Prices, Markups and Trade Reform

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The goal of this paper:

1. Estimate Effects of India's Trade Liberalization on
   - Costs,
   - Markups,
   - Prices.
2. In order to answer this we develop a method to jointly estimate markups and marginal cost of production using production and price data.

Why do we care?

- Gains from trade depend on markups (currently few models allowing for this channel)
- Help us identify how gains from trade are distributed across producers and consumers. Leads to political economy of trade and explain often cited resistance to trade liberalization.
- Relationship to large literature on inefficiencies and frictions in developing countries (Bloom and Van Reenen, Hsieh and Klenow): why is productivity lower in India? Due to competition, frictions?
- Here we consider a policy change that:
  1. Increases competition due to decline in output tariffs (residual demand effect)
  2. Removal of one particular friction: tax on intermediates (marginal cost effect)

Motivation

- Conventional wisdom:
  1. Trade liberalization increases productivity (reallocation effects and within-firm productivity improvements)
  2. Trade liberalization decreases markups (because of the pro-competitive effects of the reforms)
- Conventional wisdom subject to caveats related to the use of revenue data (see several recent studies).
- Further, the analysis of markups has focused on the output side of liberalization (tariff reductions on **final** goods). Exception is Amiti and Konings (2008).
- However, trade liberalization typically also reduces costs to the producers (through reductions of tariffs on imported intermediate products). Markups effects will depend on whether the cost savings are passed through to consumers (function of demand and market structure).

Motivation ctd: why one more study?

- Better Data: Firm/Plant Level Data but with information on physical output and price by product
- Methodology delivers full distribution of markups and marginal costs, while addressing the caveats associated with earlier studies (multi-product, prices, etc.), allowing for a complete analysis of firm performance in aftermath of trade reforms.
- Indian's trade liberalization: big and exogenous leading to reduction in tariffs: directly measurable!
- Variation in both Output and Input Tariffs:
  - Output Tariffs shift residual demand
  - Input Tariffs affect costs of production

General Approach

- Use Firm/Plant-level data to estimate production functions
- Use optimal input choices and production to infer productivity and markups
- Marginal Costs are backed out in standard IO way: use Price/Markup
- Relate estimates to trade reform
- Advantage of approaching the questions from the production side: Valid under any demand system and market structure.
- Disadvantage: We do not model the market structure. Potential for counterfactuals limited

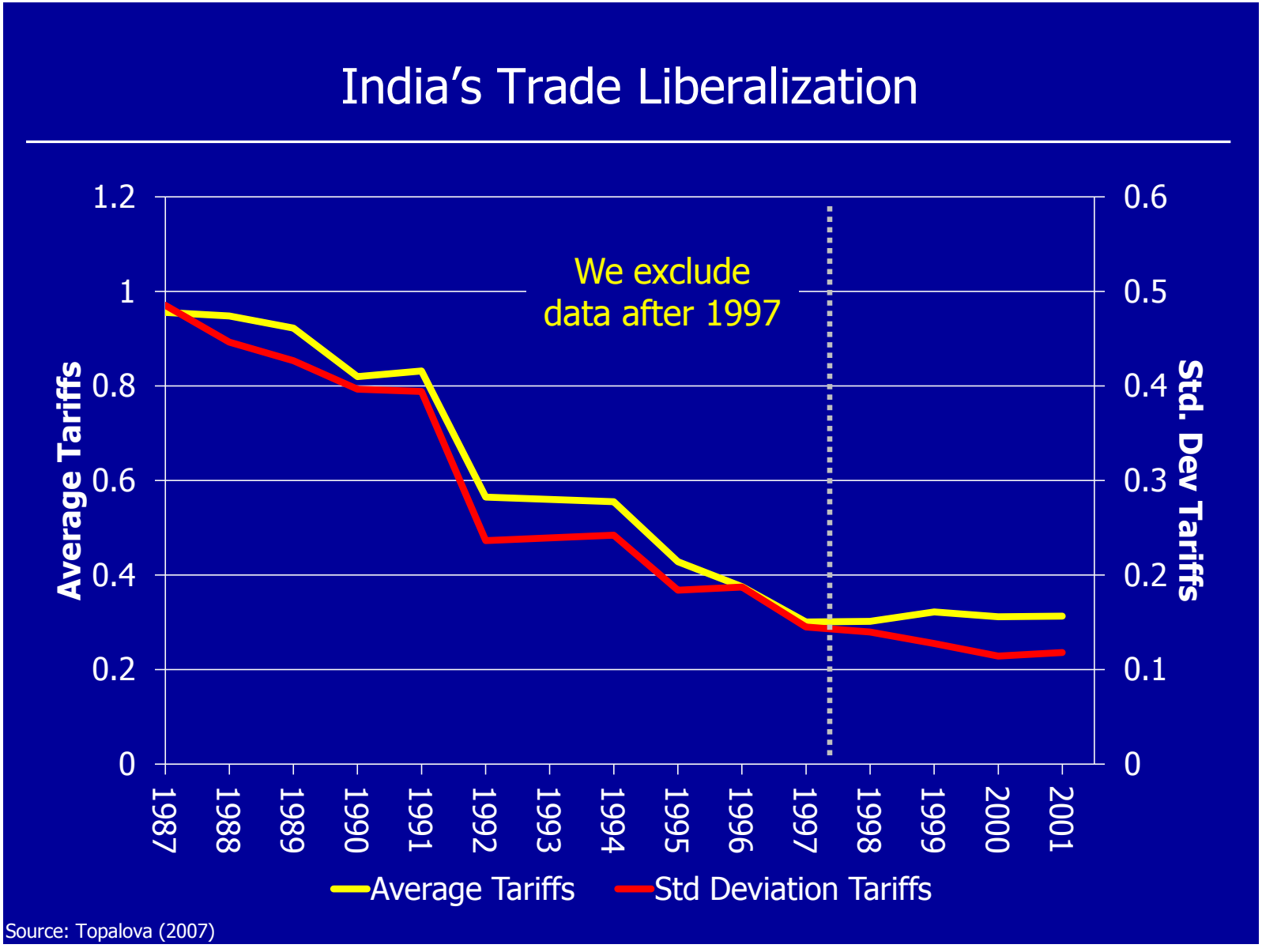
Novelties on Methodological Side

1. Product-level **output-based** production functions on single product firms.
2. Explicit Treatment of **multi-product** firms.
3. Use price and input tariff data to control for unobserved variation in firm input prices.
4. Obtain estimates of productivity for multi-product firms without any assumptions on input proportionality. Show how to infer allocation of input expenditures across products.
5. Do the above for a large set of industries/products that may be characterized by product differentiation and imperfect competition.

Road map for this talk

- Brief discussion of trade liberalization and data. For details, see GKPT (previous papers).
- Methodology:
  1. Deriving Markups and Costs from Production Functions:
  2. Estimation and Identification of Single-Product Production Function with Output Data
  3. Inference of Productivity and Input Allocation for Multi-Product Firms
- Results
  1. Production Function Estimation
  2. Markups, MC, Pass-through
  3. Effects of Trade on firm performance
- Conclude

Trade liberalization in India



Data on firms, products and tariffs

- Center for Monitoring of Indian Economy (CMIE) Covers 60-70% of Indias economic activity in organized industrial sector
- Firm-level panel data 1989-2003 and spans the period of trade reforms
- Medium and large Indian firms: Well suited to study changes among big and medium-sized mfg firms
- Manufacturing firms required by law to disclose product-level information in their annual reports (1956 Companies Act) Product module contains annual product-level information
- 1,886 products comparable to product definition used in the literature, such as e.g. BRS (2008) (1500 5-digit SIC)

Definition of a product

- Based on CMIE's internal product classification and products reported in companies annual reports
- 1,886 products: Comparable to BRS (2006a) product definition (ca 1500 5-digit SIC), Linked to 108 4-digit NIC industries
- Coverage across firms: Product info available for vast majority (85%) of mfg firms, 85% of manufacturing output, over 90% of exports
- Coverage within firms: Total product-level sales reported in Product module account for 92% of independently reported overall sales of the firm, 99% of independently reported mfg sales of the firm

Example of product space

Examples of Industries, Sectors and Products

NIC Code		Description
27		Basic Metal Industries (Sector *s*)
2710		Manufacture of Basic Iron & Steel (Industry *i*)
	130101010000	Pig iron
	130101020000	Sponge iron
	130101030000	Ferro alloys
	130106040800	Welded steel tubular poles
	130106040900	Steel tubular structural poles
	130106050000	Tube & pipe fittings
	130106100000	Wires & ropes of iron & steel
	130106100300	Stranded wire
2731		Casting of iron and steel (Industry *i*)
	130106030000	Castings & forgings
	130106030100	Castings
	130106030101	Steel castings
	130106030102	Cast iron castings
	130106030103	Maleable iron castings
	130106030104	S.G. iron castings
	130106030199	Castings, nec

Products (*j*)

Notes: This table is replicated from Goldberg et al. (2010b). For NIC 2710, there are a total of 111 products, but only a subset are listed in the table. For NIC 2731, all products are listed in the table.

Empirical Framework

- A firm faces a production function of the general form:

$$Q_{ft} = F_t(\mathbf{X}_{ft}) \exp(\omega_{ft}) \tag{1}$$

- where $\mathbf{X}$ captures:
  1. variables inputs $(V^1, ..., V^V)$: such as materials, electricity, etc.
  2. dynamic inputs of production $\mathbf{K}$, such as capital and potentially labor.
- For now we supress the product subscript j.
- Note this approach allows for frictions, such as adjustment costs, in both capital and labor markets. But firms optimize against these frictions.

Firm behavior: cost minimization

- We follow DLW and rely on cost minimization of variable input(s), conditioning on dynamic inputs:

$$\mathcal{L}(V_{ft}^1, ..., V_{ft}^V, \mathbf{K}_{ft}, \lambda_{ft}) = \sum_{v=1}^{V} P_{ft}^v V_{ft}^v + \mathbf{r}_{ft}\mathbf{K}_{ft} + \lambda_{ft}(Q_{ft} - Q_{ft}(.)) \tag{2}$$

$$\frac{\partial \mathcal{L}_{ft}}{\partial V_{ft}^v} = P_{ft}^v - \lambda_{ft}\frac{\partial Q_{ft}(.)}{\partial V_{ft}^v} = 0 \tag{3}$$

$$\frac{\partial Q_{ft}(.)}{\partial V_{ft}^v}\frac{V_{ft}^v}{Q_{ft}} = \frac{1}{\lambda_{ft}}\frac{P_{ft}^v V_{ft}^v}{Q_{ft}} \tag{4}$$

- Cost minimization implies that optimal input demand is realized when a firm equalizes the output elasticity of any variable input V_{ft}^{v} to $\frac{1}{\lambda_{ft}} \frac{P_{ft}^{v} V_{ft}}{Q_{ft}}$.
- Define markup μ_{ft} as $\mu_{ft} \equiv \frac{P_{ft}}{\lambda_{ft}}$. DLW show that the cost-minimization condition can be rearranged to write markup as:

$$\mu_{ft} = \theta_{ft}^{v} (\alpha_{ft}^{v})^{-1} \tag{5}$$

- with θ_{ft}^{v} the output elasticity of variable input v, μ_{ft} the markup and α_{ft}^{v} the share of expenditures on v in total sales.

Markups at the firm-product level

- In our data we have product-level information on output and prices.
- Using the framework and moving to multi-product firms does not pose problems for theory, in fact we get:

$$\mu_{fjt} = \theta^{v}_{fjt}(\alpha^{v}_{fjt})^{-1} \tag{6}$$

- The problem arises in getting an estimate of both RHS variables at the product-firm level.
- These firms cannot be ignored as they make up about 47% of firms in our data.

Multi-Production Functions: challenges

- We consider the following production function:

$$q_{fjt} = f(\mathbf{x}_{fjt}; \boldsymbol{\beta}) + \omega_{ft} + \epsilon_{fjt} \tag{7}$$

- However, it is hard (if not impossible) to measure $\mathbf{x}_{fjt}$ across a wide set of products, producers, industries and time.
- We do observe, for a given input x_{ft} and $x_{fjt} \equiv \rho_{fjt} + x_{ft}$

$$q_{fjt} = f(\mathbf{x}_{ft}; \boldsymbol{\beta}) + \omega_{ft} + A(\rho_{fjt}, \mathbf{x}_{ft}; \boldsymbol{\beta}) + \epsilon_{fjt} \tag{8}$$

- Remember the traditional approach was/is to consider:

$$r_{ft} = \mathbf{x}_{ft}\boldsymbol{\beta} + \omega_{ft} + \nu_{ft} \tag{9}$$

Identification I

- Identification strategy: use the (unbalanced) set of single product firms in a given industry to recover production function using extended proxy approach.
- In addition, include selection correction for non-random event of becoming multi-product based on underlying productivity of the firm, and other state variables (capital and even labor).
- This insight avoids treating unkown input allocation across inputs, $A(\rho_{fjt}, \mathbf{x}_{ft}; \beta)$, which depends on underlying demand and competition of each product.
- Our entire approach is based on not having to specify or take a stand on demand and pricing game.

Implications multi-product production

- Economies of scope in production are allowed for, or in our case:

$$C_{ft}(\mathbf{Q}) \leq \sum_{j} C_{fjt}(Q_{fjt}) \tag{10}$$

- We simply restrict product j's production to follow $Q_{fjt} = F_t(\mathbf{X}_{fjt})\Omega_{ft}$, regardless of whether the firm produces any other product. Economies of scope can still arise due to:
  1. Differences in input prices due to buying in bulk,
  2. Productivity differences capture differences *across* single and multi-firms.

Identification II

- In addition, we directly observe quantity produced and can therefore immediately eliminate demand and price effects that plague production function identification (De Loecker 2011).
- Remember:

$$(q_{fjt} + p_{fjt}) = \mathbf{x}_{fjt}\boldsymbol{\beta} + \omega_{ft} + p_{fjt} + \epsilon_{fjt} \tag{11}$$

- With revenue data unobserved demand shocks would bias coefficients and lead to incorrect measure of productivity. Here important to get correct output elasticitity and not revenue elasticity.
- Comment. This puts us in unkown territory, and will require to think about input quality variation since product differentiation.

Identification III

- Key identification assumption in this class of models is productivity process. We move away from the standard assumption of exogenous Markov process, and consider:

$$\omega_{ft} = g_{t-1}(\omega_{ft-1}, \tau_{t-b}) + \xi_{ft} \tag{12}$$

- Also see Doraszelski and Jaumandrei (2008) and De Loecker (Forthcoming) for discussion on importance.
- Both labor and capital face adjustment costs and focus on variable inputs to compute markups and carry through logic in production function identification and estimation.

Identification IV: selection

- Using the set of single product producers potentially introduces a selection bias *if adding one or more products* depends on the firm's productivity and input use.
- If adding products only depends on the firm's productivity, the use of an unbalanced panel of single product firms is sufficient: include all firms that are single product at some point. (here at leat 2 consecutive periods)
- If in addition to ω, selection is on x we include the propensity score of remaining single product, S_{ft-1}, given $(\mathbf{x}, \mathbf{z})$ into the law of motion, i.e. $g_{t-1}(\omega_{ft-1}, \boldsymbol{\tau}_{t-b}, \widehat{S}_{ft-1})$.
- This correction rests on various models of multi-product firms (MMO is very close to our structure). For more details next slide.

Selection control: more details

- Define an indicator of remaining single product at time t given the firm's information set at $t-1$ as $\chi_{ft}=1$; and the probability to remain single product $Pr(\chi_{ft}=1)$ is:

$$\begin{aligned} Pr\left[\omega_{ft} \leq \bar{\omega}_{ft}(l_{ft},k_{ft},\mathbf{z}_{ft})|\bar{\omega}_{ft}(l_{ft},k_{ft},\mathbf{z}_{ft}),\omega_{ft-1}\right] \\ = \kappa_{t-1}(\bar{\omega}_{ft}(l_{ft},k_{ft},\mathbf{z}_{ft}),\omega_{ft-1}) \\ = \kappa_{t-1}(l_{ft-1},k_{ft-1},i_{ft-1},\mathbf{z}_{ft-1},\omega_{ft-1}) \\ = \kappa_{t-1}(l_{ft-1},k_{ft-1},i_{ft-1},\mathbf{z}_{ft-1},m_{ft-1}) \\ \equiv S_{ft-1} \end{aligned} \tag{13}$$

- Remaining single product depends on two different indices, productivity and the threshold, and we can thus write the threshold as $\bar{\omega}_{ft}=\kappa_{t-1}^{-1}(S_{ft-1},\omega_{ft-1})$, where the last element already enters the law of motion.
- Including propensity score corrects for the selection based on the firm's state variables (flexible).

Estimation: single product firms

- We consider a flexible production function, and note that although single product we need f, j and t:

$$q_{ft} = f(\mathbf{x}_{ft}; \boldsymbol{\beta}) + \omega_{ft} + \epsilon_{ft} \tag{14}$$

- Standard simultaneity bias through unobserved productivity shocks ω_{fjt} where we rely on extension of proxy estimator approach.
- *New* problem of potential input price variation left in measured inputs in quantity setting. Equivalent to price bias but now on input side.
- Comment on *dollar* on *dollar* approach, whereas here potentially *tonnes* on *dollars*, and role quality on input and output side.

Input demand and productivity

- We rely on a static input demand equation to proxy for unobserved productivity, simply restates cost min. conditions:

$$m_{ft} = m_t(\mathbf{k}_{ft}, \mathbf{z}_{ft}, \omega_{ft}) \tag{15}$$

$$\omega_{ft} = h_t(m_{ft}, \mathbf{k}_{ft}, \mathbf{z}_{ft}) \tag{16}$$

- where $\mathbf{z}_{ft}$ affecting choice of m_{ft}, including both demand and cost factors.

$$\mathbf{z}_{ft} = \{\tau^i_{it}, \tau^o_{it}, p_{ft}, \mathbf{D}_j, ms_{ft}\} \tag{17}$$

Estimation algorithm

1. *Predicting output*: Using input demand to control for ω_{ft}:

$$q_{ft} = \phi_t(\mathbf{x}_{ft}, \mathbf{z}_{ft}) + \epsilon_{ft} \tag{18}$$

2. *GMM*: We form moments constructing shock to productivity:

$$\xi_{ft}(\beta) = \omega_{ft}(\beta) - E(\omega_{ft}(\beta)|\mathcal{I}_{ft-1}) \tag{19}$$

$$E\left(\boldsymbol{\xi}_{ft}(\boldsymbol{\beta})\mathbf{Y}_{ft}\right) = 0 \tag{20}$$

with instruments $\mathbf{Y}_{ft}$ containing l_{fjt-1} (l_{fjt}), m_{fjt-1} and k_{fjt}, and their appropriate higher order terms.

Input price/quality bias

- Once we take the physical production function seriously we run into similar problem of omitted price bias (KG, DL).
- In the data we only observe deflated (by sector and not firm) input expenditures, $\tilde{x}_{ft}$. Therefore:

$$q_{ft} = f(\tilde{x}_{ft}; \beta) + \omega_{ft} + B_{ft}(\tilde{x}_{ft}, \nu_{ft}) + \epsilon_{ft} \tag{21}$$

- No instruments available here that satisify orthogonality with productivity, while correlated with inputs.
- We include control for input price/quality ν_{ft} using $d_t(p_{ft}, ms_{ft}, \tau_{st}, D)$, generated from a large class of models of market structure/demand.
- The control for unobserved quality/price comes from underlying structure of quality production and complementarity among inputs. Mostly worried about input quality variation across producers, and less about input price variation conditional on quality.

Second stage: creating moments

- No restriction on production function $f(.)$ so far, only Hicks neutrality, and we now know productivity up to a vector of parameters and taking stand on $f(.)$:

$$\omega_{ft}(\boldsymbol{\beta}, \boldsymbol{\delta}) = \phi_{ft} - \mathbf{x}_{ft}\boldsymbol{\beta} - d_t(\tau^i_{it}, \tau^o_{it}, p_{ft}, ms_{ft}; \boldsymbol{\delta}) \qquad (22)$$

- where inclusion of $d(.)$ is important to control for unobserved quality/input prices which would bias coefficient.
- This leads to modified *GMM*, where set of $\boldsymbol{\delta}$ are estimated alongside $\boldsymbol{\beta}$

Full model:

- We form moments:

$$E\left(\xi_{ft}(\beta)\mathbf{Y}_{ft}\right) = 0 \tag{23}$$

- with instruments $\mathbf{Y}_{ft}$ containing l_{fjt-1} (l_{fjt}), m_{fjt-1} and k_{fjt}, and their appropriate higher order terms, and lagged prices, market shares, and current tariffs.
- We exploit fact that current shocks to productivity immediately impact a firm's intermediate input's use, and partially labor use, whereas capital stock cannot not directly react.
- Additional parameters δ have similar economic conditions for identification, e.g. price coefficient $E(\xi_{ft}p_{ft-1}) = 0$ reflects relationship between output price and input price/quality. (Note large set of applications become feasible).

Recovering productivity, markups and marginal costs: single-product firms

- We recover markups and marginal costs as follows:

$$\mu_{ft} = \theta^{v}_{ft}(\beta)\frac{R_{ft}}{C^{v}_{ft}} \tag{24}$$

$$mc_{ft} = \frac{P_{ft}}{\mu_{ft}} \tag{25}$$

- where C^{v}_{ft} denotes product j's expenditure on input v.

Recovering markups and marginal costs: multi-product firms

- Our identification strategy eliminates the problem of dealing with multi-product production, and we back out

$$\widehat{\omega}_{fjt} = q_{fjt} - \tilde{\mathbf{x}}_{ft}\beta \tag{26}$$

$$= \omega_{ft} + \rho(\rho_{fjt}, \mathbf{x}_{ft}, \beta) \tag{27}$$

- where $\rho_{fjt} = \ln\left\{\frac{\tilde{x}_{fjt}}{\tilde{x}_{ft}}\right\}$, are cost shares of an input j.
- The shares are specific to a demand and market structure for each product produced.
- Instead we rely on $\widehat{\beta}$ to recover productivity, markups and marginal costs as follows.

Multi-product firms ctd.

- Under translog we solve, by firm and time, for (ρ_j, ω) where $j = \{1, ..., J\}$ using:

$$\widehat{\omega}_j = \omega + a\rho_j + b\rho_j^2 + c\rho_j^3 \tag{28}$$

$$\sum_j \exp(\rho_j) = 1 \tag{29}$$

- where $\widehat{\omega}_j = E(q_j|.)$ and a, b are data related to translog term
- System of $(J+1)$ equations to solve for $(J+1)$ unknowns, where we use various starting values (revenue shares, random, etc.).

Markups and marginal costs for multi-product firms

- We compute the markup and marginal costs using price data according to

$$\mu_{fjt} = \theta^{v}_{fjt}(\boldsymbol{\beta}) \frac{R_{fjt}}{\exp(\rho_{fjt}) C^{v}_{ft}} \tag{30}$$

$$mc_{fjt} = \frac{P_{fjt}}{\mu_{fjt}} \tag{31}$$

Results: Overview

1. Production Function coefficients,
2. Firm performance correlation matrix,
3. Change in distributions,
4. Regression framework to identify trade reform's effect.

Results: Output elasticities and RTS

Sector	Obs. in Single-Product Firm Estimation (1)	Labor (2)	Materials (3)	Capital (4)	Returns to Scale (5)
15 Food products and beverages	1,681	0.29 [0.02]	0.61 [0.03]	0.08 [0.03]	0.98 [0.04]
17 Textiles	2,054	0.31 [0.01]	0.57 [0.02]	0.11 [0.02]	0.98 [0.02]
18 Wearing apparel	301	0.39 [0.08]	0.61 [0.09]	0.09 [0.07]	1.09 [0.19]
21 Paper and paper products	761	0.29 [0.02]	0.59 [0.02]	0.10 [0.01]	0.97 [0.05]
23 Coke, refined petroleum products	172	0.30 [0.00]	0.60 [0.00]	0.10 [0.00]	1.00 [0.00]
24 Chemicals	2,367	0.31 [0.03]	0.56 [0.04]	0.14 [0.03]	1.01 [0.09]
25 Rubber and Plastic	1,072	0.30 [0.12]	0.66 [0.08]	0.10 [0.04]	1.06 [0.21]
26 Non-metallic mineral products	978	0.42 [0.08]	0.60 [0.04]	0.05 [0.08]	1.08 [0.13]
27 Basic Metal	1,392	0.13 [0.15]	0.53 [0.10]	0.04 [0.16]	0.70 [0.37]
28 Fabricated metal products	637	0.29 [0.03]	0.57 [0.05]	0.10 [0.01]	0.96 [0.08]
29 Machinery and equipment	964	0.25 [0.08]	0.61 [0.06]	0.07 [0.07]	0.93 [0.15]
31 Electrical machinery and apparatus	610	0.25 [0.06]	0.55 [0.06]	0.11 [0.06]	0.91 [0.16]
32 Radio, TV and communication	437	0.25 [0.05]	0.63 [0.08]	0.06 [0.07]	0.93 [0.12]
34 Motor vehicles, trailers	598	0.30 [0.03]	0.90 [0.25]	0.01 [0.05]	1.21 [0.22]

Notes: Table reports the output elasticities from the production function. The first column reports the number of observations for each production function estimation. As noted in the text, these observations are the number of firms that remain single-product for three consecutive years. Columns 2-4 report the average estimated output elasticity with respect to each factor of production for the translog production function for these single-product firms. Stardard deviations of the output elasticities reported in brackets are below the mean values. The 5th column reports the average returns to scale, which is the sum of the mean values from

Results: The importance of corrections

	Estimates without Correcting for Input Price Variation				Estimates on a Balanced Panel of Single-Product Firms			
Sector	Labor (1)	Materials (2)	Capital (3)	Returns to Scale (4)	Labor (5)	Materials (6)	Capital (7)	Returns to Scale (8)
15 Food products and beverages	1.22	0.50	0.36	2.09	0.25	0.65	0.14	1.04
17 Textiles	3.17	-0.24	-2.50	0.43	0.42	0.63	0.09	1.13
18 Wearing apparel	0.74	0.14	0.33	1.21	0.37	0.54	0.06	0.97
21 Paper and paper products	0.00	1.30	1.19	2.49	0.26	0.55	0.14	0.96
23 Coke, refined petroleum products	0.53	0.10	-0.04	0.59	0.33	0.61	0.14	1.08
24 Chemicals	0.00	1.36	0.42	1.78	0.30	0.58	0.08	0.96
25 Rubber and Plastic	-1.12	1.19	1.88	1.96	0.32	0.64	0.07	1.03
26 Non-metallic mineral products	-2.53	1.96	0.28	-0.29	0.36	0.63	0.21	1.19
27 Basic Metal	-1.04	0.73	1.15	0.85	0.46	0.55	0.07	1.08
28 Fabricated metal products	2.01	0.44	-0.02	2.43	0.29	0.59	0.09	0.97
29 Machinery and equipment	0.37	-0.02	0.39	0.74	0.37	0.60	0.11	1.08
31 Electrical machinery and apparatus	-0.71	-0.03	-0.70	-1.44	0.30	0.73	0.03	1.06
32 Radio, TV and communication	-3.01	0.54	2.20	-0.27	0.29	0.65	0.12	1.06
34 Motor vehicles, trailers	0.43	0.47	0.25	1.16	0.29	0.63	0.21	1.13

Notes: The table reports the output elasticities from production function estimations that do not account for input price variation or sample selection. The first panel reports the elasticities and returns to scale for the estimation that does not account for input price variation. The second panel reports the output elasticities and returns to scale for the estimation that uses only a balanced set of single-product firms from 1989-2003. To save space, the standard deviations of the elasticities are not reported.

Results: Markups

	Markups	
Sector	Mean	Median
15 Food products and beverages	2.02	0.97
17 Textiles	1.45	1.11
18 Wearing apparel	1.15	1.10
21 Paper and paper products	1.05	0.98
23 Coke, refined petroleum products	4.17	0.93
24 Chemicals	2.11	1.00
25 Rubber and Plastic	1.96	1.28
26 Non-metallic mineral products	4.40	2.05
27 Basic Metal	1.86	0.91
28 Fabricated metal products	3.35	1.07
29 Machinery and equipment	2.34	1.27
31 Electrical machinery	2.42	1.04
32 Radio, TV and communication	1.78	1.31
34 Motor vehicles	2.16	1.81
Average	2.13	1.10

Notes: Table displays the mean and median markup by sector for the sample 1989-2003. The table trims observations with markups that are above and below the 3rd and 97th percentiles within each sector.

Firm Performance measures

	Prices	Markups	Marginal Costs	Productivity
Prices	1.00			
Markups	0.16	1.00		
Marginal Costs	0.94	-0.19	1.00	
Productivity	-0.39	0.04	-0.40	1.00

Notes: Table reports the pairwise correlation matrix across four performance variables: prices, markups, marginal costs and productivity. All variables are expressed in logs. Prices, markups and marginal costs vary at the firm-product level while productivity varies at the firm level. The table trims observations with markups that are above and below the 3rd and 97th percentiles within each sector.

Back to our product listing: Ferro Alloys (130101030000)

Year	Price	Markup	Mc	Output elasticity
1992	2.1	1.3446	1.5	0.72
1993	2.0	1.3336	1.4	0.70
1994	1.6	1.5390	1.0	0.73
1996	1.8	1.2304	1.4	0.72
1997	1.7	1.3994	1.2	0.61
1998	1.7	1.5062	1.1	0.62
1999	1.5	1.5439	1.0	0.60
2000	1.7	1.5578	1.1	0.58
2001	1.7	1.5781	1.1	0.56

Pass-through

- We consider standard pass-through regression exploiting time series variation in prices and marginal costs.
- We perform this at the product-firm level, while controling for output tariffs' effect on residual demand.
- We find incomplete pass-through of around 0.6 indicating strong departure from CES-monop. comp. framework.

A look at pass-through

	Log Price$_{fjt}$	
	(1)	(2)
Log Marginal Cost$_{fjt}$	0.293***	0.603***
	0.037	0.052
Observations	20,631	20,631
Firm-Product FEs	yes	yes

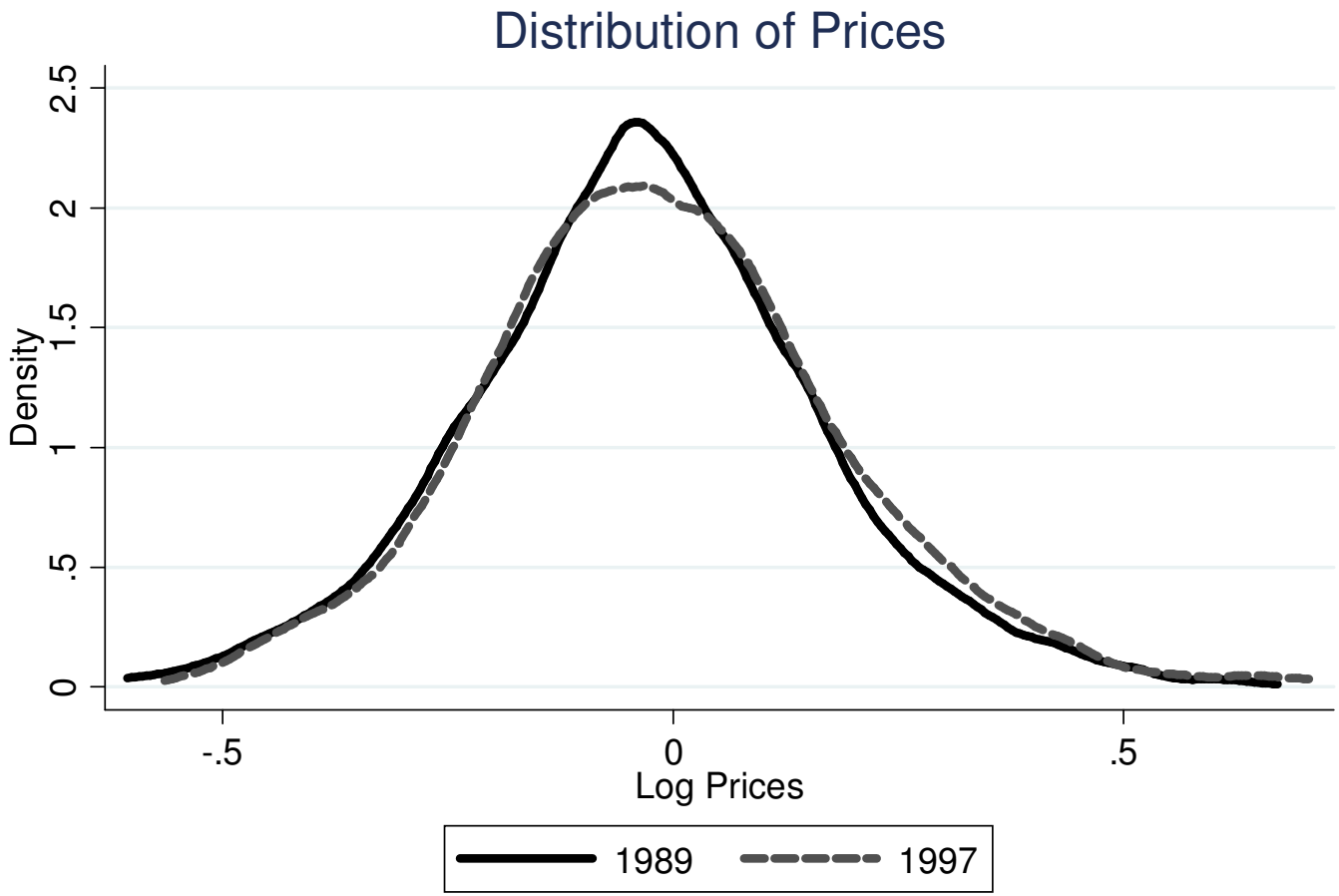
Notes: The dependent variable is (log) price. The regressions exclude outliers in the top and bottom 3rd percent of the markup distribution. All regressions include firm-product fixed effects. Column 1 is a OLS regression on log marginal costs. Column 2 instruments marginal costs with firm-level productivity and input tariffs. The coefficients on productivity and input tariffs in the first stage are -0.70 and 0.52, respectively, and are both statistically significant at the 1-percent level. These are the expected signs and the joint F-statistic is 137. The regressions are run from using data from 1989-1997 and the standard errors are clustered at the industry level. Significance: * 10 percent, ** 5 percent, *** 1 percent.

- Pass-through obtained without restrictions on market structure and demand. We get an insight in the dynamic competition effects, and implications for both demand and market structure *over time* in IO models.

The role of trade liberalization: distributions

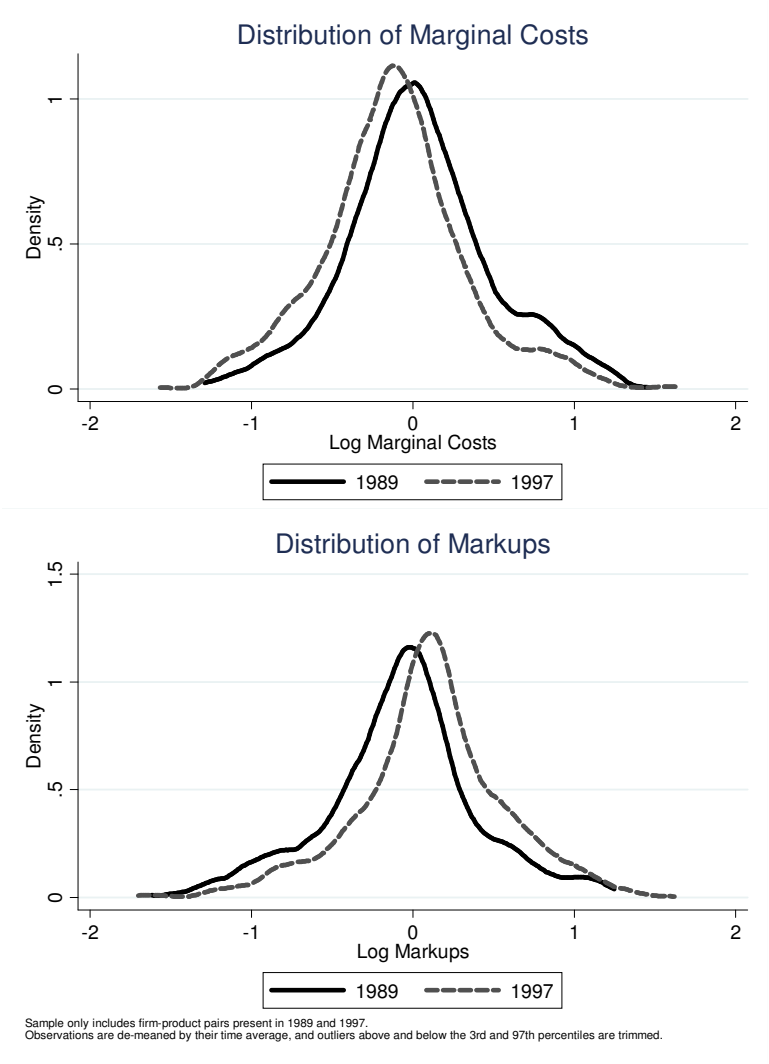
- We exploit the exogenous trade liberalization episode and plot for 1989 and 1997
  1. Markups
  2. Marginal costs
  3. Prices

Change in prices



Sample only includes firm-product pairs present in 1989 and 1997.
Observations are de-meaned by their time average, and outliers above and below the 3rd and 97th percentiles are trimmed.

Change in markup and mc distribution



The impact of trade liberalization

- We now consider the following specifications:

$$a_{fjt} = \alpha_{fj} + \alpha_{st} + \beta_1 \tau_{it}^{output} + \beta_2 \tau_{it}^{input} + \eta_{fjt} \qquad (32)$$

- where a: prices, markups and marginal costs.
- Cluster s.e. on industry everywhere.

Firm performance and trade liberalization: a decomposition

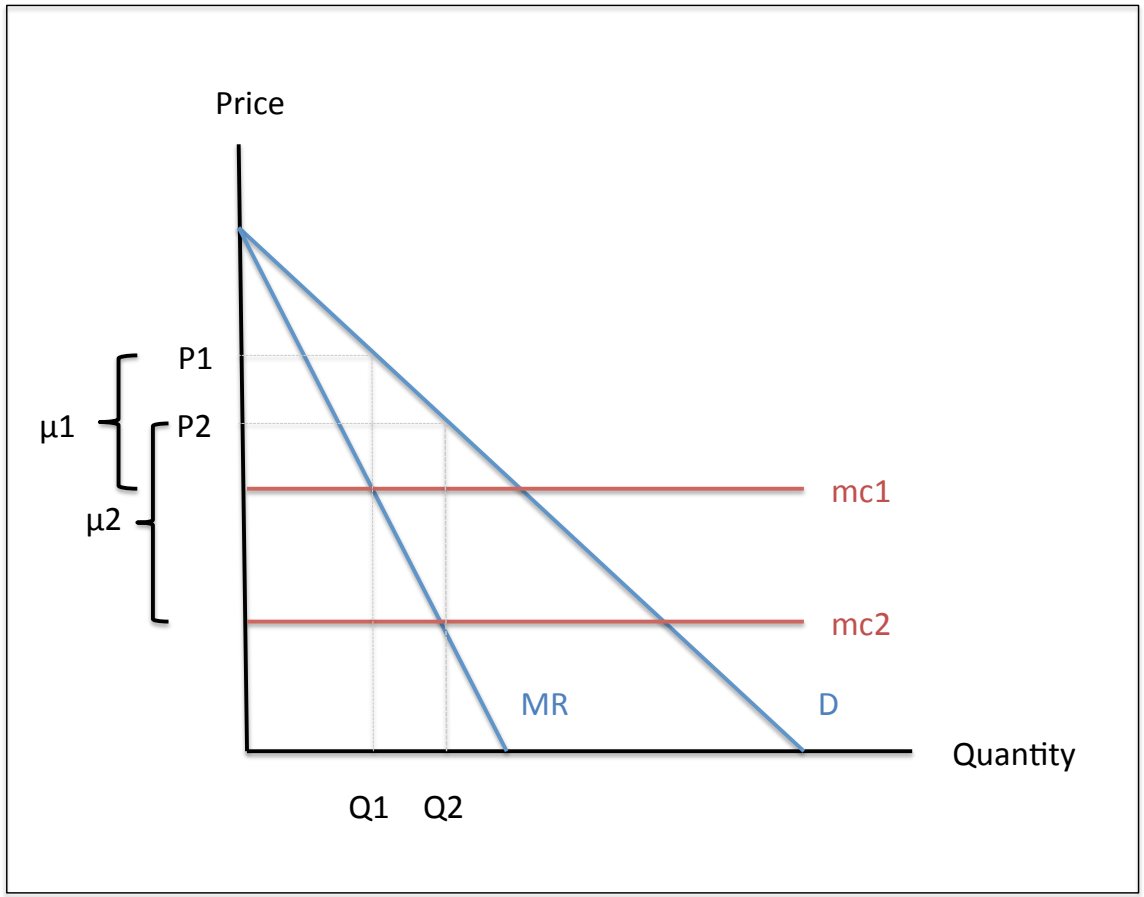
	Log Prices$_{fjt}$	Log Marginal Cost$_{fjt}$	Log Mark
	(4)	(5)	(6)
Output Tariff$_{it}$	0.135 ***	0.083	0.052
	0.053	0.116	0.083
Input Tariff$_{it}$	0.343	1.405 *	-1.062 **
	0.450	0.876	0.544
marginal cost			
R-squared	0.02	0.03	0.03
Observations	20,654	20,654	20,654
Firm-Product FEs	yes	yes	yes
Sector-Year FEs	yes	yes	yes

Identifying the mechanism

	Log Markup$_{fjt}$	
	(1)	(2)
Log Marginal Cost$_{fjt}$	-0.726***	-0.726***
	0.063	0.063
Output Tariff$_{it}$	0.093**	0.093**
	0.038	0.042
Input Tariff$_{it}$		0.025
		0.309
R-squared	0.62	0.62
Observations	19,768	19,768
Firm-Product FEs	yes	yes
Sector-Year FEs	yes	yes

Notes: The dependent variable is (log) markup. The regressions exclude outliers in the top and bottom 3rd percent of the markup distribution. All regressions include firm-product fixed effects and sector-year fixed effects. The regressions are run from 1989-1997 and standard errors are clustered at the industry level.
Significance: * 10 percent, ** 5 percent, *** 1 percent.

A Stylized Illustration of our findings



Conclusion

- Provide a new method to deal with multi-production function estimation using product-level quantity data. We think there is a lot of room for applying our framework.
- Recover full distribution of markups, marginal costs and productivity using minimal assumptions on firm behavior, i.e. cost minimization and assumptions on technology.
- Trade reform: Input tariff effects dwarf output tariffs effect, and lead to large changes in marginal costs that are almost fully turned in markup increases.
- Prices react very little, and gains from trade liberalization captured by producers' markup increase.

Implications of findings

- Implications for demand systems we use in pass-through and welfare analysis of policy changes. In particular it will help shed light on dynamic competition: how do firms adjust prices in light of changes in market structure and facing *a demand curve*. We are not restricting two important ingredients. Talk about thought experiment.
- Relationship to large literature on inefficiencies and frictions in developing countries (Bloom and Van Reenen, Hsieh and Klenow).
- Connect our results to previous findings of Goldberg et al (2010): product entry post trade reforms. Increase in variable profits, due to higher markups, are used to cover product introduction and development costs. (Table 11 in paper).