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► **To cite this version:**

Charlotte Emlinger, Karine Latouche. When quality management helps agri-food firms to export. 17èmes Journées de Recherches en Sciences Sociale, SFER; INRAE; CIRAD, Dec 2023, Palaiseau, France. hal-04330744

**HAL Id: hal-04330744**

**<https://hal.inrae.fr/hal-04330744v1>**

Submitted on 8 Dec 2023

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## When quality management helps agri-food firms to export

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**Abstract:** This article deals with the effects of firms' quality policies on export performance. We rely on the presence of quality management personnel to assess the level of commitment of firms on issues related to reliability and safety of products, using French administrative employee-firm-level data. We merge these data with French customs data providing the value and quantity of exports, for each firm, by product and destination. We show that firms with quality management employees have a better markets penetration and export higher volumes, especially on markets with high standards requirement (higher number of sanitary and phytosanitary or technical measures). Overall, our paper highlights the role of "quality investment" of agri-food firms in export performance, underlining that product quality is not limited to product differentiation perceived by final consumers. Product traceability and reliability is an essential factor in firms' competitiveness, especially in the perspective of the global value chains.

**Keywords:** Non-tariff-Measures, quality management, export competitiveness.

**Classification JEL:** F14

### 1. Introduction

From the Bovine Spongiform Encephalopathy outbreak in the 90's to the milk powder scandal in China in 2008, food safety incidents have led to an increasing demand for traceability and safety of food products, from both consumers and distributors. Governments have answered to this demand by strengthening public regulation on their territory (see for example the European Community Regulation 178/2002 on food traceability) or by increasing the number of Sanitary and Phytosanitary measures (SPS) and Technical barriers to trade (TBT) at the border. The private sector also implemented several certifications to facilitate the standardization of safety and traceability (HACCP, ISO standards) or to manage the buyer-supplier relationship (IFS, BRC retailers standards).

Therefore, the ability to make safe products, to ensure traceability and to have it recognized through certification appears to be an essential element of the international competitiveness of agri-food companies. Even if these characteristics are not systematically observed by final

consumers, they may help to access to markets with high levels of sanitary requirements or enable to benefit from international retailer networks.

In this paper, we investigate the effects of firms' commitment to traceability and food safety on export performance. We rely on the presence of quality management and control personnel in agrifood firms to proxy their level of commitment to product reliability and safety issues. Using French administrative employee-firm-level data merged with French customs data, we measure the effect of firms' quality management system on the intensive and extensive margins of trade. Focusing on a single country's exports allows us to control for consumers' preferences for the different exporting countries. We compare exports of firms with quality management personnel with exports of firms without this category of employees to a given destination, product (defined within 6 digit code of the Harmonized System) and year. Using firm fixed effect, we also perform a within-firm estimation, which allows us to see the effect of quality personnel hiring in a given firm on trade. We furthermore explore whether these effects vary according to destination countries, depending on the level of Non Tariff Measures (NTMs) applied at their border.

Quality management and control personnel are in charge of the firm's products quality. They ensure that goods are safe, reliable and durable, that they meet customers' expectation and that they follow regulatory requirements. According to the size and the organization of the firm, the activities of the employees in charge of quality management may be manifold. They define the quality criteria to fulfill safety and regulatory requirements and design the quality protocols. They ensure that these protocols are followed by conducting inspections and testing at the different stages of the production, processing and distribution. They also have the responsibilities to create quality documentation along the chain of production, allowing to track and trace products through traceability systems. Finally, they report feedback from customers and analyse safety issues by improving processes.

Quality managers are therefore major players in the firm's quality policy, both by preventing failure and by coping with those that do occur. They are key in the adoption of standards and in their maintenance. Working both with the firms' other employees and with external partners such as suppliers, customers, health inspectors or customs, they can lead to better export performance through four channels. First, the increase of product safety allowed by the implementation of quality systems limits consumers' exposure to potentially hazardous foods, and reduces recalls and consumers complains. Second, quality control and management may increase the effectiveness of operation and the efficiency of supply chain, through a better optimization of the processes, inducing higher productivity and a reduction of losses or products

deterioration. Third, quality specialists help to comply sanitary, phyto-sanitary or technical legal requirements in destination markets, both by applying the necessary procedures, and by being able to provide evidence of compliance with the measures. Finally, better procedures and traceability can increase firms' reputation among buyers, whether they are intermediaries, retailers or final consumers. This confidence can come from a simple perception or from different certifications (such as HACCP, IFS or ISO), whose adoption is facilitated by the presence of qualified and specialized personnel. The firms' commitment in traceability and food safety may thus lead to a differentiation of products for the buyers' point of view. Of course, firms do not need to have a dedicated staff on quality management to be able to meet standards, implement traceability systems and have certifications. We can however expect that firms hiring specialized employees have stronger policy and capability on these issues, and consequently better export performance.

The effect of firms' quality control and management on trade has not been studied in the literature to our knowledge. This paper is however linked to the literature on traceability and quality in the food supply chain. A first strand of this literature investigates the effect of traceability and quality management systems on firms competitiveness. Alfaro and Rábade (2009) use a case study in the Spanish vegetable industry and show that traceability systems do not only guarantee food safety, but also give quantitative and qualitative advantages along the different stage of the supply chain, which has also been highlighted by Epelbaum and Martinez (2014) and Aiello et al. (2015). A second strand of literature focuses on the valuation of food traceability systems by consumers, assessing their willingness to pay through choice experiment. Gao and Schroeder (2009), Gracia et al. (2013), and Liu et al. (2019), among others, highlight the heterogeneity of the willingness to pay for traceability information and quality certification among consumers. In this paper, we focus on the impact of quality management on firms' export value, trade unit values and quality, to assess the effect of firms' quality commitments on international competitiveness.

Our paper also participates to the literature on standards and their effect on trade. An abundant empirical trade literature deals with NTMs which are public regulations applied at the border and within of each countries. These works provide mixed evidence on NTMs effect on trade (see Santeramo and Lamonaca (2019) and Disdier and Fugazza (2020) for a summary). Peterson et al. (2013), Fontagné et al. (2015) and Murina and Nicita (2015) show that US and European SPS measures act as a trade barriers. This is confirmed by Grundke and Moser (2019), demonstrating that enforcement of US standards induce a counter-cyclical, hidden protectionist effect. On the other hand, Crivelli and Groeschl (2015) and de Frahan (2006) suggest that NTMs

can positively impact trade. Xiong and Beghin (2014) confirm the ambiguous effect of NTMs on trade by showing that NTMs both enhance import demand and reduce foreign exporters' supply. Few papers deal with private standards. Anders and Caswell (2009) show that HACCP requirement for seafood products in the USA acts as a trade catalyst for developed and big exporters and as a trade barrier for developing and small exporters. In this paper, we do not focus on the impact of standards on trade but show how quality management help firms to export on markets with NTMs.

Finally, our work contributes to the extensive literature on quality and trade. Among others, Verhoogen (2008), Manova and Zhang (2012) and Baldwin and Harrigan (2011) show that quality is an important component of a firm's export success. This outcome is confirmed for the agri-food sector by Crozet et al. (2012) and Curzi and Olper (2012) who demonstrate that quality increases both the probability of market entry and the amount of exported values. Quality may also change the geography of trade as underlined by Fan et al. (2018) who show that quality upgrading leads Chinese firms to reorient their exports to high income countries. The majority of empirical studies on trade uses indirect measures to proxy a product's quality. Hummels and Skiba (2004), Schott (2004), Schott (2008) and Hummels and Klenow (2005) use trade unit values, assuming that higher prices correspond to higher quality of goods. Khandelwal (2010) (developed in Amiti and Khandelwal (2013)) proposes an indirect measure of quality derived from econometric estimation and widely used in literature in recent years. Few studies use direct quality measures to assess the quality of products. A notable exception is Crozet et al. (2012) and Chen and Juvenal (2016), who use quality ranking by experts and show that quality increases firm-level price, probability of market entry and export values. Hansman et al. (2020) rely on a direct measure of fish quality in the Peruvian fishmeal industry to assess the impact of organizational structure on quality upgrading. R&D and innovation are also used as a proxy for quality of products at the firm level, as in Curzi and Olper (2012) or Kugler and Verhoogen (2012). Our approach differs as we consider another dimension of quality differentiation, which is the safety and traceability of products. This component of the goods' quality may not be directly observable by final consumers but is essential, especially to reach countries with stricter sanitary standards.

We show that quality control and management personnel help firms to export more in value and quantity, but that this effect is limited to destination-products where Non Tariff measures are implemented. This outcome suggests that firms hiring employees specialized in quality management and control are more able to meet the standards on foreign markets than other firms.

The paper is organized as follows. In a first section, we describe the firm-employee data we rely on to assess the firm's commitment in traceability and safety and the trade data we use. We provide some stylized facts on quality management and French firms exports. In section 2 we present our empirical strategy and discuss our results. Section 3 concludes.

## **2. Data and descriptive Evidence**

### **2.1 Quality control and management**

To study the impact of firms' commitment to product reliability and safety issues on trade we rely on French firm-level data on trade and employment from 2009 to 2019. We assess the quality control and management commitment of firms using information from the DADS Poste dataset. This later is the compilation of annual compulsory declarations by all private French companies (except self-employed) and provides for each firm the number of working hours, the total salary and the number of employee, by occupation.

From 2009 to 2018, 13,285,709 firms appear in the DADS Poste data, identified by a unique identifier SIREN. We restrict our sample to the 82,516 French agrifood firms (which corresponds to the code 10 in the APE classification of firm's activities). This excludes non only services and manufacturing firms from our sample, but also wholesalers and retailers who can sell agrifood products but do not produce them. We only keep firms that that have operated continuously from 2009 to 2019 and end up with a dataset of 79,359 firms for the whole period. The occupation of each worker in the company is defined in the DADS database according to a 4-digit classification. Quality control and management employees correspond to two occupations according to the DADS categories: quality control manager and engineer (387d) and quality control technician for the processing industries (475b). Figure 1 displays the number of agrifood firms from 2009 to 2019 with and without quality control and management employees. It appears that 7% of agrifood companies employ workers in positions dedicated to quality control and management, which is much higher than the 0.5% obtained if we consider all the firms present in the DADS .

### **2.2 Trade**

The information on quality control and management from the DADS poste are merged with data on French firm-level trade on the same period. These data come from the French customs and provided for each firm the quantity and value of export, by destination, product (at the 6-digits level of the Harmonised System) and year. Only 6% of our agrifood firms of the DADS

dataset export so when we reduce our sample to exporting firms, our sample has only 2,501 firms in 2015.

Figure 1: Number of firms

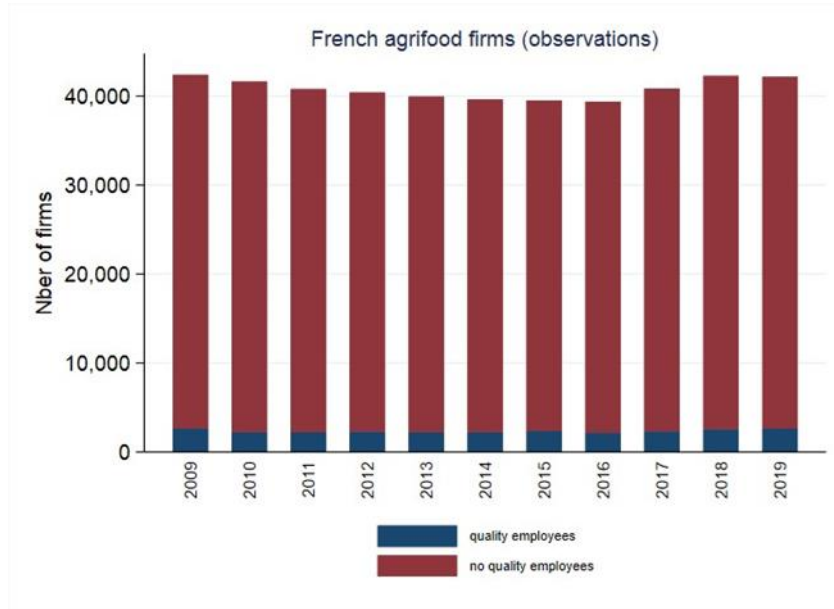


Figure 2 shows the share of exporting firms with and without quality control and management employees from 2009 to 2019. The comparison with figure 1 suggests that exporting firms tend to employ more staff dedicated to quality control and management than non exporting ones. 52% of agrifood exporting firms have quality employees in the DADS poste.

Figure 3 displays the total French export made by agrifood companies, distinguishing trade made by firms with quality management and control employees and others. It appears that firms with quality personnel export more than the firms without quality control and management since they account for more than 95% of trade, whereas they only represent half of the exporting firms as seen above.

This observation is confirmed by figure 4 which shows the kernel density of the export values and quantity by firm, destination, product and year. Firms with quality control and management personnel generate more flows with higher values or quantities than the other firms.

Figure 2: Number of exporting firms

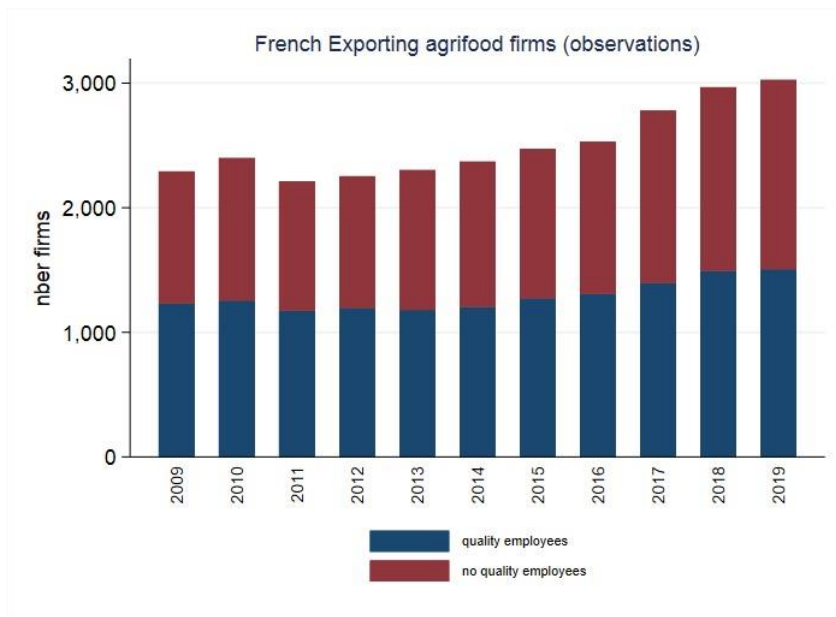
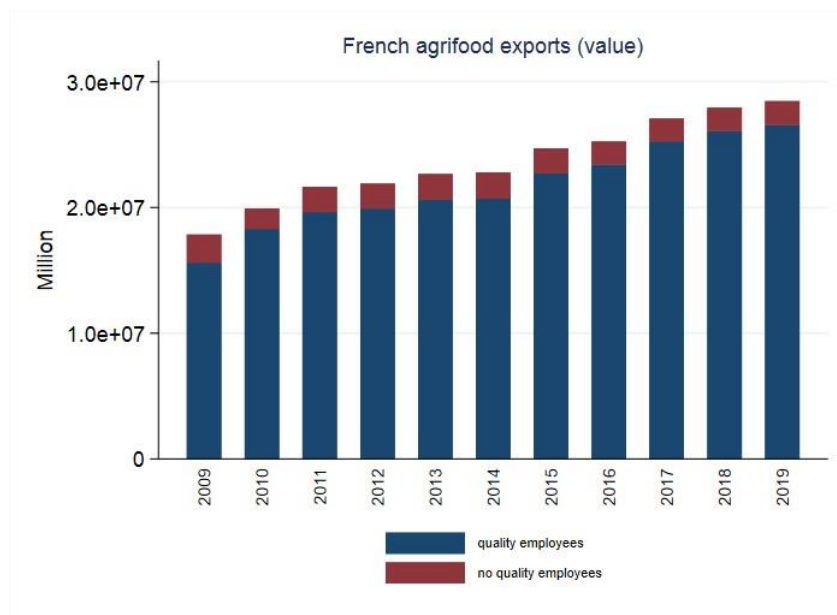


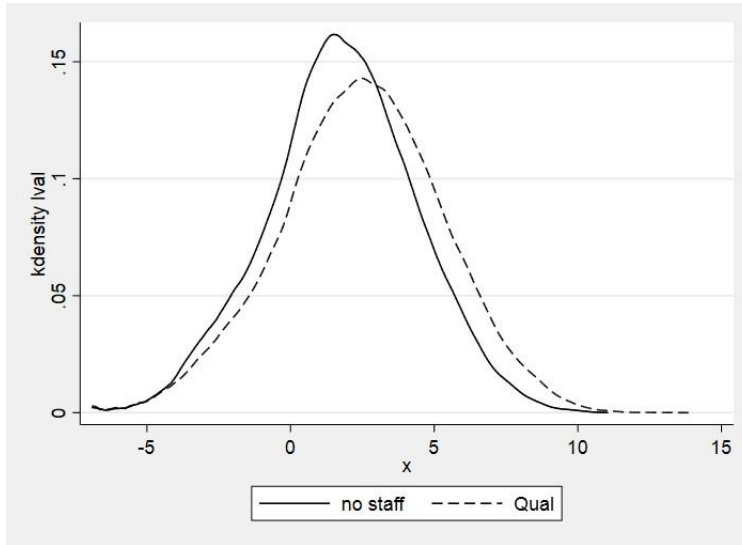
Figure 3: Number of exporting firms



Descriptive data combining data on occupations and trade in French firms suggests that firms employing quality control and management personnel export more than others. These observations can be explained by a greater efficiency of the supply chain, a better reputation and a better ability for these companies to comply with regulatory requirements. The rest of the paper will test these assumptions using an empirical model.



Figure 4: Number of exporting firms



### 3 Empirical Analysis

#### 3.1 Specification

Our empirical analysis assesses the impact of quality control and management employees on firm's export performance. We investigate both the extensive margin of trade (probability of export of the firm  $f$  of product  $k$  to destination  $j$  the year  $t$ ) and the intensive margin of trade with its different components, the exported value, the exported quantity and the unit value. We also test whether quality control and management allow firms to have a higher perceived quality as compared to other firms. We estimate the following equation:

$$\text{Expfjkt} = \alpha_1 \text{Qualityft} + \xi_{jkt} + \nu_f + \varepsilon_{fjkt} \quad (1)$$

where  $\text{Qualityft}$  is a dummy indicating whether firm  $f$  has quality management the year  $t$ ,  $\nu_f$  a set of firm's characteristics variables (such as productivity and size) and  $\xi_{jkt}$  a destination-product-time fixed effect which control for characteristics of the market of country  $j$  and good  $k$  the year  $t$ . These fixed effects allow us to compare firms with and without quality control and management personnel on a given market (product-destinationyear), controlling for firms characteristics.

In the intensive margin estimations the dependent variables  $\text{Expfjkt}$  is  $\ln \text{vfjkt}$  the logarithm of the export values of firm  $f$  to destination  $j$  for the product  $k$  at time  $t$ , or  $\ln \text{qfjkt}$  the logarithm of export quantities of  $f$  to  $j$  for  $k$  at  $t$ . In the extensive margin estimation, the dependant variable

$Exp_{fjkt}$  is  $X_{fjkt}$ , a binary variable equal to 1 if a flow exist for the firm  $f$  and the product  $k$  for the destination  $j$  at time  $t$ .

The firm's decision to invest in quality management staff may be driven by different factors : the need to differentiate products in a very competitive market, previous safety or sanitary issues, evolution of domestic regulation, changes in products portfolio... The will to expand activities worldwide or to export to a specific destination could also be one of the reason why a given firm would hire some employees dedicated to sanitary and traceability, which raises an endogeneity issue in our estimation. To deal with this potential reverse causality, we use an instrumental approach, using the share of firms in the same sector (APE) and departement with quality management personnel as first IV, and the share of exported products with NTM on the European market, considering that a firm will be more likely to hire quality management staff if she's producing (exporting) products subject of regulation on the European (therefore the French) market. As the endogeneous variable is a dummy variable, we use a two stage approach. First we predict  $Quality_{ft}$  from a linear probability model including our two instruments. This prediction is used as the instrument in the 2SLS estimation.

### **3.2 Result: effect of quality management on exports**

Table 1 lists estimations of equation 1 on the value of trade. In columns (1) to (3) we compare firms with quality management employees with firms without this kind of staff, for a given market product-destination-year. The variable  $Quality_{ft}$  exhibits a positive and significant coefficient in column (1), suggesting that firms with quality control and management personnel export more in value than other firms. This result remains when we restrict our sample to firms which do not change status between 2009 and 2019 (i.e. that have or don't have quality management for the whole period, without any change) in column (2). The coefficient is still significant and positive, in column (3) using an instrumental variable approach<sup>1</sup>. Results confirm the endogeneity of the  $Quality_{ft}$  variable. Accounting for endogeneity increases the effect of  $Quality_{ft}$  on the exported value.

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1 the value of the Kleibergen and Paap Wald F statistic of the first order estimation (test for weak identification) suggests that our instrument is not weak. The validity of our instruments is also supported by the rejection of underidentification (a Kleibergen-Paap rk LM statistic significant at 1 percent).

In columns (4) and (5), we add a firm fixed effect which allows us to control for all non observable and time invariant firm characteristics. The identification of the effect of quality management is thus within time for a given firm. The coefficient relative to  $Quality_{ft}$  is still positive and significant, meaning that a firm hiring quality management personnel (switching to  $Quality_{ft}=0$  to  $Quality_{ft}=1$ ) will increase its value of trade. As previously, 2SLS and OLS differ in terms of magnitude, which is explained by the fact that the two estimators do not estimate the effect of quality exactly on the same population.

Table 1: Effect of quality management on the intensive trade margin

	ln $v_{fjkt}$				
	(1)	(2)	(3)	(4)	(5)
	All OLS	$\Delta Quality_{ft}=0$ OLS	All IV	All OLS	All IV
Quality <sub>ft</sub>	0.183*** (0.017)	0.239*** (0.038)	0.865*** (0.062)	0.027** (0.011)	0.156*** (0.036)
productivity <sub>ft</sub>	0.408*** (0.012)	0.458*** (0.015)	0.382*** (0.013)	0.028*** (0.009)	0.029*** (0.009)
Size 2 <sub>ft</sub>	0.484*** (0.023)	0.531*** (0.036)	0.281*** (0.031)	0.030 (0.025)	0.013 (0.025)
Size 3 <sub>ft</sub>	0.710*** (0.029)	0.832*** (0.046)	0.381*** (0.043)	0.118*** (0.032)	0.100*** (0.033)
Size 4 <sub>ft</sub>	1.455*** (0.029)	1.545*** (0.044)	1.010*** (0.050)	0.184*** (0.041)	0.160*** (0.041)
N	639,419	421,836	639,419	638,791	638,791
r <sup>2</sup>	0.367	0.385	0.077	0.488	-0.000
Underidentification stat.			21608.765		19241.165
F stat for weak id			2047.976		1787.498
Weak id. p-value			0.000		0.000
Endogeneity test stat			145.445		14.526
p-value endogeneity test			0.000		0.000
destination-product-year	yes	yes	yes	yes	yes
firm	no	no	no	yes	yes

Notes: All continuous variables are in logarithm.

Robust standard errors clustered by destination-product in parentheses.

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 2 replicates the estimation of table 1 on the probability of trade. We observe the same pattern than previously, with a positive and significant coefficient in all columns, showing that quality control and management increase not only the intensive margin of trade, but also the extensive margin. Firms with quality personnel not only have higher exported trade values, they also have an higher probability to export. Firms hiring quality personnel also increase their market access.

Table 2: Effect of quality management on the extensive trade margin

	ln $v_{fjkt}$				
	(1)	(2)	(3)	(4)	(5)
	All	$\Delta Quality_{ft}=0$	All	All	All
	OLS	OLS	IV	OLS	IV
Quality <sub>ft</sub>	0.183*** (0.017)	0.239*** (0.038)	0.865*** (0.062)	0.027** (0.011)	0.156*** (0.036)
productivity <sub>ft</sub>	0.408*** (0.012)	0.458*** (0.015)	0.382*** (0.013)	0.028*** (0.009)	0.029*** (0.009)
Size 2 <sub>ft</sub>	0.484*** (0.023)	0.531*** (0.036)	0.281*** (0.031)	0.030 (0.025)	0.013 (0.025)
Size 3 <sub>ft</sub>	0.710*** (0.029)	0.832*** (0.046)	0.381*** (0.043)	0.118*** (0.032)	0.100*** (0.033)
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p-value endogeneity test			0.000		0.000
destination-product-year	yes	yes	yes	yes	yes
firm	no	no	no	yes	yes

Notes: All continuous variables are in logarithm.

Robust standard errors clustered by destination-product in parentheses.

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

In table 3, we interact the variable  $Quality_{ft}$  with the logarithm of the total salary paid by the firm to quality control and management employees. Results in columns (1) and (3) on the intensive and extensive margin of trade shows that having quality staff increases the trade value, volume and probability, but above a certain threshold of salary. Above this threshold, the higher the "investment in quality", the higher is the positive impact on trade. Coefficients of columns (2) and (4), where we restrict our sample to firms with quality management staff, confirm that the amount paid for quality management personnel increases both trade values and probability of trade.

Table 3: Effect of quality management expenditures on the trade margins

	ln $v_{fkt}$		$X_{fkt}$	
	(1)	(2)	(3)	(4)
	all firms	Quality $_{ft}$ =1	all firms	Quality $_{ft}$ =1
Quality $_{ft}$	-0.266*** (0.070)		-0.003* (0.002)	
Quality $_{ft}$ ×Salary $_{ft}$	0.027*** (0.006)	0.054*** (0.010)	0.000** (0.000)	0.001*** (0.000)
productivity $_{ft}$	0.030*** (0.010)	0.042** (0.017)	0.002*** (0.000)	0.001*** (0.000)
Size 2 $_{ft}$	0.026 (0.025)	-0.137* (0.070)	0.006*** (0.000)	0.009*** (0.001)
Size 3 $_{ft}$	0.119*** (0.033)	-0.055 (0.079)	0.012*** (0.001)	0.015*** (0.001)
Size 4 $_{ft}$	0.176*** (0.042)	0.014 (0.089)	0.015*** (0.001)	0.018*** (0.002)
N	593,758	335,380	11,127,997	5,376,025
r2	0.4829	0.4937	0.1707	0.1916
destination-product-year	yes	yes	yes	yes
firm	yes	yes	yes	yes

Notes: All continuous variables are in logarithm.

Robust standard errors clustered by firm-year in parentheses.

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

### 3.3 Result: quality management and Non Tariff Measures

In table 4, we estimate the impact of quality control and management on trade, distinguishing destination-product pairs with Non-tariff-Measures from those without, using two interacted variables  $Quality_{ft} \times NTM_{jk}$  and  $Quality_{ft} \times noNTM_{jk}$  with  $NTM_{jk}$  a dummy variable equal to one whether the destination  $j$  implement a NTM for the product  $k$ , and zero otherwise, and  $noNTM_{jk}$  a dummy variable equal to one whether the destination  $j$  does not implement a NTM for the product  $k$ , and zero otherwise. Data on the presence of NTM come from the UNCTAD database, cover 80 countries and do not have time dimension.

Our results in column (1) show that the positive impact of quality control and management employees on trade revealed in the previous section only occurs when the exporter is facing a NTM, as only  $Quality_{ft} \times NTM_{jk}$  displays a positive and significant coefficient. This outcome argues in favor of a compliance effect induced by quality control and management staff. Having personnel dedicated to these particular issue helps firms to export more in value to destination with higher requirements in terms of safety and traceability.

In columns (2) and (3), we distinguish EU destination from non EU destination as NTM applied by EU countries are the same than those who are applied at the French border, therefore, on the domestic market. We could thus expect NTM on European destinations to have a different impact than on non EU destinations. Our results confirm this intuition as the positive impact of quality management is only significant on non European markets with NTM (column 3). The "investment in quality management" does not seems to positively impact trade towards other European countries with the same sanitary requirement than in France. On the contrary, we observe a negative coefficient on the variable  $Quality_{ft}$  for products without any NTM on the European market in column (2). Columns (4) to (6) of table 4 confirm the previous results using the total amount paid to quality management staff instead of a dummy.

Table 4: Effect of quality management on the intensive trade margin with NTM

	ln $v_{fjkt}$					
	(1)	(2)	(3)	(4)	(5)	(6)
	All	$EU_{ft}=1$	$EU_{ft}=0$	All	$EU_{ft}=1$	$EU_{ft}=0$
		all firms	all firms	Quality $_{ft}=1$	Quality $_{ft}=1$	Quality $_{ft}=1$
Quality $_{ft} \times NTM_{jk}$	0.026**	0.022	0.042**			
	(0.013)	(0.015)	(0.021)			
Quality $_{ft} \times noNTM_{jk}$	-0.058	-0.141*	0.061			
	(0.056)	(0.076)	(0.076)			
productivity $_{ft}$	0.029***	0.055***	0.001	0.042**	0.090***	0.010
	(0.010)	(0.012)	(0.017)	(0.019)	(0.022)	(0.032)
Size 2 $_{ft}$	0.040	0.077**	0.024	-0.139*	-0.128	-0.034
	(0.027)	(0.034)	(0.042)	(0.076)	(0.089)	(0.139)
Size 3 $_{ft}$	0.124***	0.194***	0.016	-0.062	0.043	-0.183
	(0.035)	(0.041)	(0.059)	(0.085)	(0.097)	(0.158)
Size 4 $_{ft}$	0.214***	0.393***	-0.023	0.051	0.280**	-0.326*
	(0.044)	(0.053)	(0.073)	(0.094)	(0.110)	(0.172)
Quality $_{ft} \times Salary_{ft} \times NTM_{jk}$				0.064***	0.064***	0.026
				(0.011)	(0.012)	(0.022)
Quality $_{ft} \times Salary_{ft} \times NoNTM_{jk}$				0.006	0.029	-0.004
				(0.033)	(0.043)	(0.051)
N	541,567	358,155	183,189	300,998	206,039	94,875
r2	0.49	0.53	0.47	0.50	0.53	0.49
destination-product-year	yes	yes	yes	yes	yes	yes
firm	yes	yes	yes	yes	yes	yes

Notes: All continuous variables are in logarithm.

Robust standard errors clustered by firm-year in parentheses.

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 5 follows the same structure than table 4 but focuses on the extensive margin of trade. The pattern is slightly different than on the intensive margin. Having employees dedicated to safety and traceability issues help firms to reach destinations with NTM, and European countries in general but have a negative impact on the probability of trade on other non-EU destination. It suggests that firms with quality management staff concentrate their export to

markets with NTM as they have a comparative advantage on these markets with their higher safety and sanitary quality, except on the European countries which have the same requirements than the domestic market.

Table 5: Effect of quality management on the extensive trade margin with NTM

	$X_{fjkt}$					
	(1)	(2)	(3)	(4)	(5)	(6)
	All	$EU_{ft}=1$ all firms	$EU_{ft}=0$ all firms	All Quality $_{ft}=1$	$EU_{ft}=1$ Quality $_{ft}=1$	$EU_{ft}=0$ Quality $_{ft}=1$
Quality $_{ft} \times NTM_{jk}$	0.002*** (0.000)	0.002*** (0.001)	0.001*** (0.000)			
Quality $_{ft} \times noNTM_{jk}$	-0.007*** (0.001)	0.007** (0.003)	-0.003*** (0.001)			
productivity $_{ft}$	0.002*** (0.000)	0.004*** (0.000)	0.001*** (0.000)	0.002*** (0.000)	0.005*** (0.001)	0.000 (0.001)
Size 2 $_{ft}$	0.007*** (0.001)	0.015*** (0.001)	0.003*** (0.001)	0.012*** (0.001)	0.028*** (0.003)	0.001 (0.001)
Size 3 $_{ft}$	0.015*** (0.001)	0.028*** (0.002)	0.007*** (0.001)	0.020*** (0.002)	0.039*** (0.003)	0.007*** (0.002)
Size 4 $_{ft}$	0.019*** (0.001)	0.038*** (0.002)	0.007*** (0.001)	0.025*** (0.002)	0.050*** (0.004)	0.007*** (0.002)
Quality $_{ft} \times Salary_{ft} \times NTM_{jk}$				0.001*** (0.000)	0.000 (0.001)	0.002*** (0.000)
Quality $_{ft} \times Salary_{ft} \times NoNTM_{jk}$				-0.002** (0.001)	-0.001 (0.002)	-0.000 (0.001)
N	7,830,743	3,199,581	4,631,141	3,838,337	1,631,313	2,207,023
r2	0.18	0.21	0.16	0.20	0.22	0.18
destination-product-year	yes	yes	yes	yes	yes	yes
firm	yes	yes	yes	yes	yes	yes

Notes: All continuous variables are in logarithm.

Robust standard errors clustered by firm-year in parentheses. \*

$p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$



## 4 Conclusion

In this article, we discuss the effects of the "investment in the quality" of agri-food firms on their export performance, underlining that product quality is not limited to product differentiation perceived by final consumers. Product traceability and reliability is an essential factor in firms' competitiveness, especially in the perspective of the global value chains.

Other avenues of research may be considered to continue to work on these issues. The analysis of the effects of certain standards such as the ISO 26000 standard on Social Responsibility, which brings a new, more social and environmental dimension, could be particularly interesting to understand differentiation strategies of firms on international markets.

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### **Aknowledgement:**

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 861932 – BATModel. This article reflects only the author's view and the Research Executive Agency is not responsible for any use that may be made of the information it contains.

# BATModel

better agri-food trade modelling for policy analysis



THIS PROJECT HAS RECEIVED FUNDING FROM  
THE EUROPEAN UNION' HORIZON 2020 RESEARCH  
AND INNOVATION PROGRAMME  
UNDER GRANT AGREEMENT N. 861932

Access to some confidential data, on which is based this work, has been made possible within a secure environment offered by CASD – Centre d'accès sécurisé aux données (Ref. 10.34724/CASD)