

# Lecture 2: Empirical Studies on India

## An Application

Abhiroop Mukhopadhyay

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# Trade Liberalization and Productivity

- Cross Sectional Studies: Estimate the effects of trade liberalization on firm performance in Indian Manufacturing
  - Krishna and Mitra 1998: ( for the period 1986-1993)
  - Sivadasan 2009
- Panel Data Study:
  - Topolova and Khandelwal 2010

- Exploits the 1991 liberalization episode to examine effects of trade reforms on firm level productivity
- Apart from the obvious interest of Indophiles in this episode, the other rationale for this study
  - The reforms were not endogenous to productivity. In other words, it was not the case that the reforms were phased in as domestic firms improved productivity.
  - Panel Data availability (Prowess, ASI)

# Some Stylized Facts about India's Trade Liberalization

- 1947-early 1980s: India's trade regime very restrictive
- 1980s onwards: India embarked on market reforms to ease import and industrial licenses. But Trade reforms still restrictive (Average Tariff Rate still around 90 percent)
- Late 1980s: Macroeconomic Imbalance (Oil price hike, fall in remittance) led to Structural Adjustment Program: lowering of tariff rates and easing on quantitative control on imports
- Average tariff rates fell from more than 87 percentage points in 1990 to 43 percentage points in 1996.
- Standard deviation of tariffs dropped by about 30 percentage.
- The share of products subject to quantitative restrictions decreased from 87 percent in 1987-88 to 45 percent in 1994-95.

# Effect of Tariff Reduction

- Imports Increased particularly among intermediate Inputs
- Trade to GDP ratio increased from an average of 13 percent in 1980s to 19 percent of GDP by 1999/00

# Variation Used in the Analysis

- Variation in tariff rates at six digit level industry classification (Different from earlier papers, that used a dummy variable to indicate whether the period analyzed was before or after the trade liberalization)
- Natural Question: Is the change in tariff for an industry a function of its past performance (We return to this later).

# Productivity Measure:

- Construction of firm level TFP: Levinsohn Petrin
- Rationale: To control for productivity affecting input choice
- Aside: In the PROWESS data set, the information is limited to large firms. Hence exit is not a big issue.
- Production function estimation done at the 2 -digit National Industrial Classification level (NIC). Too few firms at a higher level of disaggregation.
- Capital Stock for each period generated by the Perpetual Inventory Model: that is sum investments every year from a base year. (appropriately depreciated)

# TFP Calculation

- Obtain the input coefficients
- Subtract the predicted value from the actual value to get residuals:  
TFP
- To standardize it across industries: creation of a productivity index by subtracting it from a reference firm's productivity in the particular industry in a base year.



- Impact of trade on firm level TFP:

$$pr_{ijt} = \alpha + \alpha_t + \alpha_j + \beta \cdot trade_{jt-1} + X' \gamma + v_{ijt}$$

where  $i$  : firm,  $j$  : industry  $t$  : time

- $trade_{jt-1}$  : lagged tariff at 4 digit NIC level

- Recall that when we used LP we assumed that productivity follows a Markov process. So it must be a function of previous period's productivity if we are to be consistent with LP
- Therefore we include lagged dependent variable (TFP) as a regressor in a fixed effects regression.

- Consider the  $i$  the firm. Let 0,1,2 in the subscripts refer to time.

$$\omega_{ij1} = \alpha_j + \beta\omega_{ij0} + e_{ij1}$$

$$\omega_{ij2} = \alpha_j + \beta\omega_{ij1} + e_{ij2}$$

- Subtracting, we can get rid of the fixed effects:  $\alpha_j$ . But now:

$$\omega_{ij2} - \omega_{ij1} = \beta(\omega_{ij1} - \omega_{ij0}) + (e_{ij2} - e_{ij1})$$

- Problem:  $\omega_{ij1}$  and  $e_{ij1}$  are by construction correlated. So the variable  $(\omega_{ij1} - \omega_{ij0})$  is correlated to  $(e_{ij2} - e_{ij1})$ . This will give inconsistent results.
- Solution: Systems GMM (Arellano and Bond)

# Measuring Tariff

- One can use nominal tariffs faced by an industry as a measure of trade protection
- But tariff may not be equivalent to protection: Because lower tariffs on intermediate goods may have an effect on firms. For example, while lowering output tariffs discipline firms, there may be an offsetting lowering of input tariff which makes inputs cheaper (which would have an impact on how firms behave)
- Therefore measure the net effect of lowering tariffs on output and intermediate inputs

$$erp_{jt} = \frac{\text{outputtariff}_{jt} - \text{inputtariff}_{jt}}{1 - \sum_s \alpha_{js}}$$

where  $\alpha_{js}$  is the share of input  $s$  in the value of output  $j$ .

- Annual tariff data for 1987-2001 at six digit level of Indian Trade Classification Harmonized System.
- Input-Output transaction table from 1993-1994 to get  $\alpha$  s.

# A Note on PROWESS

- Income statements and balance sheets of publicly listed companies (commonly available across most developing countries)
- 70 percent of the organized sector
- Since it is not a census: disappearance of firms from the data does not necessarily mean exit of firms. (Implication for LP?)
- Need to estimate both fixed effects as well as LP to check robustness (But what to make of the difference?)

# Endogeneity of Trade Policy

- The relatively less efficient industries may have enjoyed higher degree of protection.
- If liberalization was not as intensive in the least productive industries, then small declines in tariffs may be associated with small increases in productivity. (therefore we may erroneously conclude that trade liberalization boosted productivity)
- Therefore need to argue that this is not the case for this to be a valid exercise!

## Check 1: Examining the Tariff Data

- Analysis of tariff changes of the 5045 products for 1992-1996 and 1997-2001 reveals that movements in tariffs were uniform until 1997
- Policy makers more selective in setting product tariffs during 1997-2001: Potential Endogeneity of Trade Protection during this period.

## Check 2: Relation with Industry Characteristics

- Use Annual Survey of Industries (ASI) data.
- Regress change in output tariff/input tariffs/effective rate of protection (1987-1997) on industry characteristics in 1987 (employment, output, average wage, concentration of industry, share of skilled workers and growth of industry output and employment in 1980s)
- Result: No statistical correlation
- Plausibility: Gang and Pandey (1996): Tariff Policy never evolved after the second five year plan.



## Check 3: Relation with Industry's Productivity

- Regress industry-level output tariffs, input tariffs and ERP in period  $t + 1$  on industry-level productivity in period  $t$ , controlling for industry and year fixed effects and weighting each industry by the number of companies in the industry for the particular year.
- Correlation between future trade protection and current productivity is insignificant for 1989-96
- Correlation is negative and significant for 1997-2001.
- So sample restricted to 1989-1996.

# Results: Output Tariff

- Table 4a: Estimates of  $\beta$  negative and significant: Reduction of tariff leads to increase in TFP
- Re-allocation of market share towards more productive firms/ exit of inefficient firms: limitation of PROWESS.
- Estimation on balanced panel shows not much change in estimates: maybe it is not such an issue (but this is not proof)
- "Direct Approach": Put trade variable in the production function estimation.
- 10 percent reduction in output tariffs raise firm TFP by 0.53 percent

# Results: ERP and Input Tariffs

- Table 4b and 5
- A 10 percentage point reduction in ERP leads to a 0.25 percent increase in TFP
- Coefficient of input tariffs much higher than output tariffs.
- A 10 percentage point decline in output tariff : 0.32 percentage point increase in TFP. A 10 percentage point decline in Input tariff leads to 4.8 percentage point increase in TFP.
- This suggests the main route of improvement is through a wider choice of intermediate inputs and, perhaps, the embodied technology that comes with it (More on this later)

# Industry Characteristics

- Presence of Non Tariff Barriers in some industries. Higher in Consumer non durables (only 34 percent could be imported by 1996).
- Estimate the model for groups of industries.
- Impact of reduction in output tariffs and ERP are much larger for Basic, Intermediate and Capital goods industries.

- Since tariff reduction at the same time as changes in domestic industrial regulation (More on this later)
- Check whether productivity impact of trade reforms was related to the extent to which an industry was subject to licensing at the onset of trade reforms
- Trade reforms did not increase the productivity of highly regulated industries (a bit counter intuitive; perhaps they were stuck with their production technologies)

- Domestic Industries gained more.
- No differential impact for different firm sizes (recall PROWESS problem)

- If reductions in output tariffs across industries and over time is correlated with the process of delicensing and opening to FDI
- Throw in time varying measures of licensing and openness to FDI for 1989-1996.
- Effect of trade liberalization still present.

- Recall the huge impact of reducing tariffs on imported inputs
- Goldberg, Khandelwal, Pavcnik and Topolova (QJE 2010): GKPT
  - Access to new imported inputs enables firms to expand domestic product scope (introduction of new variety): generate gain from trade.



- Potential Reverse Causality: Firms may decide to introduce new products for reasons unrelated to international trade
- For these new products, they may demand imported inputs: existing as well as new varieties
- Therefore Growth of Products may increase demand of imported inputs and not the other way!

- Trade reform unexpected (as before)
- Input tariffs reduced differentially across sectors.

# Brief Over-view of Results

- Increasing product variety
- Increase in R & D
- Increase in TFP

- contains detailed firm-product.
- Therefore possible to look at change in product mix of firms
- Recall the usual disclaimers

# What Theory Tells Us:

- Lowering of input tariff on existing inputs raises the variable profit and makes some goods that were unprofitable earlier profitable (Pure Price Effect)
- Import of new input varieties expands the set of inputs available to a firm. But its not obvious that this will have an impact. It depends on the substitutability between existing domestic input and the new foreign inputs (extensive margin effect)
- This will need some theory than just looking at the impact of input tariff changes since that is not able to separate the two effects.

# What Raw Data Tells Us:

- Real Imports grew by 130% between 1987 and 2000
- Intermediate inputs grew by 227%
  - Intermediate products unavailable prior to the reform period account for 66 percent of this growth (mostly from OECD countries)
- Final products grew by 90%

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- Final products grew by 90%
  - Extensive margin accounted for only 37 percent

# Some Reduced Form Evidence: I

$$\ln(v_{ht}) = \alpha_h + \alpha_t + \beta \cdot \tau_{ht} + \varepsilon_{ht}$$

where  $v_{ht}$  is the number of imported varieties within a category  $h$ .

- Significant and negative  $\beta$  is some evidence that this hypothesis may be plausible
- Moreover, when  $h$  is the group of intermediate products then the coefficient is twice as large as compared to when we look at only final goods.



## Some Reduced Form Evidence: Product Scope

$$\ln(n_{it}^q) = \alpha_i + \alpha_t + \beta \cdot \tau_{qt}^{inp} + \varepsilon_{it}$$

where  $n_{it}^q$  is number of products manufactured by firm  $i$  in industry  $q$  at time  $t$ .

- Result: Significant and negative  $\beta$
- Sign remains even after you control for FDI, Delicensing and Output tariff.

## Some Reduced Form Evidence: Product Scope

- Identification requires that there were no existing pre reform trends in the number of products that were systematically correlated with input tariff changes
- Control for this by introducing pre-reform industry growth rate in number of products (1989-1991)
- Again entry and exit considerations taken care of by looking at a balanced panel of firms in one specification and comparing it with other specifications: No great change in coefficient.

# Disentangling Input Price Effect from Variety Effect

- Recall from the previous lecture.

$$\ln C_q = \left\{ \sum \alpha_{iq} \omega_{iF} \ln P_{iF}^{Conv} + \alpha_{Lq} \ln P_L + \alpha_{sq} \ln P_S \right\} + \left\{ \sum \alpha_{iq} \omega_{iF} \ln \Lambda_{iF} \right\} + v$$

Define:

$$\ln P_q^{inp,conv} = \sum \alpha_{iq} \omega_{iF} \ln P_{iF}^{Conv} + \alpha_{Lq} \ln P_L + \alpha_{sq} \ln P_S$$

$$\ln \Lambda_{qF}^{inp} = \sum \alpha_{iq} \omega_{iF} \ln \Lambda_{iF}$$

- The model relates the change (between 1989 and 1997) in firms product scope to the observable input price indices and variety indices in the firm's minimum cost function

$$\Delta \ln n_f^\alpha = \alpha + \beta_1 \ln P_q^{inp,conv} + \beta_2 \ln \Lambda_{qF}^{inp} + \varepsilon_f$$

- Recall  $\Lambda$  is decreasing in newer varieties.
- Therefore theory predicts that  $\beta_1 < 0$  and  $\beta_2 < 0$ .

# Identification Problem

- $\varepsilon$  which is also a function of  $v$  in the cost function has the domestic price index. Just like foreign input bundle, it has an input price component and a variety component.
- Suppose firms expand domestic varieties in response to input price and variety effect of imported inputs
- This will affect the exact price index of domestic inputs that is in the error term
- This will further drive down minimum cost and hence raise variety of output.
- Alternatively, suppose firms introduce new domestic varieties of products in response to demand shocks and manufacturing these require more imported inputs: Reverse causality

# Identifying Assumption

- Input tariffs affect the price index of domestic inputs and TFP only through their impact on imported input prices and varieties. : *First Instrument*
- Also changes in TFP within firms are not a function of switching to more efficient products and X inefficiency in management.

# Endogenous Variables

- Since the choice of inputs is endogenous, both the variables are endogenous.
- We therefore need two instrumental variables
- The second instrument is based on the idea: the potential for exporting to India following the liberalization may be higher for those countries that are proximate to India: English speaking countries and which have a comparative advantage in the particular industry.
- More the countries (weighted by their GDP) with the two properties, higher the likely increase in extensive margin (Some notion of fixed cost of exporting to India)
- Depending on comparative advantage for each industry and its "proximity" , this will vary by industry.