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Networks and export performance of agri-food firms: New evidence linking micro and macro determinants

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Abstract: The paper complements a new line of research that includes the firm heterogeneity in trade models. The central idea of this research is that only the largest and most efficient firms are capable of exporting. However, the empirical evidence has confirmed that a large number of SMEs is also involved in internationalisation. Given this context, the aim of the paper is to analyse the influence of collaborative networks between firms and institutions as an alternative mechanism to the small size of the majority of the firms in the agri-food industry. To this end, there was used a longitudinal panel between 1994 and 2012 comprising a sample of 342 Spanish firms involved in the business sectors of the food, meat, drink and tobacco industries, and a dynamic Heckman-Probit model was implemented. The first stage studies the positive influence of collaborative networks in firms' decision to export and the second stage analyses the effect of cooperation mechanisms on export intensity. The results show a positive effect of business cooperation networks in both stages suggesting that SMEs can overcome the barrier of their small size in their internationalisation process through other mechanisms, such as collaborative networks.

Keywords: agribusiness, export performance, firm heterogeneity, gravity equation, Heckman model, internationalisation, networks

The intense globalisation process of economic activity has made addressing the internationalisation process a condition for the survival of firms in the agro-industrial sector. However, entering international markets is still a challenge for a number of firms. For small firms, crossing the border involves paying the initial costs of the internationalisation process and then competing and managing an international business in a heterogeneous and more demanding context than the local market. Since the traditional agro-exporters are small in size and lack the necessary resources and skills, it is hard for them to exceed the required profitability threshold (Serrano et al. 2015a). Nevertheless, the limitations of a small size, the scarcity of financial, human and technical resources and the lack of dimension to take advantage of economies of scale can be compensated by the managers establishing collaborative networks with other firms (Johanson and Mattsson 1988). Networks can help firms acquire knowledge of foreign markets, institutions, rules and regulations (Coviello and Munro 1997; Johanson and Mattsson 1988), and, therefore, facilitate the internationalisation process. In this context, the aim of this paper is to analyse the influence of collaborative networks as an alternative mechanism to the small size of the firms. As Van Dijk (1997) mentions, the food industry has changed by becoming highly sophisticated and globalised, thus creating new opportunities to develop marketing structures such as the differentiation, vertical integration, alliances, joint ventures and firm collaboration.

Despite the importance of the agri-food industry in the international markets, the research in this sector has been very limited in comparison with studies covering other sectors (see Kirca et al. 2012, for a review). Numerous studies have analysed the impact of business networks on export in the knowledge-intensive firms (Coviello and Munro 1997; Crick and Spence 2005; Moen et al. 2004; Ojala 2009), but fewer authors have concentrated on analysing

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the agri-food industry (Karelakis et al. 2008; Maurel 2009; Fernández-Olmos 2011). As Ibeh (2005) outlines, the international research has predominantly focused on the high growth, high technology and service firms; significantly, less attention has been paid to their counterparts in the more traditional agribusiness sector, and that is why studies on this aspect are needed. We believe that analysing the agri-food industry is important because is the main manufacturing industry in Europe, representing 14.9% of the total sales (Food Drink Europe 2012) and over one third of the world trade in agricultural products and food (Serrano and Pinilla 2014). In Spain, the agri-food industry represents over 18.1% of the sales of the manufacturing sector and employs approximately 18.5% of the workforce (INE 2012). According to data from the economic report by the Instituto Internacional San Telmo y Rabobank (2004), the agri-food industry was the leading export sector in 2013. Progress in the international expansion of the industry is seen in both the growing intensity of the sales abroad and the rising number of the destination countries for exports (Serrano et al. 2015a). From 1992, before the Spain's accession to the EU, the industry exports accelerated much faster (Serrano et al. 2015b). In this period, numerous concentration processes resulted in some firms becoming larger to take advantage of the economies of scale by exploiting the geographical position of Spain as a platform to cater for the European consumers (Albisu and Gracia 2002). However, the Instituto Internacional San Telmo y Rabobank (2004) highlighted that the small size of agri-food firms is a general problem in the industry. The study showed that 75% of the entrepreneurs perceived the problem of size as a challenge for the survival of the firm itself, due to internationalisation. The literature on the international trade has expanded its focus by introducing the firm heterogeneity into the international trade models (Melitz 2003; Chaney 2008; Bernard et al., 2012; among others). The possibility of using micro-data relating to firms in their internationalisation process has led to a new theoretical current based on the firm heterogeneity that is modifying the traditional trade models (Eaton et al. 2012). Empirical findings from the micro-data on firms show that only some firms export and that those exporters are larger and more productive than the non-exporters (Greenaway and Kneller 2007; Bernard et al. 2012).

However, several empirical studies on the firm heterogeneity have highlighted the need to include more of the firms' individual characteristics when analysing firm behaviour than merely their size and productivity (Bernard et al. 2012). In this respect, Arkolakis et al. (2012) provide a new theoretical framework for affording the fixed costs of entering new markets. The basic idea is that even small firms, operating in the large markets where fixed costs can be divided among a large number of potential consumers, can internationalise.

From the network theory point of view, an alternative mechanism the firms use to overcome their resource and skill limitations is the cooperation with other firms (Johanson and Mattsson 1988; Mínguez 2010). The inter-firm collaboration to enter foreign markets allows the firms to take advantage of the existing synergies by sharing costs and risks, promotes the access to resources and markets (Chetty and Blankenburg 2000) and is a particularly useful alternative for small firms during their internationalisation process (Ibeh 2005). From the resources and skills point of view, the firm networks can facilitate access to a wide variety of resources, such as the political influence, reputation, special skills, mutual trust, and so on (Coviello and Munro 1997; Johanson and Mattsson 1988; Boehe 2013). Cooperation helps the firms accumulate the required information on export markets, facilitates the product adaptation to the target market's needs and demands, and ultimately enhances the export performance (Karelakis et al. 2008). Furthermore, cooperation between organisations is especially useful for small firms as it helps them to reduce the uncertainty of accessing international markets, decreases transaction costs, takes advantage of the synergies and complementarity of resources and/or increases the size in the activities or sectors requiring some volume to obtain positive outcomes (Gebhard 1987; Mínguez 2010). In other words, by collaborating with other firms, the SMEs can benefit from the same advantages as large firms when exporting by benefiting from the economies of scale, minimising risks, removing the redundant risks, and so on (Gebhard 1987). Nevertheless, cooperation also involves some inconveniences, such as the costs for management, information, coordination, the loss of independence, and so on (Mínguez 2010).

From the transaction costs theory point of view (Coase 1937; Williamson 1973), minimising costs leads firms to cooperate in their environment as an alternative mechanism to further their competitiveness and to take advantage of the economies of scale and learning (Porter and Fuller 1986; Gebhard 1987).

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In relation to the Spanish case, despite the small size of food and drink firms in Spain, exports have more than doubled in the agri-food industry in the recent decades and the number of firms with transactions in the foreign markets is constantly on the rise (Clar et al. 2015). This leads to the assumption that other factors besides size have helped firms to enter foreign markets in the case presented here (Serrano and Pinilla 2014). In the context of the significant restructuring process that the Spanish industry experienced in the nineties when Spain joined the European Union (Serrano et al. 2015b), this paper analyses the driving force behind the export cooperation in Spanish agri-food firms using a homogenous sample, which, as Zahra and Bogner (2000) and Ojala (2009) outline, could lessen the possibility of obtaining confused or biased results. Our research highlights the firms' participation in cooperation networks as an alternative mechanism to overcome the size limitations and to improve their competitiveness in the international markets (Porter and Fuller 1986). As a result, it joins a new line of research that allows to reconcile the trade models and the existence of a fair number of small exporters with a good performance in international transactions (Eaton et al. 2011a).

Following the above arguments, we propose that the collaboration agreements have a positive effect on the firm's export activity (decision to export and export volume).

H1: Cooperation networks between firms have a positive effect on the export performance

MATERIALS AND METHODS

Taking into account the trade gravity models with the firm heterogeneity, the econometric strategy employed consists of estimating a dynamic Heckman-Probit model that can control the selection bias (Melitz 2003; Chaney 2008; Bernard et al. 2012). Following on from the previous research with micro-data (Roberts and Tybout 1997; Bernard and Jensen 2004) using a sunk-cost hypothesis, the first stage studies the influence of the collaboration models on the firms' decision to export. The second stage analyses the effect of cooperation mechanisms on export intensity using a model inspired by the previous studies by Helpman et al. (2008), for example, and the extensions by Eaton et al. (2011b) and Arkolakis and Muendler (2010), among others. In this sense, two equations are estimated for that purpose: the first analyses the determinants of the firms' decision to export (extensive margin), while the second considers the determinants of the export intensity, in other words, the volume of sales in a specific region (intensive margin).

In line with the recent research, this paper considers the firm heterogeneity using a panel with the firm micro-data (Chevassus-Lozza and Latouche 2012). Our empirical work uses a longitudinal panel between 1994 and 2012 comprising a sample of 342 Spanish firms involved in the business sectors of the food, meat, drink and tobacco industries. The data come from the Survey on Business Strategies (ESEE) (Foundation S.E.P.I. 2014).

Selection model (extensive margin)

Roberts and Tybout (1997), Bernard and Jensen (2004) and Bernard et al. (2012) describe the firms' decision to export as the result of a series of the firms' individual characteristics and the specific costs of entering each target market. Based on this idea, this study considers that the likelihood of exporting depends, therefore, on the benefits the firms expect, which in turn depend not only on the size and costs of entering a market (macroeconomic variables), but also on the firms' internal characteristics (microeconomic variables); a special attention also needs to be paid to the effect of participating in the collaborative networks with other firms and institutions. The proposed econometric model combines the firms' individual characteristics and the heterogeneity of various regional markets using a gravity equation with micro-data. As we know, the gravity equation has been the reference econometric technique used to analyse the foreign trade determinants (Anderson 1979; Bergstrand 1985; Anderson and van Wincoop 2003; Chaney 2008; Haq et al. 2013; among several others).

The first equation is estimated using a probabilistic model (Probit). This analyses the factors affecting the likelihood of exporting and also provides the inverse Mills ratio[1] for each firm and target.

[1]The inverse Mills ratio, named after John P. Mills, is the ratio of the probability density function to the cumulative distribution function of a distribution. Using of the inverse Mills ratio is often motivated by the following property of the truncated normal distribution. If X is a random variable having a normal distribution with mean μ and variance σ^2, then

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$$D_{i,j,t}^{\exp} = \begin{cases} 1(\exp) \Rightarrow P\,(D_{i,j,t} = 1) \\ \quad = f\,(\text{Networks} + \text{Control Variables}) \\ \\ 0\,(\text{no} - \exp)\ \text{in other case} \end{cases} \quad (1)$$

where the dependent variable ($D_{i,j,t}^{\exp}$) is a fictitious variable taking the value 1 if the firm *i* exported to region *j* in the year *t* and zero otherwise. This measure on the propensity to export has been widely used in the literature (Calof 1994; Zhou and Zo, 2002; Fernández and Niet 2006; Boeh 2013). Our study takes three target regions into account: the EU (European Union), the OECD (Organisation for Economic Co-operation and Development) and the rest of the world[2].

Since the objective is to analyse the influence of cooperation between firms in the decision to export (*Hypothesis 1 – extensive margin*), the probit model inspired by the gravity equation would be specified as follows:

$$\begin{aligned} D_{i,j,t}^{\exp} = {} & \beta_1 + \beta_2\, Networks_{it} + \beta_3\, l\_FirmSize_{it} + \\ & \beta_4\, l\_ExternalDemand_{jt} + \beta_5 l\_Age_{it} + \\ & \beta_6\, HumanResources_{it} + \beta_7\, Int\_Marketing_{it} + \\ & \beta_8\, Int\_R\&D_{it} + U_{ijt} \end{aligned} \quad (2)$$

Firm collaboration (***Networks)*** is introduced as an alternative mechanism to size. It is defined as a fictitious variable that takes value 1 if the firm *i* participated in the year *t* in a collective marketing action for the overseas expansion, such as the sector export agreement, association of exporters or export cooperatives, and zero if it did not.

In line with the previous studies (Bonaccorsi 1992; Calof 1994; Pla-Barber and Alegre 2007), the empirical model includes the firm size ***(Firm Size)*** approximated using the number of employees logarithm; a positive influence on the export performance is expected (Acedo and Jones 2007; Richter 2007; Boehe 2013). According to the resource-based view, the larger the firm, the more resources it has (Maurel 2009). Similarly, under the transaction cost theory, a larger size is considered to enable the firm to adopt a governance structure that suits the requirements of international trade by reducing the transaction costs (Maurel 2009). Therefore, the majority of theoretical explanations suggest that larger firms can better absorb the risks associated with entering a foreign market, take advantage of the economies of scale and have more financial resources to meet the costs of the initial stages of entering new markets (Bernard and Jensen 1999; Verwaal and Donkers 2002; Majocchi et al. 2005; Maurel 2009).

The model also controls for the heterogeneity of the markets, in other words, it considers the diversity of the target markets. Consequently, the ***ExternalDemand*** variable was introduced. It was inspired by the Anderson's (1979) original proposal of the gravity equation, which assumes that the trade flows depend positively on the countries' economic size (approximated by income) and negatively on the distance between them. Following Yang and Mallick (2014), the *ExternalDemand* variable was calculated for each of the three regions by totalling the size of each country in the region weighted by the inverse of their distance. This results in a synthetic measurement of the traditional variables of the gravity equation.

$$ExternalDemand_{j,t}^{region} = \sum \frac{GDP_{country\_i}}{Dist_{country\_i}} \quad (3)$$

where $GDP_{country\_i}$ is the gross domestic product of the country in region *j*, as an approximation to the market size, and $Dist_{country\_i}$ is the distance between the target export market and Spain, as an approximation of the trade barriers. A positive sign is expected from the variable: as the size of the target market,

$$E[X|X > \alpha] = \mu + \sigma \frac{\phi\left(\frac{\alpha - \mu}{\sigma}\right)}{1 - \Phi\left(\frac{\alpha - \mu}{\sigma}\right)},\ E[X|X < \alpha] = \mu + \sigma \frac{-\phi\left(\frac{\alpha - \mu}{\sigma}\right)}{\Phi\left(\frac{\alpha - \mu}{\sigma}\right)}$$

where α is a constant, ϕ denotes the standard normal density function, and Φ is the standard normal cumulative distribution function. The two fractions are the inverse Mills ratios. Heckman (1979) proposed a two-stage estimation procedure using the inverse Mills ratio to take the selection bias into account. In a first step, a regression for observing a positive outcome of the dependent variable is modelled with a probit model. The inverse Mills ratio must be generated from the estimation of a probit model; a logit cannot be used. The probit model assumes that the error term follows a standard normal distribution. The estimated parameters are used to calculate the inverse Mills ratio, which is then included as an additional explanatory variable in the OLS estimation.

[2]EU: The percentage of exports to the EU over the total exports. OECD: The percentage of exports to the OECD (except the EU) over the total exports. Rest of the World: The percentage of exports to the rest of the world (including Latin America) over the total exports (all countries except those belonging to the EU and the OECD).

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weighted by distance, expands, it becomes more attractive for export, and, therefore, the likelihood of firms making a profit increases as they can spread the costs of entering the market among a higher number of clients (Krautheim 2007).

The model also controls for the ***Age*** of the firm. The effect of the age of a firm during internationalisation is ambiguous. On the one hand, older firms are usually more stable than the younger firms in their provision of resources; therefore, they have more capacity to perform internationalisation processes (Zahra and George 2002). Furthermore, older firms might be more stable and have a larger network as their experience is more extensive, all of which can bring them export success (Maurel 2009). Young firms, on the other hand, are more flexible, and they have the advantages of the learning effect (Autio et al. 2000; Sapienza et al. 2006) as well as a more entrepreneurial attitude (Maurel 2009). Therefore, the effect of age is ambiguous. Age is calculated in the models using the logarithm of the number of years (plus one) from the year the firm was established up to the year in which the survey is taken (Anderson and Reeb 2003).

In accordance with the Dunning's resource theory and the eclectic paradigm (1977), firms with unique intangible resources can exploit their advantage in foreign markets (Lu and Beamish 2004). The model includes the firm's human capital (***HumanResources***), by the means of the employee training, calculated as a proportion of the firm's employees with a university degree (percentage of engineers and other graduates out of the staff total), in line with authors such as Plechero and Chaminade (2010), who also adopted this measure as a proxy of human capital. *HumanResources* variable is, therefore, expected to have a positive effect on exporting.

Finally, the model includes the ***Intensity of R&D activities*** (***Int_R&D***) variable and the firm's ***Intensity of Marketing activities*** (***Int_Marketing***) variable as the sources of competitive advantage; a positive effect on the exporting activity is expected (Maurel, 2009). *Int_R&D* is calculated as a percentage of the R&D cost out of the sales total, while *Int_Marketing* is approximated based on the quotient between advertising costs out of the firm's total sales (Qian et al. 2010).

Determinants of export intensity (intensive margin)

The second stage of the Heckman model analyses the determinants of export intensity. The possible selection bias has been corrected in this stage using the inverse Mills ratio calculation for each firm and target market, as seen in the Equation (4):

$$l\_V\_Exp_{ijt} = \beta_1 + \beta_2 Networks_{it} + \beta_3 l\_FirmSize_{it} + \beta_4 l\_ExternalDemand_{jt} + \beta_5 l\_Age_{it} + \beta_6 HumanResources_{it} + \beta_7 Int\_Marketing_{it} + \beta_8 Int\_R\&D_{it} + \beta_9 InvMills_{ijt} + U_{ijt} \quad (4)$$

The dependent variable in this second stage is the firm's export value *i* towards the region *j* in the year *t* (***V_Exp***$_{ijt}$). This measure of the export intensity has been widely used in the literature (Calof 1994; Zhou and Zou 2002; Fernández and Nieto 2006; Boehe 2013). As in the previous stage, the export to three target regions is taken into account: the EU, the OECD and the rest of the world.

As the aim is to analyse the influence of the firm collaboration on the firms' export intensity (*Hypothesis 1 – intensive margin*), the model includes the *Networks* variable as in the previous stage. The model also introduces the macro control variables (*ExternalDemand*), as well as the micro ones, such as: *Firm Size*, *Age*, *Human Resources*, *Marketing intensity* and *R&D intensity*. As mentioned above, a positive effect on the export intensity was expected from all the variables.

To facilitate understanding of the variables used in the models, the Table 1 contains their description. The table also includes the main descriptive statistics of the sample. We can observe that the proportion of firms using collaborative networks is 0.70. On the other hand, the firms in the sample are relatively young (average 31 years) and the proportion of the firms' employees with a university degree is low. The intensity of marketing activities and the R&D is also low, especially regarding the R&D.

Furthermore, in an analysis of manufacturing companies as a whole, Fernández-Núñez (2000) points out that size continues to be a key variable in the decision of Spanish firms to export. In fact, our sample from the Survey on Business Strategies (ESEE) also shows how the Spanish firms in the industry are small.

According to a report by the Instituto Internacional San Telmo y Rabobank (2004), the agri-food industry was consolidated as the first export sector in 2013. Progress in the international expansion of industry is seen in both the growing intensity of sales abroad and the rising number of destination countries for exports. However, the majority of the process can be explained by the intensification of the intraregional

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Table 1. Descriptive statistics

Variable	Description	Mean	Standard Deviation	Min.	Max
V_Exp	**Export Value**: Firm's export value i towards region j in year t.	7 963 476	2.12e+07	82.5	4.50e+08
Networks	**Collaborative Networks**: Fictitious variable that takes value 1 if the firm i participated in year t in a collective marketing action for overseas expansion, such as the sector export agreement, association of exporters or export cooperatives, and zero if it did not.	0.70	0.83	0	1
L_FirmSize	**Firm Size**: Number of employees (in logarithm form).	235.94	514.63	1	7400
l_Age	**Firm Age**: Logarithm of the number of years (plus one) from the year the firm was established up to the year in which the survey is taken.	31.35	24.07	1	176
HumanResources	**Human Resources**: Proportion of the firm's employees with a university degree (percentage of engineers and other graduates out of the staff total).	4.40	5.58	0	36.1
Int_Marketing	**Intensity of Marketing activities**: The quotient between advertising costs out of the firm's total sales.	4.81	11.49	0	99
Int_R&D	**Intensity of R&D activities**: Percentage of the R&D cost out of the sales total.	0.23	1.22	0	40.05

trade. Since the end of the transition to the accession to the European Union in 1992, the Spanish food and drink industry has focused its exports on large-scale regional markets in the developed and geographically close countries (Clar et al. 2015). Breaking down the Spanish agricultural exports by the destination region highlights that the removal of barriers to enter the EU intensified the degree of internationalisation and the importance of this region; however, it did not vary the main destination markets for Spanish exports (see Figure 1). France, Italy, Germany, the United Kingdom and Portugal have always been very important countries for the Spanish trade. Recently, there has been a rising importance regarding the export destinations of countries in other regions, namely Russia, China or the Arab countries, although their participation is still relatively small (Serrano et al. 2015a).

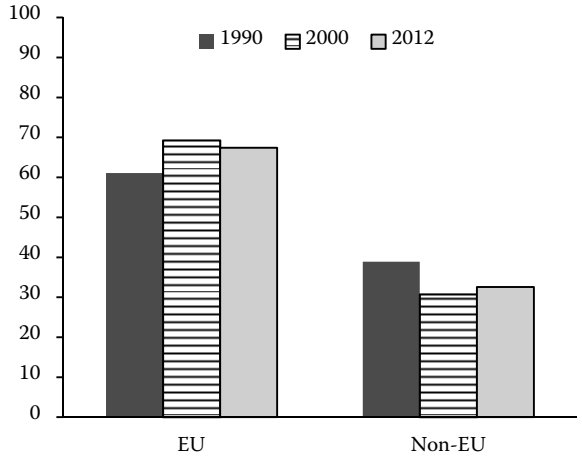

Figure 1. Distribution of food, drink and tobacco industry exports by destination regions, 1990–2012 (in percentages)

Data Source: UN-COMTRADE (2013)

RESULTS

Before producing the estimations of the models described in the previous section, a preliminary analysis was conducted to determine the relationships between each of the independent explanatory variables used in the regression models. Table 2 shows the correlation

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Table 2. Spearman correlation matrix

		1	2	3	4	5	6	7	8
1	**V_Exp**	1.00							
2	**Networks**	0.03**	1.00						
3	**L_FirmSize**	0.53**	0.01	1.00					
4	**L_ExternalDemand**	0.16**	–0.11**	–0.12**	1.00				
5	**l_Age**	0.09**	0.11**	0.25**	–0.08**	1.00			
6	**HumanResources**	0.12**	0.17**	0.04**	–0.02	0.12**	1.00		
7	**Int_Marketing**	0.06**	0.10**	0.28**	–0.07**	0.27**	0.23**	1.00	
8	**Int_R&D**	0.18	0.05**	0.37**	–0.08**	0.07**	0.25**	0.34**	1.00

**Significant at the 1% level, *significant at the 5% level

matrix for each of the independent variables[3]. None of these correlations present levels implying serious multi-collinearity problems.

The estimation technique used is the panel data. A Probit regression with random effects, the selection equation, is used in the first stage (column 1, Table 3). The second stage (columns 2 and 3) presents the regression equation with fixed effects (FEM); besides the first-stage variables, the inverse Mills ratio (selection bias) is also included. The *Inverse Mills* variable presents statistical significance, which justifies including it in the second stage.

The FEM[4] model controls the 'multilateral resistance' formulated by Anderson (1979) to avoid erroneous specifications as Anderson and van Wincoop (2003) suggest. The FEM also controls for the 'unobservable bilateral heterogeneity', in this case shown by the individual firms exporting to different markets. The inclusion of fixed effects by the firm-market pairs allows to take into account factors that are constant

Table 3. Dynamic Heckman Probit model results

	(1) Selection Equation Probit	(2) Regression Equation FEM	(3) Regression Equation FEM-PCSE
Networks $_{it}$	0.91*** (0.05)	0.19*** (0.05)	0.16*** (0.04)
l_Firm Size$_{it}$	0.62*** (0.04)	0.59*** (0.06)	0.52*** (0.07)
l_ExternalDemand$_{jt}$	0.96*** (0.08)	0.86*** (0.16)	0.93*** (0.18)
l_Age$_{it}$	0.24*** (0.06)	0.63*** (0.08)	0.62*** (0.10)
HumanResources$_{it}$	0.04*** (0.06)	0.01** (0.01)	0.01* (0.01)
Int_Marketing$_{it}$	0.00 (0.00)	–0.00 (0.00)	0.00 (0.00)
Int_R&D$_{it}$	–0.00 (0.02)	–0.02 (0.01)	–0.00 (0.01)
Inverse Mills$_{ijt}$	...	0.23** (0.10)	0.19** (0.09)
Firm-market pair effects (FE)	No	Yes	Yes
Constant	–26.43*** (1.67)	–10.84** (3.55)	12.78** (4.48)
No. Observations	13755	5005	5005
No. groups	1584	695	695
R-Squared	..	0.26	0.87
Prob > X^2	0.00	0.00	0.00

Standard errors in parentheses; ***significant at the 1%, **at the 5%, *at the 10% level

[3]The Kolmogorov-Smirnov test shows that variables do not show normality in distribution. Consequently, we cannot employ the Pearson's correlations using the Spearman's correlations.

[4]The fixed-effects model (FEM) was also compared with the random-effects model (REM), and the Hausman test showed a preference for the fixed-effects model (FEM). The Hausman test's null and alternative hypotheses are H_0: $cov(u_{jt}, X_{kjt}) = 0$ and H_1: $cov(u_{jt}, X_{kjt}) \neq 0$, respectively. u_{jt} represents the random time and the country-variant effects and k is the number of explanatory variables. If the null hypothesis is valid, it is efficient to use the REM as a consistent estimator. Otherwise, it is efficient to use the FEM as a consistent estimator.

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over time and affect the trade between firms and target markets (Mátyás 1997, 1998; Egger 2002), such as the common language, the common border, regional trade agreements, etc. since these factors have not been explicitly controlled in the model.

It is important to note here that, even after modelling heterogeneity in time and space, according to the Wald test (Greene 2000) our model raises problems of heteroscedasticity. Furthermore, according to the Wooldridge test (Wooldridge 2001), the estimation presents autocorrelation problems. Both problems were solved using the fixed-effect estimation per pair with the panel-corrected standard errors (PCSE). The results are shown in column (3).

The selection equation results (column 1) show that the coefficient of the $\boldsymbol{Networks}_{it}$ variable is positive and significant. This result confirms that the firms that are more inclined to collaborate with other firms are more likely to enter new markets. The positive and significant effect continues in the second stage (column 3). This implies that the firms participating in collaborative networks export more intensely. Consequently, we cannot reject Hypothesis 1. Although some authors (Furtan and Sauer 2008) state that business networking is very expensive in terms of the management time, this does not seem to be an impediment for the firms, and the collaboration has a positive effect on the export performance. Therefore, the results show that the use of collaborative networks is an alternative tool for some SMEs wishing to internationalise and they can help them to overcome barriers arising from their small size. Furthermore, the results show that the effect of collaborative networks is more intense in the first stage (i.e. the decision to export-extensive margin) than in the second stage (export intensity-intensive margin). This could indicate that using these networks is particularly important at the beginning of the internationalisation process.

The size of the firm is also confirmed to be a determining variable on the export performance. The coefficient of the $\boldsymbol{FirmSize}_{it}$, variable shows a positive and statistically significant sign in both stages, influencing both the likelihood of exporting and the intensity of foreign operations. This result consolidates the opinion that large firms benefit more from the size and have the necessary resources to start exporting.

In relation to other control variables, a positive and significant effect of the $\boldsymbol{ExternalDemand}_{jt}$ variable is observed in both stages. This confirms that the larger the target market and/or the shorter the distance between countries, the more likelihood there is of the firm deciding to export and doing so more intensely (Krautheim 2007; Yang and Mallick 2014). This result shows that the firms are more likely to export and export more intensely when addressing larger and closer markets.

The $\boldsymbol{Age}_{it}$ variable also has a positive and significant effect on both the selection equation and the gravity equation. In this sense, the most experienced firms meet fewer barriers to enter new markets, and their export volume is higher (Majocchi et al., 2005) since age is considered a proxy of experience in the internationalisation process.

A positive and significant effect is also observed for the ***HumanResources*** variable in both export likelihood and export intensity. This positive effect highlights the importance of including trained and qualified employees in the firm, since this increases both the likelihood to export and the export intensity.

On the other hand, the ***Int_Marketing*** and ***Int_R&D*** variables do not present any statistical significance in either of the stages. The results of the marketing intensity variable are in line with the Caves' argument (1981) that marketing does not play a determining role outside the national borders. The lack of significance of the investment in the process R&D variable corroborates the research by Sterlacchini (1999), who demonstrated that the traditional 'R&D investment' indicator is not suitable for studying innovation in small industries that do not perform an intensive R&D, such as the Spanish agriculture industry. For the future research, we can conclude that one output measure for innovation could be preferable to the R&D intensity to analyse innovation in the agriculture industry.

DISCUSSION AND CONCLUSIONS

This study has researched the relationship between the firm collaboration and the firm export performance for a uniform sample of firms in the food and drink industry, which are usually small. The paper presents a new empirical evidence on the study of international trade in the context of the firm heterogeneity by considering both macroeconomic and microeconomic variables. The results obtained in the study show that the firms more likely to collaborate with other firms and entities have a higher likelihood of entering new markets and more export intensity; in other words, the firm collaboration facilitates access to exporting. This can be considered an alternative

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mechanism, especially for small firms with more barriers to entering international markets. Therefore, the firms interested in the internationalisation process, especially smaller ones, can be supported by collaborative networks both to start the internationalisation process and to expand it.

This study shows that the Spanish food industry has a dynamic behaviour. The Spanish firms seized the opportunities afforded by the barrier-free access to the European market. The limitations of being small in size, or of scarce financial, human and technical resources, have not prevented an intense process of internationalisation. (Serrano et al. 2015b). Our paper has shown how the SMEs' initial limitations to taking advantage of the economies of scale could be compensated by their managers establishing collaborative networks with other firms.

The aim of this study is to shed light on the previous research focusing exclusively on the firm size and productivity as a source of the firm heterogeneity. Our work has highlighted other new sources of the firm heterogeneity, such as the case of the firms and managers more likely to collaborate with others to export. As a result, it offers an alternative explanation that can provide a better understanding of how a fair number of small exporters operating in international markets fit into the trade models (Eaton et al. 2011a). The key is the use of collaborative networks as a mechanism to help some firms overcome their small size and to cope with the internationalisation process.

One of this study's contributions is the use of a new methodology, namely the estimation of a dynamic Heckman-Probit model, which presents a combination of micro and macro determinants that has been rarely used in this area and pays a special attention to micro variables, specifically the effect of the firm collaboration. The classical gravity models generally use cross-sectional data to estimate the trade determinants and relationships for a specific time period. However, in reality, the cross-sectional data over several time periods provide a more realistic and useful information (Lee and Lim 2014). Therefore, we contribute to the literature by studying the business results of the internationalisation process for a very broad period, 1994–2012, since, as Chiao et al. (2006) and Boehe (2013) highlight, longitudinal studies are more appropriate for capturing the dynamic nature of the internationalisation phenomenon of firms. The previous literature that has analysed the sector mostly focused on the descriptive and cross-sectional research, and the use of micro-data with a dynamic view of the international process is rare (for example, Fernández and Díez 2015; Karelakis et al. 2008; Maurel 2009; Fernández-Olmos 2011).

The study also highlights some limitations that open up interesting areas for the possible lines of research. The main limitation is that the study considers exports to only three target regions (EU, OECD and the rest of the world). We are aware that there is a wide variety of countries with differing characteristics in each of these three regions, so the future studies could collate and include information itemised by a target country. It would also be interesting if the future research analysed the effect of other forms of collaboration, for example the technological or manufacture collaboration, rather than merely the trade collaboration.

Finally, as far as study implications are concerned, identifying the determinants of the firm internationalisation, specifically the effects of various forms of the collective participation on the firms' exporting activity, is crucial for institutional managers. The results could be interesting for the policymakers designing and implementing export programmes for firms. The internationalisation policy actions can plan improvements and establish new programmes that promote the collaboration between firms and research centres as an alternative mechanism to improve the firm competitiveness. As shown in this paper, the inter-firm cooperation allows small firms to access foreign markets. It might, therefore, be of interest to produce export support programmes especially for the SMEs focusing on encouraging the cooperation between organisations.

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