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Exchange rates and firm survival: An examination with Turkish firm-level data

Nazlı Toraganlı[a,*], M. Ege Yazgan[b,*]

[a] MEF University, Department of Economics, Istanbul, Turkey
[b] Istanbul Bilgi University, Department of Economics, Istanbul, Turkey

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ABSTRACT

Micro-level empirical research has begun to obtain important results on the effects of currency variations on firms' survival. The literature has, however, lacked a detailed analysis of the effects of exchange rates on firms' survival behavior in emerging markets due to a scarcity of firm-level information. Using a firm-level dataset, we investigate the impact of currency appreciation on the survival behavior of Turkish firms in the manufacturing industries for 2002–2009. Our results suggest that real exchange rate appreciation decreases the probability of survival in the manufacturing industries. We also find that high-productivity firms have a higher probability of survival than low-productivity firms following an appreciation of the exchange rate. Our findings indicate that the negative effect of a 1% real appreciation of the domestic currency on the survival probability of a given firm ranges from 4.5 to 9%, providing evidence for the vulnerability of developing countries to exchange rate movements. This evidence indicates that, especially for emerging market economies, economic events and policies leading to an appreciation in the domestic currency should be managed cautiously.

1. Introduction

Exchange rate movements have important implications for survival patterns, particularly for exporting firms in developing countries where exchange rates are more volatile compared to the developed world. To date, the literature has lacked a detailed analysis of the effects of exchange rates on firms' survival behavior in emerging markets due to a scarcity of firm-level information. Recent improvements in micro data provide an opportunity to test the effects of currency variations on firms. This paper exploits a detailed dataset compiled by the Central Bank of Turkey (CBRT) to examine the effects of exchange rates on firms' survival behavior in Turkey.

Real exchange rate movements are thought to act like tariffs in how they affect survival behavior by altering firms' competitive positions in both domestic and international markets.[1] In this context, real exchange rate appreciation acts as an increase in foreign tariffs, creating a cost disadvantage for domestic producers in the export markets and raising the level of competition. Consequently, the least productive firms exit the market. For the case of a developing country, the impact of

* Corresponding authors.
E-mail addresses: nazli.toraganli@mef.edu.tr (N. Toraganlı), ege.yazgan@bilgi.edu.tr (M. E. Yazgan).

[1] In this framework, exchange rate appreciations (depreciations) are modeled as a decrease (increase) in domestic tariffs or an increase (decrease) in foreign tariffs. See Feenstra (1989) and Baggs et al. (2009).

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exchange rate appreciation on firms' survival is expected to be larger, as transactions are generally not hedged because forward markets are not accessible to the bulk of the traders.

This paper uses a detailed dataset compiled by the Central Bank of Turkey that contains information on income statement and balance sheet items, the starting date of the establishment's operation, and industry affiliation classified according to the General Industrial Classification of Economic Activities within the European Communities Revision 1.1. This rich dataset provides a unique platform with which we empirically test the effects of exchange rates on the survival patterns of firms and compare the results with the theoretical predictions presented in the literature. The study covers the period 2002–2009.

The literature examining exchange rate variations on firms' survival patterns[2] has been rather limited and mostly concentrated on developed countries. The evidence on emerging markets has remained scarce. To the best of our knowledge, this study constitutes the first empirical study to examine the impact of exchange rates on firm survival in Turkey and only the second one for an emerging market, after China. Our results suggest that a 1% real appreciation of the Turkish Lira for a given firm decreases the probability of survival by between 4.5 and 9% depending on the specification, providing evidence for the vulnerability of a developing country to exchange rate movements. Moreover, we find evidence that high-productivity firms have a higher probability of survival than low-productivity firms following an appreciation in the domestic currency, a finding that confirms those of previous studies.[3]

2. Literature

The available longitudinal plant- or firm-level data has demonstrated the existence of large and persistent productivity differences among establishments in similar industries. Studies have further shown that these productivity differences are strongly associated with the establishments' export status (Bernard and Jensen, 1995; Aw and Hwang, 1995; Bernard and Wagner, 1997). This evidence has motivated the development of the new–new trade theory starting with the seminal paper of Melitz (2003), in which cross-firm heterogeneity in productivity has become a central assumption. With the emergence of this new literature, firms' international trading activity as a determinant of firm performance, and productivity in particular, has received much attention.

In a related literature, research has concentrated on the performance of firms engaging in international trade using a different measure other than productivity, firms' survival. Studies investigating the determinants of firms' survival behavior both in domestic and export markets include the impacts of changes in tariffs (Baggs, 2005), imports (López, 2006; Namini et al., 2011), two-way trading (Wagner, 2012), financial development and financial constraints (Görg and Spaliara, 2009), multinational status (Alvarez and Görg, 2009), and foreign direct investment (Kimura and Kiyota, 2006). For the Turkish case, Taymaz and Yılmaz (2014) analyze the impact of the presence of foreign firms on domestic firms' performance with an emphasis on survival and employment growth. They do not find conclusive evidence suggesting that foreign presence in the sector reduces domestic firms' survival probability. On the other hand, they document that several sector- (entry rate, growth rates of sectoral output and prices, the Herfindahl-Hirschman index and minimum efficient scale) and firm-specific variables (size, capital intensity and skill level) appear to have strong and consistent impacts on the survival probabilities.[4]

A number of studies have focused on the impact of exchange rate fluctuations on firm survival. In this line of research, Baggs et al. (2009) investigate the impact of real exchange rate changes on the survival and sales of firms in the manufacturing sector in Canada. They document that real appreciation reduces real sales and the probability of firms' survival. They also find that the effect of real domestic currency appreciation on firms' survival is larger for less productive firms. Baggs et al. (2010), concentrating on Canadian service sectors, show that the exchange rate effects on the survival of service sector firms are similar to those for the manufacturing firms discussed in Baggs et al. (2009). Baldwin and Yan (2011) examine the effects of real exchange rate movements and tariff reductions on plant death in Canadian manufacturing industries.[5] They report that a 1% appreciation in the real exchange rate increases the probability of exit by 0.3%. In a more recent study, Baggs et al. (2014) examine the asymmetric effects of appreciation versus depreciation on firm survival and entry. Their results do not provide conclusive evidence of asymmetry in the response of firm survival to exchange rate changes. Feinberg (2010) analyzes US data, focusing particularly on retail and wholesale trade to explain small firms' exit rates, and documents that wholesalers respond negatively to a stronger currency, while appreciation has no impact on retailers on average.

[2] Depending on the coverage of the dataset used, studies in this area analyze survival patterns in export markets or in both local and export markets. This study focuses on the survival patterns in all markets without differentiating between local and export markets.

[3] We expect that the results for firms' survival can also elucidate, albeit indirectly, exchange rate pass-through behavior. A central question in the literature on exchange rate pass-through is whether prices of traded goods respond proportionally or less than proportionally to exchange rate changes, i.e., whether the pass-through is complete or incomplete (see Goldberg and Knetter, 1997, for a survey of this literature). An insignificant effect of exchange rate appreciation on the survival of firms can be interpreted as evidence of incomplete pass-through because firms are not able to transmit exchange rate changes to export prices.

[4] For a more detailed survey of the literature, see Wagner (2007),Wagner (2013) and Greenaway and Kneller (2007).

[5] Parteka and Wolszczak-Derlacz (2013) analyze the impact of trade integration with the European Union on sectoral productivity growth in Poland and document that an increase in domestic sectors' openness exerts a positive effect on productivity. Similarly, Özler and Yılmaz (2009) document that the trade reforms of the 1980s and early 1990s had a substantial impact on productivity growth in the Turkish manufacturing industry. Taymaz and Yılmaz (2007) document that after the Custom Union, the productivity performance of Turkish manufacturing sectors slowed down substantially due to the worsening macroeconomic environment, while productivity gains were largest in import competing industries compared to export-oriented and non-traded sectors.

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The effects of exchange rate fluctuations on survival patterns in export markets only have also been investigated. In this line of research, the exclusion of a firm from the export market is treated as the end of survival as long as it remains active by relying solely on the domestic market. For example, Baldwin and Yan (2011) investigate how changing market access conditions, as characterized by changes in tariffs and real exchange rates, impact the export market entry/exit process and the relative productivity performances of exporters and non-exporters. For the Canadian manufacturing sector, they report that a 1% appreciation in the real exchange rate increases the likelihood that exporters will stop exporting by approximately 1%. Li et al. (2015), using detailed Chinese firm-level data for 2000–2007, examine the effect of exchange rate movements on the export behavior of Chinese firms and find that the appreciation of the domestic currency reduces the probability that a firm exports.

The theoretical literature examining the impact of current appreciation and survival patterns is motivated by the productivity aspect of individual firms. Building on Melitz (2003), Tomlin (2014) uses a dynamic structural model to investigate the effect of real exchange rate fluctuations on plant entry and exit decisions in the Canadian agricultural implement industry. In this framework, exchange rate appreciation is considered in a similar way to the trade liberalization exercise introduced in Melitz (2003). Accordingly, an appreciation (which operates in a similar way to a decrease in domestic tariffs) in the domestic currency opens up export opportunities for domestic plants and increases the number of foreign competitors in the domestic market. In parallel with an increase in foreign demand, the demand for domestic factors of production increases, which in turn drives up factor prices. As a result, less productive firms exit the market and new entrants are forced to be more productive. The empirical results are consistent with previous papers such as Baggs et al. (2009), where an appreciation (depreciation) of the real exchange rate decreases (increases) the probability that a given plant will stay in the market, and higher productivity plants are more likely to stay in the market than lower productivity plants. The exchange rate and productivity link has also been noted in Berman et al. (2012). Based on a model with local distribution costs and firm heterogeneity, the authors show that real depreciation reduces threshold productivity, defined as the minimum productivity level at which firms earn positive profits, leading to firm entry, and therefore has a positive impact on the extensive margin. Using a French firm-level dataset, they find that a 10% appreciation with respect to a specific destination decreases the exporting probability by around 1.8%. Fung (2008) investigates the impact of large real exchange rate appreciations on continuing firms' scale of production and productivity growth based on a partial equilibrium model following Krugman (1986).[6] The empirical results based on Taiwanese firm-level data are consistent with the predictions of the theoretical model, suggesting that a real domestic currency appreciation leads to a scale expansion of the surviving firms, which in turn raises industry productivity.

3. Data: regularities and sources

This paper exploits a dataset compiled by the Central Bank of Turkey, the Real Sector Company Accounts Database. The bank surveys firms annually, with the firms responding on a voluntary basis.[7] These data contain information on income statement and balance sheet items, employment, the starting date of the establishment's operation, location, industry affiliation classified according to NACE Revision 1.1, and legal status of the firms for the period 2002–2009.[8]

We limit the data to the sample of firms that have complete records on employment numbers, because we rely on this variable when calculating the labor productivity for each firm.[9] A comparison of the descriptive statistics between firms with missing employment data and those with complete employment data shows that firms with missing employment numbers have smaller real assets and are younger than the firms we use in our analysis. We also excluded companies that do not have complete records for all variables (in addition to employment data) used in the subsequent regression analysis or that possess inconsistent values for certain variables. Accordingly, less than 1% of the observations have been dropped. Additionally, to control for the potential influence of outliers, we exclude observations in the 0.5% of the upper and lower tails of the distribution.

In our analysis, we only take into consideration manufacturing industries. Consequently, we end up with 4821 firm-year observations consisting of 616 firms[10] belonging to 14 industries, defined according to the 2-digit NACE Revision 1.1 level.[11] Based on their exit status, the firms are categorized into two groups: survivors and exiters. Differently from some of the

[6] On the demand side, a symmetric expenditure function in translog form as in Bergin and Feenstra (2000, 2001) is assumed. This functional form implies a positive relationship between the price of a good relative to competing goods and demand elasticity. Accordingly, increased prices cause more elastic demand, which increases the competition faced by domestic firms.

[7] Central Bank officials at the statistics department have stated that the response rate for the survey was 75% for 2009. According to the net sale criteria, manufacturing firms account for 64.7% of Turkey's total sales for the year 2009.

[8] The year 2002 is a turning point in the exchange rate regime for the Turkish Economy. A severe currency crisis occurred in February 2001, which resulted in a shift in the exchange rate regime from (managed) pegged to floating. Since that time, monetary policy has primarily focused on price stability rather than targeting exchange rate stability (Atasoy and Saxena, 2006; Kara et al., 2007).

[9] Unfortunately, by eliminating such firms, we lose a significant number of firms included in the original dataset. The Real Sector Company Accounts Database reports employment information only if a given firm declares its employment numbers for three consecutive years. Otherwise, employment information is represented by a missing value in the database. Because the time span of our study covers a period longer than 3 years, for some firms the employment data are not available for the intermediate years.

[10] As can be seen in Table 2, the number of firms varies across years with small changes.

[11] A list of these industries can be found in Table 2 below.

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Table 1
Descriptive statistics.

Sample	Variable	Mean	N
Survivors	Age	30.3	4680
	Employment	399.6	4680
	Labor Productivity	37.7	4680
	Export Share	0.31	4680
	Real Assets	1150000	4680
Exiters	Age	31.4	141
	Employment	241.3	141
	Labor Productivity	35	141
	Export Share	0.27	141
	Real Assets	637981	141
Whole Sample	Age	30.3	4821
	Employment	395	4821
	Labor Productivity	37.7	4821
	Export Share	0.31	4821
	Real Assets	1140000	4821

studies mentioned above, in our case exit does not refer only to the end of the firms' activities in the export market but in all markets. Table 1 provides the descriptive statistics of firm-specific variables such as labor productivity (real sales[12] per employee), age, number of employees, export share (export sales as a share of total sales), and real assets (the sum of current and fixed assets divided by the sector-level producer price index (PPI)). As shown in Table 1, on average, exiters have lower employment, real assets, export shares and labor productivity than survivors.

In principle, firm exits can be identified on the basis of missing values in our dataset. Unfortunately, this is not a reliable procedure, because missing values can result from the failure to report items or the failure to respond to the survey for reasons other than exit. Therefore, the information in the CBRT Company Accounts Database is supplemented with an additional data source from the Central Bank that contains information on the identity numbers of exited firms. However, because this additional data source does not provide us with the exact date of the exit, we assume that the exit date is the last year the firm has non-missing values on its balance sheet or income statement items. Based on this assumption, 5% of the 616 firms in the CBRT Company Accounts Database (30 out of 616) exited during the period 2002–2009.

Table 2 provides information on the rates of exit across industries, which range between 25% (for medical precision and optical instruments) and 2% (for manufacture of machinery and equipment n.e.c.).

As indicated above, all the real values are deflated using the sectoral PPI obtained from the Turkish Statistical Institute (TURKSTAT). All the remaining data were obtained from the IMF's International Financial Statistics. GDP with constant prices and three-month deposit rates for Turkey are used for the domestic GDP and interest rate, respectively. For foreign GDP, we used the weighted average of OECD countries' GDPs (constant prices), where bilateral trade flows as shares in Turkey's total trade are used as weights. To examine the impact of currency variation on firm survival, we used a CPI based equally weighted basket of US Dollar/Turkish Lira and Euro/Turkish Lira real exchange rates.[13] An increase (decrease) in the real exchange rate represents an appreciation (depreciation) of the Turkish Lira.

4. Empirical analysis

We follow Baggs et al.'s (2009) methodology to investigate firms' survival behavior as a result of exchange rate movements. This method involves regressing the survival status of a given firm on the real exchange rate and a set of firm- and industry-level control variables. Using the specification given below, we investigate i) whether exchange rate appreciation has any effect on firm survival, ii) whether appreciation has a lower impact on more productive firms, and iii) the impact of the control variables on firm survival. The equation under investigation is as follows:

$$P(S_{it}) = \phi\left[\beta_1 Q_t + \beta_2 P_{it} + \beta_3 GDP^f{}_t + \beta_4 GDP^d{}_t + \beta_5 r_t + \beta_6 AGE_{it} + \beta_7 EMP_{it} + \beta_8 t\right] + \varepsilon_{it}, \quad (1)$$

where the subscript i indexes firms and t time. S_{it} is a dummy variable equal to 1 if firm i is in operation in year t and 0 otherwise. Q_t is the logarithm of the real exchange rate. P_{it}, AGE_{it}, and EMP_{it} represent the logarithm of labor productivity, age, and employment. GDP^d_t and GDP^f_t are domestic and foreign GDP growth and are used to control for country-specific and international business cycles as well as the expansion of domestic and foreign demand. r_t is the interest rate, and time trend t is used to control for time-specific effects.

[12] Total sales divided by the sector-level producer price index (PPI).
[13] For the period of this study, approximately 45% of Turkish exports are denominated in Euro, while 48% are denominated in US dollar.

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Table 2
Number of firms and exit year.

Industry	NACE Rev.1.1 Code	Number of Firms								Exit Rate
		2002	2003	2004	2005	2006	2007	2007	2009	
Food products and beverages	15	116	116	116	116	114	114	112	112	0.03
Tobacco products	16	5	5	5	4	4	4	4	4	0.20
Textiles	17	109	109	108	106	105	105	104	102	0.06
Wearing apparel	18	45	45	44	43	42	42	41	41	0.09
Wood and products of wood	20	10	10	10	9	9	9	9	9	0.10
Publishing, printing and reproduction of recorded media	22	9	9	9	9	9	9	9	8	0.11
Chemicals and chemical products	24	70	70	70	69	69	68	68	68	0.03
Rubber and plastic products	25	38	38	37	37	37	37	37	37	0.03
Other non-metallic mineral products	26	57	57	57	56	55	55	54	54	0.05
Fabricated metal products except machinery and equipment	28	38	38	38	38	38	38	38	37	0.03
Machinery and equipment n.e.c	29	48	48	48	48	48	47	47	47	0.02
Electrical machinery and apparatus n.e.c.	31	26	26	26	26	25	25	24	24	0.08
Medical precision and optical instruments	33	4	4	4	4	4	4	4	3	0.25
Motor vehicles trailers and semi-trailers	34	41	41	41	41	40	39	39	39	0.05
Sum		616	616	613	606	600	596	589	586	0.05

β_1 is the main coefficient of interest and is expected to be negative. A negative and significant value for β_1 implies that a real exchange rate appreciation leads to a decrease in the probability of survival for firms in general. Put differently, a real appreciation of the Turkish Lira decreases the probability of survival for the average Turkish firm. We estimate Eq. (1) both using a pooled probit model and a linear probability model with fixed effects. The results are illustrated in Tables 3 and 4, respectively.

As can be seen from the first column of Table 3, the coefficient of the real exchange rate is negative and significant. To evaluate the magnitude of the effect of real appreciation on the probability of survival, we use the marginal effects calculated at the mean of the explanatory variables. The marginal effects, given in the second column of Table 3, indicate that a 1% real appreciation of the Turkish Lira for a given firm decreases the probability of survival by 4.5%. In comparison to previous empirical studies covering developed countries, such as that by Baldwin and Yan (2011), the impact of currency appreciation on firm survival is much higher, providing evidence for the relative vulnerability of developing countries. For the Canadian

Table 3
Probit estimation – Firm survival (dependent variable: 1 if it survives to the end of year t; 0 otherwise).

	(1) Pooled Probit	(2) Marginal Effect	(3) Model with Interaction	(4) Marginal Effect
Real exchange rate	−5.092*	0.045*	−4.358	−0.040
	(2.804)	(0.024)	(2.903)	(0.026)
Labor productivity	0.208***	0.002***		
	(0.072)	(0.001)		
Foreign GDP growth rate	−0.005	0.000	−0.019	−0.000
	(0.271)	(0.002)	(0.275)	(0.002)
Domestic GDP growth rate	−0.025	−0.000	−0.005	−0.000
	(0.206)	(0.002)	(0.206)	(0.002)
Interest rate	0.018	0.000	0.023	0.000
	(0.033)	(0.000)	(0.034)	(0.000)
Age	−0.515**	−0.005**	−0.504**	−0.005**
	(0.204)	(0.002)	(0.203)	(0.002)
Employment	0.197***	0.002***	0.210***	0.002***
	(0.053)	(0.001)	(0.054)	(0.001)
Time trend	0.319	0.003	0.341	0.003
	(0.295)	(0.003)	(0.295)	(0.003)
Dummy for high-productivity firms			6.374	0.727
			(6.218)	(1.078)
Real Exchange Rate×			−1.280	−0.012
Dummy for high-productivity firms			(1.302)	(0.011)
Observations	4821	4821	4821	4821
Log lik.	−165.784	−165.784	−168.172	−168.172
Chi-squared	69.440	69.440	63.371	63.371
Pseudo R-squared	0.115	0.115	0.102	0.102

Notes: Marginal effects are calculated at the mean. Robust standard errors are in parentheses. Real exchange rate, labor productivity, age, and employment are in logarithmic form.
*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

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Table 4
Linear Probability Model (LPM).

	(1) LPM	(2) Model with Interaction	(3) LPM – FE	(4) Model with Interaction	(5)LPM – Firm FE	(6) Model with Interaction
Real Exchange Rate	−0.090*	−0.087*	−0.090*	−0.087*	−0.069*	−0.085**
	(0.049)	(0.051)	(0.049)	(0.051)	(0.039)	(0.042)
Labor productivity	0.004**		0.004**		0.017**	
	(0.002)		(0.002)		(0.006)	
Foreign GDP growth rate	0.003	0.003	0.003	0.003	0.001	0.002
	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)
Domestic GDP growth rate	−0.002	−0.002	−0.002	−0.002	−0.002	−0.002
	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)
Interest rate	0.000	0.000	0.000	0.000	−0.000	−0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Age	−0.009**	−0.008**	−0.009**	−0.009**	0.046	0.049
	(0.004)	(0.004)	(0.004)	(0.004)	(0.036)	(0.038)
Employment	0.004***	0.004***	0.004***	0.004***	0.016***	0.009***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.005)	(0.004)
Time trend	0.003	0.004	0.004	0.003	−0.003	−0.002
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Dummy for high-productivity firms		0.032		0.028		−0.070
		(0.071)		(0.072)		(0.081)
Real Exchange Rate×		−0.006		−0.005		0.016
Dummy for high-productivity firms		(0.015)		(0.015)		(0.017)
Observations	4821	4821	4821	4821	4821	4821
R-squared	0.009	0.007	0.011	0.010	0.264	0.259

Notes: Column (1) is the linear probability model (LPM) with no fixed effects (FE).
Column (3) is the linear probability model (LPM) with industry fixed effects (FE). Column (5) is the linear probability model (LPM) with firm fixed effects (FE).
Marginal effects are calculated at the mean. Robust standard errors are in parentheses.
Real exchange rate, labor productivity, age, and employment are in logarithmic form.
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

manufacturing sector, Baldwin and Yan (2011) reported that a 1% appreciation in the real exchange rate increases the probability of exit by approximately 0.3%.[14] Labor productivity is significant and correctly signed. As its marginal effect calculated at the mean indicates, a 1% change in productivity leads to an increase in the probability of survival by 0.2%. Surprisingly, age appears to be negative and significant. This surprising result has been reported in Baggs et al. (2010).[15] The counterintuitive result that younger firms are less affected by exchange rate appreciation may be caused by missing observations in the employment variable. The coefficients of growth in domestic and foreign GDP and interest rate are insignificant.

We add an interaction term to the model to test the hypothesis of whether a firm having high or low productivity increases or decreases the probability of survival in the context of exchange rate appreciation. We therefore create a dummy for high- and low-productivity firms, i.e. those belonging to the highest and lowest 50%, respectively, and include it among the regressors. Then, we create an interaction term between the real exchange rate and the dummy for high- and low-productivity firms, D^h, as an additional regressor.[16]

$$P(S_{it}) = \phi[\alpha_1 Q_t + \alpha_2 D^h{}_{it} + \alpha_{12}\left(Q_t \times D^h{}_{it}\right) + \alpha_3 GDP^f{}_t + \alpha_4 GDP^d{}_t + \alpha_5 r_t + \alpha_6 \mathrm{AGE}_{it} + \alpha_7 \mathrm{EMP}_{it} + \alpha_8 \mathrm{t}] + \varepsilon_{it},$$

The results of the regressions including the productivity dummy and the interaction effect are presented in columns 3 and 4 of Table 3. The productivity dummy appears to be not significant, as does the interaction term. However, the interpretation of interactions in the context of a nonlinear model is more complex than in a linear model, where the marginal effect of the interaction term is basically equal to the coefficient of the interaction term. As has been stressed in Ai and Norton (2003), the interaction effect cannot be evaluated simply by looking at the sign, magnitude, or statistical significance of the coefficient on the interaction term, α_{12}, when the model is nonlinear. The interaction effect may have different signs for different values of covariates, and therefore the sign of α_{12} does not necessarily indicate the sign of the interaction effect. For example, the

[14] We restrict our comparison to studies in which survival is defined in all markets and firms belong to the manufacturing industries, as in our study.
[15] Baggs et al. (2010) explain this counterintuitive result by the substantial number of surviving firms in their sample being one year old, making the average logarithm of age for surviving firms smaller. This finding may be due to a technological effect where younger firms are technologically more advanced and capable to adapt. They may be less prone to issues of unionization in the workplace that might not allow for flexibility in dealing with demand-side changes.
[16] Obviously, we drop the labor productivity variable, which is now captured by the categorical dummy variables.

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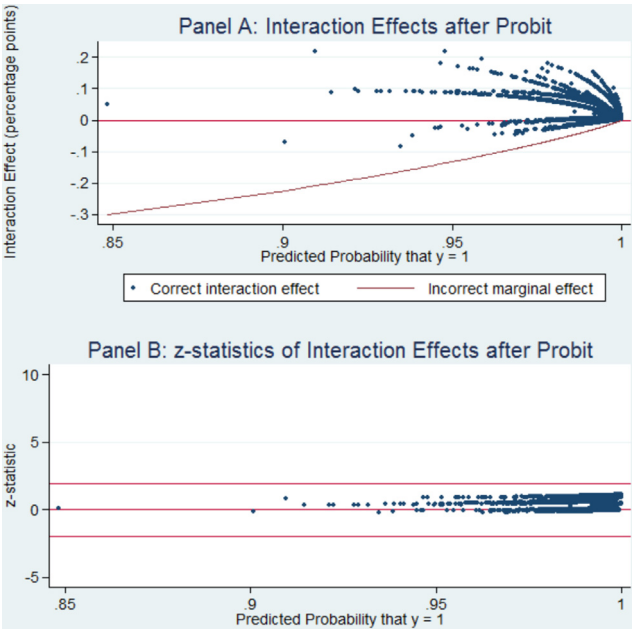

Fig. 1. Interaction effect between the real exchange rate and high-productivity firms.

interaction effect could be nonzero even if $\alpha_{12} = 0$. Also, the statistical significance of the interaction effect cannot be tested with a simple t-test on the coefficient of the interaction term α_{12}.[17]

According to the results presented in column 4 of Table 3, the marginal effect of the interaction term between the real exchange rate and the dummy for high and low productivity is not statistically significant. Despite the lack of statistical significance for the marginal effect of the interaction term in the regression results presented in Table 3, the correct interaction effect, calculated based on Ai and Norton's (2003) methodology, is statistically significant for all the observations (see Fig. 1, Panel B). We find that the marginal effect of the interaction term between the real exchange rate and the dummy for high-productivity firms varies widely and is positive for many observations (see Fig. 1, Panel A). Even though the interaction term itself is not statistically significant, the interaction effect is positive and significant for most of the observations, meaning that high-productivity firms have a higher probability of survival than low-productivity firms in the presence of exchange rate variations.

We also incorporate fixed effects into our methodology in the context of the linear model. The fixed effects estimator has been relatively little used in nonlinear models because there is no feasible way to remove the heterogeneity in the probit model in the presence of fixed effects (Green, 2001).[18] The results of the linear probability model are presented in Table 4. We first estimate a linear probability model without including any fixed effect. Later, we include industry and firm fixed effects in the regression equations. The results of the linear probability model without any fixed effect are presented in column 1 of Table 4 (specification 1), while the results of the estimation using industry and firm fixed effects are presented in columns 3 and 5 (specification 2 and 3), respectively. We include the dummy for high-productivity firms and the interaction term between the real exchange rate and the dummy for high-productivity firms, as in the probit estimation, in our specifications and provide the results in columns 2, 4 and 6.

The estimation results for productivity and the real exchange rate obtained through the linear probability model are consistent with the previous findings obtained through the pooled probit model. The results suggest that real exchange rate appreciation decreases the propensity[19] for survival in all specifications. Overall, in all specifications, we document that a 1% increase in the exchange rate increases the propensity for survival by between 7 and 9%.

[17] In our case, we interact a continuous variable, the exchange rate, with a dummy variable (high productivity). The interaction effect is the discrete difference with respect to the dummy variable of the single derivative of the cumulative distribution function with respect to the exchange rate, Q_t. See the Appendix for details on the calculation.

[18] Roberts and Tybout (1997) also stress this issue and state that they do not control for firm-specific heterogeneity by using plant-specific dummy variables because of the "incidental-parameters problem" stressed in Neyman and Scott (1948) and Heckman (1981). Note that in Girma et al. (2004) probit regression, in Bernard and Jensen (2004) a linear probability model with and without fixed effects, and in Roberts and Tybout (1997) a probit model with random effects are employed.

[19] To emphasize the fact that in the context of linear probability models predictions may exceed 0 and 1, the term "propensity" is used instead of "probability".

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Table 5
High-productivity firms.

	(1) Pooled Probit	(2) Marginal Effect	(3) LPM – No Fixed Effect	(4) LPM – Industry FE	(5) LPM – Firm FE
Real Exchange Rate	−3.929	−0.011	−0.039	−0.038	−0.018
	(4.055)	(0.012)	(0.065)	(0.066)	(0.055)
Foreign GDP growth rate	0.487	0.001	0.003	0.003	0.002
	(0.602)	(0.002)	(0.004)	(0.004)	(0.004)
Domestic GDP growth rate	−0.631	−0.002	−0.003	−0.003	−0.002
	(0.567)	(0.002)	(0.003)	(0.003)	(0.003)
Interest rate	−0.064	−0.000	−0.000	−0.000	−0.000
	(0.095)	(0.000)	(0.000)	(0.000)	(0.000)
Age	−0.316	−0.001	−0.004	−0.003	0.040
	(0.325)	(0.001)	(0.004)	(0.004)	(0.051)
Employment	0.161*	0.000	0.002	0.003*	0.007
	(0.091)	(0.001)	(0.001)	(0.001)	(0.005)
Time trend	−0.796	−0.002	−0.002	−0.002	−0.006
	(0.879)	(0.003)	(0.003)	(0.003)	(0.004)
Observations	2534	2534	2534	2534	2534
Log lik.	−67.806	−67.806	3198.364	3203.228	3657.512
Chi-squared	335.901	335.901			
Pseudo R-squared	0.110	0.110			

Notes: Column (3) is the linear probability model (LPM) with no fixed effects (FE).
Column (4) is the linear probability model (LPM) with industry fixed effects (FE). Column (5) is the linear probability model (LPM) with firm fixed effects (FE).
Marginal effects are calculated at the mean. Robust standard errors are in parentheses.
Real exchange rate, labor productivity, age, and employment are in logarithmic form.
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Productivity appears to be positive and significant (in all specifications). The coefficient of employment appears to be positive and significant in all specifications as well, suggesting that larger firms in terms of employment are more likely to survive.

Other covariates, more specifically the interest rate and growth in domestic and foreign GDP, are insignificant in all specifications, while the coefficient of age is significant and negative in specifications 1 and 2. The marginal effects of the interaction terms obtained through the linear probability model are insignificant in all specifications (columns 2, 4 and 6 of Table 4), which is in contrast to the probit model (Fig. 1).

To further test the impact of exchange rate appreciation on firms with different productivity levels, we split the data between high- and low-productivity firms as described above and run separate regressions for each of them. The results of the probit and linear probability models for the high- and low-productivity samples are presented in Tables 5 and 6. According to the estimation results, exchange rate appreciation does not have any effect on the survival behavior of the high-productivity firms (columns 1, 3, 4 and 5 of Table 5). However, the coefficient of the real exchange rate appears to be negative and significant in the sample of low-productivity firms, indicating that appreciation decreases the probability of survival for the low-productivity firms (columns 1, 3, 4 and 5 of Table 6). These results are consistent with the probit model with the inclusion of the interaction variable (Fig. 1). The linear probability models (columns 3–5 of Table 6) imply that a 1% increase in the real exchange rate (appreciation) decreases the propensity of survival of low-productivity firms by between 11.5% and 15.5%.

5. Conclusion

The results of the empirical research presented in this paper provide some evidence of the impact of real exchange rate variations on the survival behavior of firms in Turkish manufacturing industries. Our results suggest that currency appreciation decreases the probability of survival for manufacturing firms. Consistent with the implications of the Melitz (2003) model, real exchange rate appreciation puts domestic producers at a cost disadvantage in export markets, raising the level of competition faced by these exporting firms. Consequently, the least productive firms exit the market. We find evidence that high-productivity firms have higher probabilities of survival than low-productivity firms in the presence of exchange rate variation. It should be reemphasized that, unlike in some previous studies, survival is defined in this study not only as remaining active in export markets but also as staying in business irrespective of the market at which these firms' products are targeted. Therefore, when the firms considered in this study are faced with exchange rate appreciation, they do not seem to be successful in compensating for their profit losses in export markets by relying on domestic demand, and are forced to exit.[20]

[20] It should be emphasized that the argument that domestic currency appreciation is harmful for export firms does not imply that an abrupt depreciation is beneficial to them. Clearly, the latter can also be harmful in situations in which export firms carry excessive un-hedged foreign currency debt.

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Table 6
Low-productivity firms.

	(1) Pooled Probit	(2) Marginal Effect	(3) LPM – No Fixed Effect	(4) LPM – Industry FE	(5) LPM – Firm FE
Real Exchange Rate	−7.877*	−0.095*	−0.155**	−0.152**	−0.115*
	(4.550)	(0.056)	(0.075)	(0.075)	(0.060)
Foreign GDP growth rate	0.095	0.001	0.004	0.004	0.001
	(0.360)	(0.004)	(0.006)	(0.006)	(0.005)
Domestic GDP growth rate	0.017	0.000	−0.001	−0.001	−0.000
	(0.240)	(0.003)	(0.005)	(0.005)	(0.004)
Interest rate	0.033	0.000	0.000	0.000	0.001
	(0.037)	(0.000)	(0.001)	(0.001)	(0.001)
Age	−0.624**(0.253)	−0.008* (0.004)	−0.012* (0.007)	−0.014* (0.007)	0.122** (0.061)
Employment	0.238*** (0.067)	0.003*** (0.001)	0.005** (0.002)	0.005** (0.002)	0.017** (0.008)
Time trend	0.629**	0.008*	0.010	0.010	0.002
	(0.316)	(0.004)	(0.007)	(0.007)	(0.007)
Observations	2287	2287	2287	2287	2287
Log lik.	−97.636	−97.636	2254.107	2263.585	2722.131
Chi-squared	80.146	80.146			

Notes: Column (3) is the linear probability model (LPM) with no fixed effects (FE).
Column (4) is the linear probability model (LPM) with industry fixed effects (FE). Column (5) is the linear probability model (LPM) with firm fixed effects (FE).
Marginal effects are calculated at the mean. Robust standard errors are in parentheses.
Real exchange rate, labor productivity, age, and employment are in logarithmic form.
*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

From an economic development policy perspective, these results emphasize the danger involved in domestic currency appreciation following a surge of capital inflows and in relying on internal demand, through the expansion of domestic credits, as the main driver of economic growth. The case of Turkey provides such an example, as its highly volatile GDP growth is dependent on the intensity of capital inflows (see Akat and Yazgan, 2013, and Özatay, 2015, among others). Especially in a resource-constrained (due to low domestic savings) emerging market economy such as Turkey, the tradable sector should play an important role in driving sustainable and employment creating growth through its capacity to create foreign resources. However, the evidence presented in this paper indicates that the continuing appreciation of the domestic currency may have detrimental effects on the development of resilient and strong tradable sector firms.

From a monetary policy perspective, however, these results should not be expected to be a main concern to a central banker, whose primary objective is reaching an inflation target. On the contrary, in an emerging market economy such as Turkey where exchange rates pass through domestic prices, which is usually one of the main drivers of inflation (see Arslaner et al., 2014; among others), one might think that the central bank even enjoys the dampening effect of real appreciation on inflation. In this regard, maintaining relatively high interest rates as a monetary policy instrument seems to serve the inflation objective through two channels simultaneously. On the one hand, it exerts its usual contractionary effect on domestic demand, and on the other it helps to alleviate pass-through effects by attracting capital inflows and causing an appreciation of the domestic currency.[21]

However, even the most aggressive inflation-targeting central banks do not have the luxury of being unconcerned about the real economy, no matter how low the degree of importance associated with real economy objectives. Therefore, while pursuing an explicit inflation target, the central bank can follow, albeit implicitly, a real exchange rate target. This target should correspond to an equilibrium level that is consistent with the inflation objective but not harmful to real sector exporting firms. It should be neither “too depreciated”, to avoid being inconsistent with the inflation target, nor “too appreciated”, to avoid being detrimental to the tradable sector. Obviously, attaining such an optimal level is a difficult task and requires the delicate calibration of economic policy.[22]

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[21] The former contractionary effect on domestic demand is usually counterbalanced by the latter because the surge of capital inflows is usually associated with domestic credit expansion that is mostly spent in non-tradable sectors such as construction.
[22] Due to the link between exchange rate and inflation, this alignment refers to a more complicated problem that is usually referred to in the context of the macroeconomic policy trilemma for open economies. See Akcelik et al. (2014) for an assessment of the trilemma or policy trade-offs for the Turkish economy.

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Appendix A

Our regression equation is denoted as:

$$P(S_{it}) = \phi\left[\alpha_1 Q_t + \alpha_2 D^h{}_{it} + \alpha_{12}\left(Q_t \times D^h{}_{it}\right) + \alpha_3 GDP^f{}_t + \alpha_4 GDP^d{}_t + \alpha_5 r_t + \alpha_6 AGE_{it} + \alpha_7 EMP_{it} + \alpha_8 t\right] + \varepsilon_{it} \quad (1)$$

$$= \phi[u] + \varepsilon_{it} \quad (2)$$

where D^h is a 0–1 dummy that stands for high- and low-productivity firms ($D^h = 1$ for high productivity and = 0 otherwise). Most applied researchers misinterpret the coefficient of the interaction term as being $\alpha_{12}\ \phi'(u)$. However, the intuition in linear models does not apply here because the marginal effect of a change in both interacted variables is not equal to the marginal effect of changing just the interaction term. In our case, one continuous variable (real exchange rate) and one dummy variable are interacted. The interaction effect is the discrete difference (with respect to D^h) of the single derivative (with respect to Q_t) and is given below:

$$\frac{\partial \phi}{\partial Q_t} = \left(\alpha_1 + \alpha_{12} D^h{}_{it}\right)\phi'(u) \quad (3)$$

$$\frac{\frac{\partial \phi}{\partial Q_t}}{\Delta D^h{}_{it}} = (\alpha_1 + \alpha_{12})\phi'(u|D^h{}_{it} = 1) - \alpha_1 \phi'(u|D^h{}_{it} = 0) \quad (4)$$

We use equation 4 to obtain the correct estimates of the interaction effect. As shown in equation 4, the sign of α_{12} does not necessarily show the sign of the interaction effect, which is different from the interaction effect in linear models. Note also that the interaction effect may have different signs for different values of covariates. The standard error of the estimated interaction effect α_{12} is found by applying the Delta method.[23]

References

Ai, Chunrong, Norton, Edward C., 2003. Interaction terms in logit and probit models. Econ. Lett. 80, 123–129.
Akat, Asaf S., Yazgan, M. Ege, 2013. Observations on Turkey's recent economic performance. Atlantic Econ. J. 41 (1), 1–27.
Akcelik, Yasin, Cortuk, Orcan, Turhan, Ibrahim, 2014. Mitigating Turkey's trilemma tradeoffs. Emerging Markets Finance Trade 50 (6), 102–118.
Alvarez, Roberto, Görg, Holger, 2009. Multinationals and plant exit: evidence from Chile. Int. Rev. Econ. Finance 18 (1), 45–51.
Arslaner Ferhat, Dogan Karaman, Nuran Arslaner, Suleyman Hilmi Kal, (2014). The Relationship between Inflation Targeting and Exchange Rate Pass-Through in Turkey with a Model Averaging Approach. Technical Report, Central Bank of the Republic of Turkey.
Atasoy, Deniz, Saxena, Sweta C., 2006. Misaligned? overvalued? The untold story of the Turkish lira. Emerging Markets Finance Trade 42 (3), 29–45.
Aw, B.-Y., Hwang, Amy Ruey-Meng, 1995. Productivity and the export market: a firm-level analysis. J. Dev. Econ. 47 (2), 313–332.
Baggs, Jen, Beaulieu, Eugene, Fung, Loretta, 2009. Firm survival, performance, and the exchange rate. Can. J. Econ. 42 (2), 393–421.
Baggs, Jen, Beaulieu, Eugene, Fung, Loretta, 2010. Are service firms affected by exchange rate movements? Rev. Income Wealth 56 (1), 156–176.
Baggs, Jen, Beaulieu, Eugene, Fung, Loretta, 2014. Persistent effects of transitory exchange rate shocks on firm dynamics. Contemp. Econ. Policy 32 (2), 334–350.
Baggs, Jen, 2005. Firm survival and exit in response to trade liberalization. Can. J. Econ. 38 (4), 1364–1383.
Baldwin, John, Yan, Beiling, 2011. The death of Canadian manufacturing plants: heterogeneous responses to changes in tariffs and real exchange rates. Rev. World Econ. 147 (1), 131–167.
Bergin, Paul R., Feenstra, Robert C., 2000. Staggered price setting, translog preferences, and endogenous persistence. J. Monetary Econ. 45, 657–680.
Bergin, Paul R., Feenstra, Robert C., 2001. Pricing-to-market, staggered contracts, and real exchange rate persistence. J. Int. Econ. 54, 339–359.
Berman, Nicolas, Martin, Philippe, Mayer, Thierry, 2012. How do different exporters react to exchange rate changes? Q. J. Econ. 127 (1), 437–492.
Bernard, A.B., Jensen, J. Bradford, 1995. Exporters, jobs, and wages in US manufacturing: 1976–1987. Brookings Papers on Economic Activity. Microeconomics 67–119.
Bernard, Andrew B., Jensen, J. Bradford, 2004. Why some firms export? Rev. Econ. Stat. 86 (2), 561–569.
Bernard, Andrew B., Wagner, Joachim, 1997. Exports and success in German manufacturing. Rev. World Econ. 133 (1), 134–157.
Feenstra, Robert C., 1989. Symmetric pass-through of tariffs and exchange rates under imperfect competition: an empirical test. J. Int. Econ. 27 (1/2), 25–45.
Feinberg, Robert M., 2010. Do international shocks affect small wholesalers and retailers? Rev. World Econ. 146 (2), 323–338.
Fung, Loretta, 2008. Large real exchange rate movements, firm dynamics, and productivity growth. Can. J. Econ. 41 (2), 391–424.
Görg, Holger, Marina-Eliza Spaliara, (2009). Financial Health, Exports, and Firm Survival: A Comparison of British and French Firms. CEPR Discussion Paper No. DP7532.
Girma, Sourafel, Greenaway, Avid, Kneller, Richard, 2004. Does exporting increase productivity? a microeconometric analysis of matched firms. Rev. Int. Econ. 12 (5), 855–866.
Goldberg, Pinelopi K., Knetter, Michael M., 1997. Goods prices and exchange rates: what have we learned? J. Econ. Lit. 35 (3), 1243–1272.
Green William, H., (2001). Fixed and Random Effects in Nonlinear Models. NYU Working Paper No. EC-01-01.
Greenaway, David, Kneller, Richard, 2007. Firm heterogeneity, exporting, and foreign direct investment. Econ. J. 117 (517), F134–F161.
Heckman, James J., 1981. Incidental Parameters Problem and the Problem of Initial Conditions in Estimating a Discrete Time-Discrete Data Stochastic Process. MIT Press, Cambridge.
Kara, Hakan, Kucuk-Tuger, Hande, Ozlale, Umit, Tuger, Burc, Yucel, Eray M., 2007. Exchange rate regimes and pass-through: evidence from the Turkish economy. Contemp. Econ. Policy 25 (2), 206–225.
Kimura, Fukunari, Kiyota, Kozo, 2006. Exports, FDI, and productivity: dynamic evidence from Japanese firms. Rev. World Econ. 142 (84), 695–719.

[23] For further details see Ai and Norton (2003).

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Krugman, P.R., (1986). Pricing-to-Market When the Exchange Rate Changes.
López, Ricardo A., 2006. Do international shocks affect small wholesalers and retailers? Econ. Lett. 92 (1), 58–62.
Li, Hongbin, Hong, Ma, Yuan, Xu, 2015. How do exchange rate movements affect Chinese exports? A firm-level investigation. J. Int. Econ. 97 (1), 148–161.
Melitz, Mark J., 2003. The impact of trade on intra-Industry reallocations and aggregate industry productivity. Econometrica 71 (6), 1695–1725.
Namini Emami J., Giovanni Facchini, Ricardo A. Lopez, (2011). Export Growth and Factor Market Competition: Theory and Evidence. CEPR Discussion Paper No. DP8256.
Neyman, Jerzy, Scott, Elizabeth L., 1948. Consistent estimates based on partially consistent observations. Econometrica 16 (1), 1–32.
Özatay, Fatih, 2015. Turkey's distressing dance with capital flows. Emerging Markets Finance Trade 1–15 (ahead-of-print).
Özler, Sule, Yılmaz, Kamil, 2009. Productivity response to eduction in trade barriers: evidence from Turkish manufacturing plants. Rev. World Econ. 145 (2), 339–360.
Parteka, Aleksandra, Wolszczak-Derlacz, Joanna, 2013. The impact of trade integration with the european union on productivity in a posttransition economy: the case of Polish manufacturing sectors. Emerging Markets Finance Trade 49 (2), 84–104.
Roberts, Mark J., Tybout, James R., 1997. The decision to export in Colombia: an empirical model of entry with sunk costs. Am. Econ. Rev. 87 (4), 545–564.
Taymaz, Erol, Yılmaz, Kamil, 2007. Productivity and trade orientation: Turkish manufacturing industry before and after the customs union. J. Int. Trade Diplomacy 1, 127–154.
Taymaz, Erol, Yılmaz, Kamil, 2014. Innovation, Globalization and Firm Dynamics: Lessons for Enterprise Policy. Chapter Foreign Ownership, Survival and Growth Dynamics in Turkish Manufacturing, Routledge.
Tomlin, Ben, 2014. Exchange rate fluctuations, plant turnover and productivity. Int. J. Ind Org. 35, 12–28.
Wagner, Joachim, 2007. Exports and productivity: a survey of the evidence from firm-level data. World Econ. 30 (1), 60–82.
Wagner, Joachim, 2012. International trade and firm performance: a survey of empirical studies since 2006. Rev. World Econ. 148 (2), 235–267.
Wagner, Joachim, 2013. Exports, imports, and firm survival: first evidence for manufacturing enterprises in Germany. Rev. World Econ. 149 (1), 113–130.

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