The Scandinavian
Journal of Economics

Scand. J. of Economics 115(2), 326–353, 2013
DOI: 10.1111/sjoe.12006

How do Multiproduct Exporters React to a Change in Trade Costs?*

Antoine Berthou

Banque de France, FR-75001 Paris, France
antoine.berthou@banque-france.fr

Lionel Fontagné

Paris School of Economics (Université Paris I), FR-75013 Paris, France
lionel.fontagne@univ-paris1.fr

Abstract

We use data on individual French exporters to document how a change in trade costs, following the introduction of the euro, affected the export margins of firms in relation to export decisions, the number of products exported, and the average sales per product. Our results confirm two effects predicted by the theory: firms increase the range of products they export as well as their intensive margin. This effect is most evident in markets with moderate monetary policy coordination before 1999. General equilibrium competition effects reduce the initial positive impact on each of these margins. We find no evidence that firms increase their participation in the export market.

Keywords: Firm heterogeneity; international trade; multi-product exporters
JEL classification: *F*12; *F*15

I. Introduction

A country's exports are concentrated in a few large firms that export large volumes to several countries. These firms produce and export several varieties of differentiated goods (their "product mix"), and are flanked by a large number of very small single-product exporters. Therefore, in order to improve our understanding of the effects of changes in trade costs on aggregate exports, it is important to better identify the underlying microeconomic adjustments, and in particular the role of products.

In this paper, we investigate empirically how changes in trade costs affect firm-level exports, using the introduction of the euro in 1999 as a natural experiment. Our objective is to shed new light on the contribution

*We are indebted to Matthieu Crozet, Kathryn Dominguez, Karolina Ekholm, Pierre-Olivier Gourinchas, Ann Harrison, Philippe Martin, Sofia Villas-Boas, and four anonymous referees for their helpful comments and suggestions. We acknowledge funding from the EFIGE project, European Commission's FP7 Contract 225551. This paper does not reflect the views of the Banque de France.

of firms and product selection in export markets, to overall adjustments in firm-level exports.

We use a firm-level database provided by the French Customs, which reports the annual export flow values of individual exporters, by product and destination, for the period 1995–2003.[1] These data allow us to identify the effects of trade costs on firms' decisions to export to particular markets, the number of products they export to those markets, and the average sales per product. Thus, we are able to measure the effect of trade costs on firms' total export sales, and to quantify the impact on each margin. We find that the acknowledged limited aggregate impact on trade flows of the introduction of the euro hides a very rich set of microeconomic adjustments. These are the result of the combined gross effects of trade costs and competition.

The choice to use the introduction of the euro in 1999 as a natural experiment was motivated by the fact that this was the largest shock, in terms of economic integration among European countries, covered by available firm-level trade data for France.[2] The introduction of the euro in 1999 was associated with a permanent elimination of nominal exchange rate volatility within the euro area, which reduced the cost of trading with euro-area destinations. All potential French exporters were affected, although we would expect the reduction in trade costs to be larger for the group of euro-area destinations characterized by moderate monetary policy coordination before 1999 and, consequently, higher short-term nominal exchange rate volatility. An important feature of the introduction of the euro is that monetary integration involved many countries. This possibly led to an increase in competition in each euro-area destination market, because of the simultaneous reduction in trade costs for other euro-area exporters. For instance, trade costs for exporting to Italy were reduced for French firms, but also for their German competitors. Martin and Méjean (2008) have provided empirical evidence of increased competition (i.e., price dispersion within the euro area decreased after 1999).[3]

The results of our estimates show that the introduction of the euro only weakly affected the average value of the exports of French firms to destinations in the euro area, with respect to the other EU15 destinations. The introduction of the euro provided the greatest benefit to the most

[1] We would like to thank the French customs administration for making this dataset available to researchers at CEPII, where estimations have been carried out.

[2] Our contribution (using firm-level and product-level data) is in the vein of papers testing the euro's effects on trade using aggregate data (Flam and Nordström, 2003; Micco *et al.*, 2003) or product-level data (Flam and Nordström, 2007).

[3] Other authors have highlighted this channel. For example, Ottaviano *et al.* (2009) have calibrated a model similar to that of Melitz and Ottaviano (2008), and have also predicted that European integration increased the competitive pressure on firms.

productive exporters. We also find that the trade-creation effect is heterogeneous across the treated destinations. It is conditioned by the intensity of monetary policy coordination before 1999, which affected short-term nominal exchange rate volatility. For destinations in the euro area characterized by moderate monetary policy coordination before 1999, the adoption of the euro increased firm-level exports by 12.8 percent with respect to destinations in the non-euro area. About 20 percent of this effect is the result of an increase in the number of products exported. However, no effect can be identified regarding the decision to export. For destinations in the euro area with closer monetary policy coordination before 1999 – and lower nominal exchange rate volatility (the so-called "D-Mark zone") – the adoption of the euro had a negative impact on the decision to export, on the number of products exported, and on the average per product value of exports. For each group of treated destinations, the size of the euro effect has been growing over time.

If we control for competition among exporters in the euro area to destinations in the euro area, we are able to identify the gross effect of the reduction in trade costs: taking all euro-area destinations, the average exports of firms to euro-area destinations have increased by almost 7 percent. About 18 percent of this effect is a result of the number of products exported. This is confirmed by the aggregate estimations.

These results are in line with the empirical predictions in a series of theoretical works. Recent trade models have introduced the possibility for firms to choose endogenously between the range of products that they sell in the domestic market and/or export. Our results show that changes in trade costs have a significant impact on the range of products exported by firms, especially the most productive ones. However, competition effects dampen the gross impact of trade-cost reductions on firms' exports.

This paper contributes to a series of empirical studies that show how changes in the macroeconomic environment of firms can affect export behavior. Considering the US, Bernard *et al.* (2009) have shown that changes in aggregate exports are explained mostly by the intensive margin. Ekholm *et al.* (2012) have studied the effects of the real appreciation of the Norwegian krone in the early 2000s, and have shown that net exporters decreased employment and increased productivity. Using similar data to ours, Berman *et al.* (2012) have shown that, following exchange rate movements, more productive firms tend to do more pricing to market, and to adjust the quantities exported less.

The paper is organized as follows. In Section II, we present the theoretical background, and we place this study within the empirical work on multiproduct exporters. In Section III, we describe the data and the empirical methodology. In Section IV, we present the estimation results, and we conclude in Section V.

II. Related Literature

There is ample evidence that only a small proportion of domestic firms are exporters, that aggregate exports are concentrated in a small number of major players (Eaton *et al.*, 2004), and that larger exporters are involved in exporting more than one product (Arkolakis and Muendler, 2010; Iacovone and Javorcik, 2010; Bernard *et al.*, 2011; Eckel *et al.*, 2011). Decreased trade costs stemming from the introduction of the euro might have affected the export decisions of firms in relation to the number of products exported and the average value of exports per product. In several studies, the authors have provided evidence of these mechanisms. Eckel and Neary (2010) have developed a model with oligopolistic competition and flexible manufacturing technology, where firms endogenously select the set of goods categories to be produced. Each firm has a "core competence" and, while expanding product lines is possible, it involves diseconomies of scope. Globalization increases competition among the products exported by each firm (supply-side competition). Firm sales increase, but the scope of the goods produced by the firm is reduced because of "cannibalization effects" among varieties of goods.

Our paper is more closely related to New Trade Theory models with monopolistic competition and firm heterogeneity, because these include predictions specific to the export market. Melitz (2003) has found that a decrease in fixed export costs allows less productive firms to start exporting. A change in variable trade costs affects firm entry and the intensive margin of incumbents. Also, Bernard *et al.* (2011) have modeled the possibility that firms manufacture several products. Their model predicts that the proportion of multiproduct firms that export, the number of destinations for each variety, and the range of products they export to each market all increase in response to reduced variable trade costs. However, the effect of trade liberalization on the value of sales by exported product is ambiguous because new products are exported in smaller volumes.[4]

Because the introduction of the euro was expected to increase competition in product markets, we need to rationalize how it potentially affected the exports margins of firms. Melitz and Ottaviano (2008) have used a linear demand system that allows mark-ups to vary across different markets. Market size and trade affect the degree of competition, and feed back into firms' selection in foreign markets. Increasing competition is expected to negatively affect the export decisions and export sales of firms, especially for the less productive firms. Baldwin and Gu (2009) and Mayer *et al.* (2011) have extended this framework to the case of

[4] Marginal products are subject to lower demand in the market.

multiproduct exporters. Both models feature firm heterogeneity, but Mayer *et al.* (2011) have also included product heterogeneity within the firm: as competition increases in a given market, firms stop selling marginal (less efficient) product lines in that market and concentrate on sales of top products.

The empirical body of literature has provided some evidence of the existence of these mechanisms. Iacovone and Javorcik (2010) have used the experience of the North American Free Trade Agreement (NAFTA) to provide evidence of symmetric trade liberalization between Mexico and the US. The number of products exported by Mexican firms increased most in those sectors where US tariffs declined the most, while Mexican firms reduced product scope in the domestic market in sectors where there was a significant decline in Mexican tariffs. These results are illustrative of the effects of simultaneous changes to trade costs and competition. Bernard *et al.* (2011) have provided evidence that, coincident with the enforcement of the Canada–US Free Trade Agreement (CUSFTA) in 1989, the US firms most exposed to trade liberalization concentrated on the production of fewer products. Finally, Mayer *et al.* (2011) have used data for France similar to the data utilized for our study, in order to show that in markets where there is tough competition, firms concentrate foreign sales on their best product.

Our work uses the introduction of the euro in 1999 as a natural experiment that affected both trade costs and the degree of competition, over time, in European markets. This event was unique, in that it involved many countries, and it can be expected to have increased competition in export markets. Nitsch and Pisu (2008) have provided evidence of the effects of introduction of the euro on Belgian exporters. We have three main contributions to the body of literature on multiproduct firms. First, for French exporters, we identify the effect of trade costs and the effect of competition on the export decisions of firms, the number of products exported to each market, and the average value of exports to each market by product. Second, we quantify the relative importance of product adjustments to firm-level exports. Third, we investigate how these adjustments are related to firm productivity.

III. Data and Empirical Methodology

Data

Firm-Level Export Data. We have used a database provided by French Customs, which includes data on the export flows of individual French firms in the period 1995–2003, differentiated by product

category and destination country.[5] Firms are identified by their SIREN number.

These data provide fairly exhaustive information on the world of French exporters, although French customs limit the reporting of certain information. Beyond the borders of the European Union (EU), shipments valued at less than 1,000 euros are subject to a simplified declaration procedure, and these do not appear in our data. Within the borders of the Single European Market, the reporting threshold is based on each firm's cumulated yearly export value. Although this threshold has increased over time, up to 100,000 euros in 2002, we have used the same threshold value for the entire period.

The classification of products utilized is the European Combined eight-digit Nomenclature (CN8), which includes 8,482 different groups of manufactured products. At the CN8 level, changes to the European product nomenclature are recorded every year. We aggregate products to the six-digit level of the United Nations Harmonized System, based on the 1992 revision (HS6-92).[6] This allows comparability of products over time.

We have used the product categories corresponding to manufacturing industries: International Standard Industrial Classification of All Economic Activities (ISIC) 311–390. Because we are merging customs and Business Survey data based on firm identifiers, we select only those firms whose main activity is manufacturing.

Other Firm Characteristics. The French annual business survey, Enquête Annuelle d'Entreprises (EAE), is used to identify firm characteristics. The EAE survey includes exporting and non-exporting firms with more than 20 employees, in all manufacturing sectors. These data include a series of variables, such as the wage bill, number of employees, value added, and investment. Based on this information, we compute the total factor productivity (TFP) for each exporter using the Olley–Pakes methodology.

Other Data Sources and Controls. In the empirical strategy discussed in the next section, we use a set of aggregate controls that allow us to disentangle the effects of the introduction of the euro on the exports of French firms from other macroeconomic shocks, such as the importing country's gross domestic product (GDP) or the real exchange rate, computed as the ratio of producer price indexes. The vector of aggregate controls also includes

[5] Eaton *et al.* (2004, 2011) have used similar data for 1986. Original data are available for a longer period; we have dropped subsequent years on the basis that the entry of 10 new member states into the EU in 2004 would constitute a second, and different, shock.

[6] We have retained the first six digits of the CN code, which corresponds to the HS6 nomenclature, and then we have converted the codes into the 1992 revision using conversion tables provided by the UN Comtrade.

Table 1. *Descriptive statistics (1995–2003)*

	Mean	Std Dev.	1st quartile	Median	3rd quartile	Top 5 percent
All EU15 destinations (15,088 firms)						
No. of products (*fjt*)	5.17	11.84	1	2	4	19
Exports by product (*fjt*)	348.55	1990.02	7.76	38.13	172.27	1, 351.64
Total exports (*fjt*)	1, 661.33	23, 400.00	16.68	101.50	505.50	4, 969.97
Log TFP (*ft*)	1.12	0.43	0.86	1.06	1.31	1.84
EU15 outside euro area (11,804 firms)						
No. of products (*fjt*)	4.81	11.22	1	2	4	17
Exports by product (*fjt*)	326.36	1, 597.85	6.15	32.01	154.57	1, 316.08
Total exports (*fjt*)	1, 446.32	18, 900.00	12.40	78.01	444.16	4, 622.41
Log TFP (*ft*)	1.13	0.44	0.87	1.06	1.31	1.86
Euro area (14,998 firms)						
No. of products (*fjt*)	5.27	12.01	1	2	5	20
Exports by product (*fjt*)	354.73	2, 086.02	8.29	39.98	177.36	1, 362.11
Total exports (*fjt*)	1, 721.15	24, 400.00	18.22	108.65	521.95	5, 074.96
Log TFP (*ft*)	1.12	0.43	0.86	1.06	1.30	1.84

Notes: Export values are expressed in thousands of euros. All statistics are provided for firms with more than 20 employees, over the period 1995–2003. We use f, j, and t to denote firms, destinations, and years, respectively.

Table 2. *Correlation between the main variables of interest*

	TFP (*ft*)	No. of products (*fjt*)	Exports by product (*fjt*)	Total exports (*fjt*)
TFP (*ft*)	1			
No. of products (*fjt*)	0.13	1		
Exports by product (*fjt*)	0.0116	0.0646	1	
Total exports (*fjt*)	0.0621	0.4559	0.9176	1

Notes: All variables are expressed in logarithm. Statistics are provided for firms with more than 20 employees, over the period 1995–2003. We use f, j, and t to denote firms, destinations, and years, respectively.

the import price index of the destination country, defined by industry, and a measure of competition from other euro-area countries, which we detail later. We justify the use of these variables in the empirical methodology section.

Descriptive Statistics. We provide descriptive evidence for the number of products exported by destination, the average export value by product, the total export value by firm for each EU15 destination, and the TFP. Table 1 reports the mean, standard deviation, and percentile statistics for each variable: 15,088 French exporters with more than 20 employees, exported to the EU15 at least once in the period 1995–2003. Each exporter ships an average of 5.17 products to each destination annually. The distribution

of the number of exported products is highly skewed: 50 percent of exporters export a maximum of two products to each destination, while the top 5 percent of exporters export 19 or more products to each destination. The distribution is similar for average sales per product to each destination: mean sales per product is about 348,000 euros, although it is less than this for the median firm. Export sales by destination are highly concentrated among the top 5 percent of exporters. Table 2 shows that the different margins of firms' exports and exporters' TFPs are positively correlated.

Similar empirical patterns are observed for euro-area markets (14,998 exporters) and EU15 destinations outside the euro area (11,804 exporters). For both groups of destinations, the distribution of productivity among firms is comparable because most of the 15,088 firms in our sample export to both regions. However, firms' exports to euro-area destinations slightly dominate exports to EU15 non-euro-area destinations, with respect to all margins.

Empirical Methodology

Rationale. Our empirical analysis uses the introduction of the euro by 11 European countries in 1999 as a natural experiment on reductions in trade costs. Traditionally, nominal exchange rate volatility and the transaction costs associated with exchanges of currencies have been considered a major source of trade costs (Anderson and van Wincoop, 2004). On this basis, the adoption of a single currency was expected to generate two effects: reduced trade costs and increased competition within the euro area. Using the euro experiment to identify the effect of changes in trade costs on the exports margins of firms (i.e., export decision, number of products exported, and average sales per product) has several advantages. First, we can identify a clear point in time when trade costs fell. Second, all French exporters were subject to the same shock.

We apply a difference-in-difference approach, which is traditional in euro-related empirical studies, to compare the evolution of exports to two different types of destination groups. The first group is composed of nine treated destinations that joined the euro area in January 1999: Austria, Finland, Germany, Italy, Ireland, the Netherlands, Spain, Portugal, and Belgium and Luxembourg.[7] The control group is composed of three member states of the EU15 that did not join the euro area: the United Kingdom, Sweden, and Denmark.

Therefore, our baseline estimations are based on a sample of 12 destinations (listed in Table A1 in the Appendix), subject to the same degree

[7] The last two countries are considered as a single destination, Benelux, in the French data, Greece is not included because it did not join the euro until 2001, and France is the source, making a total of nine treated destinations.

of economic integration and, with the exception of the introduction of the euro, to the same economic reforms over the period of analysis.

Baseline Estimation Strategy. The effect of the euro on the probability of exporting is estimated with a linear probability model using ordinary least-squares (OLS). Our estimations only include switchers (i.e., firms whose export status changed at least once during the period analyzed). This allows us to identify whether the introduction of the euro affected the decision to export to euro-area destinations compared to the control group destinations. Equation (1) corresponds to the estimated specification:

$$T_{fjt} = \alpha_1 EZ_{99-03} + \beta_1 \ln(TFP_{ft-1}) + \gamma_1 \mathbf{Z}_{jt} + \kappa_{fj} + \kappa_t + \epsilon_{jt}. \quad (1)$$

Here, f denotes the firm, j is the destination, t is the year, T_{fjt} is the dependent variable, which takes the value of 1 if the firm exports and 0 otherwise, EZ_{99-03} is a dummy variable equal to 1 during the period 1999–2003, if the destination country was a member of the euro area, and 0 otherwise, TFP_{ft-1} is the TFP of firm f, lagged by one year to avoid reverse causality, and $\mathbf{Z}_{jt}$ is a vector of macroeconomic controls, including the real exchange rate (RER_{jt}), the real GDP ($RGDP_{jt}$), and the import price index (MP_{jkt}) of the destination, defined for each industry k. These controls isolate the effects of the euro from other macroeconomic shocks, such as price-competitiveness, the business cycle, and competition from the rest of the world.[8] Also, κ_{kj} is the fixed effect $firm \times destination$, which corresponds to our individuals in the panel, and κ_t is the set of year dummy variables.

The effect of the euro on firm-level exports to each destination is estimated using a "within fixed effect estimator" for positive trade flows only. The value of firms' exports to each destination is decomposed into the number of products exported (N_{fjt}) and the average sales per product ($\overline{x}_{fjt}$). The value of firm-level exports to each destination (X_{fjt}) is the product of these two variables: $X_{fjt} = N_{fjt} \times \overline{x}_{fjt}$. The following specification is estimated, where $M_{fjt} = \{N_{fjt}; \overline{x}_{fjt}; X_{fjt}\}$ is one of the margins:

$$\ln(M_{fjt}) = \alpha_2 EZ_{99-03} + \beta_2 \ln(TFP_{ft-1}) + \gamma_2 \mathbf{Z}_{jt} + \kappa_{fj} + \kappa_t + \mu_{jt}. \quad (2)$$

Only the dependent variable has changed compared to equation (1). The estimation relies on positive export values by firms ($X_{fjt} > 0$). Based on this empirical strategy, the marginal effect of the introduction of the euro on firm-destination exports can be decomposed into the adjustment due to

[8] Competition, especially from emerging countries, must be accounted for and might evolve differently in different sectors. This effect is generally captured in a gravity model with a multilateral resistance term. In equation (1), for the sake of simplicity, we integrate this control with a sectoral dimension in the vector **Z**.

the number of products, and the value of exports per product:

$$\frac{\partial \ln(X_{fjt})}{\partial EZ} = \frac{\partial \ln(N_{fjt})}{\partial EZ} + \frac{\partial \ln(\overline{x}_{fjt})}{\partial EZ}.$$

This decomposition quantifies the contribution of the within-firm product extensive margin to the overall change in the value of firm exports predicted by the theory.

When we are combining microdata with macroeconomic variables, it is important to account for possible correlation between disturbances within groups (Moulton, 1990). This would bias the standard errors downwards and increase the economic significance of the regressors. Traditional clustering methods apply only in the presence of large numbers of groups (Wooldridge, 2003; Donald and Lang, 2007). Here, standard errors are clustered by destination and year; because we have 12 destinations and eight years, this gives 96 clusters.[9] The use of destination–year groups allows us to account for the fact that the size of groups changes annually based on entries and exits of exporters in each market.[10]

Heterogeneity among Firms. Besides the euro effects on the average firm, we want to know whether our results interact with firm TFP before 1999. For each exporter, we compute the average TFP for the period 1996–1998.[11] Four productivity quartiles are identified based on the pre-1999 firm TFP. We construct interaction variables between the EZ_{99-03} variable, and TFP quartile dummies Q1, Q2, Q3 and Q4. EZ_{99-03} is then omitted from the estimation, so that the effect of the euro on firms, for each TFP quartile, is measured directly by the coefficient on the $EZ_{99-03} \times Q_1$, $EZ_{99-03} \times Q_2$, $EZ_{99-03} \times Q_3$, and $EZ_{99-03} \times Q_4$ variables.

Heterogeneity among Destinations. Given the existence of monetary cooperation among euro-area countries before 1999, the absolute decrease in nominal exchange rate volatility at the time of the introduction of the euro is highly heterogeneous among the group of treated destinations. This implies that the reduction in trade costs was heterogeneous across euro-area destinations. The empirical strategy exploits this heterogeneity of treatment across euro-area countries to improve the identification of the effects of trade costs on French exporters.

Monetary cooperation in Europe started in 1979 with the creation of the European Monetary System (EMS), which included eight members of

[9] The eight years correspond to the period 1996–2003; 1995 is dropped because we lag firm TFP by one year.

[10] A similar clustering method was applied in the firm-level studies of Berman *et al.* (2012) and Iacovone and Javorcik (2010).

[11] It is possible to calculate TFP using EAE data after 1995, but data for 1995 are scarce.

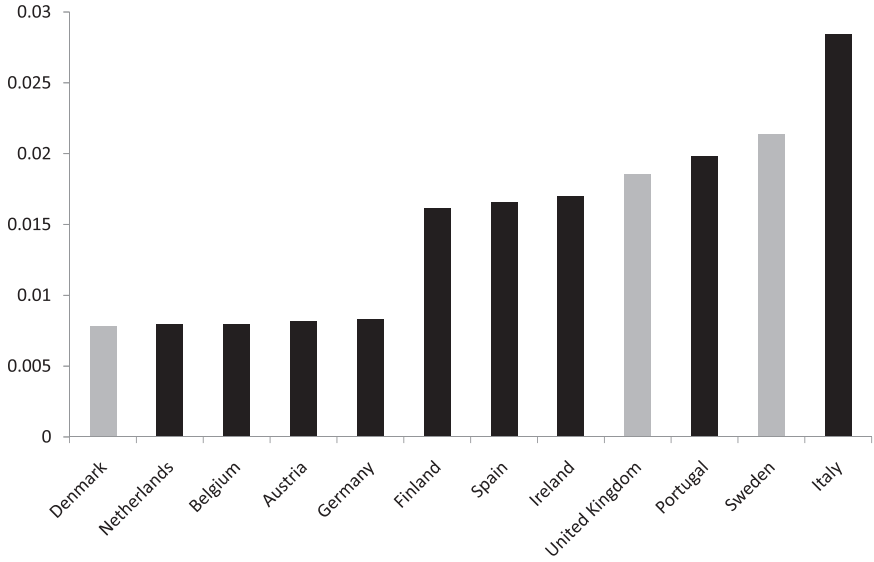

Fig. 1. Volatility in relation to the french franc, 1995–1996 average by country.
Notes: The authors' calculations are based on "Ecowin" data. The dark bars correspond to countries entering the euro area in 1999, and the light gray bars are EU15 countries outside the euro area.

the European Community. Before the 1992–1993 crisis, the EMS stipulated that nominal exchange rate fluctuations among participants should not exceed ±2.25 percent. However, this period of low volatility is relevant only for a few European countries. The UK joined in 1990 with a large fluctuation band, and left in 1992 during the EMS crisis. The Italian lira entered the EMS with a larger fluctuation band (±6 percent); the Irish punt was devalued by 10 percent in 1993, following the crisis in the EMS in 1992–1993. Following the 1992–1993 crisis, the fluctuation bands were widened to allow nominal exchange rate fluctuations of 15 percent, more or less. Countries that did not devalue during the 1992–1993 period (France, Belgium, Luxembourg, the Netherlands, Germany, and Denmark), and that had been members of the EMS from the beginning, were identified as belonging to a *de facto* D-Mark zone.[12]

Figure 1 depicts the average short-term nominal exchange rate volatility of the French franc against the currencies of the EU15 member states, for the years 1995–1996. Volatility is low in relation to Denmark, the Netherlands, Belgium, Austria, and Germany, and higher in relation to

[12] See De Grauwe (1989) and McKinnon (2002) for a complete discussion. The term "D-Mark zone" was initially created to refer to the core group of countries that did not leave the "snake in the tunnel".

the rest of the EU15 countries. Two subgroups emerge from the treated destinations: (1) the D-Mark zone (the Netherlands, Belgium and Luxembourg, Austria, and Germany), which shows low nominal exchange rate volatility in relation to the French franc before 1999; (2) the euro-area destinations outside the D-Mark zone, consisting of Finland, Spain, Ireland, Portugal, and Italy, which show high nominal exchange rate volatility in relation to the French franc, before 1999.

Because the decrease in trade costs is expected to be larger for euro destinations with less tight monetary policy cooperation before 1999 and higher short-term nominal exchange rate volatility, we expect a larger trade creation effect outside the D-Mark zone. A second set of estimations differentiates treated destinations belonging to the D-Mark zone from the rest of the euro area. We keep Denmark out of the control group because it had a managed exchange rate with the D-Mark zone before the introduction of the euro.

Competition from Other Euro-Area Countries. The introduction of the euro reduced trade costs for French firms who were exporting to treated destinations. However, this reduction in trade costs also benefited competitors from other euro-area countries. We need to control for the competition effect due to the euro, which we do by introducing a measure of ease of trade between each destination j and the rest of the euro area, excluding France.

To proceed, we introduce a measure of trade integration between each destination and other euro-area countries. This variable, derived from the theory, is inversely related to the trade costs related to any two destinations.[13] It is constructed to identify, for each destination j and ISIC Rev. 2 industry k, the ease of trading with euro-area destinations. This time-varying measure, the "phi-ness" of trade, is adapted from Head and Mayer (2004):

$$Phi\text{-}ness_{jkt}^{\mathrm{EUR}} = \sqrt{\frac{M_{\mathrm{Eur},jkt} M_{j,\mathrm{Eur}kt}}{M_{\mathrm{Eur,Eur}kt} M_{jjkt}}}.$$

Here, $M_{\mathrm{Eur},j}$ measures the value of imports by country j from the euro area (excluding France) Eur, $M_{j,\mathrm{Eur}}$ is the reverse flow, and $M_{\mathrm{Eur,Eur}}$ and $M_{j,j}$ measure the domestic absorption in the euro area and each country j, computed as production minus exports.

This indicator is computed for ISIC Rev. 2 industries, using data from the Trade and Production database provided by the CEPII. It is merged with our main database using the same strategy as for the import price

[13] This measure is derived from a monopolistic competition model.

index (see the Appendix). We replicate the baseline estimations augmented with this new control. We expect the coefficient of this variable to have a negative sign. The estimation also includes (ISIC) industry–year dummies to control for possible correlation between the $Phi\text{-}ness_{jkt}^{\mathrm{EUR}}$ variable and the trade phi-ness of France, with respect to the same destination.[14] The large number of fixed effects requires a different estimator for the decision to export. Equation (1) is re-estimated using a linear probability model with OLS. This strategy enables us to identify the gross effect of trade costs that are the result of the introduction of the euro.

IV. Results

Baseline Estimations

Table 3 presents the estimation results from the baseline specification (equations (1) and (2)).[15] The dependent variables in Columns 1–4 are the export decision (T_{fjt}), the number of products exported by each firm (N_{fjt}), the average value exported per product by each firm ($\overline{x}_{fjt}$), and the total export value of each firm to each destination (X_{fjt}), respectively. In Columns 5 and 6, the estimations also control for the firm-level lagged TFP (TFP_{ft-1}), to account for changes in firm productivity that can be correlated with the introduction of the euro.

Our results show that the introduction of the euro had only a negligible positive effect on firm-level exports. We find no effect on export propensity (Column 1) or on the number of exported products by firm to each destination (Column 2). We find a weakly significant positive effect of the euro on the average exports per firm (Column 3). Overall, the introduction of the euro increased firms' exports by about 5 percent ($\exp(0.051) - 1$), mostly because of an increase in the average value of exports per product.

This result is independent of price competitiveness. As expected, the real exchange rate variable has a negative coefficient: the real appreciation of the French currency tends to decrease firm-level exports, although the coefficient of this variable is not significant. One reason for this is that the adoption of the euro in 1999 eliminated annual nominal exchange rate fluctuations with euro-area partners. Year fixed effects also control for real exchange rate fluctuations in the French currency in relation to all destinations. Columns 5–8 in Table 3 show that, as expected, productivity is positively related to all exports margins of firms. The GDP, as expected, always has a positive effect. Overall, competition from the rest of the world

[14] We are deeply indebted to an anonymous referee for suggesting this approach.
[15] Our main results remain unchanged when we carry out a Heckman two-step estimation to account for selection (see the online Appendix).

Table 3. *Effects of the euro on firm-level exports, baseline estimations*

Treatment group	Members of euro area							
Control group	EU15 non-euro area							
Dep. variable	(1) T_{fjt}	(2) N_{fjt}	(3) $\overline{x}_{fjt}$	(4) X_{fjt}	(5) T_{fjt}	(6) N_{fjt}	(7) $\overline{x}_{fjt}$	(8) X_{fjt}
$Euro99_{jt}$	**0.006**	**0.006**	**0.046***	**0.051***	**0.006**	**0.006**	**0.046***	**0.052***
	(**0.042**)	(**0.006**)	(**0.026**)	(**0.030**)	(**0.042**)	(**0.006**)	(**0.026**)	(**0.030**)
RER_{jt}	−0.049	−0.046	−0.151	−0.197	−0.054	−0.046	−0.150	−0.196
	(0.364)	(0.030)	(0.162)	(0.177)	(0.366)	(0.029)	(0.162)	(0.177)
MP_{jkt}	−0.066	−0.008	0.257***	0.249***	−0.066	−0.008	0.256***	0.248***
	(0.135)	(0.011)	(0.035)	(0.041)	(0.136)	(0.010)	(0.035)	(0.040)
$RGDP_{jt}$	1.336***	0.267***	0.743**	1.011***	1.338***	0.267***	0.743**	1.010***
	(0.316)	(0.058)	(0.296)	(0.345)	(0.315)	(0.057)	(0.296)	(0.345)
TFP_{ft-1}					0.120***	0.052***	0.144***	0.196***
					(0.036)	(0.003)	(0.012)	(0.012)
Observations	208,169	445,771	445,771	445,771	208,169	445,771	445,771	445,771
Estimator	Cond. FE logit		Within fixed-effect		Cond. FE logit		Within fixed-effect	
Fixed effects	Firm × destination, year							

Notes: ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. Dependent variables and right-hand side variables (with the exception of the euro dummy) are in logarithm. Robust standard errors are in parentheses. Standard errors are clustered by destination country and year.

Table 4. *Effects of the euro interacted with productivity before 1999*

Treatment group Control group	Members of euro area EU15 non-euro area				
Dependent variable	(1) T_{fjt}	(2) N_{fjt}	(3) $\overline{x}_{fjt}$ All products	(4) $\overline{x}_{fjt}$ Products exported before 1999	(5) X_{fjt}
Euro99$_{jt}\times$ **TFP**$_{Q1}$	**0.022**	**−0.002**	**0.037**	**0.029**	**0.035**
	(0.049)	**(0.007)**	**(0.029)**	**(0.032)**	**(0.034)**
Euro99$_{jt}\times$ **TFP**$_{Q2}$	**−0.009**	**0.006**	**0.042**	**0.055***	**0.049**
	(0.049)	**(0.006)**	**(0.027)**	**(0.032)**	**(0.031)**
Euro99$_{jt}\times$ **TFP**$_{Q3}$	**−0.005**	**−0.001**	**0.043**	**0.062****	**0.042**
	(0.051)	**(0.006)**	**(0.026)**	**(0.030)**	**(0.030)**
Euro99$_{jt}\times$ **TFP**$_{Q4}$	**0.017**	**0.021*****	**0.060****	**0.091*****	**0.081*****
	(0.051)	**(0.007)**	**(0.024)**	**(0.030)**	**(0.028)**
RER$_{jt}$	−0.024	−0.048	−0.146	−0.169	−0.194
	(0.367)	(0.030)	(0.165)	(0.191)	(0.180)
MP$_{jkt}$	−0.070	−0.009	0.244***	0.273***	0.236***
	(0.137)	(0.010)	(0.035)	(0.042)	(0.040)
RGDP$_{jt}$	1.330***	0.266***	0.738**	0.581*	1.004***
	(0.309)	(0.058)	(0.293)	(0.345)	(0.342)
TFP$_{ft-1}$	0.113***	0.054***	0.151***	0.177***	0.205***
	(0.038)	(0.003)	(0.012)	(0.012)	(0.012)
Observations	202,004	422,663	422,663	382,065	422,663
Estimator	Cond. FE logit	Within fixed-effect			
Fixed effects	Firm × destination, year				

Notes: ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. Dependent variables and right-hand side variables (with the exception of the euro dummy) are in logarithm. Robust standard errors are in parentheses. Standard errors are clustered by destination country and year.

(which is inversely related to the price index) has a negative impact on the intensive margin only (positive coefficient on the import price index).

Heterogeneity among Exporters

While these results show that the adoption of the euro had only a fairly small positive impact on the average French exporter, this possibly hides some heterogeneity among firms. We can expect larger and more productive firms to be affected differently. On this basis, we introduce interaction variables between the $euro99_{jt}$ variable and the four dummy variables that identify firms by groups according to productivity before 1999. The TFP quartile dummies are fixed over time and rank firms from the low-productivity group (TFP_{Q1}) to the highest productivity group (TFP_{Q4}).

The estimation results are presented in Table 4. Columns 1, 2, 3, and 5 report the estimation results corresponding to the already used decomposition of firm-level exports. In order to identify possible composition effects, Column 4 reports results for the average intensive margin,

where products have been exported at least once before 1999. The results in Column 1 confirm that the introduction of the euro in 1999 had no effect on exporters' selection in euro-area markets, irrespective of their productivity. The results in Columns 2, 3, and 5 show that the introduction of the euro promoted exports only for the most productive firms before 1999. Firms in the highest quartile increased their exports to the euro area by 8.4 percent ($\exp(0.081) - 1$) compared to the control destinations. The contribution of new products and average exports per product to the evolution of firm exports can also be quantified. About a quarter of the effect comes from an increase in the scope of products exported to euro-area markets; the remaining overall impact is explained by an increase in average sales per product. For less productive exporters, no effect is observed.

Column 4 in Table 4 shows that the results for the intensive margin are more positive, and are significant for products that were exported at least once before 1999. The demand for new products is generally lower than the demand for goods previously exported, which has a negative impact on average sales per product (Bernard *et al.*, 2011). These estimations that control for firm heterogeneity shed light on our baseline estimations. We initially found no effect on the number of products exported by firm. Then, we obtained a positive effect of the euro, but only for the most productive firms. We initially found a limited positive impact on the intensive margin. We have also found this effect to be concentrated in the most productive firms. Overall, these results are evidence that the net reduction in trade costs as a result of the introduction of the euro has benefited the most productive exporters more.

Different Impacts among Euro-Area Destinations

We subsequently test the different impacts of the euro depending on monetary policy prior to 1999. As already discussed, the decrease in trade costs is larger for destinations that, prior to 1999, had moderate monetary policy coordination and, thus, high nominal exchange rate volatility in relation to the French franc. We would expect trade creation to be more pronounced for these destinations after the introduction of the euro.

The estimations reported in Table 5 consider two subsamples of treated destinations separately. The first four columns report the results of estimations that consider only the euro-area destinations outside the D-Mark zone in the treatment group, excluding the D-Mark zone destinations from the estimation. Columns 5–8 report the estimation results where the treated destinations are the D-Mark zone destinations only, excluding the remaining euro-area destinations from the estimation. Denmark is excluded from the control group because of its narrow fluctuation band in relation to the French franc, before 1999.

Table 5. *Heterogeneity among treated destinations before 1999*

Treatment group	Euro area excluding D-Mark zone				Euro area D-Mark zone only			
Control group	EU15 non-euro area less Denmark							
Dep. variable	(1) T_{fjt}	(2) N_{fjt}	(3) $\overline{x}_{fjt}$	(4) X_{fjt}	(5) T_{fjt}	(6) N_{fjt}	(7) $\overline{x}_{fjt}$	(8) X_{fjt}
Euro99$_{jt}$	**0.017**	**0.026*****	**0.095*****	**0.121*****	**−0.165*****	**−0.015****	**−0.041***	**−0.055***
	(**0.048**)	(**0.007**)	(**0.032**)	(**0.037**)	(**0.060**)	(**0.007**)	(**0.024**)	(**0.028**)
RER$_{jt}$	0.082	−0.015	−0.026	−0.040	0.153	−0.045	−0.174	−0.219
	(0.434)	(0.035)	(0.222)	(0.243)	(0.358)	(0.033)	(0.171)	(0.196)
MP$_{jkt}$	−0.077	−0.010	0.171**	0.161**	−0.136	−0.002	0.278***	0.275***
	(0.198)	(0.016)	(0.065)	(0.070)	(0.155)	(0.012)	(0.035)	(0.042)
RGDP$_{jt}$	0.737**	0.100**	0.138	0.238	0.548	0.117	0.598	0.715
	(0.326)	(0.048)	(0.255)	(0.289)	(1.426)	(0.114)	(0.453)	(0.529)
TFP$_{ft-1}$	0.126***	0.052***	0.174***	0.226***	0.108**	0.055***	0.120***	0.175***
	(0.040)	(0.004)	(0.014)	(0.015)	(0.053)	(0.004)	(0.015)	(0.016)
Observations	125,770	240,890	240,890	240,890	99,162	253,879	253,879	253,879
Estimator	Cond. FE logit	Within fixed-effect			Cond. FE logit	Within fixed-effect		
Fixed effects	Firm × destination, year							

Notes: ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. Dependent variables and right-hand side variables (with the exception of the euro dummy) are in logarithm. Robust standard errors are in parentheses. Standard errors are clustered by destination country and year.

The estimation results confirm that the trade creation effect is greater for euro-area destinations that had less close monetary cooperation prior to 1999: outside the D-mark zone, firm-level exports increased by 12.8 percent compared to the control group destinations.[16] More than 75 percent of the effect is at the intensive margin, with the rest of the effect being a result of the product range exported by the firm. The decision to export is unaffected. Thus, there is a positive effect of the net trade cost reduction on firm-level exports in terms of product range and the intensive margin.

For destinations within the D-Mark zone, firm-level exports and export propensity are negatively affected by the introduction of the euro.[17] This suggests that competition effects resulting from the introduction of the euro dominate. Firm-level exports declined by 5.5 percent relative to control-group destinations.[18]

[16] We find $\exp(0.12) - 1$ in Column 4.

[17] In unreported estimations, we have interacted the euro variable with a dummy that identifies countries with high/low nominal short-term exchange rate volatility prior to 1999. These alternative specifications confirm the results presented here: the coefficient of the euro variable is systematically more positive for destinations with the highest volatility.

[18] The control variables have the expected sign, although some (e.g., RER and real GDP) lose significance. This is not surprising, given that we consider a limited group of

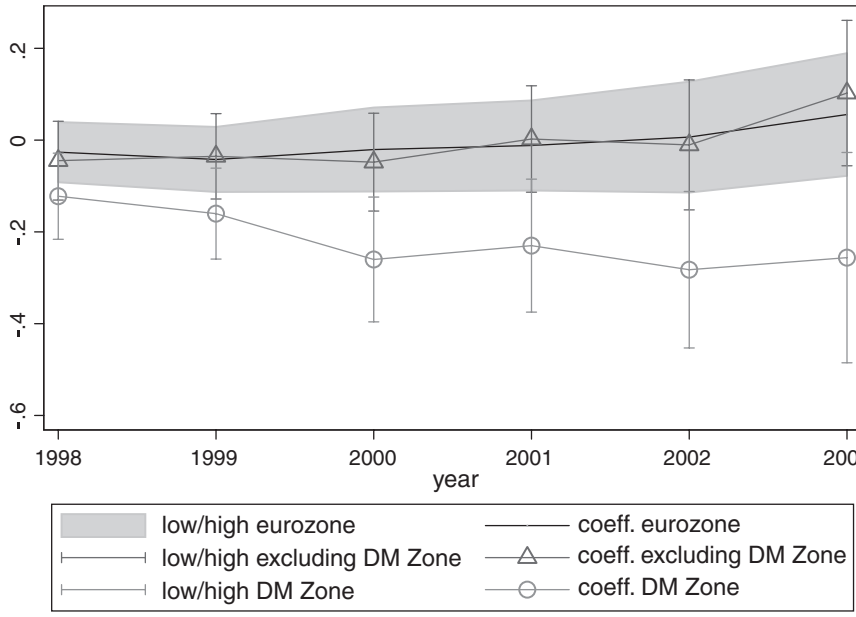

Fig. 2. Effects of the euro by year: export decision

Timing of Euro Effects

Before examining the respective role of trade costs and competition, we need to address the timing of the euro effects on the different export margins. Because the process of monetary integration had been announced, firms' expectations were modified accordingly. This cushions the trade creation effect of the introduction of the euro in our estimations.[19] However, exporters need time to adjust to a new environment, to absorb the costs of entry into new markets, leading to a progressive response of exports.

We address this issue by relying on euro × year dummies starting in 1998 (prior to the introduction of the euro). We reproduce the euro effects for each year in Figures 2–5, separately for the whole euro area, the D-Mark zone, and the rest of the euro area. Each curve plots the estimated coefficient and the confidence intervals at 95 percent. These four figures confirm our previous findings regarding the difference between the D-Mark zone and the rest of the euro area. Nevertheless, we observe a steady

destinations with several similar characteristics. Consequently, the time dummies capture all the macroeconomic dynamics common to all destinations (e.g., real appreciation of the French franc, etc.).

[19] Friberg (2001) has provided a theoretical framework in which firms' decisions to segment markets are dependent on expectations of future exchange rate volatility.

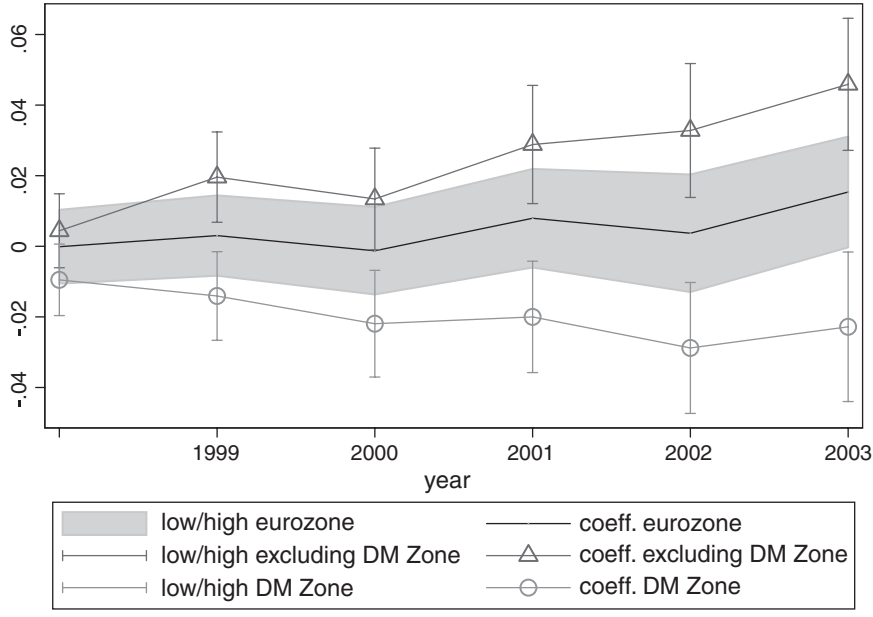

Fig. 3. Effects of the euro by year: number of products exported

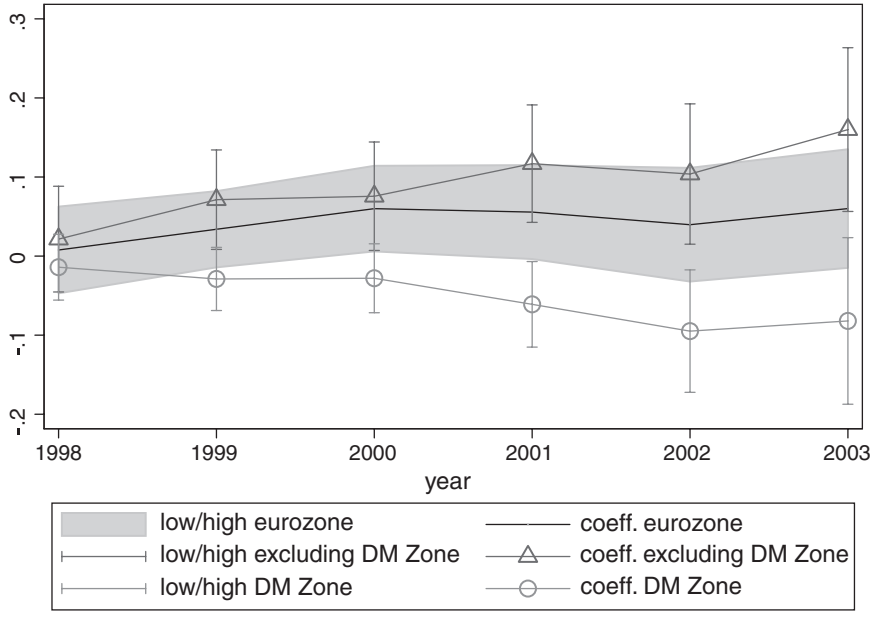

Fig. 4. Effects of the euro by year: exports of firms by product

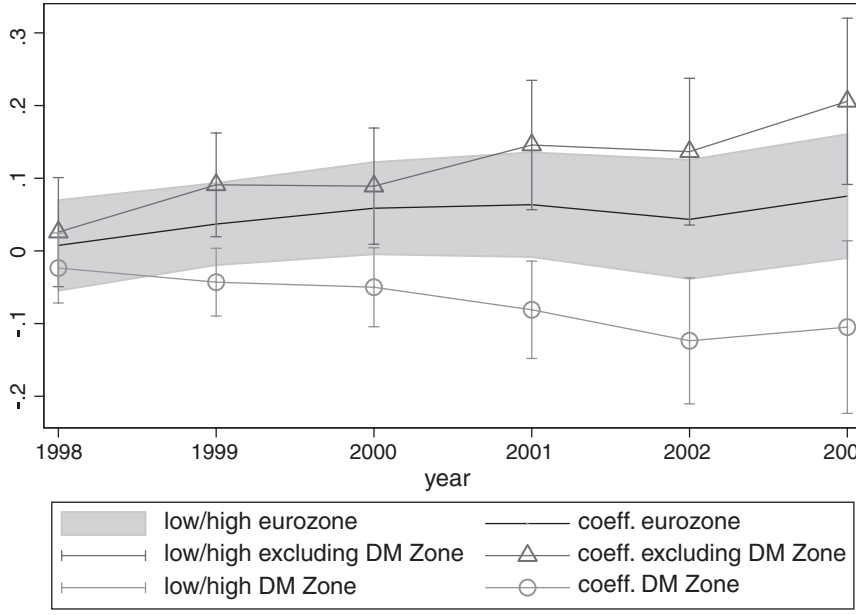

Fig. 5. Effects of the euro by year: total exports of firms

increase in the effects over time – in other words, firms take time to adjust to a trade shock. The euro dummies are mostly significant by 1999.

Competition from Other Euro-Area Countries

In the previous estimations, we have identified the net euro effect on French exporters, controlling for competition from the rest of the world. We now control for competition from other euro-area members, as discussed in the subsection *Empirical Methodology* in Section III, using a time-varying measure of trade phi-ness by destination and industry.

Estimation results are provided in Table 6. All euro-area destinations are included in the treatment group; the control group comprises all EU15 non-euro-area destinations. Results for the $euro99_{jt}$ variable are therefore comparable to the results presented in Table 3.[20] As discussed in the subsection *Empirical Methodology* in Section III, the selection equation in Column 1 of Table 6 is estimated using a linear probability model with OLS. We now control for the phi-ness of trade in Columns 1–4, and for

[20] Differences arise in terms of the number of observations because of missing industry-level production data for certain country–industry–year triples used to compute trade phi-ness. The two samples are still highly comparable.

Table 6. *Trade costs versus increase in competition*

Treatment group	Euro area Members					
Control group	EU15 non-euro area					
Dependent variable	(1) T_t^{fj}	(2) N_{pt}^{fj}	(3) $\overline{x}_t^{fj}$	(4) X_t^{fj}	(5) T_t^{fj}	(6) X_t^{fj}
Euro99$_{jt}$	**0.007**	**0.012****	**0.055****	**0.067****	**0.007**	**0.067****
	(**0.008**)	(**0.006**)	(**0.026**)	(**0.030**)	(**0.008**)	(**0.030**)
$Phi\text{-}ness_{jkt}^{EUR}$	−0.005	−0.001	−0.058***	−0.059***		
	(0.012)	(0.005)	(0.020)	(0.020)		
$Phi\text{-}ness_{jkt}^{EUR}\times$ TFP.Q1					−0.007	−0.049
					(0.018)	(0.034)
$Phi\text{-}ness_{jkt}^{EUR}\times$ TFP.Q2					−0.004	−0.087**
					(0.015)	(0.036)
$Phi\text{-}ness_{jkt}^{EUR}\times$ TFP.Q3					−0.060***	−0.107***
					(0.020)	(0.037)
$Phi\text{-}ness_{jkt}^{EUR}\times$ TFP.Q4					0.030**	0.016
					(0.014)	(0.031)
Observations	175,010	380,138	380,138	380,138	174,869	361,988
Fixed effects	Firm × destination, industry × year					
Estimator	Within fixed-effect					
	(linear probability)				(linear probability)	

Notes: ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. Dependent variables and right-hand side variables (with the exception of the euro dummy) are in logarithm. Robust standard errors are in parentheses. Standard errors are clustered by destination country and year. Estimations performed using a within fixed-effect estimator. All estimations control for RER_{jt}, MP_{jt}, $RGDP_{jt}$, and TFP_{jt-1} (not reported). The $Phi\text{-}ness_{jkt}^{EUR}$ variable is an inverse measure of trade costs by industry between the importer (j) and euro-area countries excluding France.

the interaction between phi-ness and productivity quartiles in the last two columns. This interaction controls for the fact that competition might have different effects on firms with different productivity.[21]

Our results show that the coefficient of $Phi\text{-}ness_{jkt}^{EUR}$ is negative, as expected: a 10 percent increase in competition from other euro-area countries reduces firm-level exports per product by 5.8 percent (Column 3). Most importantly, controlling for general equilibrium effects increases the coefficient of the $euro99_{jt}$ variable, which now captures the effect of gross trade costs. Reductions in gross trade costs have strong positive effects on firm-level exports. In the case of the adoption of the euro, they increase average firm exports by about 7 percent ($\exp(0.067) - 1$), 18 percent of this effect being a result of the number of products exported, with the

[21] In a framework like that of Melitz and Ottaviano (2008), competition would tend to decrease firm exports, especially for low-productivity firms, and to increase firm selection in export markets.

remaining 82 percent at the intensive margin. On average, there is no effect on export propensity. These results confirm that in our study, it is important to take into account the general equilibrium effects, as suggested by the theory.

In Columns 5 and 6 of Table 6, we show how heterogenous firms are eventually affected by competition effects. In both the selection equation and the equation for the total exports of firms, the results show that the coefficients of interaction terms are negative for all productivity quartiles, with the exception of the most productive exporters (Q4). Competition effects are focused on intermediate productivity firms (Q2 and Q3). The least productive exporters in Q1 are also negatively affected by competition from other euro-area countries, although the effect is not significant. Overall, our results show that competition effects tend to dampen the initial trade creation effect of the decrease in trade costs in the case of a monetary union involving several countries. This competition effect contributes to an explanation of the heterogeneity observed among exporters.

Aggregate Patterns

We use aggregate estimations to determine how the results observed at the micro level translate into industry-level exports. The raw export data are aggregated within 28 ISIC Rev. 2 industries, using the concordance with HS six-digit (Rev. 92) product codes.[22] Table 7 presents the estimation results. For all estimations, the dependent variable is the value of French exports to destination j in industry k. These exports are accounted for by the $euro99_{jt}$ dummy variable, the real exchange rate, the import price index, real GDP, and trade phi-ness in the alternative specifications. All of the estimations rely on country–industry fixed effects and industry–year dummies to control for industry-level shocks that are independent of the adoption of the euro.

Columns 1 and 2 of Table 7 show the treatment group comprising all euro-area members, and the control group that includes the EU15 destinations outside the euro area. The results show that the introduction of the euro increased industry-level exports to euro-area destinations relative to non-euro-area destinations. Controlling for the phi-ness of trade between destination j and other euro-area members increases the coefficient of the euro variable. The effect of the reduction in trade costs is positive and highly significant, and the magnitude of the coefficient is in line with previous findings based on aggregate data (Flam and Nordström, 2003; Micco *et al.*, 2003; Baldwin *et al.*, 2008). The aggregate pattern is also consistent with the estimation results presented in Table 4 where the

[22] This concordance table was produced by CEPII and it is available upon request.

Table 7. *Effects of the euro on industry-level exports*

Dependent variable	Industry-level French exports					
Control group	EU15 non-euro area					
Treatment group	Members of euro area		Euro-area excluding D-Mark zone		Euro-area D-Mark zone only	
	(1)	(2)	(3)	(4)	(5)	(6)
Euro99$_{jt}$	**0.066****	**0.077****	**0.079****	**0.095****	**−0.053***	**−0.049**
	(0.029)	**(0.032)**	**(0.037)**	**(0.040)**	**(0.028)**	**(0.039)**
RER$_{jt}$	−0.792***	−0.811***	−0.231	−0.201	1.117	1.204*
	(0.239)	(0.236)	(0.314)	(0.291)	(0.672)	(0.689)
MP$_{jkt}$	0.142	0.019	0.019	−0.108	0.020	0.224
	(0.186)	(0.159)	(0.306)	(0.246)	(0.196)	(0.277)
RGDP$_{jt}$	1.291***	1.595***	0.876***	1.142***	1.221***	1.428***
	(0.253)	(0.160)	(0.319)	(0.187)	(0.393)	(0.461)
$Phi\text{-}ness^{EUR}_{jkt}$		−0.052		−0.113		−0.019
		(0.042)		(0.075)		(0.059)
Observations	2,375	2,074	1,515	1,376	1,076	900
Fixed effects	Destination–industry, industry × year					
Estimator	Within fixed-effect					

Notes: ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. Dependent variables and right-hand side variables (with the exception of the euro dummy) are in logarithm. Robust standard errors are in parentheses. Standard errors are clustered by destination country and year. Estimations performed using a within fixed-effect estimator.

introduction of the euro mainly promotes exports from the most productive exporters, which are also the largest firms, and their behavior tends to drive the empirical pattern.[23]

Columns 3 and 4 of Table 7 report the estimation results for the subsample of euro-area destinations outside the D-Mark zone. These estimations confirm previous results, showing that the trade creation effect is greater for destinations where firms benefited from a larger reduction in trade costs. As in the previous estimations, the coefficient of the euro variable is larger if we include the control for competition from other euro-area members. Columns 5 and 6 report the estimation results for the members of the D-Mark zone in the treatment group. These estimations confirm our finding that the introduction of the euro had a negative effect on aggregate exports to these destinations. However, this negative effect vanishes if we control for general equilibrium effects in Column 6.

[23] Recent empirical work on firm dynamics shows that given the fat-tailed distribution of firms with respect to employment, production, and exports (distributions mainly follow the power law), the behavior of the largest firms has important consequences for the aggregate pattern (Gabaix, 2011). For empirical evidence of a concentration of exports among the largest exporters, see Mayer and Ottaviano (2007).

The control variables have the expected sign, although real exchange rate and import price variables are mostly non-significant. In terms of firm-level estimations, industry–year fixed effects capture an important share of the aggregate variation in prices. The trade phi-ness variable remains non-significant, but has the expected (negative) sign. Most importantly, the inclusion of this variable tends to make the coefficient of the euro variable more positive or less negative. Overall, the aggregate estimations confirm that the introduction of the euro promotes firm-level exports when the reduction in trade costs is sizeable. Simultaneously, it increases competition, which is detrimental to low-productivity firms.

V. Conclusion

In this paper, using the introduction of the euro in 1999 as a natural experiment, we have provided an empirical investigation of how changes in trade costs affect firm-level exports. The results shed new light on the contribution of firm and product selection on export markets, using data on French exporters over the period 1995–2003.

Overall, the adoption of the euro increased the exports of firms by about 5 percent, and this effect is weakly significant. The contribution of our study is to show how this effect was distributed among heterogeneous firms and, within firms, across export margins. Not all firms have been positively affected; the positive effects are concentrated among the largest players. This explains why the aggregate effect of the introduction of the euro is generally found to be in the range of 6–7 percent, a magnitude confirmed here when we aggregate individual data within large sectors. Within firms, between 20 and 25 percent of the effect comes from the number of products exported to each destination, with the rest at the intensive margin. On average, there is no effect on export propensity.

These results are in line with the theoretical predictions. Multiproduct firms adjust to a reduction in trade costs in two ways: the portfolio of exported products expands; sales per variety of goods exported increase, but the intensive margin dominates. However, competition increases because of general equilibrium effects and works in the opposite direction.

However, these mechanisms have operated in a specific way in the case of European monetary integration. First, the introduction of the euro was the result of a long and uneven history of monetary policy coordination. Accordingly, the expected drop in trade costs was more limited for the subgroup of destinations with tighter monetary policy cooperation prior to 1999 (the D-Mark zone). Second, monetary integration affected a highly integrated area (the large Single European Market), where general equilibrium competition effects could be expected to be particularly acute. However, if this specificity is properly taken into account in the estimation strategy, the

gross effect of trade costs is properly identified and the results reflect what is predicted by the theory.

Appendix

A.1. *List of countries*

Treatment/control group	Destination type	Country
Treatment group	Euro area excluding D-Mark zone	Spain
		Finland
		Ireland
		Italy
		Portugal
	Euro area D-Mark zone	Belgium
		Austria
		Germany
		The Netherlands
Control group	EU15 excluding euro area	UK
		Sweden
		Denmark

Note: Denmark is included in the group of D-Mark zone countries because of its low volatility against the French franc before 1999.

A.2. *Data Appendix*

Nominal Exchange Rate Volatility

For each year in our sample, we follow Tenreyro (2007) and compute the volatility of the exchange rate by taking the standard deviation of the monthly variation of the nominal exchange rate:

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

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

Real Exchange Rate

The bilateral real exchange rate variable is computed using the Producer Price Indexes (PPIs) of the exporter (i.e., France) and importer countries, in domestic currencies. Data for PPIs come from the International Monetary Fund's International Financial Statistics (IFS) and the OECD. Bilateral

nominal exchange rates are provided at annual frequency in the IFS and in European Central Bank data.

Other Gravity Controls

Data for real GDP come from the Penn World Tables 6.2. Real GDP is computed using GDP per capita in constant US dollars (taking 1996 as the reference year) and population data.

Importer's Price Index

We follow the methodology in Gaulier *et al.* (2008). The import price index variable is computed for each destination and 27 ISIC industries, as a chained geometric Paasche index of unit import prices P_{mjt}. The subscript m refers to a variety, identified by an exporter and an HS6 product category. Given that the price of the French variety is likely to be correlated with the price offered by firm f, we exclude France from the sample of exporters to avoid reverse causality. Chained indexes allow us to account for changes in the composition of traded baskets of goods imported by country j. The formula used to compute the index is

$$MP_{jkt} = \prod_{m=1,\ldots,M} \left(\frac{P_{mj,t}}{P_{mj,t-1}} \right)^{\omega_{t-1}}.$$

The import price index is computed for each ISIC manufacturing industry k, with 27 sectors, and ω_{t-1} is the trade share in value of variety m in country j and year $t-1$. All unit prices P_{mjt} are approximated by unit values. We have selected the 50 main world exporters from the trade data in CEPII's BACI database.

A concordance table between the HS6 Rev. 92 product codes and ISIC Rev. 2 industries is used to compute the total exports of firms by industry over the period 1996–2003. Each firm is then identified by its main industry. The import price index data are merged with our main database with respect to destination countries and industry. The import price index for each market and for each industry in which the French exporter operates measures price competition from the rest of the world.

Supporting Information

The following additional supporting information may be found in the online version of this article at the publisher's web site:

Appendix: Estimations controlling for selection.

References

Anderson, J. E. and Van Wincoop, E. (2004), Trade Costs, *Journal of Economic Literature 42*, 691–751.

Arkolakis, C. and Muendler, M.-A. (2010), The Extensive Margin of Exporting Products: A Firm-Level Analysis, NBER Working Paper No. 16641.

Baldwin, J. and Gu, W. (2009), The Impact of Trade on Plant Scale, Production-Run Length and Diversification, in T. Dunne, J. Bradford Jensen, and M. J. Roberts (eds.), *Producer Dynamics: New Evidence from Micro Data*, NBER Book Series Studies in Income and Wealth, University of Chicago Press, Chicago, 557–592.

Baldwin, R., Nino, V. D., Fontagné, L., Santis, R. D., and Taglioni, D. (2008), Study on the Impact of the Euro on Trade and Investment, *European Economy, Economic Papers*, 321.

Berman, N., Martin, P., and Mayer, T. (2012), How Do Different Exporters React to Exchange Rate Changes? Theory and Empirics, *Quarterly Journal of Economics 127*, 437–492.

Bernard, A. B., Jensen, J. B., Redding, S. J., and Schott, P. K. (2009), The Margins of US Trade, *American Economic Review Papers and Proceedings 2* (99), 487–493.

Bernard, A. B., Redding, S. J., and Schott, P. K. (2011), Multiproduct Firms and Trade Liberalization, *Quarterly Journal of Economics 126*, 1271–1318.

De Grauwe, P. (1989), Is the European Monetary System a D-Mark Zone?, CEPR Discussion Papers No. 297.

Donald, S. G. and Lang, K. (2007), Inference with Difference-in-Differences and Other Panel Data, *Review of Economics and Statistics 89*, 221–233.

Eaton, J., Kortum, S., and Kramarz, F. (2004), Dissecting Trade: Firms, Industries, and Export Destinations, *American Economic Review 94* (2), 150–154.

Eaton, J., Kortum, S., and Kramarz, F. (2011), An Anatomy of International Trade: Evidence from French Firms, *Econometrica 79*, 1453–1498.

Eckel, C. and Neary, J. P. (2010), Multiproduct Firms and Flexible Manufacturing in the Global Economy, *Review of Economic Studies 77*, 188–217.

Eckel, C., Iacovone, L., Javorcik, B., and Neary, P. (2011), Multiproduct Firms at Home and Away: Cost- versus Quality-Based Competence, CEPR Discussion Papers No. 8186.

Ekholm, K., Moxnes, A., and Ulltveit-Moe, K.-H. (2012), Manufacturing Restructuring and the Role of Real Exchange Rate Shocks, *Journal of International Economics 86*, 101–117.

Flam, H. and Nordström, H. (2003), Trade Volume Effects of the Euro: Aggregate and Sector Estimates, IIES Seminar Paper No. 746.

Flam, H. and Nordström, H. (2007), Explaining large euro effects on trade: the extensive margin and vertical specialization, unpublished manuscript, Stockholm University.

Friberg, R. (2001), Two Monies, Two Markets?: Variability and the Option to Segment, *Journal of International Economics 55*, 317–327.

Gabaix, X. (2011), The Granular Origins of Aggregate Fluctuations, *Econometrica 79*, 733–772.

Gaulier, G., Martin, J., Mejean, I., and Zignago, S. (2008), International Trade Price Indices, CEPII Working Paper 2008–10.

Head, K. and Mayer, T. (2004), The Empirics of Agglomeration and Trade, in J. V. Henderson and J.-F. Thisse (eds.), *Handbook of Regional and Urban Economics*, Vol. 4, Elsevier, Amsterdam, 2609–2669.

Iacovone, L. and Javorcik, B. (2010), Multiproduct Exporters: Product Churning, Uncertainty and Export Discoveries, *Economic Journal 120* (544), 481–499.

McKinnon, R. (2002), The Euro versus the Dollar: Resolving a Historical Puzzle, *Journal of Policy Modeling 24*, 355–359.

Martin, J. and Méjean, I. (2008), Trade Prices and the Euro, CEPII Working Paper No. 2008–29.

Mayer, T. and Ottaviano, G. (2007), The Happy Few: The Internationalization of European Firms, Bruegel Blueprint Series Vol. 3, Brussels.
Mayer, T., Melitz, M. J., and Ottaviano, G. I. (2011), Market Size, Competition and the Product Mix of Exporters, NBER Working Paper No. 16959.
Melitz, M. J. (2003), The Impact of Trade on Intra Industry Reallocations and Aggregate Industry Productivity, *Econometrica 71*, 1695–1725.
Melitz, M. J. and Ottaviano, G. I. P. (2008), Market Size, Trade, and Productivity, *Review of Economic Studies 75*, 295–316.
Micco, A., Stein, E., and Ordoñez, G. (2003), The Currency Union Effect on Trade: Early Evidence from EMU, *Economic Policy 18* (37), 315–356.
Moulton, B. R. (1990), An Illustration of a Pitfall in Estimating the Effects of Aggregate Variables on Micro Unit, *Review of Economics and Statistics 72*, 334–338.
Nitsch, V. and Pisu, M. (2008), Scalpel Please! Dissecting the Euro's Effect on Trade, paper presented at the 48th Panel Meeting sponsored by the Banque de France, Paris.
Ottaviano, G., Taglioni, D., and di Mauro, F. (2009), The Euro and the Competitiveness of European Firms, *Economic Policy 24* (57), 5–53.
Tenreyro, S. (2007), On the Trade Impact of Nominal Exchange Rate Volatility, *Journal of Development Economics 82*, 485–508.
Wooldridge, J. M. (2003), Cluster-Sample Methods in Applied Econometrics, *American Economic Review 93* (2), 133–138.

First version submitted May 2010;
final version received December 2011.