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Globalization and India's Technology Regime: an Empirical Analysis in the Macroeconomic Perspective

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Abstract

Technology regime of a country, in its macroeconomic perspective, is best reflected by how technology is acquired and how it is absorbed through sustaining public expenditure on R&D. After liberalisation of the Indian economy in 1991, opportunities have become ripe for the economy to acquire technology from abroad easily at a lower cost. In the present paper, an attempt has been made to study the impact of the import of technology on the public R&D of the Indian economy during the pre-and post- liberalisation periods (1980-81 to 1990-91 and 1991-92 to 2007-2008) on the basis of the Log-linear model of regression analysis.

Keywords: Technology regime, Technological innovation, Technology import, Research & Development.

JEL Classification: B25, C10, C32, O30.

I. INTRODUCTION

The central point of discussion on the technology regime is innovation. Nelson & Winter (1982) invoked the concept to provide a framework for interpreting the observed differences in innovative behavior across industrial sectors. The expenditure on Research and Development (R&D) by the industry or the firm is a convenient measure of technological innovation and the robustness of technology regime of a country is reflected by the extent to which the spillover of public R&D sustains technological innovation in the industrial sector.

Nelson and Winter, in this regard, mentioned 'the innovative R&D efforts of the firms in the industry take advantage, as it were, of new technological opportunities that have been created elsewhere. Greater R&D expenditure within

the industry means that latent productivity is tracked more smoothly, but aside from that the path of best- practice productivity is unlikely to be much higher than it is when industry R&D expenditures are less'(1982 P.293-294).

Technology acquisition is another crucial component of technology regime. The opportunity cost of making improvement over existing technology on the basis of indigenous knowledge than importing the same from abroad is high for the countries which are late-starters in the race for technological catch-up. Hence it is prudent for them to reside on the import of technology and this takes two forms- import of embodied technology appraised by the import of capital goods and the import of disembodied technology measured by the royalties, license fees, copyright, etc.

In order to understand the nature, dimension and trend of expenditure on R&D in India a closer look at the evolution of India's technology policy was necessary. On 4th March, 1958 the Government adopted the Scientific Policy Resolution. One of the aims of scientific policy had been 'to foster, promote, and sustain, by all appropriate means, the cultivation of science, and scientific research in all its aspects - pure, applied, and educational'. Table1 shows that during 1970-71 to 1980-81, the expenditure by the government on R&D at current prices (1999-2000 prices) reflected a growth rate of 29.25%. The R&D expenditure as percentage of GDP stood at 0.39 in current prices during the year 1970-71 which stepped up to 0.61% during the year 1981-82.

It was during the Sixth Plan that the Government announced its first comprehensive Technology Policy, 1983. This accorded priority to R&D on the plea that an adequate scale of investment in R&D was necessary for the absorption, adaptation and, wherever possible, improvement on and generation of new technology, making fullest use of overall national capabilities. The growth of national expenditure on R&D which was 4.32% during the period 1984-85 to 1994-95 improved to 9.02% during the period 1995-96 to 2007-08.

The Scientific and Technology Policy 2003 explicitly made it clear that every effort would be made to achieve synergy between industry and scientific research. From Table I it was evident that during the period 2003-2004 to 2007-08 the rate of growth of R&D expenditure was 11.55% whereas during the period 1983- 84 to 2002-03 the growth rate was 6.30%. It implied that Technology Policy 2003 had been able to provide momentum to the growth of R&D.

The trend of sector wise national expenditure on R&D is revealed through Table2. The data regarding expenditure on R&D by the Central, State, Private and Higher Education Sectors were provided by Department of Science and Technology (DST), Government of India at intervals.

In the year 1970-71, the share of central to total R&D expenditure was 80.55%, state sector's contribution was 9.01% and that of private sector was 10.45%.The corresponding figures for the three sectors in the year 1980-81 were 76.33%, 7.81% and 15.87% respectively. This implied that the contribution of private sector had been on the rise while that of the central and state sectors were declining. During the year 1995-96 the share of the central sector fell down to 69.48%, the state's contribution also decreased to 8.78% but that of the private sector increased further to 21.75%. In the year 2007-08, the share of central further fell to 58.78%, the state's contribution also fell to 7.20%. On the other hand, the contribution of the private sector further increased to 29.63%.

During the period 1948 to 1968 India's development effort relied on industrialization and to that effect the government put emphasis on the development of basic and heavy industries through persuasion of import substitution strategy. R&D was assigned importance for developing scientific base, however, given the weakened status of R&D infrastructure, the economy had to compromise with the acquisition of foreign technology. One way through which this could be done was to take resort to the import of embodied and disembodied technologies.

During the period 1951-52 to 1955-56 India's imports of capital goods was worth of Rs.1053.6 crores which was 28.8% of the total imports, for the next five years the import of capital goods as percentage of total imports increased to 42.2% and it further stepped up to 47.8% during the period 1961-62 to 1965-66.

Import of disembodied technology measured by the payment in terms of royalties, license fees, copyright, etc of India is shown in Table III. India's import, in this regard, was Rs.1.2crores in the year 1956-57 which rose to Rs.5.1 crores in the year 1966-67 and fell by 0.8% in the next year. Since the year 1975-76 the import of disembodied technology reached the double-digit figure and for the next few years there were some ups and downs and since the year 1986-87 it started increasing steadily except a setback in the year 1991-92.

During the period 1969 to 1980 the major objective of Indian Planning had been growth with self- reliance and social justice (Agarwal 2001). During this

phase trade regime was characterised by progressive import-substitution, industrial regime was firmly regulated and the policy of R&D was geared towards technology development. The government followed a restrictive policy towards foreign collaboration. During this period the growth rate of national expenditure was 16.70% as depicted in Table1 but the R&D expenditure as per cent of GDP at constant prices increased barely from 0.05 to 0.08. Though the import of capital goods, i.e., import of embodied technology increased from Rs. 403.9 crores in the year 1970-71 to Rs. 1458.50 crores in the year 1979-80, in terms of percentage of total imports it fell from 24.70 to 15.95.The import of disembodied technology, however, revealed a rising trend as it increased from Rs. 5.8 crores in the year 1969-70 to R. 9.6 crores. Since the focus of the development objective in the country shifted towards 'growth with efficiency and competitiveness' (*ibid*.), the trade and industrial regimes exhibited progressively deregulated traits. Table1 discloses that the national expenditure on R&D increased from Rs. 3674.35 crores in the year 1980-81 to Rs 9656.11crores in the year 1995-96 and further to Rs 27213.00 crores in the year 2007-08. GDP as the proportion of the R&D expenditure improved from 0.57 in the year 1980-81 to 0.69 in the year 1995-96 and further to 0.87 in the year 2007-08.

Table V depicts that the share of the import of capital goods in total imports which was 15.22 in the year 1980-81 increased to 28.17 in the year 2007-08.The import of disembodied technology which was worth of Rs 8.9 crores increased to Rs. 4167 crores in the year 2007-08 as shown in Table 3. Table 4 depicts the trend of India's import of technology as percentage of total imports since the year 1970-71. There had been no conclusive evidence regarding the impact of the import of technology on the efforts of carrying out R&D expenditure. While some studies found a complementary relationship between the two the findings of the some other studies entailed substituting relationship.

The relationship between the import of technology and the expenditure incurred on R&D was subject to the interaction of many variables, nevertheless, it would not be a futile exercise to discern how the efforts of carrying out R&D in India at the government levels had been moved by the trend of technology import by the country.

The remainder of the paper is organized as follows. Section 2 deals with the survey of existing literature and identification of the research gaps. Section 3 is concerned with the objectives, data source and research methodology. Section 4 discusses empirical results. Section 5 presents concluding observations.

II. REVIEW OF LITERATURE

Though the concept of 'technology regime' was an offshoot of evolutionary economics developed by Nelson and Winter (1982) the description of the term in terms of technological opportunity, appropriability, cumulativeness of learning and properties of knowledge base, was made by Malerba & Orsenigo (1993). Winter (2004) provided a theoretical sketch of what an economic theory of firm would be had it been based upon the thought of Joseph Schumpeter.

The opportunity for technological solution of the problems pertaining to the firms, rests, in many respects, upon the scope of acquisition of technology. Katrak(1985) sought an empirical analysis to discern in respect of India whether 'Import and Adapt' (IAT) technology has had a stimulating effect on local R&D and whether the experience gained while adapting technology made the development of technological capability so as to ensure self-reliance in technology.

Deolalikar and Evenson (1989) studied the determinants of inventive activity in Indian manufacturing. The study indicated that purchased technology and inventive activity were complementary to each other in Indian manufacturing. Lastly, this study vindicated that the demand for foreign technology was not related to firm size and its findings that foreign technology use and local inventive activity were complementary to each other called for a liberalized technology import policy. The paper did not take into account the fact that import of disembodied technology in India had not been insignificant during the 1956-57 to 1970-71.

There has been no significant contribution to study the impact of globalisation on India's technology regime at least at the empirical level. Most of the researches have been confined to explore the factors impacting on the productivity of Indian manufacturing and in this respect, the role played by FDI, particularly, in spillover of technology has received greater attention. However, Kumar & Agarwal (2005), analyzed the determinants of R&D behaviour of Indian enterprises by taking data from the Prowess Data Base (June 2000 Release) of the Centre for Monitoring Indian Economy (CMIE) for the period 1992-93 to 1998-99. The results suggested that competition intensified through liberalisation pushed local firms to rationalize their R&D activity and MNE affiliates revealed a lower R&D intensity compared to local firms, presumably on account of their captive access to the laboratories of their parents and associated companies. The period of

study considered has been too short to provide insight about the impact of liberalisation which made its inception since 1991.

Many a times firms do not want that their technology to be known to their competitors. But they want to license it. By licensing they get royalty. Still competitors come to know about it through magazines or trade fairs etc. - if technology is diffusing in this fashion – it is called technology spillover. Basant & Fikkert (1994), Kathuria (1996. 1998. 2002.), Saxena (2007), Bhattarcharya & Lal (2008) were concerned with the (a) impacts of R&D , foreign technology purchase, technology and knowledge spillover, technology transfer on productivity of firms, (b) how far liberalisation has intensified spillover and (c) influence of spillover from FDI , R&D and export on productivity of firms.

The studies conducted in respect of India's technology regime failed to identify whether, in line with the policies pertaining to globalisation pursued worldwide, liberalisation of the Indian economy has at all made any dent in the R&D level of the country. The present study seeks to palliate these cracks.

III. OBJECTIVE, DATA SOURCE AND RESEARCH METHODOLOGY

The objective of the study is to study the impact of the import of technology on the public R&D in the Indian economy during the pre-and post-liberalisation periods (1980-81 to 1990-91 and from 1991-92 to 2007-08).

The data on the import of technology in embodied form (import of capital goods) in current prices for the period 1980-81 to 2007-2008 were obtained from the Handbook of Statistics of the Indian Economy: 2010-11, Reserve Bank of India. The data on national expenditure on R&D in current prices were taken from the Research and Development Statistics: 2007-08, National Science and Technology Management Information System; Department of Science and Technology; Government of India. The data on the import of technology in disembodied form (payments of royalties, technical fees, etc. by the Indian firms to the foreign firms) in current prices for the period 1980-81 to 2007-2008 were obtained from the India's Balance of Payments: Concepts, Compilation and Recent Scenario: 1950-51 to 2003-04 (EPW Research Foundation: February-05), RBI Bulletin, April 7, 1999 and RBI Bulletin, March 10, 2010.

Before going into regression exercise it was pertinent to review the time series properties of the variables. While doing so the variables were transformed into log forms. This log transformation captured how and to what extent one

percent increase in the import of embodied technology made an impact on the R&D expenditure.

The outcome derived from Augmented Dickey-Fuller (ADF) unit root test of the log of import of embodied technology variable (LGEMTMP) revealed that ADF test statistic was -3.563761 at the level, which, in absolute value, was larger than the critical value at 10% and therefore, the LGEMTMP series was stationary.

The result obtained from the similar unit root test confirmed that log of R&D expenditure in current prices (LGRD) was stationary since the ADF test statistic was -4.363597. Hence there was no difficulty in carrying regression analysis involving LGRD as dependent and LGEMTMP as explanatory variables.

The outcome derived from Augmented Dickey-Fuller (ADF) unit root test of the log of import of disembodied technology variable (LGDMTMP) revealed that ADF test statistic was -6.209548 which in absolute value was quite larger than the critical value implying that the LGDMTMP series was stationary and LGRD series was already detected stationary.

Hence there was no difficulty in carrying regression analysis involving LGRD as dependent and LGDMTMP as explanatory variable.

The figures for the import of the two types of technologies were added to obtain the import of technology (TMP) figure which then was transformed into log values as usual.

The ADF unit root test for log TMP (LGTMP) series provided 't' statistic which was - 3.428965 and since in absolute value this was larger than the critical value at 10% it might be inferred that the series was stationary.

Pooling all the observations for the log of import of embodied technology variable (LGEMTMP) and log of R&D expenditure in current prices (LGRD) for the pre-and the post-reform periods in a single regression equation and introducing intercept and slope dummies the following regression model was used:

$$LGRD = \alpha_1 + \alpha_2 LGEMTMP + \alpha_3 D_1 + \alpha_4 (D_1 LGEMTMP) + u_i \ldots\ldots \textbf{1(a)}$$

where α_3 and α_4 are differential intercept and differential slope coefficient respectively, D_1 and (D_1LGEMTMP) are intercept and slope dummies respectively and i=1,2,3,……..,28 and D_1=0 for the values of 1980-1990 =1 for the values of 1991-2007.

The regression equation which was fitted in this study is :

LGRD= -0.377 + 1.203 *LGEMTMP*+ 1.070 D_1 - 1.242 (D_1 *LGEMTMP*)+ u_i ….1(b)

(-0.509) (10.767) (2.764) (-2.636)

't' values are shown in parentheses and the number of observations(N) is 28.

Pooling all the observations for the log of import of disembodied technology variable (LGDMTMP) and the log of R&D expenditure in current prices (LGRD) for the pre-and the post-reform periods in a single regression equation and introducing intercept and slope dummies the following regression model was used:

$LGRD= \alpha_1 + \alpha_2 LGDMTMP+ \alpha_3 D_1+ \alpha_4 (D_1 LGDMTMP) + u_i$…….**1(c)**

where α_3 and α_4 are differential intercept and differential slope coefficient respectively, and D_1 and (D_1LGDMTMP) are intercept and slope dummies respectively and i=1, 2, 3,…….., 28 and D1=0 for the values of 1980-1990 =1 for the values of 1991-2007

The regression equation which was fitted in this respect is :

LGRD= 5.635 + 0.867 *LGDMTMP*+ 0.369D_1 -0.204 (D_1 *LGDMTMP*) + u_i……**1(d)**

(18.255) (6.473) (1.932) (-0.723)

't' values were shown in parentheses and N=28.

Pooling all the observations for the log of import of technology (LGTMP) and the log of R&D expenditure in current prices (LGRD) for the pre- and post-reform periods and introducing intercept and slope dummies the following regression equation model was used:

$LGRD=\alpha_1 + \alpha_2 LGTMP + \alpha_3 D_1+ \alpha_4 (D_1LGTMP) + u_i$ …….**1(e)**

where α_3 and α_4 are differential intercept and differential slope coefficient respectively, and D_1 and (D_1 LGTMP) are intercept and slope dummies respectively and i=1, 2, 3,….., 28 and

D1 = 0 for the period 1980-1990 = 1 for the period 1991-2007

The regression equation which was fitted in this case is:

$LGRD = -0.347 + 1.201LGTMP + 1.056D_1 - 1.226(D_1\ LGTMP) + u_i$…….**1(f)**

(-0484) (11.049) (2.807) (-2.678)

't' values are shown in parentheses and N=28.

IV. EMPIRICAL RESULTS

The estimated values of the variables for 1(a) were shown in Table 6. The computed value of 'R^2' was 0.982 which implied that that the explanatory variable explained 98.2% of the variation of the dependent variable. The 'F' value was quite significant implying the viability of the model. The 't' values of the variables were significant except that of the intercept term. Since the 't' values of the estimated intercept and the coefficient of slope dummies appeared significant it might be concluded that the there was a significant change in the relation between the two variables in the pre-reform and post-reform periods.

For the pre-reform period the estimated relation 1(b) became:

LGRD= -0.377 + 1.203 *LGEMTMP*

It implies that the impact of EMTMP on RD was positive and the elasticity of RD with respect to EMTMP measured by (δ log RD)/(δ log EMTMP) was 1.203 which was greater than one and positive. It indicates that during the pre-reform period the import of embodied technology had a considerable impact on the R&D.

For the post-reform period the estimated relation 1(b) became:

LGRD= -0.377 + 1.203 LGEMTMP+ 1.070 - 1.242 (LGEMTMP)= 0.693-0.039 LGEMTMP.

It reflects a negative impact of EMTMP on RD and the elasticity of R&D with respect to EMTMP was -0.039 which was less than one and negative.

The estimated values of the variables for 1(c) were shown in Table 7. The computed value of 'R^2' was 0.957 which implies that the DMTMP accounted for 95.7% of the variation in RD. The 'F' statistic was also quite significant. The 't' values were significant for the estimated values of the intercept term, LGDMTMP and intercept dummy, however, that of the estimated value of the coefficient of slope dummy was not significant indicating that the estimated line of the post-

reform period had different intercept but unaltered slope compared to what appeared in the pre-reform period.

For the pre-reform period the estimated relation 1(d) became:

LGRD= 5.635 + 0.867 *LGDMTMP* which implies positive impact of *DMTMP* on *RD* and the elasticity of RD with respect to DMTMP measured by (δ log RD)/(δ log DMTMP) was 0.867 which was less than one but positive.

For the post-reform period the estimated relation 1(d) became:

LGRD= 5.635 + 0.867 *LGDMTMP*+ 0.369 -0.204 (*LGDMTMP*)

= 6.004 + 0.663LGDMTMP

It also indicates a positive impact of the import of disembodied technology on R&D and the elasticity of R&D with respect to DMTMP was +0.663 which was less than one but positive.

These findings suggest that the impact of the variable DMTMP on RD in both the pre- and post-reform periods had been positive and significant. However the elasticity values suggested that the import of disembodied technology did not make any serious dent on R&D expenditure of the country.

The estimated values of the variables for 1(e) were shown in Table 8.

The values in parentheses were the't' values. The coefficients of both the intercept and slope dummies were significant and so also the coefficient of the explanatory variable, LGTMP. It implies that there was structural change in the relation between LGRD and LGTMP in the pre-and post-reform periods.

For the pre-reform period the relation 1(f) became

LGRD=-0.347+1.201LGTMP which indicates a positive impact of TMP on RD and the elasticity of RD with respect to TMP, measured by (δ LRD/ δ LGTMP), was 1.201 which was positive and greater than one. For the post- reform period the relation 1(f) was

LGRD = - 0.347+ 1.201LGTMP+1.056D1 -1.226LGTMP =0.709 - 0.025 LGTMP which shows a negative impact of TMP on RD and the elasticity of RD with respect to TMP was -0.025 which was not only negative but highly inelastic, i.e., during the post-reform period the R&D expenditure carried out was independent of

the import of technology, rather the latter exerted a negative impact. This had far reaching implications of which one was that after liberalisation as competition became intensified the domestic firms concentrated on undertaking technological innovation to build up technological capability rather than being motivated by the objective of adapting imported technology.

V. CONCLUDING OBSERVATIONS

The import of disembodied technology casted a strong impact on the effort of carrying R&D in the post-liberalisation phase. It suggests that the import of knowledge was followed by further technological effort by the Indian firms.

In this context it was no less important to study the evolution of government policies regarding R&D. For a considerable period up to the early 1970s the government's role was restricted to supporting R&D infrastructure and activities in various government run laboratories and institutes.

As liberalisation was 'made to happen' there was a shift from regulation to market orientation which exposed the industries to market competition. As a consequence of it, the up gradation of technology became a strong ingredient of international competitiveness (Agarwal 2001). Surprisingly enough, the rate of growth of national expenditure on R&D during the 1990s declined compared to 1980s as mentioned earlier in this section.

After a careful survey of the evolution of the policies of the government regarding the import of technology and building up of the technological capability of the Indian firms Agarwal (2001) was of the opinion that balance could not be maintained either within the different components of technology policy or between technology and industrial policies affecting the performance of the National System of Innovation (NIS).

The findings of this study bear testimony to the fact that 'cumulativeness of learning', one of the components of technology regime, was missing in the Indian context despite the policies being pursued in an effort to move in that direction.

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TABLE I .National Expenditure on Research and Development (Rs.crore)

Year	R&D (Current Prices)	R&D(Constant Prices) (Base:1999-2000)	GDP(Current prices) (Rs.crore)	GDP(Constant prices) (Rs.crore)	R&D as %GDP (Current Prices)	R&D as %GDP (Constant Prices)
1970-71	168.0	244.1	42981	474131	0.39	0.05
1971-72	214.0	294.5	45731	478918	0.47	0.06
1972-73	234.1	292.7	50304	477392	0.47	0.06
1973-74	253.1	263.2	61649	499120	0.41	0.05
1974-75	324.0	269.2	72566	504914	0.45	0.05
1975-76	398.0	334.3	77071	550379	0.52	0.06
1976-77	391.0	321.7	82845	557258	0.47	0.06
1977-78	450.2	352.1	94552	598885	0.48	0.06
1978-79	558.7	436.9	101619	631839	0.55	0.07
1979-80	674.3	450.3	110887	598974	0.61	0.08
1980-81	760.52	3674.35	132520	641921	0.57	0.57
1981-82	940.73	4103.59	155158	678033	0.61	0.61
1982-83	1206.03	4848.32	173337	697861	0.70	0.69
1983-84	1381.10	5123.85	202750	752669	0.68	0.68
1984-85	1781.55	6117.37	227694	782484	0.78	0.78
1985-86	2068.78	6619.50	254427	815049	0.81	0.81
1986-87	2435.40	7292.59	283681	850217	0.86	0.86
1987-88	2853.07	7799.64	321589	880267	0.89	0.89
1988-89	3347.26	8453.26	383790	969702	0.87	0.87
1989-90	3725.74	8678.20	442134	1029178	0.84	0.84
1990-91	3974.17	8361.19	515032	1083572	0.77	0.77
1991-92	4512.81	8363.31	594168	1099072	0.76	0.76
1992-93	5004.60	8526.18	681517	1158025	0.73	0.74
1993-94	6073.02	9408.79	792150	1223816	0.77	0.77
1994-95	6622.44	9340.94	925239	1302076	0.72	0.72
1995-96	7483.88	9656.11	1083289	1396974	0.69	0.69
1996-97	8913.61	10662.41	1260710	1508378	0.71	0.71
1997-98	10611.34	11921.83	1401934	1573263	0.76	0.76
1998-99	12473.17	12967.51	1616082	1678410	0.77	0.77

1999-2000	14397.60	14397.60	1786526	1786525	0.81	0.81
2000-01	16198.80	15683.37	1925017	1864301	0.84	0.84
2001-02	17038.15	16007.14	2097726	1972606	0.81	0.81
2002-03	18088.16	16353.72	2261415	2048286	0.80	0.80
2003-04	20086.34	17575.41	2538170	2222758	0.79	0.79
2004-05	24117.24	19991.64	2877701	2388768	0.84	0.84
2005-06	28776.65	22963.91	3282385	2616101	0.88	0.88
2006-07	32941.64	24821.63	3779384	2871120	0.87	0.86
2007-08	37777.90	27213.00	4320892	3129717	0.87	0.87

Source: Compiled and computed from the data source mentioned in Section 3.

TABLE II

National Expenditure on Research and Development by Sector (Rs.crore)

Sector	1970-71	1975-76	1980-81	1985-86	1990-91	1995-96	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
Central	112.47	287.63	580.49	1654.06	3058.27	5199.79	11536.33	12251.17	13034.69	15079.95	17851.01	19909.23	22204.77
State	12.58	26.73	59.34	162.78	365.92	657.02	1494.33	1588.15	1689.78	1941.53	2227.42	2461.08	2719.24
Private	14.59	42.35	120.69	251.94	59.98	1627.07	3292.69	3498.30	4471.27	6038.96	7444.21	9128.09	11192.86
Total	139.64	356.71	760.52	2068.78	3974.17	7483.88	16323.35	17337.62	19195.74	23060.44	27522.64	31498.4	36116.87

Source: Compiled and computed from the data source mentioned in Section 3.

TABLE III

India's Import of Disembodied Technology (Rs.crore)

Year	Payment of royalties, etc.(Rs.crore)
1956-57	1.2
1957-58	0.9
1958-59	1.3
1959-60	1.8
1960-61	2.5
1961-62	2.4
1962-63	3.6
1963-64	4.6
1964-65	4.4
1965-66	2.9
1966-67	5.1
1967-68	4.3
1968-69	4.8
1969-70	5.8
1970-71	5.2
1971-72	5.9
1972-73	7.3
1973-74	6.2
1974-75	8.5
1975-76	10.5
1976-77	15.9
1977-78	19.5
1978-79	12.7
1979-80	9.6
1980-81	8.9
1981-82	16.0
1982-83	39.7
1983-84	27.6
1984-85	28.5
1985-86	23.5
1986-87	40.1
1987-88	60.4
1988-89	180.6
1989-90	197.4
1990-91	116.7
1991-92	20.5
1992-93	182.2
1993-94	258.0
1994-95	272.3
1995-96	354.6
1996-97	440.5
1997-98	618.0
1998-99	1055.0
1999-2000	1351.0
2000-01	1073.0
2001-02	1723.0

2002-03	1703.0
2003-04	2039.0
2004-05	3185.0
2005-06	2640.0
2006-07	4632.0
2007-08	4167.0

Source: Compiled and computed from the data source mentioned in Section 3.

TABLE IV

Import of Technology (embodied and disembodied) in India(Rs.crore):

Year	Import of capital goods (%)	Import of disembodied technology (%)	Import of technology as % of total imports
1970-71	24.72	0.32	25.03

1971-72	26.46	0.32	26.78
1972-73	29.50	0.39	29.89
1973-74	22.79	0.21	23.00
1974-75	16.01	0.19	16.19
1975-76	21.27	0.21	21.48
1976-77	18.38	0.30	18.68
1977-78	19.08	0.32	19.40
1978-79	19.18	0.19	19.36
1979-80	15.95	0.11	16.06
1980-81	15.22	0.07	15.29
1981-82	15.40	0.12	15.52
1982-83	19.00	0.28	19.28
1983-84	20.99	0.17	21.16
1984-85	18.49	0.17	18.66
1985-86	21.80	0.12	21.92
1986-87	32.28	0.20	32.48
1987-88	29.52	0.27	29.79
1988-89	24.63	0.64	25.27
1989-90	24.92	0.56	25.48
1990-91	13.82	0.15	13.98
1991-92	21.81	0.04	21.85
1992-93	20.71	0.29	21.00
1993-94	26.79	0.35	27.14
1994-95	26.66	0.30	26.96
1995-96	28.17	0.29	28.46
1996-97	25.35	0.32	25.67
1997-98	23.61	0.40	24.01
1998-99	23.74	0.59	24.33
1999-00	18.05	0.63	18.68
2000-01	17.69	0.46	18.16
2001-02	19.22	0.70	19.92
2002-03	21.98	0.57	22.55
2003-04	23.39	0.57	23.96
2004-05	22.54	0.64	23.17
2005-06	25.25	0.40	25.65
2006-07	25.34	0.55	25.89
2007-08	28.17	0.41	28.59

Source: Compiled and computed from the data source mentioned in Section 3.

TABLE V

Import of Capital Goods in India (Rs.crore):1970-71-2007-08

Year	Total Imports (Rs.crore)	Total capital goods import (Rs.crore)	% import capital goods
1970-71	1634.2	403.9	24.72
1971-72	1824.5	482.7	26.46
1972-73	1867.4	550.8	29.50

1973-74	2955.4	673.5	22.79
1974-75	4518.8	723.3	16.01
1975-76	5073.8	1079.4	21.27
1976-77	5264.8	967.7	18.38
1977-78	6020.2	1148.6	19.08
1978-79	6810.6	1306.1	19.18
1979-80	9142.6	1458.5	15.95
1980-81	12549.2	1910.3	15.22
1981-82	13607.6	2096.2	15.40
1982-83	14292.7	2716.3	19.00
1983-84	15831.5	3322.3	20.99
1984-85	17134.2	3168.0	18.49
1985-86	19657.7	4285.5	21.80
1986-87	20095.8	6487.6	32.28
1987-88	22243.7	6565.6	29.52
1988-89	28235.2	6955.6	24.63
1989-90	35328.4	8804.3	24.92
1990-91	75750.5	10470.6	13.82
1991-92	47850.8	10434.3	21.81
1992-93	63374.5	13124.8	20.71
1993-94	73101.0	19581.0	26.79
1994-95	89970.7	23982.4	26.66
1995-96	122678.1	34554.2	28.17
1996-97	138919.7	35223.0	25.35
1997-98	154176.3	36407.2	23.61
1998-99	178331.9	42341.4	23.74
1999-00	215236.5	38849.9	18.05
2000-01	230872.8	40846.8	17.69
2001-02	245199.7	47130.2	19.22
2002-03	297205.9	65325.1	21.98
2003-04	359107.7	83994.3	23.39
2004-05	501064.5	112935.5	22.54
2005-06	660408.9	166761.5	25.25
2006-07	840506.3	212985.9	25.34
2007-08	1012311.7	285209.3	28.17

Source: Compiled and computed from the data source mentioned in Section 3.

TABLE VI

Impact of Import of Embodied Technology on R&D in India during 1980-2007
(Dependent variable LGRD)

Variables	Constant	Intercept dummy	Slope dummy	LGEMP	R2	F statistic
Coefficients	-0.377 (-0.509)	1.07 -2.764	-1.242 (-2.636)	1.203 -10.767	0.982	427.309

('t' values are in parentheses)

Source: Compiled and computed from the data source mentioned in Section 3.

TABLE VII

Impact of Import of Disembodied Technology on R&D in India during 1980-2007.

(Dependent variable LGRD)

Variables	Constant	Intercept dummy	Slope dummy	LGEMP	R2	F statistic
Coefficients	5.635 (18.255)	0.369 (1.932)	-0.204 (-0.723)	0.867 (6.473)	0.957	180.087

('t' values are in parentheses)

TABLE VIII

Impact of Import of Technology on R&D in India during 1980-2007
(Dependent variable LGRD)

Variables	Constant	Intercept dummy	Slope dummy	LGEMP	R2	F statistic
Coefficients	-0.347 (-0484)	1.056 (2.807)	-1.226 (-2.678)	1.201 (11.049)	0.983	449.793

('t' values are in parentheses)

Source: Compiled and computed from the data source mentioned in Section 3.