EXCHANGE RATE AND FIRM-LEVEL INVESTMENTS: EVIDENCE FROM BORSA ISTANBUL

Prof. Emin AVCI (Ph.D.)[*] iD

Feride KILINÇ[**] iD

ABSTRACT

The relationship between exchange rates and firm-level investments of the companies operating in the manufacturing sector listed on Borsa İstanbul (BIST) was investigated over a period of 2008 to 2021 using panel data analysis. A total of 81 companies from 7 industries within the manufacturing sector were examined. Exchange rate and firm-level relationships were identified using the Euro-USD basket standard deviation and real exchange rates index. The findings indicated a negative relationship between firm-level investments and exchange rate volatility for all industries, but a positive relationship between firm-level investments and real exchange rates for most industries. Furthermore, it is found that the effects of exchange rate volatility and real exchange rates on investments are realized with a delay for most industries. Overall, the results suggest that firms are reluctant to invest in times of high exchange rate volatility, but are more willing to invest when the value of Turkish Lira appreciates in real terms.

Key Words: Investments, Exchange Rate Uncertainty, Exchange Rate Volatility.

Jel Codes: E22, F31, G31.

1. INTRODUCTION

Investments are long-term strategic plans that require considerable effort and time from the firm management to evaluate all pros and cons under the prevailing market conditions. These conditions do not just cover the mean time but also possibilities about the future of economy. As the future economic conditions cannot be precisely known, investment decisions are mostly surrounded by uncertainty. Therefore, the relation between investment decision and uncertainty has been studied in literature from various aspects.

There are different opinions in the literature about the effect of uncertainty on firm investments. It is theoretically stated that uncertainty will increase firm investments by increasing the marginal value of capital (Hartman, 1972; Abel, 1983). However, contrary to this view, it is argued that the uncertainty

[*] Marmara University, Department of Business Administration, İstanbul/ Türkiye, E-mail: eavci@marmara.edu.tr
[**] Marmara University, Social Sciences Institute, PhD Student, İstanbul/ Türkiye, E-mail: feridekln@gmail.com

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regarding the cost of investment projects and the expected return from the investment may discourage the investment (Bernanke, 1983; Pindkck, 1986). While there may be several sources uncertainty, exchange rate volatility has become one of the most important components of uncertainty, especially after the break down of the Bretton Woods system. The increasing international trade and the number of multinational companies, as well as expanding supply chain, also contribute the importance of exchange rate volatility for managerial decisions.

The effect of exchange rate uncertainty or volatility on investments on aggregate level, has been studied from various aspects in the related literature (Darby et al., 1999; Serven, 2002; Pradhan et al. 2004; Byrne and Davis, 2005a; Landon and Smith, 2009; Bahmani Oskooee and Hajilee, 2013; Bampia and Colombo, 2021), however the recent studies have been focusing on the firm level effects of exchange rates (Avdjiev et al., 2019; Benerjee, et.al., 2020; Li et al., 2019; Dao et al., 2021; Zeng, et al., 2022; Ko, 2022). In the Turkish literature, there are limited number of studies analyzing the effect of exchange rate on investments on aggregate level (Özçiçek, 2007; Koç and Değer 2010; Öksüzler and Ekinci, 2013; Dursun,2015), to the best of the authors' knowledge, no previous study has examined the relationship between exchange rates and firm-level investments in Turkish companies. Through this research, it is aimed to contribute to the existing literature by providing empirical evidence on the specific dynamics between exchange rates and firm-level investments in the Turkish context. It is hoped that, the findings of the study will not only enhance the understanding of the relationship between these variables but also have practical implications for businesses and policymakers in managing exchange rate risks and promoting investment activities.

The relationship between exchange rates and firm-level asset investments of the companies operating in the manufacturing sector listed on Borsa İstanbul (BIST) was investigated over a period of 2008 to 2021 using panel data analysis. A total of 81 companies from 7 industries within the manufacturing sector were examined. Exchange rate and firm-level relationships were identified using the Euro-USD basket standard deviation and real exchange rates index.

The theoretical background and the related literature has been discussed in the second part of the research, while the data set and research methodology used in the study can be found on the third section. The fourth section is the empirical finding and discussion; and fifth section concludes.

2. METHODS

The relation between exchange rates and investment is related with two strands of the literature. While one strand deals with the effects of uncertainty on investments; the other one deals with the relation between exchange rate level or movements (depreciation or appreciation) and investments.

Early finding suggest that increasing uncertainty can strength the incentive to invest as the marginal profitability of capital may increase in line with uncertainty. On the other hand, more recent

findings assert that uncertainty may cause delays in investments, which in deed decreases the current investment level (Goldberg, 1993; Carruth, et at., 2002; Byrne and Davis, 2005a; Byrne and Davis, 2005b). The effect of uncertainty on investments may be higher with the increasing irreversibility of the investments, which is also combined with high adjustment cost (Taylor, et al. 2021).

Besides the exchange rate uncertainty, also the exchange rate movements (depreciation or appreciation) expected to affect investments. According to Goldberg (1993) three main forces determine the effect of exchange rate movements on investments. The first force is the sectoral profitability, which is basically related with demand for domestic goods, the usage of imported inputs in production and international trade. The second force is the reallocation of the production facilities. And finally, the third one is the portfolio and wealth reallocation, which depends on the risk aversion of investors. It is theorized that above forces can affect the investments via two main channels. The first one is the competitiveness channel (or trade channel), in which the depreciation (appreciation) will increase (decrease) the export revenue thus will lead to an expansionary (contractionary) effect on investments. On the other hand, depreciation (appreciation) will also increase (decrease) cost of imported inputs or capital goods, which in deed weakens (strengths) the tendency toward investments (Carranza, et al., 2003; Bampia and Colombo, 2021; Banerjee, et al., 2020). Thus the effect of currency movement on investments via competitiveness channel is not clear. While, the competitiveness channel basically dealing with the sensitivity of demand and cost of production to exchange rate movements, but there are also direct financial effects of such movement, which is called financial channel. Exchange rate depreciation will have an adverse effect on firms' balance sheets, especially which are subject to foreign exchange exposure. As, these firms borrowing capacity will be limited following a depreciation, their investment capacity will also decrease. Moreover, lending activity will also be adversely effected, as lenders will be reducing their credit supply, which imply tightening of financial conditions (Bampia and Colombo, 2021; Dao, et al., 2021).

For both competitiveness and financial channel, foreign exchange movements can have expansionary or contractionary effect on investment. Several studies show that such effect is time dependent. Among of the earliest studies, Goldberg (1993) documents that the effect of exchange rate movement and volatility on investments for USA is subject to change over time, where such effects were generally more strong in 1980s. While the real depreciation of the dollar in the 1970s caused an expansion in investment expenditures, it caused a contraction in the 1980s. Time and country dependent effect of exchange rate movements are documented by Darby et al. (1999), who examined the effect of exchange rate fluctuations on investment expenditures for 5 OECD countries (England, USA, France, Germany and Italy). While, negative relationship was observed between fixed capital investments and fluctuations in real effective exchange rates in the USA, France and Germany both in the short run and in the long run; in United Kingdom and Italy, a negative relationship was obtained in the short run. Byrne and Davis (2005a), shows the long-term adverse effect of exchange rate volatility on investments

in G7 countries. Short and long term the negative effect of depreciation for 17 OECD countries on the total investment have been studied by Landon and Smith (2009). Sectoral level analysis revealed that most of the sectors negatively affected from depreciation in the short run (except manufacturing) and a few (manufacturing and mining) effected positively in the long-run. The short-term and long-term effects of exchange rate volatility on domestic investments for 36 developed and developing countries has been documented by Bahmani Oskooee and Hajilee (2013). Exchange rate uncertainty negatively affected investment in 13 countries and positively affected 14 in the short run; however, such effects do not last in the long term for most of the countries.

The literature given above presents the time dependency of exchange rate movement on investments, moreover such literature also presents the cross country differences. Similar country wise differences also reported by Pradhan et al. (2004) on the effect of real exchange rate uncertainty on aggregate private investment for East Asian countries (Indonesia, Malaysia, the Philippines, and Thailand). The findings are inconclusive, where there is a negative effect of exchange rate volatility on investment for Thailand and Philippines (with lag), such effect is positive for Malaysia. In a recent study, Brito, et al. (2018) reveal the heterogeneity in the effect of exchange rate on investment for 71 countries. Their findings showed that investments in developed economies and Asian economies tend to increase with real exchange rate depreciation, whereas the opposite is true for less complex economies including rest of the emerging markets and developing economies.

It is also documented that sectoral and firm level characteristics may be the identifying factors for country level differences. For example, Campa and Goldberg (1995) stress the importance of external exposure of sector, where the higher exposure to imported input and the less market power, the more depressed will be the domestic investment. Importance of sectoral differences is also presented by Nucci and Pozzolo (1999), Atellia, et.al. (2003) for Italian manufacturing industry and by Kandilov and Leblebicioğlu (2011) for Colombian manufacturing industry. On the other hand, Serven (2002) find negative effect of exchange rate uncertainty on investments for 61 developing countries, which have trade openness and weak financial system. Similarly, Bampia and Colombo (2021) show that effect of exchange rate appreciation has been subject to change according to sectoral trade openness for Brazilian manufacturing sector. Several other factors are also identified as determinant of sectoral or firm level differences as market power (Atellia, et.al., 2003), foreign currency dominated debt and cross border lending (Carranzaa, et al., 2003; Avdjiev et al., 2019; Benerjee, et.al., 2020)). Labor intensity and irreversibility of investments (Li et al., 2019; Dao et al., 2021; Zeng, et al., 2022) and firm leverage (Benerjee, et.al., 2020; Ko, 2022).

There are limited number of studies analyzing the effect of exchange rate fluctuations on investments for Türkiye (the studies on foreign direct investments are ignored as such studies are considered as another strand of literature). Among the earlier studies, Özçiçek (2007) reveals the negative effect exchange rate volatility on aggregate investments. Koc and Deger (2010) utilize Tado-

Yamammoto causality test to explain the relation between exchange rate uncertainty and domestic investments. They document that there is a unidirectional casualty from exchange rate to investments. Öksüzler and Ekinci (2013) investigate the relationship between real exchange rate uncertainty and private fixed capital investments. A significant negative correlation has been obtained between real exchange rate uncertainty and investments under one of the models tested. Mutluay and Turaboglu (2013) study the change in real effective exchange rate and its lagged effect on firm level financial performance. The findings show that the lagged effect of changes in real effective exchange rates on firm financial performance is mostly negative. Such effect is stronger for the firms engaging export and import activities. Dursun (2015) reveals the long terms negative impact of exchange rate volatility on domestic investments. Similarly, Ünlü (2016) presents the negative impact of exchange rate volatility on gross domestic product, and concludes that the such negative effect is evident in long term with one period lag.

3. DATA AND METHODOLOGY

To identify the impact of exchange rate volatility on firm level investments, this study analyzes manufacturing firms, which are traded in BIST from 2008 to 2021. Companies that are not continuously traded or have missing variables during the period of analyses are omitted. As noted in the related literature, the effect of exchange rate volatility may vary across industries even within the same sector. Therefore, this study examines seven different industries within the manufacturing sector. In addition, the industries with in insufficient number of companies are also excluded (namely Forestry and Logging; Other Manufacturing Industry).

Table 1. Industries and Number of Companies

No	Name of Industry	Number of companies
1	Basic Metal Industry	7
2	Stone and Soil Based	12
3	Paper and Paper Products, Printing and Publishing	10
4	Chemicals, Petroleum Rubber and Plastic Products	14
5	Metal Goods Electrical Devices and Transportation Vehicle	17
6	Food, Beverage and Tobacco	13
7	Textiles, Apparel and Leather	8

After data cleaning, total of 81 companies under 7 industries compromises the final data set to be analyzed. Table 1 shows the industries and the number of companies in each industry examined in the research.

Table 2. List of Variables

Variables	Abbreviation	Definition
Dependent Variable		
Firm Investment Rate	FIR	Net Fixed Asset Investment / Depreciation
Independent Variables		
Exchange Rate Volatility	ERV	Standard deviation of Euro – USD equally weighted basket

Real Effective Exchange Rate	REER	Real Effective Exchange Rate PPI Based
Control Variables		
Firm Size	FSIZE	Natural Logarithm Total Asset
Firm Leverage	FLEV	Total Debt / Total Assets
Interest Rate	INTR	10-Year Government Bond Interest Rate
World Uncertainty Index for Turkey	WUI	

In order to analyze the effect of exchange rate volatility on firm level investments, 3 sets of variables have been defined. The first variable set includes the dependent variable, which is the firm level investments. The second variable set includes the independent variable(s), which is the exchange rate volatility. And finally, the control variables constitute the third set for the analyses. Table 2 presents the variables and definition of the variables used in the study.

The dependent variable, firm level investments or the change in investments has been measured various accounting based measures. Among those, while capital expenditure (Capex) based investment ratios (Capex divided by total assets or fixed assets) are the most common (Brito, et al., 2018; Avdjiev, et al., 2019; Li, et.al, 2019; Doa, et al., 2021); investment expenditure (Nucci and Pozzolo, 2001, Carranzaa, etl al., 2003), change in tangible assets (Ko, 2022) and investments net of depreciation (Zeng, et. al. 2022) are also employed. In this study, the firm level investments have been measured by the firms' investment ratio, which is calculated by dividing net fixed asset by accumulated depreciation.

Related literature emphases that firm-level characteristics can also have an effect on investments. For instance, firm size is considered as one of the important variables affecting firm investments (Eberly et al., 2011; Gala and Julio, 2016). Similarly, firm's leverage ratio is regarded as a variable affecting the investments (Myers, 1977; Lang et al, 1996; Özdemir, 2016). In this study, firm size and firm leverage ratio are included in the model as control variables to control for firm-level characteristics.

It is not possible to assume that firm level investment to be free from macroeconomic factors and global risks. Therefore, in order to control the effect of macroeconomic factors on investment, interest rate and World Uncertainty Index for Turkey indicators are included in the model as control variables. Economic uncertainty indices as the World Uncertainty Index and Economic Policy Uncertainty Index are considered as variables that control the relationship between economic uncertainty and firm investment in the related literature (Gulen and Ion, 2016; Wang et al., 2014; Azimli, 2022; Tan, et al., 2022).

The independent variable for the analyses is exchange rate volatility. As mentioned by Kandilov and Leblebici (2011) and Li, et al. (2019), there is no generally accepted approach for measuring the exchange rate volatility. Various approaches have been used in the related literature. Some of these approaches are based on standard deviation (Goldberg, 1993; Atella, et al., 2003; Carranze et al., 2003; Pradhan et al., 2004; Pınar and Erdal, 2018; Li, et al., 2019; Zeng et al. 2022) while some others are based on conditional volatility measures (Serven, 2003; Kandilov and Leblebici, 2011; Dursun, 2015; Ünlü, 2016 Taylor, et al., 2021). Furthermore, while some approaches rely on real effective exchange

rates for most of the earlier studies (Atellia, et al., 2003; Serven, 2003; Kandilov and Leblebici, 2011; Bahmani Oskooee and Hajilee, 2013; Öksüzler and Ekinci, 2013; Pınar and Erdal, 2018; Doa, et al., 2021); Nucci and Pozzolo, 2001), recent studies employ nominal exchange rate indexes (Zeng, et al. 2022; Avdjiev, et al., 2019).

Figure 1. The Volatility of The Basket Currency
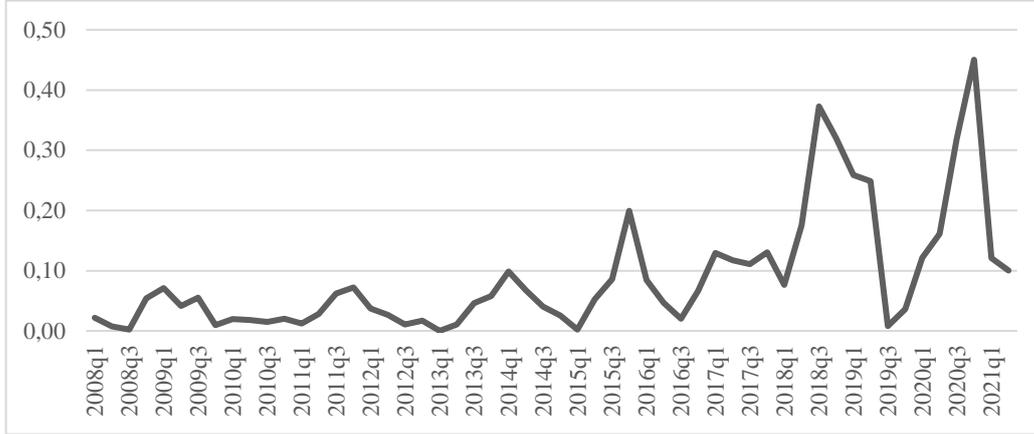
In this study, two approaches have been employed to measure the effect of exchange rates on firm-level investments. First one is the standard deviation of nominal currency basket for Euro and US Dollars (USD). The basket rate is equally weighted daily nominal exchange rate for Euro and USD.

The volatility of the currency basket was measured by quarterly standard deviation. Euro-USD basket has been widely used Türkiye, as the imports are mostly denominated in USD but exports are mostly denominated in Euro. Figure 1 presents the volatility of Euro-USD basket during 2008-2021. It is observed that the basket volatility has been increased especially after 2015.

Figure 2. PPI Based Real Effective Exchange Rate (2008-2021 quarterly)

Source: https://evds2.tcmb.gov.tr/index.php?
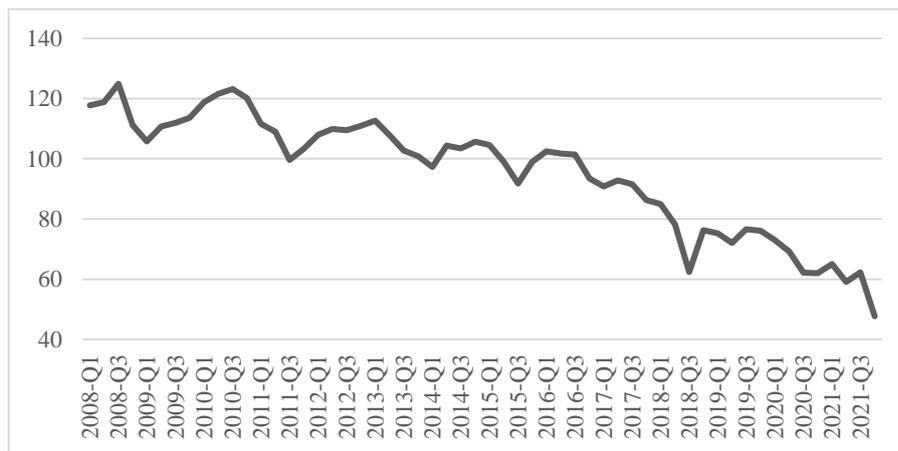
While the Euro-USD basket rate is important for the Turkish economy, bilateral exchange rates between trading partners of Turkey are also significant driving factors in international trade. Therefore, to examine the effect of bilateral exchange rate volatility, the Real Effective Exchange Rate (REER) index has been used in the study. The REER is an inflation-adjusted international trade weighted index, calculated by the Central Bank of the Republic of Turkey (CBRT). Figure 2 displays the change in REER (based on the Producer Price Index - PPI) during 2008-2021. It is evident that the value of the Turkish Lira has greatly decreased since 2008. Combining Figures 1 and 2, it can be observed that the volatility of the exchange rate tends to increase with the decreasing real effective exchange rate

By the use of variables defined above two models have been developed. Under Model 1, the effect of exchange rate on firm level investments has been analyzed by the use of standard deviation of Euro – USD basket; while in Model 2, the Equation 1 and Equation 2 presents the models employed.

Model 1:
$$FIR_{ERVit} = ß_0 + ß_1 ERV_{it} + ß_2 ERV_{it-1} + ß_3 ERV_{it-2} + ß_4 ERV_{it-3} + ß_5 FSIZE_{it} + ß_6 FLEV_{it} + ß_7 INTR_{it} + ß_8 WUI_{it} + \varepsilon_{it} + a \quad (1)$$

Model 2:
$$FIR_{REERit} = ß_0 + ß_1 REER_{it} + ß_2 REER_{it-1} + ß_3 REER_{it-2} + ß_4 REER_{it-3} + ß_5 FSIZE_{it} + ß_6 FLEV_{it} + ß_7 INTR_{it} + ß_8 WUI_{it} + \varepsilon_{it} + a \quad (2)$$

Due to the long-term planning of investment projects, exchange rate movement may not affect investments in the same period, thus the relationship between exchange rate movement and firm investments has been analyzed with lags.

The firm-level data has been collected from the Public Disclosure Platform (www.kap.gov.tr), the FİNNET Program, and the independent audit reports of the companies; the exchange rate data has been obtained from the Central Bank of the Republic of Turkey (CBRT) - Electronic Data Distribution System (EVDS); and World Uncertainty Index for Turkey (WUI) has been downloaded from Federal Reserve Economic Data.

Table 3. Summary Statistics

	FIR	**ERV**	**REER**	**FSIZE**	**FLEV**	**INTR**	**WUI**
Mean	11.61	0.0882	95.6490	13.209	0.36	0.1167	0.3489
Median	9.55	0.0547	98.5283	13.052	0.540	0.1030	0.3191
Mode	0	0.1002	99.3900	13.429	0.614	0.0914	0.3562
Stan. Deviation	11.57	0.0992	11.9543	1.690	0.237	0.0345	0.1989
Kurtosis	157.97	3.1057	-0.8936	-0.039	7.009	-0.0584	0.0405
Skewness	9.87	1.8670	-0.3657	0.277	1.043	0.9920	0.6709
Max	269.36	0.4504	114.8300	18.134	2.986	0.2063	0.8878
Min	0	0.0001	71.6267	8.575	0.061	0.0688	0.0000
Count	4374	4374	4374	4374	4374	4374	4374

Table 3 presents the mean, median, mode, standard deviation, kurtosis, maximum, minimum, and skewness of the data set, which composed of 4,374 observation within 2008-2021. The independent

variables Exchange Rate Volatility (ERV) and Real Effective Exchange Rate (REER) have a mean of 0.09 and 95.65 respectively. The control variables Firm Size (FSİZE), Firm Leverage (FLEV), Interest Rate (INTR) and World Uncertainty Index for Turkey (WUI) have a mean of 13.21 - 0.54 - 0.12 - 0.35 respectively.

Given that this study includes data from both periods and companies, panel data analysis have been employed. The LM test has been conducted to determine the classical model and random effects model, and the Hausman test to choose between the random effects and fixed effects models. Table 4 presents a summary of the panel diagnostic results, including the models used in panel analyses.

Table 4. Panel Diagnostic Results

Name of Sector	MODEL 1	MODEL 2
Manufacturing Industry	Fixed Effect	Fixed
Sub-Sectors		
Basic Matel Industry	Random Effect	Random
Stone and Soil Based Industry	Fixed Effect	Fixed
P. Paper Products Print.& Publishing Industry	Random Effect	Random
Chemical Phar. Petroleum Rubber &Plastic	Random Effect	Random
Metal Goods Electrical &Transportation Vehicle Industry	Random Effect	Random
Food, Beverage and Tobacco Industry	Random Effect	Random
Textiles, Apparel and Leather Industry	Pooled OLS	Pooled OLS

Before estimating the results, the data was tested whether it contains varying variance with Levene's Robust test, autocorrelation with Durbin Watson test.

4. EMPIRICAL FINDINGS AND DISCUSSIONS

To obtain a general understanding of the relationship between exchange rate and firm-level investments, the analyses mentioned in previous section have been conducted first for the manufacturing sector as a whole, without any industrial classification. Then the same analyses have been applied to each industry within the manufacturing sector.

Table 5 presents the findings for manufacturing sector as a whole, without any industrial classification. It has been designed to show the results for two models, with Model 1 on the left and Model 2 on the right. Model 1 indicates that exchange rate volatility (ERV), measured by Euro-USD basket standard deviation, has a negative impact on firm level investments as the coefficients for ERV variable has negative sign for all periods (lags). This finding suggests that increasing volatility decreases the firm level investments. This negative impact is also observed with lags for three periods, indicating that the effect of exchange rate volatility experienced in the current quarter will have effects lasting for the following three quarters. After the first quarter, the effect of exchange rate volatility decreases (ERV coefficient -13.093, ERV_{t-1} coefficient -7.190; ERV_{t-2} coefficient -1.850; ERV_{t-3} coefficient -20.956) but rebounds and reaches its highest level at the last quarter. All coefficients for exchange rate volatility are

significant except for ERV_{t-2}. Among the alternative control variables, size is the only significant variable, which effects firm level investments.

Table 5. Exchange Rates and Investments in Manufacturing Sector

	Model 1					Model 2			
	Coef	SE	t-ratio	p-value		Coef	SE	t-ratio	p-value
ERV	-13.094	5.335	-2.45	0.016**	REER	0.144	0.066	2.18	0.032**
ERV_{t-1}	-7.190	3.014	-2.39	0.019**	$REER_{t-1}$	0.031	0.051	0.61	0.544
ERV_{t-2}	-1.850	4.031	-0.46	0.647	$REER_{t-2}$	0.007	0.057	0.12	0.901
ERV_{t-3}	-20.956	5.509	-3.80	0.000***	$REER_{t-3}$	0.204	0.064	3.15	0.002***
FSIZE	3.931	1.533	2.56	0.012**	FSIZE	6.073	1.681	3.61	0.001***
FLEV	2.462	3.345	0.74	0.464	FLEV	4.454	3.270	1.36	0.177
INTR	15.985	11.141	1.43	0.155	INTR	4.230	8.838	0.48	0.634
WUI	2.112	1.495	1.41	0.162	WUI	1.652	1.176	1.41	0.164
cons	-41.196	20.700	-1.99	0.050	cons	-110.01	30.657	-3.59	0.001

*** Significant at the 0.01 level, ** Significant at the 0.05 level and * Significant at the 0.10 level

The findings for Model 2 revealed that exchange rate, which is measured REER index, has a positive impact on firm level investments as the coefficients for ERV variable has positive sign for all periods (lags). This finding suggests that increasing the real value of Turkish Lira increases the firm level investments. Such effect is stronger for in the last quarter. Following first quarter, the effect of exchange rate is subject to decrease ($REER$ coefficient 0.114; $REER_{t-1}$ coefficient 0.031; $REER_{t-2}$ coefficient 0.007; $REER_{t-3}$ coefficient 0.204) but reaches its maximum level at the last quarter. The coefficients for REER and $REER_{t-3}$ are also statistically significant. The firm size is the only significant control variable.

As mentioned in the literature section, several factors may be playing an important role in the effect of exchange rates on investments. One of the factors mentioned is the industrial differences among the sector. In order to examine the effects of industrial differences, the relationship between exchange rate movement and firm investments has also been investigated on industry basis under 7 industries. These are the Basic Metal, Stone and Soil Based, Paper and Paper Products Printing and Publishing, Chemical Pharmaceuticals Petroleum Rubber and Plastic Products, Metal Goods Electrical Equipment and Transportation Vehicle, Food Drinks Tobacco, and Textile Clothing Leather industries.

Table 6. Exchange Rates and Investments in Industries under Manufacturing Sector

	Model 1					Model 2			
	Coef	SE	t-ratio	p-value		Coef	SE	t-ratio	p-value
Basic Matel Industry									
ERV	-11.791	5.356	-2.20	0.070*	REER	0.335	0.135	2.47	0.049**
ERV_{t-1}	-3.602	2.859	-1.26	0.255	$REER_{t-1}$	-0.108	0.0988	-1.10	0.315
ERV_{t-2}	-7.693	5.075	-1.52	0.180	$REER_{t-2}$	0.101	0.086	1.17	0.287
ERV_{t-3}	-13.354	6.029	-2.21	0.069*	$REER_{t-3}$	0.177	0.0653	2.72	0.035**
FSIZE	2.386	1.129	2.11	0.079*	FSIZE	7.020	1.790	3.92	0.008***
FLEV	0.485	3.436	0.14	0.892	FLEV	7.155	2.955	2.42	0.052*
INTR	77.991	15.797	4.94	0.003	INTR	74.586	14.213	5.25	0.002***

WUI	3.206	1.346	2.38	0.055	WUI	1.773	1.606	1.10	0.312
cons	-24.761	15.174	-1.63	0.154	cons	-138.94	36.875	-3.77	0.009
Chemistry Pharmaceuticals Petroleum Rubber and Plastic Products									
ERV	-13.231	8.357	-1.58	0.113	REER	0.278	0.085	3.26	0.006***
ERV_{t-1}	-2.740	2.625	-1.04	0.297	$REER_{t-1}$	-0.022	0.063	-0.36	0.728
ERV_{t-2}	-2.740	3.586	-0.70	0.482	$REER_{t-2}$	0.078	0.085	0.92	3.374
ERV_{t-3}	-14.653	6.294	-2.33	0.020**	$REER_{t-3}$	0.108	0.058	1.85	0.087*
FSIZE	2.401	1.760	1.36	0.172	FSIZE	7.145	1.797	3.97	0.002***
FLEV	6.152	9.555	0.64	0.520	FLEV	3.806	4.269	0.89	0.389
INTR	28.371	18.604	1.53	0.127	INTR	29.536	9.901	2.98	0.011**
WUI	2.473	2.991	0.83	0.408	WUI	2.001	1.846	1.08	0.298
cons	-23.997	22.025	-1.09	0.276	cons	-134.188	35.229	-3.81	0.002
Paper and Paper Products Printing and Publishing									
ERV	-2.951	1.518	-1.94	0.052*	REER	0.015	0.036	0.43	0.666
ERV_{t-1}	-1.266	1.329	-0.95	0.341	$REER_{t-1}$	-0.015	0.021	-0.72	0.469
ERV_{t-2}	-0.669	1.463	-0.46	0.647	$REER_{t-2}$	0.013	0.023	0.57	0.567
ERV_{t-3}	-6.246	2.471	-2.53	0.012**	$REER_{t-3}$	0.063	0.024	2.61	0.009***
FSIZE	0.099	0.604	0.16	0.869	FSIZE	0.340	0.441	0.77	0.441
FLEV	1.504	1.459	1.03	0.303	FLEV	1.848	1.723	1.07	0.284
INTR	2.214	6.036	0.37	0.714	INTR	-3.151	7.436	-0.42	0.672
WUI	-0.539	0.981	-0.55	0.582	WUI	0.760	1.001	-0.76	0.448
cons	7.778	6.248	1.24	0.213	cons	-3.057	5.155	-0.59	0.553
*** Significant at the 0.01 level, ** Significant at the 0.05 level and * Significant at the 0.10 level									

Table 6 presents the findings based on industry classification. The current period and lagged effect (t-3) of exchange rate volatility are negative and significant with the firm-level investments in the Basic Metal industry, while they are positive and significant with the current period and lagged effect (t-3) of the real effective exchange rate. In the Chemistry Pharmaceuticals Petroleum Rubber and Plastic Products industry, firm-level investments show a negative and significant with lagged effect (t-3) of exchange rate volatility, while the current period and lagged effect (t-3) of real effective exchange rate show a positive and significant relationship.

Table 6. *Cont.*

Model 1					**Model 2**				
	Coef	SE	t-ratio	p-value		Coef	SE	t-ratio	p-value
Stone and Soil Based Industry									
ERV	-18.429	10.643	-1,73	0.111	REER	0.135	0 .148	0.92	0.379
ERV_{t-1}	-9.831	7.960	-1,24	0.243	$REER_{t-1}$	0.099	0.152	0.65	0.527
ERV_{t-2}	-12.231	13.714	-0,89	0.392	$REER_{t-2}$	0.050	0.157	0.32	0.752
ERV_{t-3}	-17.863	9.884	-1.81	0.098*	$REER_{t-3}$	0.230	0.111	2.07	0.063*
FSIZE	9.390	3.827	2.45	0.032**	FSIZE	11.125	4.039	2.75	0.019**
FLEV	13.922	14.439	0.96	0.356	FLEV	17.979	15.240	1.18	0.263
INTR	19.347	15.153	1.28	1.28	INTR	17.979	15.110	0.46	0.652
WUI	1.641	4.75	0.35	0.737	WUI	1.609	4.611	0.35	0.734
cons	-108.54	51.73	-2.10	1.111	cons	-185.59	75.655	-2.45	0.032
Metal Goods Electrical Devices and Transportation Vehicle Industry									
ERV	-3.436	1.951	-1.76	0.078*	REER	0.072	0.044	1.63	0.123
ERV_{t-1}	-0.594	1.871	-0.32	0.751	$REER_{t-1}$	-0.007	0.026	-0.29	0.776
ERV_{t-2}	-3.390	4.102	-0.83	0.409	$REER_{t-2}$	0.061	0.037	1.65	0.119
ERV_{t-3}	-1.612	5.427	-0.30	0.766	$REER_{t-3}$	0.032	0.028	1.13	0.277
FSIZE	1.133	0.549	2.07	0.039**	FSIZE	2.942	0.838	3.51	0.003***
FLEV	-1.547	2.461	-0.63	0.530	FLEV	-1.011	1.511	-0.67	0.513
INTR	7.055	7.849	0.90	0.369	INTR	7.817	6.239	1.25	0.228
WUI	-0.240	0.895	-0.27	0.788	WUI	0.506	0.767	0.66	0.519
cons	-6.680	6.363	-1.05	0.294	cons	-47.613	15.505	-3.07	0.007

Food Beverage and Tobacco Industry									
ERV	-0.6142	2.322	-0.26	0.791	REER	0.028	0.047	0.60	0.550
ERV$_{t-1}$	-4.586	1.743	-2.63	0.009***	REER$_{t-1}$	0.001	0.050	0.02	0.984
ERV$_{t-2}$	-0.008	2.629	-0.00	0.997	REER$_{t-2}$	-0.008	0.030	-0.27	0.787
ERV$_{t-3}$	-5.457	2.322	-0.00	0.019**	REER$_{t-3}$	0.077	0.045	1.70	0.088*
FSIZE	0.664	1.073	0.62	0.536	FSIZE	1.167	1.123	1.04	0.299
FLEV	1.266	3.035	0.42	0.676	FLEV	1.939	2.981	0.65	0.515
INTR	26.648	12.184	2.19	0.029	INTR	22.712	12.311	1.84	0.065
WUI	3.017	1.119	2.70	0.007***	WUI	2.556	1.237	2.07	0.039
cons	-1.978	13.766	0.14	0.886	cons	-18.891	18.175	-1.04	0.299
Textiles Apparel and Leather Industry									
ERV	-30.260	28.413	-1.06	0.288	REER	-0.037	0.226	-0.17	0.873
ERV$_{t-1}$	-34.511	33.017	-1.05	0.297	REER$_{t-1}$	0.345	0.411	0.84	0.429
ERV$_{t-2}$	30.425	37.266	0.82	0.415	REER$_{t-2}$	-0.438	0.531	-0.83	0.436
ERV$_{t-3}$	-102.01	34.514	-2.96	0.003***	REER$_{t-3}$	0.933	0.831	1.12	0.299
FSIZE	5.406	1.818	2.97	0.003***	FSIZE	5.829	2.085	2.80	0.027**
FLEV	4.608	8.189	0.56	0.574	FLEV	6.374	9.224	0.69	0.512
INTR	-80.842	84.687	-0.95	0.340	INTR	-152.50	174.10	-0.88	0.410
WUI	10.356	10.286	1.01	0.315	WUI	9.355	11.623	0.80	0.447
cons	-46.885	26.830	-1.75	0.081	cons	-134.022	66.076	-2.03	0.082
*** Significant at the 0.01 level, ** Significant at the 0.05 level and * Significant at the 0.10 level									

For the Paper and Paper Products Printing and Publishing Industry, the current period and lagged effect (t-3) of exchange rate volatility are negative and significant, while the real effective exchange rate's lagged effect (t-3) is positive and significant. In the Stone and Soil Based industry, the lagged effect (t-3) of exchange rate volatility is negative and significant for firm investments, while the lagged effect (t-3) of the real effective exchange rate is positive and significant. For the Metal Goods Electrical & Transportation Vehicle industry, there is a negative and significant relationship between firm investments and exchange rate volatility in the current period. In the Food, Beverage, and Tobacco Industry, the lagged effects (t-1, t-3) of exchange rate volatility are negative and significant, while the real effective exchange rate's lagged effect (t-3) is positive and significant. For the Textiles, Apparel, and Leather industry, the lagged effect (t-3) of exchange rate volatility is negative and significant, while the relationship between the real effective exchange rate and firm investments is statistically insignificant.

Based on the signs of the coefficients presented in Table 6, there is a generally negative relationship between firm-level investment and exchange rate volatility (ERV) measured by Euro-USD basket standard deviation. This finding is in line with previous literature (Goldberg, 1993; Carruth, et at., 2002; Byrne and Davis, 2005a; Byrne and Davis, 2005b) which suggests that exchange rate uncertainty can lead to delays in investments, and that the uncertainty experienced in the current period can have effects on subsequent periods. For most of the industries, positive relation between firm level investments and real exchange rates (REER) has been documented. This finding is also consistent with literature, which highlights effect of the exchange rate movements on investments through competitive channel (Carranza, et al., 2003; Bampia and Colombo, 2021; Banerjee, et al., 2020), The competitive channel emphases that the depreciation (appreciation) will increase (decrease) the export revenue thus will lead to an expansionary (contractionary) effect on investments. On the other hand, depreciation

(appreciation) will also increase (decrease) cost of imported inputs or capital goods, which in deed weakens (strengths) the tendency toward investments.

Table 7. Summary of the Findings

Metal Goods, Elect. Dev. and Trans. Vehicle Ind.				Textiles Apparel and Leather Industry			
ERV	-	REER		ERV		REER	
ERVt-1		REERt-1		ERVt-1		REERt-1	
ERVt-2		REERt-2		ERVt-2		REERt-2	
ERVt-3		REERt-3		ERVt-3	-/-/-	REERt-3	
Chem., Pharma., Petrol.Rubber and Plastic Products				Basic Metal Industry			
ERV		REER	+/+/+	ERV	-	REER	+/+
ERVt-1		REERt-1		ERVt-1		REERt-1	
ERVt-2		REERt-2		ERVt-2		REERt-2	
ERVt-3	-/-	REERt-3	+	ERVt-3	-	REERt-3	+/+
Stone and Soil Based Industry				Paper and Paper Products Printing and Publishing			
ERV		REER		ERV	-	REER	
ERVt-1		REERt-1		ERVt-1		REERt-1	
ERVt-2		REERt-2		ERVt-2		REERt-2	
ERVt-3	-	REERt-3	+	ERVt-3	-/-	REERt-3	+/+/+
Food Beverage and Tobacco Industry				Manufacturing Sector (All Industries)			
ERV		REER		ERV	-/-	REER	+/+
ERVt-1	-/-/-	REERt-1		ERVt-1	-/-	REERt-1	
ERVt-2		REERt-2		ERVt-2		REERt-2	
ERVt-3	-/-	REERt-3	+	ERVt-3	-/-/-	REERt-3	+/+/+
"+" or "-" indicates the sign of the coefficient. +/+/+ or -/-/- significant at the 0.01 level, +/+ or -/- significant at the 0.05 level and + or - significant at the 0.10 level.							

Table 7 provides a summary of the significant coefficients for exchange rate volatility (ERV) and real exchange rates (REER). The results indicate that ERV has a significant negative effect on firm-level investments in most industries, both in the current period and the third period. Similarly, REER has a significant positive effect on firm-level investments in most industries, also in the current period and the third period, although not all industries exhibit this relationship. Notably, there is no significant relationship between REER and investment in two industries, namely the Metal Goods Electrical Devices and Transportation Vehicle industry, and the Textiles Apparel and Leather Industry.

Such findings can be interpreted from several aspects. For example, the lack of significant effect of ERV in the current period on the Textiles, Apparel, and Leather Industry, Stone and Soil Based Industry, Food, Beverage and Tobacco Industry, and Chemicals, Petroleum, Rubber, and Plastic Products industries can be attributed to the existence of irreversibility of investments or high labor intensity (Li et al., 2019; Dao et al., 2021; Taylor et al., 2021; Zeng et al., 2022), which must be investigated in further studies.

Industrial differences in the findings can also be explained by factors such as industrial export intensity and imported input dependence. The findings show that the depreciation of Turkish Lira, measured by REER, reduces the firm-level investments. However, this relationship is not valid for Metal Goods, Electrical Devices and Transportation Vehicle; Textiles, Apparel and Leather Industry. These industries share common characteristic of having the highest export volume and export intensity in Türkiye (Demir, 2019). As these two industries have export revenues denominated in foreign currency, their investment decision may not be affected adversely as the other industries.

On the other hand, two industries (Basic Metal Industry; Chemicals, Petroleum Rubber and Plastic Products Industry) are the only industries effected by the REER at the current period. These two industries also share common characteristics, including imported input dependence and import volume. The Basic Metal Industry ranks first and the Chemical Industry ranks third in terms of imported input dependence (Aydin, 2021). A similar ranking is also valid for having the highest import volume among the other sectors in Türkiye. Therefore, the depreciation of Turkish Lira (measured by REER) increases the cost of imported input, which may decrease profitability and indeed adversely affect investment decision in these sectors.

5. CONCLUSION

The effect of exchange rate uncertainty or volatility on investments on aggregate level, has been studied from various aspects in the related literature. However, there has been a lack of research specifically examining the relationship between exchange rates and firm-level investments in Turkish companies. Therefore, this study aimed to fill this research gap by analyzing the firm-level relationship between exchange rates and investments in Turkish companies.

In this research, the relationship between exchange rates and firm-level investments have been analyzed for 81 manufacturing companies traded in Borsa Istanbul. These companies were classified under 7 different industries within the manufacturing sector, and panel data analyses were employed to examine this relationship using quarterly data from 2008-2021.

The study's findings revealed a consistent negative relationship between firm-level investments and exchange rate volatility (ERV) across all industries. This indicates that companies are less likely to invest during periods of high exchange rate volatility. On the other hand, a positive relationship was observed between firm-level investments and real effective exchange rates (REER) for most industries. This suggests that firms are more inclined to invest when the value of the Turkish Lira (TL) appreciates in real terms. Moreover, the study found that the effects of both ERV and REER on investments are realized with a delay in most industries. This means that the impact of exchange rate fluctuations on firm-level investments may not be immediate but rather occur over time. It is important to note that the relationship between exchange rates and firm-level investment can vary across different industries. This variation may be attributed to factors such as labor intensity, import or export orientation of production and sales. However, these interpretations are speculative and further research is needed to confirm them.

Overall, the results suggest that exchange rate stability is crucial for promoting investments, as firms are reluctant to invest during periods of high exchange rate volatility. Additionally, a favorable real exchange rate environment, where the TL appreciates in real terms, encourages firms to increase their investments.

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KATKI ORANI / *CONTRIBUTION RATE*	AÇIKLAMA / *EXPLANATION*	KATKIDA BULUNANLAR / *CONTRIBUTORS*
Fikir veya Kavram / *Idea or Notion*	Araştırma hipotezini veya fikrini oluşturmak / *Form the research hypothesis or idea*	Prof. Emin AVCI Feride KILINÇ
Tasarım / *Design*	Yöntemi, ölçeği ve deseni tasarlamak / *Designing method, scale and pattern*	Prof. Emin AVCI Feride KILINÇ
Veri Toplama ve İşleme / *Data Collecting and Processing*	Verileri toplamak, düzenlenmek ve raporlamak / *Collecting, organizing and reporting data*	Prof. Emin AVCI Feride KILINÇ
Tartışma ve Yorum / *Discussion and Interpretation*	Bulguların değerlendirilmesinde ve sonuçlandırılmasında sorumluluk almak / *Taking responsibility in evaluating and finalizing the findings*	Prof. Emin AVCI Feride KILINÇ
Literatür Taraması / *Literature Review*	Çalışma için gerekli literatürü taramak / *Review the literature required for the study*	Prof. Emin AVCI Feride KILINÇ

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