

The Evolution of a Developing  
Country Innovation System During  
Economic Liberalization:  
*The Case of India*

Rishiksha T. Krishnan

Indian Institute of Management Bangalore

rishi@iimb.ernet.in

# The Questions

- How has the innovation system evolved?
- Has liberalization facilitated the transition of technological capabilities into economic growth and competitiveness?
- Innovation system: More dynamic and strong *or* weak and dependent?
- Future challenges in strengthening the potential for innovation
- Can India become a knowledge society?

# IIS Before 1991

- Self-reliance became an end in itself
  - Efficiency & productivity ignored
- Public sector as fountainhead of indl devpt
  - Locus of complex tech acquisition
- Private sector allowed
  - But restrictions on growth, diversification, technology & capital flows
- Reservation for small sector
- Govt dominance of R&D activity
  - Source of finance & location of R&D work
  - Good instns of higher technological learning
- ***Strong technological capabilities but little benefit to industrial sector***

# Economic Policy Reforms

- Response to crisis
  - But addressed some structural issues
- Deregulation of licensing, imports, exports, technology flows
- Specific desire to inject “the desired level of technological dynamism in Indian industry”
- Now “Second stage” reforms

# IIS After 1991: Structure of the Indian Economy

	Share in GDP (%)		Growth per annum		
	1990-91	2001-02	1995-96	2001-02	2002-03
Service	43.7	53.0	10.5	6.8	7.1
Industry	25.4	21.8	11.6	3.3	6.0
Agri	30.9	25.2	-0.9	5.7	-3.2
Total	100	100	7.3	5.6	4.3

**Table 1 Foreign Direct Investment in India Since Liberalization (Approvals) August 1991-March 2002.**

	Category of Industry	Amount Rs. billion	Per cent
1.	Basic Goods	1075.76	38.8
2.	Capital Goods	251.17	9.0
3.	Intermediate Goods	49.93	1.8
4.	Consumer Non-durables	276.23	10.1
5.	Consumer durables	93.57	3.4
6.	Services	1029.28	37.1
	Total	2775.97	

Source: "Foreign Investment Approvals and Actuals: A Profile" *Economic & Political Weekly*, August 31, 2002, p. 3567.

# IIS After 1991:

## Govt. Support for Tech Innovation

- Programmes to support industrial sector
  - Absorption of imported technology (PATSER)
  - Commercialization of indigenous technology (HGT)
  - Innovators → Technology-based entrepreneurs (TePP)
  - New technology development (TDB, NMTLI)
- Tax benefits
  - Income tax, excise & customs duties
- National expenditure on R&D remains in range of 0.7-0.8% of GNP
  - But private sector contribution up from 13.8% to 21.6%
  - R&D intensity of Indian industry ~ 0.52% (1998-99)

**Table 3 : Research & Development Expenditure in India**

	National R&D expenditure as % of GNP	% Share of private sector industry in national R&D expenditure
1990-91	0.79	13.8
1991-92	0.78	NR
1992-93	0.76	NR
1993-94	0.79	16.2
1994-95	0.73	19.9
1995-96	0.71	21.7
1996-97	0.72	26.1
1997-98	0.77	22.9
1998-99	0.81	21.6

Source: *Research & Development Statistics 2000-01*, Department of Science & Technology, Government of India, May 2002.  
(NR=not reported)



# IIS After 1991: Strategies of Manufacturing Firms

## Manufacturing Competitiveness

- Several prominent companies improved competitiveness
- *Tata Steel*
  - Future viability in doubt ca. 1991
  - By 2001, #1 in WSD survey
  - RM 4.81 T/T → 3.71 T/T
  - LP 79T/man-yr → 189 T/man-yr
- *Reliance, Sundaram Clayton*

# IIS After 1991: Strategies of Manufacturing Firms

## Product Development & Innovation

- Automobile, 2-wheeler, pharma sectors
- Production, investment & innovation capabilities
  - Tata Motors *Indica*
  - TVS Motor *Victor*
  - Dr. Reddy's Labs: 3 molecules licensed, 19 US patents granted

# IIS After 1991: Strategies of Manufacturing Firms

## Heterogeneity of Performance

- TFP in both organized & unorganized sectors declined in the first half of '90s
- MGI study shows that Indian labour productivity in modern sectors is 15% of best
- Level of 43% attainable through better work practices, organizational changes
- China, Malaysia, Thailand preferred as manufacturing locations
- Innovation concentrated in certain sectors
- Family-owned businesses reluctant to invest in technology, but may now have no option

# IIS After 1991: Research Labs & Higher Education

- Changes in labs governance structure & incentives
- CSIR
  - 38 intl patents (1998-99)
  - External cash flows Rs. 2.04 billion
  - 18% from private industry
  - 7.3% from foreign sources
  - National Chemical Lab as trendsetter
- Sponsored research, consultancy ↑ at top engg schools

**Table 4: Revenue from Consultancy and Sponsored Research Projects at IIT Kanpur**

Year	Sponsored Projects		Consultancy Projects		Patents	
	No	Revenue Rs. Million	No	Revenue Rs. Million	Filed	Granted
2002-2003	115	302.5	136	57.4	8	1
2001-2002	59	176.7	153	71.8	7	3
2000-2001	99	161.7	130	22.4		
1999-2000	61	69.1	116	27.7		
1998-1999	83	82.9	107	14.4		
1997-1998	82	139.4	71	9.1		
1996-1997	94	61.5	74	9.0		
1995-1996	65	54.0	101	16.7		
1994-1995	72	46.3	100	5.2		
1993-1994	109	25.6	76	3.6		

Source: Dean (R&D), Indian Institute of Technology Kanpur

# IIS After 1991:

## The Services Sector: Software

### Evolution of the Software Industry

- More than 2% of GDP, 15% of exports
- Exports up from Rs. 1.35 billion in 1990-91 to Rs. 360 billion (\$7.68 billion) in 2001-02
- Employment > 500,000
- Export of manpower → “offshore” devpt
- Buoyed by global demand and trend towards outsourcing of non-core activities
- Cost arbitrage + organizational capabilities
- Government support but not policy driven

# IIS After 1991: The Services Sector: Software

## Software Industry & the Innovation System

- Early staff from research labs, public sector
- People from education system, in-house training
- Indirect positive benefits to wider innovation system:
  - “Made in India” as +ve label: enabled growth of ITES industry, R&D services
  - Global capital, acctg stds, governance, stock plans
  - Model for entrepreneurship
  - “Can do” feeling
  - Spurred growth of education sector
- Limited links with manufacturing sector

# IIS After 1991:

## The Services Sector: Software

### Role of MNCs

- 27% of software exports from India
- Helped build Indian brand (TI, HP)
- Pioneered offshore model
- Lead in quality movement (Motorola)
- Exposure to advanced technologies, managerial practices
- Pushed up salaries
- May have reduced brain drain but contributed to decline in doctoral enrolments
- Little significant interaction with local firms (e.g. no joint development of products)



# IIS After 1991: The Services Sector: Software

## Innovation & Learning

- Generally, low R&D spend (Infy 0.38%)
- Every project a learning experience?
- Quick at adopting new technologies and diffusing them in organization
- Some domain competence built
- Quality management (CMM level 5)
- “Process orientation” – conflict with innovation?

# IIS After 1991: The Services Sector: Software

## The Future of the Software Industry

- Limited success in ascending value curve into consulting, product development
- Absence of challenging customers in India, limited domain expertise, easy revenues from services, brand image & reputation
- “Lock-in” to low-end work?
- Capabilities transfer to other emerging service industries

# IIS After 1991: Other Dimensions

- Engg Education: Quantity w/o quality
  - 1990      339 instns                      87,000 places
  - 2002     1208 instns                      360,000 places
  - All 171 new instns surveyed deficient!
- Entrepreneurship
  - Higher status, at least in new economy
- Geographical Clustering
  - “Balanced devpt” → Urban concentration
- Labour Movement
  - Loss of bargaining power

# IIS After 1991: Summing Up

- Liberalization opportunity for orgns to build on capabilities, find markets that value their outputs
  - Capabilities enhanced in select sectors
  - Demand growth, regulation, competition & role models drivers of innovation
  - Increased focus on quality
  - More companies ↑ on the competitiveness continuum
- Services sector successful in leveraging resource base to exploit market opportunity
  - But difficult to break out of low value-addition
- Lack of synergies between manufacturing & services

# Future of the IIS: Challenges Ahead

- Sustain growth in employment-intensive service businesses
- Maintain competitiveness through constant upgradation of capabilities
- Recover competitiveness in important traditional sectors
- Enter & succeed in select high technology industries

# Future of the IIS: Key Issues

- Resource allocation
  - Choice of areas, magnitude of investment
- Improving the quality of education
  - Attractiveness of academic careers
- Flexibility in orgnl structures, processes
  - CDOT experience, learn from Chinese
- Promoting technological entrepreneurship
  - Networked entrepreneurs, Taiwan model
- Shaping societal values, attitudes
  - How to inculcate some key values that are absent

# Implications for Other Countries & NIS Research

- Software industry experience: Develop generic infrastructure, wait for next wave?
- Importance of innovations in business models, orgnl design, functional strategies: need for more emphasis on “other” capabilities?
- NIS research more internally focused: how to link to markets?

***Thank you***