Quality Upgrading and Food Standards:
Evidence from the EU Market

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Quality, Food Standards, and Competitiveness:
Theory and New Evidence

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Research objectives

- To move away from gravity models

- We use a distance to the frontier model of innovation and competition (Aghion et al. 2009)

- To study how the rate of **quality upgrading** in the exported foods is affected by:

    – The diffusion of voluntary **standards** in the **destination** (EU) market

    – The increase in competition, due to **tariffs** reduction, in the **origin** exporting country

Main findings

- Overall, the diffusion of EU food standards leads to **an increase** in exporters quality upgrading

  – However the effect is **heterogeneous**

    - Primary vs. processed foods

    - ISO vs. non-ISO standards

    - OECD vs. non-OECD (developing) countries

- Strong evidence that a fall in tariffs lead to a **faster** quality upgrading, but only for products **close** to the quality frontier

Outline

- ***Motivations***

- Theoretical considerations

- Data

- Empirical strategy

- Results

- Conclusions and implications

Motivations

- The diffusion of standard has generated an intensive debate on their **trade effects** (Henson, 2006; Maertens and Swinnen, 2007; Shepherd and Wilson, 2010 ; Josling et al. 2011)

- Studies used intensively **gravity** like models (e.g. Yi & Beghin, 2012 survey)

  – **Mixed** evidence: catalysts or trade barriers ?

- We depart from this by studying the extent to which standards affect exporters **quality upgrading**

  – Innovation and quality upgrading are two key channels through which standards may exert their effects (see Acemoglu et al 2010; Swann 2010) …

  – The **quality** of exported products it is now at the forefront of the explanation of firms export success and trade patterns (Verhoogen, 2008; Fajgelbaum et al., 2011; Crozet et al. 2012…)

Motivations

- **Key issue**: how to estimate products quality

  - Previous literature: **unit values** to proxy quality (e.g. Schott 2004 ...; Jouanjean 2012)

  - Problematic as many aspects not directly linked with quality are included (wages, production costs, market power ...)

In this paper

- We estimate product quality at CN 8-digit level, relying on **Khandelwal** (2010) simple intuition:

  - *higher quality is attributed to products that have higher market share, after controlling for price*

- Then, using a *distance to the frontier* model we investigated how the rate of quality upgrading is affected by:

  - The **diffusion of standards** in the EU market (importing market)

  - The **fall in tariffs** in the exporting country

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Theoretical considerations

- *Distance to the frontier* model (Aghion et al. 2005; 2009)

  $\Delta Quality = f$ (*competition, proximity to the frontier*)

  – In firms close to the frontier a tougher competition leads to a faster quality upgrading (**escape-entry-effect**)

  – In firms far from the frontier, a tougher competition leads to a slower quality upgrading (**discouragement effect**)

- Amiti and Khandelwal (2012) find considerable support to this predictions on the US market

- We extend their approach to the EU market and agri-food products, with a focus on standards

Theoretical considerations

- The relationship between **standard and quality** will depend by the competitive 'growth' effect of standardization (see Acemoglu et al. 2010)...

- Two contrasting hypotheses:
  - **H1. Catalysts of trade**: *diffusion of standards should boost quality upgrading in the leading firms, but would hinder it in laggard firms*
  - **H2. Barriers to entry**: *diffusion of standards is expected to hinder the rate of quality upgrading, and this effect should be all more that a firm is close to the technology frontier.*

- Both predict a non-linear relation btw. standards and quality upgrading ...

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Sample and data

- **Sample**: more than 1,500,000 observations; **100** exporters; more than **2,400** food products; 14 importers (EU15, except Luxembourg)

- **Trade data**: *Eurostat Comext*, Imports to EU15 at **8-digit** level, for the period 1995-2007

- **Production data**: *Eurostat Prodcom* NACE(rev 1.1), for measuring market share in the importing countries

- **Tariffs data**: ad valorem eq. from WITS-World Bank at HS **6-digit** in the period 1995-2007, …

- **EU Standards**: WB European Union Standard Database (EUSDB): **voluntary** standards HS 4-digit for 1995-2003

- **Other data**: Feenstra et al. (2002) US unit transport costs; distance from CEPII, Oil price, population (WDI), …

Data

Industries and products covered by the analysis

Industry NACE-4	Manufacture of food products and beverages	Product CN-8
1511	Production and preserving of meat	142
1512	production and preserving of poultrymeat	196
1513	production of meat and poultrymeat products	108
1520	Processing and preserving of fish and fish products	401
1530	Processing and preserving of fruit and vegetables	495
1540	Manufacture of vegetables and animal oils and fats	144
1550	Manufacture of dairy products	204
1560	Manufacture of grain mill products, starches and starch products	178
1580	Sugar and cocoa	60
1581	Manufacture of bread; manufacture of fresh pastry goods and cakes	2
1582	Manufacture of ruskd and biscuits	29
1585	Manufacture of maccaroni, noodles and couscous	11
1586	Processing of tea and coffee	22
1587	Manufacture of condiments and seasonings	11
1588	Manufacture of omogenized food preparaison and dietetic food	7
1589	Manufacture of other food products n.e.c.	37
1590	Production of ethyl alcohol, cider, malt and other non-distilled fermented beverages	18
1591	Manufacture of distilled potable alcoholic beverages	67
1593	Manufacture of wine	99
1596	Manufacture of beer	4
1598	Production of mineral water and soft drinks	11

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Empirical strategy

Quality estimation (Khandelwal, 2010)

- We estimate the following nested logit demand function for each 4-digit industry

$$\ln(s_{cht}) - \ln(s_{0t}) = \lambda_{1,ch} + \lambda_{2,t} + \alpha p_{cht} + \sigma \ln(ns_{cht}) + \gamma \ln pop_{ct} + \lambda_{3,cht}$$

- Where S_{cht} and S_{0t} are the Inside and outside varieties share; p_{cht} is the price of the Inside variety; ns_{cht} is the nest share...

- $\lambda_{1,ch}$ $\lambda_{2,t}$ and $\lambda_{3,cht}$ are the variety FE, the time FE and the residual, respectively: $\boxed{Quality \equiv \lambda_{cht} = \hat{\lambda}_{1,ch} + \hat{\lambda}_{2,t} + \hat{\lambda}_{3,cht}}$

- After a monotonic transformation of quality $[\exp(\lambda_{cht})]$ we obtain the variety proximity to the frontier as follow

$$\boxed{PF_{cht} = \frac{\lambda_{cht}^{F}}{max_{c \in ht}(\lambda_{cht}^{F})} \quad (0, 1]}$$

Empirical strategy

Quality ranking on beer
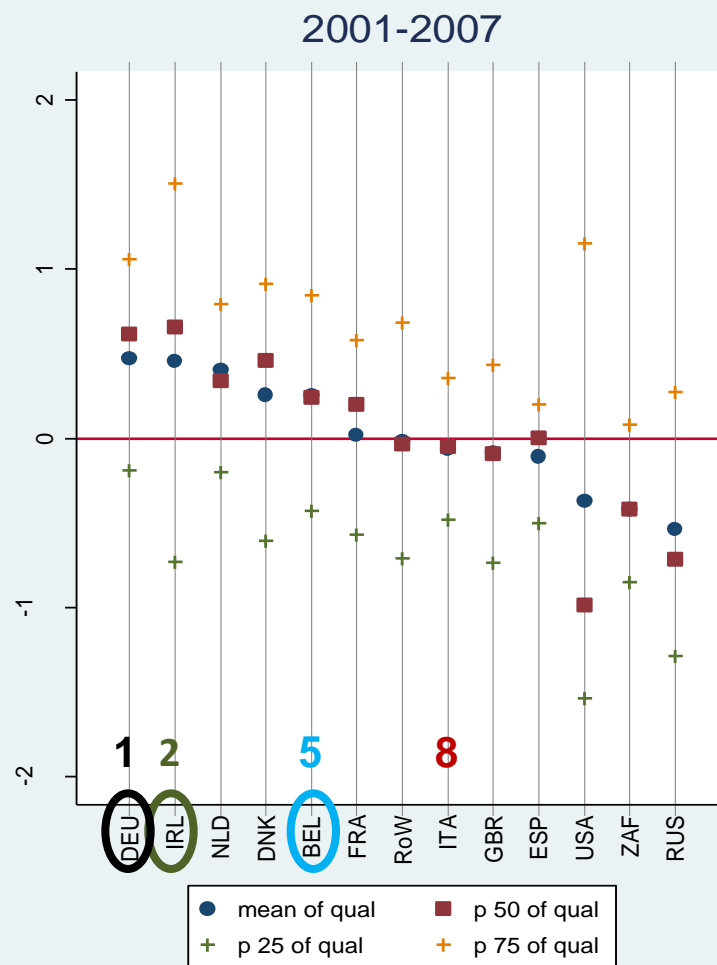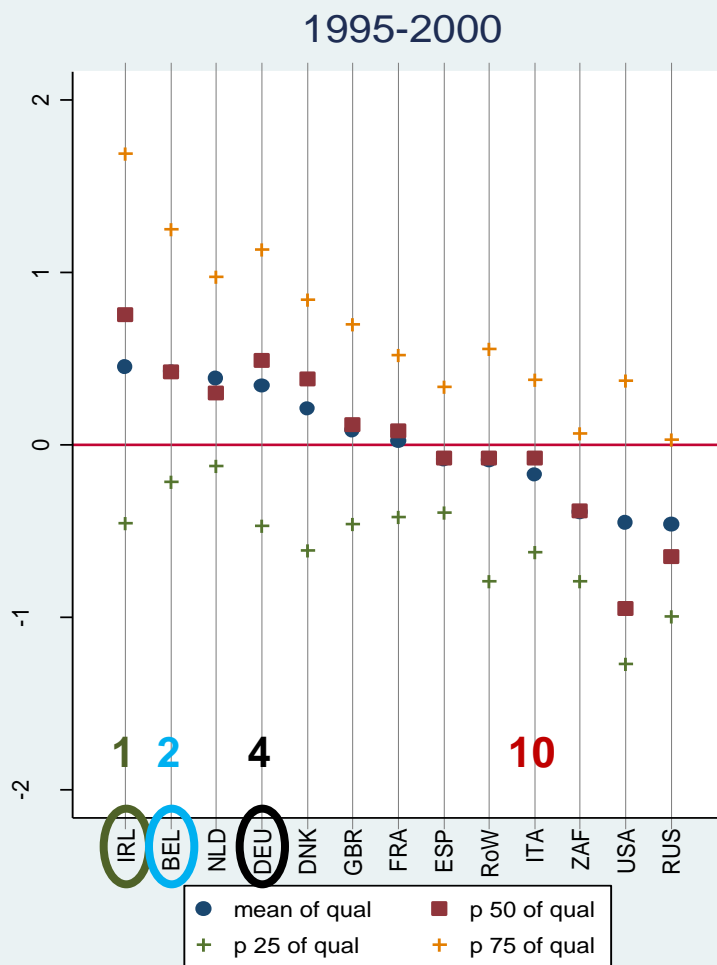
Empirical strategy

Quality ranking on wine

Empirical strategy
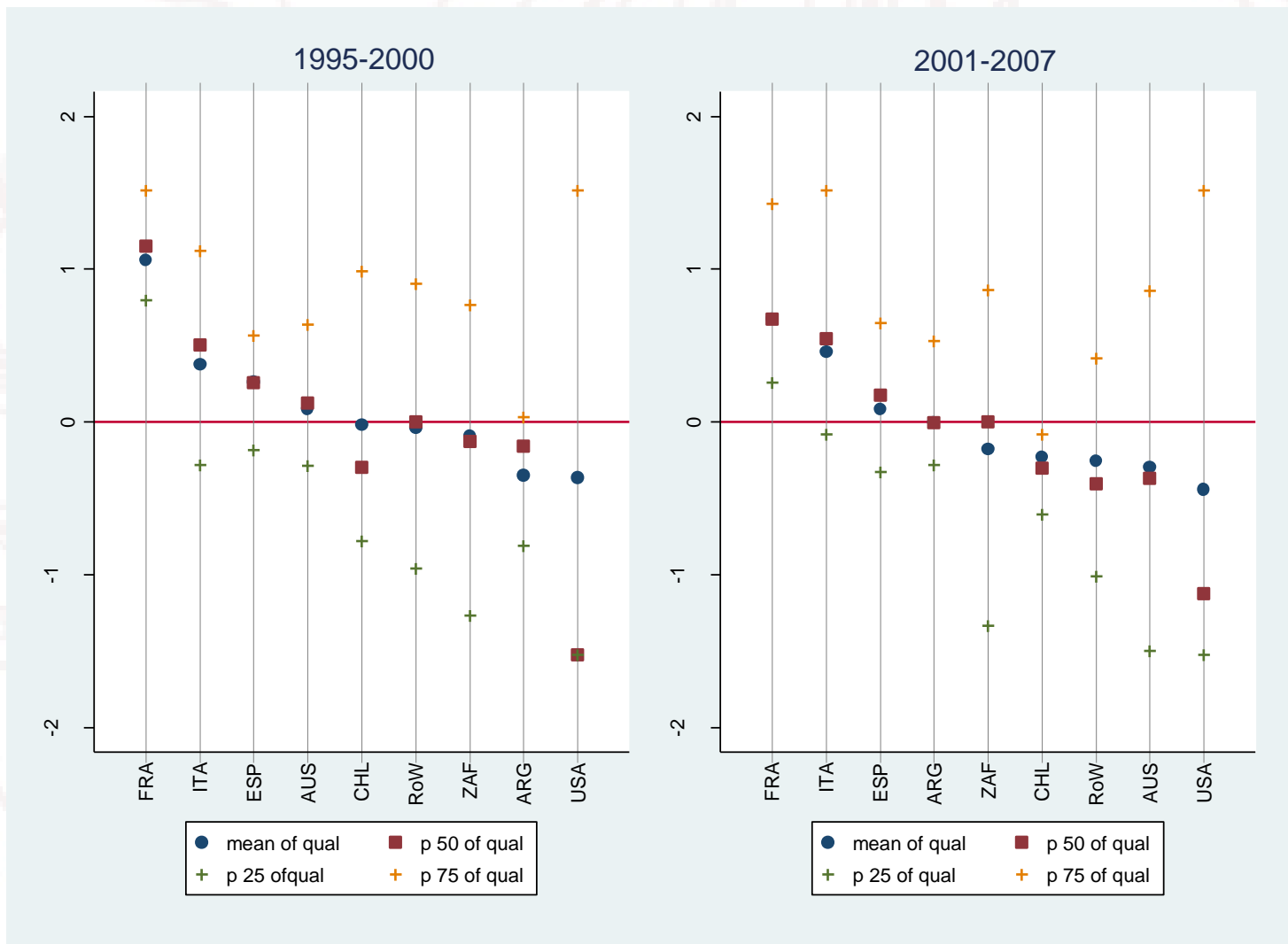
Testing the hypothesis of Aghion et al (2009)

- The relation between competition and quality upgrading depend by the varieties proximity to the quality frontier

$$\Delta ln\lambda_{cht}^F = \alpha_{ht} + \alpha_{ct} + \beta_1 PF_{cht-5} + \beta_2 tariff_{ch,t-5}$$
$$+ \beta_3\left(PF_{ch,t-5} * tariff_{ch,t-5}\right) + \varepsilon_{cht}$$

  - Where $\Delta \ln \lambda_{cht}^F$ is the change in quality from $t-5$ to t
  - α_{ht} and α_{ct} are product-year and country-year FEs
  - PF_{cht-5} proximity to the frontier of each varieties h
- Expectation: $\beta_2 > 0$ and $\beta_3 < 0$

Empirical strategy

Testing the impact of standards

– We augmented the previous specification by adding the (log of) the number of standards and their interaction with *PF*:

$$\Delta ln\lambda_{cht}^{F} = \alpha_h + \alpha_{ct} + \beta_1 PF_{cht-5} + \beta_2 tariff_{ch,t-5} + \beta_3\big(PF_{ch,t-5} * tariff_{ch,t-5}\big)$$
$$+ \beta_4 standard_{h,t-5} + \beta_5\big(PF_{ch,t-5} * standard_{h,t-5}\big) + \varepsilon_{cht}$$

– If $\beta_4 > 0$ and $\beta_5 < 0$ Standards act as a **barrier** to trade

– If $\beta_4 < 0$ and $\beta_5 > 0$ Standards act as a **catalysts** to trade

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Results: baseline

- Robust convergence in quality upgrading

- The effect of **tariffs** is strongly conditional to the proximity to the frontier
  - A 10% points fall in tariffs, 2% increase in the rate of quality upgrading (PF = 1), -0.42% (PF = 0)
  - robust especially for OECD and processed foods

- Overall, **standards** affect **positively** the rate of quality upgrading, only marginally conditional to PF
  - A 10% increase # standards, 1.5% increase rate quality upgrading (PF = 0), 1.3% (PF = 1)
  - Results **inconsistent** with both hypotheses 1 and 2

Results: non-ISO vs ISO

- **Non-ISO** standards affect quality upgrading quite independently by PF and the 'level of development':
  - **Positive** for processed food (elasticity 0.22)
  - **Negative** for primary products (elasticity 0.17)

- **ISO standards** results more sensitive to the level of development and to the PF
  - non-OECDs and primary prod. , standard act as a **barrier to trade**
  - OECD and processed prod. standards act as a **catalyst to trade**

- **EU15** results non much different from the other country groups

Results

Tariffs, proximity to the frontier and *quality upgrading*

	(1) ALL	OECD	(2) NON OECD	(3) ALL	OECD	(4) NON OECD	(5) EU 15	OECD NON EU
Lagged_5 PF	-0.485*** (0.0369)	-0.504*** (0.0303)	-0.367*** (0.0436)	-0.458*** (0.0417)	-0.469*** (0.0399)	-0.368*** (0.116)	-0.512*** (0.00680)	-0.266*** (0.0784)
Lagged_5 tariffs	0.0704** (0.0286)	0.0526* (0.0281)	0.136** (0.0513)	0.0768** (0.0293)	0.0604** (0.0282)	0.141** (0.0533)	0.0603** (0.0288)	0.0105 (0.0349)
Lagged_5 PF * tariffs	-0.184*** (0.0474)	-0.166*** (0.0441)	-0.220* (0.126)	-0.183*** (0.0471)	-0.164*** (0.0427)	-0.228* (0.124)	-0.104*** (0.00656)	-0.339*** (0.108)
Lagged_5 ln standard				0.158*** (0.0324)	0.157*** (0.0330)	0.159*** (0.0330)	0.150*** (0.0278)	0.184*** (0.0321)
Lagged_5 ln standard * PF				-0.0101* (0.00578)	-0.0133** (0.00539)	0.001 (0.0307)	-0.0105*** (0.00159)	-0.0165 (0.0342)
FE Importer-Product	YES	YES		YES	YES		YES	
FE Exporter-Year	YES	YES		YES	YES		YES	
N	226485	226485		226485	226485		226485	
R-sq	0.230	0.230		0.230	0.230		0.230	

Results

Robustness check

Our results are robust controlling for:

- Different set of fixed effects

- Controlling for EU tariff protection

- Different definition of the frontier
  - Excluding PF = 1
  - Excluding the top 2 quality products

- Splitting the sample according the doing business classification

Results

	PRIMARY PRODUCTS					PROCESSED PRODUCTS				
	(1)	(2)		(3)		(4)	(5)		(6)	
	ALL	OECD	NON OECD	EU 15	OECD NON EU	ALL	OECD	NON OECD	EU 15	OECD NON EU
PF	-0.406***	-0.409***	-0.442**	-0.392***	-0.486***	-0.484***	-0.492***	-0.409***	-0.548***	-0.212***
	(0.0636)	(0.0514)	(0.187)	(0.0242)	(0.157)	(0.0506)	(0.0527)	(0.110)	(0.00685)	(0.0755)
tariffs	0.117	0.168	0.0659	0.233	-0.133	0.0462	0.0254	0.125*	0.0208	0.0140
	(0.0778)	(0.120)	(0.143)	(0.184)	(0.117)	(0.0314)	(0.0265)	(0.0627)	(0.0292)	(0.0391)
PF * tariffs	-0.287**	-0.222	-0.298	-0.341***	0.368	-0.170***	-0.155***	-0.0943	-0.0865***	-0.357***
	(0.132)	(0.211)	(0.209)	(0.0539)	(0.440)	(0.0545)	(0.0522)	(0.181)	(0.00597)	(0.102)
ln ISO	-0.0103	0.00552	0.0888	0.00830	-0.157	-0.0639***	-0.0682***	-0.0455*	-0.0664***	-0.0710***
	(0.00855)	(0.0198)	(0.175)	(0.0396)	(0.124)	(0.0105)	(0.0128)	(0.0270)	(0.0120)	(0.0178)
PF* ln ISO	-0.0617*	-0.0655	-0.531**	-0.0334***	-0.0419	-0.0274**	-0.0254*	-0.0446	-0.0340***	0.0627**
	(0.0361)	(0.0454)	(0.253)	(0.00908)	(0.374)	(0.0114)	(0.0133)	(0.0389)	(0.00506)	(0.0249)
Ln non_ISO	-0.173***	-0.168***	-0.179***	-0.160***	-0.212***	0.227***	0.228***	0.225***	0.218***	0.261***
	(0.0459)	(0.0468)	(0.0568)	(0.0461)	(0.0671)	(0.0364)	(0.0388)	(0.0359)	(0.0320)	(0.0363)
PF * ln non_ISO	-0.0366	-0.0393***	-0.0181	-0.0498***	0.0308	0.0044	-0.0009	0.0276	0.0075***	-0.0437
	(0.0232)	(0.0142)	(0.0769)	(0.00755)	(0.0673)	(0.00790)	(0.0106)	(0.0283)	(0.00199)	(0.0358)
FE Importer-Prod.	YES	YES		YES		YES	YES		YES	
FE Exporter-Year	YES	YES		YES		YES	YES		YES	
N	31072	31072		31072		195413	195413		195413	
R-sq	0.242	0.242		0.242		0.232	0.232		0.233	

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Conclusions

- Mixed effect of standards on quality upgrading, a results consistent with the literature (e.g. Shepherd& Wilson, 2010)

- The result strongly confirm that standards may act both as a barrier and as a catalyst to trade …

- However, at the aggregate level, and for processed foods standards affect positively the rate of quality upgrading

    - This results is partially in contrast with the gravity literature where standards often affect negatively trade flows

    - What welfare implications ?

- What next:

    - We are running regressions at the industry level

    - Extension to public standards like SPS

Results

Descriptive statistics

	Obs		Mean		Std. Dev.		Min		Max	
	OECD	NON OECD	OECD	NON OECD	OECD	NON OECD	OECD	NON OECD	OECD	NON OECD
ΔQuality	197533	28952	0.204	0.225	1.329	1.244	-3.500	-3.500	3.999	3.997
L5.PF5	197533	28952	0.296	0.235	0.362	0.339	0	0	1	1
L5._tariff	197533	28952	0.233	0.199	0.241	0.232	0	0	2.235	5.536
L5.PF_new_tariff	197533	28952	0.070	0.043	0.142	0.116	0	0	2.235	5.307
L5.standard	197533	28952	2.667	2.737	0.904	1.029	0	0	4.094	4.094
L5.PF_standard	197533	28952	0.793	0.645	1.060	1.017	0	0	4.094	4.094

Empirical strategy

- ## Quality estimation (Khandelwal, 2010)

  - The nested logit demand function is estimated using OLS and 2SLS, since variety's price is potentially correlated with $\lambda_{3,cht}$ and variety's nest share

Summary statistics on quality estimates

Statistic	Mean		Median	
	OLS	2SLS	OLS	2SLS
Price	-0.260	-0.735	-0.231	-0.655
Nest Share	0.877	0.677	0.892	0.775
Observation per estimation	4,379	4,379	2,427	2,427
R-squared	0.851		0.852	

Data refer to 250 different regressions, estimated at NACE 4-digit level