Financing of industrial innovations in India,
How effective are tax incentives for R&D?

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Outline

- India’s innovative performance
- Survey of financing of Innovation
- Effectiveness of tax incentives
- Conclusion

India's innovative performance

Three conventional indicators:

- Trends in R&D investments
- Trends in patenting
- Trends in technology trade balance

Trends in R&D Investment

	Gross Expenditure on R&D (Rs in Millions)				
	At Current Prices	At Constant Prices (Base Year:1993-94)	Nominal growth rate (%)	Real Growth rate	GERD to GDP ratio
1980-81	7605.2	23421.6			
1981-82	9407.3	26297.1	23.70	12.28	0.58
1982-83	12060.3	31175.4	28.20	18.55	
1983-84	13811	32786.4	14.52	5.17	
1984-85	17815.5	39386.3	29.00	20.13	
1985-86	20687.8	42611.4	16.12	8.19	0.83
1986-87	24354	46868.1	17.72	9.99	0.88
1987-88	28530.7	50202.3	17.15	7.11	0.91
1988-89	33472.6	54345.1	17.32	8.25	0.9
1989-90	37257.4	55858	11.31	2.78	0.86
1990-91	39741.7	53972.4	6.67	-3.38	0.78
1991-92	**45128.1**	**53867.9**	**13.55**	**-0.19**	**0.77**
1992-93	**50046**	**54947.8**	**10.90**	**2.00**	**0.79**
1993-94	**60730.2**	**60730.2**	**21.35**	**10.52**	**0.78**
1994-95	**66224.4**	**60425.3**	**9.05**	**-0.50**	**0.70**
1995-96	**74838.8**	**62634.4**	**13.01**	**3.66**	**0.70**
1996-97	**89136.1**	**69497**	**19.10**	**10.96**	**0.72**
1997-98	**106113.4**	**77507.6**	**19.05**	**11.53**	**0.76**
1998-99	**124731.7**	**84362.6**	**17.55**	**8.84**	**0.78**
1999-00	**143976**	**93751**	**15.43**	**11.13**	**0.82**
2000-01	**161988**	**101962.8**	**12.51**	**8.76**	**0.85**
2001-02	**170381.5**	**103720.9**	**5.18**	**1.72**	**0.82**
2002-03	**180001.6**	**105225.7**	**5.65**	**1.45**	**0.80**
2003-04*	**197269.9**	**111989.3**	**9.59**	**6.43**	**0.78**
Average rate of growth (pre reform)			18.17	8.91	0.81
Average rate of growth (post reform)			**13.22**	**6.57**	**0.77**

Sector of performance of GERD in India, 1970-70 through 2004-05 (percentage shares)

	Government	Industry	Higher Education
1970-71	89.55	10.45	
1975-76	88.13	11.87	
1980-81	84.13	15.87	
1985-86	87.82	12.18	
1990-91	86.16	13.84	
1995-96	78.26	21.74	
1998-99	75.79	21.17	3.04
1999-00	77.21	18.46	4.33
2000-01	77.94	18.05	4.02
2001-02	76.48	19.33	4.20
2002-03	75.56	20.27	4.17
2003-04	75.44	20.05	4.51
2004-05	73.92	19.81	4.88

Growing privatization of industrial R&D in India, 1985-86 to 2002-03

(Rs in Millions at current prices)

	Government					
	Public Sector Enterprises	Govt.Research Institutions	Total government	Private Sector enterprises	Industrial R & D	Share of Private Sector In Total Industrial Development
1985-86	1986.18	1622.7	3608.88	2519.44	6128.32	41.11
1986-87	2356.99	1723.36	4080.35	2916.33	6996.68	41.68
1987-88	2884.66	1851.29	4735.95	3102.67	7838.62	39.58
1988-89	3421.24	2093.28	5514.52	4176.25	9690.77	43.10
1989-90	4129.01	2395.21	6524.22	4905.94	11430.16	42.92
1990-91	4145.33	2491.88	6637.21	5499.81	12137.02	45.31
1991-92	4843.88	2745.50	7589.38	6369.44	13958.82	45.63
1992-93	5139.50	2993.65	8133.15	8362.47	16495.62	50.70
1993-94	5428.11	NA	NA	9825.37		
1994-95	4146.09	3564.00	7710.09	13188.70	20898.79	63.11
1995-96	4275.76	4116.99	8392.75	16270.69	24663.44	65.97
1996-97	5360.52	4440.00	9800.52	23307.50	33108.02	70.40
1997-98	5392.40	5641.30	11033.70	24382.50	35416.20	68.85
1998-99	6738.70	7133.20	13871.90	21766.10	35638.00	61.08
1999-00	7576.30	7808.82	15385.12	21781.10	37166.22	58.60
2000-01	8428.80	8641.20	17070.00	24114.00	41184.00	58.55
2001-02	7673.70	8922.60	16596.30	27874.80	44471.10	62.68
2002-03	8089.50	9512.50	17602.00	30649.30	48251.30	63.52

Industry-wide distribution R&D

(cumulative share in per cent 1998-99 through 2002-03)

Industry	Share
Drugs & Pharmaceuticals	19.30
Transportation	15.16
Electricals & Electronic Equipment	8.94
Chemicals(other than Fertilisers)	8.35
Defence Industries	8.32
Fuels	6.12
Information Technology	4.69
Metallurgiical Industries	4.21
Telecommunications	3.75
Miscellaneous Industries	2.38
Soaps, Cosmetics &Toilet Preparations	2.37
Industrial Machinery	1.84
Biotechnology	1.59
Food Processing Industries	1.39
Agricultural Machinery	1.33
Misc. Mechanical Engineering Industries	1.22
Textiles(Dyed, Printed, Processed)	1.21
Consultancy Services	1.05
Other industries	6.77
Total	100.00

Trends in US Patenting of Indian Inventors, 1994-2007

(number of utility patents)

	Pre 1994	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Compound rate of growth
China, P.Rep	431	48	62	46	62	72	90	119	195	289	297	404	402	661	772	23.82
South Africa	2390	101	123	111	101	115	110	111	120	113	112	100	87	109	82	-1.59
China, Hong Kong	702	57	86	88	81	160	155	179	237	233	276	311	283	308	338	14.67
India	428	27	37	35	47	85	112	131	178	249	342	363	384	481	546	26.02
Russian Federation	3	38	98	116	111	189	181	183	234	200	203	169	148	172	188	13.09
Brazil	752	60	63	63	62	74	91	98	110	96	130	106	77	121	90	3.17

Distribution of US patents according to ownership, 1991-2005

		1991		2000		2005		1991-2005	
	Organisation	No. of Patents	share	No. of Patents	share	No. of Patents	share	No. of Patents	share
1	**Foreign**	**5**	**29.4118**	**41**	**32.54**	**138**	**45.2459**	**503**	**30.21**
	MNCs	5	29.4118	41	32.54	138	45.2459	501	30.09
	Government	0	0.0000		0	0	0	2	0.1201
2	**Indian**	**12**	**70.5882**	**85**	**67.46**	**167**	**54.7541**	**1162**	**69.79**
	GRI & others	3	17.6471	40	31.746	118	38.6885	737	44.264
	IOP	5	29.4118	12	9.5238	12	3.93443	157	9.4294
	Public sector Enterprises	1	5.8824	9	7.1429	6	1.96721	39	2.3423
	Private sector Enterprises	3	17.6471	24	19.048	31	10.1639	229	13.754
	TOTAL	**17**		**126**		**305**		**1665**	

The top 15 most emphasised patents by Indian inventors, 2002-2006

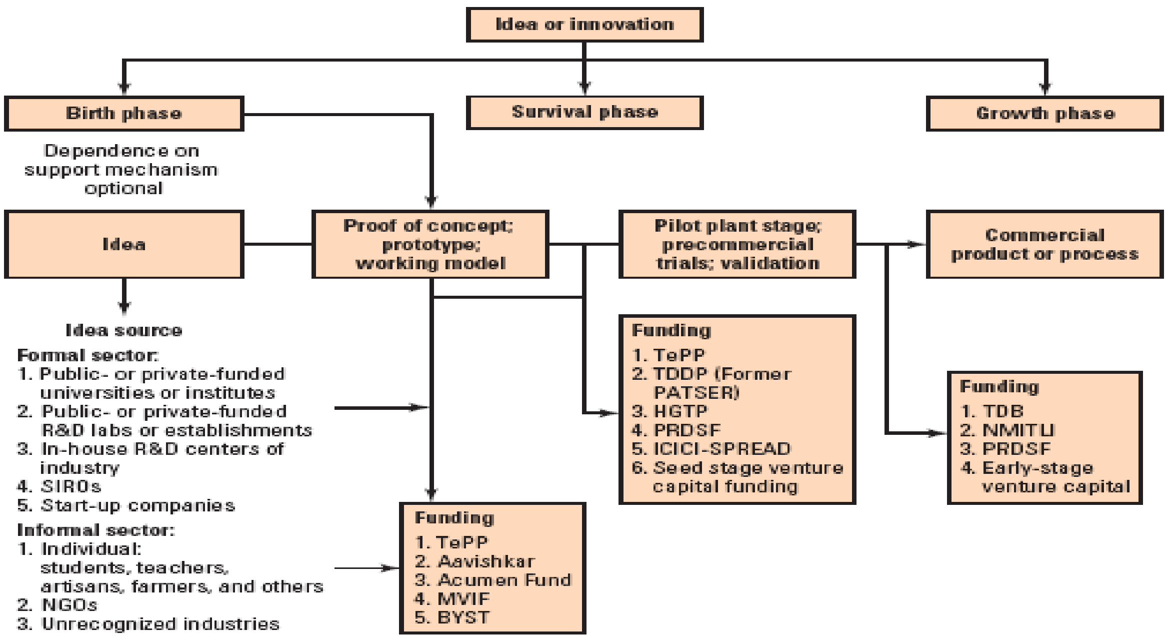
	Class Title	2002	2003	2004	2005	2006	Total
532	Organic Compounds (includes Classes 532-570)	78	70	65	61	69	343
424	Drug, Bio-Affecting and Body Treating Compositions (includes Class 514)	48	72	44	54	70	288
435	Chemistry: Molecular Biology and Microbiology	24	30	19	23	26	122
520	Synthetic Resins or Natural Rubbers (includes Classes 520-528)	8	8	14	11	13	54
327	Miscellaneous Active Electrical Nonlinear Devices, Circuits, and Systems	4	10	9	9	16	48
341	Coded Data Generation or Conversion	4	6	3	16	17	46
707	DP: Database and File Management or Data Structures (Data Processing)	4	5	13	6	9	37
423	Chemistry of Inorganic Compounds	4	5	13	5	7	34
709	Multicomputer Data Transferring (Electrical Computers and Digital Processing Systems)	1	3	8	12	10	34
370	Multiplex Communications	2	3	6	7	14	32
702	DP: Measuring, Calibrating, or Testing (Data Processing)	0	5	8	10	8	31
326	Electronic Digital Logic Circuitry	1	5	3	7	12	28
717	DP: Software Development, Installation, and Management (Data Processing)	0	3	4	7	13	27
502	Catalyst, Solid Sorbent, or Support Therefor: Product or Process of Making	2	9	5	5	5	26
711	Memory (Electrical Computers and Digital Processing Systems)	0	3	2	9	9	23
		180	237	216	242	298	1173

Trends in technology trade balance, 2000-2006

(in millions of US $)

	Payments	Adjusted Payments	Receipts	Adjusted Receipts	TBoP	Adjusted TBoP
2000	311		54		-257	
2001	236		60		-176	
2002	361		22		-339	
2003	352		23		-329	
2004	444		32		-412	
2005	712	1890	71	1709	-641	-181
2006	729	2514	129	5288	-600	2774

Financing of innovation in India (c2007)



Source: World Bank; adapted from UN ESCAP (2005).

Note: BYST = Bharatiya Yuva Shakti Trust; HGTP = Home Grown Technology Program; ICICI = ICICI Bank; MVIF = Micro Venture Innovation Fund; NGOs = nongovernmental organizations; NMITLI = New Millennium Indian Technology Leadership Initiative; PATSER = Programme Aimed at Technological Self-Reliance; PRDSF = Pharmaceutical Research and Development Support Fund; SIROs = scientific and industrial research organizations; TDDP = Technology Development and Demonstration Program; and TePP = Techno-entrepreneurs Promotion Program.

Tax incentives for financing Innovation

1. Weighted tax deduction U/s 35 (2AA) of IT Act 1961 for sponsored research programs in approved national laboratories, universities and IITs;
2. Weighted tax deduction u/s 35(2AB) of IT Act, 1961 on in-house R&D expenditure in chemicals, drugs, pharmaceutical (including clinical drug trials, obtaining approvals from any regulatory authority under any Central, State or Provincial Act and filling an application for a patent under Patent Act, 1970), bio-technology, electronic equipment, automobiles and its components; computers, telecommunication equipment and manufacture of aircrafts and helicopters as approved by the Prescribed Authority (Secretary, DSIR);
3. Customs duty exemption on capital equipment, spares, accessories and consumables imported for R&D by approved institutions/SIROs;
4. Customs duty exemption on specified goods (comprising of analytical and specialty equipment) for use in pharmaceutical and biotechnology sector;
5. Excise duty waiver on indigenous items purchased by approved institutions/ SIROs for R&D;
6. Ten year tax holiday for commercial R&D companies;
7. Excise duty waiver for 3 years on goods produced based on indigenously developed technologies and duly patented in any two of the countries out of India, European Union (any one country), USA and Japan;
8. Accelerated depreciation allowance on plant and machinery set-up based on indigenous technology;
9. Customs duty exemption on imports for R&D projects supported by Government.

Share of Venture Capital in Total Private Equity Industry in India, 2006 and 2007

Stage of Company Development	Volume/No. of Deals		Value/Amount (In million US$)			
	2006	2007	2006	Percent share-2006	2007	Percent Share 2007
Venture Capital	94	98	505	7.06	542	3.81
Growth PE	14	32	364	5.09	1321	9.28
Late	104	136	3396	47.46	5070	35.62
Pre IPO	4	14	43	0.60	434	3.05
PIPE	60	80	1401	19.58	4210	29.58
Buyout	13	7	370	5.17	173	1.22
Buyout-Large	1	3	765	10.69	474	3.33
Other	8	17	312	4.36	2010	14.12

Tax incentives for R&D: Pros and Cons (OECD, 1996)

- Tax incentives entail less interference in the marketplace, and thus allow private-sector decision makers to retain autonomy;
- Tax incentives require less paperwork and entail fewer layers of bureaucracy;
- Tax incentives avoid the need to set nebulous and detailed requirements for receiving assistance;
- Tax incentives have the psychological advantage of achieving a favourable industry reaction; and
- Tax incentives have a high degree of political feasibility.

However, criticisms of tax incentives are made in relation to the advantages listed, along with the following disadvantages of tax incentives compared to other assistance programmes:

- Tax incentives bring about unintended windfalls by rewarding what would have been done without the tax incentive;
- Tax incentives led to undesirable inequities;
- Tax incentives can raid the national treasury; and
- Tax incentives are an ineffective means to achieve focused results.

There are essentially two types of R&D tax incentives

	Volume base	Incremental	Combination of Volume based and Incremental
R&D tax credits	Canada Italy Korea Netherlands	France Japan Korea Mexico United States	Portugal Spain
R&D allowances	Denmark United Kingdom	Norway Belgium	Australia Austria Hungary

Effectiveness of R&D tax incentives

- **Fiscal incentives stimulate business R&D.** However, it is difficult to evaluate the amount of additional R&D per unit of forgone public revenue. The few tentative evaluations show a positive, but moderate level of additionality. Nevertheless, the substantial amount of potential externalities (R&D spillovers) would strengthen the positive impact of tax credit.
- Methodological difficulties in establishing the effect of fiscal incentives leave us with a large unknown factor. There is a clear **need for more formal evaluations** that would use several alternative methods. So far, there is a preponderance of evaluations for the Canadian and US tax incentives.
- There is a need for better micro-level data sets to understand the long-term impact of fiscal incentives on business R&D.

The Indian Case:
Input and output based tax incentives for R&D in India (c2008)

A. Input based tax incentives
(a) a weighted deduction of 150 per cent on any expenditure on in-house scientific research
(b) weighted tax deduction for sponsored research in publicly funded R&D and on approved in-house R & D projects;
(c) customs duty exemption on capital equipment, spares, accessories and consumables imported for R & D by approved R&D units, institutions and SIROs;
(d) excise duty waiver on indigenous items purchased by approved institutions/ SIROs for R & D;
(e) accelerated depreciation allowance on plant and machinery setup based on indigenous technology;
(f) customs duty exemption on imports for R & D projects supported by the Government;
(g) ten year tax holiday for commercial R & D companies; and
(h) a weighted deduction of 125 per cent on any payment made to companies engaged in research and development
B. Outcome based tax incentive
(a) excise duty waiver for 3 years on goods produced based on indigenously developed technologies and duly patented in any two of the following countries: India, European Union (one country), USA and Japan.

Tax foregone due to R&D tax incentives in India (Rs in Millions)

Column1	Revenue foregone due to R&D tax incentives	Revenue foregone due to all tax incentives	Share (%)
2004-05	2318	82680	2.80
2005-06	2839	101277	2.80
2006-07	1554	144318	1.08
2007-08	2024	186125	1.09
Average			1.94
*			

Effective corporate income tax rate for those industries covered under the R&D tax incentive scheme, 2006-07

Sl No:	Industry	Statutory Corporate Income Tax Rate (in per cent)	Effective Tax Rate (in per cent)
1	Drugs and pharmaceuticals	33.66	13.91
2	Electronics, including computer hardware	33.66	17.04
3	Fertilizer, chemicals and Paints	33.66	22.17
4	Automobile and Auto parts	33.66	26.03

R&D expenditure of firms receiving R&D tax incentives, 1996-2006

(Rs in Millions)

Industry	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Pharmaceutical	3954.1	7110.1	4627.3	6075	5674.7	7610.8	8937	11218.4	16609.5	22928.1	29595
Chemical industry other than pharmaceutical	1997.8	4842.9	2377.2	3178.3	2275	2368.2	2094.9	2407.6	2697.1	3303	4791
Electronics including computer	88.4	132.7	41.4	39.2	87.3	108	57.3	12.6	349.6	71.5	417.9
Communication Equipments	112.9	499.9	395.5	383.1	429	641.1	750.4	603.7	1025.1	896.3	727.4
Automobiles	1552.2	2459.6	2856	2143.8	1453.1	1742.9	2878.2	3357.9	4183	7506.9	8848.1
Autoparts	407.2	516	682.9	757.7	947.2	1081.7	1121.1	1485.7	1691.3	2194.6	2505.9
Aircrafts	NA	NA	NA	NA	NA	NA	NA	2650.6	3091.4	3066.3	4336.2
Total	8112.6	15561.2	10980.3	12577.1	10866.3	13552.7	15838.9	21736.5	29647	39966.7	51221.5
Growth Rate(%)		91.82	-29.44	145.1	-13.6	24.72	16.87	37.23	36.39	34.81	28.16
Growth Rate of all Industries(%)		18.01	34.24	6.97	0.63	4.29	10.81	7.98	8.5		
Ratio		5.1	-0.086	2.2.09	-21.72	5.77	1.56	4.67	4.28		

Elasticity of R&D Expenditure wrt tax foregone

- The first step involved in this exercise is to estimate the tax foregone due to the operation of this specific R&D tax incentive scheme.
- This is done in two stages. I
- n the first stage or instance, we estimate the total tax foregone (denoted as tf1) due to the operation of all tax incentives. This is based on the difference between the statutory corporate income tax rate and its effective rate
- In the second stage we estimate the tax foregone (denoted as tf2) due to just R&D tax incentives alone. This estimation was done under an assumption. It was found that the revenue foregone due to R&D tax incentives worked out, on an average, 1.94 per cent of revenue foregone due to all kinds of tax incentives . In other words:

- **tf2 = tf1*0.0194------------------------(1)**
- For estimating the elasticity, we fitted the following functional form:
- **ln R&Dit = a+b1lnSalesit + b2tf2it + b3lnExport +uit -----------------(2)**

Summary statistics

(Values are in Rs Crores, Intensities are in percentages)

	R&D Expenditure	Research Intensity	Sales	Tax foregone 2	Exports	Subsidy intensity
Automotive	12.25 (39.50)	1.13	1088.42(2668.18)	1.653(4.299)	87.95(265.01)	13.50
Chemicals	2.07(4.17)	0.46	449.24(151.04)	0.133(0.431)	55.61(137.43)	6.43
Electronics	7.4(21.52)	2.41	306.58(289.69)	0.218(0.898)	40.71(151.04)	2.95
Pharmaceuticals	19.05 (52.91)	5.99	318.09(289.69)	0.23(0.43)	122.05(289.69)	1.21

Regression results

	Automotive	Chemicals (other than pharmaceuticals)	Electronics	Pharmaceuticals
ln tf2	-0.0045 (-0.017)	0.429** (3.08)	-0.138 (-0.59)	0.261 (1.37)
ln sales	1.244** (2.93)	0.470* (1.78)	0.816** (1.93)	0.394 (1.10)
ln exports	-0.0734 (-2.92)	-0.028 (0.246)	0.091 (0.624)	0.553* (1.89)
Constant	-6.262** (-2.48)	-1.126 (-0.703)	-4.26 (-1.55)	-2.01 (-1.08)
Sargan	30.12 (0.181)	26.03 (0.352)	23.34 (0.50)	27.67 (0.274)
AR (1)	-1.362 (0.173)	-2.516 (0.012)	-1.678 (0.093)	-1.944 (0.52)
AR (2)	-1.699 (0.089)	-0.326 (0.74)	-0.01 (0.992)	-0.266 (0.79)

Interpretation of the results

- The elasticity of R&D expenditure with respect to tax foregone as a result of the operation of the R&D tax incentive is less than unity for all the four industries, although it is significant only in the case of the chemicals industry.

- In two of the industries, namely in automotive and electronic industries the elasticity is even negative, although not significant. From this the reasonable interpretation that is possible is that tax incentive does not have any influence on R&D, excepting possibly in the chemicals industry where it has some influence although even in this case the change in R&D as a result of tax incentive is less than the amount of tax foregone.

- This lack of significant relationship between R&D and tax foregone can be rationalized by the fact that the tax subsidy covers only a very small percentage share (on an average 6 per cent) of R&D undertaken by the enterprises in the four broad industry groups.

- So our conclusion is that for tax incentive to be effective in raising R&D expenditures it must form a significant portion of R&D investments by an enterprise.

- It is not thus a determinant of R&D investments by enterprises. In fact this result corroborates the results of innovation surveys done in the context of such diverse countries such as Brazil and South Africa where innovating firm did not find government funds for innovation as an important instrument for financing their respective innovation efforts. In the Indian case even though 150 per cent of weighted deduction of R&D expenditure is allowed, the taxable income the firm has is not much. For firms to benefit from this specific incentive, their profit before tax has to be large.

Interpretation of the results (continued)

- Sales (a proxy for size) is found to be a more important determinant. This is in line with the Schumpeterian hypothesis that large sized firms are able to devote more investments on R&D;
- Surprisingly exports turned out to have positive and significant influence on R&D only in the case of the pharmaceutical industry. The other two industries are much more inward looking where the domestic market is more important than the export on; and
- In the case of the pharmaceutical industry much of the R&D is in the development of generic versions of known drugs which are then exported. So exports act as an important fillip.

Conclusions

- Our study has shown that there have been improvements in the innovative output of Indian industry during the recent period since economic liberalisation.
- However this has been restricted to a few industries such as the pharmaceutical industry.
- India has three different types of financial incentives for R&D: research grants and loans, venture capital and tax incentives.
- Our analysis showed that the pharmaceutical industry has been a target of most of these financial incentives.
- There is thus a fine targeting of innovation financing in India.

- We endeavoured to estimate the coefficient of elasticity of R&D with respect to tax foregone as result of this incentive scheme. The resulting exercise showed that R&D expenditure of the concerned industries was inelastic. We also found that the incentives did not form a significant portion of R&D. It is therefore not prudent to make any comments on the effectiveness of R&D tax incentives. But we see that the size of the firm does appear to be an important determinant of R&D , at least, in the case of some of the industries. Allowing firms to become larger and through that process of growth enabling them to become larger investors in R&D may be a better policy than providing them directly with subsidies

Conclusions (continued)

- Our hypothesis was that this was largely due to the quirks of methodology and the dataset used for such a computation.
- So until we have firm data on tax foregone due to the operation of this specific R&D scheme we are not in a position to draw very firm conclusions about its effectiveness.
- The only safe conclusion that this study allow us to draw is the fact that the government has targeted the right sort of industries for awarding this incentive scheme.