Fiscal Implication of Environmental Taxes in India-An Exploratory Analysis

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Overview

- Environmental challenges
- The context for MBIs in India
- Environmental legislation in India-stylized facts
- Environmental taxes and optimal taxation
- Revenue potential of environmental taxes in India
- Monitoring and enforcement issues
- Removing institutional and legal barriers to MBIs in India

Environmental challenges (1)

Water

- By 2017, India will be ‘water stressed’- per capita water availability will be as low as 1600 cubic meters per person per year (down from 6000 cubic meters in 1947 and 2300 cubic meters in 1997).
- Class I and Class II cities generate around 20 billion liters of sewage wastewater daily but treat only about 2 billion liters.
- If sewage treatment capacity remains at 10% of total generation, pollution load from the domestic sector would roughly double by 2047.

Environmental challenges (2)

Air

- The impacts of nationwide exposure to indoor and outdoor air pollution are enormous - 2.5 million pre-mature deaths in 1997.

The context for MBIs

- There is an international and national mandate for MBIs—Rio Declaration, Agenda 21, Government of India: Policy Statement, Taskforce on MBIs

- Rich array of MBIs being used by countries around the world – developed and developing. List is growing…

The context for MBIs (continued)

- End of pipe treatment only one of several options (could have process modification or cleaner inputs)

- Allow shift in abatement from high cost to low cost abaters => cost savings as compared to command and control (CAC)

Evidence from simulation studies (air)

Study and Year	Pollutants Covered	Geographic Area	CAC benchmark	Assumed pollutant type	Ratio of CAC to least cost
Spofford (1984)	Particulates	Lower Delaware Valley	Uniform percentage reduction	Nonuniformly mixed	22.00
Krupnick (1986)	Nitrogen dioxide	Baltimore	Proposed RACT regulations	Nonuniformly mixed	5.9
Welsch (1988)	Sulfur dioxide	United Kingdom		Nonuniformly mixed	1.4-2.5
Oates, et al. (1989)	TSP	Baltimore	Equal proportional treatment	Nonuniformly mixed	4.0 at 90 $\mu g/m^3$
SCAQMD (1992)	Reactive organic gases/Nitrogen dioxide	Southern California	Best available control technology	Nonuniformly mixed	1.5 in 1994

TSP = Total Suspended Particulates
SCAQMD = South Coast Air Quality Management District
SIP = State Implementation Plan (strategy by a state to meet federal environmental standards)
RACT = Reasonably Available Control Technologies, a set of standards imposed on existing sources In non-attainment areas

Evidence from simulation studies (continued)

Pollutants Covered	Geographic Area	CAC benchmark	Assumed pollutant type	Ratio of CAC to least cost
Particulates	St. Louis Metropolitan Area	SIP regulations	Nonuniformly mixed	6.00
Chlorofluorocarbon emissions from nonaerosol applications	United States	Proposed emissions standards	Uniformly mixed accumulative	1.96
Sulfur dioxide	Four Corners in Utah, Colorado, Arizona and New Mexico	SIP regulations	Nonuniformly mixed	4.25
Sulfates	Los Angeles	California emission standards	Nonuniformly mixed	1.07
Sulfur dioxide	Cleveland		Nonuniformly mixed	About 1.5
Airport noise	United States	Mandatory retrofit	Uniformly mixed	1.72
Nitrogen dioxide	Chicago	Proposed RACT regulations	Nonuniformly mixed	14.40
Hydrocarbons	All domestic Du Pont plants	Uniform percentage reduction	Uniformly mixed	4.15
Particulate	Baltimore	SIP regulations	Nonuniformly mixed	4.18
Sulfur dioxide	Lower Delaware Valley	Uniform percentage reduction	Nonuniformly mixed	1.78

Environmental legislation in India- stylized facts

- Command and control (CAC)
  - set of dos and don'ts
  - long list of laws – legislate away the problem

- Judicial activism
  - constitutional "right to life" => public interest litigation
  - legislating from the bench
  - takeover of executive functions

SELECTED ENVIRONMENTAL LEGISLATION IN INDIA

1972	**Wild Life (Protection) Act**
1974	**Water (Prevention and Control of Pollution) Act**
1977	**Water (Prevention and Control of Pollution) Cess Act**
1980	**Forest (Conservation) Act**
1981	**Air (Prevention and Control of Pollution) Act**
1986	**Environment (Protection) Act**
1988	**Forest (Conservation) (Amendment) Act**
1989	**Hazardous Wastes (Management and Handling) Rules**
1989	**Manufacture, Storage and Import of Hazardous Chemical Rules**
1989	**Manufacture, Use, Import, Export and Storage of Hazardous Micro-organisms, Genetically Engineered Micro-organisms or Cells Rules**
1991	**Public Liability Insurance Act**
1992-93	**Environmental (Protection) Rules - "Environmental Statement"**
1993	**Environmental (Protection) Rules - "Environmental Standards"**
1994	**Environmental (Protection) Rules - "Environmental Clearance"**
1995	**National Environment Tribunal Act**
1997	**National Environment Appellate Authority Act**
1998	**Bio-Medical Waste (Management and Handling) Rules**
1999	**Recycled Plastics Manufacture and Usage Rules**
2000	**Municipal Solid Wastes (Management and Handling) Rules**
2000	**Ozone Depleting Substances (Regulation) Rules**
2000	**Noise Pollution (Regulation and Control) Rules**
2001	**Batteries (Management and Handling) Rules**

Air and Water Acts-stylized facts

- Command-and-control (CAC) legislation--a set of "dos" and "don'ts" backed by penalties (fines and/or imprisonment)
- Mandate uniform standards—industry-specific or general
- Require best available technology (BAT) and/or equipment mandates
- Standards are concentration-based (dilution?)

Stylized facts (continued)

- Do not take into account differences in abatement costs across firms, both within and across industries
- Same ambient air/water quality target could be met at a lower cost if firms abated differentially as they would under a MBI
- No link between ambient environmental quality and emission/effluent standards (no SIP)
- No distinction between extent of violation of standards

Environmental Standards for Thermal Power Plants in India

Process	Environmental Parameter	Concentration not to exceed in mg/litre (except for pH)
Condenser cooling waters (once through cooling system)	pH Temperature Free available chlorine	6.5 - 8.5 Not more than 5°C higher than intake water temperature 0.5
Boiler blowdowns	Suspended solids Oil and grease Copper (total) Iron (total)	100 20 1.0 1.0
Cooling tower blowdowns	Free available chlorine Zinc Chromium (total) Phosphate Other corrosion inhibiting material	0.5 1.0 0.2 5.0 Limit to be established on case by case basis by CPCB for Union Territories and SPCBs for states
Ash pond effluent	pH Suspended solids Oil and grease	6.5-8.5 100 20
Air emissions	Particulate matter: (i) > 210 MW capacity (ii) < 210 MW capacity Sulphur dioxide: (i) 500 MW capacity (ii) 200/210 to 500 MW capacity (iii) < 200/210 MW capacity	 150 mg/m^3 350 mg/m^3 Stack height in metres 275 220 $H=14(Q)^{0.3}$ (Q - emission rate of SO_2 in kg/hour)

Environmental taxes and optimal taxation

- Environmental taxes one of several revenue instruments
- Objective is to choose a vector of tax rates to achieve a given tax revenue such that deadweight loss is minimized:

$$\text{Min } D(\boldsymbol{t}) \quad \text{s.t. } \boldsymbol{tb} = R \text{ where}$$

vector of taxes $\boldsymbol{t} = (t_1, t_2, \ldots, t_n)$ applies to a set of tax bases $\boldsymbol{b} = (b_1, b_2, \ldots, b_n)$.

R is the required level of revenues.

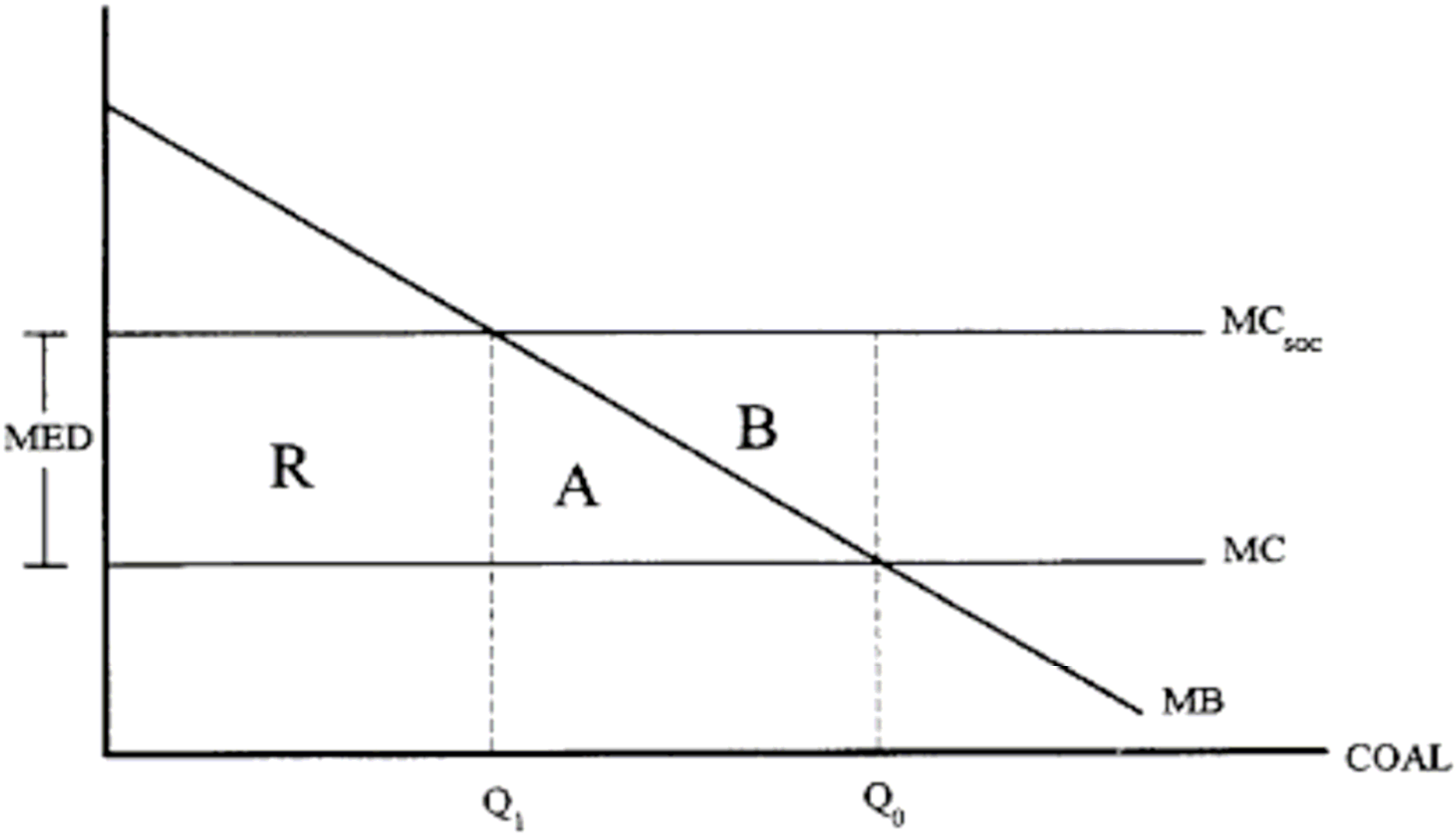
Equating marginal excess burden..

- Solution to this problem is the well known result that the tax rates should be set so that marginal excess burden from an additional dollar of tax revenues is the same for all revenue sources:

$$D'(t_i)/b_i = D'(t_j)/b_j \quad \text{for all } i, j$$

- But environmental taxes could have a *negative* excess burden.

Welfare effects of an environmental tax: partial equilibrium and first-best framework



Revenue potential of environmental taxes in India

- From a pure efficiency perspective environmental taxes not meant to be revenue instruments, *per se*
- Revenue generated incidental to correction of externalities

Calculating the tax base: numerical illustration

- No national database of emissions/pollution loads
- Focus on 15 ‘highly polluting’ industrial sectors (CPCB definition) – aluminum, sugar, caustic soda, cement, distillery, leather, dyes, etc.
- Map into Annual Survey of Industry (ASI) industrial classification to arrive at value of output for these sectors.
- Estimate pollution load using pollution intensities from Industrial Pollution Projection System (IPPS).

Mapping ‘dirty’ industries into ASI classification

CPCB category	ISIC Code	Four digit ISIC description
Aluminium smelter	3720	Nonferrous metals
Basic drugs and pharmaceuticals	3522	Drugs and medicines
Caustic soda	3511	Industrial chemicals except fertilizer
Cement	3692	Cement, lime, and plaster
Copper smelter	3720	Nonferrous metals
Distilleries	3131	Distilled spirits
Dyes and dye intermediates	3211	Spinning, weaving and finishing textiles
Fertiliser	3512	Fertilizers and pesticides
Integrated iron and steel	3710	Iron and steel
Leather	3231	Tanneries and leather finishing
Oil refineries	3530	Petroleum refineries
Pesticides	3512	Fertilizers and pesticides
Pulp and paper	3411	Pulp, paper, and paperboard
Sugar	3118	Sugar factories and refineries
Zinc smelter	3720	Nonferrous metals

Value of output (Rupees thousand at 1987-88 prices)

ISIC	Maharashtra	Gujarat	Andhra Pradesh	Tamil Nadu	Uttar Pradesh
3720	155462	0	0	0	0
3522	4790457	971344	823978	2061920	287225
3511	373848	854805	574824	599646	243317
3692	3017815	4400902	3586549	5599154	193913
3720	58356	0	53313	0	0
3131	893477	0	276006	1956470	895107
3211	2231267	6497946	0	57092	1934
3512	8244055	5827671	2766260	1775221	13605411
3710	**3665310**	1208602	3775821	462068	517631
3231	17234	41141	3083	4054542	1146688
3530	28060249	5756601	2209561	3714842	7964682
3512	4011664	6133013	1924831	796369	140420
3411	706653	832058	1401817	4225917	1510495
3118	15913434	4424972	4541418	6081343	21644261
3720	76604	0	744848	0	6195

Source: Annual Survey of Industries, Central Statistical Organisation, New Delhi

IPPS pollution intensities for air and water pollutants

			all values in kilograms/thousand rupees (1987-88 rupees)			
ISIC	**Four Digit ISIC Description**	**SO2**	**NO2**	**TSP**	**BOD**	**TSS**
3720	Nonferrous metals	1.351961340	0.044043868	0.113555517	0.103656317	1.498362598
3522	Drugs and medicines	0.063844368	0.027111992	0.012069209	0.002137125	0.535758847
3511	Industrial chemicals except fertilizer	0.407764358	0.302884678	0.065523562	0.139544548	0.215692163
3692	Cement, lime, and plaster	4.501920015	2.090282099	2.177285356	0.000041280	0.090521868
3720	Nonferrous metals	1.351961340	0.044043868	0.113555517	0.103656317	1.498362598
3131	Distilled spirits	0.135979758	0.047262324	0.011369545	0.190693507	0.342739306
3211	Spinning, weaving & finishing textiles	0.084729348	0.116913906	0.015147732	0.003434652	0.005333891
3512	Fertilizers and pesticides	0.038691436	0.037257124	0.010739847	0.001570047	0.305493727
3710	Iron and steel	0.625045108	0.271504734	**0.144830511**	0.000462478	6.812382973
3231	Tanneries and leather finishing	0.045443197	0.011999243	0.005492365	0.021248455	0.040126098
3530	Petroleum refineries	0.443027439	0.254852724	0.039076252	0.005537143	0.027789617
3512	Fertilizers and pesticides	0.038691436	0.037257124	0.010739847	0.001570047	0.305493727
3411	Pulp, paper, and paperboard	0.895045565	0.466990941	0.175895607	0.481066788	1.633885475
3118	Sugar factories and refineries	0.224872108	0.215881422	0.148958531	0.074539786	0.106872673
3720	Nonferrous metals	1.351961340	0.044043868	0.113555517	0.103656317	1.498362598

Estimated pollution load by state (kilograms)

				Maharashtra		
ISIC	**Four Digit ISIC Description**	**SO2**	**NO2**	**TSP**	**BOD**	**TSS**
3720	Nonferrous metals	210179	6847	17654	16115	232938
3522	Drugs and medicines	305844	129879	57817	10238	2566530
3511	Industrial chemicals except fertilizer	152442	113233	24496	52168	80636
3692	Cement, lime, and plaster	13585960	6308084	6570643	125	273178
3720	Nonferrous metals	78894	2570	6627	6049	87438
3131	Distilled spirits	121495	42228	10158	170380	306230
3211	Spinning, weaving and finishing textiles	189054	260866	33799	7664	11901
3512	Fertilizers and pesticides	318974	307150	88540	12944	2518507
3710	Iron and steel	2290984	995149	**530849**	1695	24969495
3231	Tanneries and leather finishing	783	207	95	366	692
3530	Petroleum refineries	12431460	7151231	1096489	155374	779784
3512	Fertilizers and pesticides	155217	149463	43085	6298	1225538
3411	Pulp, paper, and paperboard	632486	330000	124297	339947	1154589
3118	Sugar factories and refineries	3578487	3435415	2370442	1186184	1700711
3720	Nonferrous metals	103565	3374	8699	7940	114780

Is India different?

- Can international experiences with MBIs be replicated in India?
- Possible problems/objections to cap and trade or other MBIs:
  - Monitoring and enforcement
  - Shortage of resources (regulatory agencies)
  - Large number of small-scale firms

Is India different? (continued)

- Are these problems any different from those for well-functioning CAC?
- Under CAC distinguish between:
  - initial compliance (checklist approach to compliance)
  - continuing compliance (standards are met on a regular basis)
- In particular, if total pollution load targeted through CAC would monitoring/enforcement requirements be any less?

Monitoring in a second best world

- Use knowledge of relationship between input/output to estimate emissions – emission intensities. Examples--Industrial Pollution Projection System (IPPS) developed at the World Bank http://www.worldbank.org/nipr/
- Promote self-monitoring by large firms by using default emission rates (that are greater than average rates) Example—NOx charges in Sweden

Monitoring in a second best world
(continued)

- Target output/input of polluting industry (e.g., chromium used by tanneries, fuel used by industries, carbon taxes based on carbon content of fuel)

Monitoring and enforcement regime—directions for reform

- Shift emphasis from “pseudo-monitoring and enforcement” to monitoring actual discharges
- Amend Air/Water Act to provide for on-the-spot remote monitoring
- The move from criminal offence to administrative fines should go hand in hand with reducing burden of proof (for establishing violation of standards)

Monitoring and enforcement regime—directions for reform (continued)

- Pecuniary incentives to SPCB staff (a la Customs)
- Encourage self-reporting--amend Companies Act to make Environment Statement mandatory part of Annual Report—use presumptive emissions for non-reporting firms
- Leveraged enforcement -- create institutional memory of defaulting firms

Removing institutional and legal barriers to MBIs

- Strengthen knowledge base for MBIs. Compile and analyze best practices worldwide for possible lessons for India. Regular updates crucial!
- Maintain/accelerate process of deregulation and globalization of the economy. Market-oriented mindset by industry increases receptivity to MBIs

Removing institutional and legal barriers to MBIs (continued)

- Comprehensive overhaul of functioning of State Pollution Control Boards (SPCBs)
- Autonomy from state governments--while some boards face resource constraints, lack of autonomy often a greater problem
- Ensure environmental experts rather than generalists manage these agencies

Removing institutional and legal barriers to MBIs (continued)

- Amend/enact environmental laws to empower central/state governments to prescribe MBIs
- Prerequisite--convince the political establishment at the highest level about MBIs
- Right to information--key requirement for greater transparency and accountability--critical for effective functioning of MBIs
- Necessary to build this into environmental laws and to implement it seriously