INVESTIGATING EXCHANGE RATE EXPOSURE OF ENERGY FIRMS: EVIDENCE FROM TURKEY

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Abstract:
This study investigates the exchange rate exposure of Turkish energy firms from 2002 to 2010. We employed a regression model that is constructed by adding exchange rate and oil price factors to Fama-French Three Factor Model. Empirical results suggest that exchange rate risk appears to impact energy firms diversely. Among the 9 energy firms in our sample, only 2 firms seem to be exposed to exchange rate risk. These two energy firms appear to have larger open foreign currency positions and do not use any hedging methods. On the contrary, rest of the energy firms that are not found to be affected by exchange rate risk either seem to have smaller open foreign currency positions or employ hedging methods to manage exchange rate risk. Overall, our results provide evidence that energy firms exposed to exchange rate risk share similar characteristics.

Keywords: energy firms, stock returns, exchange rate exposure
JEL Classification: G12, G32

1. Introduction

Theoretically, the value of a firm may be computed by summing up the discounted expected future cash flows (Shapiro, 1975). Level of cash flows as well as risk attitudes of investors toward risk would impact value of a firm. These expected cash flows would naturally be affected by several economic factors. For example, economic variables, such as inflation, interest rates, production costs, national income, economic growth and exchange rates have great potential to impact profitability and value of firms (Arouri, 2011). Thereby, exchange rate risk impacts firm value *via* its influence on expected cash flows arising from export and import transactions, foreign debt, cash flows of foreign subsidiaries and foreign portfolio investments (Bartram, 2004). The degree of exchange rate exposure is presumably determined by two factors. First, the competitiveness of a firm relative to rival firms is altered by relative price movements. At this point, unexpected exchange rate variations are reflected in higher prices. As different industries have distinct competition circumstances, exchange rate movements might affect some industries differently than others. Second, firms' hedging practices may impact their exchange rate exposures as well. Greater hedging efforts are expected to yield smaller degrees of exchange rate exposure (Chow and Chen, 1998).

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Although exchange rate impact is expressed for all types of firms, two significant issues introduce a distinguishing feature for energy firms. First, exchange rate impact is more pronounced for firms that use foreign exchange in their operations. Fossil fuels have a crucial role in the modern economic environment. 80 per cent of the world's energy use comes from fossil fuels in the form of coal, oil and natural gas (Suganthi and Samuel, 2012). However, fossil fuel reserves and demand for these commodities are not evenly distributed throughout the world. Thereby, energy firms generally trade raw materials and final products in the global market. For example, in 2008, 66.8 per cent of the world's daily oil production of 81.82 million barrels, was traded internationally (Ediger and Berk, 2011). Since, fossil fuels are traded globally, energy firms have to intensively purchase and sell raw materials and final products in a global environment. As a result, exchange rate arises as a significant value variable for energy firms. Second issue is related with the cost structure of energy firms. An important characteristics of energy firms is that their value is significantly influenced by commodity prices (Boyer and Filion, 2007). Cost items of energy firms depend on homogeneous and raw natural resources. Since product differentiation is not possible with raw commodities, the best performing energy firms are generally those firms that minimize production costs (Sadorsky, 2001, p.18).

When we examine energy structure of Turkey, we observe that energy price variations generate a significant source of risk. In 2006, oil accounted for 33.2% of Turkey's primary energy production, followed by natural gas (29.5%), and coal (26.4%). Although oil appears to prevail in terms of total energy production, the situation changes for electricity production. In 2009, electricity generation of Turkey originated from three main sources: natural gas by 48.6%, coal by 28.3%, hydroelectric by 18.5% (see www.enerji.gov.tr). Two important aspects make Turkish economy more vulnerable to rising energy prices. First, an important characteristics of the Turkish energy industry is that it is a net importer. Turkey has to import nearly 70% of the primary energy consumption in the form of fossil fuels (Sözen, 2009). Second, as Basher and Sadorsky (2006) note, "emerging economies tend to be more energy intensive than more advanced economies and are therefore more exposed to higher oil prices". Since Turkey is an emerging economy, we expect a similar situation as a result of higher oil prices.

There are two basic methods for hedging against exchange rate risk. These methods are financial hedging and operational hedging. Operational hedging strategies mostly comprise geographic diversification of firm operations (Allayannis, *et al.*, 2001). Financial hedging is maintained by using derivative financial instruments, namely forwards, futures, swaps and options (Nance *et al.*, 1993). Nevertheless, hedging would be better understood if it is handled as a hierarchical procedure. Before employing operational or financial hedging alternatives, firms may prefer a less costly hedging method, namely natural hedging. A natural hedging aims at matching foreign currency cash inflows with cash outflows in the same currency or a highly correlated currency (Nguyen and Faff, 2006). Thereby, a firm may try to get closer to a neutral foreign currency position.

Aim of this study is to investigate exchange rate exposure of Turkish energy firms. In this manner, data of 9 energy firms whose shares are traded on Istanbul Stock Exchange (ISE) and listed in Industrial Development Bank of Turkey (TSKB) Energy Index for the time period that spans from July of 2002 to June of 2010 are used (see www.Tskbendeksleri.Com). Moreover, additional data required by regression models are also employed. Thus, sample of the study covers all non-financial firms listed in ISE for the 2002–2010 period. The regression model used in the analysis is developed by adding shifts in exchange rates and oil prices as explanatory variables to Fama-French Three Factor Model (FFM).

We contribute to the empirical literature through our sample construction and empirical methodology. FFM is rarely used for examining exposure of firms to variations in exchange rates. Furthermore, up to our knowledge, this model is not used to investigate exposure of Turkish firms to changes in either exchange rates or energy prices. Our other contribution to the literature rests on our innovation in examining behaviour of single firms instead of examining movements of industrial indices. This method would generate more firm-specific information than working on averages of a group of firms. Finally, a significant contribution to the literature will depend on merging two separate literatures, namely, asset-pricing literature and exchange risk literature.

This paper is organized as follows. The next section summarizes the literature. Third section presents methodology and data. Empirical results are reported in fourth section. The last section concludes the paper.

2. Literature Review

Empirical studies that investigate exchange rate exposure of firms comprise a wide variety of countries and industries. Nevertheless, empirical studies tend to focus on developed markets, aggregate stock market returns and industries other than energy industry. In this section, findings of empirical studies are summarized.

Nydahl (1999) measures the extent to which Swedish firms are exposed to exchange rate for the period December 1992 to February 1997. He finds evidence of a pervasive impact of varying exchange rates on stock prices. This impact is more pronounced for firms that engage in foreign trade, while the impact is diminished for firms that use currency derivatives. Bartram (2004) examines exchange rate exposure of 447 non-financial German firms for the 1981–1995 period and detects existence of both linear and nonlinear exchange rate exposures. Kolari *et al*. (2008) investigate exchange rate exposure of US stock returns for the time period that spans from 1973 to 2002. A four-factor model is employed in the study. The factors in this model are stock market, size factor, book-to market factor, momentum factor and exchange rate factor. Findings show that exchange rate risk is negatively priced in the US stock market. Huffman *et al*. (2010) examined exchange rate exposure of 185 US manufacturing multinational firms for the time period of 1997–2004. Capital asset pricing model (CAPM) and FFM are employed in the study. Results suggest that non-hedging and small firms are more exposed to exchange rate risk. Likewise, firms with higher foreign sales ratios demonstrate higher exposure levels.

The studies summarized above focus on several industries other than energy industry. Nevertheless, there are several studies that directly focus on exchange rate exposure and energy price sensitivity of energy firms. Sadorsky (2001) examines exposures of Canadian firms to stock market index, energy price, interest rates, and exchange rates for the period 1983–1999. Findings suggest that the rise of the stock market index and oil price has a positive effect on oil firms' returns, while the rise of interest rates and exchange rates has a negative impact. El-Sharif *et al*. (2005) test the relationship among crude oil price, exchange rate and equity values in the oil and gas sector. The sample consists of the United Kingdom firms from 1989 to 2011. Findings reveal that changes in crude oil prices, the stock market and the exchange rate have a significant impact on stock returns of oil and gas firms. Increases in the US dollar seem to cause a decline in stock returns. Boyer and Fillion (2007) focused on the determinants of Canadian oil and gas firm stock returns over the period 1995–2002. The sample includes 105 Canadian oil and gas corporations, whose shares are traded on Canadian Stock Exchange. Findings suggest that stock returns of Canadian energy firms are negatively related with exchange rates and positively related with increases in crude oil prices and natural gas prices. Jayasinghe and Tsui (2008) investigate exchange rate exposure of fourteen Japanese industrial industries by employing a bivariate GJR-GARCH Model for the period from 1992 to 2000. Their findings indicate that returns of oil and gas industries are negatively impacted by exchange rate changes. Oberndorfer (2009) analyses the relationship between energy market developments and the pricing of European energy stocks over the period 2002–2007. The results imply that exchange rate positively affects the excess portfolio returns of oil and gas industries. Ramos and Veiga (2011) investigate the impact of oil prices and exchange rates on oil and gas industries of 34 countries. Sample period spans from 1998 to 2009. Findings suggest that oil price has a positive impact on the market returns of the oil and gas industries. On the contrary, exchange rate negatively affects oil and gas industries.

3. Methodology and Data

Sample covers 9 energy firms whose shares are continuously traded on Istanbul Stock Exchange and listed in TSKB Energy Index for the time period that spans from July of 2002 to June of 2010. TSKB (Industrial Development Bank of Turkey) is the first private investment and development bank of Turkey. TSKB Energy Index has been initiated by the collaboration of TSKB and ISE (Istanbul Stock Exchange) and computed since December 31, 2008. The index comprises 10 energy firms. The selection criterion of TSKB Energy Index is that at least 40 per cent of consolidated revenues of firms should arise from energy related activities. Activities of energy firms can be summarized in two major areas. First area consists generation (from either conventional or renewable sources) and distribution of electricity. Second area is related with searching, producing, refining and selling oil and gas. Moreover, producing and selling materials required to support these activities are also treated as related with energy area. By the end of the year 2011, TSKB Energy Index comprises 10 energy firms. In Table 1, energy firms listed in TSKB Energy Index are presented (TSKB, Content of Index).

Although there are 10 firms listed in TSKB Energy Index, AKSEN is excluded from the sample due to the data unavailability. Another issue that we have to handle is that we will avoid using names of firms during our interpretations. Since, shares of the energy firms in our sample are publicly traded; we will code the energy firms in order to avoid manipulating the stock market. Moreover, the sample is not restricted with energy firms. Additional data required by regression models are also employed. Nevertheless, some shares that do not comply with certain criteria are excluded from the sample. Negative-equity firms are not sampled as stated by Fama and French (1995). Likewise, in line with Strong and Xu (1997), firms with more than one class of ordinary shares are not included in the sample. Monthly return and price data of stocks come from official internet site of ISE (http://www.imkb.gov.tr/Data/StocksData.aspx).

Table 1 | Firms Listed in TSKB Energy Index

1. AKENR: AKENERJİ ELEKTRİK ÜRETİM A.Ş.
2. AKSUE: AKSU ENERJİ VE TİCARET A.Ş.
3. AYEN: AYEN ENERJİ A.Ş.
4. AYGAZ: AYGAZ A.Ş.
5. ENKAI: ENKA İNŞAAT A.Ş.
6. PTOFS: PETROL OFİSİ A.Ş.
7. TRCAS: TURCAS PETROL A.Ş.
8. TUPRS: TÜPRAŞ-TÜRKİYE PETROL RAFİNERİLERİ A.Ş.
9. ZOREN: ZORLU ENERJİ ELEKTRİK ÜRETİMİ OTOPRODÜKTÖR GR. A.Ş
10. AKSEN: AKSA ENERJİ ÜRETİM A.Ş.

Source: TSKB, Content of Index, www.tskbendeksleri.com, 2011

Empirical studies report a wide-spread impact of exchange rates on energy firms (Sadorsky, 2001; Boyer and Filion, 2007; Jayasinghe and Tsui, 2008; Oberndorfer, 2009; Ramos and Veiga, 2011). We employ exchange rate factor in our model in order to measure sensitivity of energy firms to variations in exchange rate. Exchange rate is expressed as Turkish Lira (TL) value of 1 US dollar.

Oil price fluctuations are a significant source of inflationary pressure in the economy which in turn could impact investments of all types (Sadorsky, 1999). Thereby, oil price movements are another common risk factor for energy firms. Price fluctuations directly affect revenues, profits, investments and cash flows, thereby firm value. Nevertheless, direction of the impact of energy prices on countries and firms is not so clear. Firms in oil-exporting countries appear to benefit from increases in energy prices (Sadorsky, 2001; Dissou, 2010). On the contrary, oil-importing economies seem to suffer from rising energy prices (Cunado and Gracia, 2003; Park and Ratti, 2008). Energy literature documents impact of oil prices on a wide variety of industries including energy related economic activities (Faff and Brailsford, 1999; Sadorsky, 2001; Boyer and Filion, 2007; Oberndorfer, 2009; Dissou, 2010; Ramos and Veiga, 2011). In order to account for this impact, change in oil prices is also included in the model.

Empirical findings reveal that firm size would impact sensitivity of firms to either exchange rate variations or energy price changes. Vygodina (2006) reveals that large and small US firms indicate discrepancy in terms of the relationship between stock returns and exchange rate variations. Sadorsky (2008) report size effect for sensitivities of firms to shifts in energy prices for US firms. Huffman *et al.* (2010) find the existence of size effect for US multinational firms. In the light of prior empirical studies, we include size factor in our model with the aim of controlling for size effect.

Although book-to-market effect is not pronounced for energy firms, empirical findings reveal impact of it on the general stock market returns. Dos Santos *et al*. (2011) analyse and compare the performance of value stock portfolios (high book-to-market ratio) and growth stock portfolios (low book-to-market ratio) for the 2005–2010 period. Portfolios comprise the stocks listed in the IBrX 50 index of São Paulo Stock Exchange. They find that investments in value stock portfolios do not result in higher returns when compared to investments in growth stock portfolios. Hahn (2011) examines the role of book-to-market ratio in explaining the long run returns of new stock issues. Hahn (2011) finds out that book-to-market effect is negative and significant in explaining new issue returns.

The empirical model employed in the study is an augmented version of FFM. We add exchange rate and energy price factors to original FFM, where FFM relies on CAPM. The original form of CAPM is developed by Sharpe (1964), Lintner (1965) and Mossin (1966):

$$R_{it} – R_{ft} = a_i + b_i(R_{mt} – R_{ft}) + \varepsilon_{it} \quad (1)$$

α constant term,
R_i return of the security i,
R_m return of the market portfolio,
R_f risk free rate of return,
ε_i residual error term.

In foreign exchange literature, an extended version of CAPM is generally employed. Following Adler and Dumas (1984) foreign currency exposure of firms are defined as a regression coefficient of dollar changes and added to original CAPM equation and formulated as below (Jorion, 1991):

$$R_{it} – R_{ft} = a_i + b_i(R_{mt} – R_{ft}) + r_i(ER_t) + \varepsilon_{it} \quad (2)$$

ER: change in relevant exchange rate.

Faff and Brailsford (1999) add an oil price factor to this extended version of CAPM:

$$R_{it} – R_{ft} = a_i + b_i(R_{mt} – R_{ft}) + r_i(ER_t) + p_i(OILP_t) + \varepsilon_{it} \quad (3)$$

OILP: change in oil prices.

However, empirical studies indicate that CAPM does not fit well with real financial data. Thereby, FFM empirically outperforms CAPM (Lawrance, *et al.*, 2007). FFM is originally developed by Fama and French (1992) and Fama and French (1993). In its original form, FFM requires employment of size and book-to-market (B/M) factors beside market risk:

$$R_{it} – R_{ft} = a_i + b_i(R_{mt} – R_{ft}) + s_i(SMB_t) + h_i(HML_t) + \varepsilon_{it} \quad (4)$$

SMB: return difference between small and big stock portfolios,

HML: return difference between high B/M and low B/M stock portfolios.

The final model used in the study requires the addition of variations in exchange rates and oil prices to the original form of FFM. This new version of FFM is referred to as Augmented FFM (AFFM) and rarely used to examine exchange rate exposure (Hsin, *et al.*, 2007; Kolari *et al.*, 2008; Huffman, *et al.*, 2010):

$$R_{it} – R_{ft} = a_i + b_i(R_{mt}– R_{ft}) + s_i(SMB_t) + h_i(HML_t) + r_i(ER_t) + p_i(OILP_t) + \varepsilon_{it} \quad (5)$$

AFFM is estimated for 9 energy firms in the sample. Existence of serial correlation in the regression models is tested by Breusch-Godfrey Langrange Multiplier test (Breusch, 1978; Godfrey, 1978). Heteroscedasticity is tested by White test (White, 1980). Serial correlation is detected in some of the regression models and Newey and West Heteroskedasticity and Autocorrelation Consistent Standard Errors are employed to adjust estimations (Newey and West, 1987). On the other hand, in some of the regression models heteroscedasticity is detected and White Heteroskedasticity Consistent Standard Errors are used to adjust estimations (White, 1980).

Some preliminary work is required in order to generate size and B/M factors that are crucial for developing AFFM. These studies are summarized below.

In order to generate SMB and HML factors, firm size and B/M ratio are used as portfolio construction criteria. In portfolio construction, the ordinary calendar period of January–December is not used. The declarations of 12 month balance sheets are generally completed in the first six months of the following year (Fama and French, 1992). In this manner, portfolio construction periods begin at the end of June in each year t and ends in June of each year t+1. Financial statement data of the year t-1 is matched with stock return data of the month June in year t. Return calculations depend on the time period between July of each year t and June of each year t+1.

Firm size has been found as a significant factor for stock returns. In portfolio construction, market value is used as the measure of firm size. Market value of each firm included in the sample is calculated by multiplying number of shares outstanding by stock price. Following Fama and French (1995), market value of each stock for each year t are derived by calculating the market value in June of the same year. After the computation of market values of June, the first step requires ranking all of the stocks from small to big according to their market values. At the second step, ranked stocks are sorted into two stock portfolios. Allocation of stocks into two portfolios is based on median value. Stocks with a market value equal to or less than median value are included into small stock portfolio, while stocks with a market value greater than median value are included into big stocks portfolio. Finally, returns of both portfolios are arranged as monthly time series. Monthly portfolio returns are derived by computing value-weighted returns of stocks in each portfolio.

Another factor that is hypothesized to impact stock returns is the B/M ratio. In line with Fama and French (1995), B/M ratio for each firm is computed by dividing book equity of year t-1 by market value of December of year t-1. These B/M ratios are used for constructing portfolios for the period which begin in July of year t and end in June of year t+1. Computing the returns of B/M portfolios require a three-step process. At the first step, all stocks are ranked from lowest to highest according to their B/M ratios. Second, three stock portfolios are constructed: lowest 30%, medium 40%, and highest 30%. Finally, returns of the three portfolios are arranged as monthly time series. Monthly portfolio returns are obtained by calculating value-weighted returns of stocks in each portfolio.

Next procedure in portfolio construction is to construct intersection portfolios. Following Fama and French (1995), six intersection portfolios are constructed. Intersection portfolios are constructed annually and they are designed as intersections of two size portfolios and three B/M portfolios. Definition of intersection portfolios is summarized below:

SL = Stocks in this portfolio are small and have the lowest B/M ratios.
SM = Stocks in this portfolio are small and have moderate B/M ratios.
SH = Stocks in this portfolio are small and have the highest B/M ratios.
BL = Stocks in this portfolio are big and have the lowest B/M ratios.
BM = Stocks in this portfolio are big and have moderate B/M ratios.
BH = Stocks in this portfolio are big and have the highest B/M ratios.

Value-weighted stock returns are used in computing intersection portfolio returns. Returns of the six portfolios are calculated for the time period that spans from July of year t to June of year t+1.

The final procedure required for generating SMB and HML factors is to construct SMB and HML portfolios by using intersection portfolios. SMB portfolio is constructed as follows (Charoenrook and Conrad, 2005):

$$SMB = 1/3(SL + SM + SH) - 1/3(BL + BM + BH)$$

Likewise, construction of HML portfolio may be formulated as follows (Charoenrook and Conrad, 2005):

$$HML = \tfrac{1}{2}(SH + BH) - \tfrac{1}{2}(SL + BL)$$

The data used in the study come from various sources. Monthly ISE-100 index data is obtained from stock market database displayed in the official internet site of ISE (http://www.imkb.gov.tr/Data/Consolidated.aspx). Risk free rate of return data used in calculating risk premium is derived by converting Annually Compounded Interest Rates of Treasury Discounted Auctions into monthly values. Interest rate data come from official internet site of Republic of Turkey Prime Ministry Undersecretariat of Treasury (www.hazine.gov.tr). Financial statement data is required for calculating sizes and B/M ratios. Financial statements are obtained from the official internet site of ISE (www.imkb.gov.tr).The next explanatory variable employed in the AFFM is ER. ER represents monthly changes in the exchange rate and expressed as TL value of 1 US dollar. Exchange rate data come from the official internet site of Central Bank of the Republic of Turkey (http://evds.tcmb.gov.tr). Oil prices (in US dollars) are proxied by the average of U.K. Brent, Dubai, and West Texas Intermediate oil prices and obtained from International Monetary Fund website.

4. Empirical Findings

In this section, exchange rate exposures of energy firms are investigated by a five factor model and the findings are reported. Prior to analysis, summary statistics of the data are provided. Table 2 demonstrates mean returns and standard deviations of returns of energy firms and factor portfolios.

Table 2 | Excess Returns of Energy Firms' Shares, Market Portfolio and Returns of SMB and HML Portfolios (%)

	Mean Return	Standard Deviation
RM	2.44	10.14
SMB	0.35	4.31
HML	0.48	4.36
ER	0.11	3.98
FIRM 1	1.67	12.21
FIRM 2	2.10	14.96
FIRM 3	2.33	13.90
FIRM 4	2.85	12.59
FIRM 5	2.37	10.95
FIRM 6	2.68	15.14
FIRM 7	3.86	15.68
FIRM 8	3.10	11.45
FIRM 9	1.71	13.59

Source: Own calculation based on data from Istanbul Stock Exchange, Republic of Turkey Prime Ministry Undersecretariat of Treasury and Central Bank of the Republic of Turkey, 2010.

Table 2 demonstrates that risk and return structures of energy firms are rather different. The highest risk and return figures belong to Firm 7, whereas Firm 5 has the lowest risk and Firm 1 has the lowest return values. Another observation is that SMB and HML generate lower return than the market portfolio and their risks are at lower levels. On the other hand, risk and return of US dollar is lower than that of SMB and HML portfolios, as well as the market.

Regression results are reported in Table 3. The results of AFFM indicate that market is a significant factor for all 9 energy firms. On the other hand, variations in exchange rate seem to be significant for only 2 energy firms (Firms 3 and 9). Likewise, variations in oil price appear to be significant for only 2 energy firms, namely firms 5 and 9. This finding is not surprising, as firms 5 and 9 are extensively engaged in exporting and importing raw materials and do not use financial hedging. Firm 5 employs derivatives solely to manage interest rate and currency risk. Commodity price risk does not seem to be controlled. Moreover, Firm 9 even does not use financial hedging methods. On the contrary, firms 4, 6 and 8 use derivatives to manage various forms of risks, including commodity price risk. While firms 1, 2 and 3 are not intensively involved with foreign trade, firm 7 seems to handle the issue by natural hedging methods. Findings related with SMB and HML factors are similar among energy firms. HML seems to impact just Firm 6, while SMB does not appear to influence energy stock returns. The positive sign of the SMB factor (s_i) implies that firms with smaller capitalization tend to have higher returns. Firms (5, 6, 8) have higher capitalization than the other firms in the sample which explains the negative signs of SMB in Table 3. Similarly, the positive sign of the HML (h_i) indicates that firms with higher B/M ratio tend to have higher returns. So, firms (1, 4, 6, 7) have lower B/M ratios than the rest of the firms in the sample have negative (h_i) coefficients. Moreover, operating areas seem important in the determination of coefficient (p). Firms 4 and 6 are the only firms engaging with oil distribution and tend to be sensitive to oil price changes. Thus, coefficient (p) of firm 4 has a negative sign. On the other hand, R^2 values vary significantly among models. An important finding prevailing all of the estimations is that statistically significant beta coefficients of exchange rate variable possess negative values. Thus, the energy firms that are exposed to exchange rate seem to be negatively influenced by exchange rate risk. This finding is in line with results of the empirical studies (Sadorsky, 2001; El-Sharif *et al.*, 2005; Boyer and Fillion, 2007; Jayasinghe and Tsui 2008; Oberndorfer, 2009; Ramos and Veiga, 2011).

Table 3 | AFFM Regression Analysis Results

FIRM	a	b	s	h	r	p	F-Stats	Adjusted R^2
FIRM 1	-0.007 (0.459)	0.765** (0.000)	0.161 (0.531)	-0.097 (0.703)	-0.318 (0.257)	0.071 (0.549)	14.970 [0.000]	0.424
FIRM 2	-0.008 (0.512)	0.859** (0.000)	0.516 (0.118)	0.246 (0.449)	-0.211 (0.554)	0.233 (0.125)	12.417 [0.000]	0.375
FIRM 3[a]	-0.004 (0.702)	0.813** (0.000)	0.444 (1.133)	0.083 (0.775)	-0.348** (0.048)	0.098 (0.469)	13.694 [0.000]	0.401
FIRM 4	0.004 (0.638)	0.920** (0.000)	0.332 (0.165)	-0.070 (0.765)	-0.065 (0.802)	-0.077 (0.481)	22.281 [0.000]	0.528
FIRM 5	-0.001 (0.892)	0.575** (0.000)	-0.018 (0.943)	0.202 (0.405)	-0.146 (0.583)	0.189* (0.095)	10.295 [0.000]	0.328
FIRM 6[a]	0.006 (0.666)	0.867** (0.000)	-0.036 (0.896)	-0.425* (0.063)	-0.484 (0.123)	0.001 (0.995)	11.523 [0.000]	0.356
FIRM 7[a]	0.017 (0.173)	1.116** (0.000)	0.415 (0.104)	-0.208 (0.487)	-0.293 (0.483)	0.206 (0.233)	22.915 [0.000]	0.536
FIRM 8[a]	0.004 (0.663)	0.789** (0.000)	-0.117 (0.641)	0.014 (0.946)	-0.189 (0.384)	0.198 (0.143)	18.697 [0.000]	0.482
FIRM 9	-0.010 (0.414)	0.571** (0.000)	0.064 (0.836)	0.078 (0.802)	-0.614** (0.035)	0.337** (0.021)	9.320 [0.000]	0.305

Notes: * and ** denotes statistical significance at 10% and 5% levels, respectively.
Figures inside round brackets are probability values of respective coefficients.
Figures inside square brackets are probability values regarding F-statistics.
[a] t-statistic of coefficient reflects correction according to white heteroskedasticity-consistent standard errors.

Source: Own calculation based on data from Istanbul Stock Exchange, Republic of Turkey Prime Ministry Undersecretariat of Treasury and Central Bank of the Republic of Turkey, 2010

Exchange rate exposures of Turkish energy firms indicate significant discrepancies. As Firms 3, 6, 8 and 9 seem to be exposed to exchange rate risk, rest of the energy firms are not found to be exposed to exchange rate risk. The difference among the levels of exchange rate exposure of energy firms may be associated with the magnitude of net foreign currency positions. Since there are considerable scale differences among energy firms in the sample, scaling appears to be a necessity while evaluating the relative importance of net foreign currency positions of energy firms. Firm size is proxied by total assets. In this manner, scaling is performed by dividing net foreign currency positions of energy firms to their total assets and results are demonstrated in Table 4.

Table 4 | Ratios of Net Foreign Currency Positions of Energy Firms to Their Total Assets

Net Position/ Size	FIRM1	FIRM2	FIRM3	FIRM4	FIRM5	FIRM6	FIRM 7	FIRM8	FIRM9
2010	-0.435	0.000	0.035	-0.035	0.114	-0.324	0.042	-0.183	-0.578
2009	-0.374	0.000	0.052	-0.068	0.099	-0.167	0.023	-0.157	-0.489
2008	-0.180	0.000	0.073	-0.138	0.044	-0.174	0.007	-0.145	-0.751
2007	-0.115	0.000	0.255	-0.187	-0.031	-0.319	0.042	-0.264	-0.428
2006	-0.047	0.000	-0.312	-0.099	-0.083	-0.404	0.078	-0.225	-0.279
2005	0.079	0.000	-0.336	-0.123	-0.142	-0.359	-0.069	-0.205	-0.278
2004	0.170	0.000	-0.503	-0.094	-0.157	-0.027	-0.170	-0.179	-0.195
2003	0.176	0.000	-0.443	-0.032	0.181	-0.027	-0.339	-0.192	-0.044
2002	0.269	0.000	-0.449	-0.179	0.132	-0.452	-0.249	-0.288	-0.149
Average	**-0.051**	**0.000**	**-0.181**	**-0.106**	**0.018**	**-0.250**	**-0.071**	**-0.204**	**-0.355**

Source: Own calculation based on data from Istanbul Stock Exchange, Republic of Turkey Prime Ministry Undersecretariat of Treasury and Central Bank of the Republic of Turkey, 2010.

Scaled net foreign currency positions of energy firms indicate that diverse structures are observed among energy firms. Energy firms with the codes 3, 6, 8 and 9 have considerably larger open positions than other energy firms. As Firms 1, 4, 5 and 7 have smaller ratios, Firm 2 possess a neutral foreign currency position. When operations of Firm 2 are examined, zero open position seems to be justified. The major operations of Firm 2 consist of generating electricity from its hydroelectric station and distributing it. Thereby, there are no assets or liabilities denominated in foreign currency. Operations of Firm 1 show similarity with Firm 2. It also focuses on generating and distributing electricity. Nevertheless, Firm 1 also engages with trade of natural gas. Moreover, natural gas power stations constitute some portion of total capacity of the firm. Since Turkey is a net importer of natural gas as well as oil, a small (but different than zero) foreign currency position is not surprising. Although operations of Firm 3 is much like the firms 1 and 2, financing practices of Firm 3 is rather different. A significant portion of financial obligations of Firm 3 is denominated in foreign currency. Thereby, open currency position is relatively more important than Firms 1 and 2. Likewise, Firm 9 also generates a significant portion of total electricity production from natural gas stations. Furthermore, Firm 9 uses a considerable amount of short-term and long-term debt denominated in foreign currency. As a result, Firm 9 has the biggest open foreign currency position ratio among the energy firms. An important common aspect of Firms 1, 3 and 9 is that they completely depend on natural hedging in managing currency risk. They do not employ derivatives to minimize currency risk. As Firm 1 has relatively small open currency position and is not found to be exposed to currency risk, it appears to achieve this matching to some extent. Nevertheless, Firm 3 and Firm 9 do not seem to be successful in natural hedging, as they have the biggest open currency positions and are exposed to foreign exchange risk.

Operation areas of Firms 4, 5, 6, 7 and 8 are rather complex. Their operations indicate a great variety: Refining crude oil, fuel distribution, producing petrochemicals and plastic goods, *etc*. Another common characteristic of these firms is that, except for Firm 7, all of these firms extensively engage with hedging. They use natural hedging as well as hedging by derivatives. Natural hedging practices comprise matching assets and liabilities denominated in foreign currency. Derivatives are employed in the form of forward and futures contracts. Although Firms 4, 5, 6 and 8 employ natural hedging, only Firms 4 and 5 seem to achieve matching assets and liabilities. They have relatively smaller open foreign exchange positions. Moreover, they do not seem to be exposed to exchange risk. Firms 6 and 8 carry large open currency positions. Thus, these two firms do not appear to maintain a favourable relationship between their assets and liabilities. Nevertheless, they still do not seem to be exposed to foreign exchange risk. The reason of this may be employing adequate level of derivatives. Since Firms 6 and 8 employ derivatives to manage currency risk, the amount of derivative usage seem to control the currency risk. Thus, neither of the firms seems to be exposed to foreign exchange risk. Firm 7 maintains that they do not employ derivatives. However, Firm 7 appears to be successful in applying natural hedging method, as they have a relatively small open currency position.

5. Conclusion and Policy Implications

This paper investigates exchange rate exposures of Turkish energy firms. In this manner, our sample includes 9 ISE energy firms from July of 2002 to June of 2010. The regression models used in the analysis is developed by adding variations in exchange rates and oil prices as explanatory variables to Fama-French Three Factor Model (FFM). The new model generated is referred to as AFFM.

We document that exchange rate risk appears to impact energy firms diversely. Among the 9 energy firms in our sample, only 2 firms seem to be exposed to exchange rate risk. Although 2 energy firms are found to be exposed to exchange rate risk, other energy firms do not seem to be sensitive to exchange rate movements. Different levels of exchange rate exposure may be tied to firms' sizes of the net open foreign currency positions and hedging practices. Firms that seem to have smaller open currency positions do not show sensitivity to exchange rate variations. Among the rest of the energy firms, the firms that have large open currency positions are exposed to exchange rate risk. The same firms also do not employ any hedging methods. Although there are other firms that have large open currency positions, they do not seem to be exposed to currency risk. This result may be due to their intensive hedging efforts. Overall, our results provide evidence that energy firms exposed to exchange rate risk share similar characteristics. They have large open currency positions and do not use hedging methods. On the contrary, the firms that are not exposed to currency risk either have small open currency positions or employ hedging methods. Thus, the use of currency hedging seems to reduce the exchange rate exposure of energy firms.

Our findings should be of interest to investors, energy firms' managers and regulators. First, findings of this study may help investors in market timing of investment in energy firms. Second, energy firms' managers may have a better understanding of the outcomes of open currency positions. Another implication of the study is that it reveals the role of natural and financial hedging in risk management practices of energy firms. Thus energy companies may use our results to build efficient hedging strategies or limit their open currency positions. Finally, legal authorities of the energy market may also beware of the potential benefits of hedging exchange rate exposure. Turkey has to import majority of the primary energy consumption. Thus regulators may stimulate use of hedging techniques among energy companies. Future research in this area may examine other factors that might impact energy firms' exposure to exchange rate movements. Moreover, investigation of nonpublic energy firms' exchange rate exposure may provide a larger sample and shed light on different but related issues.

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