The Role of EU Harmonization in Explaining the Export-Productivity Premium of Food Processing Firms

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Abstract

Recent literature on firm-level heterogeneity and trade has emphasized a self-selection mechanism: only the most productive firms can recover the transaction (sunk) costs for serving foreign markets and become exporters. The role of trade integration is that a productivity gap between exporters and non-exporters becomes lower when the market becomes more integrated due to a fall in trade costs. The focus of this chapter is the role of EU harmonization of food regulations in explaining the intra-EU export-productivity premium. The food industry is an interesting case to examine because many directives and regulations of the Single Market Program concern this important economic sector and have the potential to affect trade and productivity. We use data on Dutch food processing firms for the 1979-2005 period which we link with a dataset that codes food products subject to EU harmonization. The paper confirms that more productive firms are more likely to enter the EU export market. The result of EU harmonization is that this probability increases. Second, we find a positive and significant export-productivity premium: that is, firms that export to other EU markets are more productive than non-exporting firms. This finding is robust to the estimation technique and the way we measured TFP growth. Third, when we test whether the export-productivity premium is affected by EU harmonization, we find weak evidence that is the case for Dutch food processing firms: much depends on the estimation method, the way we measure TFP growth, and the population of exporting

firms.

Key Words: technical barriers to trade, EU harmonization, exports, productivity, food firms

JEL Classifications: C23, D24, F15, L11

1. Introduction

In the vast literature on exports and productivity (growth), there is very large evidence that exporting firms are more productive than non-exporting firms. An extensive review has been documented by Wagner (2007a). Based on a review of 54 studies with data from 34 countries that were published between 1995 and 2006, the author concludes that “exporters are found to be more productive than non-exporters, and the more productive firms self-select into export markets, while exporting does not necessarily improve productivity”.[1] From a micro-econometric analysis, studies have investigated a wide variety of factors that may shape the decision to export. Like most other studies, we find that exporting firms tend to be larger, more productive and more capital intensive than non-exporting firms. Such evidence confirms the so called firm self-selection explaining why only the best performing firms will be able to enter an overall export market because export costs must be overcome. [2]

Our focus being the exporting behavior of Dutch firms in the food industry, the subject of this chapter is to focus on the role of trade policy in explaining productivity gains that can be associated with intra-EU export entry. The specific question to be investigated is whether trade liberalization, under form of EU harmonization, affects the productivity towards a lower level that is needed to enter markets. By doing so, we attempt to address the heterogeneity in the export-productivity premium when exporters are affected by EU harmonization. We also analyze how EU harmonization and other firm-level

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[1] See also additional reviews of this literature documented by Bernard et al.(1999, 2007); Eaton et al. (2004); and Roberts and Tybout (1997).

[2] The most influential paper that introduced self-selection is by Melitz (2003) who introduced firm-level heterogeneity in a theoretical Krugman-type model. Other theoretical papers that have followed or extended the results by Melitz are, amongst others, Bernard et al., 2003; Melitz and Ottaviano, 2008 and Baldwin and Forslid, 2010.

characteristics affect the export decision: if this probability increases among non-exporting firms, this leads to a reallocation of more productive, exporting firms.

The focus on harmonization of food regulations through the Single European Market Program (SMP) provides an interesting example for analyzing the link between trade liberalization, the exporting status and productivity. Thanks to the SMP more trade integration can be attained through decreasing entry costs of domestic and foreign competitors because of the reduction or complete removal of regulatory barriers to trade across countries known as technical barriers to trade (TBT).[3] Therefore, the trade policy aspect of EU harmonization of regulations is trade facilitation through a reduction of trading costs. We document this heterogeneity using a very rich firm-level dataset with production characteristics including the intra-EU exporting status of the firm. We use these data for the 1992-2005 periods. We link these data to a database on EU harmonization of regulations in the food industry. The product classification of this second database follows the detailed European Combined Nomenclature (CN) trade classification that codes the relevant harmonization initiatives of technical regulations at the product level (8-digit level of the tariff line codes).[4]

The food industry is an interesting case to examine because many directives and regulations of the SMP concern this important economic sector and have the potential to affect trade, competitiveness and productivity of its firms. The evidence in Henry de Frahan and Vancauteren (2006) confirms the hypothesis that indeed EU harmonization of food regulations can be considered as a trade-promoting, market-integrating or trade-

[3] The EU approach to remove TBT is by mean of harmonization regulations across EU member states through agreements on a common set of legally binding requirements. Subsequently, no further legal impediments can prevent market access of complying products anywhere in the EU market because domestic and foreign regulations coincide.

[4] Aspects of this data have been used in Henry de Frahan (2006), Vancauteren and Henry de Frahan (2011) and Vancauteren (2012).

liberalizing instrument in the Single Market.[5] The authors find that the impact of harmonization of food regulations, measured at a very detailed level of product disaggregation, facilitates EU intra-trade.[6]

To our knowledge, this is the first study that exploits such detailed data to explain the export-productivity responses to Single market effects under EU harmonization and how it affects intra-EU export probabilities. Other studies analyzing specific aspects under the Single Market addressing the heterogeneity of firms' exports include Chevassus-Lozza and Latouche (2011), Serti and Tomasi (2008), Wagner (2007b) and Reyes (2011). Chevassus-Loza and Latouche (2011) find evidence that heterogeneous export market access costs for French food processing firms still exist within the EU market as a result of remaining trading costs despite the implementation of Single market policies. Serto and Tomasi (2008) and Wagner (2007b) find that firms exporting to European countries are less productive than exporters directed towards to other destination markets. Reyes (2010) studies the impact of EU harmonization of standards in the electronic sector to conclude that it increases the probability that U.S. firms enter the EU market.

The remainder of this chapter is organized as follows. The following section surveys some theoretical underpinnings when interacting trade liberalization, productivity and exports, and sets up the research specification. The third section presents the data and some summary statistics. The fourth section presents the empirical methodology. Section 5 discusses the empirical finding and the last section concludes.

[5] "Expected" trade gains from the harmonization of food regulations have also been clearly identified in Cecchini et al., 1988; CEC, 1997, 1998.

[6] In particular, their regression results find that the EU harmonization variable has positive and significant coefficients for overall intra-EU trade in food products and, at a more disaggregated level, for trade in 9 out of the 10 categories of food products. They conclude that harmonization in food regulations has increased intra-EU trade in all food products by about two thirds, and in fruits and vegetables by around one third between 1990 and 2001.

2. Related Literature

A growing interest in the international trade literature deals with the interaction between the microeconomic heterogeneity of firms and trade liberalization. Using micro-level data, researchers have documented a number of robust facts about the export performance across firms. More productive firms are more likely to export, have higher export revenues and enter more markets.

In heterogeneous-firm models of international trade (e.g. Bernard et al., 2003; Melitz, 2003; Baldwin and Forslid, 2010), the productivity gap between exporters and non-exporters can be explained by self-selection: exporters are more productive because they are able to bear variable and fixed exporting costs. Under these conditions, a selection of firms takes place that rely on firm heterogeneity. The role of symmetric trade cost liberalization is that a productivity gap between exporters and non-exporters becomes lower when the market becomes more integrated: highly productive firms gain access to cheaper markets and grow, lower productivity firms become exporters while the remaining non-exporting firms with the lowest productivity are more likely to exit the market due to import competition. These effects lead to a rise in average productivity through the reallocation of productive resources from less to more efficient firms.[7] But besides productivity gains generated by inter-firm reallocation, there is also within-firm productivity gains from trade liberalization. The general presumption is that any form of trade liberalization growth opportunities also leads to improvements in productivity through cost reductions, higher profits, greater market size and further investments.

In line with the ideas outlined above, it is therefore anticipated that the productivity gap

[7] The reallocation mechanism is explicitly modeled in Eaton et al. (2004), Melitz (2003) and Bernard et al. (2003). See Redding (2010) for a recent review of the theoretical literature on heterogeneous firms and trade.

between exporters and non-exporters becomes lower when a market becomes more integrated. Using U.S. manufacturing data, Bernard et al; (2006), for instance, show that a decline in trade costs (using tariff and freight rates) lead to higher within-plant productivity, higher exit probabilities of low productivity firms, higher entry export probabilities of high productive firms while existing exporting firms increase their shipments. Lileeva and Trefler (2007), considering the impact of U.S. tariff reduction under the Canadian-U.S. Free Trade Agreement (FTA), find that it encourages firms not only to export but also to invest in order to raise productivity. Baldwin and Yan (2010) look at how tariff reductions between Canada and the United States and the Canadian dollar depreciation affect Canadian exporters. The paper also finds that these trade cost reductions increase the probability that more efficient non-exporters will enter export markets. The paper also finds evidence that improved export market access affects the productivity positively.

On the basis of foregoing predictions and evidence, in this paper, we ask about the effect of EU harmonization of food standards in mediating the effect of exporting on total factor productivity (TFP). TFP is said to increase if more output is possible from a certain set of inputs or if less input is needed for a certain set of outputs. We derive two testable hypotheses:

Hypothesis 1 (export probabilities). More EU harmonization of food standards increases the average export probability of Dutch firms to other EU countries, the exporting margin.

As EU harmonization of standards involves a multilateral trade liberalization effect through eliminating TBT across the EU market, it is expected from the heterogeneous-firm models we described, that TBT liberalization causes firms to increase their market access by becoming exporters because of cost reduction effects. In other words, firms gain access to the entire EU market when a single compliance costs is overcome. This lowers the productivity threshold for exporting, increasing the number of firms which export. On the other hand, it may well be so that the compliance cost to export may be higher than the pre-harmonized fixed cost to align with technical standards. Because of this opposite effect, the exporting margin increase, whereby more productive non-exporting firms are now able to become exporters, is only valid if the market access improvement outweighs the increase of compliance costs. It is noted that our data do not indicate the destination of exports. This means that we can no examine any destination asymmetries that are the focus of the seminal paper by Chaney (2008).

In the context of EU standard harmonization, Reyes (2010) study the impact of EU harmonization of standards in the electronic sector to conclude that it increases the probability that U.S. firms enter the EU market. In addition, the author finds that the probability of becoming an EU exporter is higher in industries with greater harmonization of product standards. When testing this first hypothesis, we will also allow for such an interaction effect.

Hypothesis 2 (export productivity premium) More EU harmonization of food standards lowers the productivity gap between exporters and non-exporters.

We expect that more EU harmonization lessens differences in the relative productivity growth of exporters versus non-exporters. Due to EU harmonization, the productivity threshold that cuts off the decision to export or not will be lower due to lower compliance costs. A more open and integrated intra-EU markets will be accessible to a larger number of exporters that were initially less productive. In addition, existing exporting firms will also be able to increase their trade to other EU markets as a result of EU harmonization of food regulations as, among others, highlighted by Henry de Frahan and Vancauteren (2006) and Chevassus-Lozza et al. (2008).

When testing our predictions, we also consider some heterogeneous responses. First, the empirical results shown by Reyes (2010) suggest that the extensive margin of trade (probability increases of productive firms entering the EU market) is higher for firms entering the EU market but not exporting to another developing country than for firms entering the EU market but already exporting to a developing country. Overall, the results suggest that the impact of the extensive margin outweighs the impact at the intensive margin of exports. The author defines the intensive margin as export volumes constructed from firm-level exports that remain as EU exporters throughout the entire sample years. With the type of data at hand, we test this heterogeneity by considering the export status for new entrants (switchers) versus existing exporters. For example, the effect of EU harmonization on the export productivity premium is likely to differ between existing exporters versus those who started exporting.

3. Data

We use two data sources in this study. The primary data source for measuring firm-level production, wages, capital costs, number of employees comes from the Production Statistics (PS) provided by Statistics Netherlands. We also observe the firm-level export status and total export sales. The exporting data are only collected for intra-EU exports. Each of the variables is deflated with the appropriate price indices from the input-output tables available at the NACE rev. 1 2-digit food sector classification. We also observe information of the firm's primary and secondary production activities at the 4-digit level. This information enables us to generate multiproduct dummies in case a firm is also involved in secondary production activities.

Total factor productivity (TFP) is measured using the Levinsohn and Petrin (2003) approach where we estimated a translog (value-added) production function by the sub-sector. The assumption of a flexible functional form, such as the translog, imposes a more flexible structure on the data to reveal production patterns for heterogeneous firms of widely different sizes (see Vancauteren, 2012). The translog production function is presented as, $\ln y_{it} = \beta_0 + \beta_k \ln k_{it} + \beta_l \ln l_{it} + \beta_{kk} (\ln k_{it})^2 + \beta_{ll} (\ln l_{it})^2 + \beta_{kl} \ln l_{it} \ln k_{it} + \varepsilon_{it}$,

where y_{it} is value-added of firm i in year t, k_{it} is capital, l_{it} is employment and ε_{it} is the disturbance term. After estimating the above equation, a measure of TFP can also be recovered using the method proposed by Olley and Pakes (1996) and later modified by Levinsohn and Petrin (2003). The estimated TFP of firm i is equal to the sum of the fitted values of β_0 and ε_{it}. Since firm's production technology is very likely to vary across food sub-sectors, I estimate the above equation using the Levinsohn-Petrin method by sub-sector.[8]

The data on EU harmonization of technical regulations come from a purpose-build database that is recently updated in Vancauteren and Henry de Frahan (2011) and Vancauteren (2012). The product classification of the database follows the detailed CN

[8] I also estimated the scale elasticities using the Olley-Pakes (OP) method. The use of the OP method leads to minor changes in the return to scale estimates while both the OP and LP specifications for the markup give very similar results.

classification of the EU identifying products that are covered by EU harmonization initiatives of technical regulations in the food industry. Each EU Directive that stipulates a harmonization initiative identifies the scope of products or sub-sectors to which it is pertained. We construct coverage ratios by food subsector which we define as the number of CN codes subject to EU harmonization as a percentage of total CN codes for each sub-sector.[9] To make data on EU harmonization firm-specific, we weight each product harmonization coverage by the firm's production level calculated as the ratio of firm *i* sales in time *t* divided by the firms' total sales in each three-digit sub-sector *j*. To correct for the changing number of firms in each year, as a result of changes in the population design of the production statistics or due to true entering and exiting firms, we follow Nickell (1996) and define total sales as the average sales of a firm in sub-sector *j* at time *t*, multiplied by the number of firms in sub-sector *j* chosen in the base year 1992. This weighting scheme reflects the structure of products that is subject to EU harmonization, and its weight as a producer. Thus this measure captures the fact that the more a particular firm produces EU complying products the more it is affected by EU harmonization.[10]

3.1. Summary Statistics

Our dataset constitutes an unbalanced panel data with 17,601 observations spanning over

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[9] We refer to Vancauteren and Henry de Frahan (2012) for a more detailed description on the incidence of EU harmonization across food sub-sectors and time. The major findings are that for a majority of the sub-sectors within the food industry, the share of products subject to EU harmonization varies and changed slightly during the 1992-2005 period. When looking at the overall evolution of the number of products that became subject to EU harmonization, there is a positive trend in the number of new products covered by EU harmonization.

[10] Ideally, the sum of production and imports minus exports would have been a better measure that relates a firm's output to the size of the market; however, the link between the production and trade data does not exist for the period considered in this paper. Since we use the weighting scheme as a time-series, the unobservable factors are likely to be relatively stable over time which implies that one might expect a correlation firm-level production weights and its exposure to EU harmonization (see also Vancauteren, 2012, for this issue).

14 years (1992-2005) and over 12 food subs-sectors (Nace rev. 1: 151-158).

Table 1 reports some basic sample statistics. We only include firms for which we have at least two consecutive observations for all variables. Throughout the sample period, the PS surveys include some changes in their population designs resulting in an unbalanced panel of the entire population. As a result, we cannot distinguish whether the entry or exit rates of firms resulted from survey response or real economic structural behavior. Because the panel is unbalanced, the reported descriptives are not strictly comparable across time.

Table 1: Summary statistics of production and EU harmonization data of the Dutch food processing firms, 1992-2005

Variable	**Mean**	**Std. Dev.**	**1992**	**1996**	**2000**	**2005**
Weighted Harmonization	0.007	0.038	0.007	0.008	0.007	0.008
Herfindahl	0.07	0.14	0.05	0.04	0.07	0.10
Capital-labor ratio	0.28	0.26	0.26	0.28	0.25	0.24
Employment	66.99	168.51	136.74	113.69	97.41	99.41
Production (€ millions)	32.75	12.68	78.69	78.86	30.41	36.630
Exports/production ratio	0.13	0.28	0.14	0.16	0.17	0.18
TFP level	47.24	32.60	39.82	46.14	52.50	51.15
Number of observations	17,621		662	691	655	785

Note, for example, that average employment equals to 67 persons, TFP level is around 47.24 and remains positive throughout the sample years. The share data variables further indicate, for example, that production-weighted proportion of products subject to EU harmonization is .007 and remains quite stable over time and the average export intensity is 13 per cent and seems to slightly increase throughout the years.

We classify firm i to be an exporter if it enters export markets during the period. To examine some differences between exporters and non-exporters, Table 2 shows some average annual firm-level characteristics between exporters and non-exporters. Following previous firm-level studies on exports and productivity (e.g., Bernard and Jensen, 1999), we regress a simple OLS regression, $x_{it} = \alpha + \beta_1 EXP_{it} + \beta_2 \log EMPL + \varepsilon_{it}$, where x refers to firm-level characteristics of firm *i* in year *t*, *EXP* is the export status dummy, log *EMPL* is the log of the number of employees, year effects are also included. According to the table, it can be seen that on average, annual TFP growth was 0.02 log points faster for export entrant firms than for continuing non-exporting firms. Moreover, the weighted share of products that are subject to harmonization are for exporting firms is 83% higher than for non-exporters; In addition, exporters pay higher wages (11.5%), sell more (26.2%), are more capital intensive (11.8%) and are larger (68.8%). These characteristics are in line with findings of other related studies using country-specific, firm-level data (e.g., see De Loecker, 2007; Van Biesebroeck, 2007; Bernard and Jensen, 1999).

Table 2: OLS regressions of the export premia

Firm Characteristics	β_1	SE(β_1)	R^2
TFP growth	0.021	0.007	0.588
Sales per worker	0.262	.0118	0.699
Value-added per worker	0.089	0.008	0.526
Capital-labor ratio	0.118	0.015	0.179
Employment	0.688	0.020	0.471
Average wage	0.115	0.006	0.965
Average wage per worker	0.104	0.006	0.630
Weighted Harmonization	0.215	0.013	0.836

Note: All variables expressed in values are deflated by the appropriate sector deflators. All regressions include the log of employment and time dummies (except for the employment equation). Standard errors are adjusted for clustering at the firm-level.

4. Empirical Implementation

We consider two models that allow us to identify and estimate heterogeneous responses of firms to EU harmonization. The first model consists of a probit model that enables us to identify how EU harmonization and other firm-level characteristics affect the probability of entering and exiting exporting markets. The second model looks at productivity responses where we, essentially, regress productivity growth on an export dummy, EU harmonization variable, its interactions and other firm-level characteristics.

4.1. EU Harmonization and the export decision

The probability of entering and exiting exports markets is specified as,

$$
\begin{aligned}
EXP_{it} &= 1 \text{ if } EXP_{it}^{*} = \alpha_{1i} + \beta_1 HARM_{it} + \beta_2 HARM_{it} \cdot D_{it} + \beta_3^{'} \mathrm{x}_{1it} + \varepsilon_{it} \geq 0 \quad , \qquad (1)\\
&= 0 \text{ otherwise,}
\end{aligned}
$$

where EXP^{*} is the corresponding latent variable, α_1 represents firm-specific heterogeneity, the variable *HARM* is production weighted EU harmonization variable, x_1 is a vector of firm-related independent variables, the variable *D* is used as an interaction term with *HARM* in order to capture heterogeneous impacts of *HARM* on export probabilities (hypothesis 1), and ε is an error term.[11]

As independent variables to explain export probabilities, we include in the vector x_1 employment, capital intensity, export dynamics (motivated below), firm-level productivity, a multiproduct indicator and wages. We also include year and sub-sector fixed effects. These additional firm characteristics all have been found to be important determinants for measuring the probability of entering export markets (e.g., Bernard et al., 2007; Van Biesebroeck, 2007).

[11] When presenting the results, we report the marginal effects evaluated at mean values. Marginal effects for the interaction term are calculated using cross derivatives (see Baldwin and Yan, 2010, for the more details on the computation).

In additional, we also control for firm-level unobserved heterogeneity (e.g., organizational design, managerial ability, innovation attributes, and product specification) at the firm-level, denoted by $\alpha_{1i,}$ in order to verify its importance in explaining export probabilities. By definition, these unobserved characteristics should be uncorrelated with the firm characteristics included in vector $\mathbf{x_1}$ which is unlikely the case.

In addition, there are several papers that stresses the importance of past export behavior on the current decision to export. This assumption of dynamics can be explained by several factors. First, it can be based on sunk costs whereby "exports beget more exporting" (Bernard and Wagner, 2001). Second, thus dynamic formulation is also in line with factors of success. More specifically, once a firm exports, it may generate positive externalities on the current decision to export (Aw et al., 2011). This persistence in exporting will also be likely correlated with these unobserved characteristics which tend to be highly serial correlated.[12]

In this analysis, we consider estimating equation (1) using a random effects probit specification, a pooled probit model, while correcting standard errors for clustering. In an extended, dynamic model where we capture dynamics by including a lagged exporting status, we use a maximum likelihood (ML) model with individual effects that is proposed by Wooldridge (2005) so to control for the initial condition problem. Under this approach, the distribution of the unobserved individual effects, α_{1i}, is modeled as follows,

$$\alpha_{1i} = \alpha_{10} + \delta_1 EXP_{i0} + \delta_2' z_i + \xi_{it} \quad , \tag{2}$$

where α_{10} is the constant, z is a vector including the time averages of the variables, EXP_{i0} is the initial value and ξ is assumed to be the independent error following a normal

[12] See Heckman (1981) for a theoretical analysis and Bernard and Wagner (2001) with specific reference of an export decision equation.

distribution.

4.2. EU Harmonization and the export-productivity premium

To examine the effect of EU harmonization on the export-productivity premium, we model a firm-level productivity growth as a function of EU harmonization, its interaction with the export status of the firm and additional firm-specific characteristics,

$$\Delta \ln TFP_{it} = \alpha_{2i} + \gamma_1 \Delta HARM_{it} + \gamma_2 \Delta HARM_{it} \cdot D_{it}^{EXP} + \gamma_3 D_{it}^{EXP} + \gamma_4^{'} \mathrm{x}_{2it} + \varepsilon_{2it} \quad , \tag{3}$$

where D^{EXP} is a dummy variable which takes the value of one if a firm i enters the EU export market during sample period and zero if it remains a non-exporter. The corresponding coefficient γ_3 measures the export productivity premium which can be interpreted as the average productivity differential between an exporting and a non-exporting firm. The coefficient γ_2 verifies hypothesis 2 where we would expect that due to more EU harmonization the average productivity is higher although export productivity is smaller. In other words, TFP differentials between exporters and non-exporters are smaller when EU harmonization intensifies. We therefore expect that $\gamma_1>0$ and $\gamma_2<0$.

We also control for the sensitivity of our key results by adding additional controls. We include the firm capital intensity, employment, wages and a multiproduct status that have been shown to increase factor productivity (Bernard et al., 2006). We also add a Herfindahl concentration ratio that is defined as the sum of the squared market shares in each 3-digit sub-sector. The Herfindahl concentration ratio measures the concentration of firms within a market.

Equation (3) is the standard models. However, there might be a problem of endogeneity, given that the regressors could be correlated with past errors values. The variables capital and employment are endogenous since TFP depends on the strategic quantity choices made by firms. Competition variables can also influence the TFP since more competition forces firms to become more efficient. For instance, some studies find that more intense competition in a firm's market is positively correlated with best-practice management which in turn affects TFP positively (Syverson, 2011). The export decision is also a possible endogenous estimator since firms may perform better through expansion to foreign markets. The potential endogeneity of EU harmonization with TFP may be less of a concern since EU harmonization of regulations which can be seen as a trade policy measure at the EU supranational level is not directly affected by the national level of TFP performance but rather by an EU economy wide performance. However, the EU harmonization variable is made firm-specific by using a production weight, which also enters indirectly TFP. Nevertheless, we treat all firm-specific variables as potential endogenous.

A possible solution is to apply an Ordinary Least Squares (OLS) instrumented variable approach. However, the problem with this approach is the lack of good instruments. Staiger and Stock (1994) discuss the bias that exists when inadequate instruments are used. Instead, we follow the conventional approach and estimate the model using the Generalized Method of Moments (GMM) technique for panel data, where the available lags of the pre-determined variables are used as instruments. Therefore, under the assumption that current random shocks are uncorrelated with past values from firm-level regressors, we use past values from t-2 onwards as instruments. In addition, time dichotomous variables are also included. Instead of using Arellano and Bond (1991), we use the more efficient method of Arellano and Bover (1995) and Blundell and Bond (1998).[13] This estimator, labeled as "system GMM", is based on an augmented system which includes level equations with lagged differences as instruments in addition to the equations in differences with lagged levels as instruments.

5. Results

5.1. Decision to export

Table 3 reports the results on firms' exporting probability, using different estimation methods. Column (I), (II) and (IV) report probit estimates, columns (III) reports the random effect probit estimate and columns (V) and (VI) report the random effect probit developed by Wooldrigde (2005). As predicted, EU harmonization of regulations has a positive impact on export probabilities. A 10% increase in EU harmonization increases the exporting around 10 percentage points in all static specifications using the probit model (see column I and II); the effect raises to 33% in the full specification model using the random effect probit model (see column III), and in the dynamic specification, the effect of EU harmonization on the probability of exporting is between 18 to 20 percentage points (column IV and V).[14] These results support those of Reyes (2010) who finds a positive impact between EU harmonization and U.S. export probabilities in the electronic sector.

[Table 3: Probability of exporting]

Turning to the other variables, we find, as expected, that larger and more capital intensive

[13] Blundell and Bond (1998) note that the standard GMM estimators may suffer from the problem of "weak instruments" when lagged levels of series are used as instruments. This problem can be overcome by applying an extended GMM estimator proposed by Arellano and Bover (1995).
[14] Similar conclusions can be inferred when HARM variable is expressed in levels instead of annual changes.

firms are more likely to become exporters, as are capital intensive, multiproduct and firms that pay higher wages. A positive and significant coefficient for productivity is only found when I consider the full specification model using the probit estimator without random effects. Without taking into account the unobserved heterogeneity, Reyes (2010) and Smeets et al. (2011) also find a positive effect of productivity on export entry. It may well be so that the poor performance of productivity on export probabilities is due partly to the inclusion of plant characteristics (lagged export status and unobserved firm-level heterogeneity). Turning to the dynamics, indeed, we find a strong, positive and significant effect of past exporting on current export status. Exporting today increases the probability of being an exporter tomorrow by 73%. It is also interesting to see that the inclusion of lagged exports lowers the estimated coefficient on EU harmonization. This implies that the persistence in exporting picks up some of the effects of EU harmonization in addition to other observed and unobserved firm characteristics. In other words, the persistent characteristic of firms exporting EU harmonized products may be an important factor for explaining the persistence in exporting.

To examine the differential impact of harmonization according to high versus low harmonized subsectors, we use an indicator variable which we interact with EU harmonization. We construct a dummy variable that is equal to one for firms belonging to sub-sectors that are highly affected by EU harmonization. These sectors include meat, fruits & vegetables, oils & fats, dairy products, animal feed and sugar and cacao (Vancauteren, 2012, Table 1). We find that the effect is more important for food sectors that are less subject to EU harmonization. These results are in contrast with those of Rey (2010) who find that the probability of becoming an exporter is higher in industries with greater EU harmonization. One plausible explanation is that a significant number of harmonized measures relating to the food industry have been adopted prior the Single Market Program (European Commission, 1997, Table 3.1.). It is therefore possible that the increase in exports have already occurred well before time.

5.2. Export premium

We now turn to the second part of empirical results of the paper. Table 4, column I-III report the estimates of various specifications of the model presented by equation (3) using the fixed effect estimator with firm- and year-fixed effects.[15] In column (I) *HARM* is the only variable explaining productivity growth; in column (II) we added the export dummy and the interaction with *HARM* and, in column (III), the model is estimated using the full set of other explanatory variables. At this point, the impact of EU harmonization is significant and positively associated with TFP growth: a coefficient of 0.05 implies that for when sales-weighted coverage ratio of EU harmonization increases by 50% points, TFP growth increases by about 2.5% points. In addition, we also find weak evidence that exporters turn out to be more productive than non-exporters but EU harmonization has so far no impact on narrowing this productivity gap.

[Table 4: Firm-level TFP growth in the Dutch food processing industry, 1992-2005]

In column (IV), we report the results for the full and static model specification using the system GMM technique when treating the explanatory variables as being endogenous. We used the available lags of the variables from (t-2) and before as instruments. The panel data

[15] The Hausman test rejects with a p-value=0.000 the null hypothesis that the independent variable(s) and the random error are not correlated in each of the regressions.

estimates are far more accurate than the fixed effect estimates reported in column (I-III). The reduction in standard errors reflects a greater precision due to the extra moment conditions. There are some changes in the coefficients. We now find evidence that EU harmonization have a significant impact on narrowing differences between the relative productivity performances of exporters versus non-exporters. An increase of EU harmonization increases TFP growth for both non-exporters and exporters but more for non-exporters. On average, a 50% increase in EU harmonization increases TFP growth by about 4% points compared to 1.5% points for exporting firms. This suggests a narrowing of the TFP growth premium (gap) between exporters and non-exporters when EU harmonization increases. It is noted (not reported in the table) that these results are robust to alternative estimators. First, we re-estimated the equation using the conventional dynamic specification of the SYS-GMM where lagged TFP growth becomes an additional explanatory variable. Second, similar conclusion can be drawn when using the Arellano-Bond GMM estimator.

In column (V) of the paper, we check whether the results are sensitive to the measurement of productivity. The dependent variable is now TFP growth by an exact index number approach. Under this approach, a measure of TFP growth is equal to differences between the relative change in output and the relative changes in inputs without estimating any parameters (e.g., see Henry de Frahan and Vancauteren, 2012). Regarding this alternative productivity measure, we find that the coefficient on the interaction term is not significant: the export premium is not affected by EU harmonization.

5.3. Sensitivity other forms of export and productivity

When examining the impact of EU harmonization on export probabilities, export premiums and productivity growth, it is also very useful to consider a subsample of firms where we consider "new" exporters and "none"-exporters. New exporters and non-exporters are defined as follows: firms that changed their export status during the sampling period but did not export during the 1980-1990 period are classified as exporters; similarly, non-exporters are those that did not export since 1980-1992 prior period.

[Table 5: Robustness]

Probit results to determine the probability of export entry in the EU during the 1992-2005 periods are presented in column I and II of Table 5. In column III and IV we report the productivity growth as a result of EU harmonization. The results on EU harmonization and export probabilities are strengthened using the subsample. However, the interaction term is not significant. The impact of productivity growth on export probabilities has now become an important determinant. In addition, we also find that product diversification is not significant for new exporters while it was highly significant when we consider the export probabilities for all firms. This latter result suggests that older exporters diversify their product line but not new exporters. Regarding the export-productivity premiums, it is shown that exporting firms enjoy a higher TFP growth than non-exporting firms; however, the interaction of *HARM* with the exporting dummy is not significant.

6. Conclusion

Despite the growing evidence that EU harmonization of technical regulations can be viewed as trade promoting instrument, little is documented on how it has affected the productivity and export decisions of firms. This chapter investigates how export decisions are affected by EU harmonization, and how EU harmonization affects the export-productivity premium.

Using a very detailed dataset of Dutch food processing firms over the period 1992-2005, the results confirm previous findings. First, we confirm that more productivity firms are more likely to enter the EU export market. The result of EU harmonization is that this probability increases. Furthermore, it is also shown that this impact is not affected by controlling for firms that belong to low versus high EU harmonized sectors. In addition, we also find that product diversification is only significant when we consider the export probabilities for all firms. Using a sample of "new" exporting firms, it is shown that product diversification is no longer significant. This latter result implies that new exporters remain competitive on exporting markets by solely focusing on their core products. Second, we find a positive and significant export-productivity premium: that is, firms that export to other EU markets are more productive than non-exporting firms. This finding is robust to the estimation technique and the way we measured TFP growth. Third, when we test whether the export-productivity premium is affected by EU harmonization, we do not find any overwhelming evidence that is the case for Dutch food processing firms: much depends on the estimation method, the way we measure TFP growth, and the export definition. For instance, if we only include a subset of export starter firms, EU harmonization does not affect the export-productivity premium gap between exporters and non-exporters.

Our results imply that export markets may be more competitive than just the trade gains following EU harmonization which reinforce firms even to be more productive. For instance, other effects such as import competition and the trade orientations of firms may play an important role in further understanding the gap between exporters and non-exporters.

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Table 3: Probability of Exporting

	I	II	III	IV	V	VI
Exported (t-1)				.724*** (.039)	.731*** (.039)	.751*** (.041)
Δ Log (*HARM*)	.083*** (.002)	.108*** (.010)	.330*** (.040)	.209*** (.030)	.180*** (.025)	.157*** (.026)
Δ Log (*HARM*) x High						-.038** (.012)
Log (Wages)		.153*** (.022)	.638*** (.102)	.185** (.066)	.713*** (.068)	.710*** (.068)
Log(*K/L*)		.021** (0.010)	.133** (.049)	-.003 (.011)	.096** (.031)	.089** (.032)
Log(Employment)		.132*** (.024)	.284*** (.101)	.188** (.070)	.172** (.070)	.169** (.072)
Multifactor Productivity		.028 (.025)	.170* (.093)	-.060 (.011)	-.038 (.074)	-.039 (.074)
Multi-product		.158*** (.011)	.253*** (.065)	.162*** (.044)	.184*** (.042)	.183*** (.042)
Year Dummies	Y	Y	Y	Y	Y	Y
Sub-sector Dummies	Y	Y	N	Y	N	N
N	7019	7019	7019	7019	7019	7019
Log-Likelihood	-4509.4	-4421.2	-4179.7	-3407.4	-3643.8	-3637.8
Estimation method	Probit	Probit	Probit RE	Probit	MLE-Dynamic Probit RE	MLE-Dynamic Probit RE

Notes: Standard errors in parentheses are adjusted for clustering at the firm-level. ***Significant at the 1 per cent level; **Significant at the 5 per cent level; *Significant at the 10 per cent level. Coefficients for the regression results of the constant and the time dummies are suppressed. The table shows average marginal effects.

Table 4: Firm-level TFP growth in the Dutch food processing industry, 1992-2005

Dependent variable	TFP_LP (I)	TFP_LP (II))	TFP_LP (III)	TFP_LP (IV)	TFP_TQ (V)
Δ Log (*HARM*)	0.034*** (.006)	0.021*** (.005)	0.052*** (.008)	0.081*** (.018)	0.046** (.014)
Dummy Export		0.018* (.010)	-.003 (.010)	.085** (.032)	0.110*** (.021)
Δ Log (*HARM*) x Dummy Export		-0.0001 (.001)	-0.0009 (.002)	-0.055*** (.007)	0.023 (.026)
Log(*K/L*)			-0.086*** (.010)	-0.194*** (.017)	0.080** (.026)
Log(Employment)			-0.338*** (.026)	-0.161*** (.022)	-0.080*** (.008)
Multi-product			0.003 (.011)	0.018 (.016)	-0.059* (.031)
Herfindahl			-0.009*** (.001)	-0.004** (.002)	0.002** (.0009)
Observations	7019	7019	7019	7019	7019
R^2	0.206	0.235	0.236	0.249	0.198
Estimation method	FE	FE	FE-	GMM-SYS	GMM-SYS
Hansen-Sargan test				16.678 (p=0.115)	35.990 (p=0.081)
Arellano-Bond (AR2)				p=0.231	p=0.662

Notes: Standard errors in parentheses are adjusted for clustering at the firm-level. ***Significant at the 1 per cent level; **Significant at the 5 per cent level; *Significant at the 10 per cent level. Coefficients for the regression results of the constant and the time dummies are suppressed. R^2 is the squared correlation between actual and predicted values. The Hansen–Sargan test is used for testing the validity of over-identifying instruments in an over-identified model (a p-value of .0.05 does not reject the null hypothesis that over-identified restrictions are valid). The Arrellano–Bond AR(2) tests for zero autocorrelation in FD errors at order 2 (a p-value of .0.05 rejects the null hypothesis that FD errors are serially correlated).

Table 5: Robustness

	Exporting (1/0) (I)	Exporting (1/0) (II)	TFP Growth (III)	TFP Growth (IV)
Exported (t-1)	.613*** (.0)	.731*** (.039)		
Δ Log (*HARM*)	.238* (.136)	.245*** (.105)	.199*** (.061)	.091*** (.028)
Δ Log (Harmonization) x High		-.077 (.057)		
Dummy Export			.778*** (.451)	.568*** (.038)
Δ Log (*HARM*) x Dummy Export				0.083 (.122)
Log (Wages)	.455*** (.091)	.473*** (.011)		
Log(K/L)	.118 (.092)	.120 (.092)	-.178*** (.024)	.245*** (.105)
Log(Employment)	.390** (.202)	.401** (.203)	-.753*** (.045)	-.182*** (.023)
Multifactor Productivity	.499** (.227)	.528** (.231)		
Multi-product	-.171 (.127)	-.168 (.126)	-.100*** (.017)	-.009*** (.003)
N	2566	2566	2566	2566
Log-Likelihood	-393.07	-392.85		
Estimation method	MLE-Dynamic Probit RE	MLE-Dynamic Probit RE	GMM-SYS	GMM-SYS

Notes: see Table 3, 4.