How do multi-product exporters react to a change in trade costs?

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Abstract

Recent literature has pointed to the major contribution of multi-product firms in international trade activity. This stylized fact has motivated new theoretical research on the effects of trade liberalization. Bernard et al. (2009b) and Eckel and Neary (2008) suggest that within firm adjustments play a key role in the case of a trade liberalization, through the number of products exported and the value of exports by product. We use individual French exports data at the firm and product level, over the period 1995-2003, to test these predictions. We first show that the ambiguous effect of distance on the intensive margin is the result of the combination of within firm product composition effects and between firm composition effects. We then use euro adoption as a natural experiment to test the effects of a decrease in trade costs on multi-product exporters. We find that the effects of greater economic integration channels mainly through the number of products exported by firm on each destination. This effect is unevenly distributed across firms, with only most productive firms experiencing a positive effect. No significant effect of euro adoption is found on firm selection and the average value of exports by product within firms. These results suggest that the dynamic effects of economic integration mostly channel through a within-firm adjustment. These results are accordingly only partially in line with the export-side predictions of the recent models of multi-product firms.

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Introduction

Aggregate exports at the country level are concentrated among few - but large - firms, and those firms typically export several product categories (Bernard et al., 2007). While such high concentration of exports among few exporters has been well documented in recent studies using European and US data (Bernard et al., 2007; Eaton et al., 2004; Mayer and Ottaviano, 2007), the most interesting feature is that a large proportion of firms export more than a single product, and must therefore be considered as ***multi-product exporters***. Beyond the usual distinction between the ***country*** extensive and intensive margins of trade, it suggests a distinction between the ***firm-level*** extensive and intensive margins. Considering the firm level a key pattern is that individual exporters do ship only a limited subset of products on a limited subset of destinations. Such stylized facts, related to the high persistence of zero trade flows in international trade datasets, are at odds with the background of the New Trade Theory *à la* Krugman according to which all varieties are exported to all destinations.

Figure 3 first reveals that more than 70% of French exporters do export more than a single product category, while 30% of exporters in our sample are mono-product exporters. A large proportion of French firms exports 10 product categories or more: for instance, about 2% of exporters ship 10 product categories abroad in a given year. At the same time, 99 percent of the observations are zeros in such data at the individual firm-product-destination level, for a given year. This contrasts with the US data where 40% of exporters are mono-product exporters (Bernard et al., 2007), and Mexican data where 62% of exporting firms export a single product category (Iacovone and Javorcik, 2008).[1]

Figure 1: Distribution of the number of product categories exported by French firms over all destinations, 1998

[1] Indeed, national customs record trade flows using a country specific further break down of the international HS6 classification of products. Accordingly, international comparisons of that kind must be handled cautiously.

Data also show that French exporters export several product categories *on each market*. Figure 2 below refers to the actual number of products exported by firm on each destination. The Figure reveals that many French exporters are multi-product on each individual market: about 50% of firm-destination observations in a given year correspond to firms exporting more than a single CN8 product category to a given destination.[2] These simple stylized facts are informative: a large tale of French firms export several product categories to single destinations. Hence *firms can adjust their exports to any destination through the number of product categories exported, or the value of exports by product category*.

Figure 2: Distribution of the number of product categories exported by French firms on individual destination, 1998

The New New Trade Theory contrasts with previous models of trade with imperfect competition, where firms export to all destinations a single product category (*mono-product exporters*). Trade models *à la* Melitz (2003) consider firms being heterogenous in terms of their productivity. In the presence of (sunk, fixed and variable) trade costs, only most productive firms export while firms with lower productivity levels only sell goods to domestic consumers. Trade integration raises the number of exporters, as well as the value of exports by individual firm. While the value of shipments of new exporters is typically lower, the effect of trade integration on the average value of exports by firm remains ambiguous. More recently, the New New Trade Theory has expanded to take into account stylized facts related to the existence of multi-product firms: selection effect can occur not only between firms, but also within firms through the number of product categories shipped to domestic and foreign consumers.

Eckel and Neary (2008) develop a model with oligopolistic competition and flexible manufacturing technology, where firms endogenously select the set of goods categories that are produced. Each firm has a "core competence", while expanding product lines is

[2] CN8 stands for Combined Nomenclature 8-digit: this European classification comprises some 6,000 different groups of manufactured products.

possible but subject to diseconomy of scope and creates cost heterogeneity between varieties. In their model, globalization arises from the increase in the number of countries that participate to the global economy. This has two effects: (i) the demand addressed to each firm increases, and (ii) competition is strengthened. In the end, firms benefit from greater integration through larger sales, but the scope of goods produced by the firm is reduced ("*cannibalization e ect*").[3] Eckel and Neary (2008) also extend their model to allow for firm entry and exit. They show that the effect of globalization is actually ambiguous, and may lead to firm exit if flexibility is low.

While the theory developed by Eckel and Neary (2008) incorporates strategic interactions, which is highly relevant with respect to the high concentration of exports between few - but large - exporters, their model does not enable to derive empirical predictions that are specific to multi-product ***exporters***. A second type of multi-product firms' model is proposed by Bernard et al. (2009b), with a monopolistic competition framework. They develop a model of trade with heterogenous firms exporting several product categories. As compared to Melitz (2003), consumers are heterogenous in their preferences, which allows for a within-firm adjustment through the number of goods produced and exported. While firm ability is common across goods - the firm produces all its varieties with the same constant marginal cost, there is heterogeneity on the consumer side (preferences) at the *product and destination* levels. This mirrors the fact that products' attributes affect the profitability of the firm differently across markets and differently for each product. There are now two independent draws for each firm, after the sunk cost of entry is paid: one for the firm productivity which is common across all of its products, one for the consumer tastes for each of its product in each of the destination countries. The model implies that firms only export goods with higher values of consumer taste - or preferred goods - for which demand is high enough to cover the sunk or fixed entry cost.

The model predicts that with trade liberalization, varieties with low value of consumer taste are dropped from the domestic market, while varieties with higher value of consumer taste are exported. Surviving firms concentrate on their core competencies. Specifically, surviving exporters drop less preferred goods from the domestic market and increase the range of their exported products. New exporters drop less preferred goods on the domestic market and start exporting products with higher value of consumer tastes abroad. Bernard et al. (2009b) also show that the effect of trade liberalization on the average value of exports by product is ambiguous: while the decrease in trade costs raises the demand addressed to individual goods, demand addressed to newly exported goods is typically lower. Hence, the average value of exports by shipments may not increase, or even decrease. All in all, a decrease in variable trade costs does not only

[3] This "cannibalization effect" is also reproduced in Agur (2006), in a model with heterogenous firms in terms of productivity that allows free entry.

promotes the entry of new firms on the export market, as predicted by Melitz (2003). A decrease in trade costs also increases the number of product categories exported by each firm.

So far the empirical literature has provided only few test of the effects of trade costs on multi-product firms. Bernard et al. (2009b) use the Canada-US Free Trade Agreement (CUSFTA) as a natural experiment of reduction in trade costs affecting domestic firms. They find evidence that US firms facing above the median tariff reduction with Canada have decreased the number of 5-digit SIC goods categories they produce, after 1999. Alternatively, they use bilateral distance as a proxy for trade costs to test the export-side predictions of their model in a cross-section estimation. They first decompose the value of US exports to each destination into trade margins, before estimating a gravity-like equation in cross section. Their results show that bilateral distance has a negative effect on the number of individual trade flows, with no effect on the average value of export by flow. They interpret this result as an empirical validation of their model, which predicts that a decrease in trade costs may have ambiguous effects on the product intensive margin, since new products are typically expected to be exported with a lower value.

Interestingly, Bernard et al. (2009a) clearly make the distinction between cross sectional variance, which is primarily due to extensive margins, while year-to-year variation in US exports is mainly explained by the intensive margin. This contrast simply mirrors the huge difference in size between permanent exporters and switchers. They ultimately consider the Asian crisis as a natural experiment (a macroeconomic shock reducing foreign demand) authorizing a differences-in-differences approach. Based on simple descriptive statistics they find both a contribution of the extensive and intensive margins to the decline in US exports to affected Asian countries.

Hence, the effects of trade and economic integration on multi-product exporters over time may be very different from the effects of a simple variation of trade costs in a cross-section analysis.[4]

However, testing the effects of a change in trade costs over time on multi-product firms is highly demanding regarding the data. First, this requires information on export activity at the firm, product and destination level. Second, these information must be available over several years, so that the effect of a change in trade costs can be investigated. Finally, a shock affecting all firms in a similar way is needed. In addition, firm-level characteristics such as Total Factor Productivity must also be controlled for, which requires balance-sheet or survey data to be merged with individual Firms' export data.

[4]This is confirmed by Trefler (2004). Trefler uses the Canada-US Free Trade Agreement in 1988 as a natural experiment, and provides evidence of long and short-run effects on industry-level employment and productivity.

We make use of French firm-level exports data over the period 1995-2003 to investigate the effect of a change in trade costs, and take the euro adoption in 1999 as a natural experiment to identify the reaction by multi-product exporters.

Euro adoption by 11 European countries in 1999 was indeed expected to foster trade within the eurozone, as a result of the elimination of short-run nominal exchange rate volatility and transaction costs related to the exchange of currencies. Empirical investigations using *aggregate* trade data have provided evidence of a trade creation effect of euro adoption (Micco et al., 2003). Using euro adoption as a natural experiment to test the effects of a change in trade costs has several advantages. First, we can clearly identify a point in time - the adoption of a single currency - when nominal exchange rate volatility, and some transaction costs, have been eliminated among participating countries. Second, the shock has affected all firms identically within these countries. Off course firms may have been affected differently due to their geographical composition of exports. But the decrease in trade costs is similar for all firms, which is not the case when Free Trade Agreements are considered. Thirdly, the agreement is reciprocal and most importantly involves more than two countries. This may therefore imply a more complex reaction of firms on the export market, due to a possible rise in competition on the export market, within the euro area, by 1999. Such a rise in competitiveness consecutive to euro adoption is documented by Ottaviano et al. (2009), through the calibration of a Melitz-Ottaviano type model with European data.

We perform a careful examination of the euro effects on French exporters. Our empirical investigation combines French customs data with the "Enquête Annuelle d'Entreprises" (EAE) French business survey. The combination of these two datasets allows to control for firm characteristics such as Total Factor Productivity in our analysis of the euro effects.[5] This information in particular enables to address issues related to the heterogeneous response of firms consecutive to euro adoption. We use all these data over the period 1995-2003, i.e. before the EU enlargement to 10 new member States in 2004. Hence, the period we consider is characterized by a single major shock regarding trade and economic integration.

We begin the empirical analysis with a cross section analysis to investigate the effect of distance on the number of individual French export flows, and the average value of exports by flow, as in Bernard et al. (2009b). We then extend the analysis to the firm-level estimations, and estimate the effect of distance on the probability of exports by firm, on the number of product categories exported by firm, and on the average value of exports by product on each destination. Estimation results confirm the result of Bernard et al.

[5] Note that in Bernard et al. (2009b), such merge between firm-level export data, and balance sheet data, is only available for a single year.

(2009b) on US data, namely the existence of a negative effect of bilateral distance on the number of individual trade flows, while no significant effect can be found on the average value of exports by flow. Considering firm-level estimations though, the effect of distance on the average value of exports by product, within firm, turns negative and significant. This first result suggests that the ambiguous effect of distance on the intensive margin is related to the composition of firms on the export market, rather than to the composition of products within firms. This result indicates that distance strongly reduces the demand addressed to each variety, within firms.

In a second step, we investigate the effect of euro adoption on multi-product exporters, as a natural experiment related to a decrease in trade costs over time. We consider a treatment group (eurozone destinations) and a control group (OECD or EU15 non-eurozone destinations) to perform a difference-in-difference approach using post-1998 years as the shock affecting the treatment group. This analysis is ultimately performed excluding D-Mark zone countries, that have a lower nominal exchange rate volatility with the French Franc before 1999.

When the control group is properly defined, estimation results indicate that the effect of euro adoption on trade exclusively channels through the number of product categories exported by firm, with no effect on the average value of exports by product, within each firm and no effect on firm selection. Importantly, the reaction of French exporters highly depends on their productivity level before 1999, with only most productive firms benefiting from a positive effect. Hence, all these results confirm the importance of taking into account the evolution of the composition of products within heterogenous firms, as in recent trade models. More generally, short term adjustment to exogenous shocks such as trade liberalization or economic integration may occur ***within firms, across products***.

Our work contributes to a recent literature that attempts to test the effects of macroeconomic shocks on firms. Papers like Berman et al. (2009) use similar data to analyze the effects of real exchange rate movements on French exporters. Regarding the empirical multi-product firms' literature, other papers such as Iacovone and Javorcik (2008) have provided evidence that "product churning" within firms is an important feature of firms' dynamics. Eckel et al. (2009) also show that multi-product features of the firm may differ at home and abroad, with firms selling a broader range of products at home. Our work departs from these studies by providing the first empirical investigation on the effects of a decrease in trade costs on multi-product exporters. In particular, our data enable to measure an heterogenous response of firms according to their characteristics.

1 Data and methodology

1.1 Data sources

Individual firms' export database. In a first step, we make use of the database provided by the French customs, that comprises all individual firms' French export flows over the period 1995-2003. We keep records at the firm $\times$ destination level for the main 50 export destinations. We make use of the product-level information to count the number of products exported by firm on each destination. Importantly, information contained in this database is exhaustive, which enables an in-depth analysis.[6] All exporting firms located in France are considered. Accordingly, these exporters can belong to the manufacturing sector or to the service sector: what matters is to export a product, not a service. Indeed, not all exported products are manufactures, and we restrict our sample of trade flows to the manufactured products (including agro-food).[7] An elementary record comprises the SIREN identification number of the firm, the CN8 code of the product, the ISO code of the destination country, the FOB value of the flow and the quantity shipped.

With some 100,000 exporters each year, with a maximum number of 50 destinations considered in our investigation and 9 years, we have potentially 45 million ***firm-destination pairs*** in our data set (100,000 x 50 x 9).[8] These 45 million observations correspond to the maximum number of shipments of French firms, each exporting to each market (each year), in the perspective of the traditional New Trade Theory envisaging mono-product firms. Though, the picture of French exports is dominated by zeros: exporters only export to few destinations and not all years. To illustrate this let's consider the sample of firms having exported at least once to a given destination over the period considered: we are left with only 7.5 million observations. Now, it is clear that some of these firms may have disrupted their shipments at some point. Accordingly, there are still numerous zeros among the 7.5 million observations left. Dropping all the zeros, we are left with 3.0 million positive observations. All in all, we have some 42 million zeros out of 45 million possible firm $\times$ destination pairs. On the top of this firms do export in some 6,000 different headings of the product classification (corresponding to manufactured products): we leave it to the reader to figure out what the whole universe

[6] Thresholds are present in the original database due to simplified declarations of small exporters. To put in a nutshell, very small exports are not recorded, and small exports are recorded in a simplified manner: the product code is not recorded for instance. Also, the thresholds are different between exports to the European community and toward third countries. Lastly, the former threshold is varying over time. We harmonize the threshold for intra-EU exports to 150,000 euros per year for an exporter. This total value of export is calculated on the basis of the yearly sum of all shipments to the EU by a single firm.

[7] The selection criterion used here is the nature of the product and not the main activity of the firm.

[8] Notice that there is a large turnover in the sample. Each year some 20,000 new firms enter in the sample, while a similar number disappears. Accordingly, some 300,000 different firms are present at some point in the database.

of export possibilities is, when this dimension is added. The overwhelming presence of zeros in the data not only illustrates an empirical regularity; it also strongly constraints the estimation strategy to be adopted.

Firm-level characteristics. We use a second database - the annual business survey "Enquete Annuelle d'Entreprises (EAE)" in order to identify firm characteristics. The EAE survey is available for firms with more than 20 employees, which can be exporters or non exporters, in all sectors. A series of information are provided, such as the wage bill, the number of employees, the value added or investment. We make use of this information to compute Total Factor Productivity for each exporter, following the Olley-Pakes methodology. Finally, the SIREN identification number of the firm authorizes to match this database with the firm-level export data provided by the French customs. The combination of these two databases enables to perform the econometric analysis that is provided in this paper.

Our approach is based on a different data set than Eaton et al. (2009). They use data for two years, 1986 and 1992, and keep 114 destinations. Custom data at the firm level is merged with information on French firms' characteristics and turnover contained in their fiscal declarations. Interestingly, they rely on the full universe of the 225,000 French manufacturing firms, exporting or not, and retain information on their domestic sales. In the final data set information on domestic sales and characteristics of only 34,035 exporters is available [9]. This is more than the some 16,000 French exporters (of more than 20 employees) exporting manufacturing products to at least one of the main 50 French export destinations in a given year. This is less than the some 100,000 French exporters of manufacturing products (present in the individual French customs data). These figures incidentally illustrate the large concentration of exports on a limited number of large and multi-product firms. In contrast, Eaton et al. (2009) do not have information on product level exports, but on sectoral exports, aggregated with a European classification similar to the 3-digit ISIC.

Other data sources.

Proceeding to the econometric analysis requires to include a full set of control variables. In the cross section estimates, i.e. when we do not include country-pair fixed effects, we control for the bilateral distance between France and each destination. The data for bilateral distance are provided by the CEPII.[10] In all estimations, we control for real GDP of the destination. Data for real GDP are provided by the Penn World Tables. We also calculate a bilateral real exchange rate between using the producer

[9]The threshold for a mandatory declaration to the administration is defined in terms of turnover, rather than in terms of employment

[10]http://www.cepii.fr/anglaisgraph/bdd/distances.htm

prices of the exporter - France - and importer countries, in the domestic currencies. The data for producer price indices come from the International Financial Statistics (IMF) and the OECD. We also use bilateral nominal exchange rates to compute our bilateral real exchange rate. All data related to nominal exchange rate are provided by the International Financial Statistics (IFS), and the European Central Bank.

Finally we make use of measure of nominal exchange rate volatility in the descriptive statistics. We compute the volatility of the exchange rate by following Tenreyro (2007). We take, for each year in our sample, the standard deviation of the monthly variation of the nominal exchange rate:

$$Vol_{jt} = Std.Dev. \left(\frac{e_{jt,m} - e_{jt,m-1}}{e_{jt,m-1}} \right)$$

With $m = 1...12$. Vol_{jt} is the yearly volatility of the monthly nominal exchange rate of the French currency against the foreign currency.

1.2 A decomposition of aggregate trade flows

Our baseline observation in the customs data corresponds to the value of exports by $firm(f) \times product(p) \times destination(j)$ in a given year, which we note x_p^{fj}, omitting t by sake of simplicity.

We begin with a decomposition of firm-level exports to a given destination, into the **product intensive and extensive margins at the firm-level**:

$$X^{fj} = N_p^{fj} \times \overline{x}^{fj} \tag{1}$$

Where X^{fj} is the value of exports by firm f to destination j; N_p^{fj} is the number of CN8 product categories exported by firm f to destination j; $\overline{x}^{fj} = \frac{\sum_p x_p^{fj}}{N_p^{fj}}$ is the average value of exports by product category for firm f and destination j.

Summing over all firms, the total value X^j of French exports to destination j can be expressed as follows:

$$X^j = \sum_f N_p^{fj} \times \overline{x}^{fj} \tag{2}$$

Alternatively, French exports to any destination j can be decomposed as follows:

$$X^j = N_{fp}^j \times \overline{x}^j \tag{3}$$

Where N_{fp}^j is the number of individual trade flows - or $firm \times product$ observations - from France to destination j. $\overline{x}^j$ is the average value of exports by individual trade flow.

Importantly, the average value of individual exports ($\overline{x}^j$) differs from the average value of exports by product within a firm ($\overline{x}^{fj}$). $\overline{x}^{fj}$ is indeed subject to a single composition effect, related to the composition of products exported by firm to country j. In comparison, $\overline{x}^j$ can be influenced by the composition of firms exporting to market j, in addition to the within-firm product composition.

Both between and within firm composition effects can be important. In Melitz (2003), new exporters are typically smaller; hence, the entry of new firms is expected to lower the average value exports by firm even through demand addressed to incumbent increases. In Bernard et al. (2009b), new products exported by firm typically face a lower demand. Hence, increased demand addressed to individual firms can be possibly balanced by this within-firm product composition effect. Overall, the effect of a decrease in the variable trade cost is ambiguous, since increased demand to individual varieties previously exported can be balanced by the entry of new exported products within firms, or by new firms, which lowers the average value of exports by variety.

1.3 Cross-sectional evidence on trade costs

We now ask how the different trade margins observed at the country and the firm levels are impacted by differences in trade costs at some point in time. We start with the country level (namely the decomposition of the total value of French exports) and then turn to the individual firm level (namely the decomposition of the value of exports by firm).

Distance and the trade margins.

As suggested above in Equation (3), the value of French exports to any destination j can be decomposed as the product of the number of individual trade flows and the average value of export by individual flow. Taking logs, the total value of French exports to destination j can be expressed as a linear combination of the two components. We follow Bernard et al. (2009b) and estimate a simple gravity equation on each of those components.

$$ln(N^j_{fpt}) = \mu_0 + \mu_1 ln(RGDP_{jt}) + \mu_2 ln(Dist_j) + \mu_3 \kappa_t + \epsilon_{jt} \tag{4}$$

$$ln(\overline{x}^j_t) = \nu_0 + \nu_1 ln(RGDP_{jt}) + \nu_2 ln(Dist_j) + \nu_3 \kappa_t + \epsilon_{jt} \tag{5}$$

Where $RGDP_{jt}$ is the real GDP of the destination, $Dist_j$ is the bilateral distance, κ_t is a set of time dummies, and ϵ_{jt} is the error term. We use the cross-section dimension of the panel to investigate the effect of distance on the intensive and extensive margins.

Data are pooled over the 1995-2003 period. As discussed above, distance is expected to have an ambiguous effect on the intensive margin due to between and within firm composition effect.

Our estimation results reported in Table 1 are highly consistent with previous estimations on U.S. data, and in particular Bernard et al. (2009b): the larger the market, the larger the number of individual trade flows and the average value of exports by individual flow, at the country level.[11]. Importantly, we additionally observe that bilateral distance has a negative effect on the number of bilateral trade flows, but no significant impact on the average value of exports by flow. Again, this result is very much in line with Bernard et al. (2009b). Off course this effect can be the result of between or within-firm composition effect. We next proceed to firm-level estimations to document the existence of the between firm composition effect.

Table 1: Trade margins, pooled data (1995-2003)

Sample	All destinations	
Estimator	OLS	
Dependent variable	$ln(N^j_{fpt})$	$ln(\overline{x}_{jt})$
$RGDP_{jt}$	0.580***	0.262***
	(0.025)	(0.018)
$Dist_j$	-0.772***	-0.026
	(0.026)	(0.016)
Nb observations	500	500
R-squared	0.73	0.45

Note: Significance levels: *10%, **5%, ***1%. All variables - with the exception of dummy variables - are in logarithms. Robust standard errors in parentheses.

Distance and firm-level exports

Using firm-level information rather than trade margins at the country-level enables to determine whether the ambiguous effect of distance on the intensive margin disappears when the average value of exports by product, within firm, is considered - i.e. when we avoid any source of between-firm composition effect.

Equation (1) shows that the value of exports by firm can be expressed as the product of the number of product categories exported by firm, and the average value of exports by individual firm. Taking the full sample of potential exporters, the expected value of exports by any individual firm f to destination j at time t can be expressed as the product of the probability of export $Prob(X^{fj}_t > 0)$ to market j, the expected number of product categories exported $E(N^{fj}_{pt}|X^{fj}_t > 0)$ to that market and the expected

[11]Again, a trade flow can be defined as a firm exporting a single product category to a given destination. Hence, individual trade flows are associated to trade in varieties.

average value of exports by firm $E(\overline{x}_t^{fj})$.[12]

$$E(X_t^{fj}) = Prob(X_t^{fj} > 0) \times E(N_{pt}^{fj}|X_t^{fj} > 0) \times E(\overline{x}_t^{fj}|X_t^{fj} > 0) \tag{6}$$

In our empirical approach, we estimate a gravity-like equation on each of those components and isolate the effect of trade costs. We first exploit the cross-section dimension of the panel over the period 1995-2003 to estimate the effect of distance, and estimate the following equation:

$$T_t^{fj} = \alpha_0 + \alpha_1 ln(RGDP_{jt}) + \alpha_2 ln(Dist_{jt}) + \alpha_3 ln(TFP_{ft-1}) + \alpha_4 \kappa_k + \alpha_5 \kappa_t + \epsilon_{fjt} \tag{7}$$

Where T_t^{fj} is a dummy variable that is equal to unity when firm f exports to destination j in t, and zero otherwise. In addition to destination and country pair characteristics, we control for the one-year lagged firm-level Total Factor Productivity (TFP). Finally, we use information contained in the EAE business survey to control for the main activity of the firm κ_k; specification also includes year dummy variables. With this first specification, we use a logit estimator to estimate the marginal effect of each regressor on the probability of export.

We then estimate the following two similar equations by taking the number of products exported by firm, and the average value of exports by product as dependent variables, for positive values of trade.

$$N_{pt}^{fj} = \beta_0 + \beta_1 ln(RGDP_{jt}) + \beta_2 ln(Dist_{jt}) + \beta_3 ln(TFP_{ft-1}) + \beta_4 \kappa_k + \beta_5 \kappa_t + \epsilon_{fjt} \tag{8}$$

$$\overline{x}_t^{fj} = \gamma_0 + \gamma_1 ln(RGDP_{jt}) + \gamma_2 ln(Dist_{jt}) + \gamma_3 ln(TFP_{ft-1}) + \gamma_4 \kappa_k + \gamma_5 \kappa_t + \epsilon_{fjt} \tag{9}$$

Working with data on the number of products exported by firm raises a major issue: even though many firms are multi-product, they export a discrete number of products each time they export. Hence, taking logs when the dependent variable is the number of products exported to a given destination, and estimating the equation with Ordinary Least Squares, is not feasible. Silva and Tenreyro (2006) also argue that, taking the logs of the dependent variable in the presence of heteroskedasticity, while estimating a gravity-like equation, leads to biased estimates. They therefore recommend to keep the dependent variable in levels and use a Poisson estimator. We therefore follow their recommendations, and estimate the marginal effect of each regressor on the number of products exported by firm, and the average value of exports by product, using a Poisson.

A major issue related to the use of firm-level data, is that variables which are not firm-specific generate as many observations as the number of firms within the panel.

[12]Remind that we do consider only French firms exporting at some point in time at least once over the period considered. But when it comes to exporting to a given market, not all firms export. This is why we use the concept of potential exporters.

We therefore cluster standard errors by destination in each estimation. A second major issue is related to the size of the sample of firms. As suggested above, non-trade firm-level information such as TFP and main activity is only available for firms with more than 20 employees, in the EAE business survey. We therefore rely on a substantially reduced sample of exporters each time we control for firm-level characteristics. Hence, we report estimation results with and without controlling for firm-level characteristics. Table 2 below reports estimation results at the firm-level: the first three columns use the full universe of French exporters, while the last three columns are restricted to French exporters with more than 20 employees due to the control for lagged TFP.

Table 2: Firm-level exports, pooled data (1995-2003)

Sample	All destinations					
Estimator	Logit	Poisson		Logit	Poisson	
Dependent variable	T_t^{fj}	N_{pt}^{fj}	$\overline{x}_t^{fj}$	T_t^{fj}	N_{pt}^{fj}	$\overline{x}_t^{fj}$
$Dist_j$	-0.508***	-0.229***	-0.314***	-0.397***	-0.232***	-0.395***
	(0.102)	(0.023)	(0.072)	(0.063)	(0.018)	(0.040)
$RGDP_{jt}$	0.206***	0.105***	0.373***	0.276***	0.146***	0.405***
	(0.072)	(0.024)	(0.058)	(0.057)	(0.020)	(0.038)
TFP_{ft-1}				0.395***	0.293***	0.642***
				(0.016)	(0.014)	(0.019)
Nb observations	7,505,486	3,013,935	3,013,876	1,729,113	1,020,152	1,020,130
Fixed effects		*year*			*year, industry*	

Note: Significance levels: *10%, **5%, ***1%. All variables - with the exception of dummy variables - are in logarithms. Robust standard errors in parentheses. Standard errors are clustered by destination.

First of all, it is important to clearly comment the number of observations that we use for each estimation. Considering the first panel of Table 2 with the full sample of French exporters, we see that 7.5 million of observations are used to estimate the logit. These observations correspond to the maximum number of $firm \times destination$ pairs observations over the period (including zero and positive values of trade), with selected pairs associated to at least one positive trade flow during the period 1995-2003 (i.e. we drop $firm \times destination$ pairs for which we have no positive trade flow over the period 1995-2003). Regarding poisson estimates over the number of products exported by firm, and the average value of exports by product, we only keep the 3 million positive values of trade in order to differentiate firm-selection from within-firm adjustment from exporters. As discussed above, we have fewer observations (respectively 1.7 versus 1.0 million) when we control for TFP_{ft-1} in the second panel of Table 2, since we only observe this variable for firms with more than 20 employees. Note however that results remain quantitatively unchanged in this case, and we keep a large number of observations.

Estimation results reported in Table 2 show that Total Factor Productivity (TFP) affects positively export decision, the number of products exported by individual firms and the average value of exports by product within firms. Turning to distance as a mea-

sure of trade costs, results show that fewer exporters export fewer products and a lower average value of exports by product to more distant destinations. This last result on the extensive margin differs from empirical results provided by Bernard et al. (2009b). While bilateral distance has no significant effect on the average value of individual trade flows at the country level ($\overline{x}^j$), we find a negative and significant effect at the firm-level ($\overline{x}^{fj}$). This suggests that between-firm composition effects are important: smaller firms export low values to proximate markets, therefore reducing considerably the average value of individual trade flows.

This first approach provides a first test of the effects of trade costs on trade margins and multi-product exporters. This also suggests that within-firm estimations should be preferred to avoid between-firms composition effects. However, the analysis of a variation of trade costs over time requires a natural experiment. As discussed in introduction, we use euro adoption in 1999 in order to identify the effect of greater integration on multi-product exporters.

2 Euro introduction as a natural experiment

2.1 Rationale

So far the empirical literature in international trade has provided only few tests for the predictions of the multi-product trade models. For instance, Bernard et al. (2009b) only investigate the effect of distance on trade margins in a cross section estimation, while Bernard et al. (2009a) investigate the change over time in the various components of US exports. They ultimately consider the East Asian Crisis in 1997 as a source of shock in their descriptive statistics analysis. However, this shock is related to a demand shock rather than to a shock on trade costs.

As discussed in introduction, we consider the euro adoption by 11 European countries in 1999 as a natural experiment for a change in trade costs. Short term nominal exchange rate volatility and transaction costs associated with the exchange of currencies have been considered as major sources of costs in international trade activity (Anderson and van Wincoop, 2004). Hence, the creation of a single currency is expected to boost international trade flows, and evidence of such positive effect is numerous.

The macroeconomic impact on bilateral trade flows has been widely examined and quantified: the value of trade flows between insiders has increased by less than 10% since 1999, as compared to other kind of country pairs that can be considered as the control group (Flam and Nordstrom, 2003; Micco et al., 2003; Baldwin, 2006). On the microeconomic side, testing transmission mechanisms embedded in the New New Trade Theory requires to make use of highly disaggregated trade data. The first strategy that

has been implemented in the empirical literature relies on the use of bilateral trade data at the level of the product.[13] Two related papers by Baldwin and Nino (2006) and Flam and Nordstrom (2007) find some evidence that the effects of euro adoption on trade channeled through a higher number of product categories exported within the eurozone, consistent with the view that euro adoption shrunk the fixed cost of exporting to eurozone partners. Though, previous approach by Baldwin and Nino (2006) and Flam and Nordstrom (2007) that rely on product-level trade data do not allow to identify the adjustments that may occur (1) ***between firms*** through the selection process, and (2) ***within firms*** through the number of products exported by firm and the value of exports by product.

Using firm-level export data allows to identify properly all the margins of adjustment that have been explored by the New New Trade Theory. Using such data for Belgium, France and Hungary, Baldwin et al. (2008) investigate the effects of the euro introduction on the firm-level and product-level trade margins. Findings based on simple descriptive statistics indicate that the number of products exported by French firms to eurozone destinations raised by 1999, as compared to other destinations. Findings are similar for the number of destinations by product by firm in French and Belgian data. While the descriptive statistics displayed in Baldwin et al. (2008) offer a first overview of the possible transmission channels of the euro at the micro-level, unconditional evidence requires a careful econometric analysis. Nitsch and Pisu (2008) use firm-level trade data for Belgium. Empirical results suggest a positive effect of euro adoption on firm-level exports by least productive and smaller firms.

With regards to the theory developed by Bernard et al. (2009b), euro adoption and the consecutive reduction in trade costs should have impacted French exports through more exporters, more products exported by firm and a larger value of exports by variety. Though, Bernard et al. (2009b) also predict an ambiguous effect of trade costs reduction on the intensive margin : new products are typically exported at lower value, which reduces the average value of exports by incumbent firms. Eckel and Neary (2008) does not specifically address the consequences of a reduction in trade costs, and works with a fixed number of firms choosing their optimal basket of goods produced. Here, the increased competition may lead to firm exit.

In order to rely on a natural experiment clearly dated at a point in time and affecting all firms from an exporting country in the same way, we are interested in the impact of euro introduction on trade composition: number of firms, products, destinations. Ottaviano et al (2009) use euro introduction as a shock associated with a decrease in trade costs among the participating countries. They calibrate a Melitz-Ottaviano type model using European data at the sectoral level, and simulate the impact of euro adoption on

[13] Typically, those databases display bilateral trade flow data within 5,000 product categories.

trade and competition. This approach based on simulation aims to bypass the lack of homogenous microeconomic data for several individual countries. They show that least productive firms are forced to exit, while some domestic firms gain access to foreign markets. Here, however, firms are mono-product, which does not enable to conclude on the firm level product extensive margin.

Here, we rely on individual firm data and examine the impact of euro introduction on export patterns of the whole set of individual French exporters. We are interested in participation (how euro introduction affected the probability to enter a foreign market), in the firm level product-extensive margin (measured at the destination level) and in the firm-destination intensive margin. We rely on a difference-in-difference approach. The treatment group is the first set of destination countries that made up the euro area, while the control group is the remaining destination EU15 countries that did not join.[14] Since France did join the eurozone from the beginning, we expect trade costs to be reduced for French exporters to other eurozone destinations from 1999 on. Greece joined later on and is accordingly dropped of our sample. We stop the experience at the end of 2003, even if we have data also for two subsequent years, in order not to introduce a new shock, namely EU enlargement to the ten new Member states in 2004.

2.2 Methodology

Estimation strategy.

As discussed above, we take the euro as a natural experiment to test the effect of a change in trade costs on multi-product exporters. This approach differs from the analysis of the effects of distance, since we consider **a change of trade costs over time, for a fixed set of destinations**.

We first estimate the euro effect on the probability that a firm exports to a foreign market. In our estimation strategy, we make use of a ***conditional FE logit***, which estimates the effect of each independent variable on the probability that the firm "switches" from the non-exporter to the exporter status. Hence, the estimation procedure drops all observations that correspond to non-switching firms, i.e. firms that continue exporting to a given destination market over the whole 1995-2003 period. Accordingly, we begin by estimating the following equation with the conditional FE logit:

$$T_t^{fj} = \alpha_1 EZ_{99-03} + \alpha_2 ln(RER_{jt}) + \alpha_3 ln(RGDP_{jt}) + \alpha_4 ln(TFP_{jt-1}) + \alpha_5 \kappa_{fj} + \alpha_6 \kappa_t + \epsilon_{kjt} \tag{10}$$

[14]Destination countries treated by euro introduction in 1999 are accordingly: Austria, Finland, Germany, Italy, Ireland, The Netherlands, Spain, Portugal, Belgium and Luxembourg – two countries corresponding to the same aggregated destination for trade data. The United-Kingdom, Denmark and Sweden staid out and Greece joined in 2001. A decade later, the euro area is made of 16 Member states, including Malta, Cyprus, Slovenia and Slovakia.

$EZ_{1999-2003}$ is a dummy variable, which is equal to one during the period 1999-2003 when the destination country is a member of the eurozone, and zero otherwise. RER_{jt} is the real exchange rate. $RGDP_{jt}$ is the real GDP. κ_{kj} is the fixed effect $firm \times destination$, which correspond to our individuals in the panel. κ_t is the set of year dummy variables.

Having estimated the effects of the euro on the firm decision to export to a given destination, we investigate the euro effect on the remaining components of the value of exports by each individual firm on each destination: the number of products exported and the average value of exports by product. We rely on a conditional FE poisson estimator, which allows for $firm \times destination$ fixed effects.

We keep the control variables that were reported in Equation (10), and estimate the effect of the euro on the number of products exported N_{pt}^{fj}, and that on the average value of exports by product $\overline{x}_t^{fj}$, using the conditional FE poisson estimator. We estimate those equations over positive values of trade.

$$N_{pt}^{fj} = \beta_1 EZ_{99-03} + \beta_2 ln(RER_{jt}) + \beta_3 ln(RGDP_{jt}) + \beta_4 ln(TFP_{jt-1}) + \beta_5 \kappa_{fj} + \beta_6 \kappa_t + \epsilon_{kjt} \quad (11)$$

$$\overline{x}_t^{fj} = \gamma_1 EZ_{99-03} + \gamma_2 ln(RER_{jt}) + \gamma_3 ln(RGDP_{jt}) + \gamma_4 ln(TFP_{jt-1}) + \gamma_5 \kappa_{fj} + \gamma_6 \kappa_t + \epsilon_{kjt} \quad (12)$$

Note that controlling for TFP requires to rely on a reduced sample of firms with more than 20 employees. However controlling for TFP is necessary: euro adoption may have indeed affected firm productivity. What we attempt to capture is the euro effects on French exporters that are independent from the evolution of TFP.

Our objective is to identify a pure shock on trade costs, affecting French exporters by 1999. This raises two issues: choice of the control group and anteriority of monetary cooperation in Europe.

The first issue concerns the control group. Ideally, this control group should be only composed of EU15 destination countries, that have been affected by all EU policies during the period, with the exception of the euro. We end up with three countries in the control group - the United Kingdom, Sweden and Denmark. We also consider OECD countries as an alternative group of control. Accordingly, we first rely on a sample of OECD or EU15 destinations.

Heterogenous response of firms

We are interested in determining whether productivity interacts with the euro effect on French exporters. For each firm, we compute the average TFP over the period 1996-

1998[15]. We then generate four quartiles according to the firms' average productivity over the same period, and also generate interaction variables between the EZ_{99-03} variable, and quartiles Q1, Q2, Q3 and Q4. The EZ_{99-03} is then omitted in the estimation, so that the euro effect on firms, for each TFP quartile, is directly measured by the coefficient on $EZ_{99-03} \times Q_1$, $EZ_{99-03} \times Q_2$, $EZ_{99-03} \times Q_3$ and $EZ_{99-03} \times Q_4$ variables.

Table 3: Number of products exported by destination

TFP quartile	Mean	Standard deviation
1^{st} quartile	3.63	8.26
2^{nd} quartile	3.87	8.07
3^{rd} quartile	4.15	9.67
4^{th} quartile	5.64	12.85

Table 3 shows descriptive statistics about the number of product categories exported by firm, according to the productivity quartiles. It shows that firms with a larger productivity also export more product categories to each partner. For the fourth quartile we also observe a larger standard deviation, which suggests that adjustment through the number of products exported to each destination can be an important source of adjustment at the firm-level.

D-Mark zone issue.

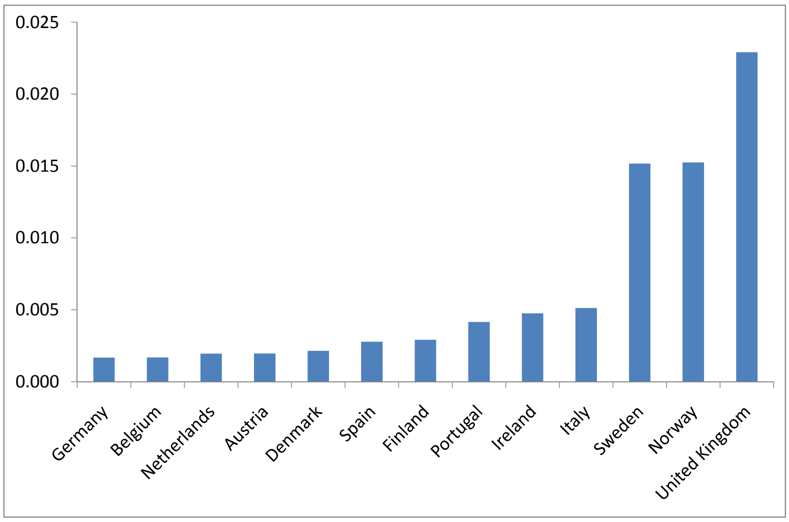
The second issue is about the history of monetary integration in the EU. Due to previous monetary *coordination* along the lines of the European Monetary System, the extent of the reduction in volatility may be low for French firms exporting to the eurozone. Figure 3 shows nominal exchange rate volatility across trade partners for France over the period preceding the introduction of the euro. One drawback of using the euro adoption as a natural experiment is that monetary policy coordination has preceded euro adoption, so that the shock that we identify is actually heterogenous across destinations. This would indeed imply that individual exports may have already benefited from the reduction in exchange rate volatility, when we consider euro adoption in 1999. Preliminary steps before euro introduction have actually been quite chaotic: 8 Members of the European Community entered the European Monetary System (EMS) in 1979.[16] The EMS implied that nominal exchange rate fluctuations between participants should not exceed more or less 2.25%. Though, the Italian Lira entered the EMS with a more or less 6% fluctuation band. The Irish Punt was devaluated by 10% in 1993, consecutive to the crisis affecting the EMS in 1992-1993. Consecutive to the crisis, fluctuation bands were enlarged and allowed more or less 15% nominal exchange rate fluctuations by 1993. Though, this first initiative of monetary coordination can be considered as a first step towards monetary

[15] It is possible to calculate TFP from the EAE data by 1995, but data are very scarce in 1995.

[16] The UK entered in 1990 in the ERM with a large band of fluctuation and left the system in 1992.

integration, and countries that did not devaluate during 1992-1993 (France, Belgium, Luxembourg, Netherlands, Germany and Denmark) have been qualified of being part of a D-Mark zone, characterized by a greater monetary policy coordination before 1999 and euro adoption.[17] Figure 3 indeed shows that nominal exchange rate volatility of selected currencies with respect to the French Franc is low when D-Mark destinations are considered, as compared to other European destinations.

Figure 3: Volatility vis-a-vis French Franc, 1995-99



Authors calculations based on “Ecowin” data

In order to account for this anteriority of monetary integration among a sub-group of EU countries, we remove D-Mark zone countries from potential destinations in a second step.[18] Hence, this restriction in the sample of countries should enable to better identify a pure shock with a decrease in trade costs that occurred in 1999. Still, it might be the case that *de jure* and *de facto* exchange rate regimes differed in Europe before adoption of the euro. In particular, Austria had a *de facto* peg on the D-Mark, while not participating in the EMS. This is confirmed in Figure 3. The observed volatility is clearly much in line with the DMark zone for the Austrian Schilling. We therefore consider the *de facto* D-Mark zone in our estimations.

Endogeneity issue.

[17]See McKinnon (2002) for instance. This term of D-Mark zone was initially used to characterize the core group of countries having not exited from the ’snake in the tunnel’ (Germany, Denmark, Belgium, Luxembourg, Netherlands). Off course the ”treatment” considered here is only partial since it does not remove transaction costs associated with multiple currencies.

[18]We are indebted to Adriaan Dierx for suggesting this sensitivity analysis.

Finally, our results may be biased because of self-selection of firms into various destinations. Indeed, firms that export to eurozone and non-eurozone destinations within the EU15, before and after euro introduction, may have different characteristics. Heterogenous firms' characteristics across destinations may introduce some bias in our estimations. We therefore proceed to robustness checks by selecting only firms in our sample that export both to eurozone and non-eurozone (EU15) destinations, during the sample period.

2.3 Euro adoption and firm-level adjustment

In this section, we present panel estimations of the euro effects on firm selection, product selection, and the average value of exports by product within each firm. In each table, we present estimation results that rely on a sample of OECD or EU15 countries in the control group. Accordingly, we restrict $firm \times destination$ pairs to those with OECD or EU15 destinations. The second control group being composed of United Kingdom, Denmark and Sweden is very restrictive, but enables to precisely identify the euro effects on French exporters, with no bias arising from EU policies, such as competition or structural policies. Note that all standard errors are clustered by destination.

Table 4 relies on the full sample of OECD or EU15 destinations - i.e. we do include D-Mark zone countries, and report the effect of each independent variable on firm selection (T_t^{fj}), product selection within firms (N_{pt}^{fj}), and the average value of exports by product category within firms ($\overline{x}_t^{fj}$).[19]

Table 4: Euro effects on the components of firm-level exports

Sample	OECD			EU15		
Estimator	Cond. FE logit	Cond. FE poisson		Cond. FE logit	Cond. FE poisson	
Dependent variable	T_t^{fj}	N_{pt}^{fj}	$\overline{x}_t^{fj}$	T_t^{fj}	N_{pt}^{fj}	$\overline{x}_t^{fj}$
$EZ_{1999-2003}$	-0.134*	0.019	0.013	-0.058	0.000	-0.009
	(0.080)	(0.015)	(0.032)	(0.045)	(0.010)	(0.041)
RER_{jt}	-1.570***	-0.229***	-0.317*	-0.735	-0.167*	-0.847*
	(0.479)	(0.084)	(0.189)	(0.783)	(0.086)	(0.445)
$RGDP_{jt}$	2.009***	0.440***	0.474	1.148**	0.388***	0.203
	(0.677)	(0.118)	(0.479)	(0.479)	(0.099)	(0.644)
TFP_{jt-1}	0.150***	0.059***	0.126***	0.072	0.061***	0.107***
	(0.020)	(0.006)	(0.029)	(0.045)	(0.007)	(0.034)
Nb observations	493,090	621,988	621,978	184,528	373,602	373,592
Fixed effects	Firm × destination, year			Firm × destination, year		

Note: Significance levels: *10%, **5%, ***1%. All variables - with the exception of dummy variables - are in logarithms. Robust standard errors in parentheses. Standard errors are clustered by destination.

[19] Note that as in previous estimations, we report the coefficients of each independent variable, but not the marginal effect, when the conditional fixed-effect logit is considered in the firm selection equation.

First, results indicate that lagged productivity has a positive effect on all components of firm-level exports, with the exception of firm-selection in the sample of EU15 destinations. This may imply that the productivity premium is much lower when EU15 destinations are considered, due to lower entry cost. Hence, a variation of firm productivity has no effect on firm decision to export to EU15 destinations.

Interestingly, variations of the real GDP of destination country has a positive effect on firm and product selection, but no effect on the average value of exports by product within firm. This may imply that ***within*** firm composition effect is in action here: an increase in foreign demand enables firms to export more product categories, but with a lower value for new products, which reduces the average value of exports by product within firms.

Real exchange rate movements affect all components of firm-level exports when we consider the OECD sample of destinations, with a weaker effect on the average value of exports by product within firms. We find however little evidence of an effect of real exchange rate movements on the components of firm-level exports when the sample of EU15 destinations is considered. This may be due to the fact that we have over the whole period only a weak nominal exchange rate volatility affecting this sample of destinations. After 1999, nominal exchange rate variations can indeed only be observed for the United Kingdom, Denmark and Sweden destinations. By 1999, real exchange rate variations are only driven by variations in relative prices when eurozone destinations are considered. This may suggest that weaker real exchange rate variations imply a lower reaction of firm-level exports, as suggested by Baldwin and Krugman (1989).

Results associated with the euro effects on the components of firm-level exports are more provocative and somehow unexpected. Results presented in Table 4 indeed show that euro adoption had - ***on average*** - an insignificant effect on the number of products exported by firm and the average value of exports by product within firms, when the full sample of exporters with more than 20 employees is considered. We also find a weak but negative effect of euro adoption on firm participation, which suggests that competition increased on eurozone markets, consecutive to euro adoption.[20] Note however that the absence of a positive effect of euro adoption on the components of firm-level exports, ***on average***, is not contradictory with the positive effect that is found at the aggregate level in previous literature (Micco et al., 2003). The euro effects may actually differ according to firms characteristics. This issue is important, since more productive and larger firms represent a large proportion of French aggregate exports (Mayer and Ottaviano, 2007). We investigate the issue of firm heterogeneity in the next section.

The absence of effect of euro adoption on firm-level exports in the Table 4 may also

[20]This effect is insignificant when the rest of the EU is used as a control group

be the result of past monetary coordination within the EU, which mainly characterized the D-Mark zone countries. We therefore proceed to a second estimation by excluding D-Mark zone countries - i.e. Germany, Netherlands, Belgium and Luxembourg, and Denmark, from the sample of destinations for French exporters. Hence, our sample of eurozone destinations is now composed of Italy, Spain, Ireland, Portugal, Finland and Austria, for which we expect a larger "treatment" due to weaker coordination in monetary policy before 1999. Results are provided in Table 5 below.

Table 5: Euro effects on firm-level exports, D-Mark Zone destinations excluded

Sample	EU15, de jure D-Mark zone excluded			EU15, de facto D-Mark zone excluded		
Estimator	Cond. FE logit	Cond. FE poisson		Cond. FE logit	Cond. FE poisson	
Dependent variable	T_t^{fj}	N_{pt}^{fj}	$\overline{x}_t^{fj}$	T_t^{fj}	N_{pt}^{fj}	$\overline{x}_t^{fj}$
$EZ_{1999-2003}$	0.016	0.021**	0.021	0.034	0.023***	0.042
	(0.040)	(0.009)	(0.055)	(0.056)	(0.008)	(0.054)
RER_{jt}	-0.239	-0.045	-0.818	-0.077	-0.022	-0.582
	(0.814)	(0.077)	(0.783)	(0.879)	(0.075)	(0.715)
$RGDP_{jt}$	0.727	0.207**	0.104	0.563	0.194**	0.039
	(0.465)	(0.081)	(0.685)	(0.474)	(0.076)	(0.696)
TFP_{jt-1}	0.082	0.064***	0.089*	0.081	0.065***	0.084
	(0.055)	(0.008)	(0.051)	(0.065)	(0.009)	(0.053)
Nb observations	141,516	236,116	236,116	121,557	212,470	212,464
Fixed effects	Firm × destination, year			Firm × destination, year		

Note: Significance levels: *10%, **5%, ***1%. All variables - with the exception of dummy variables - are in logarithms. Robust standard errors in parentheses. Standard errors are clustered by destination.

Results reported in the left panel of the Table are obtained by excluding the *de jure* D-Mark zone destinations. Note that the number of observations is considerably reduced since D-Mark zone destinations correspond to major destinations for French exports. With this restricted sample of destinations, coefficients on lagged TFP, real GDP and real exchange rate are quantitatively unchanged. Regarding the effects of euro adoption, results show that coefficients on the $EZ_{1999-2003}$ variable are now larger than in previous estimations. Most importantly, the marginal effect of euro adoption on the number of products exported by firm is now highly significant: euro adoption increased the number of product categories exported by French firms to eurozone destinations, when we exclude destinations that were part of the so-called D-Mark zone. We find however no significant effect of euro adoption on the firm selection, and the average value of exports by product category within firms. Results reported in the left panel of the Table are obtained by excluding *de facto* D-Mark zone destinations (e.g. *de jure* destinations plus Austria). Overall, this second estimation excluding D-Mark zone countries shows that some of the gains associated with lower nominal exchange rate volatility may have preceded euro adoption in 1999. This restricted sample of countries therefore better captures the pure shock related to the variation of trade costs in 1999.

We repeat the exercise but this time, we only consider de jure D-Mark zone destinations

in the treatment group. As in previous estimation, the control group is only composed of United Kingdom and Sweden. Estimation results are reported in Table 6.

Table 6: Euro effects on firm-level exports, treatment group with only D-Mark Zone destinations

Sample	EU15, de jure DM-zone only		
Estimator	Cond. FE logit	Cond. FE poisson	
Dependent variable	T_t^{fj}	N_{pt}^{fj}	$\overline{x}_t^{fj}$
$EZ_{1999-2003}$	-0.212***	-0.021***	-0.042
	(0.024)	(0.008)	(0.033)
RER_{jt}	-0.773***	-0.155***	-0.391**
	(0.227)	(0.028)	(0.163)
$RGDP_{jt}$			

Table 7: Robustness: firms exporting both to eurozone and non-eurozone (EU15) destinations

Sample	EU15			EU15, D-Mark zone excluded		
Dependent variable	T_t^{fj}	N_{pt}^{fj}	$\overline{x}_t^{fj}$	T_t^{fj}	N_{pt}^{fj}	$\overline{x}_t^{fj}$
Estimator	Cond. FE logit	Cond. FE poisson		Cond. FE logit	Cond. FE poisson	
$EZ_{1999-2003}$	-0.064	0.001	-0.004	0.026	0.024***	0.040
	(0.046)	(0.010)	(0.038)	(0.057)	(0.008)	(0.052)
RER_{jt}	-0.734	-0.143*	-0.702	-0.128	-0.003	-0.522
	(0.753)	(0.080)	(0.442)	(0.879)	(0.072)	(0.676)
$RGDP_{jt}$	1.173**	0.397***	0.275	0.584	0.213***	0.040
	(0.464)	(0.097)	(0.652)	(0.456)	(0.078)	(0.700)
TFP_{jt-1}	0.105***	0.047***	0.049	0.140***	0.047***	0.062
	(0.030)	(0.007)	(0.041)	(0.033)	(0.011)	(0.060)
Nb observations	162,129	343,657	343,647	108,868	198,262	198,256
Fixed effects	Firm × destination, year			Firm × destination, year		

Note: Significance levels: *10%, **5%, ***1%. All variables - with the exception of dummy variables - are in logarithms. Robust standard errors in parentheses. Standard errors are clustered by destination.

newly integrated area may lead to firm exist, especially when the decrease in trade costs is only weak. Hence, our result on firm selection is much more in line with the Eckel and Neary (2008) model that predicts an increase in competition consecutive to greater integration, with a possibility for firm exit.[21]

2.4 Euro adoption and the heterogenous response of exporters

In a last step, we evaluate whether the euro effects on French exporters differ according to the level of firm-productivity before the introduction of the euro in 1999. We define four productivity quartiles according to the distribution of total factor productivity of French exporters before 1999, and generate four dummy variables that indicates whether firms belong to the first, second, third or fourth quartile of TFP before 1999. We then interact these four dummy variables with the euro dummy, in order to determine whether the reaction of French exporters to euro adoption in 1999 was heterogenous. Again, we repeat our estimation exercise by first selecting the full sample of destinations, before excluding the D-Mark zone countries in a second step. Estimation results with the full sample of destinations are provided in Table 8 below.

First of all, results presented in Table 8 show that while no effect of euro adoption can be observed *on average* when we consider all EU15 destinations, the response of French exporters is actually highly heterogenous when we consider the initial productivity of firms before 1999. We find no significant effect of euro adoption on firm selection, for any productivity quartile. Within firms, the average value of exports by product category is

[21] They extend their model to allow for firm entry and exit, and show that greater integration can lead to firm exit. However, and as discussed previously, their model does not discriminates between exporters and pure domestic firms, which makes it more difficult to derive clear predictions for multi-product exporters.

Table 8: Euro effects according to initial TFP

Sample	OECD			EU15		
Estimator	Cond. FE logit	Cond. FE poisson		Cond. FE logit	Cond. FE poisson	
Dependent variable	T_t^{fj}	N_{pt}^{fj}	$\overline{x}_t^{fj}$	T_t^{fj}	N_{pt}^{fj}	$\overline{x}_t^{fj}$
$EZ_{1999-2003} \times Q1$	-0.100	-0.007	-0.034	-0.059	-0.027**	-0.056
	(0.083)	(0.015)	(0.043)	(0.056)	(0.011)	(0.048)
$EZ_{1999-2003} \times Q2$	-0.117	0.020	0.013	-0.075	0.000	-0.009
	(0.080)	(0.016)	(0.057)	(0.049)	(0.011)	(0.059)
$EZ_{1999-2003} \times Q3$	-0.122	0.001	0.012	-0.079	-0.019*	-0.010
	(0.086)	(0.015)	(0.027)	(0.058)	(0.011)	(0.034)
$EZ_{1999-2003} \times Q4$	-0.097	0.051***	0.035	-0.055	0.031***	0.012
	(0.080)	(0.014)	(0.045)	(0.038)	(0.011)	(0.053)
RER_{jt}	-1.595***	-0.225***	-0.374**	-0.765	-0.168*	-0.927**
	(0.489)	(0.085)	(0.189)	(0.720)	(0.086)	(0.445)
$RGDP_{jt}$	1.932***	0.434***	0.504	1.246***	0.375***	0.261
	(0.676)	(0.117)	(0.488)	(0.465)	(0.096)	(0.656)
TFP_{jt-1}	0.151***	0.059***	0.105***	0.128***	0.062***	0.079***
	(0.021)	(0.006)	(0.027)	(0.026)	(0.007)	(0.030)
Nb observations	477,579	580,485	580,474	160,236	342,758	342,747
Fixed effects	Firm × destination, year			Firm × destination, year		

Note: Significance levels: *10%, **5%, ***1%. All variables - with the exception of dummy variables - are in logarithms. Robust standard errors in parentheses. Standard errors are clustered by destination.

not affected either. However, results indicate that euro adoption promoted the number of product categories exported by firm, but only for most productive ones ($Q4$). For the EU15 sample, results show a negative effect of euro adoption on the number of product categories exported by firms reporting a lower productivity level before 1999. This is especially the case for the least productive ones ($Q1$).

In a second step, we proceed to similar estimations by restricting the sample of destinations to countries located outside the so-called D-Mark zone. Estimation results are reported in Table 9 below.

The numbers reported in Table 9 clearly confirm previous findings: euro adoption only affected French exporters through the number of product categories exported by each firm. Estimations also show a positive - but non significant - effect on the average value of exports by product category for least productive firms ($Q1$ and $Q2$), but this effect disappears when we only keep EU15 destinations.

In Table 10 we proceed to a third estimation by only keeping D-Mark zone destinations in the treatment group. Estimation results first show that euro had a negative effect on export market participation for all types of firms. We find also a negative effect on the number of products exported by firm and the average value of exports by product for least productive firm. Most productive exporters are not affected through their sales. This feature is highly consistent with a rise of competition on D-Mark zone destinations after 1999, affecting especially least productive exporters.

Table 9: Euro effects according to initial TFP, excluding D-Mark zone destinations

Sample	EU15, de jure D-Mark zone excluded		
Estimator	Cond. FE logit	Cond. FE poisson	
Dependent variable	T_t^{fj}	N_{pt}^{fj}	$\overline{x}_t^{fj}$
$EZ_{1999-2003} \times Q1$	0.013	-0.007	0.051
	(0.059)	(0.011)	(0.042)
$EZ_{1999-2003} \times Q2$	0.009	0.021	0.075
	(0.041)	(0.014)	(0.047)
$EZ_{1999-2003} \times Q3$	0.016	0.003	0.011
	(0.053)	(0.010)	(0.038)
$EZ_{1999-2003} \times Q4$	-0.007	0.052***	-0.009
	(0.047)	(0.009)	(0.078)
RER_{jt}	-0.284	-0.044	-0.845
	(0.771)	(0.077)	(0.777)
$RGDP_{jt}$	0.795*	0.199***	0.100
	(0.449)	(0.076)	(0.666)
TFP_{jt-1}	0.160***	0.064***	0.086*
	(0.023)	(0.009)	(0.052)
Nb observations	135,633	225,639	225,631
Fixed effects	Firm × destination, year		

Note: Significance levels: *10%, **5%, ***1%. All variables - with the exception of dummy variables - are in logarithms. Robust standard errors in parentheses. Standard errors are clustered by destination.

Table 10: Euro effects on firm-level exports, treatment group with only D-Mark Zone destinations

Sample	EU15, de jure D-Mark zone only		
Estimator	Cond. FE logit	Cond. FE poisson	
Dependent variable	T_t^{fj}	N_{pt}^{fj}	$\overline{x}_t^{fj}$
$EZ_{1999-2003} \times Q1$	-0.192***	-0.045***	-0.128***
	(0.064)	(0.011)	(0.037)
$EZ_{1999-2003} \times Q2$	-0.245***	-0.020**	-0.080
	(0.037)	(0.009)	(0.070)
$EZ_{1999-2003} \times Q3$	-0.279***	-0.043***	-0.035
	(0.045)	(0.011)	(0.042)
$EZ_{1999-2003} \times Q4$	-0.131***	0.010	0.024
	(0.014)	(0.011)	(0.062)
RER_{jt}	-0.741***	-0.163***	-0.449***
	(0.224)	(0.028)	(0.169)
$RGDP_{jt}$	0.635	0.222**	-0.143
	(0.910)	(0.094)	(0.530)
TFP_{jt-1}	0.089*	0.065***	0.089***
	(0.047)	(0.009)	(0.028)
Nb observations	73,314	192,840	192,835
Fixed effects	Firm × destination, year		

Note: Significance levels: *10%, **5%, ***1%. All variables - with the exception of dummy variables - are in logarithms. Robust standard errors in parentheses. Standard errors are clustered by destination.

Last, we proceed to a robustness check by selecting only firms that export to both eurozone and non-eurozone (EU15) destinations over the period. Results are presented in Table 11.

Results are in line with previous estimations: only most productive firms show a

Table 11: Robustness: firms exporting both to eurozone and non-eurozone (EU15) destinations

Sample	EU15			EU15, D-Mark zone excluded		
Dependent variable	T_t^{fj}	N_{pt}^{fj}	$\overline{x}_t^{fj}$	T_t^{fj}	N_{pt}^{fj}	$\overline{x}_t^{fj}$
Estimator	Cond. FE logit	— Cond. FE poisson		Cond. FE logit	Cond. FE poisson	
$EZ_{1999-2003} \times Q1$	-0.061	-0.017	-0.048	0.035	0.002	0.064
	(0.059)	(0.010)	(0.047)	(0.061)	(0.013)	(0.049)
$EZ_{1999-2003} \times Q2$	-0.062	-0.006	0.006	0.028	0.018	0.128***
	(0.049)	(0.010)	(0.057)	(0.069)	(0.012)	(0.04)
$EZ_{1999-2003} \times Q3$	-0.079	-0.016	-0.001	0.058	0.009	0.036
	(0.058)	(0.011)	(0.033)	(0.052)	(0.01)	(0.036)
$EZ_{1999-2003} \times Q4$	-0.051	0.033***	0.007	-0.016	0.051***	-0.001
	(0.038)	(0.011)	(0.051)	(0.071)	(0.009)	(0.076)
RER_{jt}	-0.719	-0.143*	-0.734*	-0.098	-0.001	-0.522
	(0.738)	(0.08)	(0.441)	(0.855)	(0.072)	(0.663)
$RGDP_{jt}$	1.154**	0.383***	0.277	0.566	0.207***	0.010
	(0.456)	(0.095)	(0.651)	(0.446)	(0.074)	(0.670)
TFP_{jt-1}	0.102***	0.047***	0.038	0.146***	0.047***	0.057
	(0.030)	(0.008)	(0.041)	(0.030)	(0.012)	(0.060)
Nb observations	157,220	329,354	329,344	105,626	190,000	189,994
Fixed effects	Firm × destination, year			Firm × destination, year		

Note: Significance levels: *10%, **5%, ***1%. All variables - with the exception of dummy variables - are in logarithms. Robust standard errors in parentheses. Standard errors are clustered by destination.

positive reaction through the number of products. Firms that belong to the second productivity quartile show a positive reaction through the average value of exports by product category. This implies that firms with lower productivity may react to a decrease in trade costs through the within-firm intensive margin.

2.5 Discussion

Overall, estimations results indicate that exporters reacted to euro adoption through the number of product categories exported to eurozone markets, with no effect on the average value of exports by product. This effect however can only be observed for the most productive exporters. Regarding firms with a lower productivity level, results even show that the effect of euro adoption on the number of product categories exported can be negative.

These results depart from the empirical predictions of Bernard et al. (2009b) consecutive to a decrease in trade costs. First, firms with a lower productivity that export to few markets are indeed expected to enter new markets, and therefore increase the number of product categories exported and the average value of exports by product on each of those markets. Second, firms with a higher productivity that already export to more markets are expected to increase the number of product categories exported to each market, with an ambiguous effect on the average value of exports by product. Our empirical results

differ from these predictions in that we cannot identify a positive effect of euro adoption on firm participation. Our empirical results also fail to confirm the positive effect of euro adoption on the number of products by firm for the least productive firms.

Our results rather suggest few empirical regularities regarding firm-selection and within-firm adjustment. (i) A greater degree of economic integration that involves more than two countries has an ambiguous effect on firm selection, and can lead to firm exits. This effect may be related to an increased competition on the export market. (ii) Exporters characterized by a low degree of productivity may react to greater economic integration through a higher value of exports by product, as in Melitz (2003). (iii) Firms characterized by a high productivity react to greater economic integration through the number of products exported, with an ambiguous effect on the average value of exports by product, as in Bernard et al. (2009b). This also suggest that multi-product exporters expand their exports by adding marginal varieties, corresponding to a lower value of sales.

3 Conclusion

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