

Infrastructure Regulation and Industry Equilibrium when Firms Have an Outside Option: Evidence from Indian Firms

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Infrastructure and private sector development

- ▶ Firms face inadequate provision of important infrastructure inputs, e.g electricity
 - ▶ Unreliable and expensive
 - ▶ Firm surveys in Southern Asia and SSA: a major or severe obstacle for business

- ▶ In many countries, firms can resort to an outside option
 - ▶ To address issues in the supply of power: a captive generator.
 - ▶ In SEA and SSA adoption rates between 40% and 70+%

Research questions

- ▶ What determines the adoption of captive power generators among firms?
 - ▶ Firm characteristics
 - ▶ The economic environment (i.e. openness or deregulation)
 - ▶ The regulatory process (i.e. electricity pricing policies)
- ▶ How does the uneven adoption of captive power affect an industry's configuration?
 - ▶ Average industry productivity
 - ▶ Reallocation of production and profits across firms

Research approach

- ▶ **To address these issues I combine a model that links the regulatory process in the upstream to firm's adoption behaviour in the downstream.**
- ▶ Test predictions using data from Indian firms in the 90s.

Why India in the 90s?

- ▶ Substantial adoption of captive power: e.g. almost 60% among urban firms
- ▶ Substantial variation in industry protection: trade tariffs and licensing
- ▶ Substantial differences in regulatory outcomes across states: cross-subsidies, low quality

Model features: Regulation

- ▶ I build on Laffont-Tirole (1993) model of public utility regulation
- ▶ The regulator sets price and can price discriminate among consumers (farmers or industries)
- ▶ In particular, regulator has an industry-specific consumer bias that captures the sector's lobbying power (λ , relative to farmers), and there's a cost of taxing consumers (γ)
- ▶ In the simplified version, optimal price of electricity charged to industries is
$$P_e = \frac{c\eta_d}{\eta_d - 1 + \frac{\lambda}{1+\gamma}}$$

Model features: Industries

- ▶ Consumers have a taste for variety (i.e. monopolistic competition)
- ▶ Firm heterogeneity over idiosyncratic productivity (as in Melitz (2003) and Bernard et al. (2006))
- ▶ Marginal cost depends on the price of electricity

- ▶ There's a productivity cut-off (determined as a market equilibrium) above which a firm survives.

Model features: Adoption of generator

- ▶ The generator: a marginal cost-reducing device (more effective the greater the price of electricity).
- ▶ Modeled as an additional fixed cost: in general, only more productive firms will adopt.

Two important points at the industry level:

1. Cut-off productivity for adoption greater than for survival.
2. The increase in profits (reduction in costs) of adopters increases the productivity needed to survive (implying average productivity goes up)

Changes in the environment

- ▶ A change in P_e only affects industries in the presence of the outside option
- ▶ An increase in P_e increases the survival threshold and reduces the adoption threshold
 - ▶ i.e. increases the proportion of adopting firms
- ▶ In more protected environments (i.e. licensing or trade protection) there is more adoption
 - ▶ A more open environment implies lower prices, i.e. it's harder to recoup the generator's fixed cost

Predictions in the Indian context

1. States with relatively stronger rural lobbies will charge industries more
2. Adoption should increase with price of electricity (and with lower quality)
3. Adoption should be greater in industries subject to licensing and protected from trade
4. Adopting firms should be, on average, more productive (within industry)

Data

- ▶ Repeated cross-section of firms for 1990, 1994 and 1997
- ▶ State level data on electricity prices and quality (T&D losses, outages)
- ▶ Industry-level data on trade tariffs (3-digit) and licensing requirements (4-digit)

Summary Statistics

Variables	Mean	Std. Dev.
Adoption of Captive Generator	30.5%	0.46
Rural	30.6%	0.46
Urban	57.8%	0.49
Public Company	14.1%	0.35
Multiproduct	61.8%	0.49
Census Sector	25.1%	0.43
Access to Credit	73.9%	0.44
Log Workers	3.63	1.35
Log Output	15.98	2.09
Ind. Tariff / Avg. Tariff	1.83	0.40
T&D Losses	20.8%	4.43
Licensed	48.7%	0.50
Trade Tariff	0.86	0.45

Farmers and Electricity Pricing

	Incidence of Green Revolution		
	Low	High	Difference
Avg. Tariff / Unit cost	0.76	0.71	0.05**
Ind. Tariff / Avg. Tariff	1.46	1.80	-0.34***
Ind. Tariff / Unit Cost	1.05	1.28	-0.23***
Agr. Tariff / Avg. Tariff	0.28	0.17	0.11**
Agr. Tariff / Ind. Tariff	0.24	0.09	0.15***

Adoption and Regulatory Outcomes

	(1)	(2)	(3)
	Adoption of Captive Generator		
Ind. Tariff / Avg. Tariff	0.095 (0.016)***	0.094 (0.014)***	0.116 (0.014)***
T&D Losses		0.017 (0.002)***	0.012 (0.001)***
Electricity Connections			-0.039 (0.004)***
Firm Characteristics	Yes	Yes	Yes
Observations	133186	133186	133186
R-squared	0.22	0.25	0.26

Adoption and Industry Protection

Adoption of Captive Generator

Licensed	0.09 (0.01)***	0.07 (0.02)***	0.07 (0.01)***
Trade tariff		0.07 (0.02)***	0.06 (0.02)***
Electricity intensity			0.005 (0.003)*
Firm Characteristics	Yes	Yes	Yes
Observations	119054	119054	119054
R-squared	0.35	0.36	0.36

Adoption and Output/Productivity

	(1)	(2)	(3)	(4)
		Log Real Output		
Licensed	-0.11 (0.04)**	-0.07 (0.02)***	-0.17 (0.04)***	-0.07 (0.02)***
Trade Tariff	-0.32 (0.10)***	-0.01 (0.03)	-0.38 (0.10)***	-0.01 (0.03)
Adoption			0.98 (0.03)***	0.04 (0.01)***
Inputs		yes		yes
Individual Controls	yes	yes	yes	yes
Observations	96448	96448	96448	96448
R-squared	0.44	0.90	0.44	0.90
