International Trade: M2 CIE

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M2 Paris I

Lesson 2: Trade and Technology

- Input Trade Liberalization and Foreign Techology Adoption
- **Suggested readings:**
- Bas, M. and Berthou, A. (2017) "Does Input-trade Liberalization Affect Firms' Foreign Technology Choice?", World Bank Economic Review, 31 (2): 351-384.

Motivation

- **Trade liberalization** is a core component of economic reforms implemented by **developing countries** over the past two decades;
- Cost, quality and availability of foreign varieties of inputs are an important concern for firms in developing countries.
- **Endogenous-growth literature:** the use of foreign inputs enhance economic growth (Ethier, 1979 (AER), Grossman and Helpman, 1991).
- **Micro-level studies:** have confirmed that input-trade liberalization played a key role on firm productivity growth (Amiti and Konings, 2007 (AER); Topalova and Khandelwal, 2010 (REStat))
- $\rightarrow$ Our paper explores the linkage between input-trade liberalization in India and foreign technology adoption embodied in imported capital goods.

Foreign inputs - technological adoption linkage

Main argument:

- The mechanisms through which input-trade liberalization affects firms' foreign technology choice:
- (1) **A supply shock** of input tariff reductions and
- (2) **A complementarity channel** between imported variable intermediate goods and fixed capital equipment
- $\rightarrow$ This complementarity and the existence of fixed costs of upgrading foreign technology are observed in the micro-data of Indian firms used in the empirical analysis.

Empirical Motivation

- Empirical facts from Indian firms in the period of trade liberalization (1989-1997), Prowess dataset.
- Empirical fact 1*: A large proportion of firms imports intermediate goods (73 %), while only a subset of those firms also imports capital equipment goods (38%).*
- Empirical fact 2*: Firms producing with foreign technology embodied in imported capital goods have larger sales, capital stock, are more profitable and have a higher share of imported inputs than non-importers of capital goods.*

Empirical Motivation

Table: Importers vs. non-importers of capital goods

	(1) Importer inputs & capital goods	(2) Non-importer capital goods
Sales	227	45
Capital	169	25
Wage-bill	19	3,4
Profit	10	0,8
Imported inputs share	0,22	0,12

Notes: The table reports the average sales, capital stock wage-bill, profits and imported input share (imported inputs over total inputs) in constant rupees crore for the period 1989-1997 for firms with positive values of imports of capital goods (importers of capital goods) and for those firms that do not import (non-importers of capital goods).

- $\rightarrow$ (1) and (2) imply the existence of fixed costs of importing capital goods.

Empirical Motivation

- Empirical fact 3*: The decision of sourcing capital goods from abroad is positively correlated with imports of intermediate goods.*

Table: Complementarity between imports of capital goods and intermediate inputs

Dependent variable: Importer of capital goods status				
	(1)	(2)	(3)	(4)
Imported inputs>0	0.500***	0.378***	0.333***	0.410***
	(0.006)	(0.007)	(0.015)	(0.006)
Firm size		Yes		Yes
Industry 3 digit fixed effects	Yes	Yes		
Firm fixed effects			Yes	Yes
Year Fixed effects	Yes	Yes	Yes	Yes
Observations	14,680	14,680	14,680	14,680
R-squared	0.262	0.326	0.092	0.294

Notes: The dependent variable is a dummy for firm i having positive imports of capital goods in year t. Firm size is measured by the logarithm of wage-bill and it is included in columns (2) and (4). Heteroskedasticity-robust standards errors are reported in parentheses. ***, **, and *indicate significance at the 1, 5 and 10 percent levels respectively.

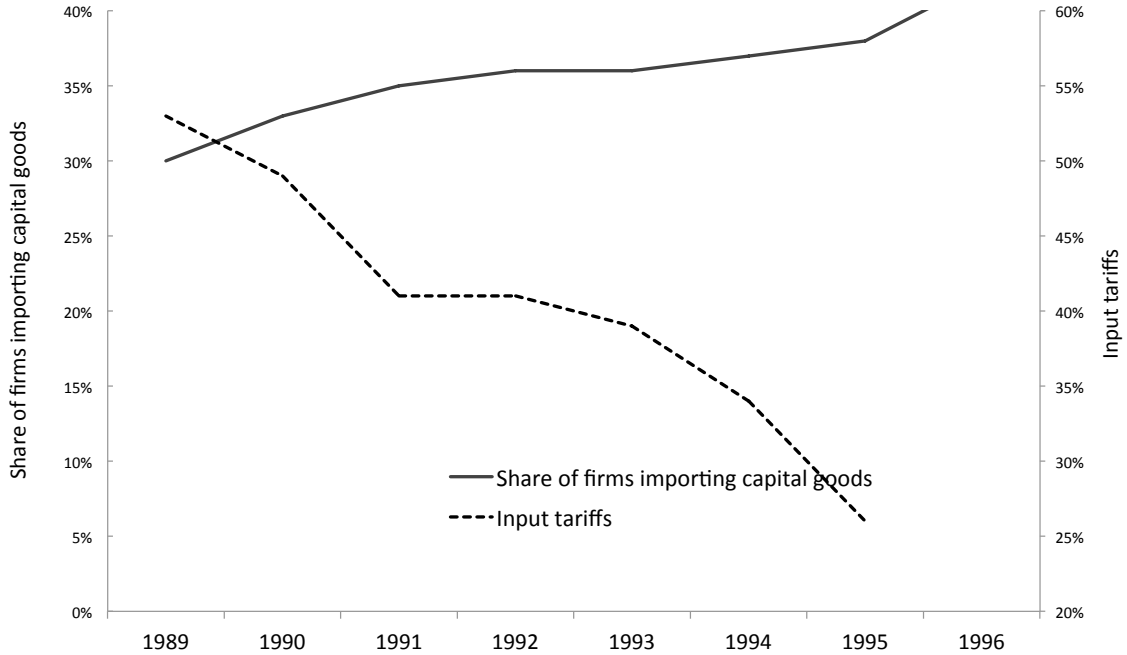
Empirical Motivation

- Empirical fact 4*: Producing with both imported inputs and foreign capital equipment goods improves firms' global efficiency in the production process (production function estimation)*
- (3) and (4) imply a **complementarity** between imported inputs and capital goods in the production process.
- $\rightarrow$ Under this complementarity, input tariffs cuts should affect firms' decision to import capital goods.

Empirical Motivation

- Empirical fact 5*: As average input tariff fall, the share of firms importing capital goods increase.*

Figure: The share of firms importing capital goods as input tariff fall



What We Do: Theoretical motivation

- **A simple theoretical model** of endogenous technology adoption, fixed costs of foreign technology (empirical facts 1 and 2) and heterogeneous firms that rationalizes the empirical facts.

- Theory features **complementarity (empirical facts 3 and 4)** between foreign variable inputs and foreign technology in fixed imported capital goods:
  - Foreign technology firms use foreign inputs more efficiently, low m.c.;
  - They are more intensive in the use of foreign inputs

- **Supply shock:** Tariff cuts on variable inputs reduce the cost of high-technology relative to low- technology;

- **Testable predictions:**
  - Input tariff cuts increase the probability of technology upgrading through imports of capital (empirical fact 5);
  - Heterogeneous effects concentrate on firms below high-tech productivity threshold

What We Do: Empirical test

- **Identification strategy:** the unilateral trade liberalization episode in India: 1989-1997 (Eighth five year Plan);
- Difference-in-difference: causal link exploiting exogenous changes in input tariff cuts on firms' decision to upgrade foreign capital goods;
- **Firm-level data** (Prowess) disentangle variable intermediate inputs imports and capital equipment goods imports from other types;
- **Exogeneity of tariffs** industry-level input tariff variations over the period unrelated to initial firm / industry characteristics.
- **Estimations confirm theoretical predictions:**
  - Input tariff reductions increased the probability of technology upgrading through imports of foreign equipments;
  - Effect concentrates on the middle-upper range of initial productivity distribution

Related literature

Input-tariff cuts enhance firm performance:

- Firm productivity (Amiti and Konings, 2007 (AER); Topalova and Khandelwal, 2010 (REStat)), Product scope (Goldberg et al., 2010,(QJE)), Export performance (Bas, 2012 (JDE), and Bas and Strauss-Kahn, forth.(JIE)), Wages (Amiti and Davis, 2012 (RES)).

Trade liberalization and technology / quality upgrading (demand channel)

- Verhoogen, 2008 (QJE); Bustos, 2011 (AER); Aw et al., 2011 (AER); Lileeva and Trefler, 2010 (QJE); Bas and Ledezma, 2012 (RWE).

- **Contribution** $\rightarrow$ We bring new evidence of the effect of trade liberalization on firms' *technology adoption* through a supply channel of input tariff cuts.

Outline

1. Theoretical model
2. Testable predictions
3. Data & Identification strategy
4. Empirical tests
5. Alternative explanations
6. Robustness tests

Set-up of the model

- Firms produce final goods in **monopolistic competition**
- **Firm heterogeneity** in terms of initial productivity (φ) a la Melitz
- **Domestic and imported capital and intermediate goods** to produce the final good: k_d, k_m, x_d, x_m
- Domestic intermediate goods are produced in perfect competition using one unit of labor, which is elastically supplied and the wage is normalized to one.
- Price of domestic inputs, $p_x = 1$ and the price of imported inputs is $p_x \tau_m$ where $\tau_m > 1$
- **Fixed costs of technology** embodied in imported capital goods (f_h)
- The foreign technology is complementary with imported intermediate goods.

Set-up of the model

Production

$$q(\varphi) = \varphi x^{\eta} k^{1-\eta} \tag{1}$$

Where

$$x = (x_{di}^{\alpha} + \gamma_i^{\alpha} x_{mi}^{\alpha})^{\frac{1}{\alpha}} \qquad for \quad i = \{l, h\} \tag{2}$$

- γ represents the complementarity between imported inputs and foreign technology.
- The high value of this factor is only available to firms that pay the fixed technology cost (f_h):
- $\gamma > 1$ if the firm produces with high-foreign technology ($i = h$) and $\gamma = 1$ if the firm produces with low-domestic technology ($i = l$).
- Firms producing with high-technology embodied in imported capital goods combine both types of capital goods by a Cobb-Douglas function $k = k_m^{\beta} k_d^{1-\beta}$

Set-up of the model

Prices and marginal costs

- Prices reflect a constant markup $\frac{\sigma}{\sigma-1}$ over marginal cost:
- $p_i(\varphi) = \frac{\sigma}{\sigma-1}\frac{c_i}{\varphi}$
- c_i can be expressed as a CES cost index :
- $c_l = \left(1+\tau_m^{\frac{\alpha}{\alpha-1}}\right)^{\frac{\eta(\alpha-1)}{\alpha}}$ and $c_h = \tau_k^{\beta(1-\eta)}\left(1+\left(\frac{\tau_m}{\gamma_h}\right)^{\frac{\alpha}{\alpha-1}}\right)^{\frac{\eta(\alpha-1)}{\alpha}}$.
- Using the foreign technology reduces the cost of sourcing foreign inputs
- $\Rightarrow$ Firms operating with the foreign technology are more intensive in the use of foreign inputs.

Input tariffs and the relative production cost

- Changes in input tariffs affect the relative production cost of high-technology

$$\frac{c_h}{c_l} = \tau_k^{\beta(1-\eta)} \left(\frac{\tau_m^{\frac{\alpha}{1-\alpha}} + 1}{\tau_m^{\frac{\alpha}{1-\alpha}} + \gamma_h^{\frac{\alpha}{1-\alpha}}} \right)^{\frac{\eta(1-\alpha)}{\alpha}} \tag{3}$$

$\Rightarrow$ **The relative costs $\frac{c_h}{c_l}$ is an increasing function of input tariffs.**

$\partial \frac{c_h}{c_l} / \partial \tau_m > 0$ since $0 < \alpha < 1$ and $\gamma_h > 1$.

Firms' decision to exit or stay and produce

- Firms need to pay f every period to operate
- Profits for both types of firms are given by $\pi_l(\varphi) = \frac{r_l(\varphi)}{\sigma} - f$ and $\pi_h(\varphi) = \frac{r_h(\varphi)}{\sigma} - f - f_h$.
- The profits of the marginal firm that decides to stay and produce are equal to zero: $\pi_l(\varphi_l^*) = 0$.
- φ_l^* is the **productivity cutoff** to produce and is determined by the following condition:

$$\frac{r_l(\varphi_l^*)}{\sigma} = f$$

Firms with a productivity draw greater than the survival cutoff stay in the market and produce ($\varphi > \varphi_l^*$).

Firms' decision to adopt high-foreign-technology

- **The indifference condition** for the marginal firm to acquire the foreign and more advanced technology is given by $\pi_h(\varphi_h^*) = \pi_l(\varphi_h^*)$:

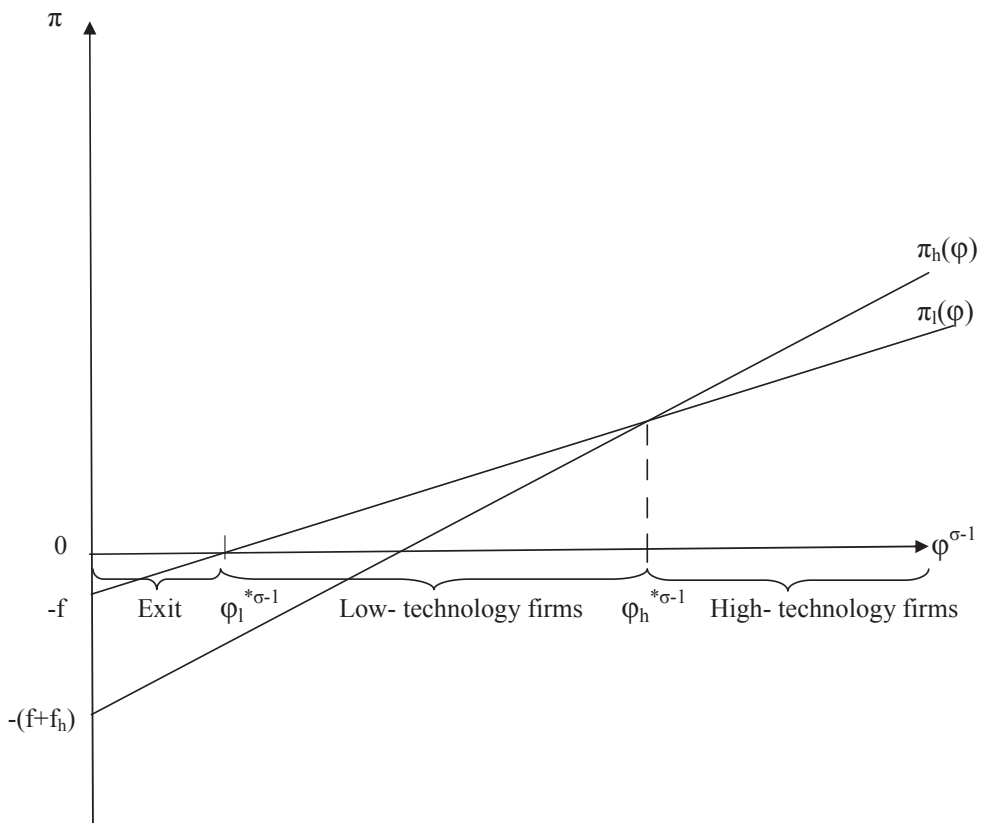
$$\frac{r_h(\varphi_h^*) - r_l(\varphi_h^*)}{\sigma} = f_h; \tag{4}$$

- φ_h^* is the minimum productivity level for the marginal firm able to adopt high technology:

$$\varphi_h^* = \varphi_l^* \left(\frac{f_h}{f}\right)^{\frac{1}{\sigma-1}} \left(\left(\frac{c_h}{c_l}\right)^{1-\sigma} - 1\right)^{\frac{1}{1-\sigma}} \tag{5}$$

- $\varphi_h^* > \varphi_l^*$ if f_h sufficiently high

Figure: Technology choice by productivity levels



Main predictions

We can show that:

- The equilibrium exists (FE = ZCP);
- φ_l^* increases when input tariffs is reduced (relative price of domestic inputs increase);
- φ_h^* decreases when input tariffs is reduced;
- The probability of adopting the foreign technology (ρ_h) increases as input tariffs are reduced;

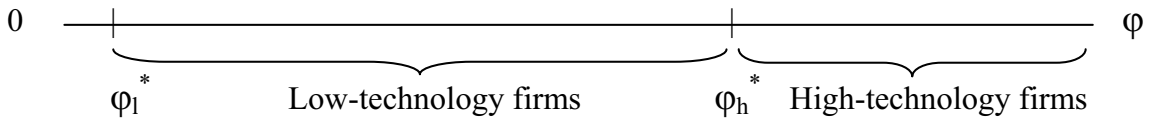
Testable implication 1: *Input-liberalization has a positive effect on firms' decision to import capital goods.*

Main predictions

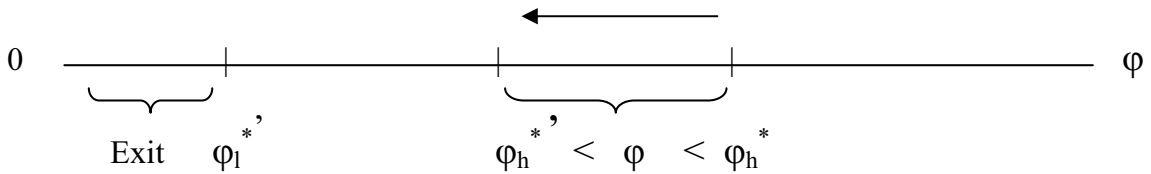
Testable implication 2: *Technology adoption concentrates on the most productive firms using the low technology before input trade liberalization*

Figure: Heterogeneous effect of input-trade liberalization on firms' technology choice

(a) Before input-liberalization



(b) After input-liberalization



Firms adopting high-technology

Empirical test of the model's predictions

- Model's predictions are tested for the period of Indian unilateral trade liberalization at the beginning of the 90s.
- **Firm level data:** Prowess database provided by the Centre for Monitoring the Indian Economy (CMIE) for the 1989-1997 period.
- Information from the income statements and balance-sheets of listed companies comprising more than 70 percent of the economic activity in the organized industrial sector of India.
- **Detailed information on imports by type of good:**
- (1) Capital equipment goods;
- (2) Variable intermediate inputs (materials, parts and accessories);
- (3) Final consumption goods.

Identification strategy

- Unilateral trade liberalization episode in India: 1989-1997 during the Eighth five year Plan;
- **Difference-in-difference:** exploits changes in input tariff cuts across industries on firms' decision to upgrade foreign capital goods;
- **Identification of a causal effect of tariff cuts on variable inputs:**
  1. Disentangle the direct effect of tariffs on capital goods and the indirect effect of tariffs on variable inputs (complementarity channel);
  2. Exogenous input tariff variations.

Input tariffs and capital goods tariffs

- **Tariff data:** MFN applied tariff data is provided by WITS at the industry level ISIC (rev 2) 4-digit.
- Input-output matrices of India at the 4-digit NIC codes in 1993.
- **Identification strategy**: differentiates capital goods tariffs from variable input tariffs (indirect effect).
- For each industry, s, the input (capital goods) tariff is generated as the weighted average of tariffs on all the variable intermediate goods (capoital goods) used in the production of the final goods of that industry:

$$\tau_{st} = \sum_{z} \alpha_{zs} \tau_{zt}$$

- Where the weight α_{zs} is the value share of input z in the production of output in the 4-digit industry s using IO matrix

Endogeneity of trade policy

- Change in tariffs could be influenced by firms / industries through lobbying
- Wealthier firms / sectors may lobby for tariff reduction whereas vulnerable firms / sectors may lobby for keeping tariffs unchanged
- Examine the correlation of tariffs changes with initial industry or firm performance (Goldberg et al. 2010 (QJE), Topalova and Khandelwal 2011 (REStat)

Table: Tariff reductions between 1989 and 1997 and pre-reform industrial characteristics in 1989

Dependent variable: change in input tariffs between 1989-1997					
	(1)	(2)	(3)	(4)	(5)
Sales(s,1989)	0.004				
	(0.008)				
Capital stock(s,1989)		0.003			
		(0.009)			
Wages(s,1989)			0.004		
			(0.009)		
Imports capital goods(s,1989)				0.007	
				(0.008)	
Imports inputs(s,1989)					0.001
					(0.005)
Observations	47	47	47	47	47
R-squared	0.918	0.917	0.918	0.919	0.917

Notes: The dependent variable is the changes in input tariffs between 1989 and 1997. The table shows regressions at the 3-digit industry level of changes in input tariffs on different industry level characteristics. All regressions include indicators for industry use type (consumer goods, capital and intermediates). All industry-level variables are expressed in logarithms. Heteroskedasticity-robust standards errors are reported in parentheses.

Table: Initial firm characteristics in 1989 and input tariff changes between 1989-1997

	(1) Importer of K	(2) Imports K /sales	(3) Capital stock	(4) TFP
Δ Input tariffs(s,97-89)	0.071	-0.005	0.709	0.081
	(0.385)	(0.092)	(0.500)	(0.335)
Observations	676	676	676	676
R-squared	0.070	0.039	0.087	0.361

Notes: The dependent variables in each column are the initial firm-level outcomes in 1989. The table shows the coefficients on changes in input tariffs between 1990 and 1996 from firm-level regressions of initial firm characteristics on input tariff changes and 2 digit industry fixed effects. Firm-level variables are expressed in logarithms except for the impporter of capital goods dummy and the ratio of imports of capital goods over total sales. Heteroskedasticity-robust standards errors are reported in parentheses. Errors are corrected for clustering at the 3-digit industry level.

T1: Effect of input tariffs on capital goods imports decision

- Probability that firm i imports capital goods in year t using the following linear probability model:

$$Importer(k)_{ist} = \gamma_1 Input\ \tau_{s,t\text{-}1} + \gamma_2 Z_{s,t\text{-}1} + \gamma_3 X_{i,t\text{-}1} + \mu_i + \upsilon_t + \epsilon_{ist}$$

- $Importer(k)_{ist}$: dummy variable for firm i producing in industry s having positive imports of capital goods in year t.
- Input $\tau_{s,\ t\text{-}1}$ represents the MFN input tariffs with respect to the Rest of The World of industry s in year $t-1$.
- $Z_{s,t\text{-}1}$ is a set of industry level controls: Output tariffs, tariffs on capital inputs and Herfindhal index.
- $X_{i,t\text{-}1}$ is a set of firm level controls: capital intensity, the age and importer of intermediate goods.
- All specifications include year and firm fixed effects.

Table: Input-tariff liberalization and firms' decision to import capital goods in India (1989-1997)

Dependent variable: dummy equal to one if the firm i imports capital goods in t.					
	(1)	(2)	(3)	(4)	(5)
Input tariff(s)(t-1)	-0.149**	-0.152**	-0.152**	-0.151**	-0.012
	(0.060)	(0.060)	(0.060)	(0.069)	(0.078)
Input tariff(s)(t-1)× imported inputs>0					-0.170**
					(0.066)
Capital goods tariff(s)(t-1)	-0.165**	-0.168**	-0.170**	-0.168*	-0.173**
	(0.073)	(0.073)	(0.073)	(0.086)	(0.083)
Output tariff(s)(t-1)	-0.057	-0.057	-0.053	-0.026	-0.030
	(0.047)	(0.047)	(0.047)	(0.041)	(0.040)
Herfindhal index(s)(t-1)		0.044	0.045	0.022	0.024
		(0.049)	(0.049)	(0.059)	(0.059)
Age(t-1)			-0.004	-0.016	-0.011
			(0.028)	(0.033)	(0.034)
Capital intensity(t-1)			0.013**	0.014**	0.015*
			(0.006)	(0.007)	(0.007)
Imported inputs>0				0.333***	0.405***
				(0.028)	(0.041)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	14,680	14,680	14,680	14,680	14,680
R-squared	0.036	0.036	0.036	0.093	0.094

→ Average input tariff reductions during the 1989-1997 (27 pp) is estimated to produce a 4.6 percent increase in the probability of importing capital goods for the average firm importing intermediate goods.

T2: Heterogeneous effect of input tariff liberalization

- **Firms classified using TFP distribution:** three quantiles of firm TFP in the initial year of the sample (Low, Medium and High initial TFP);
- Baseline specification extended by the inclusion of interaction terms between input-tariffs and the firm's initial TFP quantiles.
- We extend the previous equation to:

$$Importer(k)_{ist} = \sum_{\rho=1}^{3} \chi^{\rho}(Input\tau_{s,t-1} \times Q_{is}^{\rho}) + \gamma_2 Z_{s,t\text{-}1} + \gamma_3 X_{i,t\text{-}1} + \mu_i + \upsilon_t + \epsilon_{ist}$$

Table: The heterogeneous effects of input-tariff liberalization on firms' decision to import capital goods in India (1989-1997)

Dependent variable: dummy equal to one if the firm i imports capital goods in t.				
	(1)	(2)	(3)	(4)
Input tariff(s)(t-1)	-0.201*			
	(0.102)			
Input tariff(s)(t-1)× Low initial TFP		-0.111	-0.145	-0.149
		(0.111)	(0.105)	(0.104)
Input tariff(s)(t-1)× Medium initial TFP		-0.315***	-0.345***	-0.346***
		(0.110)	(0.104)	(0.103)
Input tariff(s)(t-1)× High initial TFP		-0.043	-0.067	-0.058
		(0.164)	(0.146)	(0.151)
Capital goods tariff(s)(t-1)	-0.181*	-0.150	-0.170*	-0.176*
	(0.095)	(0.108)	(0.096)	(0.095)
Output tariff(s)(t-1)	-0.040	-0.055	-0.041	-0.033
	(0.047)	(0.052)	(0.048)	(0.051)
Firm level controls	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Observations	7,861	7,861	7,861	7,861
R-squared	0.087	0.038	0.088	0.088

→ Firms in the middle range of the initial productivity distribution increase their probability of sourcing capital goods by almost 10 percent.

Alternative explanations

- (1) Controlling for other reforms in India: time varying industry and region level shocks.
- (2) Foreign demand shocks
- (3) Firms' financial health

Table: Other reforms in India

Dependent variable: dummy equal to one if the firm i imports capital goods in t.				
	(1)	(2)	(3)	(4)
Input tariff(s)(t-1)× imported inputs>0	-0.170**	-0.158**	-0.156**	
	(0.066)	(0.065)	(0.066)	
Imported inputs>0	0.405***	0.397***	0.404***	0.348***
	(0.041)	(0.039)	(0.042)	(0.031)
Input tariff(s)(t-1)	-0.011		0.018	
	(0.078)		(0.078)	
Input tariff(s)(t-1)× Low initial TFP				-0.112
				(0.101)
Input tariff(s)(t-1)× Medium initial TFP				-0.296***
				(0.103)
Input tariff(s)(t-1)× High initial TFP				-0.005
				(0.121)
Capital goods tariff(s)(t-1)	-0.173**		-0.141	-0.147
	(0.084)		(0.093)	(0.095)
Output tariff(s)(t-1)	-0.029		-0.045	-0.053
	(0.040)		(0.047)	(0.057)
Herfindahl index(s)(t-1)	Yes	Yes	Yes	Yes
Firm level controls	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Industry year fixed effects	No	Yes	No	No
Region year fixed effects	No	No	Yes	Yes
Observations	14,680	14,680	14,430	7,825
R-squared	0.094	0.130	0.135	0.156
Number of id	3,744	3,744	3,640	1,232

Table: Demand shocks and firms' financial health

Dependent variable: dummy equal to one if the firm i imports capital goods in t.						
	(1)	(2)	(3)	(4)	(5)	(6)
Export tariff(s)(t-1)	-0.049	-0.045	-0.034			
	(0.061)	(0.059)	(0.074)			
Leverage(t-1)				-0.155***	-0.155***	-0.092
				(0.036)	(0.036)	(0.059)
Input tariff(s)(t-1)	-0.162**	-0.024		-0.139**	0.000	
	(0.074)	(0.083)		(0.064)	(0.076)	
Input tariff(s)(t-1) × imported inputs		-0.170**			-0.170**	
		(0.067)			(0.067)	
Imported inputs	0.334***	0.406***	0.346***	0.332***	0.405***	0.344***
	(0.029)	(0.041)	(0.029)	(0.029)	(0.040)	(0.029)
Input tariff(s)(t-1) × Low TFP			-0.163			-0.140
			(0.103)			(0.101)
Input tariff(s)(t-1) × Medium TFP			-0.361***			-0.343***
			(0.105)			(0.099)
Input tariff(s)(t-1) × High TFP			-0.071			-0.058
			(0.157)			(0.149)
Capital goods and output tariff(s)(t-1)	Yes	Yes	Yes	Yes	Yes	Yes
Herfindahl index(s)(t-1)	Yes	Yes	Yes	Yes	Yes	Yes
Firm level controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14,425	14,425	7,731	14,678	14,678	7,861
R-squared	0.093	0.094	0.088	0.096	0.097	0.089

Notes: The dependent variable is a dummy for firm i having positive imports of capital goods in year t. All control variables are defined in table **??**. Heteroskedasticity-robust standards errors are reported in parentheses. Errors are corrected for clustering at the 3-digit industry level. pairs.***, **, and *indicate significance at the 1, 5 and 10 percent levels respectively.

Sensitivity tests

1. The decision to start importing capital goods in the previous years;
2. Alternative samples: excluding MNF, state-owned firms and only private;
3. Intensive margin of imports of capital goods;
4. Other firms outcomes: imported inputs, sales, wages, ...

Table: The decision to start importing capital goods and past import experienced

Dependent variable: dummy equal to one if the firm i imports capital goods in t.						
	(1)	(2)	(3)	(4)	(5)	(6)
	Non importer in the past 4 years		First time importing		Past import experience	
Input tariff(s)(t-1)	-0.342***		-0.895***		-0.211**	
	(0.090)		(0.327)		(0.098)	
Input tariff(s)(t-1) × First quartile TFP (99)		0.006		-0.274		-0.143
		(0.155)		(0.444)		(0.154)
Input tariff(s)(t-1) × Second quartile TFP (99)		-0.238		-0.216		-0.235
		(0.139)		(0.425)		(0.148)
Input tariff(s)(t-1) × Third quartile TFP (99)		-0.340**		-0.809**		-0.281**
		(0.132)		(0.403)		(0.132)
Input tariff(s)(t-1) × Fourth quartile TFP (99)		-0.407***		-1.442***		-0.084
		(0.121)		(0.400)		(0.138)
Importer capital goods(t-1)					0.029**	0.051***
					(0.015)	(0.016)
Capital goods and output tariff(s)(t-1)	Yes	Yes	Yes	Yes	Yes	Yes
Herfindahl index(s)(t-1)	Yes	Yes	Yes	Yes	Yes	Yes
Firm level controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	10,053	5,571	3,490	2,072	19,685	12,783
R-squared	0.037	0.030	0.039	0.044	0.010	0.016

Table: Alternative samples: the role of firm ownership

Dependent variable: dummy equal to one if the firm *i* imports capital goods in *t*.				
	(1)	(2)	(3)	(4)
	Without MNF firms		Private firms	
Input tariff(s)(t-1)	-0.224**		-0.260**	
	(0.102)		(0.103)	
Input tariff(s)(t-1) × First quartile TFP (99)		-0.110		-0.219
		(0.163)		(0.179)
Input tariff(s)(t-1) × Second quartile TFP (99)		-0.215		-0.264
		(0.156)		(0.165)
Input tariff(s)(t-1) × Third quartile TFP (99)		-0.283**		-0.339**
		(0.139)		(0.139)
Input tariff(s)(t-1) × Fourth quartile TFP (99)		-0.058		-0.071
		(0.149)		(0.154)
Capital goods and output tariff(s)(t-1)	Yes	Yes	Yes	Yes
Herfindahl index(s)(t-1)	Yes	Yes	Yes	Yes
Industry level controls	Yes	Yes	Yes	Yes
Firm level controls	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Observations	18,317	11,786	15,393	9,795
R-squared	0.016	0.013	0.017	0.013

Table: Input-trade liberalization and the intensive margin of imports of capital goods, 1999-2006

Dependent variable: the share of imported capital goods over total sales of the firm i in t.						
	(1)	(2)	(3)	(4)	(5)	(6)
	Within		Pooled Tobit		Random effects Tobit	
Input tariff(s)(t-1)	-0.0248**	-0.0279**	-0.0660**	-0.0629**	-0.0708**	-0.0693**
	(0.0116)	(0.0121)	(0.0280)	(0.0279)	(0.0276)	(0.0275)
Capital goods and output tariff(s)(t-1)	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes				
Random effects					Yes	Yes
Industry fixed effects			Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	19,685	19,685	19,685	19,685	19,685	19,685
R-squared	0.008	0.010				
Log likelihood	5002	5002	5002	5002	5002	5002
Sigma u			0.0678	0.0674	0.0602	0.0594
Sigma e					0.0513	0.0513

Table: Other firm outcomes

	(1) Imported inputs over total inputs	(2) Sales	(3) Sales	(4) R&D	(5) R&D
Input tariff(s)(t-1)	-0.112***	-0.217	0.391	-0.154**	0.012
	(0.040)	(0.320)	(0.364)	(0.063)	(0.074)
Input tariff(s)(t-1) × Importer inputs(t-1)			-0.950***		-0.251***
			(0.213)		(0.064)
Importer inputs(t-1)			0.624***		0.089***
			(0.069)		(0.018)
Capital goods and output tariff(s)(t-1)	Yes	Yes	Yes	Yes	Yes
Herfindahl index(s)(t-1)	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	19,334	19,685	19,685	19,685	19,685
R-squared	0.005	0.033	0.071	0.011	0.013

Conclusion

Theory: Simple theoretical model of heterogeneous firms to rationalize the effects of input trade liberalization on foreign technology adoption.

- Tariffs cuts increase the probability of foreign technology upgrading, especially among high productive low technology firms

Empirics:

- The probability of importing capital goods is higher for firms producing in industries that have experienced greater cuts on tariff on intermediate goods in India.

- Only those firms in the middle range of the productivity distribution have benefited from input tariff cuts as predicted by the model.