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Trade Margins and Product Quality Adjustments to Non-Tariff Measures

Work in progress

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1. Objective

We test whether the ‘*quality*’-focused non-tariff measures, such as *technical barriers to trade* (TBT) or *sanitary and phytosanitary* (SPS) measures, are (product) **quality-improving** and **trade-distorting**.

A fast growing literature on their economic effects on trade flows.

But, the current literature

- disregards the effects on the quality of product imported
- fails to capture microeconomic effects (selection effect & reallocation of resources among heterogeneous firms)

Surprising ! two important welfare components

Our paper aims to fill this gap by using a new approach.

1.1 What are public standards ?

Measures adopted by governments establishing product requirements for fulfilment of public policy objectives, such as human health and safety, environmental protection, consumer information, or quality

Two major categories of ‘*quality*’-focused public standards

- **Sanitary or PhytoSanitary (SPS) measures** –*regulations and restrictions to protect human, animal or plant life or health*
Ex Maximum levels of pesticide residues in or on food
- **Technical Barriers to Trade (TBT)** *labelling, standards on technical specifications and quality requirements*
Ex The labelling of food, the safety of toys, the technical specifications of cars, the safety and energy efficiency of our home appliances

☞ **National public standards are non-tariff measures (NTMs) ≠ non-tariff barriers (NTBs).**

- NTB: discriminatory regulations set by governments to favor domestic over foreign suppliers (example: *quota*)
- Quality standards as SPS measures and TBTs are not *a priori* discriminatory policies. They apply to a given product *regardless of the origin country (including the domestic country)*
⇒ quality standard has to be met by the foreign firms *and* the domestic firms.

However, national standards are at the heart of many trade disputes at the WTO (concerns also bilateral trade negotiation, CETA).

→ Some countries viewed QS as a form of trade barrier [example Beef Hormone Dispute]

1.2 The fall in import tariffs and the rise of NTMs

Standards on all products across the 56 destinations of the dataset

	<i>All products</i>	<i>Products exported by France</i>
Share of products affected by:		
SPS measures	28.5%	25.8%
TBT measures	47.9%	49.3%
other NTMs	56.3%	56.1%
Average number of measures on a product:		
SPS measures	5	4.4
TBT measures	3	3
other NTMs	2.6	2.7

The data follows the Harmonized System (HS) classification at the 6-digit level covering more than 5,000 different products.

EU: 4450 (6-digit) products on which the EU imposes NTMs

Frequency Index by product (HS sections):

Higher SPS coverage for food products

Higher TBT index for processed food, textile, chemical products

	SPS	TBT
Live animals	67.9	29.7
Vegetable products	68.9	31.6
Fats and Oil	61.0	51.0
Processed food	65.0	56.9
Minerals products	5.5	27.3
Chemical products	8.8	45.6
Rubber and Plastics	4.5	49.8
Raw hide and skins	15.7	18.4
Wood	14.9	16.5
Paper	3.4	27.6
Textile	3.6	47.1
Footwear	2.2	44.4
Stone and Cement	4.3	29.3
Base Metals	4.2	35.3
Machinery Electrical Equipment	5.7	36.5
Motor Vehicles	2.4	42.5
Optical & Medicals instruments	2.2	35.6
Miscellaneous goods	4.1	31.6

1.3. The consequences of Quality Standards on trade?

☺ **Facilitate trade:** Increase demand for foreign products due to

- (i) a better quality of products
- (ii) a reduction in information asymmetry between *domestic* consumers and *foreign* producers

☹ **Eliminate trade:** (its impact is non-uniform in favor of *domestic firms* at the expense of foreign firms)

- (i) less foreign firms can export due to an additional cost of production (compliance costs)
- (ii) Effect is magnified if standards differ among countries (increases significantly the cost of doing business internationally)

1.4 Contribution

Akerlof's Lemons Principle: Information asymmetry gives rise to an underprovision of quality. As buyers only know the *average quality* of products, the high-quality (high price) products are driven out of the market by the low-quality (low-price) products.

The introduction of **minimum standard quality** favors the entry of high-quality product under information asymmetry [Leland, JPE, 1979, Shapiro, QJE, 1983)]

Firms are price-taker and homogeneous

No horizontal differentiation

A single market (country), no international trade (so, no trade friction)

→ We provide a more general approach

Trade literature: Product Quality and export performance

- A growing literature considers *vertical differentiation* in international trade model *à la Melitz (-Chaney)* to explain the quality-sorting found in international trade [Baldwin & Harrigan, AEJ, 2011; Kugler & Verhoogen, REStud 2012; Hallak & Sivadasan, J. Int Eco, 2013]

The competitiveness of firms is determined by their *quality-adjusted prices*.

The higher quality products are able to enter more distant markets.

- Gagné and Larue (Am J. of Agr Eco, 2016) consider the effects *minimum quality standards* on export decision, trade, quality of products, and welfare

No information asymmetry – We extend this literature by introducing uncertainty on product quality

NTM Literature: Empirical studies on the effect of public quality standards on exports of the individual firms.

- TBTs imposed by the foreign countries affects firms' export performance in developing countries (Chen et al., 2008)
- Smaller exporters appear to be more affected in their exporting decisions, compared to the larger ones, by SPS measures (Fontagné et al., 2015, French data) and TBTs (Reyes, 2011, from US data)

Limits:

- ✓ no micro-foundation
- ✓ no empirical evidence on the effects of SPS measures and TBT on quality of products imported

Results

Under information asymmetry and with *heterogeneous* firms, the effect of a stricter minimum quality standard on average quality is ambiguous

The winners are high-productivity firms supplying a variety with a quality just above the minimum quality.

2. Theory

A multi-country trade model with

- ✓ heterogeneous multi-product **firm** operating under **imperfect competition (monopolistic competition)**
- ✓ **vertical** and **horizontal differentiation**
- ✓ **information asymmetry** [Consumers cannot identify the quality of each product and only the average quality of product]

to provide microeconomic foundations of the impact of *minimum quality standards* on trade margins (export decision and export sales) and average quality of products delivered by firms

2.1 Consumers: preference for diversity and value quality

- Demand for a variety $q_{ij}^k(v) = f[\bar{\theta}_{ij}^k, p_{ij}^k(v), \dots]$

$p_{ij}^k(v)$ price in country j of variety v (belonging to product k) produced in country i

$\bar{\theta}_{ij}^k$ average quality *perceived* by consumers in country j on product k imported from country i

with $\bar{\theta}_{ij}^k \geq \underline{\theta}_j^k$ where $\underline{\theta}_j^k$ is the *Minimum Quality Standard* (country/product specific)

- If CES demand $q_{ij}^k(v) = (\bar{\theta}_{ij}^k)^{\beta_j^k (\varepsilon^k - 1)} E_j^k (P_j^k)^{\varepsilon^k - 1} [p_{ij}^k(v)]^{-\varepsilon^k}$

Index of (*quality-adjusted*) prices $P_j^k = \sum_{\ell} \int_{\Omega_{\ell,j}} [p_{\ell,j}^k(v) / (\bar{\theta}_{ij}^k)^{\beta_j^k}]^{1-\varepsilon^k} dv$

Expenditures for products k in country j E_j^k

Preference parameters: $\varepsilon^k > 1$ (CES) and $\beta_j^k > 0$ (degree of preference for the quality)

2.1 A continuum of firms: multi-product and heterogeneous in

- productivity (φ^k firm-product specific)
- quality of its variety (θ^k firm-product specific)

- Profit associated with each destination and each product (*segmented markets*)

$$\pi_{ij}^k(v) = [p_{ij}^k(v) - c_{ij}^k(\varphi^k, \theta^k, \tau_{ij}^k)]q_{ij}^k(v) - \phi_{ij}^k(\theta^k)$$

c_{ij}^k marginal cost of production; τ_{ij}^k ‘iceberg’ cost; ϕ_{ij}^k fixed cost of distribution

Example $c_{ij}^k = \frac{(\theta^k)^{\alpha^k}}{\varphi^k} \tau_{ij}^k$ and $\phi_{ij}^k = f_{ij}^k(\theta^k)^{\eta^k}$

- Equilibrium prices $p_{ij}^k(v) = \frac{\varepsilon^k}{\varepsilon^k - 1} c_{ij}^k(\cdot) = \frac{\varepsilon^k}{\varepsilon^k - 1} \frac{(\theta^k)^{\alpha^k}}{\varphi^k} \tau_{ij}^k$

2.3 Export decision: A firm serves country j iff

$$\pi_{ij}^k(v) \geq 0 \iff p_{ij}^k(v)q_{ij}^k(v) > \varepsilon^k f_{ij}^k(\theta^k)\eta^k$$

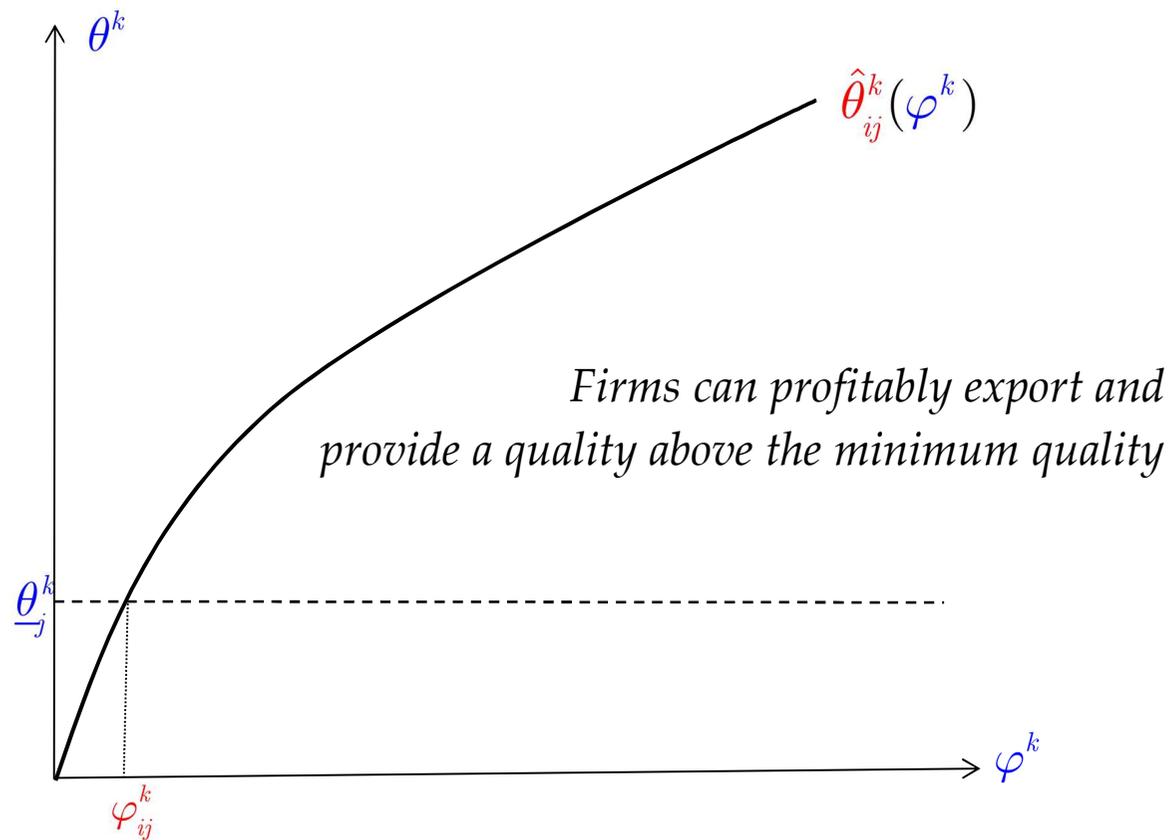
$$p_{ij}^k(v)q_{ij}^k(v) = (\bar{\theta}_{ij}^k)^{\beta_j^k(\varepsilon^k-1)} E_j^k (P_j^k)^{\varepsilon^k-1} [p_{ij}^k(v)]^{1-\varepsilon^k} \quad \text{with} \quad p_{ij}^k(v) = \frac{\varepsilon^k}{\varepsilon^k-1} \frac{(\theta^k)^{\alpha^k}}{\varphi^k} \tau_{ij}^k$$

- Export sales increases with firm's *productivity* and decreases with firm's *product quality* (cost effect)
- There exists a cutoff quality $\hat{\theta}_j^k$ above which a firm cannot export its variety (given by $\pi_{ij}^k(\hat{\theta}_j^k) = 0$)

$$\hat{\theta}_j^k = \underline{\theta}_j^k \left(\frac{\varphi^k}{\varphi_{ij}^k} \right)^{\rho^k} \quad \rho^k \equiv \frac{\varepsilon^k - 1}{\eta^k + \alpha^k(\varepsilon^k - 1)}$$

φ_{ij}^k cutoff productivity below which a firm cannot export (regardless of its product quality)

The cutoff-quality curve



Thus, under information asymmetry a firm exports to country j its variety iff

$$\underline{\theta}_j^k < \theta^k < \hat{\theta}_j^k \quad \text{and} \quad \varphi^k > \varphi_{ij}^k$$

2.4 Implications of a higher MQS

- Exit of low-quality firms
- BUT the productivity-cutoff φ_{ij}^k increases (*making competition tougher, so that Price index declines*) and the quality-cutoff $\hat{\theta}_j^k$ decreases
 - ⇒ Exit of high-quality firms
 - ⇒ Ambiguous effect on average quality of products imported
- Reallocation of demand from high-quality low-productivity firms towards ‘low’-quality high-productivity firms

$$p_{ij}^k(v)q_{ij}^k(v) = (\underline{\theta}_j^k)^{\eta^k} \left[\frac{\varepsilon^k}{\varepsilon^k - 1} \frac{(\theta^k)^{\alpha^k}}{\varphi^k} \tau_{ij}^k \right]^{1-\varepsilon^k} (\hat{p}_{ij}^k)^{\varepsilon^k - 1}$$

$$\frac{\partial p_{ij}^k q_{ij}^k}{\partial \underline{\theta}_j^k \partial \varphi^k} > 0 > \frac{\partial p_{ij}^k q_{ij}^k}{\partial \underline{\theta}_j^k \partial \theta^k}$$

To sum up: An MQS leads to:

- the exit of low-quality firms and high-quality low-productivity firms
- an increase in the sales of incumbents and even more so for high-productivity low-quality firms
- an ambiguous effect on average quality since both low- and high-quality firms exit the market

3. Data

3.1 SPS measures and TBTs

Source: TRAINS database – all the measures in force by country, product, instrument (data collection between 2012 and 2016)

- ✓ Focus on SPS measures and TBT
- ✓ Other types of measures introduced as control variables
- ✓ Information detailed at the HS6 level (~5000 products)
- ✓ 56 countries (including EU-27 aggregated)

→ We count the Nb of SPS and TBT measures enforced by country j on product k

Limits:

no time variation

no information on the restrictiveness of SPS and TBT measures (we assume that restrictiveness is positively correlated with the # of measures)

3.2 French firms

- French customs data: Exports flows (**value** and **volume**, -> **unit value proxy for price**) for each *firm/HS6 product/destination country* triplet [Year: 2012]
- Balance sheet dataset BRN (Bénéfices Réels Normaux)
Information for each firm: value added, industry, and balance-sheet variables (-> **TFP [OP methodology]**, **labor productivity** (φ_f^k))
- How to estimate ‘**quality cost**’ $(\theta_f^k)^{\alpha^k}$? challenging exercise

From price equation $p_{ij}^k(v) = \frac{\varepsilon^k}{\varepsilon^k - 1} \tau_{ij}^k \frac{(\theta_f^k)^{\alpha^k}}{\varphi_f^k}$, we can infer $(\theta_f^k)^{\alpha^k}$

$$1 - \log p_{France,j,f}^k = F_j^k + F_f^k + \mu_{F,j,f}^k \quad (p_{France,j,f}^k \sim \text{unit value})$$

$$2 - \hat{F}_f^k = \log \varphi_f^k + \zeta_f^k \quad \text{with } \zeta_f^k \equiv \log(\theta_f^k)^{\alpha^k} \quad (\text{‘quality cost’ as a residue})$$

4.1 Results (extensive margin)

Prob(**Export Sales** $_{f,j}^k > 0$) [linear probability model]

	(5)	(6)	(7)	(8)
# of SPS/TBT	+	---	+++	---
# of SPS/TBT x ln productivity		+++		+++
# of SPS/TBT x ln 'quality cost'			+++	+++
# of SPS/TBT x (ln 'quality cost') ²			---	---
Control variables
Fixed effects				
Firm/Destination & Product	no	no	no	no
Firm/Product & Destination	yes	yes	yes	yes
R ²	0.50	0.50	0.50	0.50

of observations : 22,806,297; +++, ++, + significant at the 1%, 5% and 10% level respectively;

errors are clustered at the HS6 product-destination level

Control variables : other non-tariff & tariff barriers, proxy for expenditures on product k in country j , if firm f was already exporting product k to destination j in the previous years

4.2 Results (intensive margin)

Dependent variable: log of vol. of Export_{f,j}^k

	(5)	(6)	(7)	(8)
# of SPS/TBT	---	---	---	---
# of SPS/TBT x ln productivity		+++		+++
# of SPS/TBT x ln 'quality cost'			--	--
Control variables
Fixed effects				
Firm/Destination & Product				
Firm/Product & Destination	yes	yes	yes	yes

of observations : 1,180,811; +++, ++, + significant at the 1%, 5% and 10% level respectively ;
errors are clustered at the HS6 product-destination level

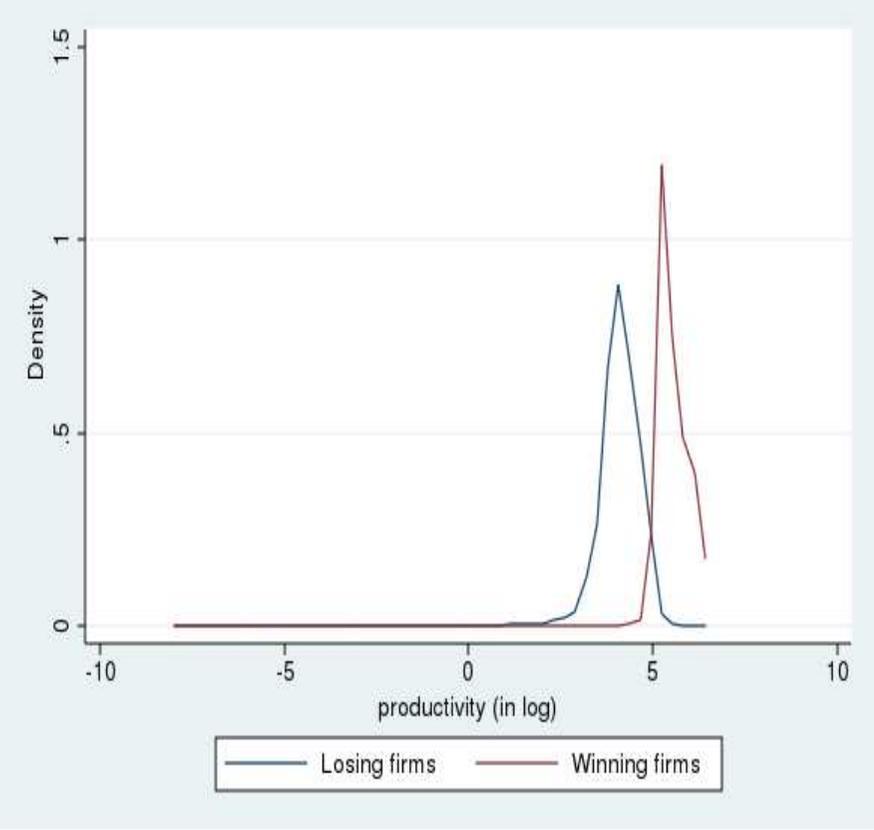
Control variables : other non-tariff & tariff barriers, proxy for expenditures on product k in country j ,
if firm f was already exporting product k to destination j in the previous years

4.3 The magnitude of the effects on the intensive margin

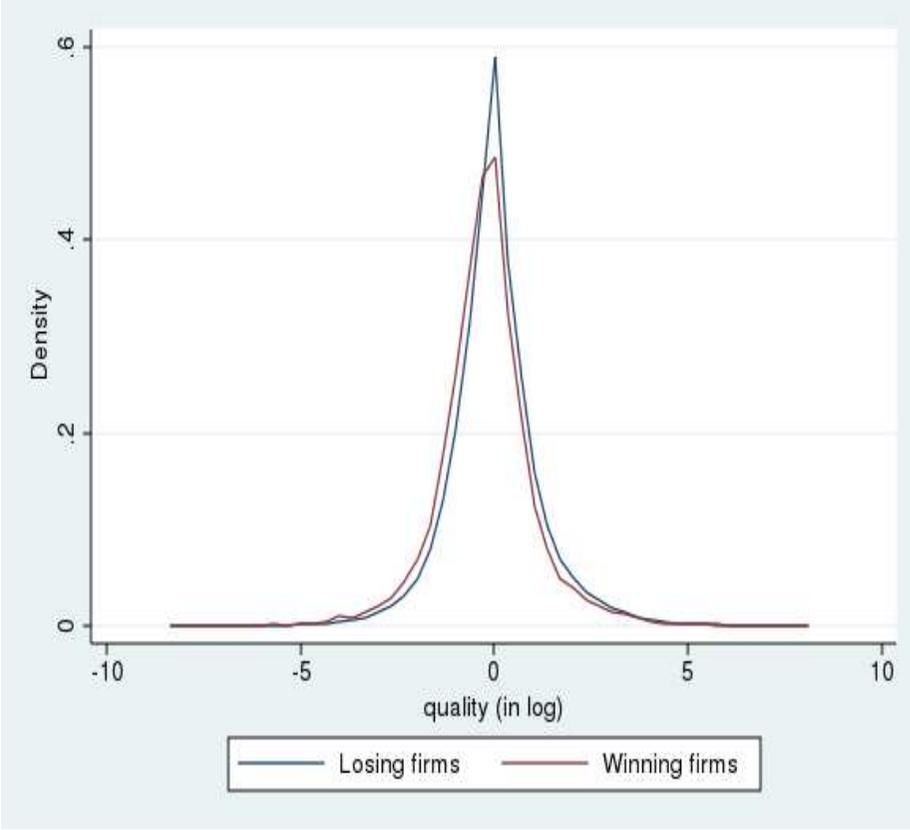
If all countries enforce the number of TBT & SPS measures at the maximum level observed across destinations for a given product, then

- *French* export sales would decline by 4.6% (- 2.6 billions €)
- The winners would represent 27% of exporters
Their export sales would increase by 5.1% (+0.5 billions€)
- The winners are more productive than losers

Productivity distribution of winning and losing firms



'quality cost' distribution of winning and losing firms



4.3 The effects on average quality

- How to estimate the origin-and-destination specific average quality perceived by foreign consumers $(\bar{\theta}_{ij}^k)^{\beta_j^k}$? challenging exercise (again).

- From **aggregate** (CES) demand equation and bilateral trade data at the **country/6-Digit product** level (\sim Khandelwal et al., AER, 2013)

$$Q_{ij}^k = (\bar{\theta}_{ij}^k)^{\beta_j^k (\varepsilon^k - 1)} E_j^k (P_j^k)^{\varepsilon^k - 1} [\bar{p}_{ij}^k]^{-\varepsilon^k} \text{constant}_i^k \quad (\text{from our framework})$$

where Q_{ij}^k is the volume of bilateral trade in product k and \bar{p}_{ij}^k is the unit value (6 digit)

- We regress $\log Q_{ij}^k + \varepsilon^k \log(\bar{p}_{ij}^k) = F_i^k + F_j^k + \lambda_{ij}^k$ [λ_{ij}^k : error term]

- so that $\log(\bar{\theta}_{ij}^k)^{\beta_j^k} = \frac{\lambda_{ij}^k}{\varepsilon^k - 1}$ ('average quality' as a residue)

■ Effects of SPS & TBT measures on average quality

	'Average Quality'	'Average Quality'
Nb. of SPS/TBT	0.012*	
Nb. of SPS/TBT x animal products		0.138***
Nb. of SPS/TBT x vegetable products		0.026**
Nb. of SPS/TBT x fats & oils		0.008
Nb. of SPS/TBT x Prepared foodstuffs & beverages		0.071***
Nb. of SPS/TBT x Textile		-0.080***
Nb. of SPS/TBT x Toys		-0.051**
Nb. Of SPS/TBT measures x other products...		...
Control variables (other trade policies)		
Observations	77,150	77,150
R2	0.49	0.49
Fixed effects: Destination & Product	yes	yes

It is time to conclude my talk

- Extensive margin: Quality standards induce the exit of low-quality firms & high-quality/low-productivity firms
 - Intensive margin: Standards decrease total export sales but increase export sales of high-productivity/low-quality incumbents
 - Average quality. *Theory* suggests an ambiguous effect on the average quality under quality uncertainty.
Empirics: increase in the average quality of products exported by French firms, but vary according to industry
- More Quality standards seem to imply higher average quality of products and better allocation of resource among firms