EXCHANGE RATES, PRICES AND PROFITABILITY: THE TURKISH EVIDENCE

by

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Abstract

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This dissertation consists of three essays. The first essay, published in the Turkish Central Bank Review I, 2010, examines the impact of exchange rate movements on export prices and profitability, at sectoral and at firm level respectively, for Turkish manufacturing. The results suggest that i) Turkish firms tend to stabilize their local currency prices implying that they have market power in international markets, and ii) exchange rate movements affect the profitability of firms. The results also show that the profits of export oriented firms are more likely to be affected by exchange rate movements.

In the second essay, I develop a two-country model of international trade, built on Melitz (2003) model, where plant level heterogeneity is the key assumption. In this framework I analyze the impact of currency appreciation on productivity thresholds using a Newton Algorithm. The numerical

simulation suggests that exchange rate appreciation increases productivity thresholds for both exporting and domestic production. In addition, I incorporate liquidity constraints in line with Manova (2010) into a model of heterogeneous firms and numerically show that, in the presence of liquidity constraints, the productivity threshold for exporting increases.

The third essay, co-authored with Professor Yazgan from Bilgi University, uses unique firm level dataset, to test the impact of currency appreciation on the survival behavior and sales of Turkish firms in traded and nontraded industries for 2002-2009. The results suggest that real exchange rate appreciation decreases the probability of survival in both traded and nontraded industries. We find that high (low) productivity firms have higher (lower) probability of survival than low (high) productivity firms in both traded and nontraded industries as a result of domestic exchange rate appreciation. We further test the impact of currency appreciations on the sales of continuing firms belonging to both traded and nontraded industries. Our results show that real exchange rate appreciations do not have any impact on continuing firms' sales in both traded and nontraded industries.

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To my grandmother, Lâle

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Chapter 1

Introduction

This dissertation consists of three self-contained essays on international economics. First essay is an empirical work investigating the impact of exchange rate movements on export prices and profitability, at sectoral and at firm level respectively, for Turkish manufacturing. In the second essay, based on a two-country model of international trade, built on Melitz (2003) model, I investigate the impact of real exchange rate appreciation on the productivity thresholds for exporting and domestic production. Last chapter, coauthored with Prof. Ege Yazgan, addresses the impact of currency appreciation on the survival behavior and sales of Turkish firms in traded and nontraded industries for 2002-2009.

Economists have studied both exchange rate pass-through and exposure but few studies examine them simultaneously. First essay investigates these two interrelated phenomenon, exchange rate pass-through, and exposure, simultaneously in the context of a structural model introduced by Bodnar, Dumas, and Marston (2002). Exchange rate pass-through to export prices is an important factor in the analysis of exchange rate exposure because exchange rate movements are often perceived as costs shocks for an exporting firm. As a result of exchange rate appreciation, firms tend to reduce their prices denominated in local currency which results in a decrease in their profit margins. Consequently, exchange rate pass-through to export prices and profits are jointly determined by the degree of adjustment in the profit margins. This study is the first empirical work investigating the exchange rate pass-through to export prices in the Turkish economy. For emerging markets, exchange rate pass-through is mostly treated as the impact of exchange rates on consumer price index because these countries are small-open economies therefore exchange rate pass-through behavior is considered to be small. In terms of data sources I use data at different aggregation levels while studying exchange rate pass-trough and exposure. The exchange rate pass-through analysis is based on sectoral level data due to the data limitations on export price at firm level. On the other hand the exchange rate exposure analysis is based on a firm level data. The results suggest that i) Turkish firms tend to stabilize their local currency prices implying that they have market power in international markets, and ii) exchange rate movements affect the profitability of firms. The results also show that the profits of export oriented firms are more likely to be affected by exchange rate movements.

The next chapter, called "A Model of Heterogenous Firm" provides a theoretical framework that is consistent with recent empirical research examining the impact of currency variations on firms' survival. This empirical literature documents that firms' survival is negatively associated with the appreciation of the exchange rate and the impact on survival is less pronounced for more productive firms. In this chapter, introducing a two country model of international trade, built on Melitz (2003) model, I analyze the impact of currency appreciation on the productivity thresholds using a Newton Algorithm. In this framework, individual firms are subject to significant barriers to engaging in export activity, so that only firms with productivity above a certain threshold are able to export. The numerical simulation suggests that exchange rate appreciation increases productivity thresholds for both exporting and domestic production causing less productive firms exit the market. In addition, I incorporate liquidity constraints in line with Chaney (2005) and Manova (2010) and numerically show that, in the presence of liquidity constraints, the productivity threshold for exporting increases. The results provide a theoretical framework that is consistent with recent empirical findings, such as Fung (2008), on firms' survival patters in the context of exchange rate variation.

Last chapter is motivated by the recent micro-level empirical research examining the impact of real exchange rate variations on firms' survival and sales. In this context real exchange rate movements are thought to act like tariffs in the way they affect survival behavior and sales by altering firms' competitive position in both domestic and international markets. To date, the literature has lacked detailed analysis of the effects of exchange rates on the firms' survival behavior and sales in emerging markets due to a scarcity of firm-level information. This paper uses a detailed dataset compiled by the Central Bank of Turkey (CBRT) that contains information on income statement and balance sheet items, starting date of the establishment's operation, and industry affiliation for 2002 to 2009. This rich dataset provides a unique platform in which we empirically test the effects of exchange rates on survival and sales of the firms and compare the results with theoretical predictions presented in the literature and the theoretical model introduced in Chapter 3. To the best of our knowledge this is the first empirical study to examine the impact of currency variations on firm survival in Turkey. Our results suggest that domestic currency appreciation decreases the probability of survival of firms in both traded and nontraded industries. This finding also provides an empirical support for the theoretical model introduced in Chapter 3. As a result of an exchange rate appreciation the productivity threshold increases. Consequently less productive firms exit the market. Additionally we find that high (low) productivity firms have higher (lower) probability of survival than low (high) productivity firms in traded and nontraded industries as a result of domestic exchange rate appreciation. We further test the impact of currency appreciations on the sales of continuing firms belonging to both traded and nontraded industries. Accordingly, we find that real exchange rate appreciations do not have any impact on continuing firms' sales in traded and nontraded industries.

Chapter 2

Exchange Rate Pass-Through and Exposure: Empirical Evidence from Turkey

2.1 Introduction

Movements in exchange rates have important implications for (1) export prices; and (2) profitability of firms. There is no empirical work for the Turkish Economy examining the relation between exchange rates and export prices. On the other hand, several studies such as Kıymaz (2003) have investigated the effect of exchange rate movements on firms' profitability in Turkey. These studies estimate reduced form models, regressing a measure of profitability on exchange rates controlling for non-exchange rate related factors that affect firms' profits such as changes in the investment sentiment.[1] Such models are often criticized, especially in the context of multi-firm studies or large-scale cross-firm comparisons of exchange rate exposures, because they ignore firms' strategic pricing behavior as they fail to incorporate competitive reactions and impacts of market parameters and structure. Motivated by this claim, the purpose of this chapter is to analyze the impact of exchange rate movements on prices and profitability using a structural model based on a duopoly model of exporting firms.

As noted, a large literature studies exchange rate exposure, defined as the responsiveness of profits to exchange rates. This literature argues that exchange rate movements affect a firm's profitability in two ways. First, exporting companies' revenues will increase as a result of local currency depreciation and increased demand for products it exports. On the other hand, depreciation will increase production costs of companies that rely on imported inputs. Exchange rate pass-through (ERPT) to export prices, defined as the change in local currency export prices arising from a one percent change in the exchange rate, is an important factor in the analysis of exchange rate exposure since profitability and pass-through are closely related. As a result of exchange rate appreciation, firms tend to reduce their prices denominated in local currency which results in a decrease in their profit margins. Consequently, exchange rate pass-through (ERPT) to export prices and profits are jointly determined by the degree of adjustment in the profit margins.

My empirical research leads to the following conclusions: i) Turkish ex-

[1] To control for other macroeconomic influences on the measures of profit, most empirical studies include the return to a market portfolio in the empirical model.

porters do price to market and pricing to market varies across time and sectors, ii) exchange rate variations affect the profitability of manufacturing firms. The magnitude of this effect varies across firms within the industry, and iii) the profitability of export oriented firms is more likely to be affected by exchange rate variations than the profitability of domestically oriented firms.

This chapter is organized as follows. The next section describes the existing literature on exchange rate pass-through and exposure. The third section describes the model and methodology. The fourth section outlines data sources. The fifth section presents the results. The sixth section concludes.

2.2 Review of the Literature

Economists have studied both pass-through and profitability, but few studies examine them simultaneously. Bodnar, Dumas and Marston (hereafter BDM, 2002) present the first theoretical model of an exporting firm that incorporates these two phenomena. In BDM, pass-through and exposure are functions of product substitutability. Increased substitutability implies a more elastic demand for the exported good, which results in smaller price changes to achieve the profit-maximizing level of exports. This implies a smaller pass-through and increased exposure as a result of declining profits. BDM also present an empirical analysis using eight Japanese export industries which are all major exporters.[2] However their empirical results

[2]Eventhough the selected industries are major exporters, the share of output that the firm sells in the domestic market may affect exposure elasticities. As a solution to this problem, BDM (2002) modifies the theoretical model of the exporting firm by taking into account the impact of domestic sales on the exporting firms' profits.

are mixed.[3] Bartnam et al. (2009) extends the BDM model by adding a domestic market. They show that pass-through is an important factor in reducing the level of exchange rate exposure.

Most of the studies on ERPT are empirical and do not take into account a firm's pricing behavior.[4] These studies document that prices of goods change less than the exchange rates. This situation is referred as incomplete pass-through and has been explained by the mark-up variability of firms, meaning that firms respond to home currency appreciations by decreasing the domestic currency prices of their exports in order to limit increases in the foreign currency prices of their products. This destination specific mark-up adjustment driven by exchange rate movements is called Pricing to Market (PTM) by Krugman (1987). Marston (1990), based on the first order conditions of a model of a price discriminating monopolist, showed that optimal price is a function of mark-up which is a function of the demand elasticity perceived by the exporters, and the marginal cost. In this context, convex demand implies a variable demand elasticity. For example if the demand becomes more elastic as a result of price increase (caused by the depreciation of the exporters currency) mark-up decreases. Subsequent research has shown that pricing to market is closely related to industry characteristics such as the degree of competition, product substitutability, and the relative domestic and foreign shares in the market (Knetter, 1989 and 1993; and Yang, 1997).

[3]Their pass-through values range from 0.15 for the film industry to 0.81 for the construction machinery industry. The empirical results for exposure elasticity, which equals the percent change in profits resulting from a one percent change in the exchange rate, is either insignificant or are not within the theoretical limits (> 1) in the five of eight sectors studied.

[4]For more detailed information on this literature, see Goldberg and Knetter (1997).

For the case of Turkey, ERPT studies have focused mostly on import and domestic prices. Turkcan (2005) estimates the ERPT elasticities of imported intermediate and final goods following Goldberg and Campa's (2002) methodology. Turkcan (2005) used quarterly data from 1989 to 1996 for prices on imported final and intermediate goods for Turkey's trade with 12 OECD countries. His results suggest that the short- and long-run ERPT to import prices, defined as the change in local currency import prices arising from a one percent change in the exchange rates, for final and intermediate goods, are complete at both aggregated and disaggregated level. The aggregate analysis is conducted at the country level whereas disaggregate analysis is at industry level where the data are averaged across countries. The results also show that intermediate goods have relatively higher pass-through rates than final goods.

ERPT to domestic prices in Turkey has been analyzed extensively because imported inputs constitute a high share of production costs; therefore they have an indirect impact on domestic prices. Arbatli (2005) uses a VAR framework to investigate the ERPT to domestic prices. Her results document that pass-through is lower during periods of economic contraction, depreciations and falling inflation. Kara et al. (2007) investigate the evolution of ERPT to domestic prices in Turkey with a special focus on the role of monetary policy and exchange rate regime. Their results indicate that ERPT to domestic prices increased after Turkey adopted a floating exchange rate regime. Additionally, tests for structural breaks reveal several breaks coinciding with major monetary and exchange rate regimes. This finding underlines the importance of the regime changes for ERPT behavior in Turkey.

The responsiveness of profits to exchange rate movements, so-called exchange rate exposure, has been measured using Adler and Dumas' (1984) methodology or the modified Capital Asset Pricing Model (CAPM). Adler and Dumas (1984) calculate exposure by regressing firm returns on the change in the trade-weighted exchange rate index. Instead, the modified CAPM studies regress firm returns on the change in the exchange rate and the return on the market portfolio. According to either model, firms exhibit exchange rate exposure if the coefficient of the exchange rate is significant. Nonetheless, these models do not take into account the firm's pricing behavior or industry characteristics such as product substitutability, degree of competitiveness and market share; therefore, they are sometimes criticized for misrepresenting the firm's economic behavior.

The exchange rate exposure of US multinationals has been extensively analyzed (Jorion, 1990, and Bodnar and Gentry, 1993). A common finding in the studies of US firms is that exposure estimates are rarely statistically significant, implying little impact of exchange rate changes on profitability. On the other hand, studies of exposure for countries such as Canada and Japan have found significant relationships between exchange rates and firm values (Bodnar and Gentry, 1993; He and Ng, 1998; Dominguez and Tesar, 2006).

For the case of Turkey, Kıymaz (2003) investigates the foreign exchange rate exposure of firms based on a sample of 109 firms traded on the Istanbul Stock Exchange during 1991-1998. He finds that Turkish firms are highly exposed to exchange rate risks and their profits (measured by share prices) are affected significantly by exchange rate variations (51 significant exposure elasticities in the sample of 109 firms). In particular, textile, machinery, chemical and financial industries have high exposure elasticities. Additionally, exchange rate exposure is positively correlated with the firms' involvement in exports and imports. Solakoglu (2005), investigates the relationship between exchange rate exposure and firm-specific factors such as firm size, maturity, level of international activity (as measured by the share of export revenue in total revenue and the share of import expenditures in total costs) using a panel data covering 137 Turkish firms in 2001-2003. He finds that firm size and level of export revenue have a negative effect on the elasticities of exchange rate exposure. Contrary to Kıymaz (2003), he finds statistically significant exposure estimates for only 8% of firms in 2003.

The studies reviewed so far have used stock prices as a proxy for profit. Other studies examine the relationship between profit and exchange rates using corporate profit data (Clarida, 1997 and Uctum, 1998).[5] For example, Clarida (1997) found that during the strong (weak) dollar period 1980:3-1985:2 (1985:3-1989:2), the appreciation (depreciation) of the dollar reduced (boosted) real manufacturing profits by more than 20% (25%) in 1984 and 1985 (1987 and 1988). Clarida (1997) states that the impact of currency variations on profits are independent of the magnitude of exchange rate pass-through coefficients, implying that currency appreciations (depreciations) always reduce (increase) profits. Uctum (1998) examines the determinants of profits in an international context where real depreciation affects profits

[5] Uctum (1998) uses aggregate indices of non-financial corporate gross operating surplus exclusive of non- financial depreciation and taxes, while Clarida (1997) uses aggregates of domestic manufacturing profits with inventory valuation and capital consumption adjustments.

through three channels: valuation, volume and cost.

A depreciating currency results in a lower foreign currency price of exports, higher sales and therefore higher profits (the volume channel). The depreciation of the currency also raises the domestic currency value of exports improving profits in domestic currency (the valuation channel). The depreciating local currency increases the domestic currency cost of the imported inputs, which may dampen the positive effect of exchange rate depreciation on profits (the costs channel). Uctum (1998) finds that an appreciating currency is likely to hurt profits of US firms at least three times as much as in Japan and Germany, explaining why an overvalued currency is sustainable for a longer period in Japan and Germany than in the USA.

In this paper, I investigate the impact of exchange rate variations on export prices and the profits of Turkish firms. The contribution of this paper to the literature is threefold. First, this study is the first to document the effect of exchange rates on export prices in Turkish manufacturing. A better understanding of this relationship will contribute to the understanding of firms' pricing behavior. Additionally, I will identify the industries and products vulnerable to exchange rate fluctuations. This has importance for foreign investment and foreign exchange rate risk management (Yang, 1997). Finally, I investigate the relationship between a firm's profitability and exchange rates by using better measures of profit than those used in other empirical research, which has generally relied on stock price data as a proxy for corporate profits.

2.3 Model and Methodology

The exchange rate pass-through and exposure elasticities will be calculated following Bodnar, Dumas and Marston's (hereafter BDM, 2002) methodology The BDM model is based on the strategic pricing behavior of an exporting firm that competes with a foreign firm in the export market.

2.3.1 Demand Side

The model assumes that pass-through and exposure are functions of substitutability between the exported goods and those produced in the foreign market. The foreign consumers have the following utility function:

$$U(X_1, X_2) = [\lambda X_1^\rho + (1-\lambda)X_2^\rho]^{\frac{1}{\rho}} \tag{2.1}$$

where

$U(.)$ = the utility function of the consumers in the foreign market,

X_1 = the quantity of the exporting firm's product sold in the foreign market,

X_2 = the quantity of the foreign import-competing firm's product sold in the foreign market,

λ = a preference weighting parameter, and

ρ = a parameter measuring the substitutability between these products.

The inverse demand functions for the two products are given as:

$$P_1 = D_1(X_1, X_2) = \frac{\lambda X_1^{(\rho-1)} Y}{[\lambda X_1^\rho + (1-\lambda)X_2^\rho]} \tag{2.2}$$

$$P_2 = D_2(X_1, X_2) = \frac{\lambda X_2^{(\rho-1)} Y}{[\lambda X_1^{\rho} + (1-\lambda) X_2^{\rho}]} \tag{2.3}$$

where Y is the total expenditures on the industry's products.

2.3.2 Firms' Profits

It is assumed that exporting firms production is based in its home country, and the import competing firm has sales only in the foreign market. Each firm's profit is measured in its own currency. The exchange rate, E, is defined as the foreign currency value of domestic currency (an increase represents depreciation). The exporting firm produces its product using domestic as well as imported inputs. The profit of the exporting firm in its own currency is given as:

$$\Pi_1{}^* = EPX_1 - (C_1{}^* + EC_1)X_1 \tag{2.4}$$

where P is the export price, X_1 is quantity of the good exported, $C_1{}^*$ is the unit cost of production based on domestic inputs and $EC_1{}^*$ is the unit cost of production based on imported inputs. The profit of the import competing firm denominated in its own currency is given as:

$$\Pi_2 = P_2X_2 - C_2X_2 \tag{2.5}$$

This firm has only domestic sales (X_2) and its production is based only on domestic inputs (C_2). The duopoly model of the exporting firm is solved under quantity competition. One important modification to the model is the inclusion of the domestic market. The theoretical model assumes a pure exporting firm but empirical analysis may fail to identify these firms due to the lack of suitable data.[6] Pass-through and exposure will be estimated by using the following equations for price and profit:

$$d\ln EP - d\ln {P_i}^D = \alpha_1 \times (d\ln E + d\ln C - d\ln {P_i}^D) \tag{2.6}$$

$$\hat{\eta} = (1 - \hat{\alpha_1}) \tag{2.7}$$

where C_2 is the marginal cost index in the foreign market (weighted average of the foreign consumer price indexes using export weights[7] of firm's export markets), $\hat{\eta}$ is the pass-through coefficient, and P_d is the domestic price index (proxied by the wholesale price index).

The intuition behind the price equation is the following. The expression on the right hand side is the percentage change in the ratio of the rest of the world's price index to the domestic price index, that is, the real exchange rate. According to equation 2.6, the variation in the real exchange rate is related to the percentage change in the ratio of export prices to domestic prices through α_1 which gives us information on the degree of exchange rate pass-through behavior exhibited by a firm. Suppose $\hat{\alpha}_1 = 1$. This implies that if the real exchange rate depreciates by 1 percent, the firms adjust the ratio of export prices (denominated in producer currency, Turkish Lira in this case) to domestic prices so that it increases by 1 percent. This situation

[6] In order to deal with this problem BDM use industry level measures for the percentage of foreign sales to total sales available for the year 1985, 1990 and 1994. In this paper, we will use firm level measures for the percentage of foreign sales to total sales averaged for the period 1995-2007.

[7] See Appendix I for the corresponding weights of each country.

indicates that pass-through is equal to zero.

The exposure elasticity of a pure exporter is calculated by using the following expression:

$$d\Pi^{*}_{1jt} - d\ln E_t Y_t = \alpha_{2j} \times (d\ln E + d\ln C - d\ln {P_i}^{D}) \tag{2.8}$$

$$\hat{\delta}_j = (1 - \gamma_i)\hat{\alpha}_{2j} + 1 \tag{2.9}$$

where Π is the profit, Y is the foreign expenditure index (weighted average of Turkeys trade partners GDPs), γ is the proportion of imported inputs in total cost, and $\hat{\delta}$ is the exposure elasticity. The expression on the right hand side is the real exchange rate and the left hand expression is the differences between percentage change in profit and the percentage change in the foreign expenditure index. The model requires that $\delta_j \succ 1$ which is satisfied when $\alpha \succ 0$. This implies that the real exchange rate and the difference between percentage change in the profit and foreign expenditure index are positively related. Note that the firms in our sample also have significant domestic markets; therefore the following modification must be made. It will be assumed that, at the beginning of each period, the ratio of export profits in total profits is equal to θ and exchange rates affect only export profits.

$$\frac{\prod^{EXPORT}}{\prod^{TOTAL}} = \theta \tag{2.10}$$

After taking log differences of equation 2.10 and substituting into 2.8 we have the following expression:

$$d\ln\Pi_{1j}{}^{EXPORT} - \theta_j d\ln SY = \alpha_{2j}\theta_j d\ln\left(\frac{SC}{P_D}\right) \qquad (2.11)$$

The equations (2.6) and (2.11) will be estimated by using Generalized Least Squares (GLS). The resulting estimates of α_1 and α_{2j} will be used to calculate pass-through (η), and exposure (δ) elasticities, using equations (2.7) and (2.9). In estimating equation 2.11, firms with negative profit values were dropped from the sample. This may bias our results therefore a robustness check will be performed by creating a positive measure for profit using stock prices. The proxy for profits will be calculated based on the following expression:

$$d\ln\Pi = d\ln V - \beta_j d\ln V_{ISE100} \qquad (2.12)$$

Π = the proxy for profit

V_j = the market value of firm j (in TL)

V_{ISE100} = the market value of the ISE100 index, and

β_j = the beta of firm j with the ISE100 index.[8]

As mentioned, using the specification described in equation 2.11 is problematic because of the negative values of profit. Therefore an alternative specification, implied by the model and described in the following equation (2.13), will be used to test the relationship between exchange rates and the profitability of a firm.

$$\Delta GM_{1jt} = \phi_0 + \phi_{1j}\Delta\ln E_t + \varepsilon_{jt} \qquad (2.13)$$

[8]See Appendix IV for the calculation of beta and the firms' betas.

ΔGM_{1jt} stands for gross margin percentage for the firm j, E_t is the nominal exchange rate, and ε_{jt} is an error term. ϕ_{1j} represents the change in the gross margin percentage of a firm as a result of 1 percent change in the exchange rate. Positive (negative) values of ϕ_{1j} imply that depreciation of the currency has a positive (negative) impact on the profitability of the firm.

In the empirical section, firstly I will investigate the exchange rate pass-through behavior in the five manufacturing industries using equations 2.6 and 2.7. $\hat{\eta}$ is the PTM elasticity and therefore the main coefficients of interest in the study. If the exchange rate pass-through coefficient, $\hat{\eta}$, is equal to 0, this means that destination market prices fully respond to exchange rate variations; price remains unchanged in the exporters currency, and pass-through is complete. If $\hat{\eta}$ is equal to 1, destination market prices are insensitive to exchange rates; exporters fully adjust their profit margins in order to absorb price changes and pass-through elasticity is equal to zero. If values of $\hat{\eta}$ are between 0 and 1, this implies that there is some degree of pricing to market behavior with incomplete exchange rate pass-through. Literature, such as Knetter (1993), Yang(1997), points out the importance of the industry structure in explaining the differences in the PTM behavior, therefore I would expect the pass-through coefficients to vary depending on the industry characteristics such as the degree of competition, product substitutability, level of imported input use, and the relative domestic and foreign shares in the market.

Secondly I will investigate the impact of exchange rate variations on the profitability of the firms. With this regard, two specification will be used.

First specification, described in equation 2.11, is based on the duopoly model of exporting firm. Main drawback of this specification is that it is not able to capture the negative values of profit. As a solution to this problem second specification, described in equation 2.13 is used. The main coefficients of interest are exposure elasticity, $\hat{\delta}$, and the change in the gross margin percentage of a firm as a result of 1 percent change in the exchange rate, ϕ_{1j}, in the first and second specifications, respectively. Positive (negative) values of $\hat{\delta}$ and ϕ_{1j} imply that depreciation of the currency has a positive (negative) impact on the profitability of the firm.

Finally I will explore the role of exchange rate regime in the determination of pass-through and exposure. In order to compare the exchange rate pass-through and exposure dynamics between regimes, I divide the period 1995-2007 into two subperiods to 1) floating (after 2001) and 2) pre-floating(2001 and before). I expect the size of pass-through and exposure estimates to decline in the floating regime period because of the increased exchange rate volatility.

2.4 Data

The estimation of equations 2.8, 2.11, and 2.13 requires data on export prices, exchange rates, imported input shares, the share of export profits in total profits, domestic GDP and wholesale price indexes, as well as GDPs and wholesale price indexes of the Turkey's major trading partners. The exposure estimates will be calculated at the firm level and exchange rate pass-through estimates will be analyzed at the sectoral level due to the lack of available data on export unit values at firm level. Data on export unit values, domestic wholesale price indexes and exchange rates are available through TURKSTAT. Turkey's trade partners' GDP and wholesale price indexes are available through IMF's International Financial Statistics.

We use gross margin, the difference between total revenue and cost of sales, as a proxy for profit. Firm level revenue and cost of sales are taken from firms' quarterly financial reports available through Istanbul Stock Exchange (ISE). The share of export sales in total sales is also taken from firms' quarterly financial reports.[9] Average sectoral values of the shares of imported inputs in total production are given by Kıymaz (2003) for the period 1991-1998.[10]

2.5 Estimation Results

Exchange rate pass-through to export prices are estimated at sectoral level using equation 2.6 for the period between 1995 and 2007. The estimation results are reported in Table 2.1. The exchange rate pass-through coefficients for 3 out of 6 industries are significantly positive and fall between 0 and 1. The average pass-through estimate for the period 1995-2007 is around 0.6. This means that a one percent appreciation of the Turkish Lira would decrease export prices denominated in producer currency (TL) by 0.60 percent. As discussed in the data section the main coefficient of interest is exchange rate pass-through coefficient, $\hat{\eta}$. If $\hat{\eta}$ is equal to 0, this means that price remains unchanged in the exporters currency, and pass-through is complete.

[9]See Appendix III for the list of firms in the sample.
[10]See Appendix II

If $\hat{\eta}$ is equal to 1, exporters fully adjust their profit margins in order to absorb price changes and pass-through elasticity is equal to zero. If values of $\hat{\eta}$ are between 0 and 1, this implies that there is some degree of pricing to market behavior with incomplete exchange rate pass-through. Incomplete exchange rate pass-through implies that Turkish exporters have sufficient market power that enables them to partly stabilize their local currency export prices by adjusting their profit margins to stay competitive in their export markets.

Note that our analysis investigates the exchange rate pass-through responses in the short-run. Long-run exchange rate pass-through responses may differ from short-run responses in a given industry. For example, Mallick and Marques (2010), in their study based on Indian manufacturing industries for the period 1991-2006, find that the number of sectors with incomplete exchange rate pass-through declines considerably in the long-run. However, they also report evidence of incomplete exchange rate pass-through in the long run in several industries. This implies that pass-through in the long-run may be sector-specific. Several factors can cause exchange rate pass-through to be complete in the long run but incomplete in the short run. According to the literature, among the most important factors are menu costs, currency denomination of the trade contracts and the dynamics of demand response to price changes.[11]

There is little evidence of a relationship between exchange rates and corporate profits, according to empirical results obtained using equation (2.11). Only 1 out of 51 firms in our sample documents significant exchange rate ex-

[11] See Menon(1994) for a more detailed explanation.

Table 2.1. Exchange Rate Pass-through to Export Prices (1995-2007)

	Pass-Through($\hat{\eta}$)	z	Observations
Manufacture of Basic Metals	0.66**	2.62	51
Textile	0.90	0.71	51
Paper and Paper Products	0.65*	2.06	51
Food Products and Beverages	0.59**	2.81	51
Chemicals and Chemical Products	0.99	0.11	51
Manufacture of Fabricated Metal Products (Excluding Machinery)	0.76	1.16	51

** means that coefficient is significant at 1% and * means that coefficient is significant at 5% level.

Table 2.2. Exchange Rate Pass-through to Export Prices (1995-2000)

	Pass-Through($\hat{\eta}$)	z	Observations
Manufacture of Basic Metals	0.50*	2.56	23
Textile	0.28**	2.78	23
Paper and Paper Products	0.77	0.80	23
Food Products and Beverages	0.18**	2.26	23
Chemicals and Chemical Products	0.87	0.38	23
Manufacture of Fabricated Metal Products (Excluding Machinery)	0.74	0.61	23

** means that coefficient is significant at 1% and * means that coefficient is significant at 5% level.

posure coefficients. The results remain insignificant if the sample is expanded by including non-negative measures for profit, calculated using the expression 2.12. However, the estimates calculated using equation (2.13), which takes into consideration the negative values of profit, support the relationship between exchange rates and profitability of a firm. Table 2.4 presents the relationship between gross margin percentage and exchange rates. 18 out of 50 firms exhibit significant exposure estimates. One possible explanation of the puzzling difference in results could be the tendency of firms to make use of hedging instruments (e.g., foreign debt) to protect themselves from unexpected movements of exchange rates (Allayannis and Ofek,

Table 2.3. Exchange Rate Pass-through to Export Prices (2003-2007)

	Pass-Through($\hat{\eta}$)	z	Observations
Manufacture of Basic Metals	0.80	1.32	20
Textile	0.72**	1.92	20
Paper and Paper Products	0.77	0.80	20
Food Products and Beverages	0.54*	2.36	20
Chemicals and Chemical Products	0.71	1.37	20
Manufacture of Fabricated Metal Products (Excluding Machinery)	0.56	1.65	20

** means that coefficient is significant at 1% and * means that coefficient is significant at 5% level.

2001). Turkish firms are likely to hold foreign-currency-denominated assets due to a lack of trust in their home currency and borrow in foreign-currency-denominated debt in order to take advantage of interest rate arbitrage opportunities. Given these facts, net foreign currency position plays an important role in the interpretation of exchange rate exposure because it is closely related to investment decisions and therefore to profitability (Gönenc et al., 2003). In addition, Turkish firms have a tendency to issue foreign-currency-denominated debt, which decreases the vulnerability of their revenues to fluctuations in the Turkish Lira. Consequently, the weak relationship between exchange rates and profits in Turkey can be explained by the use of financial hedging instruments.

As noted, currency depreciation may affect exporters' profits through three channels: volume, valuation, and cost (Uctum, 1998; Clarida, 1997). To repeat: when the currency depreciates: the exporting firm lowers its foreign currency price of exports, which increases export sales and therefore profits (volume channel); the domestic currency value of exports (which is equal to total profits) increases as currency depreciates (valuation channel);

and the domestic currency cost of imported inputs increases (cost channel). Furthermore, foreign income may also affect the profits directly through the demand channel. Higher (lower) foreign income raises demand for exports and improves (decreases) profits. Depending on the magnitude of these channels, the relationship between exchange rates and profits can be positive, negative or zero.

Returning to results presented in Table 2.4, the estimated values of ϕ_{1j} vary between -0.99 and 0.7. For example if ϕ_{1j} is equal to 0.7, this means that 1 percent depreciation of the domestic currency, increases the gross margin percentage by 0.7 percent. Only 2 firms in our sample exhibit negative values for ϕ_{1j}, which imply that exchange rate depreciation has a negative impact on the profitability of the firms. This finding can be explained by the use of imported inputs (cost channel) or a decrease in foreign demand.

I divide the period 1995-2007 into two subperiods to compare the exchange rate pass-through and exposure dynamics between two different exchange rate regime periods: 1) floating (after 2001) and 2) pre-floating (2001 and before). An important difference in the floating regime period is that periods of depreciation have been followed by the periods of appreciation. This behavior of exchange rates creates expectations about the persistence of exchange rate movements in the pre-float period.

The estimates of exchange rate pass-through for the two periods are reported in Table 2.2 and 2.3. For the period before 2001, exchange rate pass-through coefficients for 3 out of 6 industries are significantly positive. The number of significant exchange rate pass-through coefficients drops to 2 for the period after 2002. This result is in line with the previous findings covering Turkish economy such as Kara et al. (2005). The declining trend in the number of significant pass-through coefficients has been explained by several factors such as exchange rate volatility. The volatility in the exchange rates deteriorates price-setters' expectations on the future marginal costs by decreasing their informational content and, therefore, exchange rate changes do show up in prices. All significant exchange rate pass-through estimates are within the range of 0 and 1.

There is evidence of cross-industry variation in exchange rate pass-through coefficients for the period before 2001. For example, the pass-through estimate is equal to 0.18 for Food Products and Beveragesand 0.5 for Manufacture of Basic Metals. This finding is consistent with the empirical literature which documents exchange rate pass-through responses vary across industries.

The estimates of ϕ_{1j} for the two periods are reported in Table 2.5 and 2.6. The number of significant ϕ_{1j} is much higher during the floating exchange rate period implying that exporters are more sensitive to exchange rate variations in this period. In addition, the magnitudes of significant $\phi_{1j}s$ are higher for all the manufacturing firms during the floating exchange rate period (See Figure 2.1).

Another finding is the positive relationship between the responsiveness of gross margin to exchange rates, ϕ_{1j}, and the ratio of foreign sales to total sales, θ (Figure 2.1). This implies that the profitability of the export oriented firms is more sensitive to exchange rate variations as expected. Figure 2.2 demonstrates the relationship between ϕ_{1j} and θ more clearly.

2.6 Concluding Remarks

This paper examines the impact of exchange rate variations on the export prices and profitability of firms in the manufacturing industry. Using generalized least square estimation, it is found that Turkish exporters do price to market. The level of pricing to market varies across time and sectors.

We also found that exchange rate variations affect the profitability of manufacturing firms. The magnitude of this effect varies across firms within the industry. Moreover, our results show that the profitability of export oriented firms is more likely to be affected by exchange rate variations than the profitability of domestically oriented firms.

Table 2.4. Estimations of ϕ_{1j} for the period 1995-2007

Firm's Name	ϕ_{1j}	Z	Sector
AKSA	0.60**	4.32	Chemicals and Chemical Products
AYGAZ	0.06	0.76	Chemicals and Chemical Products
BAGFS	0.71**	2.77	Chemicals and Chemical Products
BRISA	0.38**	2.65	Chemicals and Chemical Products
DYBYO	0.03	0.20	Chemicals and Chemical Products
ECILC	-0.07	-0.87	Chemicals and Chemical Products
EGGUB	-0.05	-0.25	Chemicals and Chemical Products
GOODY	0.26	0.26	Chemicals and Chemical Products
GUBRF	0.64**	2.92	Chemicals and Chemical Products
HEKTS	0.07	0.38	Chemicals and Chemical Products
PETKM	0.34	1.16	Chemicals and Chemical Products
PIMAS	-0.25	-0.79	Chemicals and Chemical Products
PTOFS	0.03	0.66	Chemicals and Chemical Products
TUPRS	0.17	1.16	Chemicals and Chemical Products
BANVT	-0.10	-0.33	Food Products and Beverages
KENT	0.65	0.65	Food Products and Beverages
KRVT	-0.45*	2.04	Food Products and Beverages
PINSU	-0.08	-0.44	Food Products and Beverages
PNSUT	0.10	1.11	Food Products and Beverages
TATKS	-0.04	-0.31	Food Products and Beverages
TBORG	-0.99**	3.59	Food Products and Beverages
TUKAS	0.24	0.99	Food Products and Beverages
BRSAN	0.25	1.31	Manufacture of Basic Metals
CELHA	0.61**	3.54	Manufacture of Basic Metals
CEMTS	0.01	0.03	Manufacture of Basic Metals
EREGL	0.43	1.39	Manufacture of Basic Metals
IZMDC	0.34	1.49	Manufacture of Basic Metals
SARKY	0.37**	2.44	Manufacture of Basic Metals
ALKAR	0.05	0.69	Fabricated Metal Products[12]
ARCLK	0.10	1.11	Fabricated Metal Products
BFREN	-0.10	-0.44	Fabricated Metal Products
EGEEN	0.49**	2.86	Fabricated Metal Products
FMIZP	0.19	1.00	Fabricated Metal Products
FROTO	-0.13	-0.56	Fabricated Metal Products
MUTLU	-0.03	-0.21	Fabricated Metal Products
PARSN	0.51*	2.25	Fabricated Metal Products
PRKAB	0.41*	1.92	Fabricated Metal Products
TOASO	0.12	0.86	Fabricated Metal Products
TUDDF	0.15	0.83	Fabricated Metal Products
VESTL	0.38	1.14	Fabricated Metal Products
DURDO	-0.21	-0.21	Paper and Paper Products
HURGZ	0.17	1.01	Paper and Paper Products
KARTN	0.33*	2.09	Paper and Paper Products
TIRE	-0.07	-0.45	Paper and Paper Products
AKALT	0.58**	2.84	Textiles
AKIPD	0.59**	2.65	Textiles
ALTIN	0.37*	1.81	Textiles
DERIM	0.07	0.32	Textiles
KORDS	0.47**	2.59	Textiles
YUNSA	0.63**	2.33	Textiles

[12] Excluding Machinery

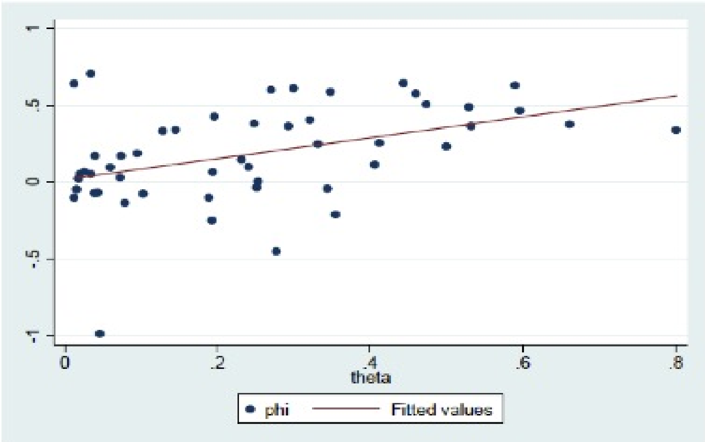
Table 2.5. Estimations of ϕ_{1j} for the period 1995-2000

Firms's Name	ϕ_{1j}	Z	Sector
AKSA	0.24	1.03	Chemicals and Chemical Products
AYGAZ	0.34	1.52	Chemicals and Chemical Products
BAGFS	0.38*	2.06	Chemicals and Chemical Products
BRISA	-0.09	-0.93	Chemicals and Chemical Products
DYBYO	0.37*	1.76	Chemicals and Chemical Products
ECILC	0.34**	2.84	Chemicals and Chemical Products
EGGUB	0.25*	1.79	Chemicals and Chemical Products
GOODY	0.54*	1.80	Chemicals and Chemical Products
GUBRF	-0.40	-0.79	Chemicals and Chemical Products
HEKTS	-0.06	-0.25	Chemicals and Chemical Products
PETKM	0.20	1.23	Chemicals and Chemical Products
PIMAS	-0.08	-0.59	Chemicals and Chemical Products
PTOFS	0.52**	4.01	Chemicals and Chemical Products
TUPRS	-0.52	-1.08	Chemicals and Chemical Products
BANVT	-0.19	-0.68	Food Products and Beverages
KENT	-1.78**	5.05	Food Products and Beverages
KRVT	0.13	0.53	Food Products and Beverages
PINSU	0.04	0.47	Food Products and Beverages
PNSUT	0.15	0.60	Food Products and Beverages
TATKS	-0.17	-1.10	Food Products and Beverages
TBORG	-0.51	-1.54	Food Products and Beverages
TUKAS	0.00	0.01	Food Products and Beverages
BRSAN	0.20	1.21	Manufacture of Basic Metals
CELHA	0.13	0.44	Basic Metals
CEMTS	0.51**	4.64	Basic Metals
EREGL	-0.37	-1.58	Basic Metals
IZMDC	0.62**	2.96	Basic Metals
SARKY	0.12	0.77	Basic Metals
ALKAR	0.14	0.47	Fabricated Metal Products
ARCLK	0.377	-1.00	Fabricated Metal Products
BFREN	-0.29	-0.91	Fabricated Metal Products
EGEEN	0.01	0.06	Fabricated Metal Products
FMIZP	0.13	0.59	Fabricated Metal Products
FROTO	0.33	1.24	Fabricated Metal Products
MUTLU	-0.63**	2.59	Fabricated Metal Products
PARSN	-0.55	-1.32	Fabricated Metal Products
PRKAB	-0.34	-1.38	Fabricated Metal Products
TOASO	0.15	1.01	Fabricated Metal Products
TUDDF	0.29*	1.80	Fabricated Metal Products
VESTL	-0.02	-0.26	Fabricated Metal Products
DURDO	0.39**	2.33	Paper and Paper Products
HURGZ	-0.26	-1.45	Paper and Paper Products
KARTN	-1.26**	3.96	Paper and Paper Products
TIRE	-0.46*	1.87	Paper and Paper Products
AKALT	0.11	0.67	Textiles
AKIPD	0.20	0.99	Textiles
ALTIN	-0.07	-0.33	Textiles
DERIM	-0.12	-0.46	Textiles
KORDS	0.27	1.15	Textiles
YUNSA	0.11	0.55	Textiles

Table 2.6. Estimations of ϕ_{1j} for the period 2002-2007

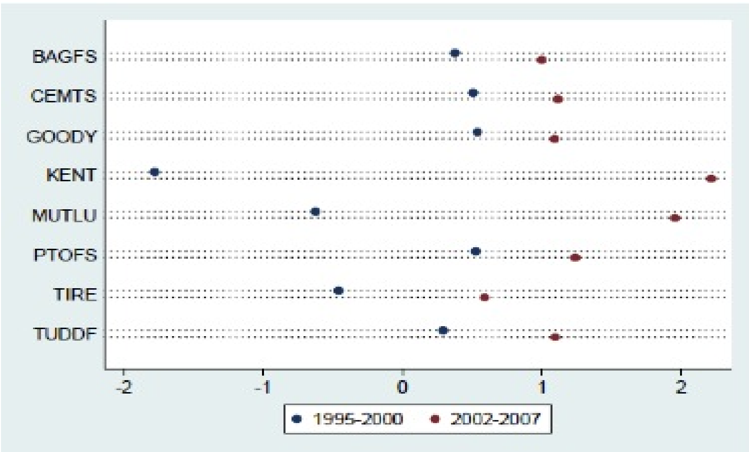
Firm's Name	ϕ_{1j}	Z	Sector
AKSA	1.03*	1.87	Chemicals and Chemical Products
AYGAZ	1.44*	2.08	Chemicals and Chemical Products
BAGFS	1.00**	3.12	Chemicals and Chemical Products
BRISA	0.10	0.8	Chemicals and Chemical Products
DYBYO	0.91	1.51	Chemicals and Chemical Products
ECILC	-0.15	-0.99	Chemicals and Chemical Products
EGGUB	0.08	0.84	Chemicals and Chemical Products
GOODY	1.09*	2.09	Chemicals and Chemical Products
GUBRF	0.44	0.7	Chemicals and Chemical Products
HEKTS	0.23	0.34	Chemicals and Chemical Products
PETKM	0.69	1.5	Chemicals and Chemical Products
PIMAS	1.07*	1.79	Chemicals and Chemical Products
PTOFS	1.24**	2.64	Chemicals and Chemical Products
TUPRS	1.28**	5.09	Chemicals and Chemical Products
BANVT	0.73**	2.97	Food Products and Beverages
KENT	2.22**	2.75	Food Products and Beverages
KRVT	-0.59*	1.75	Food Products and Beverages
PINSU	-0.42*	1.80	Food Products and Beverages
PNSUT	0.76*	2.09	Food Products and Beverages
TATKS	0.32**	8.11	Food Products and Beverages
TBORG	2.77**	4.33	Food Products and Beverages
TUKAS	-0.01	-0.06	Food Products and Beverages
BRSAN	1.06*	2.27	Manufacture of Basic Metals
CELHA	0.37	-1.19	Manufacture of Basic Metals
CEMTS	1.12*	2.02	Manufacture of Basic Metals
EREGL	0.46**	7.40	Manufacture of Basic Metals
IZMDC	0.20	0.43	Manufacture of Basic Metals
SARKY	1.25*	1.66	Manufacture of Basic Metals
ALKAR	0.66**	3.10	Fabricated Metal Products
ARCLK	1.66**	3.76	Fabricated Metal Products
BFREN	-1.29**	4.43	Fabricated Metal Products
EGEEN	1.46**	3.69	Fabricated Metal Products
FMIZP	-0.34*	2.03	Fabricated Metal Products
FROTO	1.29*	2.10	Fabricated Metal Products
MUTLU	1.96**	3.16	Fabricated Metal Products
PARSN	0.30	0.65	Fabricated Metal Products
PRKAB	-0.08	-0.29	Fabricated Metal Products
TOASO	-0.14	-0.69	Fabricated Metal Products
TUDDF	1.10*	1.66	Fabricated Metal Products
VESTL	0.02	0.42	Fabricated Metal Products
DURDO	0.55	1.51	Paper and Paper Products
HURGZ	0.10	0.34	Paper and Paper Products
KARTN	-0.55	-0.75	Paper and Paper Products
TIRE	0.59*	1.90	Paper and Paper Products
AKALT	0.42	1.27	Textiles
AKIPD	0.70*	2.16	Textiles
ALTIN	0.94*	2.05	Textiles
DERIM	0.79**	3.61	Textiles
KORDS	1.21	1.38	Textiles
YUNSA	1.94*	2.11	Textiles

Figure 2.1: The relationship between ϕ_{1j} and θ



ϕ_{1j} represents the change in the gross margin percentage of a firm as a result of 1 percent change in the exchange rate. θ is the share of exports in total sales.

Figure 2.2: Comparison of ϕ_{1j} during 1995-2000 and 2002-2007



ϕ_{1j} represents the change in the gross margin percentage of a firm as a result of 1 percent change in the exchange rate. θ is the share of exports in total sales.

Appendix I: 14-Country Trade Weighted Foreign Expenditure Index	
Country	Trade Weight (%)
Germany	24.87
USA	11.48
United Kingdom	11.20
Italy	10.43
France	8.66
Russia	6.26
Iraq	5.09
Spain	4.87
Netherlands	4.79
Belgium	6.34
UAE	3.17
Romania	3.05
Israel	3.00
Greece	2.54
TOTAL	100.00

The table displays the major export trade partners and their corresponding trade weights. Expenditure index is equal to the trade weighted average of the real GDP's of the given countries. Trade weights are based upon average bilateral trade flows for the period 1995-2007.

[13] Source: Kıymaz (2003)

Appendix 2. Share of Imported Inputs in Total Production Cost(γ) [13]

Sector	γ
Food Products and Beverages	0.11
Textiles	0.32
Paper and Paper Products	0.21
Chemicals and Chemical Products	0.38
Manufacture of Basic Metals	0.40

Appendix 3. List of Firms

Firm Name	Stock Name	Sector
BANVIT	BANVT	Food Products and Beverages
KENT GIDA	KENT	Food Products and Beverages
KEREVITAS GIDA	KRVT	Food Products and Beverages
PINAR SU	PINSU	Food Products and Beverages
PINAR SUT	PNSUT	Food Products and Beverages
TAT KONSERVE	TATKS	Food Products and Beverages
T.TBORG	TBORG	Food Products and Beverages
TUKAS	TUKAS	Food Products and Beverages
AKAL TEKSTIL	AKALT	Textiles
AKSU IPLIK	AKIPD	Textiles
ALTINYILDIZ	ALTIN	Textiles
DERIMOD	DERIM	Textiles
KORDSA	KORDS	Textiles
YUNSA	YUNSA	Textiles
DURAN DOGAN BASIM	DURDO	Paper and paper products
HURRIYET GAZETECILIK	HURGZ	Paper and paper products
KARTONSAN	KARTN	Paper and paper products
TIRE KUTSAN	TIRE	Paper and paper products
AKSA	AKSA	Chemicals and chemical products
AYGAZ	AYGAZ	Chemicals and chemical products
BAGFAS	BAGFS	Chemicals and chemical products
BRISA	BRISA	Chemicals and chemical products
DYO BOYA	DYBYO	Chemicals and chemical products
ECZACIBASI ILAC	ECILC	Chemicals and chemical products
EGE GUBRE	EGGUB	Chemicals and chemical products
GOOD-YEAR	GOODY	Chemicals and chemical products
GUBRE FABRIKALARI	GUBRF	Chemicals and chemical products
HEKTAS	HEKTS	Chemicals and chemical products
PETKIM	PETKM	Chemicals and chemical products
PIMAS	PIMAS	Chemicals and chemical products
PETROL OFISI	PTOFS	Chemicals and chemical products
TUPRAS	TUPRS	Chemicals and chemical products
BORUSAN MANNESMANN	BRSAN	Manufacture of basic metals
CELIK HALAT	CELHA	Manufacture of basic metals
CEMTAS	CEMTS	Manufacture of basic metals
EREGLI DEMIR CELIK	EREGL	Manufacture of basic metals
IZMIR DEMIR CELIK	IZMDC	Manufacture of basic metals
SARKUYSAN	SARKY	Manufacture of basic metals
ALARKO CARRIER	ALKAR	Manufacture of fabricated metal products[14]
ARCELIK	ARCLK	Manufacture of fabricated metal products
BOSH FREN SISTEMLERI	BFREN	Manufacture of fabricated metal products
EGE ENDUSTRI	EGEEN	Manufacture of fabricated metal products
F-M IZMIT PISTON	FMIZP	Manufacture of fabricated metal products
FORD OTOSAN	FROTO	Manufacture of fabricated metal products
MUTLU AKU	MUTLU	Manufacture of fabricated metal products
PARSAN	PARSN	Manufacture of fabricated metal products
TURK PRYSMIAN KABLO	PRKAB	Manufacture of fabricated metal products
TOFAS OTO FABRIKASI	TOASO	Manufacture of fabricated metal products
T. DEMIR DOKUM	TUDDF	Manufacture of fabricated metal products
VESTEL BEYAZ ESYA	VESTL	Manufacture of fabricated metal products

[14] Excluding Machinery

Appendix 4. $\text{cov}(V_j, V_{ISE100})/\text{var}(V_{ISE100})$

Firm's Name	Beta
AKALT	1.036
AKIPD	1.145
AKSA	0.815
ALCAR	0.757
ALTIN	1.274
ARCLK	0.797
AYGAZ	1.194
BAGFS	0.978
BANVT	0.576
BFREN	0.727
BRISA	0.984
BRSAN	0.882
CELHA	0.894
CEMTS	0.762
DERIM	0.399
DURDO	0.816
DYBYO	0.952
ECILC	1.165
EGEEN	0.817
EGGUB	0.711
EREGL	0.804
FMIZP	0.659
FROTO	1.119
GOODY	1.066
GUBRF	1.006
HEKTS	1.744
HURGZ	0.88
IZMDC	1.095
KARTN	0.700
KENT	0.531
KERVT	0.916
KORDS	1.074
MUTLU	1.343
PARSN	0.867
PETKM	1.307
PIMAS	1.079
PINSU	0.601
PNSUT	1.235
PRKAB	1.039
PTOFS	0.720
SARKY	0.685
TATKS	1.089
TBORG	0.603
TIRE	0.652
TOASO	1.063
TUDDF	1.447
TUKAS	0.744
TUPRS	0.785
VESTL	0.864
VKING	0.653
YUNSA	1.014

Chapter 3

A Model with Heterogenous Firms

3.1 Introduction

The recent interest in longitudinal firm-level data from several countries has provided new empirical evidence that there are large productivity differences among firms in a given industry. This evidence has motivated the development of new trade models, such as Melitz (2003), in which cross-firm heterogeneity in productivity is a central assumption. In this framework, individual firms are subject to significant barriers to engaging in export activity, so that only firms with productivity above a certain threshold are able to export. In this chapter, a two-country model of international trade with heterogeneous firms is introduced. Using a Newton algorithm I provide a numerical solution to the model and show the impact of exchange rates and model parameters, such as iceberg transportation costs[1] and

[1] A formulation of transport cost in which part of the good to be delivered melts along the way during the act of transportation (Samuelson, 1954).

domestic and foreign cost indices, on the productivity thresholds for exporting and domestic production. I further incorporate liquidity constraints into the model in the sprit of Chaney (2005) and Manova (2010), and investigate the impact of liquidity constraints on the productivity thresholds for exporting and domestic production. Finally, I examine the impact of real exchange rate appreciation on the productivity thresholds in the presence of liquidity constraints.

3.2 Literature Review

The recent empirical literature involving firm level data has found that exchange rate variations have important implications for a firm's survival. For example, Baggs et al. (2008 and 2009) investigate the impact of changes in real exchange rate on the survival of firms in the manufacturing and service sectors in Canada. They document that firms' survival is negatively associated with appreciations in the Canadian dollar. They find that the impact on survival is less pronounced for more productive firms. From a theoretical perspective, Baggs et al. (2008 and 2009) is motivated by Fung's (2008) predictions about the survival patterns of firms with exchange rate movements. Fung (2008) is based on Krugman's monopolistic competition model with the inclusion of a exchange rate variable. According to Fung (2008), the effect of changes in the exchange rate on firm survival operates through the labor market. Since labor is the only factor of production in Fung's (2008) model, an appreciation of the domestic currency (implying higher wages compared to the rest of the world) increases the competition faced by domestic firms in both domestic and export markets. As a result, in order to stay competitive, firms reduce the price they charge and lower their mark-up. Consequently, firms that are not able to tolerate the reduction in their mark-up exit the market.

Thus, domestic currency appreciation results in a reduction in the number of firms in the home country. Since this model is based on the assumption that firms are equally productive, it is not able to capture productivity differences among firms.

The exchange rate and productivity link has also been pointed out in Berman et al. (2009). Based on a model with local distribution costs with firm heterogeneity, Berman et al. (2009) show that a real depreciation reduces threshold productivity, defined as the minimum productivity level at which firms earn positive profits, leads to firm entry, and therefore has a positive impact on the extensive margin.[2] Berman et al. (2009) find that a 10% depreciation increases the probability that a firm will export by 2.1%, the entry probability by 1.9%, and the probability of remaining an exporter (i.e., reduces the exit rate) by 2.3%.[3]

The relationship between liquidity constraints and exporting activity, on the other hand, has been studied extensively (Stiglitz and Weiss, 1981; Fazzari et al., 1988; Gertler and Gilchrist, 1994). However, only a few studies, such as Chaney (2005) and Manova (2010), examine this relationship in a model of international trade with heterogeneous firms. Chaney (2005) incorporates liquidity constraints into the Melitz (2003) model. In this framework, only firms above a certain liquidity threshold are able to export because they can finance entry costs associated with exporting. Manova (2010), on the other hand, provides a more detailed model that incorporates sectoral variation in external finance dependence and asset tangibility. Using a detailed dataset covering 161 countries and 27 manufacturing sectors, she shows that financially developed countries are more likely to export bilaterally.

The model introduced in this chapter provides a theoretical framework to cap-

[2]The extensive margin of trade refers to the number of firms engaging in export activity.

[3]Entry probability is calculated based on probit, linear probability model (LPM) and a logit estimation with firm destination fixed effects.

ture the responses to changes in exchange rates of the productivity thresholds for exporting and for domestic production. Based on a two-country model of an open market economy, I provide numerical solutions for the trajectory of the productivity thresholds in response to variations in exchange rates. Another contribution of the paper is to show numerically that, in the presence of a liquidity constraint, the productivity thresholds increase. The model introduced in this chapter differs from Chaney (2005) in that it is applicable to an open market economy. In Chaney (2005), prices set by foreign exporters have a negligible impact on the general price index domestically; therefore they are not involved in the country's price index.

3.3 Demand

There are two countries: the home country and rest of the world. Consumers in each country maximize utility derived from the consumption of goods from $x+1$ sectors. Sector 0 provides a single homogenous good. The other x sectors are made up of a continuum of differentiated goods. If a consumer consumes q_0 units of good 0, and $q(x)$ units of each variety x of a differentiated good, for all varieties in the set X, she gets a utility U,

$$U = {q_0}^{1-\mu} \left[\int_{x \varepsilon X} q(x)^{(\frac{\sigma-1}{\sigma})} dx \right]^{\mu(\frac{\sigma}{1-\sigma})} \tag{3.1}$$

where σ ($\sigma > 1$) is the elasticity of substitution between two varieties of the differentiated good. Given this utility function, if income spent on all goods in the home country is Y, the demand for variety x at home is given as:

$$q(x) = \frac{p(x)^{-\sigma} \mu Y}{P^{1-\sigma}} \tag{3.2}$$

where

$$P = \left(\int_{x \varepsilon X} p(x)^{1-\sigma} d(x) \right)^{\frac{1}{1-\sigma}} \tag{3.3}$$

is the ideal price index of the differentiated goods in the home country.

3.4 Production

There are $x+1$ sectors. Differentiated goods are produced by a continuum of firms in the home and foreign country each producing a different variety x. As mentioned, sector 0 produces the homogenous good which can be freely traded. It is used as a numeraire and with a price of 1. The unit labor requirement for producing the homogenous good at home is $1/w$ and $1/w^*$ in the rest of the world. Since the home country and rest of the world produce this homogenous good, wages are equal to w and w^* at home and rest of the world, respectively. Labor is the only factor of production. The home country has a population L, and rest of the world has a population L^*.

For a firm located in the home country with a productivity level x the cost of producing q_d and q_f units of output for foreign and domestic markets are respectively given by:

$$c_d(q_d) = q_d \frac{w}{x} + wC_d \tag{3.4}$$

$$c_f(q_f) = q_f \frac{\tau w}{x} + w^* C_f \tag{3.5}$$

Equation 3.4 and 3.5 imply that, for a firm located in the home country, the requirement for producing q_d units of output for domestic market, and exporting q_f units of output, is a linear function of output. C_f represents fixed cost associated with exporting from home to the rest of world, and C_d is the fixed entry cost required in order to start production for the domestic market. Each firm has an associated productivity parameter x assumed to be randomly drawn from a pareto distribution with cumulative density function $F(x)$. In most the literature on trade, such as Melitz (2003) and Chaney (2005), the Fréchet or Pareto-like distributions are assumed as a reflection of an underlying productivity distribution. Additionally, there exists a variable iceberg transportation cost such that $\tau > 1$ units of product needs to be shipped for 1 unit to arrive. The profit maximization problem of a producer in home country is:

$$max\Pi_d = p_d(x)q_d(x) - \frac{q_d(x)w}{x} - wC_d \tag{3.6}$$

$$max\Pi_f = p_f(x)q_f(x) - \frac{q_f(x)\tau w}{x} - w^*C_f \tag{3.7}$$

subject to

$$q_d = \frac{{p_d}^{-\sigma}\mu Y}{P^{1-\sigma}} \tag{3.8}$$

$$q_f = \frac{{p_f}^{-\sigma}\mu Y^*}{{P^*}^{1-\sigma}} \tag{3.9}$$

The firms' maximization problem implies that the optimal price for domestic and export market is a constant mark-up over the marginal cost.

$$p_d = \frac{\sigma}{\sigma - 1}\frac{w}{x} \tag{3.10}$$

$$p_f = \frac{\sigma}{\sigma - 1}\frac{w\tau}{x} \tag{3.11}$$

3.5 Open Economy Equilibrium:

We assume that price indices in the rest of the world and in the home country depend both on the prices set by local firms and foreign firms selling in the domestic market. Similar to Chaney (2008), we assume that the total mass of potential entrants at home and the rest of the world is proportional to population, implying that the larger the country, the more entrants are expected to enter the market. Accordingly, we can define the aggregate price index in the home country and rest of the world as follows:

$$P = \left(L \int_{x>x_d} p_d(x)^{1-\sigma} dF_x(x) + L^* \int_{x>x_f} p_f(x)^{1-\sigma} dF_x(x) \right)^{\frac{1}{1-\sigma}} \tag{3.12}$$

$$P^* = \left(L^* \int_{x>x_d} p_d(x)^{1-\sigma} dF_x(x) + L \int_{x>x_f} p_f(x)^{1-\sigma} dF_x(x) \right)^{\frac{1}{1-\sigma}} \tag{3.13}$$

It is assumed that firms productivity shocks are drawn from a Pareto distribution with shape parameter γ and both home producers and those in the rest of the world haves the same distribution over $[1,\infty]$ according to

$$P(x < X) = F(x) = 1 - x^{-\gamma} \tag{3.14}$$

This assumption makes it possible to express price indices in Eq. 3.12 and 3.13 in the following form:

$$P^{*1-\sigma} = k(L^* w^{*1-\sigma} {x_d}^{\sigma-\gamma-1} + L w^{1-\sigma} \tau^{1-\sigma} x_f^{\sigma-\gamma-1}) \tag{3.15}$$

$$P^{1-\sigma} = k(L w^{1-\sigma} {x_d}^{\sigma-\gamma-1} + L^* w^{*1-\sigma} \tau^{1-\sigma} {x_f}^{\sigma-\gamma-1}) \tag{3.16}$$

where

$$k = (\frac{\sigma}{\sigma - 1})^{\frac{\sigma}{\sigma-1}}(\frac{\gamma}{1 - \sigma - \gamma}) \tag{3.17}$$

Domestic and exporting productivity thresholds are defined by:

$$\pi_d = 0 : \frac{\mu}{\sigma} wL \left(\frac{\sigma}{\sigma - 1} w \right)^{1-\sigma} \overline{x_d}^{\sigma-1} P^{\sigma-1} = wC_d \tag{3.18}$$

$$\pi_f = 0 : \frac{\mu}{\sigma} w^* L^* \left(\frac{\sigma}{\sigma - 1} w \right)^{1-\sigma} \tau^{1-\sigma} \overline{x_f}^{\sigma-1} P^{*\sigma-1} = w^* C_f \tag{3.19}$$

Eq. 3.18 and Eq. 3.19 imply that in order to export profitably the firm must have a productivity level above this threshold, $\overline{x_f}$; and to produce domestically the productivity cutoff should be above $\overline{x_d}$.

3.6 Financial Constraints

As in Manova (2010), it is assumed that firms can finance their variable costs internally; however, they need to borrow outside capital, $F(a)$, for a fraction d_s, $0 < d_s < 1$, of the fixed export cost, $d_s w^* C_f$, in order to export to the rest of the world. To get outside finance, firms use their tangible assets as collateral. It is assumed that a fraction t_s, $0 < t_s < 1$, of the sunk cost that a firm pays goes to fund investments in collateralizable assets such as plant property and equipment. Repayment of loans to creditors is given by an exogenous probability, λ_j, which is determined by the strength of the financial institutions located in the rest of the world that provide finance to firms in the home country. In case of default, with probability $(1 - \lambda_j)$, the creditor claims the collateral $t_s w^* C_e$. The profit maximization problem of an exporter in the home country becomes:

$$max\Pi(x) = p_f(x)q_f(x) - q_f(x)\frac{\tau w}{x} - w^*C_f + d_s w^*C_f - \lambda_j F(a) - (1-\lambda_j)\, t_s w^* C_e \tag{3.20}$$

subject to

$$(1) q_f = \frac{{p_f}^{-\sigma}\mu Y^*}{{P^*}^{1-\sigma}} \tag{3.21}$$

$$(2) A(x) = p_f(x)q_f(x) - q_f(x)\frac{\tau w}{x} - (1-d_s)w^*C_f \geq F(a) \tag{3.22}$$

$$(3) B(x) = -d_s w^* C_f + \lambda_j F(a) + (1-\lambda_j) t_s w^* C_e \geq 0 \tag{3.23}$$

Given competitive the credit markets, the third condition is equal to 0 in equilibrium. The maximization problem reduces to the following equation, given that $A(x) = 0$ and $B(x) = 0$ are satisfied.

$$max\Pi\acute{(}x) = p_f(x)q_f(x) - q_f(x)\frac{\tau w}{x} - (1-d_s)w^*C_f - F(a) \tag{3.24}$$

where

$$F(a) = \frac{d_s w^* C_f - (1-\lambda_j) t_s w^* C_e}{\lambda_j} \tag{3.25}$$

The productivity thresholds for export and domestic production are respectively, $\pi_f = 0$ and $\pi_d = 0$.

3.7 Numerical Solution

The closed form solution for productivity threshold for exporting, $\overline{x_f}$, and the domestic market, $\overline{x_d}$, defined by nonlinear equations presented in equations 3.18 and 3.19 is not available. In this section, we parameterize the profit functions defined in equations 3.18 and 3.19 and solve them numerically. Our solution to this problem involves implementation of the Newton algorithm after replacing structural parameters $(\mu, \sigma, w, w^*, \gamma, C_d, C_f, L, L^*)$ with the numerical values. The Newton method involves a simple iteration. Suppose that our current guess for threshold productivity level is x_k. For $\pi(x_k)$ we construct a numerical approximation such that:

$$\pi(x_{k+1}) = \pi(x_k)'(x_{k+1} - x_k) + \pi(x_k) \tag{3.26}$$

$\pi(x_{k+1}) = 0$ implies that:

$$x_{k+1} = x_k - \frac{\pi(x_k)'}{\pi(x_k)} \tag{3.27}$$

Convergence is achieved when $x_{k+1} - x_k < \delta$, where δ determines the tightness of the convergence and is set to be equal to 0.001. The numerical value for the elasticity of substitution between two products, σ, is set to 3.8 following the plant-level empirical analysis of Bernard et al. (2003). In addition, we directly assume that population for the home country, L, and rest of the world, L^*, are equal to 1 and 100 respectively. Income spent on homogenous goods, μ, is 0.5, implying that consumer spending is equally distributed over homogenous and differentiated goods. The fixed cost of entry into the export market, C_f, is equal to 2, following Bernard et al. (2007), and fixed costs for producing in the domestic market, C_d, is set equal to 1. The Pareto shape parameter, γ, is 5 following Balistreri et al. (2011), and the iceberg transportation cost, τ, is equal to 1.5. We also assume that the wage rate in the home country, w, and the rest of the world, w^*, are equal to 1 and 2, respectively.

3.7.1 Productivity Thresholds: Comparative Statics

In this section, I first solve the model without incorporating liquidity constraints.[4] Figures 3.1 and 3.2 show the responses of the productivity thresholds to the changes in model's parameters. Other things being equal, the iceberg transportation cost, τ, is positively associated with the productivity threshold for exporting, $\overline{x_f}$, and negatively associated with the productivity threshold for domestic production, $\overline{x_d}$. As a result of an increase in τ, only more productive firms can cover the cost of exporting, which results in a higher productivity threshold for exporting. On the other hand, a higher τ, decreases competition in the domestic market because fewer firms are able to import to the home country. As competition in the domestic market decreases, the productivity threshold for domestic production also decreases.

When the elasticity of substitution, σ, increases, the productivity thresholds for both domestic and export market rise. The more competitive the industry (the higher σ), the higher are the productivity thresholds for exporting. The productivity threshold for exporting, $\overline{x_f}$, is positively associated with C_f, the fixed cost of export. As a result of an increased fixed cost of entry into export markets, only more productive firms export. Similarly, an increase in the fixed cost of production in the domestic market, C_d, raises the productivity threshold for domestic market, $\overline{x_d}$.

I further investigate the trajectories of the productivity threshold for exporting, $\overline{x_f}$, resulting from changes in the level of financial constraints. The numerical solution, as depicted in Figure 3.3, shows that the productivity cut-off for export-

[4] Accordingly, the fraction of the sunk cost that firms pay to enter an industry going towards collateralizable assets, t_s, and the fraction of fixed export costs that needs to be financed externally are assumed to be equal to 0, while the probability of repaying the loan, λ, is assumed to be equal to 1.

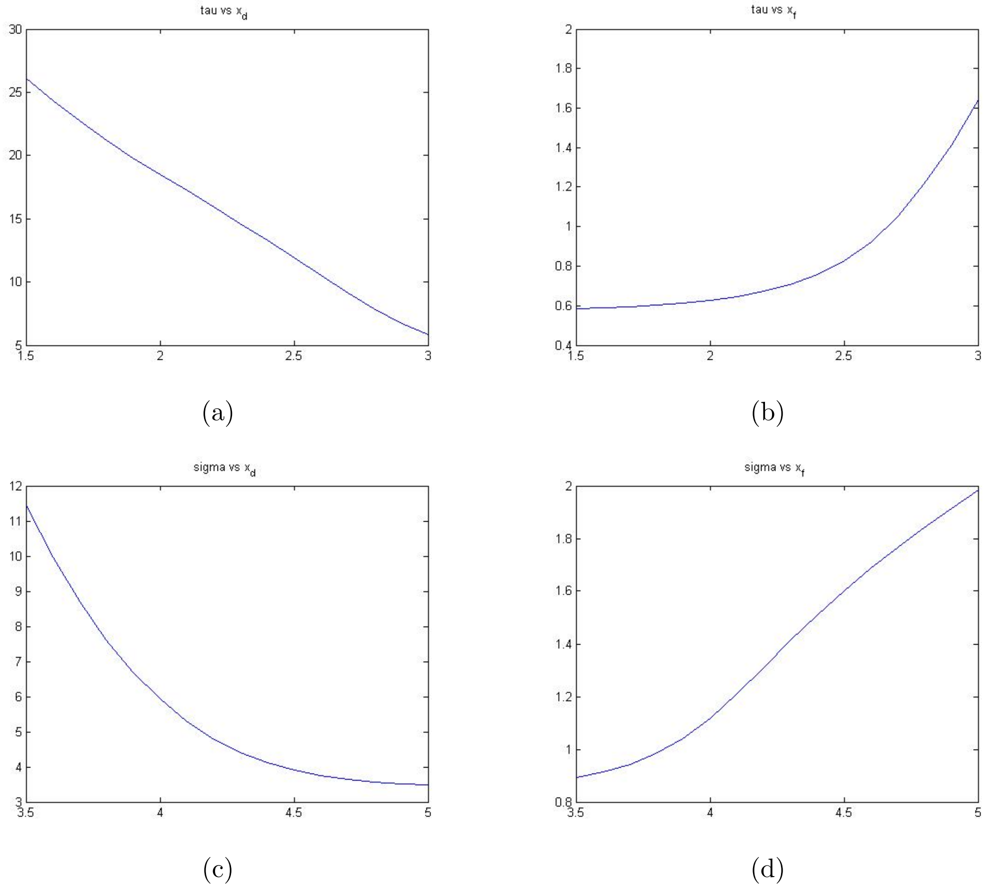


Figure 3.1: Threshold Productivity Levels vs. Parameters -I

ing, x_f, is positively associated with the need for external finance (higher d_s. For firms with fewer tangible assets (lower t_s), productivity threshold increase. Additionally, higher λ, implying a higher probability of repaying the loan, is associated with a lower productivity threshold for exporting, x_f..

3.7.2 Exchange Rates

In this section, I examine the impact of real exchange rate appreciation on the productivity thresholds. I define an appreciation of the domestic currency as an increase in the relative wage rate between home and rest of the world as in Chaney

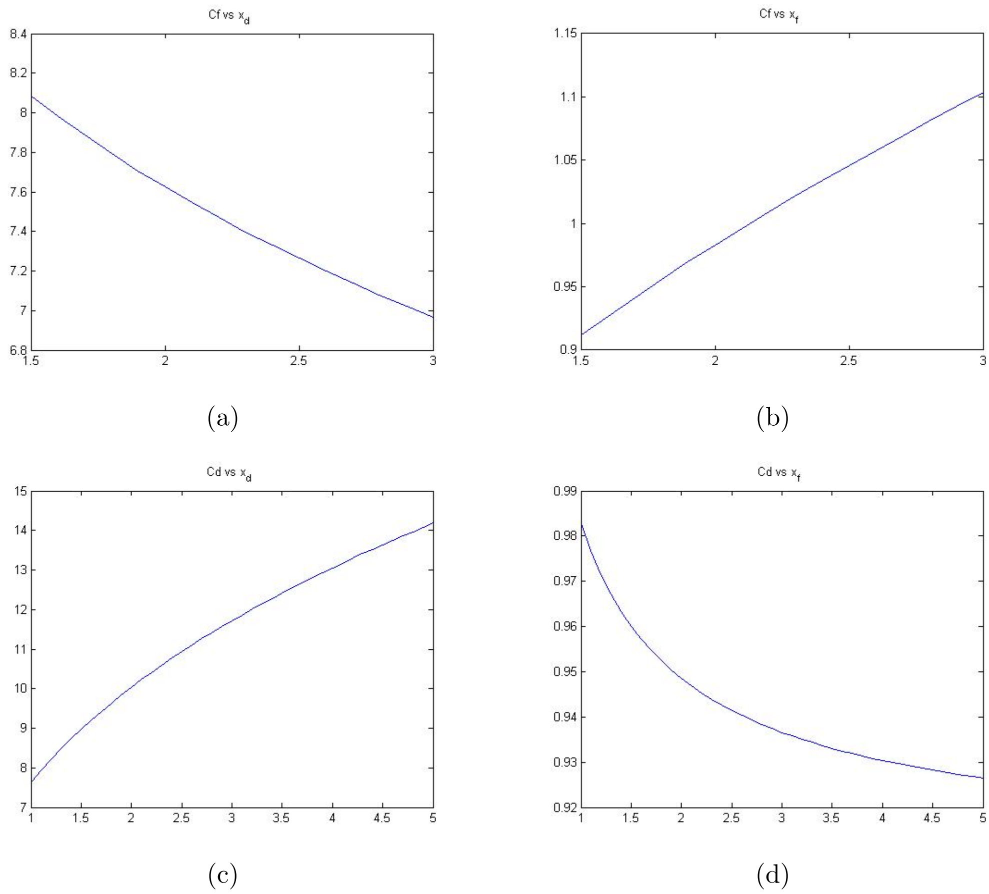
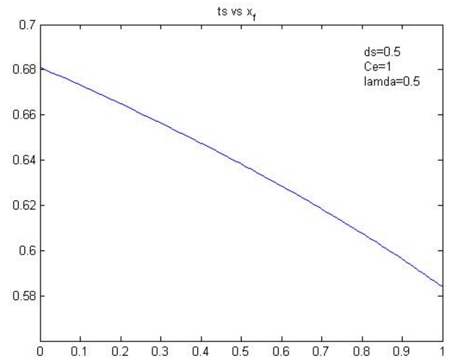
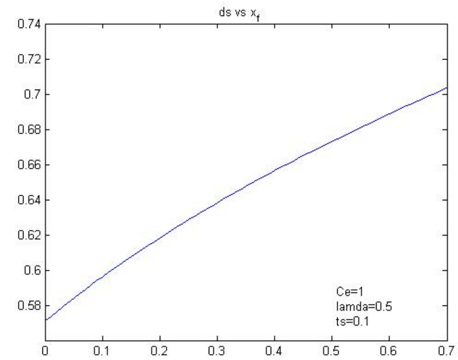


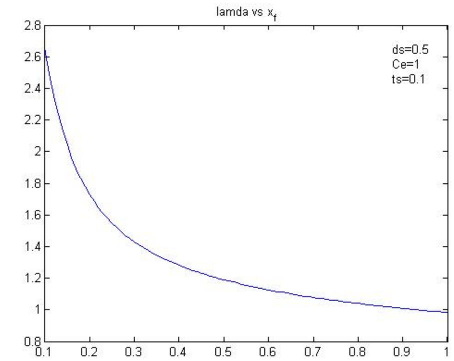
Figure 3.2: Threshold Productivity Levels vs. Parameters - II



(a)



(b)



(c)

Figure 3.3: Threshold Productivity Levels vs. Liquidity Constraints

(2005). More formally, the real exchange rate, rer, between the home country and rest of the world is defined as:

$$rer = \frac{w^*}{w} \tag{3.28}$$

Firstly, I will investigate the impact of real exchange rate appreciation on the productivity thresholds without incorporating liquidity constraints into the model. An appreciation of the real exchange rate increases the productivity thresholds for both exporting and the domestic production (Panel a and b of Figure 3.4). In this framework, firm exit is explained by the inability of the less productive firms to cover increased labor costs resulting from domestic currency appreciation. Likewise, the domestic productivity threshold increases because of intensified import competition in the domestic market.

Secondly, I analyze the impact of exchange rate appreciation in the presence of financial constraints. Similar to the previous findings, the productivity threshold for exporting and for domestic production increases, as shown in Panel c and d of Figure 3.4.

3.8 Conclusion

In this chapter, I develop a two-country model of international trade in the presence of financial constraints, built on Melitz (2003) model, where plant level heterogeneity is the key assumption. In this framework I analyze the impact of currency appreciation on productivity thresholds using a Newton Algorithm. The numerical simulation suggests that exchange rate appreciation increases productivity thresholds for both exporting and domestic production. In addition, I incorporate liquidity constraints in line with Chaney (2005) and Manova (2010) and numeri-

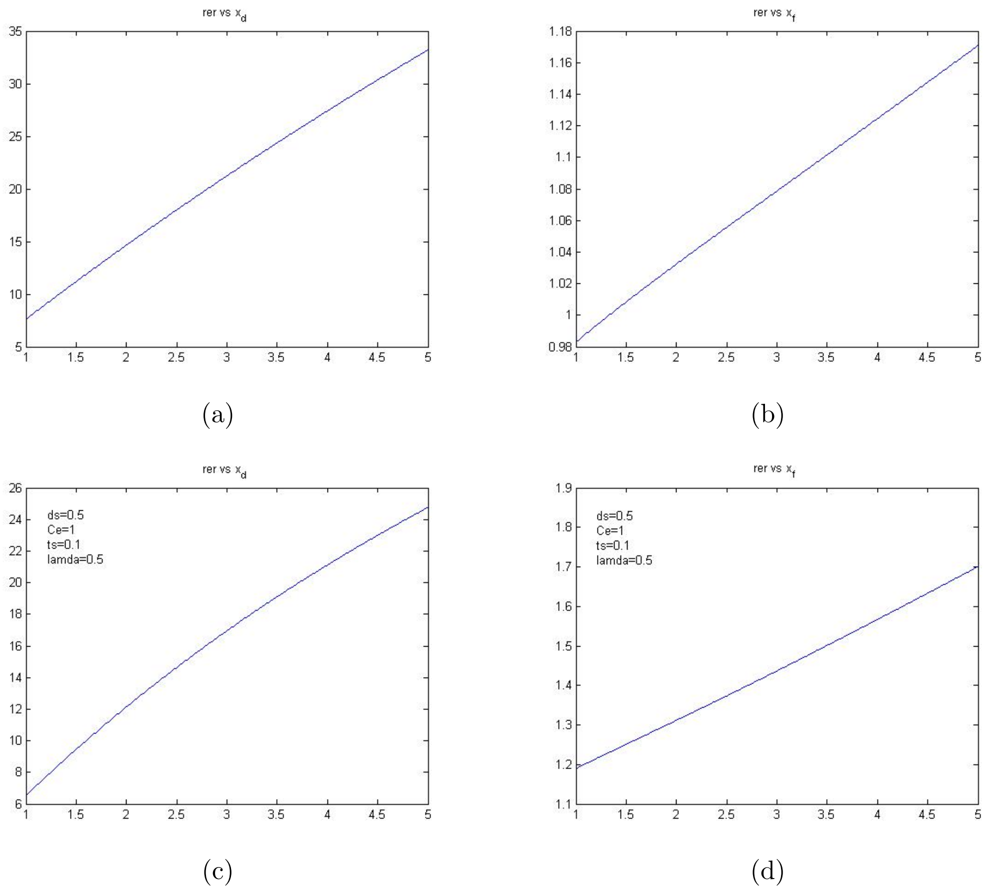


Figure 3.4: Threshold Productivity Levels vs. Exchange Rates

cally show that, in the presence of liquidity constraints, the productivity threshold for exporting increases. The results provide a theoretical framework that is consistent with recent empirical findings, such as Fung (2008), on firm survival patters in the context of exchange rate variation.

Appendix I - Derivation of Domestic and Foreign Price Indices

$$P = \left(\int_{x>x_d} p_d(x)^{1-\sigma} L dF_x(x) + \int_{x>x_f} p_f(x)^{1-\sigma} L^* dF_x(x) \right)^{\frac{1}{1-\sigma}} \tag{3.29}$$

$$P^{1-\sigma} = \left(\int_{x>x_d} p_d(x)^{1-\sigma} L dF_x(x) + \int_{x>x_f} p_f(x)^{1-\sigma} L^* dF_x(x) \right) \tag{3.30}$$

It is assumed that productivity shocks are drawn from a

$$P(x < X) = F(x) = 1 - x^{-\gamma} \tag{3.31}$$

$$dF(x) = \gamma x^{-\gamma-1} dx \tag{3.32}$$

$$P^{1-\sigma} = \int_{x>x_d} p_d(x)^{1-\sigma} L \gamma x^{-\gamma-1} dx + \int_{x>x_f} p_f(x)^{1-\sigma} L^* \gamma x^{-\gamma-1} dx \tag{3.33}$$

$$P^{1-\sigma} = \int_{x>x_d} \left(\frac{\sigma}{\sigma-1} \frac{w}{x} \right)^{1-\sigma} L \gamma x^{-\gamma-1} dx + \int_{x>x_f} \left(\frac{\sigma}{\sigma-1} \frac{w\tau}{x} \right)^{1-\sigma} L^* \gamma x^{-\gamma-1} dx \tag{3.34}$$

$$P^{1-\sigma} = \int_{x>x_d} \left(\frac{\sigma}{\sigma-1} \right)^{1-\sigma} w^{1-\sigma} L \gamma x^{\sigma-\gamma-2} dx + \int_{x>x_f} \left(\frac{\sigma}{\sigma-1} \right)^{1-\sigma} w^{1-\sigma} \tau^{1-\sigma} L^* \gamma x^{\sigma-\gamma-2} dx \tag{3.35}$$

$$P^{1-\sigma} = \left(\frac{\sigma}{\sigma-1} \right)^{1-\sigma} w^{1-\sigma} L \gamma \int_{x>x_d} x^{\sigma-\gamma-2} dx + \left(\frac{\sigma}{\sigma-1} \right)^{1-\sigma} w^{1-\sigma} \tau^{1-\sigma} L^* \gamma \int_{x>x_f} x^{\sigma-\gamma-2} dx \tag{3.36}$$

$$P^{1-\sigma} = \left(\frac{\sigma}{\sigma-1} \right)^{1-\sigma} w^{1-\sigma} L \gamma \left(\frac{x^{\sigma-\gamma-1}}{\sigma-\gamma-1} \right]_{x_d}^{\infty} \Bigg) + \left(\frac{\sigma}{\sigma-1} \right)^{1-\sigma} w^{1-\sigma} \tau^{1-\sigma} L^* \gamma \left(\frac{x^{\sigma-\gamma-1}}{\sigma-\gamma-1} \right]_{x_f}^{\infty} \Bigg) \tag{3.37}$$

$$P^{1-\sigma} = \left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} w^{1-\sigma} L\gamma \frac{{x_d}^{\sigma-\gamma-1}}{1-\sigma+\gamma} + \left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} w^{1-\sigma}\tau^{1-\sigma} L^*\gamma \frac{{x_f}^{\sigma-\gamma-1}}{1-\sigma+\gamma} \tag{3.38}$$

$$P^{1-\sigma} = k(Lw^{1-\sigma}{x_d}^{\sigma-\gamma-1} + L^* {w^*}^{1-\sigma}\tau^{1-\sigma}{x_f}^{\sigma-\gamma-1}) \tag{3.39}$$

where

$$k = \left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma}\left(\frac{\gamma}{1-\sigma-\gamma}\right) \tag{3.40}$$

Similarly,

$$P^{*1-\sigma} = \left(\int_{x>x_d} p_d(x)^{1-\sigma} L^* dF_x(x)\right) + \left(\int_{x>x_f} p_f(x)^{1-\sigma} L dF_x(x)\right) \tag{3.41}$$

$$P^{*1-\sigma} = \left(\int_{x>x_d} \left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} w^{1-\sigma} L^*\gamma x^{\sigma-\gamma-2} dx\right) + \left(\int_{x>x_f} \left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} w^{1-\sigma}\tau^{1-\sigma} L\gamma x^{\sigma-\gamma-2} dx\right) \tag{3.42}$$

$$P^{*1-\sigma} = \left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} w^{1-\sigma} L^*\gamma \left(\left.\frac{x^{\sigma-\gamma-1}}{\sigma-\gamma-1}\right]_{x_d}^{\infty}\right) + \left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} w^{1-\sigma}\tau^{1-\sigma} L\gamma \left(\left.\frac{x^{\sigma-\gamma-1}}{\sigma-\gamma-1}\right]_{x_f}^{\infty}\right) \tag{3.43}$$

$$P^{*1-\sigma} = \left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} w^{1-\sigma} L^*\gamma \frac{{x_d}^{\sigma-\gamma-1}}{1-\sigma+\gamma} + \left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} w^{1-\sigma}\tau^{1-\sigma} L\gamma \frac{{x_f}^{\sigma-\gamma-1}}{1-\sigma+\gamma} \tag{3.44}$$

$$P^{*1-\sigma} = k(L^* {w^*}^{1-\sigma}{x_d}^{\sigma-\gamma-1} + Lw^{1-\sigma}\tau^{1-\sigma}{x_f}^{\sigma-\gamma-1}) \tag{3.45}$$

Appendix II - Derivation of Profit Equations

$$max\Pi_d = p_d(x)q_d(x) - \frac{q_d(x)w}{x} - wC_d \tag{3.46}$$

$$max\Pi_f = p_f(x)q_f(x) - \frac{q_f(x)\tau w}{x} - w^*C_f \tag{3.47}$$

Given that:

$$q_d = \frac{{p_d}^{-\sigma}\mu Y}{P^{1-\sigma}} \tag{3.48}$$

$$q_f = \frac{{p_f}^{-\sigma}\mu Y^*}{{P^*}^{1-\sigma}} \tag{3.49}$$

$$p_d = \frac{\sigma}{\sigma - 1}\frac{w}{x} \tag{3.50}$$

$$p_f = \frac{\sigma}{\sigma - 1}\frac{w\tau}{x} \tag{3.51}$$

Replace $p(d)$ and q_d in Π_d,

$$\Pi_d = q_d\left(p_d(x) - \frac{w}{x}\right) - wC_d \tag{3.52}$$

$$= q_d\left(\frac{\sigma}{\sigma - 1}\frac{w}{x} - \frac{w}{x}\right) - wC_d \tag{3.53}$$

$$= \frac{{p_d}^{-\sigma}\mu Y}{P^{1-\sigma}}\left(\frac{1}{\sigma - 1}\right)\frac{w}{x} - wC_d \tag{3.54}$$

$$= \frac{\left(\frac{\sigma}{\sigma-1}\frac{w}{x}\right)^{-\sigma}\mu Y}{P^{1-\sigma}}\left(\frac{1}{\sigma - 1}\right)\frac{w}{x} - wC_d \tag{3.55}$$

$$\frac{\mu}{\sigma}wL\left(\frac{\sigma}{\sigma - 1}w\right)^{1-\sigma} x_d^{\sigma-1}P^{\sigma-1} - wC_d \tag{3.56}$$

Similarly replace $p(f)$ and q_f in Π_f.

$$\Pi_f = q_f\left(p_f(x) - \frac{w\tau}{x}\right) - w^*C_f \tag{3.57}$$

$$= q_f \left(\frac{\sigma}{\sigma - 1} \frac{w\tau}{x} - \frac{w\tau}{x} \right) - w^* C_f \tag{3.58}$$

$$= \frac{{p_f}^{-\sigma} \mu Y^*}{{P^*}^{1-\sigma}} \left(\frac{1}{\sigma - 1} \right) \frac{w\tau}{x} - w^* C_f \tag{3.59}$$

$$= \frac{\left(\frac{\sigma}{\sigma-1} \frac{w\tau}{x} \right)^{-\sigma} \mu Y^*}{{P^*}^{1-\sigma}} \left(\frac{1}{\sigma - 1} \right) \frac{w\tau}{x} - w^* C_f \tag{3.60}$$

$$= \frac{\mu}{\sigma} w^* L^* \left(\frac{\sigma}{\sigma - 1} w \right)^{1-\sigma} \tau^{1-\sigma} x_f^{\sigma-1} P^{*\sigma-1} - w^* C_f \tag{3.61}$$

Chapter 4

Firm Exit and Exchange Rates: An Examination with Turkish Firm Level Data

4.1 Introduction

Real exchange rate movements are thought to act like tariffs in the way they affect survival behavior, sales and productivity by altering firms' competitive position in both domestic and international markets.[1] Recent improvement in microdata provides an opportunity to test the effects of currency variations on firms' survival behavior and sales as well as to investigate the role of firm-specific characteristics in these relationships. Micro-level empirical research, as briefly introduced in Chapter 3, has begun to find important results on this

[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).

subject. For example, Baggs et al. (2009) have documented that appreciation of the domestic currency reduces sales and the probability of survival of firms. Additionally they find that the effect of currency appreciation on firms' survival is greater among less-productive firms.

To date, the literature has lacked detailed analysis of the effects of exchange rates on the firm survival behavior and sales in emerging markets due to a scarcity of firm-level information. This paper uses a detailed dataset compiled by the Central Bank of Turkey (CBRT) that contains information on income statement and balance sheet items, starting date of the establishment's operation, location, industry affiliation classified according to General Industrial Classification of Economic Activities within the European Communities [2] Revision 1.1, and legal status of the firms for 2002 to 2009. This rich dataset provides a unique platform in which we empirically test the effects of exchange rates on the survival patterns and sales of the firms and compare the results related with the survival patterns with theoretical predictions presented in the literature and the theoretical model introduced in Chapter 3.

We expect that the results on firms' survival can also shed light, albeit indirectly, on 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.[3] An insignificant effect of exchange rate appreciation on the survival of firms can be interpreted

[2] NACE.
[3] See Campa and Goldberg (2002) for a survey of this literature.

as evidence of incomplete pass-through since firms are not able to transmit exchange rate changes to export prices.

To the best of our knowledge this is the first empirical study to examine the impact of currency variations on firm survival in Turkey. Our results suggest that, while domestic currency appreciation decreases the probability of survival of firms in both traded and nontraded industries. Moreover, the appreciation of the domestic currency decreases the sales of the surviving firms in traded industries, a finding that confirms those of previous studies.

This paper is organized as follows. The next section briefly describes the existing literature. The third section presents information on the data sources and provides descriptive statistics. The fourth section describes the empirical methodology and presents the results from random effect and pooled probit models as well as linear probability models with the inclusion of firm-specific and/or sector specific fixed effects. The fifth section concludes.

4.2 Previous Literature

Baggs et al. (2008 and 2009) investigate the impact of real exchange rate [4] changes on the survival and sales of firms in the manufacturing and service sectors in Canada. They find that appreciation of the real domestic currency reduces the real sales and the probability of survival of firms. They also find that the effect of real domestic currency appreciation on firms' survival is larger for less productive firms.

[4] Baggs et al. (2008) and (2009) uses trade-weighted real exchange rates for each industry. For a more detailed explanation on the construction of the exchange rate index see Appendix 1 in Baggs et al. (2009)

In a recent study of the Canadian retail industry Baggs et al. (2011) found a positive relationship between exchange rate appreciation and firms' survival, contrary to their previous studies. This counterintuitive result is explained by the substantial amount of imported goods sold by Canadian retailers, since a higher value of the Canadian dollar makes imported goods cheaper. On the other hand their finding of a negative relationship between exchange rates and sales implies that appreciation decreases the total real sales volume, which is in line with their previous work.

Fung (2008) introduces a theoretical model, built on Krugman (1989), that includes an exchange rate variable, and shows that home currency appreciations make domestic goods relatively more expensive in international markets. Fung's (2008) model is a partial equilibrium model in which exchange rates and wages are assumed exogenous. On the demand side, a symmetric expenditure function in translog form as in Bergin and Feenstra (2000 and 2001) is assumed. This functional form implies a positive relation between the price of a good relative to its competing goods and its demand elasticity. Accordingly increased price causes more elastic demand which increases the competition faced by domestic firms. According to the theoretical model introduced in Fung (2008) there are two counteracting effects of exchange rate movements on the sales of surviving firms within their domestic and foreign markets. An appreciation of the domestic currency, increases the relative costs of domestic firms to the foreign competitors hence intensifies the competition faced by domestic firms. Even though the cost disadvantage causes each domestic firm to sell less, some firms exit as a result of the intensified competition. This may lead to an increase in the market share and sales of surviving firms. Consequently, the net effect of exchange rate movements on the scale of production of surviving firms depends on the relative importance of sales reductions resulting from higher relative costs and market share increases arising from the exit of other firms. The model further explains how these forces increase productivity by changing the surviving firms' scale of production. Empirical results based on Taiwanese firm level data are in line with the predictions of the theoretical model suggesting that real domestic currency appreciation leads to a scale expansion of surviving firms, which in turn raises industry productivity.

Tomlin (2010) using a dynamic structural model investigates the effect of real exchange rate fluctuations on plant entry and exit decisions in the Canadian Agricultural Implement industry. The framework is based on the Melitz (2003) with an inclusion of capital variable.[5] In this framework, exchange rate appreciation is considered in a similar way as the trade liberalization exercise introduced in Melitz (2003). Accordingly, an appreciation (which operates in a similar way to a decrease in domestic tariffs) of domestic currency opens up export opportunities for domestic plants, and increases the number of foreign competitors in the domestic market. In parallel to 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. This mechanism alters the composition of firms in the industry toward a more productive one. The empirical results are consistent with the previous papers such as Baggs et al. (2009) where an appreciation (depreciation) of

[5]In Melitz (2003) labor is the only domestic factor of production.

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.

Berman et al. (2009) investigate the role of depreciations in firms' entry decision into export markets by introducing distribution costs into Melitz's (2003) model. In the presence of distribution costs, the threshold level of productivity (the minumum productivity level at which firms earns profits) decreases as a result of depreciation, therefore less productive firms start exporting. The empirical results based on French microdata show that a 10% depreciation with respect to a specific destination increases the probability that a firm starts exporting to that destination by 1.9%.

Baldwin and Yan (2010) investigate the impact of different trading environments, characterized by different bilateral tariff reductions and differing movements in real exchange rates, on the survival of firms by focusing on plant level productivity. They find that tariff reductions and currency depreciations increase the probability that more productive non-exporters will enter the export market.

A wide literature examines the link between exchange rates and export sales at both the aggregate and disaggregate level. Aggregate studies have found small or insignificant effects of exchange rate fluctuations on export volumes, a phenomenon often referred as "the exchange rate disconnect puzzle" while studies using microeconomic or firm-level data have found more consistent evidence for a relationship between exports and exchange rates. Among those studies, Dekle and Ryoo (2007) document a large elasticity of export volumes to exchange rates in several industries using Japanese firm-level data for the period 1982-1997. Forbes (2002) examines the effects of large devaluations on firm performance, and finds that, on average, export sales increase by 4%, one year after the devaluation episodes. Dekle et al.(2005), in their study of Japanese firm-level data, document a significantly negative relation between export volumes and exchange rates.

In theoretical work, based on a model of international trade with heterogeneous firms in line with Melitz (2003), Chaney (2005) explains weak relationship between the domestic currency appreciation and total export volume through liquidity constraints. According to the model, less financially constrained firms are more likely to export. He argues that the exchange rate appreciation causes some existing exporters to lose competitiveness in the foreign market and to stop exporting. Appreciation also increases the value of domestic assets denominated in foreign currency, and therefore liquidity-constrained firms start to export. The net effect on the extensive margin remains mild despite the loss in competitiveness because a real exchange rate appreciation may actually lead to an increase in aggregate exports as liquidity-constrained firms start exporting.

For the Turkish manufacturing sector, Aldan and Günay (2008), investigate the effect of starting to export on firms' performance, and show that the larger and more productive firms are the first to enter the export market. They further show that starting to export increases firms productivity and employment.

In summary, empirical work using microdata has documented than an appreciation of the domestic currency reduces firms probability of survival. The effect of currency appreciation on firms' survival is larger for less productive firms. The relationship between exchange rates and export sales has been examined widely both at the aggregate and disaggregate level. While aggregate studies have found small or insignificant effects of exchange rate fluctuations on export volumes, studies using microeconomic or firm-level data have found more consistent evidence for a relationship between exports and exchange rates. Empirical research covering Turkey does not investigate the role of productivity in the survival behavior or firms sales in the Turkish economy. For the Turkish economy, it has been found that the larger and more productive firms are likely to export and firms productivity and employment increases as the firms start to export.

4.3 Data: Regularities and Sources

This paper exploits a dataset compiled by the Central Bank of Turkey, the Company Sector Database. The bank surveys firms annually; firms respond on a voluntarily basis.[6] 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 $2002-2009$.[7]

We limit the data to the sample of firms which have complete records on employment numbers as we will rely on this variable when calculating labour

[6]Central Bank official from the statistics department has stated that the response rate for the survey is 75% for 2009. According to the net sale criteria, manufacturing firms account for 64.7% of Turkeys total sales for the year 2009.

[7]The year 2002 is a turning point in the exchange rate regime for the Turkish Economy. A currency crisis (worst in post-war history) occurred in February 2001, which resulted in a shift in the exchange rate regime from (managed) pegged to floating. Since then, monetary policy has focused on price stability rather than targeting exchange rate stability.

productivity for each firm. Reel Sector Company Database reports employment information only if a given firm declares its employment numbers for three consecutive years. Otherwise employment information is represented as a missing value in the database. Since our study span over a longer term, for some firms employment data for the intermediate years are not available. In our analysis we do not take into consideration firms with incomplete employment data therefore we end up with a smaller sample of firms (almost 75% of the firms have missing employment information). The comparison of descriptive statistics between the firms with missing employment data and the firms 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 (See Table 4.15). Consequently, we end up with 6778 firm-year observations consisting of 865 firms belonging to 20 industries, 15 traded and 5 nontraded, defined on the 2-digit NACE Revision 1.1 level.

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% from upper and lower tails of the distribution of the variables.

In principle, firm exit can be identified on the basis of missing values in our data set. Unfortunately this is not a reliable procedure since missing values can result from failure to report items or failure to respond to the survey for reasons other than exit. Therefore we supplemented data from the CBRT Company Sector database with additional data from the Central

Bank that contains information on the identity numbers of exited firms but not the exact date of the exit. We assumed that the exit date was the last year the firm has non-missing values on its balance sheet or income statement items. Based on this assumption, 5% of the 865 firms in the Company Sector database (44 out of 865) exited during the period 2002-2009.

We divided the sample into two sub-samples covering tradable and non-tradable industries. Our categorization of tradable and non-tradable industries follows Campa and Goldberg (2006). The non-tradable industries are those having NACE Revision 1.1 classification codes higher than 40 and include domestic services, electricity, gas and water. The tradable industries are those sectors with NACE Revision 1.1 classification codes lower than 40.[8] Non-tradable industries consist of 5 sectors covering 244 firms, and tradable industries span 15 sectors covering 621 firms. The classification of industries can be found in Table 4.14.

Based on their exit status, firms are categorized into two groups: survivors and exiters. Table 4.3 gives information on the rates of exit in the traded and nontraded industries. The exit rates range between 20% (for mining of coal and lignite and for manufacture of tobacco products) and 2% (for hotels and restaurants and for manufacture of machinery and equipment n.e.c.).

Table 4.1 and 4.2 provide descriptive statistics of firm-specific variables such as labor productivity (real output per employee), age, number of employees, export sales as a share of total production, and real assets.[9]

[8] Campa and Goldberg (2006) uses OECD industry classification codes. We have matched 2-digit NACE Revision 1.1 industry classification codes to OECD industry classification using the appendix 1 in their article in order to make the categorization of tradables and non-tradables

[9] Real assets of a firm are calculated as total assets (the sum of current and fixed assets)

Table 4.1: Descriptive Statistics - Traded

Sample	Variable	mean	median	sd	min	max	N
Survivors	Age	30.4	29.0	10.6	13.0	73.0	4712
	Employment	398.9	208.0	490.0	2.0	4054.0	4712
	Labour Productivity	37.6	22.8	49.6	0.1	1065.7	4712
	Export Share	0.3	0.2	0.3	0.0	1.0	4712
	Real Assets	1150000	440317	1800000	1357	16500000	4712
Exiters	Age	31.5	30.0	11.5	15.0	57.0	148
	Employment	245.3	139.5	292.4	2.0	1399.0	148
	Labour Productivity	33.8	16.2	43.3	0.1	231.9	148
	Export Share	0.3	0.2	0.3	0.0	1.0	148
	Real Assets	632747	300809	790191	3207	3570000	148
Whole Sample	Age	30.4	29.0	10.7	13.0	73.0	4860
	Employment	394.2	205.0	485.9	2.0	4054.0	4860
	Labour Productivity	37.5	22.6	49.4	0.1	1065.7	4860
	Export Share	0.3	0.2	0.3	0.0	1.0	4860
	Real Assets	1130000	435390	1780000	1357	16500000	4860

Table 4.2: Descriptive Statistics - nontraded

Sample	Variable	mean	median	sd	min	max	N
Survivors	Age	26.96	25	8.15	13	64	1856
	Employment	198.56	69.5	337.63	2	3907	1856
	Labour Productivity	47.36	18.04	86.68	0	1122.51	1856
	Export Share	0.11	0.01	0.21	0	1	1856
	Real Assets	866659	203928	1730000	1047	16500000	1856
Exiters	Age	26.47	27	6.95	14	39	62
	Employment	61.02	22	71.78	2	276	62
	Labour Productivity	143.19	26.99	213.28	0.18	770.92	62
	Export Share	0.13	0	0.25	0	1	62
	Real Assets	499478	142263	899995	1784	3150000	62
Whole Sample	Age	26.94	25	8.11	13	64	1918
	Employment	194.12	66	333.26	2	3907	1918
	Labour Productivity	50.46	18.34	94.9	0	1122.51	1918
	Export Share	0.11	0.01	0.21	0	1	1918
	Real Assets	854790	201901	1710000	1047	16500000	1918

The tables show that exiters have lower employment and real assets in both traded and nontraded industries. In addition, survivors have higher export share in traded industries and lower export share in nontraded industries. In terms of productivity differences, exiting firms have lower productivity on average in the traded industries while they have higher productivities in nontraded industries.

All the real values are deflated using the sectoral-level PPI for the manufacturing sector, and the CPI for non-manufacturing sectors, obtained from the Turkish Statistical Institute (TURKSTAT).

All the remaining data were obtained from the IMF's International Financial Statistics. In order to examine the impact of currency variation on firm survival, our firm-level dataset is linked to real bilateral exchange rate data between U.S. dollar and Turkish Lira obtained from IMF. A decrease in the real exchange rate represents an appreciation of Turkish Lira. As foreign GDP, we used the weighted average of OECD countries's GDPs (constant prices), where bilateral trade flows as shares in total trade of Turkey are used as weights. GDP with constant prices and three-months deposit rates of Turkey are used as the domestic GDP and interest rate, respectively.

divided by sectoral PPI. If PPI is not available, CPI is used.

Table 4.3: Number of Firms and Exit Year - Traded and Nontraded Industries

Industry	Nace Rev.1.1. Code	Number of Firms								Exit Rate
		2002	2003	2004	2005	2006	2007	2007	2009	
Mining of coal and lignite	10	5	5	5	5	5	5	5	4	0.20
Manufacture of food products and beverages	15	116	116	116	116	114	114	112	112	0.03
Manufacture of tobacco products	16	5	5	5	4	4	4	4	4	0.20
Manufacture of textiles	17	109	109	108	106	105	105	104	102	0.06
Manufacture of wearing apparel	18	45	45	44	43	42	42	41	41	0.09
Manufacture of wood and of 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
Manufacture of chemicals and chemical products	24	70	70	70	69	69	68	68	68	0.03
Manufacture of rubber and plastic products	25	38	38	37	37	37	37	37	37	0.03
Manufacture of other non-metallic mineral products	26	57	57	57	56	55	55	54	54	0.05
Manufacture of fabricated metal products except machinery and equipment	28	38	38	38	38	38	38	38	37	0.03
Manufacture of machinery and equipment n.e.c.	29	48	48	48	48	48	47	47	47	0.02
Manufacture of electrical machinery and apparatus n.e.c.	31	26	26	26	26	25	25	24	24	0.08
Manufacture of medical precision and optical instruments watches and clocks	33	4	4	4	4	4	4	4	3	0.25
Manufacture of motor vehicles trailers and semi-trailers	34	41	41	41	41	40	39	39	39	0.05
Construction	45	83	83	81	81	80	80	80	79	0.05
Sale maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel	50	26	26	26	25	25	25	25	24	0.08
Wholesale trade and commission trade except of motor vehicles and motorcycles	51	79	79	79	79	79	79	77	75	0.05
Retail trade except of motor vehicles and motorcycles; repair of personal and household goods	52	9	9	9	9	9	9	9	8	0.11
Hotels and restaurants	55	47	47	47	47	46	46	46	46	0.02
Sum		865	865	860	852	843	840	832	821	0.05

4.4 Empirical Analysis

4.4.1 Exchange Rates and Firm Survival

We follow Baggs et al. (2009)'s methodology to investigate the firms' survival behavior as a result of exchange rate movements. This method involves regressing the survival status of a given firm on exchange rate and a set of firm as well as industry level control variables. Using the specification given below we investigate i)whether the exchange rate appreciate have any effect on firm survival, ii) an appreciation has lower impact for more productive firms, and iii) the impact of control variables on firm survival. More formally, our probit equation will be in the following form:

$$P(Surv_{it}) = \phi(\beta_1 Q_t + \beta_2 GDP^f{}_t + \beta_3 GDP^d{}_t + \beta_4 r_t + \beta_5 LP_{it} + \beta_6 AGE_{it} + \beta_7 EMP_{it} + \beta_8 t + \epsilon_{it}) \quad (4.1)$$

where the subscript i indexes firms; and t, time. $Surv_{it}$ is a dummy variable equal to 1 if firm i is in operation in year t, and 0 otherwise. Q is real bilateral exchange rate between Turkish Lira and US dollar. LP_{it}, AGE_{it}, and EMP_{it} stand for the logarithm of the labor productivity, age, and employment. GDP^d_t and GDP^f_t are domestic and foreign GDP growth and they are used for controlling country-specific and international business cycles and for the expansion of domestic and foreign demand. r_t is the short term interest rate and time trend, t, is used to control for time-specific effects.

β_1 is the main coefficient of interest and is expected to be positive. A positive and significant value for β_1 implies that an exchange rate appreciation decreases the probability of survival of a given firm.

As it has been pointed out in several firm level studies there are important issues regarding the assumption of the error term structure while estimating equation 4.1. It has been stressed in Bernard and Jensen (2004), Greenaway and Yu (2004), that it is highly likely that there are unobserved characteristics such as product quality or managerial ability that are potentially permanent or serially correlated that may affect the firms responses. In our study permanent unobserved plant characteristics, for example managerial ability, can make some firms more productive which may result in the increased probability of survival, therefore may result in the overestimation of the coefficients.

As a starting point we take ϵ_{it} as independent standard normal disturbances. Then we simply run pooled probit model. Subsequently we use random effect probit regression to provide a robustness check. Accordingly we assume that the disturbance term ϵ_{it} as composed of unobserved plant effects, μ_i, plus transitory term η_{it}.

The results obtained using the pooled probit and random effect probit model are presented in table 4.4 and 4.8 respectively. According to the results obtained using pooled probit and random effect probit models (columns 1-4 of tables 4.4 and 4.8), the coefficient of the real exchange rate is positive and significant indicating that an appreciation of the Turkish Lira decreases the probability of survival for Turkish firms in traded industries. Corresponding marginal effects evaluated at the mean value of all right-hand side variables of pooled probit and random effect probit models are presented in the columns 2 and 4 of tables 4.4 and 4.8, respectively. The effect of productivity is positive and significant in traded industries, showing that the higher the productivity the higher is the probability of survival. In column 2 of table 4.4, we estimate that a one-unit change in the real exchange rate decreases the probability of survival of a given firm by 5%, while a one percent change in productivity increases the probability of survival by 0.2% in traded industries.

We include several covariates to our specification in order to control country-specific and time specific effects. Surprisingly, age appears negative and significant in traded industries while it appears insignificant in non-traded industries. The negative coefficient for the age variable is also found in Baggs et al (2008). The counterintuitive result of younger firms having less affected by exchange rate appreciation could be caused by the fact that we have drop the young firms due to the lack of available data for employment. Employment is positive and significant in the traded and nontraded industries suggesting that being a small firm decreases the probability of survival. In addition, we also find that higher growth rates in foreign GDP increases the firms' probability of survival in nontraded industries.[10] However the coefficient of the growth in domestic and foreign GDP is insignificant in traded industries. The interest rate appears negative and significant in nontraded industries implying that the higher is the cost of borrowing the lower is the survival rate.

We also incorporate fixed effects to our methodology. However the fixed

[10]This contradictory result stems from the fact that several firms belonging to the non-traded industries, specifically construction, have significant export activities. Additionally, CBRT's Company Sector Database is designed to reflect the sectoral classification codes associated with each firm based on the last observation, therefore it's not possible to identify shifts in the sectoral activity.

effects estimator has seen relatively little use in nonlinear models because there is no feasible ways to remove the heterogeneity in probit model in the presence of fixed effects (Greene, 2001). Robert and Tybout (1997) also stress this issue and state that they do not control firm-specific heterogeneity by using plant-specific dummy variables because of the "incidental-parameters problem" stressed in J. Neyman and E. Scott (1948).[11] Note that in Girma, Greenway and Kneller (2004) probit regression, in Bernard and Jensen (2004) linear probability model with and without fixed effect, and in Roberts and Tybout (1997) probit model with random effects are employed.

The results of the linear probability model for traded and nontraded industries are presented in tables 4.5 and 4.9, respectively. We estimate a linear probability model first without including any fixed effect (specification 1). Later we include industry (specification 2) and firm fixed effects (specification 3) in the regression equations. The results of the linear probability model without any fixed effect is presented in column 1 while the results of the estimation using industry and firm fixed effects are presented in column 3 and 5, respectively. The estimation results for productivity and real exchange rate obtained through linear probability model are in line with the previous findings for the traded industries obtained through pooled probit and random effect probit model. The results suggest that real exchange rate appreciation decreases the probability of survival in all specifications in traded and nontraded industries. Productivity appears positive and significant in traded (in all specifications) and nontraded (in specification 3) industries. The coeffi-

[11] For a more detailed discussion on this topic please see Gary Chamberlain (1980), and Heckman (1981).

cient of employment appears significant and positive (with the exception of specification 3 in nontraded industries) suggesting that larger firms in terms of employment are more likely to survive.

Other covariates, more specifically interest rate, growth in domestic and foreign GDP are insignificant in all specification in both traded and non-traded industries, while the coefficient of age is significant and negative (in specification 1 and 2) in traded industries.

We add an interaction term between to the model to test the hypothesis whether a being high/low productivity firm increases/decreases the probability of survival in the context of exchange rate appreciation. Accordingly we create a dummy for high/low productivity firms, those belonging to highest/lowest 50%. Then we create an interaction term between exchange rate and dummy for high/low productivity firms. We test the interaction effect in both probit models and linear probability models. The results of the regressions including interactions effect are presented in column 5 of tables 4.4 and 4.8 for the probit models while in columns 2, 4, and 6 of tables 4.5 and 4.9 for linear probability models respectively.

The interpretation of the marginal effects in the context of a linear model is straightforward. In the linear model, for high productivity firms, the effect of real exchange rate appreciation is basically equal to the coefficient of the interaction term. However the interpretation of interactions in the context of a non-linear model is more problematic. As it has been stressed out in Ai and Norton (2003), the magnitude of the interaction effect in nonlinear models does not equal the marginal effect of the interaction term, can be of opposite sign, and its statistical significance is not calculated by standard software.

Moreover, the interaction effect is conditional on the value of independent variables. Consequently the magnitude and statistical significance of the interaction effect can differ over observations. For example, the interaction effect can be positive for some observations and negative for others, which makes the interaction effect calculated using standard software (at means) less accurate.

According to the results based on the sample of firms belonging to the traded and nontraded industries presented in tables 4.4 and 4.8, (column 6) the marginal effect of the interaction term between real exchange rate and dummy for high/low productivity is not statistically significant in traded industries and nontraded industries. Despite the lack of statistical significance of the marginal effect of the interaction term in the regression results presented in tables 4.4 and 4.8, the correct interaction effect, calculated based on Ai and Norton (2003) methodology, is statistically significant for many observations in the traded sector (see figures 4.2). We find that the marginal effect of the interaction term between the real exchange rate and dummy for high (low) productivity firms is negative (positive) and significant meaning that high (low) productivity firms have higher (lower) probability of survival than low (high) productivity firms in traded industries in the presence of exchange rate variation. On the other hand for the nontraded industries the magnitude and statistical significance of the interaction effect differs by observation (Figure 4.1). The marginal effect of the interaction terms obtained through linear probability model are insignificant in all specifications in both traded (columns 2, 4, and 6 of table 4.4) and nontraded industries (columns 2, 4, and 6 of table 4.9).

In order to further test the impact of exchange rate appreciation on firms with different productivity levels, we split the sample between high and low productivity firms. High productivity firms are firms belonging to the highest 50 percent while the low productivity firms are the ones belonging to the lowest 50 percent. The results of the probit and linear probability models for traded and nontraded industries are presented in tables 4.6, 4.7, 4.10, and 4.11. According to the estimation results, exchange rate appreciation does not have any effect on the survival behavior of the high productivity firms belonging to traded sectors (columns 2, 4, 5, 6, and 7 of Table 4.6). On the other hand the coefficient of the real exchange rate appears positive and significant in the sample of low productivity firms in traded industries meaning that appreciation decreases the probability of survival of the low productivity firms in the traded sector (columns 2, 4, 5, 6, and 7 of Table 4.7). The results are in line with the probit model with the inclusion of interaction variable (Figures 4.2). The marginal effects of the pooled probit (column 2 of table 4.7) and linear probability models (columns 5-7 of table 4.7), evaluated at the mean value of dependent variables, imply that one unit decrease in the real exchange rate (appreciation) decreases the probability of survival of low productivity firms between 1% and 1.5%. Similarly, for the nontraded industries estimation results based on the linear probability model suggest that exchange rate appreciation decreases the probability of survival of low productivity firms (columns 5-7 of table 4.11) while it does not have any effect on the survival behavior of the high productivity firms. Consequently, one unit decrease in the real exchange rate (appreciation) decreases the probability of survival of low productivity firms between 0.8% and 1.3%.

4.4.2 Exchange Rates and Sales

We further analyze the impact of exchange rate variations on surviving firms' real sales. In order to do this we regress the change in the real total sales on the same set of independent variables used in equation 4.1. More precisely, we will run the following regression equation, in which $\triangle(TS_{it})$ represents the percentage change in total real sales, to investigate impact of exchange rates on the sales:

$$\triangle(TS_{it}) = \varphi_1 Q_t + \varphi_2 GDP^f{}_{it} + \varphi_3 GDP^d{}_{it} + \varphi_4 r_t + \varphi_5 LP_{it} + \varphi_6 AGE_{it} + \varphi_7 EMP_{it} + \varphi_8 t_{it} + \epsilon_{it} \quad (4.2)$$

Equation 4.2 is estimated in the form of pooled OLS (specification 1) and with industry fixed effects (specification 2) and panel regressions with firm fixed effects (specification 3). Our regression results are presented in tables 4.12 and 4.13 for traded and nontraded industries respectively. In the regression analysis, we consider both the level of the real exchange rate and the percentage change from year $t-1$ to year t. Columns 1, 3, and 5 of the tables 4.12 and 4.13 investigate the effect of the level of the exchange rate while columns 2, 4, and 6 examine the effect of changes in the exchange rate from one year to the next.

Estimation results indicates that real domestic currency depreciation does not have any effect on the total real sales volume in all specifications in the traded and nontraded sectors. Similar to previous findings (Baggs et al. 2008 and 2009) the labor productivity has a positive relation with the change in total sale volume in traded industries and nontraded industries in specification 3 suggesting that productive firms tend to have larger sales volume.

4.5 Conclusion

The results of the empirical research presented in this chapter provide important implications for real exchange rate variations on survival and sales of the firms in the Turkish traded and nontraded industries. The results suggest that real exchange rate appreciation decreases the probability of survival of the firms belonging to traded and nontraded industries. We find that high (low) productivity firms have higher (lower) probability of survival than low (high) productivity firms in traded and nontraded industries in the presence of exchange rate variation. We further test the impact of currency appreciations on the sales of continuing firms belonging to both traded and nontraded industries. Accordingly, real exchange rate appreciations do not have any impact on continuing firms' sales in traded and nontraded industries.

Table 4.4: Probit Models -Traded Industries

	(1) Pooled Probit	(2) mfx	(3) Random Effect Probit	(4) mfx	(5) Interactions	(6) mfx
Real Exchange Rate	5.935*	0.047**	10.996*	0.000		
	(2.585)	(0.018)	(5.002)	(0.000)		
ln(Labour Productivity)	0.217**	0.002**	0.816***	0.000		
	(0.070)	(0.001)	(0.228)	(0.000)		
Foreign GDP Growth	0.040	0.000	-0.578	0.000	0.133	0.001
	(0.278)	(0.002)	(0.701)	(0.000)	(0.303)	(0.002)
Domestic GDP Growth	-0.044	-0.000	0.359	0.000	-0.105	-0.001
	(0.203)	(0.002)	(0.526)	(0.000)	(0.221)	(0.002)
Time Deposit	-0.006	-0.000	0.125	0.000	-0.036	-0.000
	(0.040)	(0.000)	(0.115)	(0.000)	(0.052)	(0.000)
ln(Age)	-0.499*	-0.004*	-2.480	0.000	-0.500*	-0.004*
	(0.197)	(0.002)	(1.280)	(0.000)	(0.196)	(0.002)
ln(Employment)	0.188***	0.001**	0.717*	0.000	0.201***	0.002**
	(0.053)	(0.000)	(0.280)	(0.000)	(0.054)	(0.000)
Time Trend	0.457	0.004	1.130	0.000	0.366	0.003
	(0.292)	(0.002)	(0.812)	(0.000)	(0.287)	(0.002)
Demeaned Exchange Rate					4.401*	0.034*
					(1.951)	(0.014)
Dummy for High Productivity Firms (d)					0.336*	0.003*
					(0.152)	(0.001)
Demeaned Exchange Rate*Dummy for High Productivity Firms					0.574	0.004
					(0.594)	(0.004)
Observations	4860	4860	4860	4860	4860	4860
Log lik.	-169.379	-169.379	-164.831	-164.831	-172.000	-172.000
Chi-squared	61.757	61.757	18.209	18.209	50.672	50.672
Pseudo R-squared	0.121	0.121			0.107	0.107

Marginal effects; Standard errors in parentheses
(d) for discrete change of dummy variable from 0 to 1
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4.5: Linear Probability Model - Traded Industries

	(1) LPM-No FE	(2) Interaction	(3) LPM -Industry FE	(4) Interaction	(5) LPM-Firm FE	(6) Interaction
Real Exchange Rate	0.076*	0.077*	0.076*	0.077*	0.057*	0.069*
	(0.035)	(0.036)	(0.035)	(0.036)	(0.029)	(0.031)
ln(Labour Productivity)	0.005**		0.004*		0.019**	
	(0.002)		(0.002)		(0.006)	
Foreign GDP Growth	0.004	0.004	0.004	0.004	0.002	0.003
	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)
Domestic GDP Growth	-0.003	-0.003	-0.003	-0.003	-0.003	-0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Time Deposit	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
ln(Age)	-0.009*	-0.008*	-0.009*	-0.009*	0.051	0.057
	(0.004)	(0.004)	(0.004)	(0.004)	(0.037)	(0.038)
ln(Employment)	0.004**	0.004**	0.004**	0.004**	0.017***	0.009**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.005)	(0.003)
Time Trend	0.002	0.003	0.002	0.003	-0.004	-0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)
Dummy for High Productivity Firms		0.005		0.003		0.010
		(0.005)		(0.005)		(0.006)
Real Exchange Rate*Dummy For High Productivity Firms		-0.000		-0.000		-0.015
		(0.009)		(0.009)		(0.011)
Observations	4860	4860	4860	4860	4860	4860
R-squared	0.009	0.007	0.011	0.010	0.262	0.256

Marginal effects; Standard errors in parentheses
(d) for discrete change of dummy variable from 0 to 1
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4.6: High Productivity Firms - Traded Industries

	(1) Pooled Probit	(2) mfx	(3) Random Effect	(4) mfx	(5) LPM - No Fixed Effect	(6) LPM - Industry FE	(7) LPM - Firm FE
Real Exchange Rate	3.580	0.008	6.977	0.000	0.017	0.017	0.001
	(3.656)	(0.008)	(9.067)	(0.000)	(0.043)	(0.043)	(0.037)
Foreign GDP Growth	0.371	0.001	0.761	0.000	0.002	0.002	0.001
	(0.515)	(0.001)	(3.138)	(0.000)	(0.005)	(0.005)	(0.004)
Domestic GDP Growth	-0.545	-0.001	-1.256	0.000	-0.003	-0.003	-0.002
	(0.510)	(0.001)	(2.690)	(0.000)	(0.003)	(0.003)	(0.003)
Time Deposit	-0.056	-0.000	-0.112	0.000	-0.000	-0.000	-0.000
	(0.095)	(0.000)	(0.205)	(0.000)	(0.001)	(0.001)	(0.001)
ln(Age)	-0.314	-0.001	-1.121	0.000	-0.004	-0.003	0.039
	(0.324)	(0.001)	(1.918)	(0.000)	(0.004)	(0.004)	(0.050)
ln(Employment)	0.161	0.000	0.436	0.000	0.002	0.003	0.007
	(0.091)	(0.000)	(0.278)	(0.000)	(0.001)	(0.001)	(0.005)
Time Trend	-0.610	-0.001	-1.764	0.000	-0.003	-0.003	-0.007
	(0.821)	(0.002)	(4.628)	(0.000)	(0.002)	(0.002)	(0.004)
Observations	2544	2544	2544	2544	2544	2544	2544
Log lik.	-67.805	-67.805	-66.901	-66.901	3215.808	3220.720	3676.833
Chi-squared	260.609	260.609	3.754	3.754			
Pseudo R-squared	0.111	0.111					

Marginal effects; Standard errors in parentheses
(d) for discrete change of dummy variable from 0 to 1
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4.7: Low Productivity Firms - Traded Industries

	(1) Pooled Probit	(2) mfx	(3) Random Effect	(4) mfx	(5) LPM - No Fixed Effect	(6) LPM - Industry FE	(7) LPM - Firm FE
Real Exchange Rate	9.954*	0.101*	12.971*	0.001	0.149**	0.147*	0.111*
	(5.068)	(0.041)	(6.230)	(0.009)	(0.058)	(0.057)	(0.048)
Foreign GDP Growth	0.289	0.003	0.293	0.000	0.007	0.007	0.004
	(0.460)	(0.004)	(0.556)	(0.000)	(0.007)	(0.007)	(0.006)
Domestic GDP Growth	-0.079	-0.001	-0.046	-0.000	-0.004	-0.003	-0.002
	(0.280)	(0.003)	(0.402)	(0.000)	(0.005)	(0.005)	(0.004)
Time Deposit	-0.015	-0.000	-0.002	-0.000	-0.001	-0.001	-0.000
	(0.058)	(0.001)	(0.095)	(0.000)	(0.001)	(0.001)	(0.001)
ln(Age)	-0.614*	-0.006	-1.182	-0.000	-0.013	-0.013	0.142*
	(0.244)	(0.003)	(0.837)	(0.001)	(0.007)	(0.007)	(0.063)
ln(Employment)	0.228***	0.002**	0.427	0.000	0.005*	0.005*	0.017*
	(0.066)	(0.001)	(0.266)	(0.000)	(0.002)	(0.002)	(0.008)
Time Trend	0.813*	0.008*	1.101	0.000	0.009	0.009	-0.000
	(0.344)	(0.003)	(0.684)	(0.001)	(0.007)	(0.007)	(0.006)
Observations	2316	2316	2316	2316	2316	2316	2316
Log lik.	-100.880	-100.880	-100.407	-100.407	2238.778	2248.636	2696.317
Chi-squared	77.414	77.414	6.841	6.841			
Pseudo R-squared	0.122	0.122					

Marginal effects; Standard errors in parentheses
(d) for discrete change of dummy variable from 0 to 1
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4.8: Probit Models - Nontraded Industries

	(1) Pooled Probit	(2) mfx	(3) Random Effect Probit	(4) mfx	(5) Interactions	(6) mfx
ln(Real Exchange Rate)	95.021	0.000	103.570	0.000		
	.	(0.000)	.	(0.000)		
ln(Labour Productivity)	0.080	0.000	0.086	0.000		
	(0.087)	(0.000)	(0.073)	(0.000)		
Foreign GDP Growth	3.303***	0.000	3.607***	0.000	1.701**	0.000
	(0.627)	(0.000)	(0.714)	(0.000)	(0.649)	.
Domestic GDP Growth	-1.770***	0.000	-1.939***	0.000	-0.762	0.000
	(0.515)	(0.000)	(0.567)	(0.000)	(0.543)	.
Time Deposit	-0.660***	0.000	-0.722***	0.000	-0.373**	0.000
	(0.130)	(0.000)	(0.136)	(0.000)	(0.129)	.
ln(Age)	-0.205	0.000	-0.232	0.000	-0.310	0.000
	(0.427)	(0.000)	(0.508)	(0.000)	(0.434)	.
ln(Employment)	0.311**	0.000	0.335***	0.000	0.329***	0.000
	(0.106)	(0.000)	(0.099)	(0.000)	(0.095)	.
Time Trend	5.433***	0.000	5.907***	0.000	2.725**	0.000
	(0.821)	(0.000)	(0.881)	(0.000)	(1.006)	.
Demeaned Exchange Rate					34.241***	0.000
					(3.428)	.
Dummy for High Productivity Firms (d)					1.908*	0.000
					(0.836)	(0.000)
Demeaned Exchange Rate*Dummy for High Productivity Firms					5.595*	0.000
					(2.713)	.
Observations	1918	1918	1918	1918	1918	1918
Log lik.	-58.520	-58.520	-58.428	-58.428	-54.636	-54.636
Chi-squared	.	.	.	.	445.497	445.497
Pseudo R-squared	0.197	0.197			0.250	0.250

Marginal effects; Standard errors in parentheses
(d) for discrete change of dummy variable from 0 to 1
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4.9: Linear Probability Model - Nontraded Industries

	(1) LPM-No FE	(2) Interaction	(3) LPM -Industry FE	(4) Interaction	(5) LPM-Firm FE	(6) Interaction
ln(Real Exchange Rate)	0.140**	0.132**	0.140**	0.131**	0.119**	0.121**
	(0.048)	(0.046)	(0.048)	(0.046)	(0.042)	(0.042)
ln(Labour Productivity)	0.002		0.002		0.006*	
	(0.002)		(0.002)		(0.003)	
Foreign GDP Growth	0.003	0.003	0.003	0.003	0.003	0.003
	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)
Domestic GDP Growth	-0.000	-0.000	-0.000	-0.000	-0.001	-0.001
	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)
Time Deposit	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
ln(Age)	-0.003	-0.004	-0.001	-0.002	0.020	0.012
	(0.006)	(0.006)	(0.006)	(0.006)	(0.077)	(0.077)
ln(Employment)	0.005*	0.006*	0.005*	0.005*	0.012	0.012
	(0.002)	(0.002)	(0.002)	(0.002)	(0.008)	(0.007)
Time Trend	0.009	0.009	0.009	0.009	0.004	0.004
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Dummy for High Productivity Firms		0.003		0.005		0.013
		(0.009)		(0.010)		(0.010)
Real Exchange Rate*Dummy For High Productivity Firms		0.019		0.019		0.007
		(0.017)		(0.017)		(0.018)
Observations	1918	1918	1918	1918	1918	1918
R-squared	0.014	0.016	0.015	0.018	0.252	0.251

Marginal effects; Standard errors in parentheses
(d) for discrete change of dummy variable from 0 to 1
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4.10: High Productivity Firms - Nontraded Industries

	(1) Pooled Probit	(2) mfx	(3) Random Effect	(4) mfx	(5) LPM - No Fixed Effect	(6) LPM - Industry FE	(7) LPM - Firm FE
ln(Real Exchange Rate)	30.289	0.000	35.670	0.000	0.145	0.146	0.145
	.	(0.000)	.	(0.000)	(0.075)	(0.076)	(0.076)
Foreign GDP Growth	2.135	0.000	1.903	0.000	0.006	0.006	0.006
	.	(0.000)	.	(0.000)	(0.003)	(0.003)	(0.005)
Domestic GDP Growth	-2.087***	0.000	-2.029***	0.000	-0.004*	-0.004	-0.004
	(0.111)	(0.000)	(0.115)	(0.000)	(0.002)	(0.002)	(0.003)
Time Deposit	-0.685***	0.000	-0.753***	0.000	-0.002*	-0.002*	-0.002
	(0.043)	(0.000)	(0.136)	(0.000)	(0.001)	(0.001)	(0.001)
ln(Age)	-0.754	0.000	-0.754	0.000	-0.006	-0.005	0.112
	(0.409)	(0.000)	(0.923)	(0.000)	(0.005)	(0.004)	(0.066)
ln(Employment)	0.076	0.000	0.076	0.000	0.001	0.001	0.006
	(0.165)	(0.000)	(0.161)	(0.000)	(0.002)	(0.002)	(0.009)
Time Trend	-2.319	0.000	-2.150	0.000	0.001	0.000	-0.004
	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.002)	(0.005)
Observations	879	879	879	879	879	879	879
Log lik.	-19.089	-19.089	-19.089	-19.089	1132.125	1135.517	1211.571
Chi-squared	.	.	.	.			
Pseudo R-squared	0.253	0.253					

Marginal effects; Standard errors in parentheses
(d) for discrete change of dummy variable from 0 to 1
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4.11: Low Productivity Firms - Nontraded Industries

	(1) Pooled Probit	(2) mfx	(3) Random Effect	(4) mfx	(5) LPM - No Fixed Effect	(6) LPM - Industry FE	(7) LPM - Firm FE
ln(Real Exchange Rate)	90.959	0.000	101.649	0.000	0.133*	0.129*	0.077*
	.	(0.000)	.	(0.000)	(0.060)	(0.057)	(0.039)
Foreign GDP Growth	3.143***	0.000	3.517***	0.000	0.000	-0.000	0.004
	(0.821)	(0.000)	(0.817)	(0.000)	(0.009)	(0.008)	(0.006)
Domestic GDP Growth	-1.561*	0.000	-1.766**	0.000	0.003	0.003	-0.003
	(0.643)	(0.000)	(0.653)	(0.000)	(0.007)	(0.007)	(0.005)
Time Deposit	-0.563***	0.000	-0.637***	0.000	0.000	0.000	-0.000
	(0.156)	(0.000)	(0.176)	(0.000)	(0.001)	(0.001)	(0.001)
ln(Age)	-0.072	0.000	-0.112	0.000	-0.001	0.001	0.028
	(0.686)	(0.000)	(0.669)	(0.000)	(0.011)	(0.011)	(0.088)
ln(Employment)	0.453***	0.000	0.492***	0.000	0.009*	0.008*	0.017
	(0.115)	(0.000)	(0.133)	(0.000)	(0.003)	(0.003)	(0.013)
Time Trend	5.585***	0.000	6.198***	0.000	0.016	0.016	-0.000
	(1.008)	(0.000)	(1.064)	(0.000)	(0.011)	(0.011)	(0.009)
Observations	1039	1039	1039	1039	1039	1039	1039
Log lik.	-33.186	-33.186	-33.113	-33.113	1071.459	1076.492	1355.902
Chi-squared	.	.	.	.			
Pseudo R-squared	0.292	0.292					

Marginal effects; Standard errors in parentheses
(d) for discrete change of dummy variable from 0 to 1
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4.12: Real Sales - Traded Industries

	(1) OLS	(2) OLS	(3) OLS -Ind. FE	(4) OLS- Ind. FE	(5) OLS-Firm FE	(6) OLS-Firm FE
ln(Real Exchange Rate)	-5.320		-5.324		-5.691	
	(6.854)		(6.852)		(6.849)	
Foreign GDP Growth	-1.188	-1.006	-1.190	-1.007	-1.281	-1.094
	(0.814)	(0.716)	(0.814)	(0.716)	(0.815)	(0.716)
Domestic GDP Growth	0.850	0.775	0.850	0.775	0.864	0.789
	(0.602)	(0.579)	(0.601)	(0.579)	(0.601)	(0.579)
Time Deposit	0.086	0.050	0.086	0.050	0.080	0.043
	(0.116)	(0.098)	(0.116)	(0.098)	(0.116)	(0.098)
ln(Labour Productivity)	0.367	0.367	0.390	0.390	2.234***	2.233***
	(0.244)	(0.244)	(0.266)	(0.266)	(0.648)	(0.648)
ln(Age)	-0.853	-0.853	-1.143	-1.143	-4.045	-4.064
	(0.708)	(0.708)	(0.741)	(0.741)	(8.680)	(8.680)
ln(Employment)	0.111	0.111	0.156	0.155	1.042	1.040
	(0.185)	(0.185)	(0.191)	(0.191)	(0.682)	(0.682)
Time Trend	0.477	0.858	0.486	0.868	0.495	0.912
	(0.820)	(0.917)	(0.820)	(0.917)	(0.873)	(0.964)
dlnreal_fx		-2.992		-2.994		-3.299
		(4.777)		(4.776)		(4.774)
Observations	4712	4712	4712	4712	4712	4712
Log lik.	-2.0e+04	-2.0e+04	-2.0e+04	-2.0e+04	-1.9e+04	-1.9e+04
Chi-squared						
Pseudo R-squared						

Marginal effects; Standard errors in parentheses
(d) for discrete change of dummy variable from 0 to 1
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4.13: Real Sales - Nontraded Industries

	(1) OLS	(2) OLS	(3) OLS -Ind. FE	(4) OLS- Ind. FE	(5) OLS-Firm FE	(6) OLS-Firm FE
ln(Real Exchange Rate)	-78.415		-80.270		-90.510	
	(108.957)		(108.963)		(108.992)	
Foreign GDP Growth	-19.728	-17.095	-19.944	-17.235	-20.743	-17.634
	(12.941)	(11.378)	(12.942)	(11.379)	(12.944)	(11.378)
Domestic GDP Growth	13.858	12.791	13.926	12.825	14.030	12.755
	(9.563)	(9.207)	(9.563)	(9.207)	(9.557)	(9.201)
Time Deposit	1.295	0.780	1.300	0.772	1.298	0.699
	(1.849)	(1.565)	(1.849)	(1.565)	(1.849)	(1.566)
ln(Labour Productivity)	0.371	0.351	2.623	2.596	10.057*	9.977*
	(2.522)	(2.522)	(3.030)	(3.029)	(4.531)	(4.529)
ln(Age)	-1.118	-1.107	-3.424	-3.421	-21.171	-21.537
	(13.616)	(13.616)	(14.271)	(14.272)	(159.410)	(159.422)
ln(Employment)	1.709	1.695	0.966	0.954	6.979	6.859
	(2.608)	(2.608)	(2.678)	(2.678)	(8.030)	(8.027)
Time Trend	8.275	13.968	8.211	14.024	7.822	14.337
	(13.052)	(14.585)	(13.054)	(14.586)	(14.327)	(15.723)
dlnreal_fx		-44.839		-45.730		-50.895
		(75.934)		(75.935)		(75.911)
Observations	1854	1854	1854	1854	1854	1854
Log lik.	-1.2e+04	-1.2e+04	-1.2e+04	-1.2e+04	-1.2e+04	-1.2e+04

Marginal effects; Standard errors in parentheses
(d) for discrete change of dummy variable from 0 to 1
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4.14: OECD Industry Classification, with NACE Rev.1.1. mapping

Industry Description	OECD Classification	Nace Rev. 1.1. Code
Traded Industries		
Mining of coal and lignite; extraction of peat	2	10
Manufacture of food products and beverages	3	15
Manufacture of tobacco products	3	16
Manufacture of textiles	4	17
Manufacture of wearing apparel; dressing and dyeing of fur	4	18
Manufacture of wood and of products of wood and cork, except furniture	5	20
Publishing, printing	5	22
Manufacture of chemicals and chemical products	8	24
Manufacture of rubber and plastic products	10	25
Manufacture of other non-metallic mineral products	11	26
Manufacture of fabricated metal products, except machinery and equipment	14	28
Manufacture of machinery and equipment n.e.c.	15	29
Manufacture of electrical machinery and apparatus n.e.c.	17	31
Manufacture of medical, precision and optical instruments, watches and clocks	19	33
Manufacture of motor vehicles, trailers and semi-trailers	20	34
Nontraded Industries		
Wholesale trade and commission trade, except of motor vehicles and motorcycles	27	51
Retail Trade except motor vehicles	27	52
Construction	26	5
Sale Maintenance and repair of motor vehicles	28	50
Hotels and Restaurants	33	63

Following Campa and Goldberg (2006) the nontradables industries are from OECD industry 25 and higher, excluding industry 27 and 29. The tradable industries are those sectors which have OECD industry lower than 25 including wholesale and retail trade as well as transport.

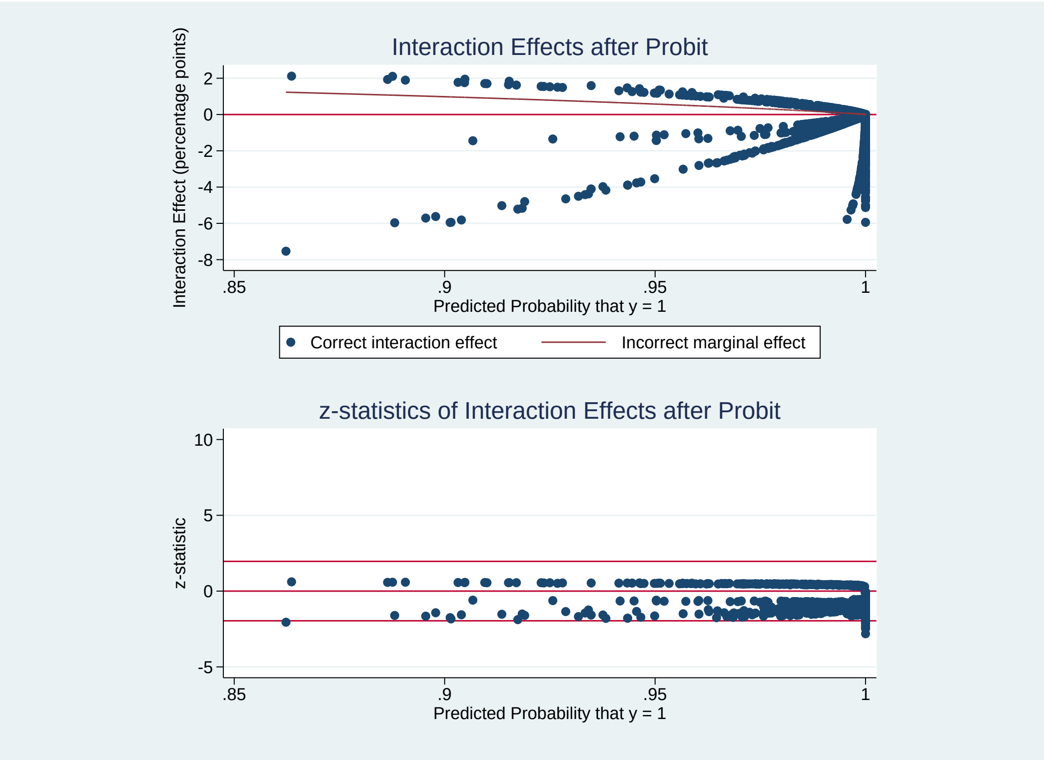


Figure 4.1: Interaction Effect between Real Exchange Rate and High Productivity Firms - Nontraded Industries

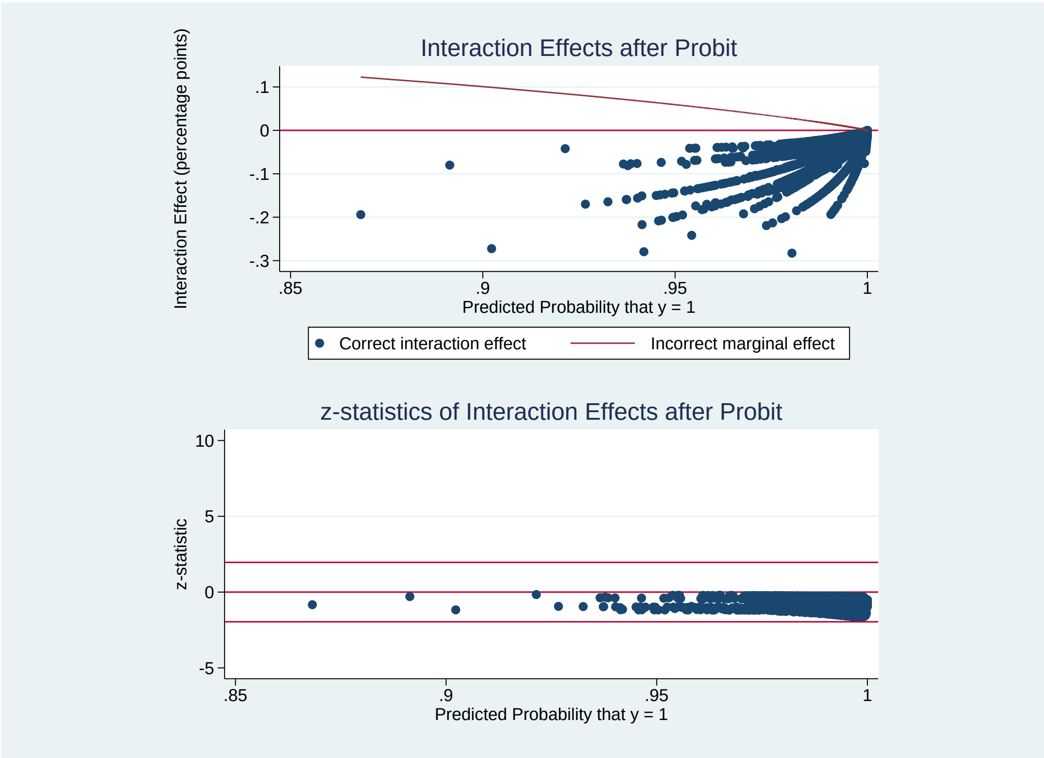


Figure 4.2: Interaction Effect between Real Exchange Rate and High Productivity Firms - Traded Industries

Table 4.15: Descriptive Statistics - Firms with and without Employment Data

	Firms without Missing Employment Data		Firms with Missing Employment Data	
Variable	Observations	Mean	Observations	Mean
Nominal Sales	6778	80,900,000	21591	59,100,000
Domestic Sales	6778	59,000,000	21591	46,700,000
Exports	6778	21,000,000	21591	11,500,000
Employment	6778	338	0	-
Age	6778	29.4	1367	21.9
Real Sales	6778	10,608	21591	6,233
Total Assets	6778	84,300,000	21633	47,000,000
Real Total Assets	6778	1,054,346	21425	395,854
Labor Productivity	6778	41.13	0	-
Export Share	6778	0.25	20831	0.17

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