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"Industrial Organization and the Food Industry"

**Product quality and export volatility in
international trade: an empirical assessment**

Carl GAINNE Francesco GUERRA Stéphane TUROLLA



MOTIVATIONS

FIRM DETERMINANTS OF EXPORT PERFORMANCES

- TFP, intermediate inputs' imports, skill intensity, level of investments, innovation.. (Wagner 2012)
- Product quality
 - Enter more markets (Curzi & Olper 2012; Martin & Mayneris 2015)
 - Bigger worldwide sales (Crozet *et al.* 2012; Manova & Zhang 2012)
 - Export more to richer countries (Bastos *et al.* 2018; Crinò & Epifani 2012)

Consensus: Exporting higher quality products has advantages

MOTIVATIONS

- Recent studies on the trade collapse in 2008: larger contraction for
- higher quality products (Chen & Juvenal 2018)
 - products exported at higher price (Esposito & Vicarelli 2011; Berthou & Emlinger 2010)

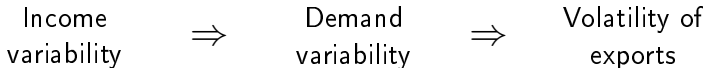
Negative income shock \Rightarrow Reduction of demand for high quality goods more than proportionate

Mechanism (Hallak 2006; Fajgelbaum *et al.* 2011)

- Demand for quality depends on the intensity of the preference for quality which depends on income
- Variations of income \rightarrow variations on preference for quality

MOTIVATIONS

Income variability is a source of export volatility



Export flows could be impacted differently according to the quality of products exported

RESEARCH QUESTION

- \Rightarrow Determine whether quality of a product is a determinant of the the volatility of its exports
 - Analysis at the large scale

MOTIVATIONS

APPROACH

- ⇒ Derive the estimation of quality from structural demand system
- ⇒ Reduced form regression: product quality → export volatility

CONTRIBUTION

- ⇒ Estimation of quality of exported varieties for a large number of importing countries
- ⇒ Go one step further on export performances of quality: volatility
Export volatility is harmful for business
 - decreases firm's profitability (Wagner 2014)
 - decreases investment in productivity (Juvenal & Monteiro 2013)

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LITERATURE

Quality as determinant of trade patterns

- ⇒ Quality increases with income and endowments of physical and human capital of exporter (Schott 2004; Hummels & Klenow 2005)
- ⇒ Quality increases with distance (Alchain & Allen 1964, Hummels & Skiba 2004)

Quality estimation using trade data

- ⇒ Estimation from the demand side (A. Khandelwal 2010; Hallak & Schott 2011; Feenstra & Romalis 2014; A. K. Khandelwal *et al.* 2013).

Determinants of export volatility

- ⇒ Firm's export strategies (Comin & Philippon 2005; Vannoorenberghe 2012; Vannoorenberghe *et al.* 2016).



International trade and bilateral relations (CEPII)

⇒ BACI database: values and weights at 6-digits

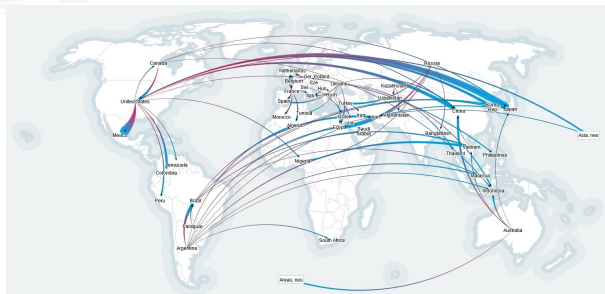
⇒ Gravity database

Domestic production at country-industry level

⇒ UNIDO database at 4-digits

DATABASE

- 108 importing countries
- Time range: 1997 - 2008
- 16,702,187 observations
- 22 manufacturing sectors
- 116 industries
- 4596 products



Example

- Sector: food (15)
- Industry: manufacture of dairy products (1551)
 - Product: Cheese nesoi (040690)
 - Variety: Cheese nesoi exported by Italy

QUALITY ESTIMATION

methodology

Measures of product quality in international trade:

- Proxies (Kugler & Verhoogen 2011; Hallak & Sivadasan 2013)
- Direct measures (Chen & Juvenal 2018; Crozet *et al.* 2012)
- Statistical inference (Hallak & Schott 2011; A. Khandelwal 2010)

Quality estimation (A. Khandelwal 2010)

Structural model of demand of Berry 1994

- ⇒ Quality corresponds to the vertical component of the estimated model and captures the mean valuation consumers attach to a product
- ⇒ Higher quality is assigned to products with higher market shares conditional on price.

QUALITY ESTIMATION

methodology

Demand function for industry-importing country

$$\ln(s_{ihjt}) - \ln(s_{0jt}) = \lambda_{1,ih} + \lambda_{2,t} + \alpha p_{ihjt} + \sigma \ln(s_{ihjt|g}) + \lambda_{3,ihjt}$$

Measure of quality

$$\lambda_{ihjt} = \hat{\lambda}_{1,ih} + \hat{\lambda}_{2,t} + \hat{\lambda}_{3,ihjt}$$

i = exporter

h = product

j = importer

t = year

s_{ihjt} variety market share

s_{0jt} outside variety market share

p_{ihjt} price

$s_{ihjt|g}$ variety market share within its nest

QUALITY ESTIMATION

methodology

Estimation for each industry-importer (5787 estimations)

★Endogeneity

$$\ln(s_{ihjt}) - \ln(s_{0jt}) = \lambda_{1,ih} + \lambda_{2,t} + \alpha p_{ihjt} + \sigma \ln(s_{ihjt|g}) + \beta \ln(pop)_i + \lambda_{3,ihjt}$$

2SLS regression

- Market share of the variety within its nest $\ln(s_{ihjt|g})$
 - Number of varieties imported within product
 - Number of varieties exported by the exporting country
- Price p_{ihjt}
 - Hausman type instrument: $inst_{ihjt} = \frac{\sum_{j \neq j'} p_{ihjt} * \omega_{ihjt}}{N}$
 - Interaction of bilateral distance with annual oil prices.

QUALITY ESTIMATION

Results

Demand model

$$\ln(s_{ihjt}) - \ln(s_{0jt}) = \lambda_{1,ih} + \lambda_{2,t} + \alpha p_{ihjt} + \sigma \ln(s_{ihjt|g}) + \beta \ln(pop)_i + \lambda_{3,ihjt}$$

Summary results

	Mean		Median	
	OLS	2SLS	OLS	2SLS
Coefficient on price	-0.905	-2.9647	-0.2616	-0.9708
Coefficient on nest share	0.7997	0.3346	0.8286	0.3325
Coefficient on population	0.1718	0.8919	0.0691	0.052
R-squared	0.9252	0.9391	0.9035	0.8996
Hansen-Saragan test (p-value)		0.2680		0.2270
Observation per estimation	2738	2706	1112	1111
Estimations with stat. sign. price coef.			78%	
Total estimations			5787	
Total observations across all estimations		15,845,253		

	ln(price)		quality	
quality	-0.186*** (0.000)			
quality*ladder	0.055*** (0.000)			
quality(KWS)		0.001*** (0.000)		
ln(GDP/capita)			0.190*** (0.001)	
ln(distance)			0.036*** (0.001)	0.167*** (0.002)
contiguity			-0.008* (0.004)	0.090*** (0.004)
language			0.082*** (0.004)	-0.099*** (0.004)
colony			0.358*** (0.009)	0.148*** (0.011)
currency			-0.061*** (0.005)	-0.076*** (0.006)
ln(quantity)			0.620*** (0.001)	0.646*** (0.001)
FE exporter-prod-year	Yes	Yes	No	Yes
FE importer-prod-year	Yes	Yes	Yes	Yes

QUALITY ESTIMATION

Results

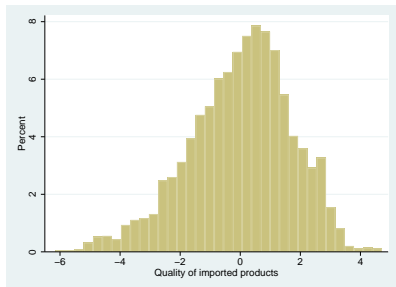


Figure: French Market

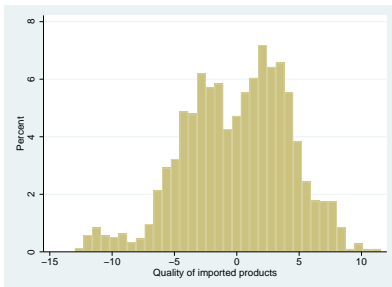


Figure: US Market

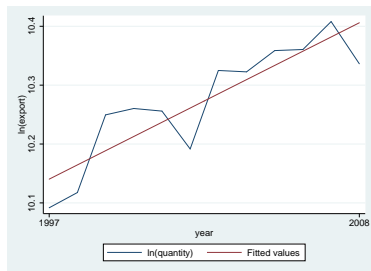
Distribution of quality of imported products for industry "1520 -
Manufacture of dairy products"

Export volatility for product-export-importer

Volatility: Average deviation around a linear trend

$$\hat{exp}_{ihjt} = \hat{\alpha} + \hat{\beta}t$$

$$vol_{ihj} = \sqrt{\sum_t (exp_{ihjt} - \hat{exp}_{ihjt})^2}$$



Sample selection:

- Positive export values for at least 10 years between 1997-2008
- Quality estimation available on at least 8 years

Number of observations: 10,482,300

Reduced-form model

$$\ln(vol_{ihj}) = \beta_1 quality_{ihj} + \beta_2 gravity_{ij} + FE_{ih} + FE_{jh} \quad (1)$$

$$\ln(vol_{ihj}) = \beta_1 quality_{ihj} + \beta_2 size_{ih} + FE_{ij} + FE_{jh} \quad (2)$$

	log of volatility of exports			
quality	0.072*** (0.000)	0.074*** (0.000)	0.044*** (0.003)	0.059*** (0.001)
quality*vol(expenditure/cap)			0.004*** (0.000)	
quality*herf				0.033*** (0.003)
log distance	-0.747*** (0.003)		-0.746*** (0.003)	-0.747*** (0.003)
contiguity	0.416*** (0.006)		0.416*** (0.006)	0.415*** (0.006)
common language	0.207*** (0.006)		0.207*** (0.006)	0.207*** (0.006)
colony	0.036*** (0.006)		0.037*** (0.006)	0.037*** (0.006)
religion	0.285*** (0.009)		0.285*** (0.009)	0.287*** (0.009)
common currency	0.120*** (0.006)		0.119*** (0.006)	0.120*** (0.006)
size		0.666*** (0.001)		
FE exporter-product	Yes	No	Yes	Yes
FE importer-product	Yes	Yes	Yes	Yes
FE importer-exporter	No	Yes	No	No

CONCLUSION

Export of higher quality products are more volatile

⇒ Volatility of exports increases with quality as the level of expenditure per capita in the importing country is more volatile

- Role of intensity for preference ([Hallak 2006](#))
 - Positive income shock → preference for quality increases
 - Negative income shock → preference for quality decreases

⇒ Volatility of exports decreases with quality the higher is the level of competitiveness of the importing market

- Competition increases volatility ([Comin & Philippon 2005](#))
 - Higher quality products embody richer set of product characteristics
 - Lower quality goods are closer substitute for one another and so more exposed to volatility in highly competitive markets

CONCLUSION

Exporting higher quality products

- has certainly several advantages
- more likely to expose the firm to demand shocks of the importing country

Exports of higher quality products are likely to be relatively more volatile in countries where the level of expenditures is highly variable.



THANK YOU

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Demand model

$$\ln(s_{ihjt}) - \ln(s_{0jt}) = \lambda_{1,ih} + \lambda_{2,t} + \alpha p_{ihjt} + \sigma \ln(s_{ihjt|g}) + \beta \ln(pop)_i + \lambda_{3,ihjt}$$

Distribution of the Sanderson-Windmeijer Chi2 and F test for the instrumented variables

	SW Chi2 price (p-value)	SW Chi2 nest (p-value)	SW F test price	SW F test nest	Hansen J-test (p-value)
mean	0.1356	0.0594	28621.72	406.48	0.3045
p25	1.04E-08	2.83E-11	1.4628	2.9469	0.0544
p50	0.0077	1.82E-05	3.2691	6.4365	0.2270
p75	0.1855	0.0139	10.2395	13.1779	0.4979

The first two columns report the distribution of the p-value for the SW chi-squared Wald statistic; columns three and four reports the result of the distribution of the F SW statistic for weak instruments. Column 5 reports the distribution of the p-value of Hansen J-test for exogeneity.

	<i>vol1_{ihj}</i>	<i>vol1_{ihj}</i>	<i>vol2_{ihj}</i>	<i>vol2_{ihj}</i>	<i>vol3_{ihj}</i>	<i>vol3_{ijh}</i>
quality	0.072*** (0.000)	0.074*** (0.000)	0.036*** (0.000)	0.038*** (0.000)	0.156*** (0.001)	0.162*** (0.001)
log distance	-0.747*** (0.003)		-0.376*** (0.001)		-1.620*** (0.006)	
contiguity	0.416*** (0.006)		0.209*** (0.003)		0.864*** (0.012)	
common language	0.207*** (0.006)		0.105*** (0.003)		0.435*** (0.013)	
colony	0.036*** (0.006)		0.020*** (0.003)		0.101*** (0.014)	
religion	0.285*** (0.009)		0.143*** (0.004)		0.611*** (0.019)	
common currency	0.120*** (0.006)		0.060*** (0.003)		0.263*** (0.014)	
size		0.652*** (0.001)		0.330*** (0.001)		1.432*** (0.003)
FE exporter-product	Yes	No	Yes	No	Yes	No
FE importer-product	Yes	Yes	Yes	Yes	Yes	Yes
FE importer-exporter	No	Yes	No	Yes	No	Yes
R-squared	0.826	0.801	0.830	0.806	0.809	0.782
observations	769,954	802,919	769,954	802,919	769,954	802,919

	Volatility of exports					
quality	-0.014*** (0.002)	-0.017*** (0.002)	0.044*** (0.003)	0.027*** (0.002)	0.059*** (0.001)	0.065*** (0.001)
quality*vol(cons)	0.010*** (0.000)	0.010*** (0.000)				
quality*vol(cons/cap)			0.004*** (0.000)	0.006*** (0.000)		
quality*herf					0.033*** (0.003)	0.025*** (0.002)
log distance	-0.742*** (0.003)		-0.746*** (0.003)		-0.747*** (0.003)	
contiguity	0.416*** (0.006)		0.416*** (0.006)		0.415*** (0.006)	
common language	0.213*** (0.006)		0.207*** (0.006)		0.207*** (0.006)	
colony	0.035*** (0.006)		0.037*** (0.006)		0.037*** (0.006)	
religion	0.284*** (0.009)		0.285*** (0.009)		0.287*** (0.009)	
common currency	0.119*** (0.006)		0.119*** (0.006)		0.120*** (0.006)	
size		0.649*** (0.001)		0.651*** (0.001)		0.652*** (0.001)
FE exporter-product	Yes	No	Yes	No	Yes	No
FE importer-product	Yes	Yes	Yes	Yes	Yes	Yes
FE importer-exporter	No	Yes	No	Yes	No	Yes
R-squared	0.826	0.802	0.826	0.801	0.826	0.801
observations	769,954	802,919	769,954	802,919	769,954	802,919

EMPIRICAL MODEL

The outside option is intended at industry level and is obtained as

$$s_{0jt} = 1 - IP_{jt}$$

$$IP_{jt} = \frac{M_{jt}}{P_{jt} - X_{jt} + M_{jt}}$$

$S_{ihjt} = \frac{q_{ihjt}}{\text{Consumption}_{jkt}}$ but we do not have consumption in quantity so

$$Q_{jt} = \sum_{ih} \frac{q_{ihjt}}{1 - s_{0jt}}$$

$$S_{ihjt} = \frac{q_{ihjt}}{Q_{jt}}.$$

Reduced-form model

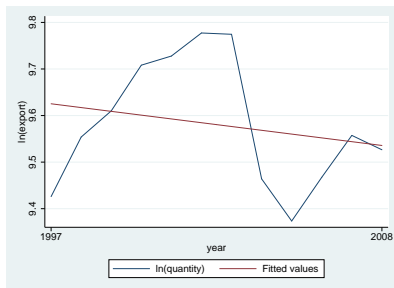
$$\ln(vol_{ihj}) = \beta_1 quality_{ihj} + \beta_2 gravity_{ij} + \beta_3 quality_{ihj} * var + FE_{ih} + FE_{jh}$$

Interaction variable *var*

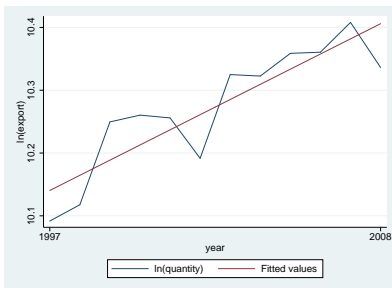
- **vol(cons)** volatility of consumption of importing country (4 digits)
- **vol(cons/cap)** volatility of consumption per capita of importing country
- **herf** Herfindal index → degree of competitiveness of market for specific imported product

EMPIRICAL ANALYSIS

Methodology



from IT to FR



from IT to US

Volatility of imports of cheese nesoi (code hs6=040690) in French market

QUALITY ESTIMATION

Results

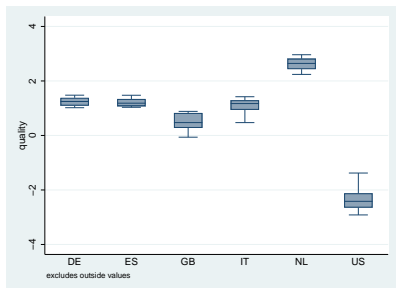


Figure: French Market

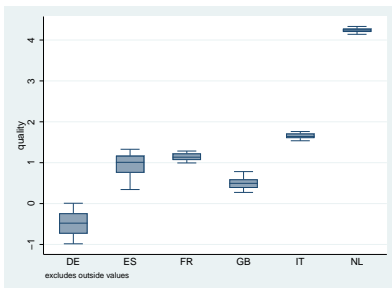


Figure: US Market

Estimated quality of cheese nesoi (code hs6=040690) in French and US markets

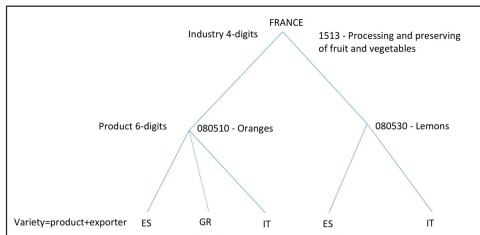
QUALITY ESTIMATION

methodology

Nested logit framework by Berry 1994

$$u_{nht} = \lambda_h - \alpha p_h + \epsilon_{nh}$$

- Nested structure
- Outside variety



Demand function

$$\ln(s_{ihjt}) - \ln(s_{0jt}) = \lambda_{1,ih} + \lambda_{2,t} + \alpha p_{ihjt} + \sigma \ln(s_{ihjt|g}) + \lambda_{3,ihjt}$$

Measure of quality

$$\lambda_{ihjt} = \hat{\lambda}_{1,ih} + \hat{\lambda}_{2,t} + \hat{\lambda}_{3,ihjt}$$