

Quality and export performance: Evidence from the French cheese industry *

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PRELIMINARY VERSION

Abstract

The paper questions the impact of geographical indication label on firm export competitiveness in the cheese and cream industry. We use firm level data from the French custom and an original dataset of firms and products concerned by protected designations of origin (PDO). Our econometric estimations show that PDO labelling impacts both the extensive margin and the intensive margin of trade (the value of trade) while the effect on unit value is not significant. Finally, observing multiproduct firms, we highlight a spillover effect of PDO certification on export of non-certified products for firm authorized to handle PDO products.

Keywords: Quality label, PDO, trade margin

JEL: F10, F14.

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1 Introduction

Quality labels are developed at the European level through a European Union (EU) quality policy. This policy aims at fitting consumer concerns about the attributes of food products, such as quality and geographical characteristics. It is also expected to sustain competitiveness within the agri-food chains.

In this paper we investigate the role of Protected Designations of Origin (PDO) on French export performance in the agri-food industry. We use trade firm level data and an exhaustive dataset of the firms and products concerned by PDO in the cheese industry, which is with wine, one of the main sector concerned by PDO. French export performance is assessed analyzing the impact of PDO label on the probability of trade, the quantity of trade, and trade unit values.

This paper contributes to the literature on European geographical labels concerning food products (PDO but also Protection Geographical Indicator -PGI- that is less restrictive). This literature can be presented along two axes. First, papers dealing with the consumer's perception of labelled products. This perception is analyzed measuring either consumers' willingness to pay for geographical labels (Menapace et al. (2011)), prices elasticities (Hassan et al. (2011)) or price premiums (see for example the meta-analysis of Deselnicu et al. (2013)). These different approaches deal with different food sectors and suggest that the premium for geographical indicators vary substantially according to the nature of products or markets. A second axis of the literature focuses on the producer side. Bouamra-Mechemache and Chaaban (2010a) analyze the determinant of adoption of PDO by French brie producers and show that the attractiveness of PDO certification depends on the cost of raw material and the size of the companies. Bouamra-Mechemache and Chaaban (2010b) use a theoretical model and show that PDO labelling is efficient for the producers as it allows them to signal their quality, but that private collective certification bring more welfare. Bontemps et al. (2013) estimate the impact of PDO on the survival of French cheese firm and show that labelling reduces the risk for smaller firms. These different studies focus on the production aspects but do not consider the exports of the firms producing PDO. In our paper, we analyze the impact of PDO labelling on trade patterns, distinguishing its impact between European and non European markets.

Our work also relates to papers investigating the relationship between quality and trade. A first strand of this empirical literature assesses the impact of different trade costs on trade according to the quality of the products, using either country-level data (Schott (2004), Schott (2008) ,

Hummels and Klenow (2005), Baldwin and Harrigan (2011)) or firm level data (Bastos and Silva (2010), Martin (2012)). A second strand of the literature focus on firm-level heterogeneity in quality. Johnson (2012) shows that firms with high productivity export higher quality goods and charge higher prices than other firms. Manova and Zhang (2012) shows that Chinese firms with higher quality goods have better export performance. Crozet et al. (2012) test the Melitz model (2003) with firm heterogeneity and show that quality increases both the probability of market entry and the exported values. Curzi and Olper (2012) also confirm the relationship between productivity, product quality and export performance in the food sector. Except Crozet et al. (2012) who use quality ranking by experts and Curzi and Olper (2012) who use R&D and innovation to proxy quality, the majority of these works use trade unit values as proxy for the quality of the product. In this paper, we investigate the impact of another measure of quality that is the Protected Denomination of Origin and show that this label has a positive impact of trade flows.

The contribution of this article is threefold. First, we show that PDO labelling in the cheese industry has a positive impact on exporting firms both at the extensive (probability to export and number of export destinations) and at the intensive margin (quantity exported). Second, we distinguish the effect of PDO according to the destination markets and show that the effect is mainly driven by European markets, meaning that PDO labelling is mainly recognized by European consumers. Third, considering that exporting firms are multiproduct, our estimations highlight a spillover effect of PDO certification on export of non-certified products in firm authorized to handle PDO products.

These different outcomes thus suggest that the European quality policy through the promotion of geographical labels positively impacts trade performance of the cheese and cream French producers. However, the fact that this effect is mainly observed on European markets raise the issue of the identification and protection of PDO out of the community market.

The paper is organized as follows. In the first section, we describe our dataset and give first evidence on differences in trade patterns between PDO and non-PDO products. In the second section, we present our empirical strategy and compare export performance of PDO and non-PDO products. We also compare the export performance of authorized and non-authorized firms for their non-labelled products. The third section concludes.

2 Data and stylized facts

2.1 Data

We use French firm-level data from the French customs to evaluate the effect of PDO labelling on export performance. This database provides for each firm its exports in value and quantity by product (defined at the NC8 level of the classification of goods of the EU statistics) and destination. We restrict the sample to the firms exporting cheese or cream (products that belong to the HS4 categories 0405 or 0406, i.e. 40 different products) in order to have a homogenous sample of firms in terms of products.

The customs database is merged with data on firms's characteristics from the French national institute of public statistics (INSEE). This dataset provides information on the main activity, the total sales and the added value per worker of each firm. In order to compare firms with the same activity, we restrict our analysis to firms from the agri-food sectors exporting cheese or cream. Doing so, our final dataset gather 220 exporting agri-food firms.¹

We identify the firms and products concerned by PDO labelling by using the exhaustive list of firms and products of the French national institute responsible for these official designations (INAO- Institut National de l'Origine et de la Qualité) for 2012. The correspondence between INAO's definition of products and NC8 codes is not straightforward, as a PDO labelled product may not have an exclusive NC8 code and as a NC8 may correspond to both PDO and non-PDO products. In the latter case, we assume that the PDO label applies to all the NC8 category. Because of this approximation, the effects of labels may be under-estimated in our empirical analysis. In 2012, 29 authorized firms among the 220 exporting firms export 16 different PDO labelled NC8. It should be noted that in our dataset, both authorized and non-authorized firms are multiproducts firms. As a consequence, authorized firms do not only export labelled products but may also export non-labelled products.

2.2 Descriptive statistics

The combination of French Customs and INAO datasets allows us to distinguish PDO authorized firms from non-authorized firms among French exporters of cheese and cream. As said above, among the 220 firms of our dataset, 29 firms are authorized to handle PDO. (Table 1) presents descriptives

¹In this study, we focus on exporting firms as we do not know what are the products actually produced by the firm. We are only able to identify the products exported by the firm.

Table 1: Descriptive statistics on authorized and non authorized firms

	Type of firm	Nber of firms	Mean	Sd	Median	Min.	Max
productivity	<i>Authorized</i>	29	1,489	5,264	355.6	145.9	28,759.1
	<i>Non-authorized</i>	191	582	1,949	292.8	0	26,131.4
Number of Employees	<i>Authorized</i>	29	244	428	87	10	1744
	<i>Non-authorized</i>	191	211	383	52	1	2,620
Number of products	<i>Authorized</i>	29	7.59	6.31	6	1	24
	<i>Non-authorized</i>	191	3.33	4.23	2	1	29
Number of destinations	<i>Authorized</i>	29	15.8	18	9	1	73
	<i>Non-authorized</i>	191	5.9	12.4	2	1	101
Total export value	<i>Authorized</i>	29	23,705.8	54,030	2,078.5	0.43	238,541
	<i>Non-authorized</i>	191	6,575.2	30,304.6	92.8	0.173	372,192

Notes: Authors' computation using INSEE and INAO datasets.

statistics for authorized and non authorized firms. Authorized firms appear to have a slightly higher productivity (computed at the firm level) and to be bigger in terms of number of employees. This is consistent with the fact that having such an authorization may induce fixed costs, that can only be born by more productive firms. The higher average productivity and size may also partly explain why authorized firms export an higher number of products (without distinguishing PDO and non PDO products), to a larger number of destinations, and have higher total export value. At the aggregated level, authorized firms represent more than 22% of the total export value of cheese and cream whereas they only represent 13% of the number of exporters.

PDO products represents 23.5% of exports value of authorized firms. As a consequence, PDO products represent a relatively small share (5%) of French total exports of cream and cheese. Non-labelled products are exported by both non-authorized firms (for 78% of total trade) and authorized firms (for 17%). Figure 1 presents the French Cheese median exports by firm and product. It shows that export values and quantities are higher for authorized firms. The difference in export is more pronounced when we consider labelled products. The level of exports by authorized firms for labelled products is more important than for non labelled products, whatever the destination market (EU or non-EU). This observation is confirmed by the Figure 2, which displays the kernel density of the export values and quantities by firm-product pair. There are more flows from authorized firms with labelled products with high trade values or quantities than other flows.

In Figure 3, we assess the extensive margin of trade by computing the median number of destination countries by firm and NC8 category of product. The number of destinations is higher for authorized firms exporting PDO products. For non-PDO products, differences on the number

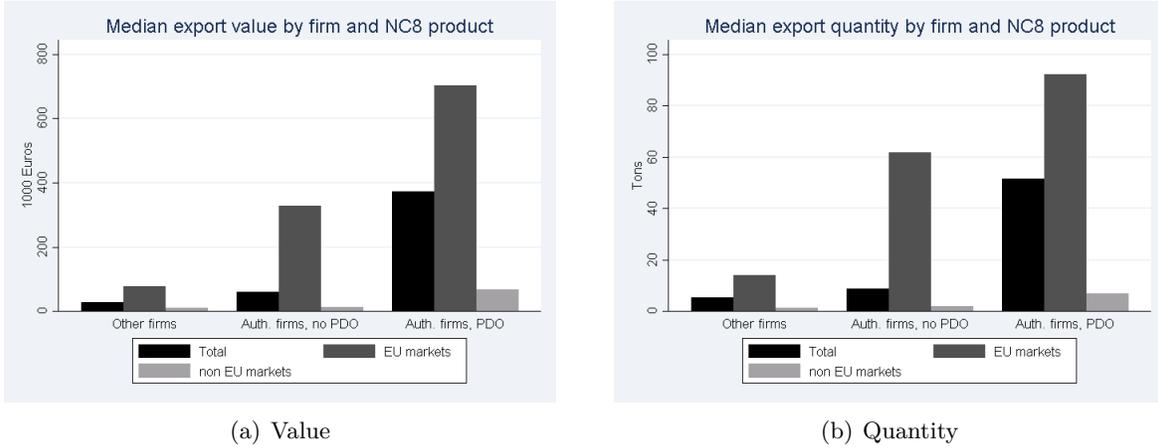


Figure 1: Export by firm and product (nc8)

Notes: Authors' computation using French Customs and INAO datasets.

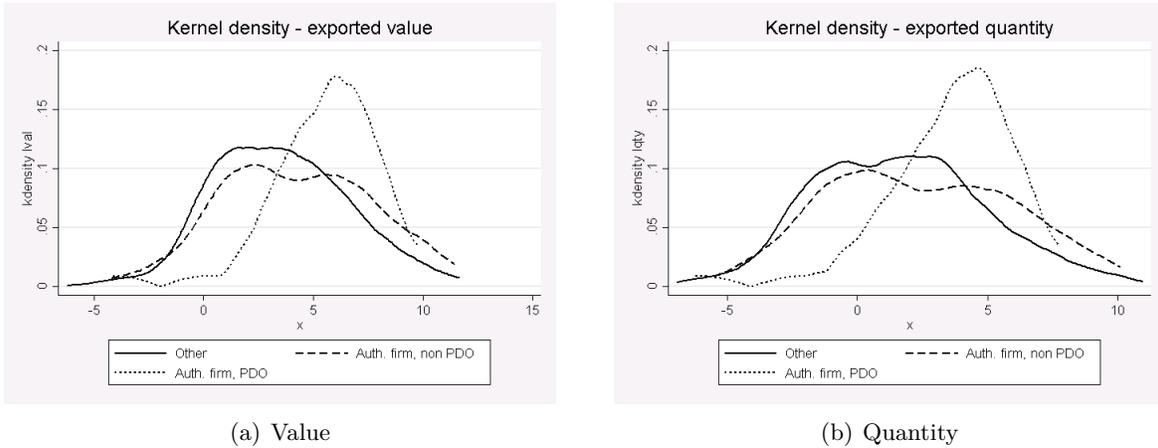


Figure 2: Kernel density of export

Notes: Authors' computation using French Customs and INAO datasets.

of destinations between authorized and non-authorized firms only appear on European markets.

In Figure 4, we compute the median of trade unit value of cheese and cream product for the three categories of firms-product pairs. Contrary to the export values and the number of destinations, the unit value does not differ a lot according to the type of firms and products. Trade unit values of non-authorized firms are not different from those of authorized firms. Within PDO authorized firms, PDO products are exported at a higher price than non-labelled products, in particular on the non-European markets.

So far, the descriptive statistics suggest a positive role of PDO labelling in firms export performance in the cheese and cream industry. This impact appears both at the extensive and the intensive margins. Moreover, we observe these differences in trade margins both within and be-

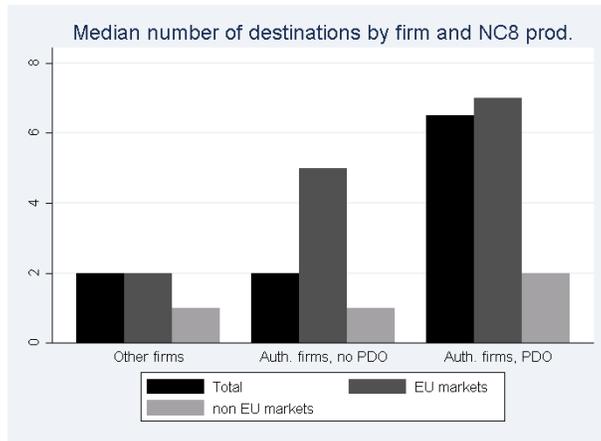


Figure 3: Number of destinations by firm and product (nc8)

Notes: Authors' computation using French Customs and INAO datasets.

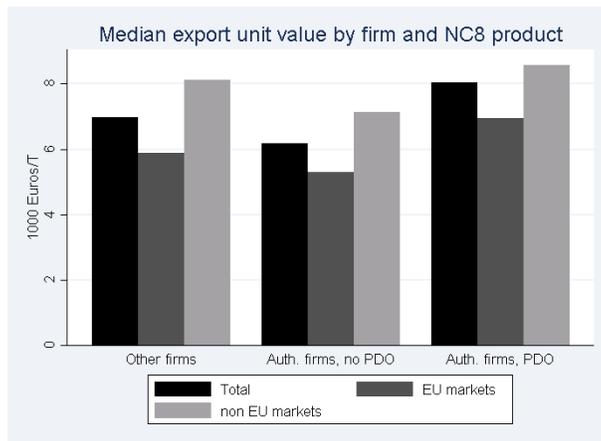


Figure 4: Exported unit value by firm and product (nc8)

Notes: Authors' computation using French Customs and INAO datasets.

tween firms. An authorized firm export more and to more destinations than non-authorized firms especially to EU markets and the value exported by an authorized firm is higher for its labelled products than for its non-labelled products.

3 Empirical model and identification strategy

Our empirical analysis assesses the impacts of PDO labelling on export performance of French exporters in the cheese and cream industry. We first study whether benefiting from a label entails a higher probability of exporting (the extensive margin of trade) and a higher quantity exported (the intensive margin of trade). The objective is to quantify the direct impact of PDO by comparing export performance of firms selling labelled products to firms providing non-labelled products.

Then, we investigate the origins of the difference in export performance between suppliers of PDO products and the other firms. We focus on two key variables : product quality perceived by consumers and price. Last, test whether an authorized firm benefits from spill-over effects of PDO on export performance for its non-PDO products.

3.1 Theory

Consumers have identical Cobb-Douglas preferences over differentiated products $U_j = \Pi_k U_{jk}^{\delta_k}$. We posit a CES sub-utility function for the differentiated products:

$$U_{jk} = \left[\sum_{\ell} \int_{\Omega_{\ell k}} [\lambda_{\ell j k}(v) q(v)]^{\frac{\varepsilon-1}{\varepsilon}} dv \right]^{\frac{\varepsilon}{\varepsilon-1}} \quad (1)$$

where $q(v)$ is the quantity purchased for each variety of product k , $\Omega_{\ell j}$ is the set of varieties of product k available in country j and produced in country ℓ , $\varepsilon > 1$ is the substitution elasticity between varieties and $\lambda_{kj}(v)$ is the quality perceived by consumers living in country j for variety v of product k . Consumers value (vertical) quality. In Appendix A, we show that the equilibrium demand for variety v of product k in country j is such that:

$$q_{ijk}(v) = [\lambda_{ijk}(v)]^{\varepsilon-1} E_{jk} P_{jk}^{\varepsilon-1} [p_{ijk}(v)]^{-\varepsilon} \quad (2)$$

where E_{jk} is the amount of income allocated to the differentiated product k in country j and P_{jk} is the price index in country j associated with product k , defined as:

$$P_{jk} = \left[\sum_{\ell} \int_{\Omega_{\ell j}} [p_{\ell j k}(v) / \lambda_{\ell j k}(v)]^{1-\varepsilon} dv \right]^{\frac{-1}{\varepsilon-1}}$$

Note that the price index reacts negatively in response to an increase in quality of products.

We assume that foreign consumers value varieties as follows

$$\lambda_{ijk}(v) = [\theta_{ik} e^{\xi_j \times PDO(v)}] \eta_j \quad (3)$$

where $PDO(v)$ is equal to one if variety v of product k has a PDO label. If a variety belonging to product k is not a PDO variety then the quality is given by θ_{ik} which is the minimum quality offered for product k . Parameters ξ_j is a quality shifter associated with PDO labeling and η_j represents the consumer valuation of variety v . Note that $\zeta_j \equiv \xi_j \times \eta_j$ is the elasticity of perceived quality by

consumers to PDO labelling.

We now describe production technology and market structure. Firms produce under monopolistic competition. They supply at least one variety and each variety is provided by a single producer. Labor is the only input Technology is such that the marginal cost is given by

$$c_{ijk}(f) = \omega_i(f)[\theta_{ik}]^\alpha e^{\beta \text{PDO}_{fk}} \tau_{ijk} / \varphi_{fk} \quad (4)$$

where $\omega_i(f)$ is a price index of inputs used by firm f and τ_{ij} represents trade costs for product k shipped from country i to country j . The variable $[\theta_{ik}]^{\alpha_j}$ with $\alpha \geq 0$ can be interpreted as a cost shifter due to product quality without PDO label while $e^{\beta \text{PDO}_{fk}}$ is an additional cost shifter due to PDO labelling. We have $\text{PDO}_{fk} = 1$ if firm f has a PDO certification for a variety of product k and $\text{PDO}_{fk} = 0$ otherwise. Remember that, within its product line, a firm can be authorized to handle some of its products. Higher marginal costs can be caused by a higher quality because of a more thorough selection of ingredients and/or additional production tasks.

The variable φ_{fk} is the productivity of firm f producing product k . We also consider that the multi-product firm has a core competence product which it produces at lowest cost. Adding more products incurs additional costs as it pulls a firm away from its core competency (Eckel and Neary, 2010; Mayer et al., 2014). An additional product entails a decrease in productivity as follows as $\varphi_{fk} = \varphi(f) \times \text{Rank}_{fk}^{-\gamma}$ with $\gamma > 0$ and where φ_f is the productivity in producing the core product and Rank_{fk} is the rank of product k within the product line of firm f . It follows that the marginal production cost increases with the number of varieties supplied by the manufacturer. Note that we fall back on the “standard” firm-based theory when $\beta = 0$, $\alpha = 0$ and $\gamma = 0$.

The profit of the firm producing variety v located in country i is given by:

$$\pi_i(f) = \sum_j \sum_k \pi_{ijk}(\varphi, \theta) \quad \text{with } \pi_{ijk}(f) = p_{ijk}(f)q_{ijk}(f) - c_{ijk}(f)q_{ijk}(f) - \phi_{ijk}(f) \quad (5)$$

where $\phi_{ijk}(f)$ is a fixed cost associated with exporting product k from country i to country j incurred by firm f . The profit-maximizing prices are

$$p_{ijk}(f) = \frac{\varepsilon}{\varepsilon - 1} \frac{\omega_i(f)[\theta_{ik}]^\alpha e^{\beta \text{PDO}_{fk}} \tau_{ijk}}{\varphi(f) \text{Rank}_{fk}^{-\gamma}} \quad (6)$$

Hence, firms charge a markup ($\varepsilon/(\varepsilon - 1)$) over its marginal cost (c_{ijk}).

3.2 Trade margins

Remember that there are two sets of varieties for a given product: the set of PDO varieties (denoted by Ω_{PDO}) and the set of non-PDO varieties (denoted by Ω_N). In addition, there are two sets of firms: the set of firms authorized to handle some PDO varieties ($I_{Auth} = 1$) and the others ($I_{Auth} = 0$). Hence, authorized firms can also supply non-PDO product while non-authorized companies produce exclusively non-PDO products.

The direct effect of PDO on trade margins is estimated by using (2), (3), and (6). Then, the logarithm of quantity exported of product k for firm f located in France to country j is given by

$$\log q_{fjk} = \mu_0 + \mu_1 \text{PDO}_{fk} + \mu_2 \log \text{Rank}_{fk} + FE_f + FE_{jk} + \epsilon_{fjk} \quad (7)$$

with

$$\mu_1 \equiv (\varepsilon - 1)\zeta_j - \varepsilon\beta \quad \text{and} \quad \mu_2 \equiv -\varepsilon\gamma. \quad (8)$$

Our interest variable is PDO_{fk} , a dummy variable equals to 1 if the firm f benefits from PDO labelling for a product k (defined at the NC8 level) and zero otherwise. The destination-by-product fixed effects FE_{jk} capture the role of all types of market size, price index, taste for NC8 products, trade barriers, ... We add a separate firm fixed effect (FE_f) which capture all firm-specific determinants, such as productivity, size, prices of inputs used by firms, ... Our coefficient of interest is μ_1 . Two opposite effects are at work. On the one hand, PDO labelling increases the product quality perceived by the consumers and, in turn, the demand for the PDO variety (demand effect). On the other hand, PDO labelling implies higher marginal costs and prices leading to a lower demand for the PDO variety (cost effect). We expect that the former effect dominates the latter effect. Note that the PDO effect is identified in the firm dimension. Hence, the estimates have a natural interpretation with a set of fixed effects corresponding to a between-panel estimator. The between estimates identify, for a given destination-product, the effect at the firm level of supplying a PDO product in terms of intensive margins. The standard errors are clustered at the destination-8-digit-product level.

We also test the effect of PDO on the probability of exporting product k and serving a foreign country $Pr[q_{fjk} > 0]$ is our dependent variable: (i) extensive export margin X_{fjk} which equals to 1 for observations with positive export flows for the firm f , the product k and the country of destination j , and to zero otherwise and (ii) log of quantity exported (Q_{fjk}).

3.3 Quality and price

The objective of this subsection is to disentangle the two opposite effects at works. To quantify the effect of PDO on product quality perceived by foreign consumers, we need to compute an index of quality at the firm/destination/product level.

To estimate product quality from the demand side, we use the methodology developed in Khandelwal et al. (2013). The quality for each firm-product-destination observation can be estimated as the residual from the following OLS regression:

$$\log q_{fjk} + \sigma \log p_{fjk} = \mathbf{FE}_{kj} + \eta_{fjk} \quad (9)$$

where the destination fixed effects include the destination country's income and price index, while the product fixed effects capture the fact that prices and quantities are not necessarily comparable across product categories. As in Khandelwal et al. (2013), we assume $\varepsilon = 4$. Hence, estimated quality perceived by foreign consumers is $\ln \hat{\lambda}_{fjk} = \hat{\eta}_{fjk}/(\sigma - 1)$.

Using (3), we have

$$\ln \hat{\lambda}_{fjk} = \text{constant} + \zeta_j \text{PDO}_{fk} + FE_{jk} + \nu_{fjk} \quad (10)$$

where FE_{jk} includes $\eta_j \log(\theta_k)$ (see (3))

Prices are proxied by the unit value (uv_{fjk}).

$$\ln(p_{fjk}) = \text{constant} + \beta \text{PDO}_{fk} + \gamma \log \text{Rank}_{fk} + FE_f + FE_{jk} + \nu_{fjk} \quad (11)$$

3.4 Export decision

Inserting 6 in 5 yields

$$\pi_{fjk} = \Pi_{fjk} - \phi_{fjk} \quad (12)$$

with $\Pi_{fjk} \equiv \frac{p_{fjk} q_{fjk}}{\varepsilon}$ (operating profit) and

$$\log \Pi_{fjk} = \frac{\varepsilon - 1}{\varepsilon} (\zeta_j - \beta) \text{PDO}_{kf} - \frac{\varepsilon - 1}{\varepsilon} \gamma \log \text{Rank}_{kf} + FE_{kj} + FE_f + \nu_{fjk} \quad (13)$$

where we have considered 3 and 2. A firm exports product k to country j if and only if $\log \Pi_{fjk} > \log \phi_{fjk}$.

3.5 Spillover effects.

We also aim at investigating the indirect impacts of PDO labelling on trade of non-PDO varieties. We test whether there is an effect of “family brand” that affects the perceived quality of all a firm’s products (the firm-specific component of quality). In this case, we have

$$\lambda_{fjk' \notin P}(v) = [\theta_{ik}^{\eta_j} e^{\zeta_j^{spill} \times PDO_{fk'}}]. \quad (14)$$

We consider the following estimation

$$y_{f,j,k' \notin P} = \mu_0 + \mu_1 X_{f,j,k' \in P} + \mu_2 Auth_f \times X_{f,j,k' \notin P} + \mu_3 \ln(Rank_{fk}) + FE_f + FE_{jk} + \varepsilon_{fjk} \quad (15)$$

in which we restrict our sample to non-PDO products and we include a new variable of interest $X_{f,j,k' \in P}$ indicates whether the firm exports some PDO products to country j . We also control for whether the firm exports other non-PDO products to country ($X_{f,j,k' \notin P} \times Auth_f$) where $Auth_f$ indicates whether firm f supplies at least one PDO product.

Note that

$$\begin{aligned} \mu_1 &= \mathbb{E}(y_{f,j,k' \notin P} \mid X_{f,j,k' \in P} = 1, Auth_f = 1 \times X_{f,j,k' \notin P} = 1) \\ &\quad - \mathbb{E}(y_{f,j,k' \notin P} \mid X_{f,j,k' \in P} = 0, Auth_f = 1 \times X_{f,j,k' \notin P} = 1) \\ &= \mathbb{E}(y_{f,j,k' \notin P} \mid X_{f,j,k' \in P} = 1, Auth_f = 1 \times X_{f,j,k' \notin P} = 0) \\ &\quad - \mathbb{E}(y_{f,j,k' \notin P} \mid X_{f,j,k' \in P} = 0, Auth_f \times X_{f,j,k' \notin P} = 0) \end{aligned} \quad (16)$$

Hence, for a given destination, we compare trade margins of non PDO products of firms with at least one PDO product which is exported to that destination to the other firms.

Equation 8 on the probability of trade is estimated using a linear probability model and with a PPML model as robustness check (presented in Appendix A). Equation 8 on trade quantities and unit values are estimated with OLS.

4 Results

4.1 Results: impacts of PDO labelling on export performance

Table 2 reports our estimates of equation 8. The dependent variable is the decision to export (i.e. a dummy indicating whether the firm exports a given product to a given destination). Product-country fixed effects are included. The dummy PDO_{fjk} exhibits a positive coefficient in columns (1). This result means that for a given product and destination, benefiting from a PDO labelling entails a higher probability to be exported. The variable $\ln \text{Rank}_{fk}$ controls for the rank of the product k in the exports of the firm f and has a negative coefficient, as expected. The export performance of a firm is lower for its products that do not corresponds to its core business.

In column (2), we distinguish the impact of labelling according to the destination, assuming that the impact of PDO may be different within the European Union, as this label is defined at the community level and benefits from a legal protection in this area. Only the interacted variable $PDO_{fk} \times UE_j$ has a positive and significant coefficient, meaning that PDO labels increase the probability of products to be exported only towards European markets. Column (3) explores the heterogeneity of non-European countries by differentiating countries recognizing PDO labels from the others. The PDO dummy is interacted with an dummy GI_j equal to one whether the destination country j recognizes European PDO label or has similar system of geographical indications. The coefficient of the interacted variable is positive and significative while the coefficient relating to other non-European countries remains non significant. PDO labelling favors the entry on countries with a similar policy of denomination of origin of food products as the European Union. Column (4) investigates the impact of labelling on the probability of trade according to the rank of the exported product. This latest specification shows that the positive impact of PDO labels of export probability only occurs when the exported products has a rank under 4 in the firms, that is to say when the product is among the main products exported by the firm. In addition, we observe that for products with a small rank, PDO labelling entails an higher probability of trade whatever the destination, even if the impact is less important on non-European countries.

The table 3 follows the same specification than table 2 but with the logarithm of the quantity exported as explained variable (the intensive margin of trade). The PDO dummy has a positive and significative coefficient only when interacted with the dummies UE_j and Rank_{fk}^{1-3} , meaning that PDO labelling increases the quantities of French firms exports as compared to non labelled products, but only toward European countries and when the product is among the main exports

of the firm.

Our result suggests that PDO products entail better export performance in the cheese and cream sector but that this effect is limited to the cases where the product is the core business of the firm. In that case, PDO labelling may favor the entry on new markets, at a higher level on European markets and on countries with similar system of labelling. PDO products also benefits from higher quality exported, but only on European markets. These results are consistent with what we observe in the descriptive statistics of section 1. It can be explained by the fact that PDO labels are only recognized and legally protected on the European market.

Table 2: Effect of PDO on trade patterns - extensive margin

Dependent variable	X_{fkj}			
	(1)	(2)	(3)	(4)
PDO_{fk}	0.014*** (0.004)			
$\ln Rank_{fk}$	-0.032*** (0.003)	-0.032*** (0.003)	-0.032*** (0.003)	
$PDO_{fk} \times UE_j$		0.087*** (0.013)	0.087*** (0.013)	
$PDO_{fk} \times non-UE_j$		-0.002 (0.004)	-0.005 (0.003)	
$PDO_{fk} \times GI_j$			0.104*** (0.033)	
$PDO_{fk} \times UE_j \times Rank_{fk}^{1-3}$				0.146*** (0.016)
$PDO_{fk} \times UE_j \times Rank_{fk}^{4-15}$				0.023 (0.018)
$PDO_{fk} \times non-UE_j \times Rank_{fk}^{1-3}$				0.026*** (0.005)
$PDO_{fk} \times non-UE_j \times Rank_{fk}^{4-15}$				-0.017*** (0.004)
$PDO_{fk} \times GI_j \times Rank_{fk}^{1-3}$				0.157*** (0.042)
$PDO_{fk} \times GI_j \times Rank_{fk}^{4-15}$				0.053 (0.057)
Fixed effects	f, kj	f, kj	f, kj	f, kj
N	59,079	59,079	59,079	59,079
r2	0.28	0.28	0.28	0.28

Notes: Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4 displays estimations on unit values. The dummy PDO_{fjk} attracts a significant and positive coefficient in column (1) but this result does not remain when we disentangle the effect of PDO by destination and according to the rank of the PDO product in column (4). PDO products

Table 3: Effect of PDO on trade patterns- intensive margin

Dependent variable	$\ln Q_{fkj}$			
	(1)	(2)	(3)	(4)
PDO_{fk}	0.141 (0.246)			
$Rank_{fk}$	-1.386*** (0.12)	-1.387*** (0.12)	-1.391*** (0.121)	
$PDO_{fk} \times UE_j$		0.227 (0.3)	0.23 (0.299)	
$PDO_{fk} \times non-UE_j$		-0.008 (0.365)	-0.189 (0.376)	
$PDO_{fk} \times GI_j$			0.73 (1.016)	
$PDO_{fk} \times UE_j \times Rank_{fk}^{1-3}$				0.997*** (0.355)
$PDO_{fk} \times UE_j \times Rank_{fk}^{4-15}$				-1.162* (0.693)
$PDO_{fk} \times non-UE_j \times Rank_{fk}^{1-3}$				0.374 (0.491)
$PDO_{fk} \times non-UE_j \times Rank_{fk}^{4-15}$				-0.24 (0.598)
$PDO_{fk} \times GI_j \times Rank_{fk}^{1-3}$				1.123 (1.276)
$PDO_{fk} \times GI_j \times Rank_{fk}^{4-15}$				-0.239 (1.053)
Fixed effects	f, kj	f, kj	f, kj	f, kj
N	2361	2361	2361	2361
r2	0.67	0.67	0.67	0.62

Notes: Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

do not seem to benefit from high a price premium, as compared to non-PDO products, on a given market. This result is in line with Deselnicu et al. (2013) who show that price premiums induced by PDO depend on the characteristics of the sectors. They argue that the premium is smaller in sectors with recognized brand names and high quality difference, as it is the case in the cheese industry where big cooperative and companies represent a high share of the production.

Table 5 show the results of the estimation of the equation 8 on the perceived quality, estimated following the Khandelwal’s methodology presented in section 3.3. The variable PDO_{fk} exhibits a positive coefficient in column (1), suggesting that PDO products are, in average, considered as a product of higher quality by consumers, as compared to non PDO products. This results holds both on European and non European markets as shown in column (2), but not on countries with geographical indications in column (3). Finally, estimated coefficients in column (4) shows that only PDO labelled products of the first ranks (under 4) are considered as quality by consumers.

4.2 Results: spill-over effect of PDO on the other products of the firm

Table 6 displays the estimation of the spill-over effects of PDO. We estimate the equation eq: spillover and restrict the sample to non-PDO flows. The first variable of interest is now the dummy $X_{f,j,k' \in P}$ which equals one when the firm f exports PDO products to the destination j and zero otherwise. The second variable of interest is the interaction $X_{f,j,k' \notin P} \times Auth_f$ which indicate whether the firm f is authorized to handle PDO products and exports non PDO products to the destination j . As PDO products exported are excluded from the sample, products exported by non-authorized firms are the new benchmark. Columns (1) and (2) estimate the effect of authorization on the extensive margin, whereas in columns (3) and (4) we analysis the intensive margin of trade. In columns (5) and (6) we estimate the spillover effects on the unit values and in columns (7) and (8) on the perceived quality.

The two variables of interest attract positive and significant coefficient in columns (1), meaning that being authorized increase the probability on exports of non-PDO products, as compared to non authorized firms, whatever the product exported. The coefficient relative to the interaction of dummies $X_{f,j,k' \notin P} \times Auth_f$ is higher than the coefficient relative to the dummy $X_{f,j,k' \in P}$. This suggests that the spillover effect entailed by the presence of the authorized firm f in the country j is higher if the firm exports non labelled products than labelled products. This results remains whatever the destination country j , as shown in column (2).

The results in columns (3) to (8) show that exporting products in a given countries do not

Table 4: Effect of PDO on trade patterns- trade unit values

Dependent variable	ln uv _{fkj}			
	(1)	(2)	(3)	(4)
PDO _{fk}	0.115** (0.052)			
ln Rank _{fk}	-0.012 (0.022)	-0.012 (0.022)	-0.011 (0.022)	
PDO _{fk} × UE _j		0.104* (0.059)	0.104* (0.059)	
PDO _{fk} × non-UE _j		0.133* (0.070)	0.164** (0.080)	
PDO _{fk} × GI _j			0.007 (0.092)	
PDO _{fk} × UE _j × Rank _{fk} ¹⁻³				0.113 (0.070)
PDO _{fk} × UE _j × Rank _{fk} ⁴⁻¹⁵				0.091 (0.096)
PDO _{fk} × non-UE _j × Rank _{fk} ¹⁻³				0.205* (0.120)
PDO _{fk} × non-UE _j × Rank _{fk} ⁴⁻¹⁵				0.072 (0.078)
PDO _{fk} × GI _j × Rank _{fk} ¹⁻³				-0.019 (0.111)
PDO _{fk} × GI _j × Rank _{fk} ⁴⁻¹⁵				0.104 (0.095)
Fixed effects	f, kj	f, kj	f, kj	f, kj
N	2,361	2,361	2,361	2,361
r2	0.71	0.71	0.71	0.71

Notes: Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 5: Effect of PDO on trade patterns- quality

Dependent variable	ln Qual _{fkj}			
	(1)	(2)	(3)	(4)
PDO _{fk}	0.198*** (0.077)			
PDO _{fk} × UE _j		0.206** (0.095)	0.206** (0.095)	
PDO _{fk} × non-UE _j		0.185* (0.095)	0.189** (0.094)	
PDO _{fk} × GI _j			0.167 (0.267)	
PDO _{fk} × UE _j × Rank _{fk} ¹⁻³				0.362*** (0.106)
PDO _{fk} × UE _j × Rank _{fk} ⁴⁻¹⁵				-0.199 (0.181)
PDO _{fk} × non-UE _j × Rank _{fk} ¹⁻³				0.298*** (0.123)
PDO _{fk} × non-UE _j × Rank _{fk} ⁴⁻¹⁵				0.012 (0.161)
PDO _{fk} × GI _j × Rank _{fk} ¹⁻³				0.262 (0.334)
PDO _{fk} × GI _j × Rank _{fk} ⁴⁻¹⁵				0.045 (0.307)
Fixed effects	f, kj	f, kj	f, kj	f, kj
N	2,361	2,361	2,361	2,361
r2	0.26	0.26	0.26	0.27

Notes: Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

entail any spillover effects on the volume exported, the export price or the quality perceived by the consumers for the products of authorized firms.

5 Conclusion

Our estimations show that PDO products benefit from better export performance, but that this premium effect depends on the degree of competition in the exports of the products. For cheese and cream products with a large and atomized number of producers, the impact of labelling on export is more significant than for products with monopolistic competition. Deepening our analysis we show that this result mainly holds on EU markets. Comparing authorized firms to non-authorized ones, we also show that authorized firms have better performance than non-authorized ones for their non-labelled products, but only on EU markets.

The results confirm the export competitiveness role of PDO labelling in the French cheese industry. Benefiting from labels allows firms to reach new markets and to export more quantities (in particular inside the EU). Further investigations are needed, especially regarding the unit value analysis. The evaluation at the extensive margin has also to be extended to non-exporting firms (our current estimation is restricted to firms who export at least once). The differences of impact we observed in European and non-European countries have to be developed, as the differences within the European countries. Indeed, some European countries have numerous PDO labels (as Italy) and consumers may be more aware of labels than in some other countries inside Europe. In the same idea, some countries outside the EU also develop their own PDO-type approaches, as Japan for instance. Such countries should also be distinguished from the other.

Table 6: Spill over effect of PDO : estimation on non-PDO products

	Extensive margin X_{fjk}		Intensive margin $\ln Q_{fjk}$		Unit value uv_{fjk}		Perceived quality $qual_{fjk}$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$X_{f,j,k \in P}$	0.009*** (0.003)		0.286 (0.335)		0.037 (0.078)		0.047 (0.121)	
$X_{f,j,k \notin P} \times Auth_f$	0.965*** (0.003)		0.158 (0.231)		0.043 (0.054)		-0.063 (0.086)	
$\ln Rank_{fk}$	-0.011*** (0.001)	-0.011*** (0.001)	-1.413*** (0.088)	-1.411*** (0.088)	0.026* (0.015)	-1.411*** (0.088)		
$X_{f,j,k \in P} \times UE_j$		0.010** (0.004)		0.529 (0.381)		0.529 (0.381)		0.033 (0.131)
$X_{f,j,k \in P} \times \text{non-UE}_j$		0.009** (0.004)		0.066 (0.355)		0.066 (0.355)		0.062 (0.137)
$X_{f,j,k \notin P} \times Auth_f \times UE_j$		0.949*** (0.004)		-0.116 (0.277)		-0.116 (0.277)		-0.148* (0.090)
$X_{f,j,k \notin P} \times Auth_f \times \text{non-UE}_j$		0.977*** (0.003)		0.519 (0.351)		0.519 (0.351)		0.052 (0.137)
Fixed effects	kj	kj	kj	kj	kj	kj	kj	kj
N	115338	115338	4377	4377	4377	4377	4377	4377
r2	0.85	0.85	0.73	0.73	0.73	0.73	0.25	0.25

Notes: Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

References

- Baldwin, R. and Harrigan, J. (2011). Zeros, Quality, and Space: Trade Theory and Trade Evidence. *American Economic Journal: Microeconomics*, 3(2):60–88.
- Bastos, P. and Silva, J. (2010). The quality of a firm’s exports: Where you export to matters. *Journal of International Economics*, 82(2):99–111.
- Bontemps, C., Bouamra-Mechemache, Z., and Simioni, M. (2013). Quality labels and firm survival: some first empirical evidence. *European Review of Agricultural Economics*, 40(3):413–439.
- Bouamra-Mechemache, Z. and Chaaban, J. (2010a). Determinants of Adoption of Protected Designation of Origin Label: Evidence from the French Brie Cheese Industry. *Journal of Agricultural Economics*, 61(2):225–239.
- Bouamra-Mechemache, Z. and Chaaban, J. (2010b). Protected Designation of Origin Revisited. *Journal of Agricultural & Food Industrial Organization*, 8(1):1–29.
- Crozet, M., Head, K., and Mayer, T. (2012). Quality Sorting and Trade: Firm-level Evidence for French Wine. *Review of Economic Studies*, 79(2):609–644.
- Curzi, D. and Olper, A. (2012). Export behavior of Italian food firms: Does product quality matter? *Food Policy*, 37(5):493–503.
- Deselnicu, O. C., Costanigro, M., Souza-Monteiro, D. M., and McFadden, D. T. (2013). A Meta-Analysis of Geographical Indication Food Valuation Studies: What Drives the Premium for Origin-Based Labels? *Journal of Agricultural and Resource Economics*, 38(2).
- Hassan, D., Monier-Dilhan, S., and Orozco, V. (2011). Measuring Consumers’ Attachment to Geographical Indications. *Journal of Agricultural & Food Industrial Organization*, 9(1):1–30.
- Hummels, D. and Klenow, P. J. (2005). The Variety and Quality of a Nation’s Exports. *American Economic Review*, 95(3):704–723.
- Johnson, R. C. (2012). Trade and prices with heterogeneous firms. *Journal of International Economics*, 86(1):43–56.
- Manova, K. and Zhang, Z. (2012). Export Prices Across Firms and Destinations. *The Quarterly Journal of Economics*, 127(1):379–436.
- Martin, J. (2012). Markups, quality, and transport costs. *European Economic Review*, 56(4):777–791.
- Menapace, L., Colson, G., Grebitus, C., and Facendola, M. (2011). Consumers’ preferences for geographical origin labels: evidence from the Canadian olive oil market. *European Review of Agricultural Economics*, 38(2):193–212.

Schott, P. K. (2004). Across-Product Versus Within-Product Specialization in International Trade. *The Quarterly Journal of Economics*, 119(2):647–678.

Schott, P. K. (2008). The relative sophistication of Chinese exports. *Economic Policy*, 23:5–49.

Appendix

A Robustness