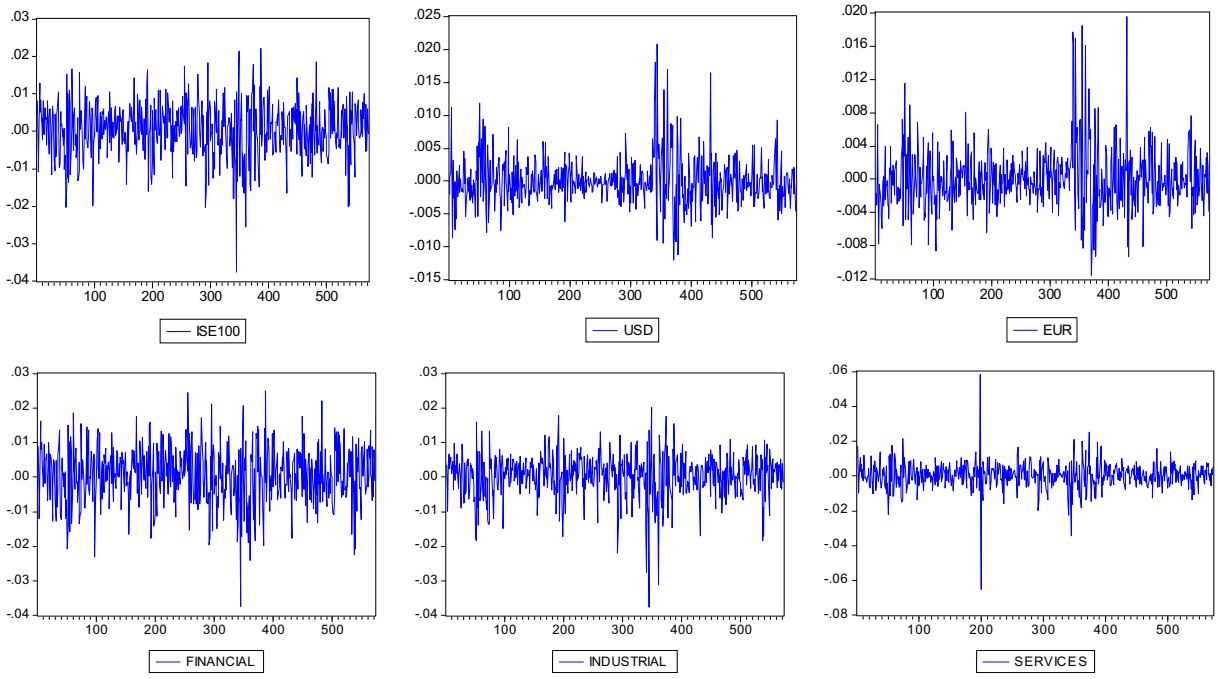


Fig. 3. Log-returns of time series for period 2 (02.01.2004-17.07.2007)

Table 1. Descriptive statistics and Jargue-Bera test results

Variable	Maximum	Minimum	Std. deviation	Skewness	Kurtosis	Jarque-Bera test
ISE100-P1	0.051200	-0.057939	0.010500	0.072000	6.643791	411.6828
Financial-P1	0.061013	-0.062113	0.012096	0.091017	6.738118	433.6229
Industrial-P1	0.049667	-0.092979	0.008960	0.091408	7.095103	520.2019
Services-P1	0.058248	-0.060119	0.010099	-0.048837	7.768893	703.7980
USD/TRY-P1	0.019262	-0.011418	0.003935	0.684120	5.028190	189.3053
EUR/TRY-P1	0.023674	-0.018126	0.004119	0.979539	6.128671	344.6295
ISE100-P2	0.022161	-0.037657	0.007325	-0.924791	4.401716	73.08323

Table 1 (continued). Descriptive statistics and Jargue-Bera test results

Variable	Maximum	Minimum	Std. deviation	Skewness	Kurtosis	Jarque-Bera test
Financial-P2	0.024946	-0.037308	0.008197	-0.330963	3.732990	23.24783
Industrial-P2	0.020200	-0.037400	0.006312	-1.083400	7.058220	504.4223
Services-P2	0.058731	-0.065190	0.007576	-0.903678	18.999020	6124.9890
USD/TRY-P2	0.020700	-0.012058	0.003657	1.096167	8.168124	791.1274
EUR/TRY-P2	0.019997	-0.011944	0.003984	1.219947	8.330187	817.9864

Table 2. The ADF and P-P Tests Results

Variables	ADF Test	P-P Test
	t-statistics	t-statistics
ISE100-P1	-28.0047	-28.0999
Financial-P1	-27.9315	-27.9995
Industrial-P1	-28.2183	-28.2298
Services-P1	-29.3822	-29.4329
USD/TRY-P1	-14.7927	-24.7829
EUR/TRY-P1	-26.9132	-27.0068
ISE100-P2	-22.9901	-22.5958
Financial-P2	-22.3860	-22.3990
Industrial-P2	-22.3580	-22.3680
Services-P2	-27.6179	-27.7643
USD/TRY-P2	-24.0702	-24.0774
EUR/TRY-P2	-23.3002	-23.3070

The Jarque-Bera test statistics show that the time series satisfy the normality distribution assumption. On the other hand, we observe an obvious negative skewness in the return distributions of the variables in the second period. An increase in the kurtosis is also observed for that period; however, standard deviation in the returns is sharply decreased. From those descriptive statistics, for the second period, we point out a non-linear but relatively stable return in the financial variables. This conclusion guides us to choose the GARCH with GED methodology for empirical tests. The reasons for that choice are discussed in detail in the methodology part.

The unit roots for serial correlation and stationary tests are performed with Augmented Dickey-Fuller (ADF) and Phillips and Perron (P-P) unit root tests. For ADF test, Schwarz Information Criterion, for P-P test Newey-West Bandwidth are preferred. The results presented in Table 2 show that they do not exit any unit root problem and the series are stationary.

3.2. Empirical Findings. In general, empirical findings point out that the exchange rates have effective in stock returns from all sectors. That effect, however, comes from one-lag, in other words, today's exchange rates influence tomorrow's stock returns. Those empirical findings might be seen a weakness of information efficiency in the market.

Table 3. FX volatility effect on stock indices by garch-m with Generalized Error Distribution (period 1)

Dependent Variable	EUR_t	USD_t	EUR_{t-1}	USD_{t-1}	R^2	DW	Akaike
ISE100-P1	0.209	0.094	-0.335*	-0.659*	0.154	2.137	-6539
Financial-P1	0.232	0.025	-0.378*	-0.682*	0.139	2.143	-6.261
Industrial-P1	0.128	0.138	-0.277*	-0.586*	0.176	2.130	-6.905
Services-P1	0.104	0.246	-0.253**	-0.556	0.137	2.189	-6.606

Notes: * Significant at 99% confidence level, ** significant at 95% confidence level.

Table 4. FX volatility effect on stock indices by GARCH-M with Generalized Error Distribution (Period 2)

Dependent variable	EUR_t	USD_t	EUR_{t-1}	USD_{t-1}	R^2	DW	Akaike
ISE100-P2	-0.017	-0.207	-0.331*	-0.8203*	0.295	2.171	-7.372
Financial-P2	0.0157	-0.288**	-0.375*	-0.857*	0.267	2.128	-7.081
Industrial-P2	0.029	-0.113	-0.270*	-0.663*	0.299	2.096	-7.767
Services-P2	-0.106	-0.017	-0.347*	-0.487*	0.122	2.390	-7.400

Notes: * Significant at 99% confidence level, ** significant at 95% confidence level.

In the first time period, the first lags of exchange rates are effective in stock returns of all sub-indices. Only the USD, however, is not effective on stocks listed in the services sector. In general about 15% of the stock returns can be explained by first lags of volatility in exchange rates. When we consider the

potential factors affecting exchange rates such as inflation, interest rates, growth, sector specific variables, R^2 is relatively high and explanatory.

When we examine the statistically significant co-efficients, we can see that about 0.33-point change in the first lag of EUR/TRY volatility creates one point change in the stock returns. For the USD/TRY, that percentage increases to 0.66 point. As theoretically expected, the effect is of negative direction.

In the second period, we observe a dramatic increase in the foreign exchange and stock return relationship in terms of both co-efficients of the USD/TRY parity and consequently, the R^2 values. Although the effect of the EUR/TRY parity still remains the same, the effect on the USD increases dramatically. In the financial sector, especially, which has been dominated by the foreign stockholders, the USD/TRY effect is high. A 0.86 point increase in the first lag USD/TRY volatility creates a 1 point decrease in the stock returns of financial firms. In addition, today's USD/TRY parity has become effective in today's stock returns in the financial sector. On the other hand, the services sector is still relatively less influenced by the exchange rates.

The R^2 values show an important explanatory power of the exchange rates on the share prices for all sectors. About one third of the daily changes in stock returns can be explained by yesterday's volatilities of the exchange rates. The services sector has not seen a change in that manner for the second period showing that it still behaves with internal dynamics.

The variance equation in Table 5 points out the GARCH effect and fat tails in the financial time series. As it can be followed from the table, there is an obvious GARCH effect in the relationship, and the return parameters in the regression equations show fat-tail characteristics. Since the GED parameters for all models are lower than 2, during the test process, the models use fat-tails rather than normally distributed returns for the financial variables.

Table 5. Variance equation for the models

Dependent variable	Constant	RESID (-1)^2	GARCH (-1)	GED Parameter
ISE100-P1	1.890	0.068*	0.911*	1.527*
Financial-P1	2.780	0.067*	0.910*	1.426*
Industrial-P1	8.310	0.067*	0.914*	1.628*
Services-P1	9.820*	0.125*	0.762*	1.369*
ISE100-P2	5.830**	0.125*	0.718*	1.952*
Financial-P2	8.750	0.090**	0.729*	1.936*
Industrial-P2	3.810**	0.175*	0.684*	1.546*
Services-P2	1.110*	0.231*	0.504*	1.229*

Notes: * Significant at 99% confidence level, ** significant at 95% confidence level.

As a conclusion, we can determine that the exchange rates have a statistically significant first-lag negative effect on stock returns in all sectors. Since 2005, that effect increased dramatically except for the services sector.

The reason for this increase might be globalization of the Turkish markets in terms of both foreign direct and portfolio investments.

Conclusion

In theory, exchange rates should be effective in the stock returns of firms. The significance of the effect might change according to the economy, sector and time period under investigation. In this empirical paper, we try to examine the exchange rates volatility effects on stock returns listed on the Istanbul Stock Exchange.

In order to see the different aspects of the effect, we divide the financial time series into different categories based on time and sector parameters. We examine the exchange rate effects on the stock returns in terms of sectoral [Gd1] and time period sub-categories.

On the sectoral side, we use financial, industrial and services sectors indices. On the time dimension, we divide data into two sub-periods from 2002 to 2004 and from 2005 to 2007. That two-dimensional division of the time series data provides us to see the EU candidateship effects of the foreign exchange rate effect on the stock returns on sectoral basis.

As a methodology, we choose GARCH-in-mean with Generalized Error Distribution to capture the GARCH and fat tail effects in the regression. The empirical findings show that first lags of the USD/TRY and the EUR/TRY parities are effective on stock returns in Turkey. The effect increased since 2005, especially for the industrial and financial firms.

The findings have the following important conclusions. First of all, the Turkish economy became a relatively open economy after its candidateship to the EU.

Due to most probably foreign direct and portfolio investments in the financial and industrial sectors, the stock returns became exchange rate dependent. Firms therefore should manage their foreign exchange rate risks more accurately in order to avoid FX risk exposure.

Second, the test results show that the error terms in that relationship are fat-tailed. This finding should encourage the researchers to use non-parametric flexible models to capture fat-tails in the returns of future researches.

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