Advanced International Trade: Lesson 5

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Lesson 5: The role of product quality on heterogeneous firms models

- Demand for quality products;
- Endogenous supply of quality;
- Empirical evidence on quality;
- Input-trade liberalization and quality upgrading.

Lesson 5

- Firm heterogeneity has been introduced as differences in technological factors across firms within the same industry.
- Heterogeneity in initial firm productivity levels captures differences in input requirements to produce one unit of output.
- In a monopolistic competition setting with heterogeneous firms:
- More productive firms are more profitable, have larger revenues, lower marginal costs and set lower prices (Melitz, 2003)

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- But recent firm level studies on the determinants of price differences across firms have shown that
- exporters are more productive and larger but also charge higher prices
- Bastos and Silva, 2010; Martin, 2012; Manova and Zhang, 2012; Harrigan, Ma and Shlychkov, 2012 and Hallak and Sivadasan -forthcoming-.
- Puzzle

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- One possible explanation for this empirical feature is related to product quality differentiation across firms;
- Introducing consumers' preferences that vary with product quality on the demand side;
- and differences across firms in the scope for quality differentiation on the supply side;
- allows explaining the empirical fact that firm productivity, prices and export status are positively correlated.

Lesson 5

- Demand side
- Supply side

Lesson 5

- On the demand side: Consumers value quality and they are willing to pay a higher price for high-quality goods.
- On the supply side: quality differentiation on final goods depends on the quality of inputs
- Output quality varies with the quality of different skilled labor in Verhoogen (2008) or the quality of intermediate goods in Kugler and Verhoogen (2012) or in Hallak and Sivadasan -forthcoming-.
- Producing high-quality goods requires high-quality inputs with high-wage or high-cost.
- Predictions

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- Predictions
- In a framework of heterogeneous firms and endogenous product quality,
- these models predict a product-quality sorting along the initial productivity level of firms.
- More productive firms choose to produce high-quality products that involve higher marginal costs and
- they can charge then higher prices than less productive firms.

Theoretical models: Demand side

- The demand for a specific variety depends on its quality attribute
- These models rely on the idea that consumers value quality.
- The valuation of quality is reflected on their willing to pay a higher price for high quality goods.
- Given that quality is expensive to produce, a rise in price may be associated with an increase in demand: consumers are ready to pay a premium for higher quality goods.

Theoretical models: Demand side

- Linder's (1961) early work already noted the role of quality as a determinant of the direction of trade
- Main argument: richer countries spend a larger share of their income on high-quality goods.
- Recent empirical work corroborates this idea:
- (1) Bils and Klenow (2005) show that the demand for quality is positively correlated with income per capita at the country level.
- (2) Hallak (2006) also identifies how product quality affects the demand for the product using international trade data:
- Richer countries import relatively more from countries that produce high-quality goods.

Demand side: CES utility function

- Varieties are combined by the following CES utility function:

$$U = \left(\int_{i \epsilon \Omega} (x_i q_i)^{\frac{\sigma - 1}{\sigma}} \, di \right)^{\frac{\sigma}{\sigma - 1}} \tag{1}$$

- where x denotes the quantity consumed and
- q the quality of a typical variety i,
- $\sigma > 1$ is the elasticity of substitution across varieties and
- Ω is the set of all varieties available in the market.

Demand side: CES utility function

- The demand for a specific variety depends then on the differentiated goods price and also on its quality attribute:

$$x_i = \left(\frac{p_i}{P}\right)^{-\sigma} q_i^{\sigma-1} X \tag{2}$$

- where p_i is the price of the variety i,
- P corresponds to the aggregate quality-adjusted price index
- X is a quality-adjusted consumption aggregate of all varieties available on the market.
- The demand for any variety is increasing in its quality and decreasing on its price.
- Quality acts as a demand shifter: q_i can be interpreted as a shift parameter in the variety's demand schedule.

Demand side: CES utility function

- This interpretation of quality reflects Sutton's (1991) idea that an improvement of quality implies a shift in the demand curve.
- Holding the price fixed, high-quality products have a larger demand.
- The quality-adjusted price for a variety i is given by $\widetilde{p} = p_i/q_i$.

Demand side: CES utility function

- These models can then be summarized by the standard CES preferences when the quality parameter q is equal to one for all varieties.
- Several recent models have adopted this demand structure to introduce product quality in consumers' preferences.
- See among others, Hallak (2006), Baldwin and Harrigan (2011), Kugler and Verhoogen (2012), Hallak and Sivadasan -forthcoming-, Crozet, Head and Mayer (2012), Johnson (2012) and Khandelwal, Schott and Wei (2013).

Production side: endogenous quality

- The recent models differ in the way they introduce endogenous product quality choice but they all share several common features:
- (1) Firms' quality choice depends on the quality of inputs (skill labor or intermediate goods) used in the production of final goods.
- (2) Producing high-quality goods is costly with marginal costs increasing in the level of quality of the final good.
- (3) Some of these models follow the framework developed by Shaked and Sutton (1982 and 1983) and Sutton (1991, 1998) assuming an endogenous sunk investment cost in quality upgrading.

Production side: Complementarity between factors to produce output quality

- Verhoogen (2008) introduces endogenous quality in a model of monopolistic competition and heterogeneous firms in terms of productivity a la Melitz.
- He assumes that product quality q of the final good produced by each firm depends on
- (1) the ability of the firm (or productivity) λ,
- (2) the quality of white e^h and blue collar e^l workers
- (3) the technical sophistication of capital equipment k

Production side: Complementarity between factors to produce output quality

- All these factors are combined by a Cobb-Douglas production function:
- $$q = \lambda (k)^{\alpha^k} \left(e^h\right)^{\alpha^h} \left(e^l\right)^{\alpha^l} \quad (6)$$
- The qualities of different workers are assumed to be complementary.
- Firms decide the input demand that maximizes profits and then input decisions determine quality of the final goods produced.

Production side: Complementarity between factors to produce output quality

- After profit maximization, optimal quality q^* and prices p^* are given by:
- $q^* = (\eta\delta^\alpha\lambda^\alpha\theta^\alpha)^{\frac{1}{1-\alpha}}$ and $p^* = \mu\delta + w^h + w^l + \alpha\delta\theta q^*(\lambda)$,
- where η is a constant and δ is the relative price between the North and the South.

Production side: Complementarity between factors to produce output quality

- The model predicts that firms with a high-initial productivity draw produce:
- (1) high-quality products for the export market,
- (2) pay higher wages to both types of labor,
- (3) are more capital intensive
- (4) and charge higher prices than those firms with a low-productivity draw.
- In this framework, quality and prices are increasing functions of firm productivity, they are positively correlated with firm size.

Predictions of heterogeneous firms models with product quality

- Theoretical predictions on the relationship between firm productivity, output and input prices, product quality and export status.
- (1) High-quality goods have a larger demand since the representative consumer values quality.
- (2) Product quality acts as a demand shifter that captures all attributes of a product other than price that consumers value.
- (3) Producing high-quality goods is costly since it involves the use of high-quality intermediate goods (skilled labor or inputs) that increase marginal costs.
- (4) High-productivity firms have a larger demand and produce high-quality goods with high-quality inputs (high-cost).

Predictions of heterogeneous firms models with product quality

- As exporting firms incur a fixed cost,
- these models provide a convincing framework to explain why exporters produce higher quality goods
- and charge higher output prices producing with high-quality inputs as well as
- why export prices are higher in more distant (Baldwin and Harrigan, 2011, Feenstra and Romalis, 2012) and more difficult to enter (Jonhson, 2012) destination markets.

Measuring Quality

- Existing measures of quality

Existing measures of quality

- Unit values .
- Direct measures of quality for specific products and markets
- Proxy of quality adjusted competitiveness based on demand function estimations

Measuring quality

- Unit values as proxy for quality
- Unit values (prices): value over quantity.
- The main idea is that higher prices are a good proxy of product quality since
- they act as a signal for higher quality in imperfect market conditions.
- Based on the theoretical framework, the firm level empirical literature argues that prices are a good proxy for quality (Baldwin and Harrigan, 2011).

Measuring quality

- The firm-level empirical literature investigates the determinants of export price variation in cross-section analyses, i.e., within-product across firms or within product-firm across markets for different countries:

- Bastos and Silva 2010 and Bastos, Silva and Verhoogen 2013 for Portugal;
- Gorg, Halpern and Murakovy 2010 for Hungary;
- Kugler and Verhoogen 2012 for Colombia;
- Martin 2012 for France;
- Manova and Zhang 2012 for China;
- Harrigan, Ma and Shlychkov 2012 for U.S.;
- Hallak and Sivadasan -forthcoming- for India, the US, Chile and Colombia

- These studies are based on customs datasets that report detailed information on firms, products at the 8 or 6 digit product level disaggregation by export destination country.

Measuring quality

- Different determinants of higher export prices:
- (1) Destination country
- (2) Firm characteristics
- (3) Product characteristics

Measuring quality

- Different determinants of higher export prices:
- (1) Destination country: Exporting firms charge higher prices in more distant markets and to high-income countries (Bastos and Silva 2010, Gorg, Halpern and Murakovy 2010, Manova and Zhang, 2012; Martin, 2012).
- (2) Firm characteristics: Bigger, more productive and skilled intensive firms charge higher prices and pay higher input prices (Harrigan, Ma and Shlychkov, 2012, Kugler and Verhoogen, 2012, Hallak and Sivadasan -forthcoming-).
- (3) Product characteristics: differentiated goods (vs. homogeneous goods, Rauch measure), high technological content products.
- This firm level evidence supports the predictions of the trade models of heterogeneous firms that incorporate product quality

Lesson 5

- Unit values imperfect measures of quality
- Why?

Lesson 5

- Unit values imperfect measures of quality
- differences in market structure (market power)
- or marginal costs.

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- Direct measures of quality for specific products and markets

- Direct measures of quality for specific products and markets:
  - Product-quality is inferred from product attributes for the Automobile market (Goldberg and Verboven, 2001)
  - Quality rankings and expert assessments of the quality of Champagne and wine (Crozet, Head and Mayer, 2012 and Chen and Juvenal 2013)
  - ISO-9000 norms adoption (international production standard) (Verhoogen 2008 and Hallak and Sivadasan 2013).
  - List of members of the Comite Colbert (Martin and Mayneris, 2013)

- Proxy of quality adjusted competitiveness based on demand function estimations:
  - A higher quality is measured as all characteristics of a good that increase demand for a given price (Khandelwal, 2010 and Khandelwal, Schott and Wei, 2013, Piveteau and Smagghue 2013)

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- At the firm level one of the few works that estimate product quality is Khandelwal, Schott and Wei (2013).
- They develop a methodology to estimate quality and quality-adjusted prices at the firm-product-country of destination relying on a demand function estimation.
- They show that assuming a CES utility function which accounts for product quality ,
- the quality for each firm-product-country-year observation can be estimated using information on quantities and unit values.

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- They estimate quality as a demand shifter that correspond to the residual of an OLS estimation of the following regression:

- $$x_{fkct} + \sigma p_{fkct} = \alpha_k + \alpha_{ct} + \varepsilon_{fkct} \tag{11}$$

- where x_{fkct} and p_{fkct} denote the natural logs of the quantity and price (unit value) of product k produced by firm f and sold in market c in year t.

- The country-time fixed effect α_{ct} controls for price index and income at destination,

- while the product fixed effect α_k controls for variation across products

- since prices and quantities are not necessarily comparable across products.

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- The estimated logarithm of firm-product-destination country level quality, q_{fkct} , depends on the residual ε_{fkct} and the elasticity of substitution σ between products:

- $$q_{fkct} = \varepsilon_{fkct}/(\sigma - 1) \tag{12}$$

- They estimate product quality at the firm level using Chinese firm-product and country of destination level customs data for the textile sector.

- They rely on the median elasticity across textile products of Broda, Greenfield and Weinstein (2006).

- The quality-adjusted price is then given by $p_{fkct} - q_{fkct}$.

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- Identification of equation (11) is based on variation across-firms in export quantities for firms selling the same product in the same destination market and year.
- Conditional on price, a variety with a higher quantity (demand) is assigned higher quality.
- In this framework, quality is any unobserved product characteristic that increases demand other than price so it acts as a demand shifter.

Syllabus

Lesson 5: Input trade liberalization and exported goods quality

- **Suggested readings:**

- Bas, M and Strauss-Kahn, V., 2015, Input-Trade Liberalization, Export Prices and Quality Upgrading, Journal of International Economics, Vol. 95 (2), p.p. 250-262.

Motivation: key questions

- **Determinants of exporting firms' product-quality (high-prices)**
- **Firms characteristics**: Firms exporting high-quality products have high revenue, access a large number of destination markets and pay high wages
  - Verhoogen 2008 (QJE), Crozet, Head and Mayer 2012 (RES), Kluger and Verhoogen 2012 (RES), Manova and Zhang 2012 (QJE), Harrigan et al. 2012.
- **Country characteristics**: firms located in developed economies have access to high-quality inputs to produce high quality exports
  - Schott 2004 (QJE), Hallak 2006 (JIE).
- **Source of economic growth**: being able to sell high quality products in exports markets is an important concern of less developed countries in search for economic growth;
- $\Rightarrow$ *Trade reforms through improving access to high quality inputs may help developing countries achieve this goal.*

Motivation: main channels

The impact of trade liberalization on output prices is ambiguous:

- **Pro-competitive channel:** lower tariffs on final goods (output tariffs) raise competition $\Rightarrow$
  - Lower markup (De Loecker et al. 2012) or
  - Revised products quality (Fernandes and Paunov, 2011, Amiti and Khandelwal, 2013)
- **Imported inputs channel:** lower input tariffs $\Rightarrow$
  - Reduced marginal cost (De Loecker et al. 2012) or
  - Opportunity to access higher-quality inputs in order to produce higher-quality products (Kugler and Verhoogen (2012), Demir (2012))

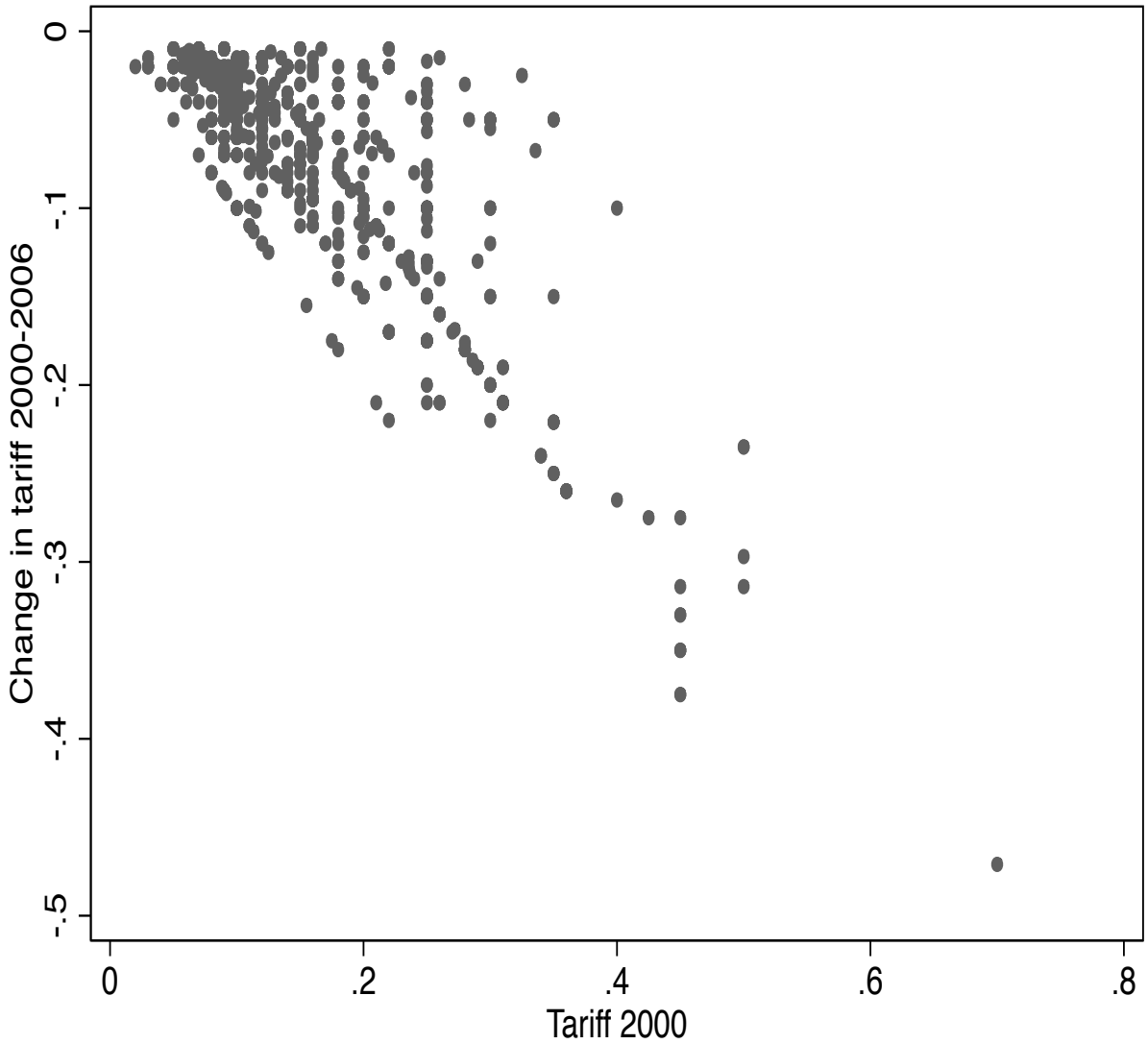
What we do

- We focus on the **imported inputs channel**
- We examine the effect of input tariff cuts on:
- (1) Firms' imported inputs prices and quality upgrading of foreign inputs,
- (2) Firms' exported products prices and their quality.
- We study the case of unilateral trade liberalization in China using firm-product(hs6)-destination (origin) level customs data for 2000-2006.

Why China?

- A quasi-natural experiment relying on two sources of identification and features of China:
- **(1) China's unilateral trade liberalization**: accession to WTO in 2001.
- Exogenous tariff changes across hs6-products
- The average input tariff decreased by about 6 percentage points,
- reaching up to 39 percentage points for some firms.

Motivation: China's unilateral trade liberalization



Why China? China's dual trade system

- A quasi-natural experiment relying on two sources of identification and features of China:
- **(2) China's dual trade system:**
- "Ordinary" vs. "Processing" trade.
- Ordinary firms pay the input tariffs, processing firms don't.

How we do it

- **Within firm-product** estimation including treated group ("ordinary" firms) and control group ("processing" firms)
- **Measuring quality**: (i) unit values and (ii) by a demand function estimation based on Khandelwal, Schott and Wei, 2013 (AER).

$\Rightarrow$ *How imported input tariffs cuts affect import and export unit values using a methodology that accounts for potential endogeneity issues*.

What we find

- **Chinese firms that benefited from input tariff cuts** (i.e, firms under the ordinary trade regime):
  - (1) Buy more expensive inputs,
  - (2) Raise their export prices,
  - (3) Only input tariffs reductions on intermediate goods from developed countries matters,
  - (4) The effect is only significant for firms' exporting to high-income countries (demanding high quality goods).

$\Rightarrow$ **Interpretation: Input-trade liberalization leads to firms to upgrade their inputs in view of a quality upgrade of their exported products.**

What we find

- **The results are robust to potential alternative explanations to the quality upgrading story**
  - (1) Demand shocks,
  - (2) Time-varying shocks other than tariffs that have a differential impact on ordinary and processing firms,
  - (3) Increase in marginal costs (wages and input price increased related to competition structure of upstream sector),
  - (4) Differentiated vs. homogeneous goods,
  - (5) Pass-through effect on import and export prices.

Contribution

Trade liberalization and firm' performance

- **Trade liberalization and firms'productivity**: import competition effect (e.g., Pavnick 2002 (RES), Fernandes 2000 (JIE) and imported inputs channel (e.g., Amiti and Konings 2007 (AER) and Topalova and Khandelwal 2010 (RESTAT)),
- **Trade liberalization and firms' product, export scopes and performance**: Goldberg, Khandelwal, Pavnick and Topalova, 2011(QJE), Bas 2012 (JDE) and Bas and Strauss-Kahn (2012),
- **Trade liberalization and markups**: De Loecker, Goldberg, Khandelwal and Pavcnik (2013),
- **Import competition and product quality**: Amiti and Khandelwal, 2012 (RESTAT), Martin and Mejean (2012),

$\Rightarrow$ **Our contribution**: The effect of trade liberalization on firms' import and export prices through the imported inputs channel (lower input tariffs)

Contribution

Papers on prices and quality using unit values

- Bastos and Silva, 2010(JIE), Martin 2012 (EER), Manova and Zhang, 2012(QJE) and Harrigan, Ma and Shlychkov (2012), Kluger and Verhoogen 2012 (RES), Hallak and Sivadasan 2013 (JIE).

$\Rightarrow$ **Cross-section analysis**: examine determinants of export prices variation within-product across firms or within product-firm across markets.

$\Rightarrow$ **Our contribution**: to investigate export prices variation within firm-product across time and markets in a period of trade liberalization identifying a causal effect.

Theoretical models on heterogeneous firms and quality

$\Rightarrow$ Our results support models of Verhoogen 2008 (QJE), Kluger and Verhoogen 2012 (RES), Hallak and Sivadasan 2013 (JIE), Baldwin and Harrigan 2011 (AEJ), Demir (2012) where:

$\Rightarrow$ producing high quality goods requires expensive high quality inputs and firms selling high quality goods might charge higher prices.

Outline

- Data
- Identification strategy
- Exogeneity of tariffs
- Processing firms as controls
- Main results
- Alternative explanations
- Sensitivity tests

Data

- **Chinese customs data 2000-2006**
- **Dual trade regime is reported in the data:** Traded goods are reported as "ordinary" goods or "processing goods".
- **Processing trade**: imported inputs that are entirely re-exported.
- Imports under processing trade regime are not subject to tariffs and are intermediate inputs.
- **Ordinary trade**: intermediates inputs for ordinary trade are identified using the classification of United Nations at hs6 product level Broad Economic Categories (BEC) .
- **Unique ordinary and processing firms**: Firms that import all their inputs under the ordinary (processing) trade regime are classified as ordinary (processing) importers. No switchers.
- 94% of the total firms importing intermediates import under one trade regime.

Data

- **Chinese customs data 2000-2006**
- There are 8,222 ordinary firms and 6,617 processing firms per year
- export across 178 destinations, source their inputs in 156 countries and trade about 2511 hs6 products (energy, services and wholesalers products are excluded).
- $\Rightarrow$ unbalanced panel of 1,345,636 observations.
- Most of the difference in sample size is a consequence of our matching procedure which requires that for each treated firm (ordinary) there is at least one control firm (processing) at the product-destination-year level. And the exclusion of foreign firms.
- Our estimated sample presents an appropriate representativeness of the full sample in term of sectoral decomposition.

Data

- Our estimated sample presents an appropriate representativeness of the full sample in term of sectoral decomposition

Industry name	full sample # firms (shares)	estimated sample # firms (shares)	# ordinary firms	# processing firms	# products
Food products and beverages	8,4%	7,0%	777	269	90
Textiles	5,3%	5,9%	350	526	141
Wearing apparel; dressing and dyien	11,8%	16,3%	315	2101	189
Leather and footwear	5,4%	5,1%	268	491	36
Wood and products of wood	1,9%	2,1%	235	70	25
Paper and paper products	2,8%	2,3%	222	124	39
Publishing, printing and reproduction	0,4%	0,5%	58	16	17
Coke, refined petroleum products and nuclear fuel	0,4%	0,1%	7	2	2
Chemicals	11,9%	8,6%	1078	204	159
Rubber and plastic products	18,8%	19,2%	2044	804	83
Other non-metallic mineral products	3,0%	2,7%	313	86	62
Basic metals	2,2%	1,2%	122	61	73
Metal products	4,7%	5,0%	489	257	130
Machinery and equipement	6,0%	5,6%	606	219	197
Office, accounting and computing machinery	1,2%	0,7%	42	59	8
Electrical machinery	4,5%	4,1%	334	277	80
Radio, television and communication equipement	3,9%	3,4%	240	269	56
Medical, precision and optical instruments	1,7%	1,6%	117	123	107
Motor vehicles, trailers and semi-trailers	0,7%	0,9%	107	26	16
Other transport equipement	0,4%	0,3%	26	23	17
Furniture	4,7%	5,7%	340	501	132
Other sectors	0,0%	1,6%	133	109	
Total	100% (# 42,398)	100% (# 14,839)	8,222	6,617	1,659

Identification strategy: step 1

Input-trade liberalization and imported input prices

- Ordinary importers stand as a treated group whereas processing importers stand as a control group.
- We interact firm's type with firm-product-year level input tariffs.

$$P_{ipkct}^{IM} = \beta_1 Ordinary_i * \tau_{k,t-1} + \beta_2 Ordinary_i + \beta_3 \tau_{k,t-1} + \beta_4 Size_{i,t0} * \alpha_t + \alpha_{ik} + \alpha_{ct} + \alpha_{st} + \alpha_{pt} + \eta_{ipkct}$$

- P_{ipkct}^{IM} corresponds to the log of the import price (unit value) of firm i located in province p for input k from country c at time t (excluding tariff)
- τ_{ikt} is the tariff on input k at time t paid by firm i that import this HS6 product.
- $Ordinary_i$ is a dummy variables taking a value of one if firm i is ordinary,
- $Size_{i,t0} * \alpha_t$ correspond to initial firm size trends
- α_{ik}, α_{ct}, α_{st} and α_{pt} are firm-product, origin-country-year, HS4-year and province-year fixed effects and η_{ipkct} an i.i.d. component.
- $=>$ **All these trends pick up firm size, origin sourcing country, sector and location time-varying shocks.**

Identification strategy: step 2

Input-trade liberalization and export prices

- For each ordinary firm there is at least a processing importer exporting the same product (hs6) to same destination in the control group.
- We interact firm's type with firm-level input tariffs.

$$P_{ipkct}^{EX} = \delta_1 Ordinary_i * \tau_{i,t-1} + \delta_2 Ordinary_i + \delta_3 \tau_{i,t-1} + \beta_4 Size_{i,t0} * \alpha_t + \alpha_{ik} + \alpha_{ct} + \alpha_{st} + \alpha_{pt} + \eta_{ipkct}$$

- P_{ipkct}^{EX} is the log of export price (unit value) of firm i located in province p for product k in country c at time t
- τ_{it} is the input tariff faced by firm i at time t.
- $Ordinary_i$ is a dummy variables taking a value of one if firm i is ordinary,
- $Size_{i,t0} * \alpha_t$ correspond to initial firm size trends
- α_{ik}, α_{ct}, α_{st} and α_{pt} are firm-product, origin-country-year, HS4-year and province-year fixed effects and η_{ipkct} an i.i.d. component.

Identification strategy

- Two sources of identification:
- (2) **Input-tariff variations:** Are input tariff changes exogenous?
- (1) **Treated vs. Control group:** Are processing firms a good control group?

Step 2: Firm level input tariffs

- Firm level input tariffs: $\tau_{it} = \sum_k \alpha_k \tau_{kt}$
- where τ_{kt} is the output tariff of HS6-product k in t and k is used in the production of firm i final output and α_k is the initial weight of a specific HS6 product import value over the period.
- Initial fixed weight: avoids bias from changes in composition of input mix due to tariff cuts,
- Free of reverse causality between changes in imported input mix and export prices,
- All findings are robust to alternative tariff measures: constant weights and input tariff computed using IO tables.

Step 2: Input tariffs exogeneity

- Decision to join the WTO was mainly motivated by the domestic reform agenda and not to lobby (Branstetter and Lardy 2006)
- No significant correlation of tariffs changes 2000-2006 with initial industry performance (Topalova and Khandelwal 2011 (RESTAT), Goldberg et al. 2012, (QJE))

	Change in tariffs 2006-2000	Observations	R-squared
Value added (2000)	0.0022	378	0.251
	(0.003)		
Intermediate inputs (2000)	-0.0016	388	0.247
	(0.003)		
Investment (2000)	-0.0005	241	0.279
	(0.002)		
Herfindhal index (2000)	-0.0001	389	0.251
	(0.001)		
Exports (2000)	-0.0004	389	0.251
	(0.001)		
Imports (2000)	-0.0000	389	0.250
	(0.001)		
Share processing (2000)	-0.0030	389	0.251
	(0.008)		
Share state-owned (2000)	-0.0013	389	0.251
	(0.009)		

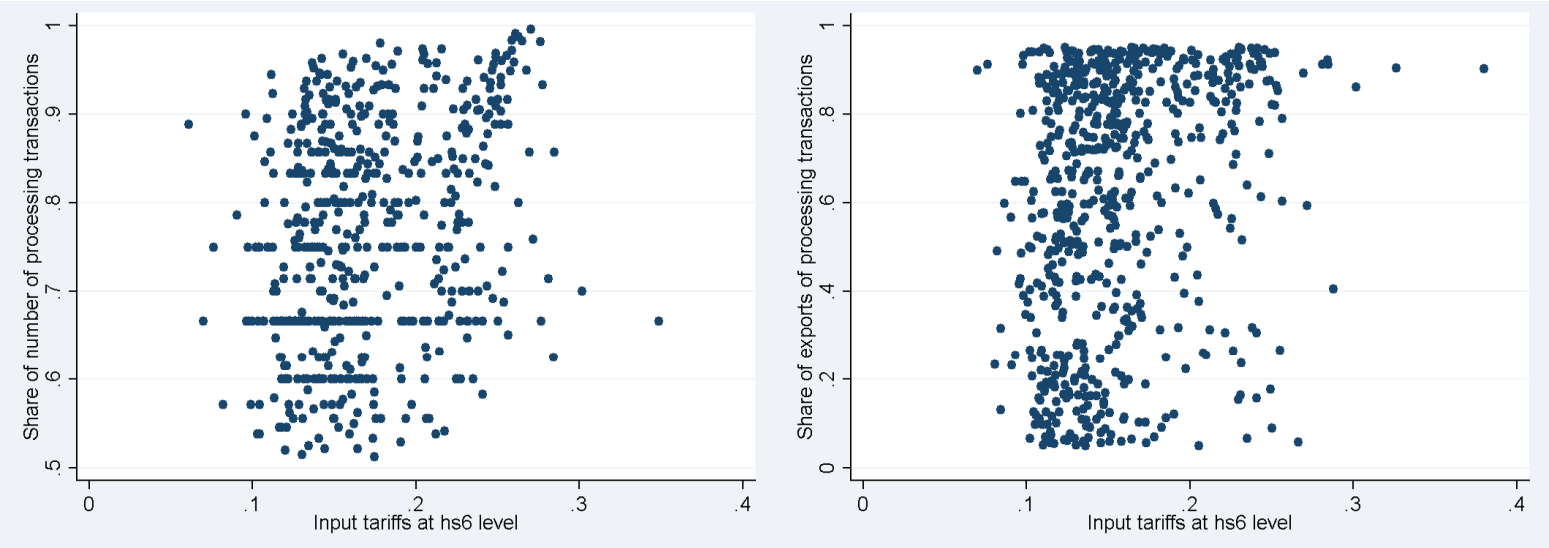
Processing firms as controls

- **The control group is similar to the treated group in terms of ownership and export patterns**:
- (1) Excluding foreign firms (mainly in the processing group)
- (2) Each ordinary firm has at least one corresponding processing firm exporting the same hs6 product, to the same destination in the same year.
- **One endogeneity concern however remains:** Is firms' trade status endogeneous to tariffs? Do firms decide to be processing in sectors where input tariffs are high?
  - Not expected since there is a high level of regulation in the attribution of processing trade certificates (Branstetter and Lardy 2006)
  - Assume that Chinese firms have information and freedom to make choices on their trade status as a reponse to tariffs level.
  - **Firms' decision:** paying the tariff vs. relative advantage of producing for the non-competitive home market.
  - In that case: processing firms should produce in sectors where the tariffs are high.

Processing firms as controls

- Absence of correlation between the choice of trade status and the input tariffs at the sector level.

Figure : Share of hs6 processing export in term of the hs6 tariffs, 2000.



Main results: Import prices and trade liberalization

Dependent variable: Import prices (excluding tariff) of firm i for product k from country c in year t						
	(1)	(2)	(3)	(4)	(5)	(6)
			Excluding raw materials		Controlling for product-country-year trends	
Tariff(t-1) × ordinary	-1.512***		-1.558***		-1.821***	
	(0.312)		(0.324)		(0.400)	
Tariff(t-1) × ordinary DC		-1.828***		-1.883***		-2.272***
		(0.312)		(0.325)		(0.398)
Tariff(t-1) × ordinary LDC		-1.035***		-1.040***		-1.173**
		(0.340)		(0.360)		(0.467)
Tariff(t-1)	-0.128	-0.024	-0.055	0.051		
	(0.267)	(0.269)	(0.278)	(0.279)		
Firm' size trends	yes	yes	yes	yes	yes	yes
Firm-product fixed effects	yes	yes	yes	yes	yes	yes
Country-year fixed effects	yes	yes	yes	yes		
Product-year fixed effects	yes	yes	yes	yes		
Province-year fixed effects	yes	yes	yes	yes	yes	yes
Product-country-year fixed effects				yes	yes	
Observations	1345636	1345636	1275545	1275545	1345636	1345636
R^2	0.921	0.921	0.920	0.920	0.935	0.935

Main results: Export prices and trade liberalization

Dependent variable: Export prices (f.o.b.) of firm i for product k in country c and year t						
	(1)	(2)	(3)	(4)	(5)	(6)
			Exporters DC		Exporters LDC	
Tariff(t-1) × ordinary	-0.080**		-0.083**		-0.056	
	(0.042)		(0.042)		(0.074)	
Tariff(t-1) × ordinary DC		-0.101**		-0.106**		-0.084
		(0.043)		(0.044)		(0.076)
Tariff(t-1) × ordinary LDC		0.099		0.109		0.274
		(0.124)		(0.130)		(0.180)
Firm' size trends	yes	yes	yes	yes	yes	yes
Firm-product fixed effects	yes	yes	yes	yes	yes	yes
Country-year fixed effects	yes	yes	yes	yes	yes	yes
Product-year fixed effects	yes	yes	yes	yes	yes	yes
Province-year fixed effects	yes	yes	yes	yes	yes	yes
Observations	2264821	2264821	1883506	1883506	381315	381315
R^2	0.903	0.903	0.911	0.911	0.931	0.931

- A 10 percentage point fall in input tariffs increases export prices by 0.8%.
- In line with the findings of De Loecker, Goldberg, Khandelwal and Pavcnik, (2013) for India: they find a small impact of the same magnitude for the output tariff reduction on domestic Indian prices.

Main results

- **The impact of input-trade liberalization on ordinary firms**
  - Buy imported inputs at a higher price.
  - Input tariffs cuts result in an increase in export prices (within firm-product effect).
  - The effect of the input tariffs cut on export prices is specific to inputs imported from developed economies.
  - This effect is only significant for exports towards high-income countries demanding high quality goods.
  - **One possible interpretation of these results:**
  - Firms take advantage of trade liberalization to upgrade their imported inputs and exported goods.

$\Rightarrow$ **Potential alternative explanations to the quality upgrading story.**

Alternative explanations to the quality upgrading story

- (1) **Alternative quality measures**: unit values are imperfect measures of product quality $\Rightarrow$ quality measure based on demand function estimation,
- (2) **Increase in marginal costs** $\Rightarrow$ sector-year and province-year fixed effects control for sectoral wages and input price increased related to competition structure of upstream sector,
- (3) **Demand shocks** $\Rightarrow$ tariff at the hs6-destination-year level or hs6-destination time specific fixed effect,
- (4) **Other time-varying shocks** different from tariffs that have a differential impact on ordinary and processing firms $\Rightarrow$ Ordinary trend,
- (5) **Pass-through effect** on import prices $\Rightarrow$ evidence against the pass-through channel such as increase in the number of imported inputs varieties and increase in import quantity explained by input tariff cuts.

Are Chinese firms upgrading the quality of their products?

- Prices (unit values) are imperfect measures of product quality.
- An increase in price may indeed reflect higher markups or marginal costs rather than quality upgrading.
- We provide several arguments that endorse our prior hypothesis of a product quality upgrading:
  - (1) **Country of origin of imported inputs:** $\Rightarrow$ trade liberalization allowed ordinary firms to source more varieties of inputs from more advanced (i.e., higher quality products) markets.
  - (2) **Alternative quality measure**: firm-level quality measure based on estimation of demand function Khandelwal, Schott and Wei, 2013 (AER),
  - (3) **Product characteristics related to the scope of quality upgrading**: Homogeneous vs. Differentiated goods (Rauch).

Alternative measure of quality

- Khandelwal, Schott and Wei (2013) rely on a CES utility function which accounts for product quality as a demand shifter:
- $U = \left(\int_{i \epsilon \Omega} (\lambda_i x_i)^{\frac{\sigma-1}{\sigma}} d_i \right)^{\frac{\sigma}{\sigma-1}}$
- where x_i and λ_i denote the quantity and the quality of a variety i.
- These preferences yield the following demand: $x_i = p_i^{-\sigma} \lambda_i^{\sigma-1} P_c^{\sigma-1} Y_c$
- Taking logs, the quality for each firm-product-country-year observation can be estimated as the residual of an OLS estimation:

$$x_{ikct} + \sigma p_{ikct} = \alpha_k + \alpha_{ct} + \eta_{ikct} \quad (1)$$

- where x_{ikct} and p_{ikct} denote the natural logs of the quantity and price of product k produced by firm i and sold in market c in t.
- α_{ct} controls for price index and income at destination,
- α_k controls for variation across products.

Are Chinese firms upgrading the quality of their products?

Dependent variable:	Quality measure from KSW			
	(1)	(2)	(3)	(4)
	Quality Imports		Quality Exports	
Tariff(t-1) × ordinary	-1.549***		-0.111*	
	(0.484)		(0.066)	
Tariff(t-1) × ordinary DC		-1.565***		-0.140**
		(0.577)		(0.067)
Tariff(t-1) × ordinary LDC		-1.492		0.163
		(1.070)		(0.200)
Initial size × year	yes	yes	yes	yes
Firm-hs6 product fixed effects	yes	yes	yes	yes
Destination/origin country-year fixed effects	yes	yes	yes	yes
Sector-Year fixed effects	yes	yes	yes	yes
Province-year	yes	yes	yes	yes
Observations	1239034	1239034	1799121	1799121
R^2	0.717	0.904	0.719	0.719

Controlling for exogenous demand and other shocks

Dependent variable: Export prices (f.o.b.) of firm i for product k in country c and year t						
	Trends in trade regime		Demand shocks		Tariff(kc,t-1) hs6-destination	
	(1)	(2)	(3)	(4)	(5)	(6)
Tariff(t-1) × ordinary	-0.082*		-0.071*		-0.079*	
	(0.046)		(0.041)		(0.042)	
Tariff(t-1) × ordinary DC		-0.098**		-0.090**		-0.103**
		(0.048)		(0.043)		(0.043)
Tariff(t-1) × ordinary LDC		0.056		0.101		0.131
		(0.147)		(0.127)		(0.126)
Tariffs (kc,t-1) HS6-dest					-0.048**	-0.048**
					(0.024)	(0.024)
Ordinary × 2001	-0.082***	-0.081***				
	(0.016)	(0.016)				
Ordinary × 2002	-0.073***	-0.074***				
	(0.018)	(0.018)				
Ordinary × 2003	-0.083***	-0.084***				
	(0.019)	(0.019)				
Ordinary × 2004	-0.072***	-0.072***				
	(0.021)	(0.021)				
Ordinary × 2005	-0.046**	-0.047**				
	(0.023)	(0.022)				
Ordinary × 2006	-0.052**	-0.051**				
	(0.024)	(0.024)				
Observations	2264821	2264821	2264821	2264821	1933433	1933433
R^2	0.903	0.903	0.913	0.913	0.908	0.908
Initial size × year	yes	yes	yes	yes	yes	yes
Firm-hs6 fixed effects	yes	yes	yeas	yes	yes	yes
Destination-year fixed effects	yes	yes			yes	yes
Destination-hs6-year fixed effects			yes	yes		
Province-year fixed effects	yes	yes	yes	yes	yes	yes
Sector-year fixed effects	yes	yes			yes	yes

Robustness tests

The previous findings are robust and stable to several sensitivity tests:

- (1) Alternative specifications: balanced sample
- (2) First differences including firm fixed effects in order to control for firm-specific time trends.
- (3) Sample of only ordinary firms
- (4) Alternative input-tariff measures (constant weight, IO tariffs),
- (5) Processing firms as control group: alternative samples:
  - Similar size: ordinary and processing firms with a size higher than the median;
  - Sector/ product characteristics -textile, electronic, raw materials-,

Conclusion

- Input-trade liberalization is associated with an increase in firms' imported inputs prices and an expansion in the number of imported inputs varieties from developed countries.
- Ordinary firms increase their f.o.b. export prices due to the input-tariff cuts.
- The country of origin and destination matters:
- The positive effect of input tariff reductions on firms' export prices is only significant for firms importing intermediate goods from developed countries
- and exporting to high-income countries (demanding high quality goods).

Conclusion

$\Rightarrow$ These findings suggest that input-trade liberalization in China allowed firms to upgrade the quality of imported inputs to produce high-quality goods for the export market.

$\Rightarrow$ Our results support models of Verhoogen (2008), Kluger and Verhoogen (2012), Hallak and Sivadasan (2009), Baldwin and Harrigan (2011), Demir (2012) where producing high quality goods requires expensive high quality inputs.