Multi-product firms, exports and exchange rate policies. Evidence from an emerging economy

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Abstract

Bulgaria follows a currency board tied to the euro. The analysis of the effects that adopting the euro might have on its export sector is crucial for Bulgaria and other similar Eastern European countries. Bulgaria, a middle-income country has now more multi-product firms (MPFs) than single-product firms (SPFs). Thus, MPFs is not only a characteristic of only high-income countries. The contribution of adding and dropping products within a single firm is important to the export sector and the aggregate economy. MPFs benefit from exporting to EU markets by becoming more productive and encouraged to exporting more product varieties while beating down the costs of producing these new varieties and the cannibalization effect. These MPFs might be in advantage as a result of facing lower exchange rate costs and being better exposed to the acquisition of know-how and technology from participating in EU markets. MPFs cut their product diversity only to non-EU countries to keep core competence and in response to adverse changes in the exchange rate.

1. Introduction

The impacts of exchange rate movements on trade flows at the country level or firm level have been widely analyzed for highly developed countries. Much fewer such studies however exist for emerging and developing countries. In addition, earlier empirical work analyzing the *exporter behavior* in response to exchange rate variations has used plant or single-product-firm data. The literature on international trade has however recently provided evidence that countries have significant number of firms that export not only multiple products but also large number of products to multiple destinations. Bernard, Redding and Schott (2010) have found that around one half of surviving U.S. firms add and/or drop products from their existing range every five years, and the contribution of the added and dropped products to aggregate output is of around the same magnitude as the contribution of firm entry and exit. So far very little has been done in the literature to analyze the role that exchange rate variations play in the internal organization of the firm, namely its optimal export price setting of each variety, its choice of the export volume of each variety, its choice of product varieties, and how these factors interrelate with each other. One of our contributions to the literature here is to carry out such analysis both theoretically and empirically. This multi-product feature in the data has recently led to the development of theoretical studies which move beyond the analysis of the inter-firm dynamics such as those of Neary and Eckel (2010); Eckel, Iacovone, Javorcik and Neary (2010); Arkolakis and Muendler (2011); Bernard, Redding and Schott (2011) and Mayer, Melitz and Ottaviano (2014). There are a couple of empirical studies considering the case of multi-product firms which are very close to our paper. We have the work of Berman, Martin and Mayer (2012) who study how the productivity of French firms influences the effect that variations in the real exchange rate have on export prices and volumes, and on the firm possibilities to participate in international trade. They do not emphasize much on intra-firm dynamics. And Chatterjee, Dix-Carneiro and Vichyanond (2013) find that the effect of real exchange rate variations on export prices depends on Brazilian firm's marginal costs of producing new product varieties.[1]

[1] In section 2, we explain more extensively these two studies and how our work is related to and different from those papers.

We contribute to the related literature on several major fronts. Our *first* contribution, modest but perhaps important, is to present an extended version of Neary and Eckel's (2010) Cournot differentiated products model in which we show how real exchange rate variations will affect the export volume and price of every product variety. In the same way as Neary and Eckel (2010), we consider the *"cannibalization effect"*, a phenomenon by which MPFs make intra-firm adjustments and internalize demand linkages between the varieties they produce which are very different from adjustments via exit and entry of firms. We here study how this effect, combined with real exchange rate variations, influences volume and prices of all product varieties that are exported. We in addition analyse how firms with *flexible manufacturing*, as defined by Neary and Eckel (2010) (see also Milgrom and Roberts (1990); Eckel (2009)), that supply additional product varieties outside their core competence, could face diseconomies of scope and increasing costs which ultimately affect the volume and price of every variety. We seek to determine how real exchange dynamics, cannibalization and high costs of product diversification jointly affect the ranges of products supplied for export by MPFs. Such effects have not been analyzed before in the relevant literature.

The *second* is, using a unique database on firm-level exports for Bulgarian firms, we test our theoretical model in order to broaden the standard analysis of inter-firm heterogeneity (e.g. with respect to industry, size, product destination, productivity), and instead explore the within-firm product heterogeneity. We specifically study the interrelation between the firm's choice of its range of varieties of goods as well as volume and unit values of each of its product varieties, and the real exchange rate variations. We should note at the outset that in 2001 there was more single-product firms (SPFs) than multi-product firms (MPFs), but since 2004, the number of Bulgarian MPFs has become larger than the number of SPFs, and the gap has only been increasing since then. The volume and value of exports have been always larger for the MPFs. Thus, MPFs is not a phenomenon of high-income countries but also of a country such as Bulgaria with USD 7,500 income per capita in 2013. *Third*, we study how between and within-firm dynamics, i.e. optimal adjustments of their export unit values and number of product varieties, depend on the Bulgarian firms' decisions about whether to serve EU markets, Non-EU markets or a combination of both. Our data indicate that the degree of market specialization is another important aspect from which Bulgarian multi-product firms

differ. We consider the following groups of Bulgarian firms: i) MPFs and Single Product Firms (SPFs); ii) MPFs across different industries; iii) MPFs of different sizes; and iv) MPFs that export exclusively to EU markets[2], solely to Non-EU markets, and to both EU and Non-EU markets.[3] Our study expands the pricing-to-market literature, which has found that variations in pricing-to-market behavior across industries and firms are more important than variations across destination countries (e.g. Knetter (1993), Feenstra et al. (1996), Atkeson and Burstein (2008), Gopinath and Itskhoki (2010), Chatterjee, Dix-Carneiro and Vichyanond (2013), Berman, Martin and Mayer (2012)). This distinction between EU, and Non-EU or combination of the two as destinations is extremely crucial for Bulgaria that has signed an EU accession treaty in 2005 and introduced a currency board since 1997 using the euro as anchor currency. Our analysis of the Bulgarian export market can be also considered as a case study for evaluating possible advantages or disadvantages of adopting the euro if its EU accession materializes. One might expect higher productivity and more positive within-firm adjustments in the Bulgarian export sector through, not only higher export volumes, but also increased numbers of product varieties (in MPFs) and more EU country destinations (for SPFs in particular), due to reductions in exchange rate transaction costs and risks and other benefits that trading with countries in the euro zone bring. This conclusion critically depends on whether it is costly for Bulgarian exporters to face uncertainties in the real exchange rates with their Non-EU trading partners, and on the costs or benefits that exporting to Non-EU countries might entail in comparison to those when exporting to EU countries.

In our empirical analysis we have an exceptional methodological advantage from the fact that Bulgarian monetary authorities currently follow a currency board tied to the euro. This implies that we can safely assume that the Bulgarian exchange rate is exogenous relative to currencies of countries outside of the euro zone. The possible effects that adopting the euro might have on the development and success of its export sector is probably one of the most important issues for Bulgaria, and many other similar Eastern European countries, for

[2] Here, the group of EU-countries includes also countries that have adopted the euro as their currency anchor.

[3] We think it is necessary to group the MPFs according to their choice of the market destinations for their exports. The grouping that we here propose allows us to maintain the actual MPFs' specialization and structure.

deciding whether or not to seek to adopt the euro as its currency in the near future. This issue should become even more relevant once the European Union successfully resolves its ongoing debt crises and takes the necessary measures to avoid further fiscal deficit impasses.

The paper is organized as follows. In section 2 we discuss the related literature; in section 3 discusses the data and some stylized facts about the Bulgarian export market; while section 4 includes our theoretical model. Section 5 presents the empirical model and the estimation strategy. Section 6 brings the empirical results; and section 7 concludes.

2. Related literature

The implications of exchange rate volatility for international trade have been extensively studied both theoretically and empirically. Much fewer studies though have used firm-level data for *individual countries* to analyze the adjustments that occur between and/or within firm-exporters as a result of exchange rate variations especially for exporters in developing countries. Important exceptions are for example the works of Roberts, Sullivan and Tybout (1995) who consider data from Colombia, Mexico and Morocco; Roberts and Tybout (1997) Roberts studied the Colombian case; and the recent work of Chatterjee, Dix-Carneiro and Vichyanond (2013) that analyzes firm-level data from Brazil.

Our work is closely related to Berthou and Fontagne (2008); Berman, Martin and Mayer (2012); and Chatterjee, Dix-Carneiro and Vichyanond (2013). Berthou and Fontagne (2008) analyze the effect of the adoption of the euro, via a reduction in the volatility of the nominal exchange rate, on the volume of exports and number of varieties per industry. They use firm level data for the period 1995-2003 to construct the industry variables. Their empirical work indicates that exports activity in the euro zone is driven by the extensive margin (*new variety*) hypothesis of the euro, and that a reduction in the nominal exchange rate volatility increases the value of exports by variety (*intensive margin*). They do not distinguish between MPFs and SPFs, and do not analyze the effect of flexible manufacturing and the cannibalization effect as we do here. They do not either control for the differences between the intra-firm organization and dynamics for firms exporting solely to EU markets, Non-EU markets or both markets.

Using also firm-level French data, Berman, Martin and Mayer (2012) find that high performance firms absorb exchange rate movements in their mark-up rates instead of in their export volumes, while low performance firms do exactly the opposite. In addition, they find that, following a bilateral depreciation, French exporters selling in sectors and countries with high distribution costs, choose to increase their mark-ups rather than their export volumes. Finally, they find that French firms will try to enter the market fairly quickly after a depreciation is experienced (i.e. the extensive margin represents around 20% of the total increase in exports), but they pointed out that these firms are small to have a significant impact at the aggregate level. Chatterjee, Dix-Carneiro and Vichyanond (2013) use Brasilian data at the firm level and find that when there is an exchange rate depreciation of the Brazilian currency, firms increase their product range and raise producer price. In addition, they report that the relative position of a product within a firm is a statistically and economically significant determinant of firm's export price responsiveness to real exchange rate shocks. Specifically, their results indicate that conditional on the firm's productivity, the increase in producer prices is greater for products closer to the core of competence.

Our paper differentiates itself from the last two studies in many ways, the most important are: i) we study how, depending on the country destination, MPFs' intra-firm adjustments (of prices and product range) can lead to higher productivity after counteracting cannibalization effects and the costs of operating with flexible manufacturing, as we defined in the introduction; ii) we analyze how the effect of real exchange movements on the volume and prices of *every variety* is influenced by the existence of the cannibalization effect and flexible manufacturing; and iii) we emphasize on how MPFs' internal organization, choice of product range and price determination depend strongly on the market destinations they serve through trade. We thus broaden their work by analyzing the dynamics of intra-firm adjustments of the production line by firms. We analyze the price strategy of MPFs as they move away from their core competence as Chatterjee, Dix-Carneiro and Vichyanond (2013). We however also focus on how such relationship between prices and deviations from core competence depends crucially on the country destination, industry and firm size. In addition, we study in detail the effects on deviating from core competence on the volumes of every variety, and not only on prices. Importantly here and in contrast to Chatterjee, Dix-Carneiro and Vichyanond (2013),

we study how cannibalization affects first the export volume and prices of every variety, and then the relation between the real exchange rate and quantities and prices of all varieties. In a nutshell, throughout our empirical analysis, we differentiate between MPFs and SPFs; between MPFs that specialize in different markets: EU and/or Non-EU countries; MPFs by size; and MPFs by industry. We measure quantitatively the effect of i) the real exchange rate dynamics; ii) rising costs when firms move away from their core competency (i.e. diseconomies of scope); and iii) cannibalization that emerge when there is internalization of demand linkages between the varieties of goods produced by exporting firms, on export volumes of each variety by existing exporters and their export prices.

There are other very early theoretical works that have studied the role of the exchange rate on international trade. Ethier (1973) and Clark (1973) find that if there is uncertainty about how the firm's revenue could be affected by future exchange rates variability, the level of trade will be negatively affected by this uncertainty. Clark however concludes that the larger the negative covariance between the foreign price and the exchange rate, the smaller the negative impact of exchange rate variability on the level of trade. Other well known theoretical works relating international trade and exchange rate are the ones of Baldwin (1988) and Baldwin and Krugman (1989) whose ideas were later formalized by Dixit (1989a,b). They argue that a non-exporter must incur an entry cost to participate in the export markets, and this entry cost is sunk. Likewise, an exporter may face fixed costs of shutting down. In Dixit's work, an exporting firm is regarded as owning an option to leave the export market, and a non-exporter has an option to enter. Dixit argues that the value of the option is influenced not only by the cost of entry and exit but also by the levels of the exchange rate.

Previous empirical work that have used more disaggregated data (e.g. firm or panel data), has focused on the effect of exchange rate changes on the entry and exit decision in export markets. The results using these micro data on relationship between export volumes and exchange rates are mixed. Campa (1993), and Roberts and Tybout (1997)[4] find evidence of the existence of sunk costs in entering and exiting the export market which result in sluggish

[4] Campa (1993) uses Spanish data while Roberts and Tybout (1997) have data from Colombia.

response of trade flows to exchange rates movements. Campa (2004) uses data from Spain and finds that trade adjustments due to changes in the exchange rate levels and volatility mainly occur through the adjustment of quantities by existing exporters (intensive margins) rather than through changes in the numbers of exporting firms (extensive margins). In contrast, Roberts, Sullivan and Tybout (1995) using data from Colombia, Japan, Mexico and Morocco find that new exporters were a major factor in explaining the export boom that these countries experience in the 1980s. These latter authors argue that the main explanation for such booms is the structural and institutional reforms that Colombia, Mexico and Morocco underwent, in addition to favorable exchange rate movements (i.e. devaluation of their currencies).

Bernard and Jensen (2001) and Bernard and Jensen (2004) use data for U.S. manufacturing plants and find that favorable exchange rate shocks do increase participation in exporting (after controlling for entry costs and other forms of intertemporal spillovers, and firm characteristics such as size, labor composition, productivity, product mix and ownership structure, but also subsidies). Bernard and Jensen (2004) argue that the delay response to the dollar depreciation (in mid 80's) is due to entry (sunk) costs. Greenaway, Kneller and Zhang (2007) use firm-level data from a sample of UK manufacturing firms and find strong evidence of sunk costs in export markets, and that the exchange rate has little effect on firms' decisions to enter and exit, but have significantly affect export shares.

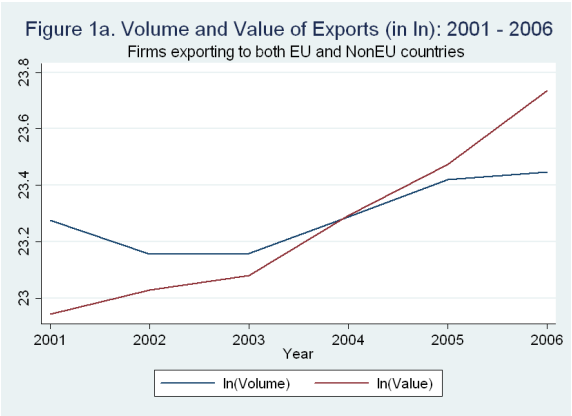
Dekle, Jeong and Ryoo (2007) consider a panel data of exporting firms of Japan for the period 1982-1997 and find that the estimates of the exchange rate elasticity of exports is negative at the firm level.

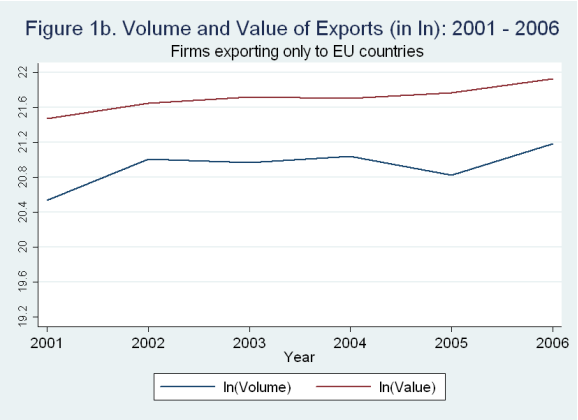
3. Stylized features of the Bulgarian export market

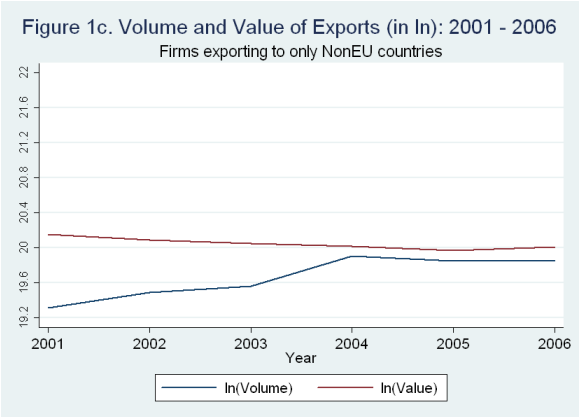
The data sources are from the Bulgarian customs for firm-level trade. The original dataset is at the quarterly basis and contain transactions-level customs for exports by product at the HS nine-digit level but also report the destination of the exports, the value of the exports, and volume (in commercial units) for each firm located in the Bulgarian territory. Each firm is uniquely recognized by its 13-digit identifier. There are about 1,954,345 exporter-quarter observations (or 1,292,945 firm-commodity-country destination quarterly observations). All

the numbers presented are in Bulgarian levs (BGN). After eliminating redundancies and converting the data into yearly data, we end up with a well organized panel dataset of 796,687 firm-commodity-country destination yearly observations.

Figures 1a, 1b and 1c show that the total value of exports to the Non-EU countries has been not only lower over the years between 2001 and 2006 than the corresponding values for firms exporting only to EU countries and values for firms exporting to both EU and NonEU countries, but also decreasing. Similar patterns, with slight more variability can be seen for the volumes







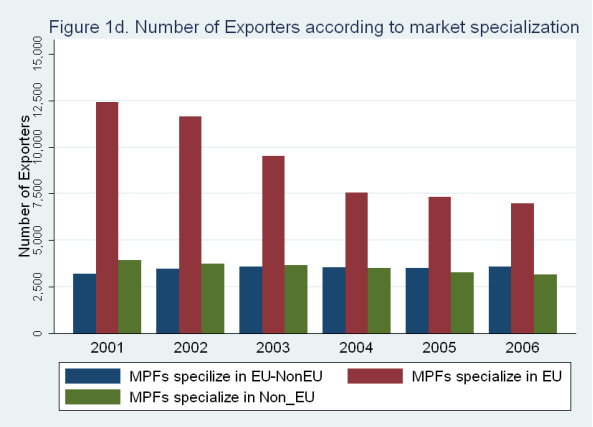
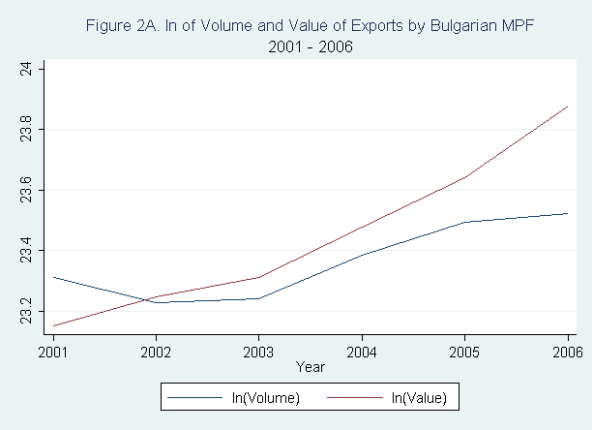


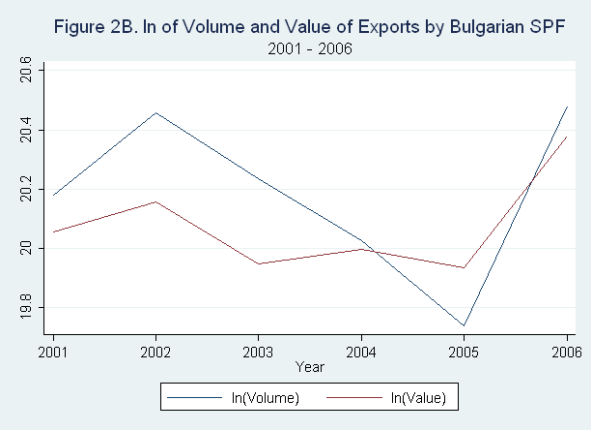
Table 1 shows on the other hand that there is a small difference between the yearly mean volume by firms exporting exclusively to EU markets and the yearly mean volume for firms exporting only to Non-EU markets, but both of these mean volumes are significantly smaller that the volume by firms exporting to both EU and Non-EU markets. The yearly average export value of firms specializing in Non-EU markets is only 57% of the average value by firms that focus on EU markets, which confirm the patterns shown in Figure (1b)

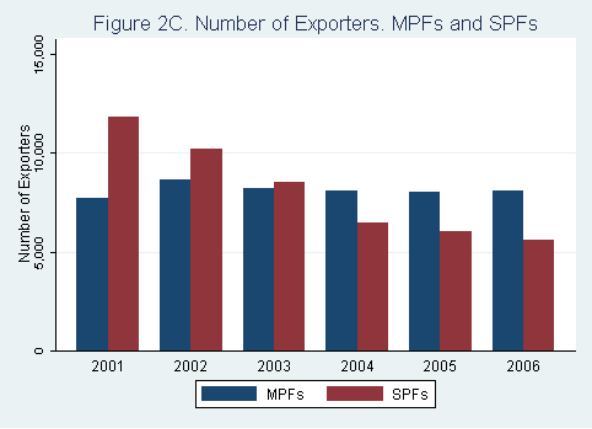
and (1c). Such low value and volume by firms exporting solely to Non-EU cannot be explained by the fact that they are fewer firms because their number is similar to the number of firms that specialize in exporting to both EU and Non-EU markets (see Figure 1d). Note also in Figure 1d that the number of MPFs focusing in EU markets has been decreasing over time, but is still larger than MPFs with other market specializations. Nevertheless, MPFs specialists in EU markets have been able to maintain relatively high volumes and values of their exports, which might imply that the firms that remain exporting to EU markets are likely quite competitive.

Fact 1*.Total volume and value of the exports by MPFs specializing in Non-EU is much smaller than their counterparts specializing in EU markets or in both EU and Non-EU markets.*

Fact 2. *The number of MPFs specializing in EU markets has been decreasing but the levels of the export quantities and values of these EU markets have been relatively stable.*







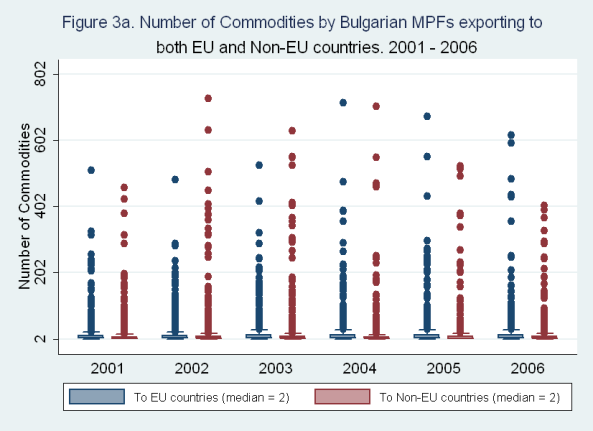
Figures (2a) and (2b) show the value and volume of both multi-product firms (MPF) and single-product firms (SPF). Table 1 indicates that the yearly mean value of export for SPFs is 44% of the volume for MPFs. Likewise, the yearly mean volume by SPFs is 57% of the corresponding volume for MPFs. The average number of MPFs that exported over the period of 2001 to 2006 is similar to the number of SPFs that also exported. See Table 1. However, in Figure 3C we notice that the number of SPFs has been decreasing dramatically.

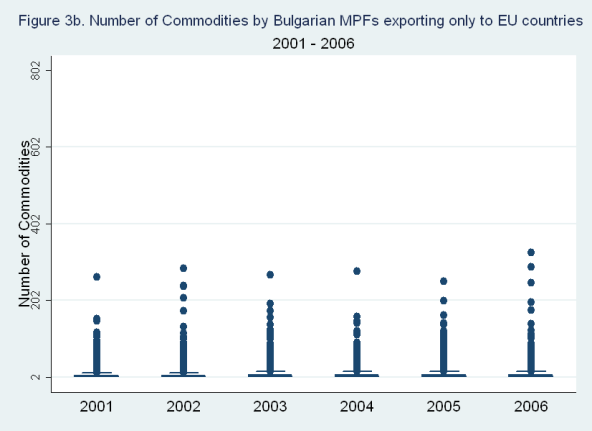
Fact 3: *The number of SPFs has been decreasing dramatically between 2001 and 2006. The value and volume of exports have been volatile.*

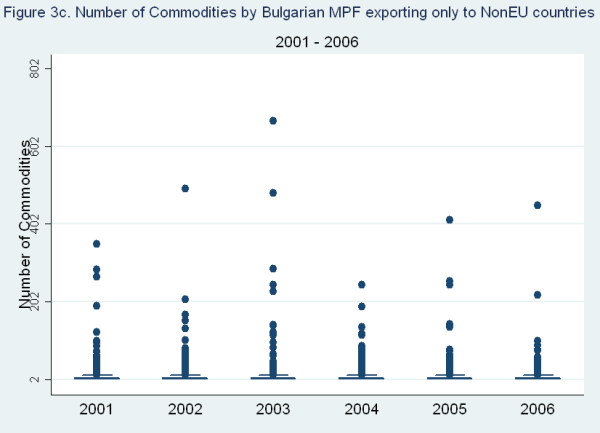
Table 1. Descriptive Statistics: 2001 - 2006

	All firms	**MPF**	**SPF**	**Firms specialized in EU+NonEU**	**Firms specialized in EU**	**Firms specialized in NonEU**
Observations: Firm-product-destination	796,687	741,456	55,231	512,405	213,493	70,789
Yearly mean value of exports	123,066	127,978	57,134	153,833	75,687	43,257
Yearly mean volume of exports	110,866	114,251	65,422	153,593	35,118	30,032
# Exporters/Firms	97,408	48,715	48,693	20,809	55,424	21,175
# Products: average/max	5.5/877	10.0/877	1/1			
# Products to EU: average/max				7.3/715	3.6/326	
# Products to NonEU: average/max				5.6/728		3.2/667
# Country destinations: average/max	2.1/64	3.0/64	1.1/40			
# EU country destinations: average/max				2.8/24	1.2/9	
# NonEU country destinations: average/max				2.6/43		1.1/9

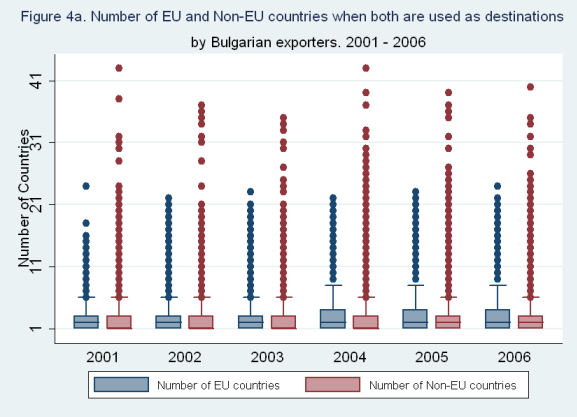
There are some differences in the number of commodities exported by Bulgarian firms over the period of 2001 to 2006. By looking at Figures (3a), (3b) and (3c), we notice that firms specializing in both EU and Non-EU markets have exported more commodities than firms exporting only to EU markets or only Non-EU markets. Table 1 indicates that a few firms that are EU and Non-EU specialists and Non-EU specialists have indeed exported a larger number of varieties than EU-specialists. Because of these outliers, over the years 2001 and 2006, EU specialists exported only 45% and 48% of the maximum number varieties exported by firms selling to only Non-EU markets and by firms specializing in both EU and Non-EU markets, respectively.

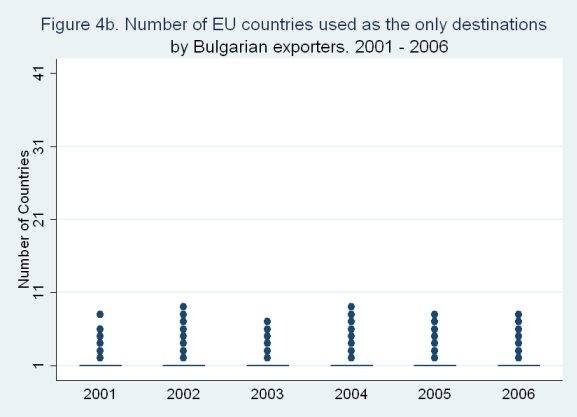


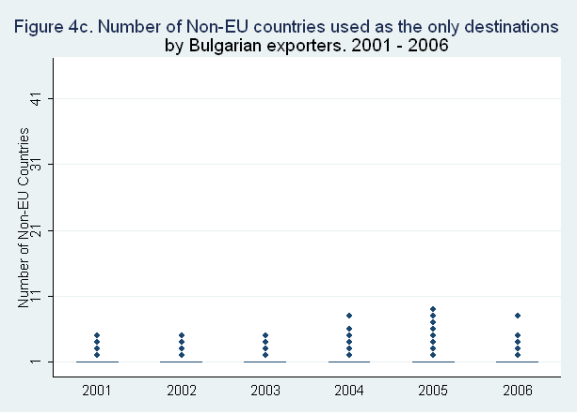




Figures (4a), (4b) and (4c) and Table 1 show that firms that are EU specialists have similar number of country destinations than Non-EU specialists. In contrast, firms specializing in exporting to both EU and Non-EU countries have a larger portfolio of countries.







One of the implications from the data description above is that firms specializing on EU markets are likely to be highly productive since they have experience steady increase in their value and volume of exports in spite of their declining population, and a moderate number of varieties and country destinations. We also noticed that firms specializing in both EU and Non-EU markets produce a relatively larger number of varieties (to also a large number of country destinations) than their counterparts. We will investigate whether exporting more varieties and therefore deviating from their core competency has given higher diseconomies of scope and cost for these firms. We have found indeed a significant heterogeneity among Bulgarian firms. We will study the implications of this below.

4. Theoretical model

4.1 Intensive margin, exporter prices and the effect of the exchange rate

Our theoretical framework to study how real exchange rate shocks affect exporting firms' optimal quantity and price decisions is based on the work of Neary (2009), Neary and Eckel

(2010), Melitz and Ottaviano (2008) and Mayer, Melitz and Ottaviano (2011) who consider multi-product firms and heterogeneous firms. Our home country is Bulgaria and assumed to have a continuum of industries, each with small number of firms. Factors are mobile within each industry, and factor prices are determined at the economy-wide level. Firms are modeled as having market power in their own industry but not in the economy as a whole. Many of these are multi-product firms and behave strategically against their local rival but take income, prices in other sectors and factor prices as given. We assume that firms in Bulgaria cannot affect the real exchange rate.

In our model, Bulgaria exports to different countries whose consumers have each preferences defined over a continuum of differentiated varieties of commodities. It is now useful to present first the behavior of consumers and then the behavior of MPFs in a single industry.

In the modeling of the behavior of consumers, following Neary and Eckel (2010), it is assumed that all consumers in any country destination k to Bulgarian exports have the same utility function and each of them maximizes a two-tier utility function that depends on their consumption levels $q(i,z)$, in which good $i \in [1,N(z)]$. $N(z)$ is the number of differentiated goods (total mass of differentiated goods) produced in the Bulgarian industry z and available for consumption. The number of industries varies over the interval [0,1].

Thus, the Bulgarian economy consists of a continuum of industries, each of which has an oligopolistic market structure. There are a finite number of country destinations to Bulgarian exports. Consumers in all the country destinations have identical preferences but because incomes may differ between countries, consumption levels and marginal utilities will be different.

Each consumer maximizes a two-tier utility function that depends on their consumption levels $q(i,z)$ of the $N(z)$ varieties produced in each Bulgarian industry z. The upper tier is an additive function of continuum of sub-utility functions, each corresponding to one industry:

$$U[u\{q(0,z)\},...,u\{q(N(z),z)\}] = \int_0^1 u\{q(0,z),...,q(N(z),z)\}dz \,. \qquad (1)$$

In the lower tier, the representative consumer in the country destination k is assumed to have, for each industry z, an additive function of a continuum of quadratic sub-utility functions:

$$u[q(0,z),...,q(N(z),z)] = a\int_0^{N(z)} q(i,z)di - \frac{1}{2}b(1-\xi)\int_0^{N(z)} q(i,z)^2 di - \frac{1}{2}b\xi\left[\int_0^{N(z)} q(i,z)di\right]^2. \quad (2)$$

The utility parameters a, b and ξ are assumed to be identical for all consumers in destination country k, denoting the consumers' maximum willingness to pay, the inverse market size and the inverse degree of product differentiation respectively. If $\xi = 1$, the goods are homogeneous (perfect substitutes) so that demand only depends on aggregate output in the entire industry. On the other hand, $\xi = 0$ describes the monopoly case where the demand for each good is completely independent of other goods. In this case, consumers give increasing weight to the distribution of consumption levels across varieties. We will assume that the Lagrange multiplier $\lambda = 1$ so that at equilibrium nominal variables are relative to the marginal utility of income (see Neary and Eckel (2010)).

Considering e_k as the number of Bulgarian levs per currency of country k, individual consumers in the destination country k will maximize utility subject to the budget constraint:

$$\int_0^1\int_0^{N(z)} \frac{p(i,z)}{e_k} q(i,z)di\,dz \le I\,; \quad (3)$$

where I denotes consumer's individual income and $p(i,z)$ is the price of this good i in terms of Bulgarian levs so that $p(i,z)/e_k$ is the price of this good i in terms of the currency in country k.

From the maximization problem, we derive the individual inverse demand function for good of variaty i in industry z by the representative consumer in country destination k:

$$\lambda\frac{p(i,z)}{e_k} = a - b(1-\xi)q(i,z) - b\xi\int_0^{N(z)} q(i,z)di\,. \quad (4)$$

The parameter λ is the Lagrange multiplier, which denotes the consumer's marginal utility of income.

To move from the individual to aggregate demands, we assume that there are *L* consumers located in each of *k* identical foreign countries. Because the goods markets of all countries are completely integrated in a single world market and free trade prevails, the price of a given variety is the same everywhere. Therefore, the market demand for a particular commodity of variety *i* in industry *z* is *x(i,z)*. A Bulgarian firm faces this demand for its product *i* from *k* country destinations. The total demand from all foreign consumers will be *υLq(i,z)*. The inverse world market demand function for good *i* in the Bulgarian industry *z* can then be rewritten as:

$$\frac{p(i,z)}{e_k} = a' - b'[(1-\xi)x(i,z) + \xi Y(z)]; \tag{5}$$

where $a' = \frac{a}{\lambda}$; and $b' = \frac{b}{\lambda \upsilon L}$. Note however that *b'*, the slope of the demand function, is negatively related to the number of total consumers in the world.

We can now define the output in an entire industry *z* in Bulgaria producing differentiated goods as:

$$Y(z) = \int_0^N x(i,z)di. \tag{6}$$

Going now to the representative multi-product firm *j* in Bulgaria, that produces a mass of products denoted by δ^j, will have profits equal to:

$$\pi_j = \int_0^{\delta_j} \left[p_j(i,z) - c_j(i,k) \right] x_j(i)di - F_k; \tag{7}$$

where F_k is a fixed costs when exporting to country *k,* and $c_j(i,k)$ is the marginal costs of producing good *i* for country *k*. These marginal costs are constant with respect to the quantity produced but differ with varieties and the destination country, e.g. an EU country destination versus a Non-EU country destination. This marginal cost will be lowest for the core competence variety because it uses the firm's most efficient production process. The firm can produce more varieties as part of its production line via flexible manufacturing which describe its ability to produce additional varieties. Nonetheless, the production of more varieties requires from the firm some modifications and to incur in higher marginal

production costs, even when its marginal production costs of producing existing products remain unchanged. Moreover, in our analysis we distinguish between the costs of exporting to EU countries and to Non EU countries in light of the facts that trading with the EU countries might imply higher competition and therefore higher costs of marketing and quality control, stricter regulation. These costs however could be compensated with the reduction in transaction costs and exchange rate risk as a result of Bulgaria using the euro as a common currency, but also the benefits of being able to acquire technology and knowledge when trading with more developed countries as those in the euro zone.

Marginal production costs for variety *i* are therefore an increasing function of the mass of good varieties produced $\frac{\partial c_j(i,k)}{\partial_i} > 0$; and satisfies $\frac{\partial^2 c_j(i,k)}{\partial_i^{\,2}} > 0$.

The market structure in a typical industry, the heterogeneous firms follows a Cournot oligopoly so that multi-product and single-product firms compete side by side determining simultaneously and strategically their scale and scope of production, assuming that the rivals do not change their scale or scope.

The first-order condition with respect to the scale of production of a particular good *i*[5] is given by:

$$\frac{\partial \pi}{\partial x_j(i,z)} = p_j(i,z) - c_j(i,k) - b'[(1-\xi)x(i,z) + \xi X_j] = 0; \qquad (8)$$

where $X_j = \int_0^{\delta_j} x_j(i)di$ is the firm j's aggregate output. The output of a good of a single variety can be found by solving (5) and (8) after eliminating the price of good *i*:

$$x_j(i,z) = \frac{e_k a' - c_j(i,k) - b'\xi(X_j + e_k Y(z))}{b'(1-\xi)(1+e_k)}. \qquad (9)$$

Result 1. A depreciation of the Bulgarian lev will increase the production of all varieties. A greater product differentiation (smaller ξ) decreases the effect of the exchange rate.

[5] In any given industry *z*.

Result 2. Greater competition (i.e. larger aggregate industry output, $Y(z)$) leads to lower output of variety *i* at equilibrium.

Result 3. Given the industry's and firm *j*'s total output, this firm j will produce less of each variety the further upward it is from its *core competence*, that is, $x_j(i)$ is decreasing in $c_j(i,k)$.

Result 4. Increases in total output by firm *j* reduces the production of variety i at equilibrium. This is the *cannibalization* effect that could occur when MPFs internalize demand linkages between the varieties of goods that they produce in particular when they face competition and they are relatively large in their markets. An MPF knows that a larger output of one variety would tend to lower the prices that consumers in country *k* are willing to pay for its other varieties. As a consequence, an MPF will have an additional incentive to restrict its output of each variety beyond the familiar own-price effect (see Neary and Eckel (2010) for further details).

Result 5. Higher costs reduce the effect of a depreciation of the Bulgarian lev. Notice that for a given depreciation, the ratio $c_j(i,k)/b'(1-\xi)(1+e_k)$ increases as $c_j(i,k)$ rises. Such effect diminishes the positive effect that depreciations have on the volume of every variety, as indicated in Result 1.

Result 6. Cannibalization reduces the effect of a depreciation of the Bulgarian lev. The reasoning here is similar to the one in Result 5.

Given the symmetric structure of demand, this result should imply that a firm will charge higher prices for products that are further from its core competence. We can obtain the price equation (10) after using (5) and (8):

$$p_j(i) = \frac{1}{(1+e_k)}\left[a' + c_j(i,k) - b'\xi(Y - X_j)\right]. \qquad (10a)$$

Result 7. There is a negative effect or real depreciation of the Bulgarian lev onto prices. Thus, depreciations make firms more price competitive.

Result 8. The reduction in the prices that firms can charge in Cournot markets in response to real depreciations is partly offset by the cannibalization effect, which encourages MPFs to charge higher prices on all their varieties

We will test these *Results* for all our firms but we will also analyze if these analytical results depend on whether the firm is exporting only to the EU markets, only to the Non-EU,

and to both EU and Non-EU markets; its size and the industry they belong to. This is the topic of the next section.

5. Empirical work

5.1 Groups of firms

We aggregate the quarterly data on exports into yearly basis and analyze it as follows:

i) *All firms*

ii) Multi-Product Firms (*MPF*) and Single Product Firms (*SPF*)

iii) *By size*: lowest 25 percentile, between 25 – 50 percentile, 50 – 75 percentile, between 75 – 95 percentile, between 95 – 99 percentile, and between 99 – 99.8 percentile.

iv) *By industry of origin*: we chose the ones with the largest export values, SITC6 (manufacturing goods); SITC7 (machinery and transportation equipment); SITC8 (miscellaneous manufacturing); SITC0 (food and live animals); SITC5 (chemical products); SITC2 (crude materials); and SITC3 (mineral fuels and lubricants).

v) *By country destination*: firms that concentrate in exporting to both EU and Non-EU countries; firms that only specialize in exporting to EU countries; and a third group of firms that only focus in exporting to Non-EU countries.

5.2 The empirical equations

We here present our empirical relations and the estimation method.

5.2.1 The fixed effects

We include the following fixed effects in the estimation of the export supply function of variety i to country k by exporter j at time t, q_{ijkt}; and the export unit price, p_{ijkt}:

Fixed effect one: A time-fixed effects, τ_t, that captures the overall evolution of the Bulgarian economy like the wage rate, business cycles and other macroeconomic effects.

Fixed effect two: Firm-commodity-country destination fixed effects is represented by μ_{ijk}.

5.2.2 The empirical export supply equation

Define the real exchange rate (*RER*) between the Bulgaria and country k as $RER \equiv (w_k e_k / w)$ in which w_k and w are the wage rate in country destination k and in Bulgaria, respectively. After

taking into consideration that the marginal costs $c_j(i,k)$ can be decomposed into distribution costs (units of labor hired in country k which receive a wage equal to w_k), and the costs (Bulgarian wages and technology expenses) of producing variety *i*, the ***export supply*** of a single variety conditional on being an exporter (equation (9)) can be represented by the following empirical relation:

$$\ln q_{ijkt} = \alpha_1 \ln(RER_{kt}) + \beta_1 \ln(RER_{kt}) \cdot c_{jt}(i,k) + \delta_1 \ln(RER_{kt}) \cdot \ln(X_{jt}) + \gamma_1 Z_{kt} + \mu_{ijk} + \tau_t + \varphi_{ijkt} \quad . \qquad (11)$$

In (11), at time t, q_{ijk} is the firm *j*'s export volumes of commodity i to country destination *k*; and φ_{ijkt} is the error term. The RER_{kt} is the average real exchange rate between Bulgaria and country destination *k* during year t. Note that including RER_{kt} alone allows us to isolate the effect of exchange rate risk of exporting to country k, and such effect is also explicit in our theoretical specification, equation (9). α is expected to be positive. X_{jt} is the firm's aggregate production at time t. $c_{jt}(i,k)$ denotes the marginal cost which a typical firm j incurs to produce good *i*. We here use different measures of $c_i(\mathrm{i,k})_t$ and these are explained below. This cost is lowest for the core competence variety, which uses the firm's most efficient production process. The parameters β and δ which according to our model should be negative, measure the effects that firm's marginal cost and total production respectively have on the sensitivity of its exported quantity of every variety to the exchange rate. Z_{kt} is a vector of characteristics of destination *k* in year t.

We will not test *Result 3* because we do not have data on total industry production. We think that it would be inaccurate to assume that the production in a given industry is determined only by the production of all the firms that export products from that industry. We do not have data on how much is produced to the domestic economy.

5.2.3 The empirical unit price (value) of exports equation

The ***export unit price function*** (10) of our theoretical model conditional on being an exporter is represented by the following empirical relation:

$$\ln p_{ijkt} = \alpha_1 \ln(RER_{kt}) + \beta_2 \ln(RER_{kt}) \cdot c_{jt}(i,k) + \delta_3 \ln(RER_{kt}) \cdot \ln(X_{jt}) + \gamma_4 Z_{kt} + \mu_{ijk} + \tau_t + \eta_{ijkt} \quad . \qquad (12)$$

η_{ijkt} is the error term. Prices charged by firms are seldom available in firm-level data, thus, we use the unit value of exports of each commodity as a proxy for the price of commodity i in terms of Bulgarian lev, and denoted as p_{ijkt}. This unit value is computed dividing total sales of product *i*, from firm *j*, to destination *k* at time *t* by the total quantity of product *i,* from firm *j*, sold to destination *k* at time *t*.

5.3 The estimation method and controlling for endogeneity of the regressors

As mentioned earlier, we can in our empirical analysis safely assume exogeneity of the Bulgarian exchange rate with respect to the countries' currencies outside the euro zone because Bulgarian monetary authorities currently follow a currency board tied to the euro. However, if this exogeneity assumption of the Bulgarian exchange rate cannot be warranted to the extent that the Bulgarian prices are not likely to be harmonized with the prices of the country members of European Union and those of countries which have pegged in some way to the euro, our estimation method should take this into consideration.

We are also aware that other explanatory variables could be also expected to be endogenous, for this reason, we find the methodology of Arellano-Bover (1995)/Blundell-Bond (1998) useful when estimating the export supply function. The Arellano-Bover (1995)/Blundell-Bond (1998) dynamic panel estimators are dynamic panel estimators designed for situations with:

- Few time periods and many individuals (i.e. exporters);
- A single left-hand-side variable that is dynamic, depending on its own past realizations;
- Independent variables that are not strictly exogenous, that is, they are correlated with past and possible current realizations of the error term;
- Fixed individual effects; and
- Heteroskedasticity and autocorrelation within individuals, but not across them.

More specifically, we will deal not only with the possibility that the exchange rate and the other regressors are endogenous variables but it can be also correlated with the exporter-commodity-country individual effect, μ_{ijk}, by using the System GMM suggested by Arellano-

Bover (1995)/Blundell-Bond (1998). Their approach is efficient in dealing with such a possible correlation as indicated above. With their approach, instead of just differentiating the regressors to cross out our fixed effects (as defined above), it transforms the instruments in differences to make them exogenous to the fixed effects or time-invariant variables. This allows the introduction of more instruments, and can dramatically improve efficiency. Thus, in System GMM, one can include time-invariant regressors.

5.4 Construction of variables

a) The bilateral exchange rate. To calculate the real exchange rate, we obtained data from Bloomberg and the Penn World Tables. It is computed as the average yearly (from weekly data) nominal exchange rate times the ratio of consumer price indexes. An increase of the exchange rate means a depreciation of the Bulgarian lev.

b) As indicated above, we consider the volume and export unit price for each triplet exporter (*j*) – commodity (*i*) - country destination (*k*) at each t. The export unit price is calculated by dividing total sales of product *i*, from firm *j*, to destination *k* at time *t* by the total quantity of product *i*, from firm *j* sold to destination *k* at time *t*.

c) The GDP for each of the countries are also computed from the Penn World Tables. We also control for each country of destination's GDP ($\ln(GDP_{kt})$).

d) Firm's total exports of all his commodities to all its markets which will serve to estimate the cannibalization effect.

e) We do not have data on the marginal cost which a typical firm j incurs to produce good i, $c_{jt}(i,k)$, which the theory defines as being lowest for the core competence variety because the firm uses its most efficient production process. We however construct variables as approximations to $c_{jt}(i,k)$:

i) The number of variety-country pairs (number of commodity times countries) to analyze the possibility that these costs are not only inherent to firm j exporting commodity i, but it also to the country destination. We here distinguish between the pair commodity-EU country and the pair of commodity-NonEU country. We should expect the costs and competition from participating in the EU markets to be different from those in the Non-EU markets.

ii) The number of varieties. Here, we also make a distinction between the number of commodities exported to EU countries and the number of commodities exported to Non-EU countries.

iii) The number of varieties that deviate from the firm's historical average number of commodities. Differentiating the case of commodities exported to EU countries from the case of commodities exported to Non-EU countries.

6 Empirical Results

6.1 Estimation of the volume of variety *i* exported to country *k* by firm *j*: All firms, MPFs, SPFs, MPFs exporting to EU and/or Non-EU markets

6.1.1 Effects of the real exchange rate

The exchange rate has the expected effect: a depreciation of the Bulgarian lev encourages a greater volume of exports of every product variety and country destination. The only exception is for our group of firms that focuses in exporting only to EU markets in which the effect is insignificant.[6] See Tables 2, 3, 4 and 5. Apart from the exception, we confirm *Result 1* of the theoretical model.

6.1.2 Firm j's marginal cost to produce good i

We here present the results on how each of our different measures of marginal costs reinforces or reduces the effect of the exchange rate on the export volume of each product.

i) Increases in variety-country pairs (number of varieties times number of countries)

For our *group of firms* shown in Tables 2, 3, 4 and 5*,* one can notice that a larger number of varieties - NonEU countries weaken the effect of a depreciation of the exchange rate, which encompasses *Result 5.* That is, the positive effect that a depreciation of the Bulgarian lev have on the supply of exports by firm j of every product variety i to Non-EU countries will be weakened if firm j increases not only if its number of varieties but also its number of Non-

[6] Notice that when considering EU markets, one should really discuss the effect of changes in relative prices of the EU countries and Bulgarian prices.

EU countries. Conversely, higher costs of exporting more varieties and to more EU countries do not discourage Bulgarian firms to export more varieties to EU countries and countries that have adopted the euro as anchor currency. These firms then appear to become more productive once they concentrate in exporting to countries where competition is very tough, like in the EU. There are certainly some factors that might be sustaining such increase in these firms' productivity: a) better opportunities to acquire more advanced knowledge and technology; and b) elimination of exchange rate risk and transaction costs since Bulgaria follows a currency board using the euro as anchor currency.

Note that column 1 in tables 2, 3 and 4 show the results on the effect of increasing the number of varieties to all country destinations without distinguishing between EU and Non-EU countries. We have just shown however that the effect of these costs is not independent of the destinations.

For SPFs, it is only relevant to consider, as representation of their marginal costs, how increases in the number of country destinations affect the export volume of each product variety. See Table 3. We found that if costs rise as a result of exporting a larger number of Non-EU countries, SPFs will be discouraged to export more of all varieties of products. This is much in contrast to the effect of increasing the number of EU-country destinations which only persuades SPFs to export more of each variety.

ii) Increases in the number of varieties

We here make a distinction between the number of varieties exported to EU countries and Non-EU countries. Our estimates here indicate that a firm' decision to export a larger number of commodities to *Non-EU markets*, will induce firms to export less of every variety, which confirms our *Result 3* from our theoretical model. As firms export more varieties, it will become gradually more costly for them continuing producing certain amounts of different varieties: q_{ijkt} is decreasing in $c_{jt}(i,k)$. As a result, the positive effect of depreciation on the volume of exports will be reduced if the number of varieties directed to Non-EU markets increases. *Result 3* cannot however be corroborated for firms that increase their number of varieties to EU markets: higher costs do not restrain Bulgarian firms to export more of every variety, even when EU markets are more challenging. And again, this is most likely

explained by the economic and technological benefits that exporting to EU countries bestows.

iii) Total number of commodities that deviates from the core competence

We again find that if a firm produces more varieties and move away from its core competence (its average number of varieties), the export volume of each variety will increase but only if the country destination is an EU country or a country that uses the euro as anchor currency. On the other hand, when the destination is a Non-EU country, our results indicate either that, in most cases, there will be a contraction in the export volume of products of each variety.

We can now draw our main first conclusion, independent of the approximation for the firm *j'* marginal cost of producing more of variety *i* exported to country *k* at time *t*, firm *j* will export less of every variety if it shifts from its core competence by producing more varieties and exports these to Non-EU countries. We are then able to confirm our *Result 3.* Nonetheless, since exporting to EU countries seems to bring some benefits which include the reduction in exchange rate transaction costs and risks, higher costs from exporting more varieties to EU markets do not prevent firms from increasing their export quantities to these tough markets. Even SPFs will be persuaded to increase their exports even when they export their single product to additional EU countries. EU countries must be gaining from the increase in product diversity from Bulgarian MPFs, and as SPFs also are eager to enter new EU markets. The opposite occurs if SPFs attempt to increase their number of Non-EU country destinations. In addition, the effect of a real depreciation in the Bulgarian lev on the volume of each variety will be overridden when the firm moves away from its core of competence to sell to Non-EU. This last conclusion is in accordance with the results of our theoretical model, *Result 5.* This is true for our firm groups: *all firms*, *MPFs in general*, *MPFs exporting to both EU and Non-EU markets, and MPFs exporting only to Non-EU markets.*

6.1.3 Cannibalization effect

Firm *j*'s total output X_{jt} has a negative effect of the output of each variety in all our firm groups: *all firms*, *MPFs as a whole*, *MPFs exporting to both EU and Non-EU markets, and*

MPFs exporting only to Non-EU markets, except for firms specializing in *EU markets*, as *Result 4* predicts. See Tables 2, 3, 4 and 5. Thus, when MPFs produce less of every good under such circumstances, we say that there is a cannibalization effect. The cannibalization effect implies that these firms have a flexible production prototype which strongly depends on the country destination and the market specialization of the MPFs. This is because a larger output of one variety tends to lower the prices that consumers are willing to pay for all other varieties. When MPFs internalize demand linkages between the varieties they produce, MPFs will have enough incentives to restrict their output of each variety beyond the familiar own-price effect. On the other hand, our empirical results also indicate that MPFs exporting exclusively to EU markets do not experience such cannibalization effect. They must be then producing high quality products as they continue exporting more of all varieties without worrying about driving their prices down, even in the tough EU markets. Just recall from *Fact 1* and *Fact 2* from Section 3 which describes the data: the number of exporters specializing in EU markets has been decreasing rapidly, but they have they have higher volumes of exports. These firms are likely more productive as they produce more of every variety not only when they increase their total production in all its varieties, but also when they face higher marginal costs. Depreciation of the exchange rate or better to say change in relative prices between Bulgarian and foreign prices is not the driving force for these firms to have incentive to export more of every variety. We will explain below how prices respond to these specific firms' decision making regarding quantities. Note also that, as our theoretical model predicts (*Result 6*), for our group of firms (except for the EU specialists), cannibalization reduces the effect of the real exchange rate on these firms' quantities.

6.1.4 Robust test of the export-volume equation: firms by size and firms by industry

Real exchange rate depreciation continues to have a positive effect on the volume of exports of every commodity, except for the largest firms as it can be seen in Table 6. This positive effect is also remarkably strong and statistically significant for firms from our selected Bulgarian industries: the ones with the largest export values.

Regarding the marginal costs, the results are industry dependent (see Table 7). Thus, we could not confirm that firms in all our selected industries are more productive when they

export to EU markets. On the contrary, we still find that firms in our considered industries will reduce the quantities of all varieties when they move away from their core competence to export more varieties to Non-EU markets. There might be then some potential losses as firms export fewer varieties to Non-EU countries because of the pressure they have in maintaining their core competence and reducing costs.

Smaller firms too find it too more challenging to export more of every variety in toughest markets such as the EU markets, but less demanding to continue exporting more of each variety to Non-EU markets even in the presence of higher costs (see Table 6). On the contraire, larger firms will be increasing their production of every variety to EU markets even as they move away from their core of competence.

6.2 Results on the estimation of the unit price of variety i exported to country k by firm : All firms, MPFs, SPFs, MPFs exporting to both EU and/or Non-EU markets

6.2.1 Effects of the real exchange rate

SPFs (last column in Table 10) decrease their prices in response to a real depreciation of the Bulgarian lev and this corresponds to *Result 7* from our theoretical model. All firms of the other groups will increase their prices in response to a real depreciation of the Bulgarian lev. See Tables 8, 9, 10 and 11. We interpret the result from SPFs as an indication that these firms market to price (i.e. lower their prices) to gain a larger share of the market. For the rest of the firms, the exporter-producer price elasticity can range between 0.095 and 0.66 which corresponds to an exchange rate pass-through between 0.905 and 0.34 before accounting for the effect of cannibalization and the marginal costs. As explained below, the net effect of real depreciations will be affected by any decisions of the SPFs to increase their number of Non-EU country destinations for their single exporting good.

6.2.2 The effect of increases in costs

The exchange rate pass-through to prices is either strengthened or weakened by the marginal costs. Moreover, the final effect depends on whether MPFs export their new varieties to EU or Non-EU markets. These results can be seen in Tables 8, 9, 10 and 11. For example, independent of the chosen approximation for marginal costs, *all* firms (Table 8) and MPFs

(Table 9, 10 and 11) will only increase their prices when they produce more varieties of goods directed to EU markets, even if that implies higher costs. Such response strengthens, to a certain degree, any price increase that results from a depreciation of the Bulgaria lev. This will be a natural response by the MPFs (and more so for firms specializing in EU markets) if they high quality goods to EU countries. We have indeed found out above that these firms are willing to expand their product diversity when exporting to EU countries even when that entails moving away from their core of competence and rising costs. From our data description in Section 3, we also learned that MPFs that focus in EU markets have higher export values that their counterparts even though the number of this type of MPFs have been decreasing a deal during our years of study. Conversely, Bulgarian firms (Tables 8, 9, 10 and 11) that produce more varieties to *Non-EU* countries (including those that solely export to Non-EU countries) will decrease their prices of each of their varieties or leave them unchanged. Again, these firms usually reduce the volume of all varieties in response to higher costs, and if these firms find it necessary to decrease their prices even when facing higher costs, it should imply that these firms must be fighting to keep their market share and be forced to decrease their prices to maintain that share. Thus, the effect of higher costs offsets the positive effects that Bulgarian depreciations will have on prices. Thus, not all the costs of depreciation are passed to Non-EU consumers.

With respect to the SPFs also, as their number of Non-EU country destinations increases, their prices of each variety will increase which might offset the effect of real depreciations on prices that exists for these SPFs. In contrast, when these SPFs increase their number of EU countries to which they trade, we found that these firms will not alter their prices to EU consumers. SPFs may have difficulties to compete in EU markets leaving them with fewer possibilities for increasing their prices. They may be seeking to gain a larger market share in the EU by absorbing the higher costs themselves.

6.2.3 The cannibalization effect

We find that prices can decrease as a result of a *cannibalization* effect. This result applies to MPFs considered as a whole, the MPFs that specializes in exporting to both EU and Non-EU markets, and those focusing in EU markets. Therefore, cannibalization reduces

the positive effect that the exchange rate has on prices, making the degree of exchange rate pass-through onto prices smaller than otherwise. This is much in line with our Result 8 of the theoretical model. Thus, the high costs of producing additional varieties and the large price differentials between Bulgarian prices and foreign prices can be partially offset by the cannibalization effect. This cannibalization effect gives these particular firms incentives to charge lower price in order to keep probably some market share.

There is a remarkable distinction from the previous groups, in how cannibalization affects prices of MPFs that export fully to Non-EU markets. They charge higher prices on all varieties which allow them to earn higher margins in the presence of cannibalization. This positive effect of cannibalization will only minimal offset any possible negative correlation between the real exchange rate and the producer-exporter price (see last column in Table 11).

7 Conclusions

We extend the model of Neary and Eckel (2010) by incorporating the exchange rate and use it as our analytical framework for our empirical study. We afterward use Bulgarian firm-level trade dataset to test our model and analyze the role that the real exchange rate plays in the adjustments between and within firms with respect to the volume and price of every variety produced by Bulgarian multi-product firms (MPFs). To our knowledge, our paper is the first to analyze the role of real exchange rate dynamics, both empirically and theoretically, in the spirit of Neary and Eckel's (2010) model. We have then tried to fill up the gap in the literature by highlighting the capabilities of firms from a low-middle income country such as Bulgaria, to drive flexible manufacturing and focusing on what Neary and Eckel (2010) have called the "intra-firm extensive margin" in response to real exchange rate variability. When paying attention to the intra-firm adjustments that occur within Bulgarian MPFs, we find that real exchange rate shocks can have considerable impact on Bulgarian exporters' decisions on the price and volume of their different product varieties. Nonetheless, we find heterogeneous responses that depend on whether the country destination for the Bulgarian exports is a country that is part of the EU or uses the euro as its anchor currency; or a country that is outside the EU. Indeed, another objective of this paper was to determine to what degree the heterogeneity across Bulgarian MPFs is an important factor in the dynamics within a firm.

We subsequently study MPFs in aggregate, according to the industry they belong to and according to their size, MPFs that specializes in exporting to both EU markets and Non-EU markets, MPFs that solely export to EU markets, and those MPFs that only export to Non-EU markets.

First of all, we find that the exchange rate has the expected effect: a depreciation of the Bulgarian lev encourages a greater firm's volume of exports of every product variety and country destination. The only exception is for our group of MPFs that focus on exporting only to EU markets for which such effect is insignificant. Thus, the participation of MPFs that focus on EU markets does not rely of facing a depreciation domestic currency, or more precisely, on a price differential between Bulgaria and other countries since Bulgaria follows a currency board regime using the euro as a currency anchor. With regard to export prices, firms in all our groups, with the exception of SPFs, increase their prices in response to a real depreciation of the Bulgarian lev. SPFs decrease their prices in response to depreciation of the Bulgarian lev which probably allows them to gain a larger share in the market.

Secondly, the effects of flexible manufacturing is disentangle after examining the effect on the volume of all varieties of higher marginal costs that result from MPFs moving away from their core competence. We conclude that a firm will export less of each variety when it increases the number of product varieties that are exported to Non-EU countries. The contrary is found when MPFs produce additional new varieties to EU countries or countries that use the euro as anchor currency. These MPFs are not discouraged to produce more varieties. It is possible that their costs of producing new varieties are counterbalanced with the reduction in exchange rate transaction costs and risk that are usually present when participating in international trade. Exporting to EU countries might also bring other benefits which allow these MPFs to increase their productivity and varieties in spite of higher marginal costs. Even SPFs benefit from exporting their single product to additional EU countries. Exporting to EU countries indeed increases the productivity of these Bulgarian SPFs. The same cannot be said for MPFs that direct their new varieties to Non-EU countries or SPFs that decide to export to additional Non-EU countries. Now, regarding export prices, MPFs that produced new varieties targeted to EU markets, will tend to increase the prices that EU consumers are willing to pay for all new varieties when their marginal costs

increases as a result of moving them away from their core competence. These results indicate that firms specializing in highly competitive markets such as the EU markets must be producing goods which persuade EU consumers to pay higher prices. In contrast, MPFs exporting exclusively to Non-EU markets will decrease their prices or leave them unchanged in response to higher marginal costs that result from moving away from their core of competence. These latter MPFs seem to be competing for market share, costs and prices when exporting new varieties to Non-EU markets. On the contrary, MPFs that introduce new varieties to EU markets seem to be competing in productivity.

The exchange rate pass-through to prices is thus affected by increases in the marginal costs that result from increasing the number of commodities/countries that move firms away from their core of competitiveness. The direction of the effects depend on the market specialization of the whether the Bulgarian MPFs, that is, EU markets or Non-EU markets. Higher marginal costs might offset to a certain degree the positive effect of depreciation on prices when MPFs export to Non-EU countries. The opposite is found when MPFs specialize in exporting to EU countries.

Thirdly, we also shed light of the cannibalization effect. We find that except for the MPFs that specialize in EU markets, increases in a firm's total output have a negative effect of the export volume of each variety reflecting the cannibalization effect. This is because a larger output of one variety tends to lower the prices that consumers are willing to pay for all other varieties. When MPFs internalize demand linkages between the varieties they produce, MPFs will have enough incentives to restrict their output of each variety beyond the familiar own-price effect. Thus, when MPFs decide to produce less of every good, we say that there is a cannibalization effect. This result applies to our groups of *all MPFs in aggregate, MPFs exporting to both EU and Non-EU markets, and MPFs exporting only to Non-EU markets.* Firms exporting exclusively to EU markets, again, do not experience such cannibalization effect. These firms must be the more productive as they produce more in response to exchange rate depreciation, and even when they face higher marginal costs and when they increase their total production in all its varieties. Regarding prices, there are here evidences that prices decrease as a result of a *cannibalization* effect. This result applies to MPFs considered as a whole, the MPFs that specializes in exporting to both EU and Non-EU

markets, and the MPFs that export uniquely to EU markets. Therefore, cannibalization reduces the positive effect that real depreciations in the exchange rate have on prices, making the degree of pass-through smaller than otherwise. Thus, these types of MPFs absorb part of the costs of the cannibalization after letting real exchange rate depreciations increase the prices they can charge.

Our study has shed light on the heterogeneous response to exchange rate movements, increases in marginal costs that result from increasing the number of product varieties, and the cannibalization effects among MPFs and between MPFs and SPFs. This has important implications for policy makers when deciding on exchange rate policies on the aggregate export sector. It is then crucial to take into account that the effects will not be uniform across industries and firm types. Another inference is that, following our findings that Bulgarian exporters seem to compete on productivity if they export to EU markets, and cost/price if they export to Non-EU markets. Policymakers could perhaps implement policies that give incentives to firms to reduce their costs and increase their productivity especially when their target is Non-EU markets. It is important here to remember that some of these costs may include the exchange rate risks. We have indeed found that MPFs benefit from exporting in EU markets by becoming more productive and encouraged to exporting more varieties while beating down the costs of producing these new varieties and the cannibalization effect. It is possible that these latter MPFs are in advantage as a result of facing lower exchange rate costs and being better exposed to the acquisition of know-how and technology from participating in EU markets. MPFs exporting to Non-EU markets may not be having the same experience.

Table 2. Export Volume: All firms. *Standard errors are in parentheses.* *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

	All Firms **Volume q_{ijk}**	All Firms **Volume q_{ijk}**	All Firms **Volume q_{ijk}**	All Firms **Volume q_{ijk}**	All Firms **Volume q_{ijk}**	All Firms **Volume q_{ijk}**
ln(gdp(t))	0.6093***	0.5916***	0.5982***	0.5962***	0.5841***	0.5506***
	(0.1227)	(0.0037)	(0.0032)	(0.0037)	(0.0018)	(0.0038)
ln(1+ #countries(t)× #varieties(t))×ln(RER(t)	-0.0028					
	(0.0266)					
ln(1+ #EUcountries(t)× #EUvarieties (t))×ln(RER(t))		0.0516***				
		(0.0234)				
ln(1+ #NonEUcountries(t)× #NonEUvarieties (t))×ln(RER(t))		-0.2265***				
		(0.0280)				
ln(1+ #EUvarieties (t))× ln(RER(t))			0.0857***			
			(0.0157)			
ln(1+ #NonEUvarieties(t))× ln(RER(t))			-0.1262***			
			(0.0171)			
(Deviation from EUCore(t))×ln(RER(t))				0.1575***		0.0944***
				(0.0258)		(0.0197)
(Deviation from NonEUCore(t))×ln(RER(t))				-0.0051		-0.1631***
				(0.0407)		(0.0315)
Volume q_j×ln(RER(t))					-0.0492***	-0.0690***
					(0.0133)	(0.0180)
ln(RER(t))	-0.0486	0.5345***	0.0949***	0.6472***	0.4867***	0.4214***
	(0.1227)	(0.1000)	(0.0547)	(0.1710)	(0.1637)	(0.2556)
Number of Observations	796,687					

Table 3. Export Volume: ALL Multi-Product Firms (MPFs) and ALL Single-Product Firms (SPFs). *Standard errors are in parentheses.* *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

	MPFs **Volume q_{ijk}**	***MPFs*** **Volume q_{ijk}**	***MPFs*** **Volume q_{ijk}**	***MPFs*** **Volume q_{ijk}**	***MPFs*** **Volume q_{ijk}**	***MPFs*** **volume q_{ijk}**	***SPFs*** **Volume q_{ijk}**	***SPFs*** **Volume q_{ijk}**
ln(gdp(t))	0.6155***	0.6023***	0.5546***	0.5800***	0.5652***	0.5174***	0.5332***	0.5270***
	(0.0041)	(0.0044)	(0.0034)	(0.0022)	(0.0018)	(0.0040)	(0.0041)	(0.0069)
ln(1+ #countries(t)× #varieties(t))×ln(RER(t))	-0.1446***						-0.1966***	
	(0.0502)						(0.0478)	
ln(1+ #EUcountries(t)× #EUvarieties(t))×ln(RER(t))		0.2839***						0.0307***
		(0.0927)						(0.0132)
ln(1+ #NonEUcountries(t)× #NonEUvarieties(t))×ln(RER(t))		-0.4640***						-0.2102***
		(0.0750)						(0.0284)
ln(1+ #EUvarieties(t))× ln(RER(t))			0.0252					
			(0.0161)					
ln(1+ #NonEUvarieties(t))× ln(RER(t))			-0.3582***					
			(0.0292)					
(Deviation from EUcore(t))×ln(RER(t))				0.2016***		0.0708***		
				(0.0246)		(0.0229)		
(Deviation from NonEUcore(t))×ln(RER(t))				-0.0097		-0.1173***		
				(0.0366)		(0.0349)		
Volume q_j×ln(RER(t))					-0.0516***	-0.0697***		
					(0.0126)	(0.0190)		
ln(RER(t))	0.8024***	0.8558***	0.6937***	0.9567***	0.4982***	0.4612***	0.6802***	0.3544***
	(0.2616)	(0.3017)	(0.0771)	(0.1475)	(0.1532)	(0.2784)	(0.1896)	(0.0758)
Number of Observations	741,456						55,231	

Table 4. Export Volume: MPFs exporting to both EU and NonEU countries. *Robust Standard errors are in parentheses.* *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

	U+NonEU Volume q_{ijk}	**EU+NonEU Volume q_{ijk}**	**EU+NonEU Volume q_{ijk}**	**EU+NonEU Volume q_{ijk}**	**EU+NonEU Volume q_{ijk}**	**EU+NonEU Volume q_{ijk}**
ln(gdp(t))	0.5873***	0.6003***	0.5848***	0.2432***	0.5836***	0.5825***
	(0.0025)	(0.0035)	(0.0024)	(0.1150)	(0.0022)	(0.0023)
ln(1+ #countries(t)× #varieties(t))×ln(RER(t))	-0.2101***					
	(0.0501)					
ln(1+ #EUcountries(t)× #EUvarieties(t))×ln(RER(t))		0.0922***				
		(0.0340)				
ln(1+ #NonEUcountries(t)× #NonEUvarieties(t))×ln(RER(t))		-0.2244***				
		(0.0392)				
ln(1+ #EUvarieties(t))× ln(RER(t))			0.0631***			
			(0.0242)			
ln(1+ #NonEUvarieties(t))× ln(RER(t))			-0.1811***			
			(0.0236)			
(Deviation from EUCore(t)×ln(RER(t))				0.0488***		0.0525***
				(0.0170)		(0.0221)
(Deviation from NonEUCore(t)×ln(RER(t))				0.0177		-0.0718***
				(0.0265)		(0.0213)
Volume q_j					-0.0560***	-0.0471***
					(0.0173)	(0.0176)
ln(RER(t))	0.9732***	0.5344***	0.3208***	0.2432***	0.7084***	0.5123***
	(0.2436)	(0.1641)	(0.0925)	(0.1150)	(0.2233)	(0.2011)
Number of Observations	512,405					

Table 5. Export Volume: MPFs exporting only to EU countries; and MPFs exporting only to Non-EU countries. *Standard errors are in parentheses.* *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

	EU Volume q_{ijk}	**EU Volume q_{ijk}**	**EU Volume q_{ijk}**	**EU Volume q_{ijk}**	**EU Volume q_{ijk}**	**NonEU Volume q_{ijk}**	**NonEU Volume q_{ijk}**	**NonEU Volume q_{ijk}**	**NonEU Volume q_{ijk}**	**NonEU Volume q_{ijk}**
ln(gdp(t))	0.5811***	0.5955***	0.5686***	0.5395***	0.4571***	0.6298***	0.6131***	0.6562***	0.6033***	0.6396***
	(0.0122)	(0.0116)	(0.0122)	(0.0138)	(0.0368)	(0.0157)	(0.0144)	(0.0139)	(0.0119)	(0.0178)
ln(1+ #EUcountries(t)× #EUvarieties(t))×ln(RER(t))	-0.0624									
	(0.5234)									
ln(1+ #NonEUcountries(t)× #NonEUvarieties(t))×ln(RER(t))						-0.0944				
						(0.0671)				
ln(1+ #EUvarieties(t))× ln(RER(t))		0.1415***								
		(0.0682)								
ln(1+ #NonEUvarieties(t))× ln(RER(t))							-0.1215			
							(0.0733)			
(Deviation from EUCore(t)×ln(RER(t))			0.8848***		0.8207***					
			(0.0307)		(0.1765)					
(Deviation from NonEUCore(t)×ln(RER(t))								-0.4109***		0.3195***
								(0.0439)		(0.0440)
Volume q_j				0.9065***	0.4047***				-0.0680***	0.1220***
				(0.0458)	(0.0841)				(0.0262)	(0.0226)
ln(RER(t))	0.1195	-0.3062	2.2337	-1.5740	-1.5993	0.7619**	0.5903*	0.9651***	0.8280**	0.9007***
	(0.2379)	(0.1987)	(2.1352)	(1.5058)	(1.4109)	(0.4078)	(0.3701)	(0.2590)	(0.3519)	(0.4477)
Number of Observations	213,493					70,789				

Table 6. Export Volume: MPFs by size of their export volume. *Standard errors are in parentheses.* *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

	Below 25 percentile Volume q_{ijk}	**25 – 50 percentile Volume q_{ijk}**	**75 – 95 percentile Volume q_{ijk}**	**75 – 95 percentile Volume q_{ijk}**	**95 – 99 percentile Volume q_{ijk}**	**99 – 99.8 percentile Volume q_{ijk}**
ln(gdp(t))	0.1309***	0.3088***	0.5031***	0.5197***	0.7698***	0.9761***
	(0.0077)	(0.0034)	(0.0036)	(0.0030)	(0.0089)	(0.0062)
ln(1+ #EUcountries(t)×	-0.1005***	0.0340	0.0481*	0.0584***	0.1580***	0.2297***
#commod(t))×ln(RER(t))	(0.0300)	(0.0294)	(0.0284)	(0.0159)	(0.0300)	(0.0969)
ln(1+ #NonEUcountries(t)×	0.0396**	-0.0719***	-0.0899***	-0.0953***	-0.2424***	-0.3831***
#commod(t))×ln(RER(t))	(0.0208)	(0.0231)	(0.0211)	(0.0214)	(0.0506)	(0.1002)
ln(RER(t))	0.2613*	0.2490***	0.1360***	0.1230*	0.5965***	0.1704
	(0.1513)	(0.1113)	(0.0731)	(0.0760)	(0.1436)	(0.3036)
# of Observations	203,117	195,276	199,120	159,321	32,620	5,756

Table 7. Export Volume: MPFs by industry SITC6, SITC7, SICT8, SICT0, SITC5, SITC2 and SITC3. *The coefficients in red bold are statistically insignificant at any reasonable level. Standard errors are in parentheses.*

	SITC6: Manufacturing Volume q_{ijk}	**SITC7: machinery, transport equip. Volume q_{ijk}**	**SITC8: misc. manufacturing Volume q_{ijk}**	**SITC0: food, live animals Volume q_{ijk}**	**SITC5: chemical prod. Volume q_{ijk}**	**SITC2: crude Materials Volume q_{ijk}**	**SITC3:mineral fuels, lubricant. Volume q_{ijk}**
ln(gdp(t))	0.5979***	0.5616***	0.5082***	0.4894***	0.7273***	0.8618***	0.9491***
	(0.0077)	(0.0062)	(0.0066)	(0.0049)	(0.0167)	(0.0299)	(0.0278)
ln(1+ #EUcountries(t)×	-0.0278	0.0498**	-0.0522***	0.2448***	0.1914***	-0.1152	-0.0058
#commod(t))×ln(RER(t))	(0.0253)	(0.0258)	(0.0152)	(0.0341)	(0.0714)	(0.0987)	(0.0253)
ln(1+ #NonEUcountries(t)×	-0.3542***	-0.1579***	-0.2533***	-0.2991***	-0.3002***	0.0726	-0.1519
#commod(t))×ln(RER(t))	(0.0696)	(0.0486)	(0.0256)	(0.0360)	(0.1166)	(0.0859)	(0.0987)
ln(RER(t))	0.9475***	0.2850*	0.9885***	0.9755***	0.7664*	0.4676*	0.6514**
	(0.1988)	(0.1598)	(0.0871)	(0.2283)	(0.4575)	(0.2727)	(0.3293)
Number of Observations	176,268	183,469	233,580	101,742	54,230	27,276	2,925

Table 8. Export Unit Price: All firms. *Standard errors are in parentheses.* *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

	All Firms ***Price*** p_{ijk}	**All Firms** ***Price*** p_{ijk}	**All Firms** ***Price*** p_{ijk}	**All Firms** ***Price*** p_{ijk}	**All Firms** ***Price*** p_{ijk}
ln(gdp(t))	0.1527***	0.1523***	0.1534***	0.1525***	0.1293***
	(0.0019)	(0.0019)	(0.0019)	(0.0016)	(0.0050)
ln(1+ #EUcountries(t)× #EUvarieties(t)) ×ln(RER(t))	0.0224***				
	(0.0082)				
ln(1+ #NonEUcountries(t)× #NonEUvarieties(t)) ×ln(RER(t))	-0.0571***				
	(0.0125)				
ln(1+ #EUvarieties(t))× ln(RER(t))		0.0314***			
		(0.0087)			
ln(1+ #NonEUvarieties(t))× ln(RER(t))		-0.0938***			
		(0.0142)			
(Deviation from EUCore(t))×ln(RER(t))			0.0213***		0.0567***
			(0.0096)		(0.0137)
(Deviation from NonEUCore(t))×ln(RER(t))			0.0023		-0.0030
			(0.0155)		(0.0210)
Volume q_j				-0.0296***	-0.0563***
				(0.0083)	(0.0228)
ln(RER(t))	0.2905***	0.3293***	0.2517***	0.5565***	0.8019*
	(0.0346)	(0.0340)	(0.0701)	(0.1006)	(0.4559)
Number of Observations	796,687				

Table 9. Export Unit Price: ALL MPFs and ALL SPFs. *Standard errors are in parentheses.* *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

	MPFs ***Price p_{ijk}***	MPFs ***Price p_{ijk}***	MPFs ***Price p_{ijk}***	MPFs ***Price p_{ijk}***	MPFs ***Price p_{ijk}***	SPFs ***Price p_{ijk}***
ln(gdp(t))	0.1517*** (0.0019)	0.1526*** (0.0019)	0.1588*** (0.0011)	0.1517*** (0.0935)	0.1594*** (0.0011)	0.1309*** (0.0117)
ln(1+ #EUcountries(t)× #EUvarieties(t)) ×ln(RER(t))	0.0210*** (0.0087)					-0.1168 (0.1082)
ln(1+ #NonEUcountries(t)× #NonEUvarieties(t)) ×ln(RER(t))	-0.0663*** (0.0084)					0.5337*** (0.1459)

ln(1+ #EUvarieties(t))×
ln(RER(t))
		0.0221***
		(0.0091)				

ln(1+ #NonEUvarieties(t))×
ln(RER(t))
		-0.0667***
		(0.0082)				

(Deviation from EUCore(t))×ln(RER(t))			0.0245*** (0.0121)		0.0355*** (0.0103)	
(Deviation from NonEUCore(t))×ln(RER(t))			-0.0425*** (0.0105)		-0.0538 (0.0344)	
Volume q_j				-0.0298*** (0.0077)	-0.0455*** (0.0142)	
ln(RER(t))	0.3482*** (0.0354)	0.3115*** (0.0327)	0.1545*** (0.0123)	0.5515*** (0.0935)	0.7321*** (0.1836)	-0.2827** (0.1464)
Number of Observations	741,456					55,231

Table 10. Export Unit Price: MPFs exporting to both EU and NonEU countries. *Standard errors are in parentheses.* *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

	EU+NonEU ***Price*** p_{ijk}	**EU+NonEU** ***Price*** p_{ijk}	**EU+NonEU** ***Price*** p_{ijk}	**EU+NonEU** ***Price*** p_{ijk}	**EU+NonEU** ***Price*** p_{ijk}
ln(gdp(t))	0.1512***	0.1534***	0.1584***	0.1523***	0.1575***
	(0.0022)	(0.0019)	(0.0011)	(0.0019)	(0.0011)
ln(1+ #EUcountries(t)× #EUvarieties(t))×ln(RER(t))	0.0182				
	(0.0110)				
ln(1+ #NonEUcountries(t)× #NonEUvarieties(t))×ln(RER(t))	-0.0175				
	(0.0106)				
ln(1+ #EUvarieties(t))× ln(RER(t))		0.0195***			
		(0.0096)			
ln(1+ #NonEUvarieties(t))× ln(RER(t))		-0.0022			
		(0.0096)			
(Deviation from EUCore(t)×ln(RER(t))			0.0187***		-0.0120***
			(0.0097)		(0.0075)
(Deviation from NonEUCore(t)×ln(RER(t))			-0.0078		0.0072
			(0.0140)		(0.0115)
Volume q_j				-0.0411***	-0.0261***
				(0.0108)	(0.0103)
ln(RER(t))	0.1595***	0.1124***	0.1873***	0.6626***	0.4472***
	(0.0488)	(0.0390)	(0.0733)	(0.1381)	(0.1246)
Number of Observations	512,405				

Table 11. Export Unit Price: MPFs exporting only to EU countries; and Firms exporting only to Non-EU countries. *Standard errors are in parentheses.* *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

	EU ***Price*** p_{ijk}	**EU** ***Price*** p_{ijk}	**EU** ***Price*** p_{ijk}	**EU** ***Price*** p_{ijk}	**NonEU** ***Price*** p_{ijk}	**NonEU** ***Price*** p_{ijk}	**NonEU** ***Price*** p_{ijk}	**NonEU** ***Price*** p_{ijk}
ln(gdp(t))	0.0828***	0.0820***	0.1697***	0.1930***	0.1405***	0.1376***	0.1408***	0.1327***
	(0.0189)	(0.0189)	(0.0068)	(0.0077)	(0.0050)	(0.0069)	(0.0064)	(0.0067)
ln(1+ #EUcountries(t)× #EUvarieties(t))×ln(RER(t))	0.0712***							
	(0.0296)							
ln(1+ #NonEUcountries(t)× #NonEUvarieties(t))×ln(RER(t))					0.0022			
					(0.0218)			
ln(1+ #EUvarieties(t))× ln(RER(t))		0.0731***						
		(0.0295)						
ln(1+ #NonEUvarieties(t))× ln(RER(t))						-0.0401		
						(0.0263)		
(Deviation from EUCore(t)×ln(RER(t))			0.0178	0.1082***				
			(0.0422)	(0.0562)				
(Deviation from NonEUCore(t)×ln(RER(t))							0.0352	0.0020
							(0.0243)	(0.0372)
Volume q_j				-0.0549***				0.0524***
				(0.0252)				(0.0148)
ln(RER(t))	0.7520***	0.7618***	0.1814***	0.7453***	0.2340***	0.2551***	0.1477***	-0.4779***
	(0.2120)	(0.2079)	(0.0600)	(0.2807)	(0.0904)	(0.1074)	(0.0559)	(0.1633)
Number of Observations	213,493				70,789			

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