

**Working Paper  
389**

**INFORMATION TECHNOLOGY AND  
PRODUCTIVITY :  
EVIDENCE FROM INDIA'S  
MANUFACTURING SECTOR**

**K. J. Joseph  
Vinoj Abraham**

September 2007

Working Papers published since August 1997 (WP 279 onwards)  
can be downloaded from the Centre's website ([www.cds.edu](http://www.cds.edu))

**INFORMATION TECHNOLOGY AND PRODUCTIVITY :  
EVIDENCE FROM INDIA'S MANUFACTURING SECTOR**

**K. J. Joseph  
Vinoj Abraham**

September 2007

---

An earlier version of this paper was presented in CDS and we are thankful to the seminar participants, especially Prof K. K. Subrahmanian. We have also benefited from the detailed comments from Prof K. Pushpangadan and Dr M. Parameswaran. For all the remaining errors and wrong interpretations, if any, we would like to blame each other.

## ABSTRACT

While India's remarkable performance in IT software and service exports may be inspirational for other Indian industries and more so for other countries in the south, the moot question is how has India fared in terms of harnessing this technology for enhancing manufacturing productivity. This paper is an attempt at addressing this issue by analyzing an unpublished data set on the investment in computers and software at the industry level made available by the CSO. The study finds that low level of IT investment intensity in the manufacturing sector notwithstanding, IT investment does have a positive and significant impact on both partial and total factor productivity. The findings of the paper suggest that in a context wherein the policy makers are concerned with low levels of growth in manufacturing output and productivity, policy measures and institutional interventions towards promoting IT diffusion in the manufacturing sector is likely to give rich dividends.

**Key words:** India, Information Technology, Productivity, Manufacturing Sector.

**JEL Classification No:** L6, D24, O14

## **Introduction**

Given the wider applicability, innovational complementarities and productivity enhancing effects in numerous downstream industries, Information Technology (IT) is generally perceived as the General Purpose Technology (Helpman 1998) of the new millennium. Analytically, the contribution of IT to an economy could be viewed at two different but interrelated levels - on account of IT growth and on account of IT diffusion. The former refers to the contribution in output, employment and export earning arising from the production of IT related goods and services (Kraemer and Dedrick 2001) and the latter refers to IT induced development through enhanced productivity, competitiveness, growth and human welfare on account of its diffusion into different sectors of the economy and sections of the society.

Among the developing countries, India is widely known for its success in profiting from the production and export of IT software and services (Schware 1987, Heeks 1996, Kumar 2001, Arora et.al 2001, Joseph and Harilal 2001, Siddharthan and Nollen 2004) that has been facilitated by the innovation system evolved over the years (Balakrishnan 2006, Joseph 2002, 2006, Kumar and Joseph 2006, Parthasarathi and Joseph 2002). The value of output of India's IT software and service sector increased by 43 fold from \$0.83 billion in 1994-95 to \$ 36.3 billion in 2005-06 accounting for about 4.8 per cent of the GDP

(NASSCOM 2006). The export of software and IT enabled service during the last two decades has been doubling in almost every alternative year with a recorded annual compound growth rate of over 50 per cent up to late 1990s and 38 per cent since 1997-98. As a result by 2005-06 the IT software and service exports accounts for over 20 per cent of India's exports and even higher than the traditionally leading item in India's export basket viz. textile and textile products (Chandrasekhar et al 2006). What is more, despite the limited R&D orientation by the Indian firms (Parthasarathi and Joseph 2002), and focus on low end of the value chain during the initial years (D'Costa 2002 and Arora et al. 2001) the recent evidence indicates that IT firms are moving up in terms of their technological competence (Joseph and Abraham 2005) and diversifying into more technology intensive areas (Parthasarathy and Aoyoma 2006). These achievements in reaping the direct benefits become all the more striking when considered against the fact that it has been almost entirely at the instance of domestic rather than foreign firms (Arora and Athreya 2002).

However, as per the commonly used indicators, diffusion of IT in India remains at very low levels. To illustrate, while the world average PCs per 100 inhabitants in 2005 was 9.71 (Sweden at the top with 76.1) it was only 1.54 in India. Similarly, the Internet penetration (number of internet users per 100 inhabitants) in India for the year 2005 is found to be only 5.44 as compared to 15.27 at the global level with Iceland recording the highest level of 87.76 (ITU, 2007)<sup>1</sup>. Yet, it is by now known that the IT provides developing economies like India, with a great opportunity to "catch up" with the developed economies. Moreover, the benefits of IT using countries/sectors tend to benefit more than the IT

---

1. <http://www.itu.int/ITU-D/ITeye/Indicators/Indicators.aspx#>

producing countries/ sectors owing to the deteriorating terms of trade for IT producers (IMF, 2001)<sup>2</sup>.

Despite low IT diffusion in general, IT use has been more promising within the organized manufacturing sector of India. The Annual Survey of Industries (ASI) for the year 1998-99 reported that nearly 35 percent of the firms that came under its purview were using IT for managerial and accounting work. While the use of computers by the ASI firms in networking, Internet and computer aided production had been very low in general, in some technology intensive sectors such as non-conventional energy, motion picture and, electric machinery & equipment it had been relatively high. The average IT investment intensity in the manufacturing sector during 1998-01 has been estimated at 9.6 percent. This however compared poorly with developed countries implying a time lag of over 20 years (Abraham and Joseph, 2007).

Given the remarkable performance in production and export of IT along with indications of enhanced IT capability and its diffusion in the manufacturing sector, it may be of relevance for policy making to explore the contribution of IT in India's manufacturing sector. Such an enquiry becomes all the more important in a context wherein our understanding on the issue at hand at best remains rudimentary and unexplored not only for India but also for many other developing countries. Remainder of this paper is organized as follows. The second section presents the analytical background of the study and makes a stock taking of our understanding on the issue under discussion. The data set used in the study and the method of analysis is the focus of section 3. While the

---

2 The estimates of consumer surplus of IT users using panel data for a sample of 41 countries over the years 1992-99 have shown that the increase in consumer surplus for the users has been quite large accounting to several percentage points of GDP. The countries with largest gain in consumer surplus (greater than 3.5 per cent of GDP) are found to be United States United Kingdom, Singapore, Australia and New Zealand (IMF 2001).

penultimate section presents the empirical findings, the concluding observations and policy implications are presented in the last section.

## **2. Analytical Background**

General Purpose Technologies (GPTs) can be defined as technologies that initially have much scope for improvement and eventually comes to be widely used and to have many Hicksian and technological complementarities (Lipsey et al., 1998). What characterize GPTs could be summarized as follows: First, these technologies perform some generic tasks crucial for the functioning of many production systems. Secondly as Rossenberg (1969) observed, change in one component of an interdependent system creating a stimulus elsewhere has been a highly fruitful source of technological change. Thus viewed, GPTs act as major inducement mechanisms for technological dynamism. Continuous innovational efforts increase the efficiency with which the generic functions are preformed over time, benefiting existing users, and inducing others to adopt new innovations. Thirdly, GPTs exhibit "innovational complementarities" with the application sectors, since technological advances in GPTs make it more profitable for its users across a broad spectrum of sectors to innovate and improve their own technologies. In turn, improvements in those sectors increase the demand for investment in improving GPTs themselves. There are positive loops caused by GPTs that may result in faster and sustained growth for the economy at large (Rosenberg and Trajtenberg, 2001: 6). Thus, as the economy is a system consisting of interrelated subsystems, technical change takes place when relationships among subsystems change or when new interfaces are established. GPTs open up more possibilities for change than specific technologies. The more generally applicable the technologies are, the greater the economic growth potential (Carlsson, 2004).

Carlsson (2004) carried out an extensive study on impacts of the IT, especially the digitization of information and the Internet, as a GPT.



He argues that there are four categories of impacts; productivity enhancement in traditional industries; restructuring of economic activities within industries; the creation of more efficient markets; and the creation of new combinations, which give rise to new products and industries.

One of the early hypotheses on the contribution of IT to the economy related to its productivity enhancing properties. Initial studies, however, highlighted the "productivity paradox" - indicating hardly any such impact of IT on productivity [Berndt, Morrison and Rosenblum (1992) Oliner and Sichel (1994) ]. However, at the firm level most of the studies reported that the marginal product of IT capital is substantially higher than the non-IT capital implying excess returns (Lichtenberg 1995). In case of Singapore Wong (2001) finds that the net return to IT capital (37.9%) is about two and a half times higher than that for non-IT capital (14.6%). More recently a number of studies have confirmed the positive contribution of IT to productivity [Siegel and Griliches (1992) Oliner and Sichel (2000), Dunne et. al. (2000) Stiroh (2001) Jorgenson and Stiroh (2000) Wong (2001) Nordhaus (2001); Jeong, Oh and Shin (2001); Niininen(2001)]<sup>3</sup>.

Broadly, studies have conceived productivity-enhancing effect of IT in two different ways. The first set of studies highlighted the substitution of IT capital for labour or other type of capital, due to drastic fall in the cost of IT capital. Studies by Card, Kramarz and Lemieux (1997); Oliner and Sichel (2000) show that computers act as a substitute for routine labour, while Doms, Dunne and Troske (1997) demonstrated that skilled labour and computers are complementary. Oliner and Sichel (2000) find that the investment in the IT goods and services is a key factor behind the observed increase in output growth and labour productivity in the US economy during the late 1990s. They also find that during the period prior to 1995, the returns to IT investment were

---

3. See Indjikian and Siegel (2005) for a recent and detailed survey.

nominal, while the returns increased by many folds during the period 1996-1999. Using the growth accounting framework they concluded that approximately half of the growth in labour productivity during 1996-99 could be accounted by the capital deepening related to information technology capital. Dunne et. al. (2000) studying the manufacturing sector reported rising labour productivity growth with the use of information technology. Similarly, Jorgenson and Stiroh (2000) also confirmed that IT capital was acting as a substitute in both business and household sectors. As the price of computers fell dramatically in the 1980s and 1990s, profit-maximizing firms and utility-maximizing consumers substituted IT for other goods and services and economizing on the use of labor effort.

Second set of studies consider the role of IT in an economy as much more complex than being substitute for labour and other type of capital. Malone, Yates and Benjamin (1987) and Bresnahan, Brynjolfsson and Hitt (2002) argued that the greatest impact of IT is in its role as a coordination technology. IT has generated possibilities of hitherto unexplored inter and intra-organizational coordination. IT has also reduced the costs of already existing organizational coordination, which can ultimately lead to rise in both labour productivity and Total Factor Productivity. Focusing on the organizational transformation that accompanies IT investment by firms and the resultant intangible benefits accrued, Brynjolfsson and Hitt (2000) argue that impact of IT investment is complimentary to the changes in the organizational structure of the firm such as allocation of decision rights leading to increased delegation of authority, workforce composition, investment in human capital, reduced vertical integration of firms and reduced firm size, which in turn makes it possible to have flexible production strategies and greater productivity. Such complex effect of IT on enhancing efficiency gets captured in the residual of economic growth devised by Solow (1957), after accounting for the growth of all inputs. Their study (Brynjolfsson and Hitt, 2000) at the firm level suggests that computerization is

accompanied by 'relatively large and time-consuming investments' in complementary inputs, whose productivity effects may not show immediately. But the IT investment along with such complimentary changes shows increase of total factor productivity (TFP) by more than five times when the IT investment is lagged by five to seven years. (Bresnahan, Brynjolfson and Hitt 2002). The industry and firm level studies find that enhanced IT use and productivity have been associated with a cluster of complementary organizational practices. These include, a transition from mass production to flexible manufacturing technologies, changing interaction with suppliers and customers, decentralized decision making, enhanced communication and increased use of skilled manpower. The industry level study on UK and US economies by O'Mahony and Vecchi (2002), after controlling for industry heterogeneity also yielded a positive and significant long-run impact of IT on TFP.

### **IT and Developing Countries**

While the earlier GPTs involved 'lumpy' investments in innovation, capacity creation, market acquisition and therefore necessitated access to critical size of capital as precondition to entry, IT is known to be less capital intensive and knowledge base is fairly universally available. This makes it relatively easy for wholly new entrants to acquire the knowledge base required for cutting edge technological contributions to the industry (Chandrasekhar 2006). IT also offers new opportunity for developing countries to participate in the global production networks and acquire the tacit and codified knowledge and (Ernst and Lundvall, 2000) thus breaking the vicious circle of idea gap and object gap (Romer 1993) that lies at the root of persisting poverty and underdevelopment. Moreover, in the context of globalization, the ability to harness this technology improves the capability of developing country-firms to withstand competition from multinational corporations or in developing partnership with them and ensure wider market for their products and services. Conversely, there is a potential threat that if unable to harness this new

source of wealth, they will fall even more behind the developed countries (Pohjola 2001).

But the available empirical evidence on the contribution of IT towards productivity and growth pertains mainly to developed countries, barring a few studies on specific industries in developing economies. Lal (2001) studying the garment manufacturing firms in the Okhla region of India, found that there existed a positive relation between labour productivity and IT investment. Another study by Basant et al (2007) based on a survey of 1000 firms in six skill and export oriented industries (auto components, soaps and detergents, electronic components, machine tools wearing apparels and plastic products) in India and Brazil has similar conclusions to offer. However, to our knowledge, there is no study reporting the effect of IT on productivity growth in the whole manufacturing sector of India, perhaps due to non-availability of a comprehensive dataset on IT investment in the manufacturing sector. The present study intends to fill up this gap in our understanding on the contribution of IT towards productivity in India's manufacturing. The study is also unique as we use, for the first time, an unpublished dataset on IT investment obtained from CSO, the official statistical agency of India.

### **3. Method of Analysis and Database**

Given the above background we focus on three questions. To what extent IT investments in India's manufacturing sector have contributed towards the observed levels and growth in labour productivity and total factor productivity? Has there been substitution of IT capital for labour? What has been the contribution of IT investment and non-IT investment towards the observed productivity growth?

To analyze the first issue we have estimated a heuristic labour productivity determinants model (1a) as specified below. In the model the influence of IT investment intensity on labour productivity is analyzed

along with a set of control variables like capital labour ratio, average size of firm in the industry and skill intensity of the industry.

The literature on growth economics, starting from Harrod and Domar has emphasized the pivotal role played by capital in economic growth. Capital could not only help effective utilization of human skills but also embody the latest knowledge and innovations important for productivity. Schultz (1989), reviewing research on the contribution of human capital to economic growth, has shown that human capital enhances the productivity of both labour and physical capital. Similar notions of productivity growth has been found in Arrow (1962) and the endogenous growth model by Romer (1986) wherein the spillovers of knowledge accruing due to a large human capital stock improves the level of technology for the producers and hence the overall productivity. It is hypothesized that skill intensity indicating the quality of labour will have a positive impact on labour productivity. Size of the firm is expected to influence labour productivity positively *inter alia* through scale economies.

Based on the above hypotheses the following model is specified:

$$\ln(LPROD_{it}) = a + \beta_1 \ln(ITINT_{it}) + \beta_2 \ln(KLINT_{it}) + \beta_3 \ln(SIZE_{it}) + \beta_4 \ln(SKILLINT_{it}) + u_{it} \quad (1a)$$

Where; *LPROD* is the measure for labour productivity; (See Appendix for method of variable construction) *ITINT* is IT Investment Intensity; *KLINT* is capital intensity in production; *SIZE* is the average size of a factory; *SKILLINT* is the measure of skill intensity in the industry. All values are taken in natural log, marked as *ln* in the equation (1a). All the variables are observed for the  $i^{\text{th}}$  industry and  $t^{\text{th}}$  year as denoted in the equation. ; and *u* is the error term.

After estimating the effect of IT investment on labour productivity levels we explore the effect of IT investment intensity on the growth of labour productivity. After accounting for the growth of labour productivity

using the growth of factor inputs, viz capital and labour, we take into account the effect of IT investment intensity. Such a specification would essentially capture the growth of labour productivity, which is not due to capital deepening, rather due to qualitative changes in the composition of investment. In other words, this specification captures the effect of IT investment levels on the residual growth in productivity, after accounting for the growth and substitution effects of factor inputs.

We estimate a labour productivity growth model, taking first difference of the dependent variable in equation 1a,  $\Delta \ln(LP_{it})$ . The independent variable ITINT is the same as equation 1a. In addition the growth of capital and labour are added in the model, by taking the first differences of the log of these two inputs,  $\Delta \ln(K_{it})$ , and  $\Delta \ln(L_{it})$ ,  $u_{it}$  is the error term.  $\beta_1$ ,  $\beta_2$  and  $\beta_3$  are the coefficients to be estimated.

$$\Delta \ln(LP_{it}) = a + \beta_1 \ln(ITINT_{it}) + \beta_2 \Delta \ln(K_{it}) + \beta_3 \Delta \ln(L_{it}) + u_{it} \quad (1b)$$

To study the productivity effect of capital composition (IT capital vs the non-IT capital) some of the earlier studies estimated production function of the Cobb-Douglas type using IT capital as a variable along with labour and Non-IT capital to explain the contribution of IT capital in productivity. However given the available data with us, construction of a capital stock series of IT was not possible. Therefore the study adopts an indirect approach to draw inference on the productivity effect of IT investment. Assume that recently purchased machinery contains more technology per unit of money invested than old ones. Then the share of capital stock made up of recent investment in plant and machinery would have a positive and significant effect on productivity. If the recent investment in capital stocks consists of both IT and non-IT investment then their respective shares in capital stock would have differential effect on productivity. Thus, apart from validating the effect of IT investment

on productivity this specification would also help bringing out the relative effect of the two types of investments on productivity. These two terms are therefore added as factors that affect productivity in a typical cobb-douglas production function framework<sup>4</sup>.

The production function, which is of Cobb-Douglas form for the  $i^{\text{th}}$  industry is specified as below:

$$\log \bar{Q}_i = b_0 + b_1 \log \bar{K}_i + b_2 \log \bar{L}_i + b_3 \log ITINV_i + b_4 \log NONITINV_i + e_i \quad (2)$$

Where  $\log \bar{Q}$  denotes log of average gross value added during the period 1998-99 to 2001-02,  $\log \bar{K}$  is log of average fixed capital stock,  $\log \bar{L}$  is log of total employment  $\log ITINV$  is log share of recent Information Technology investments in capital goods in the total capital stock,  $\log NONITINV$  is the log share of recent investment in capital goods that does not belong to Information Technology, in the total capital stock, and  $e$  is the error term.

The earlier specifications (1a and 1b) allow us to study the effect of IT investment intensity on labour productivity levels and its growth. But to affirm whether these effects of IT investment is truly associated with quality and efficiency improvements we construct an index of total factor productivity for the manufacturing sector and compare the levels and growth of this index to IT intensity.

A multilateral TFP index is used to measure the level of TFP in different manufacturing industries for each year. Multilateral TFP index, suggested by Caves, Christensen and Diewert (1982) and extended by Good, Nadiri and Sickles (1996) gives the advantage of comparison of productivity across industries and across time. Multilateral TFP index is a comparative index whereby the generated TFP index is in comparison to a base industry-year TFP. In our study we have used the Basic and

---

4 See Hassan (2002) and Parameswaran (2007) for similar methodology to arrive at the R&D capital stock.

other chemical industries (NIC code 241+242) of 1998-99 as the base and the productivity level in each industry-year is compared to this base. This particular base was chosen as this industrial group had the largest share in gross value added in the initial year of study 1998-99.

Multilateral TFP estimates are made for 52 industries at the 3 digit NIC level for the four-year period 1998-99 to 2001-02. Gross value added is taken as the output and physical capital and labour as the two inputs. Gross value added has been deflated using the relevant industry wholesale price index, capital is measured using the perpetual inventory method and labour is the total number of persons engaged as reported in ASI.

The Multilateral TFP<sup>5</sup> index based on the value added function can be written as

$$TFP_{bc} = \left( \frac{Q_b}{Q_c} \right) \prod_i \left( \frac{X_{zi}}{X_{bi}} \right)^{(S_{bi}+S_{zi})/2} \prod_i \left( \frac{X_{ci}}{X_{zi}} \right)^{(S_{ci}+S_{zi})/2} \quad i = (K, L) \quad (3)$$

The index varies across industries and over time. It expresses the productivity level in industry-year b as a ratio to the productivity level in industry-year c. Q denotes real gross value added.  $X_{bi}$  is the i'th input for industry-year b, and  $X_{ci}$  is that for industry-year c.  $X_{zi}$  is the geometric average of i'th input across all observations.  $S_{bi}$  and  $S_{ci}$  are the income shares of i'th input for industry-year b and c respectively.  $S_{zi}$  is the arithmetic average of income share of i'th input across all observations.

There has not been any systematic attempt to collect data related to the extent of diffusion of IT in Indian economy till recently. However, in 1997, the Annual Survey of Industries (ASI), conducted by Central Statistical Organization CSO), had a specific binary choice question on the use of computers, Internet, Intranet and Robots. In the next year onwards, ASI collected data on the total amount of investment in computer hardware and software by the firms. This data, though

5 See Veeramani and Goldar (2004) and Banga and Goldar (2004) for application of the same methodology in Indian context.



unpublished by CSO, was obtained at three-digit level of aggregation for the period 1998-99 to 2001-02. The present study makes use of this data set for information on IT investment. All other indicators are constructed from the data published by ASI, for the same period as mentioned above. All variables are in 1993-94 prices using appropriate price indices published by the Economic Adviser, Ministry of Finance, and Government of India. Details of the deflation procedures are given below.

The data available is at the three-digit industry level aggregation based on the National Industrial Classification - 1998. Though the analysis pertains to the period after this classification was introduced, for purpose of capital stock measurement there was the need to take the period prior to 1998 as well. Hence the data was made comparable at the three-digit level using the concordance table for NIC-1998 and NIC-1987 published by the CSO. After reclassification the available data have 208 observations in panel data form consisting of 52 industries and four years.

#### **4. Empirical Results**

##### **Labour Productivity and IT Investment: Levels and Growth**

Using the panel data described above we have estimated the labour productivity model specified above (equation 1a). Apart from the Ordinary Least Squares estimates we have also estimated the Fixed and Random effects models. Based on the Hausman specification test Fixed effects model is taken to be more appropriate than random effects for interpretation indicating the importance of industry fixed effects on explaining the productivity levels. The results of the OLS estimation are reported in column 2 of the Table 1, while Column 3 and 4 reports the random and fixed effects results respectively.

As hypothesized IT investment intensity has a positive and highly significant (at 1 percent level), effect on labour productivity level. From the estimates it appears that one percent increase in IT investment intensity would lead to an increase in labour productivity by 3.5 percent. The signs of the coefficient are the same in OLS, GLS random effects and

the fixed effects estimation. This result has been obtained after controlling for other explanatory variables like capital intensity, firm size and skill intensity in the industry, all taken in natural log. The effects of capital intensity, size of firm, and skill intensity on labour productivity are found positive and significant at least at 10 percent level. The sign and significance levels of these variables are more or less consistent across the three models estimated, indicating robustness of estimation.

**Table 1: Effect of IT investment intensity on Labour Productivity levels: Dependent Variable: Ln(Labour Productivity)**

	OLS	Random Effects	Fixed Effects
(1)	(2)	(3)	(4)
Ln(K/L)	0.5509* (10.97)	0.4062* (7.70)	0.4792* (8.66)
Ln(SIZE)	0.0743** (3.19)	0.3517* (11.09)	0.6272* (18.22)
Ln(SKILLINT)	0.2970** (3.14)	0.2596* (3.88)	0.2339* (4.10)
Ln(ITINT)	0.1536* (4.23)	0.0591** (3.04)	0.0345** (2.23)
Constant	10.6317* (29.95)	-3.757* (-9.42)	4.444* (10.44)
Observations	208		208
R-squared	0.7269	0.5307	0.4104
Within		0.6628	0.7238
F test	93.82		99.60
Prob> F	0.000		0.000
Wald Chi2		250.62	
Prob> Wald Chi2		0.000	
Wu-Hausman Test		18.86	
Number of group		52	52

Note: \*denotes 1% significance level, \*\* at 5 % and \*\*\* at 10% level. t values in parentheses of column 2 and 4, Z values in parentheses of column 3

To analyse the effect of IT investment on the growth of labour productivity we estimate the model as specified in the equation 1b. The results of the estimated equation are given in Table 2. As earlier, OLS estimation is done for the pooled data, and random and fixed effects estimation done for the panel data. The results of the OLS estimation are reported in column 2. Column 3 and 4 reports the random and fixed effects results respectively.

**Table 2: IT investment intensity and Labour Productivity Growth:  
Dependent Variable: (Lnlabprod<sub>it</sub> - Lnlabprod<sub>it-1</sub>)**

	OLS	Random Effects	Fixed Effects
(1)	(2)	(3)	(4)
Ln(ITINT_WPI)	.0592** ( 2.60)	.0602** (2.61)	0.1260** (2.39)
Emp_growth	-0.1437 (-1.58)	-.1452 (-1.60)	-0.2345** ( -2.18)
Cap_growth	0.2477** (2.50)	.2494** (2.52)	0.3340** (2.90)
Constant	-0.0804*** (-1.63)	-.0825*** (-1.65)	-0.2190** (-2.05)
Observations	151	151	151
R-squared	0.0801	.0801	0.0758
Within			0.1067
F test	4.27		382
Prob> F	0.0064		0.0124
Wald Chi2		12.92	
Prob> Wald Chi2		0.0048	
Hausman Test		3.39	
Number of group		52	52

Note : Same as Table 1

Employment rate changes (Emp\_growth) consistently have, as expected, a negative effect on productivity growth rate across various

specifications. However it turns out to be significant only in the fixed effects model. The negative sign signifies the hypothesis of diminishing employment growth with productivity growth. The positive and statistically significant coefficient of capital growth (*cap\_growth*) points to the capital deepening process involved in productivity growth.

Interestingly, the effect of IT investment intensity levels is positive and significant (at 5 %) on the growth rate of labour productivity. These results are consistent across specifications and are obtained after controlling for the effect of the two major inputs namely, labour and capital. The Hausman specification test accepts the random effects model as the preferred model. The Random effects model and OLS model shows the labour productivity growth rate would increase by six percent for one percent increase in IT investment intensity.

### **Elasticity of Output to IT Investment**

Having argued that IT investment has a positive effect on labour productivity levels and growth we now ask the question whether IT capital perform differently from non-IT capital in terms of their effect on output. To answer this question we estimate the equation 2 in section 2.

Column (1) in Table 3 reports the usual estimation of the elasticity of output for labour and capital within the Cobb Douglas production function framework. Output elasticity with respect to both the factors is statistically different from zero. The capital elasticity is at 0.71 while labour elasticity is at 0.19. The results also show that the manufacturing sector is experiencing decreasing returns to scale. This point to the fact that mere quantitative addition of existing quality of factors of production is unlikely to enhance productivity growth in the manufacturing sector. It essentially calls for a change in the composition of the factors of production, which could propel productivity growth to higher level.

Column (2) of Table 3 adds variables *ITINV* and *NONITINV* representing cumulated IT investment and cumulated non-IT investment,

respectively, expressed as ratios of the Net Fixed Capital Stock. The elasticity of output to ITINV is positive and significant at one percent level. On the other hand the effect of NONITINV is statistically not significant. The factor inputs, labour and capital are positive and significant in this specification as well. Thus an increase in the IT capital in the fixed capital stock could make considerable contribution towards output growth..

**Table 3: Cobb Douglas Production Function with IT investment  
Dependent Variable: Ln(GVA)**

	(1)	(2)
Ln $\bar{L}$	.1875 (2.47)**	.1467 (1.82)***
Ln $\bar{K}$	.7095 (11.66)*	.7818 (13.19)*
Ln( ITINV)		.2618 (3.54)*
Ln(NONITINV)		-.0595 (-0.87)
Constant	.8232 (1.68)***	1.1673 (2.87)**
No. of Observations	52	52
F values	387.55	513.11
Prob,>,F	0.0000	0.0000
R-squared	0.9237	0.9470

Note: \* significant at 1% level, \*\* is 5 % level and \*\*\* is at 10% level  
Reported t values are derived from Huber white heteroscedasticity corrected standard errors.

The analysis in this section suggests that increasing IT investment intensity is associated with both rising levels and rising growth rate of labour productivity in the manufacturing sector, moreover the elasticity

of IT investment on output is greater than that of non-IT investment. However, as we mentioned earlier, IT investment could manifest in partial productivity levels and growth due to the capital deepening and labour substituting properties of IT investment. The average labour productivity growth during the period of analysis was only 3.75 percent<sup>6</sup> (Table 4). During the same period total employment experienced a negative growth of -0.73 percent while capital stock grew at the rate of 10.03 percent, showing trends of capital deepening in the manufacturing sector. This is evident from the growth rate of capital intensity at 5.09 percent. However the gross fixed capital formation, an indicator of the gross investment, grew at very low rate of 1.64 percent. On the other hand IT investment, which is a part of the gross investment, grew at the rate of 13.62 percent. This in effect led the IT investment intensity to grow at the rate of 15.93 percent. This indicates the changing composition of capital stock during the period fostered by a deepening of IT capital within the total capital stock.

The above noted increasing share of IT investment can have two types of effects. One is a substitution of labour with capital due to declining cost of IT capital<sup>7</sup>. Secondly, there would be an efficiency increase due to the change in composition of capital stock with newer and more efficient capital. The first is a case of the movement along the same isoquant, while the second is a case of shift in isoquant toward the origin. The first case will show increase in labour productivity while it will not have any effect on the total factor productivity. The second case on the other hand will show impact on both partial and total factor

---

6 Calculated from the dataset used for the analysis.

7 The cost of computing had been continuously declining. For example, from 1990 to 1996 the acquisition price of IT equipment for investment fell 16.6% annually, while the price of computers for consumption fell even faster at 24.2% per year (Jorgenson and Stiroh, 1999). Since the cost of IT capital is declining in absolute terms the relative cost of computer capital is declining vis-à-vis labour or even other capital.

productivity. The previous analysis confirms that there is some effect of IT investment on labour productivity levels and growth. However, a sharp decline in the employment growth rate along with substantial increase in IT investment intensity raises the question as to whether the observed IT effect on labour productivity is a substitution effect or an efficiency enhancing effect. Massive substitution of computer capital for other capital and labour due to the drastic reduction in computer costs is recorded by Jorgenson and Stiroh (2000) as well. It is towards clarifying this doubt that we turn our attention to, in the next section.

**Table 4: Growth in Investment, Employment and Productivity**

Variable	Growth Rate (1998-99 to 2001-02)
Labour Productivity	3.75
Capital Stock	10.03
Employment	-0.73
Capital Intensity	5.09
Gross Fixed Capital Formation	1.64
IT investment	13.62
IT investment Intensity	15.93

Note: Growth rate is taken to be the industry average of the first difference of the natural log of the variable

### **TFP and IT Investment: Levels and Growth**

Table 5 provides a tabulation of the average of the calculated Multilateral Total Factor Productivity Index (MTFPI) at different levels of IT investment intensity for the four years under observation. The calculation of MTFPI and the measurement of inputs and output are explained in Section 2. The average MTFPI across different levels of IT investment intensity (column 6) shows that as one moves from lower IT

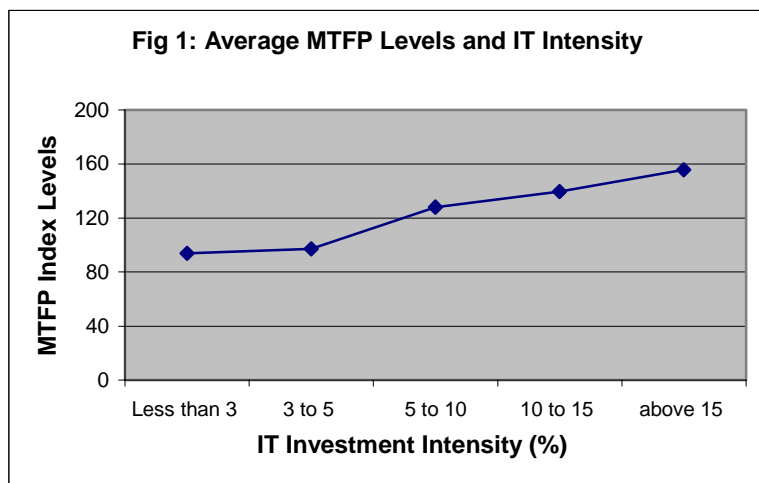
intensity class to higher class the MTFP also increases. As depicted in the fig 1 at every higher class of IT intensity the level of MTFP shows substantial increase. Moreover, when IT intensity is less than 5 percent their MTFP level lies below the industry average, consistently in all years. On the other hand when it is above 5 percent, their MTFP level lies above the industry average, barring three observations.

**Table 5 : IT Investment intensity and MTFP Levels**

	Industry Average of MTFP Levels					
(1)	(2)	(3)	(4)	(5)	(6)	(7)
IT Investment intensity	1999	2000	2001	2002	Average	No.of observations
Less than 3 percent	102.1	88.3	91.8	81.9	93.8	45
3 to 5 percent	116.9	110.5	83.6	84.5	97.3	49
5 to 10 percent	122.0	134.9	141.1	111.3	128.2	52
10 to 15 percent	105.9	126.2	130.5	179.1	139.7	29
above 15 percent	224.9	191.8	123.0	133.2	155.8	33
Total	119.3	127.8	112.8	117.9	119.4	208

A comparison of the TFP growth trends with the five levels of IT intensity as in Table 5 did not show any convincing linear relationship. While the difference in TFP growth between the highest IT intensity class and the lowest class was substantial, there was mixed results in the intermediate levels. Instead of the previous classification if we truncate the classification into a simple two level classification of less than 10 percent and more than 10 percent IT intensity then TFP growth seems to be substantially higher for the more IT intensive group than that of the group with lower IT intensity. While the average TFP growth is nearly zero, the group of industries with more than 10 percent IT intensity has a TFP growth of more than 6.9 percent in comparison to a negative growth of -3.4 percent for the less IT intensive group. These results are similar

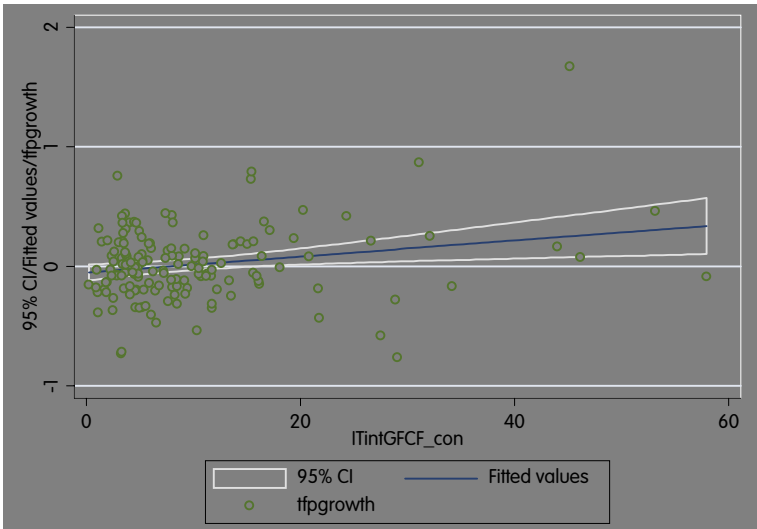




to the findings by Dumagan, Gill and Ingram (2003) who found that productivity growth in industries with higher IT investment per worker are substantially higher than industries with lower IT investment per worker. A scatter plot of the relation, with a linear fit also shows a positive slope, (Figure 2) but the slope seems to be generated more due to outlier effect rather than a genuine marginal effect on TFP growth. Hence, while there are rudimentary evidences of a positive relation between TFP growth and IT intensity, present study cannot provide conclusive evidence on this aspect.

**Table 5: TFP Growth and IT intensity Levels**

IT intensity	1999-2000	2000-2001	2001-2002	average	No. of industries
Less than 10	0.0361	-0.1390	-0.0119	-0.0344	103
More than 10	0.2837	-0.1227	0.1040	0.0698	51
Total	0.0980	-0.1332	0.0335	0.0001	154

**Figure 2: TFP growth and IT intensity**

## 5. Concluding Observations

The present study has been undertaken in a context wherein the earlier studies on IT and productivity, while confirming the positive contribution of IT towards productivity in developed countries, left behind a large knowledge deficit in our understanding on this issue in developing countries. The enquiry assumed importance on account of the remarkable performance of India in the sphere of IT production and export while the track record with respect to IT use is shown to be less remarkable as different sectors of the Indian economy were perceived as not e-ready. The main finding of this study that investment in IT in the Indian manufacturing sector does have a significant impact on productivity growth assumes immense policy relevance not only for India's manufacturing sector but also for the IT sector with respect to its market orientation. The finding may also be inspirational for many other developing countries aspiring to enhance manufacturing productivity and competitiveness through enhanced use of IT.

The lower rate of growth of manufacturing sector in India after 1991, as compared to the service sector, has been a major concern for the policy makers. More over, it has also been shown that the manufacturing-sector growth in the post reform period has been "input driven" rather than "efficiency driven," (Kalirajan and Bhide 2005). As the input driven growth has its obvious limits in a context of heightened international competition, improving industrial growth has no easy options other than to enhance productivity and make the growth process efficiency driven. To the extent that use of IT could contribute towards increasing productivity and India's IT sector is capable of providing the needed inputs for the manufacturing sector, promoting IT diffusion in the manufacturing sector should form the top agenda in promoting growth and productivity in the manufacturing sector. This may *inter alia* entail a reorientation of the present policies that lay emphasis on export market to one that involves "walking on two legs" wherein the domestic market oriented software units get additional incentives as compared to the export oriented units. To the extent that the IT infrastructure and connectivity are deficient in many regions, such policy initiatives need to be preceded by the provision of adequate IT infrastructure. Investment in IT also needs to be accompanied by managerial and organizational restructuring which in turn might call for among others, a more flexible labour market.

***K. J. Joseph*** is Professor at the Centre for Development Studies, Trivandrum. His main areas of research relates to different issues in ICT and Innovation Systems.

*E-mail contact: kjjoseph@cds.ac.in*

***Vinoj Abraham*** is Lecturer at the Centre for Development Studies, Trivandrum. His main areas of research interests are ICT and Development, Labour and Employment, Services Sector.

*E-mail contact: vinoj@cds.ac.in*

### **Appendix: Method of Variable Construction**

*Real Gross Value Added* (GVA) is taken as the measure of 'value added'. Net value added and depreciation figures reported in the ASI data are added to get the nominal gross value added. The nominal gross value added is deflated with the Wholesale Price Index to arrive at the real gross value added mentioned above. The Wholesale Price index was made comparable to the appropriate industry and price deflation was carried out at the three digit level aggregation.

*Net Fixed Capital Stock* (K) at constant price is taken as the measure for capital stock. Perpetual inventory method is used to arrive at the NFCS. Using the base year of 1993-94 fixed capital stock series was built for all the 52 industries for period 1998-99 to 2001-02. The Fixed capital series was constructed as follows. Firstly, to arrive at the implicit deflator for gross fixed capital formation for registered manufacturing, the ratio of current and constant prices of gross fixed capital formation published in the *National Accounts Statistics* is calculated for all the years starting from 1988-89. Secondly, the book value of fixed capital stock, net of depreciation in 1997-98 from ASI is taken for each industry group. This is adjusted for price changes by using the average value of the deflator for the previous 10 years (1988-89 to 1997-98)<sup>8</sup>. This provides the benchmark capital stock. Gross Investment in fixed capital is arrived at by subtracting fixed capital of current year from fixed capital of past year and summing up depreciation for the current year as reported in ASI. Real Gross investment is calculated by deflating the gross investment using the implicit deflator of GFCF. Net Fixed Capital Stock is estimated for year t is the cumulative sum of net investment from the benchmark year added to the benchmark capital stock. Real net investment in fixed assets is derived by subtracting depreciation of fixed capital from real gross investment in fixed assets. The rate of depreciation is taken as 5 per cent, which the same as assumed in Unel (2003).

---

8 See Banga and Goldar (2004)

*Total Persons engaged (L)*, that includes both workers and supervisory and managerial staff in the sector as reported by ASI is taken to be the measure for labour use in the manufacturing sector.

*LPROD* is the measure for labour productivity. In this study labour productivity is measured as Gross value added at constant prices per person engaged, which is measured in Rupees.

*SIZE* is the average Gross Value Added per factory in the particular industry.

*SKILLINT* is the skill intensity measured as the share of supervisors and managerial employees in total persons engaged.

*ITINT* is the share of IT investment, in the Gross Fixed Capital Formation in an industry. The IT investment is deflated using the price index for computer and computer based systems; and Gross fixed capital formation is deflated using price index for machinery and machine tools. Both deflators are taken from the Wholesale Price Index (WPI) and is based on 93-94 prices.

*Stock of recent investment in Information Technology capital (ITINV)* is the share of cumulated investment in IT in the recent years (1998-99 to 2001-02) in the average capital stock of the period. It is measured as the cumulated real gross investment in IT, as a share of the Net Fixed Capital Stock.

*Stock of recent investment in other capital (NONITINV)* is the share of cumulated investment capital goods other than IT in the recent years (1998-99 to 2001-02) in the average capital stock of the period. Stock of recent investment in other capital goods is measured as residual after subtracting real gross investment in IT from total real gross investment. The indicator *NONITINV* is then constructed by taking the share of this residual in NFCS.

## References

- Abraham, Vinoj and K.J. Joseph (2007) "IT Investment in Indian Manufacturing Sector: Trends, Patterns and Determinants", Centre for Development Studies, (mimeo)
- Annual Survey of Industries 1998-99, Central Statistical Organization, Government of India.
- Arora A and Athreye S. (2002) The Software Industry and India's Economic Development, *Information Economics and Policy*, Vol 14, pp 25-273.
- Arora, A., Arunachalam V.S., Asundi J. and Ronald F., (2001), The Indian Software Services Industry, *Research Policy*, Vol 30 (3), 1267-87.
- Arrow, Kenneth J. (1962), The Economic Implications of Learning by doing , *Review of Economic Studies*, Vol 29., pp 155-73.
- Balakrishnan, P. (2006)," Benign Neglect or Strategic Intent? Contested Lineage of Indian Software Industry, *Economic and Political Weekly*, Vol 41 No 36 September 9,
- Banga Rashmi and Bishwanath Goldar, (2004) "Contribution of Services to Output Growth and Productivity in Indian Manufacturing: Pre and Post Reforms", *Working Paper No.139, ICRIER*, New Delhi July.
- Basant, Rakesh, Simon Commander, Rupert Harrison, Naercio Menezes-Filho,(2007) "IT Adoption and Productivity in Developing Countries: New Firm Level Evidence From Brazil And India", IBMEC Working Paper - WPE-23-2007.
- Berndt, Ernst R., Morrison, Catherine J. and Rosenblum, Larry S., [1992], "High-tech Capital Formation and Labor Composition in U.S. Manufacturing Industries: an Exploratory Analysis," National Bureau of Economic Research Working Paper No. 4010, (March).
- Bresnahan, Tim, Brynjolfsson, Erik and Hitt, Lorin (2002) "Information Technology, Workplace Organization and the Demand for Skilled Labor", *Quarterly Journal of Economics*, 117(1), 339-76.

- Brynjolfsson, E. and L. Hitt. (2000). "Beyond Computation: Information Technology, Organizational Transformation and Business Practices." *Journal of Economic Perspectives*, Vol. 14, No. 4, Fall 2000, pp. 23-48.
- Card, D., Kramarz, and T.Lemeieux (1997) "Changes in the Relative Structure of Wages and Employment : A Comparison of the United States, Canada and France", NBER Working Paper 5487.
- Carlsson, Bo (2004) "The Digital Economy: What is New and What is Not?" *Structural Change and Economic Dynamics*, Volume 15, Issue 3, Pages 241-380.
- Caves, D. W., L. Christensen, and E. Diewert (1982) "Output, Input, and Productivity Using Superlative Index Numbers". *Economic Journal*, 92, 73-96.
- Chandrasekhar, C. P. Jayati Ghosh, and Anamitra Roychowdhury, (2006) "The Demographic Dividend' and Young India's Economic Future", *Economic and Political Weekly*, Vol 41; No. 49, 5055-5064.
- Chandrasekhar, C. P. (2006) "The Political Economy of IT-Driven Outsourcing in Political Economy & Information Capitalism" in *India; Digital Divide, Development Divide & Equity* edited by Govindan Parayil, Palgrave Macmillan.
- CSO (2001) India, Planning Commission of India, New Delhi.
- D`Costa A. (2002) "Export Growth and Path Dependence: The Locking in of Innovations in the Software Industry", *Science, Technology and Society*, Vol 7, No.1.
- Dedrick, Jason, Vijay Gurbaxani and Kenneth L. Kraemer (2001) Information Technology and Productivity Growth at the Firm and Country Level.
- DOI (2001) *Creating a Development Dynamic: Final Report of the Digital Opportunity Initiative* (Washington DC: UNDP) available at <http://www.opt-init.org/framework/DOI-Final-Report.pdf>

- Doms, Mark, Timothy Dunne and Kenneth R. Troske (1997); "Workers, Wages and Technology", *Quarterly Journal of Economics*; Vol. CXII, 254-290.
- Dumagan , Jesus, Gurmukh Gill and Cassandra Ingram (2003), "Chapter IV: Industry-level Effects of Information Technology Use on Overall Productivity", *Digital Economy* pp 45-50
- Dunne, T., L. Foster, J. Haltiwanger, and K. Troske, (2000), "Wage and Productivity Dispersion in U.S. Manufacturing: The Role of Computer Investment," NBER Working Paper 7465.
- Ernst, Dieter and Bengt-Ake Lundvall, (2000). "Information Technology in the Learning Economy: Challenges for Developing Countries," *Economics Study Area Working Papers 08*, East-West Center, Economics Study Area.
- Good, D. H., M. I. Nadiri and R. Sickles (1996) *Index Number and Factor Demand Approaches to the Estimation of Productivity*. NBER Working Paper 5790.
- Hasan, Rana. (2002) "The Impact of Imported and Domestic Technologies on the Productivity of Firms: Panel Data Evidence From Indian Manufacturing Firms," *Journal of Development Economics*, vol. 69, pp. 23-49.
- Hatzichronoglou, T. (1997), "Revision of the High-Technology Sector and Product Classification", *OECD Science, Technology and Industry Working Papers*, 1997/2, OECD, Paris.
- Heeks, Richard (1996), "India's Software Industry: State Policy, Liberalisation and Industrial Development", Sage Publishers, New Delhi.
- Helpman, Elhanan (1998), "Introduction" in Elhanan Helpman(ed), *General Purpose Technologies and Economic Growth*, The Massachusetts Institute of Technology, The MIT Press, Cambridge, Massachusetts, London.
- IMF (2001) *World Economic Outlook: The Information Technology Revolution*, October.



- IMF (2002). World Economic Outlook Database. Available at: <http://www.imf.org/external/pubs/ft/weo/2002/01/data/index.htm>.
- Indjikian, Rouben and Donald S. Siegel (2005) "The Impact of Investment in IT on Economic Performance: Implications for Developing Countries" *World Development* Vol. 33, No. 5, pp. 681-700.
- Joeng, K, Jeong Huh Oh, and Ilsoon Shin (2001) "The Economic Impact of Information and Communication Technology in Korea", in *Information Technology , Productivity , and Economic Growth* Edited by Matti Pohjola , UNU / WIDER Studies in Development Economics, Oxford University Press, New York.
- Jorgenson and Stiroh (1999) "Information Technology and Growth", *American Economic Review*, 89 (2).
- Jorgenson, Dale W. and Kevin J. Stiroh. (2000). "U.S. Economic Growth at the Industry Level." *American Economic Review, Papers and Proceedings*, Vol. 90, No. 2, May.
- Joseph K.J. (2002), "Growth of IT and IT for Development: Realities of the Myths of the Indian Experience", Discussion paper No. 2002/78, Helsinki: UNU/ WIDER.
- Joseph K. J. (2006) *Information Technology, Innovation System and Trade Regime in Developing Countries: India and the ASEAN*, Palgrave Macmillan, New York.
- Joseph K.J. and Vinoj Abraham (2005) "Moving up or Lagging Behind in Technology? Evidence from an Estimated Index of Technological Competence of India's IT Sector" in (eds) Ashwini Saith and Vijayabhaskar, *ITs and Indian Economic Development: Economy, Work, Regulation* , Sage Publications.
- Joseph, K.J. and K. N. Harilal (2001) 'Structure and Growth of India's IT Exports: Implications of an Export-Oriented Growth Strategy', *Economic and Political Weekly*, Vol. 36 (34): 3263-70.
- Kalirajan K and S. Bhide (2005) The Post-reform Performance of the Manufacturing Sector in India, *Asian Economic Papers*, 3(2):126-157.

- Kevin J. Stiroh, (2002). "Information Technology and the U.S. Productivity Revival: What Do the Industry Data Say?", *American Economic Review*, American Economic Association, vol. 92(5), pages 1559-1576, December.
- Kraemer, K.L., and Jason Dedrick, (2001) Payoffs From Investment In Information Technology: Lessons from the Asia-pacific Region; WPfile, April 13, 2001.
- Kumar, N. (2001) "Indian Software Industry Development: International and National Perspective", *Economic and Political Weekly*, 36(45):4278-4290.
- Kumar, N and K. J. Joseph (2006) "National Innovation System and India's IT Capability: Are there any lessons for ASEAN New comers", in B.A. Lundvall, Intarakumnerd, P., and Vang J. (eds) *Asia's Innovation System in Transition*, Edward Elgar, Cheltenham, pp 227-257.
- Lal, K. (2001). "The Determinants of the Adoption of Information Technology: A Case Study of the Indian Garments Industry." In Matti Pohjola (ed.) *Information Technology, Productivity, and Economic Growth: International Evidence and Implications for Economic Development*. Oxford: Oxford University Press, pp. 149-174.
- Lal, K (2005) New Technologies and Indian SMEs, Discussion paper series #2005-6, UNU-INTECH.
- Lichtenberg, Frank R. [1995], "The Output Contributions of Computer Equipment and Personal: A Firm-Level Analysis," *Economics of Innovation and New Technology*, Vol. 3: 201-217.
- Lipsey, R. G., Bekar, C. and Carlaw, K. (1998), "What Requires Explanation ?". In (E. Helpman, ed.), *General Purpose Technologies and Economic Growth*. Cambridge, Mass.: MIT Press, pp. 15-54.

- Malone, T. W., J. Yates, and R. I. Benjamin (1987). "Electronic Markets and Electronic Hierarchies," *Communications of the ACM*, Volume 30, Number 6, June.
- O'Mahony, Mary and Michela Vecchi (2002) "Is there an IT impact on TFP?: Evidence from Industry Panel Data". NIESR, October.
- National Association of Software and Service Companies (NASSCOM) (2006), *The Software Industry in India: A Strategic Review*, New Delhi: NASSCOM.
- Niininen P., 2001, "Computers and Economic Growth in Finland", in M. Pohjola (ed) *Information Technology, Productivity, and Economic Growth*, UNU / WIDER Studies in Development Economics, Oxford University Press, New York.
- Nordhaus, William D., (2001), "Productivity Growth and the New Economy," NBER Working Paper 8096, January.
- Oliner, D. Stephen and Daniel E. Sichel (2000), "The Resurgence of Growth in the Late 1990s: Is Information Technology the Story?", *Journal of Economic Perspectives*, Volume 14, Number 4.
- Oliner, Stephen D. and Sichel, Daniel E. [1994], "Computers and Output Growth Revisited: How Big is the Puzzle?" *Brookings Papers on Economic Activity*, 1994(2): 273-334.
- Parameswaran, M. (2007) *International Trade, R&D Spillovers and Productivity: Evidence from Indian Manufacturing Industry*, mimeo, Centre for Development Studies, Kerala, India.
- Parthasarathi, A. and K. J. Joseph (2002) "Limits to Innovation with Strong Export Orientation: The Experience of India's Information Communication Technology Sector", *Science, Technology and Society*, Vol 7, No.1.
- Parthasarathy, Balaji and Aoyama, Y (2006), "From Software Services to R&D Services: Local Entrepreneurship in the Software Industry in Bangalore, India", *Environment and Planning A*, 38 No 7, pp 1269-1285.

- Pohjola, Matti. 2001. "Information Technology and Economic Growth: A Cross-Country Analysis." In Pohjola, Matti (ed.), *Information Technology and Economic Development*. Oxford: Oxford University Press, pp. 242-256.
- Romer, P ( 1993), "Idea Gaps and Object Gaps in Economic Development". *Journal of Monetary Economics*, 32 : 543-73.
- Romer, Paul M. (1986), "Increasing Returns and Long Run Growth", *Journal of Political Economy*, Vol 94(5) pp 1002 - 1037.
- Rosenberg, Nathan (1969). "The Direction of Technological Change: Inducement Mechanisms and Focusing Devices," *Economic Development and Cultural Change* 18(1), Part I: 1-24.
- Rosenberg, Nathan and Trajtenberg, Manuel,(2001) "A General Purpose Technology at Work: The Corliss Steam Engine in the Late 19th Century", CEPR Discussion Paper No. 3008.
- Schware, R(1987),"Software Industry in the Third World:Policy Guidelines,Institutional Options and Constraints", *World Development*, Volume 15,No 10/11,pp 1249-1267.
- Schultz T.W.(1989), "Investing in People: Schooling in Low Income Countries", *Economic Education Review* Vol 8(3), pp 219-23.
- Siddharthan, N.S., and Nollen, S. (2004). "MNE Affiliation, Firm Size and Exports Revisited: A Study of Information Technology Firms in India". *The Journal of Development Studies*, 40 (6), 146 - 168.
- Siegel, Donald and Griliches, Zvi (1992), "Purchased Services, Outsourcing, Computers, and Productivity in Manufacturing," in Griliches et al. (Ed.), *Output Measurement in the Service Sectors*, University of Chicago Press.
- Singh, N. (2002). "Information Technology as an Engine of Broad-based Growth in India". In P. Banerjee & F.-J. Richter (Eds.), *The Information Economy in India* (pp. 24-57). London: Palgrave/Macmillan.

Solow, R.M.(1957) " Technical Change and the Aggregate Production Function", *Review of Economics and Statistics*, Vol.39, pp312-320

Stiroh, K., 2001, "Information Technology and the U.S. Productivity Revival: What Do the Industry Data Say?" Federal Reserve Bank of New York Staff Reports, Number 115, January.

Unel, Bulent (2003), "Productivity Trends in India's Manufacturing Sectors in the last TwoDecades", IMF Working Paper No. WP/03/22.

Veeramani, C and Bishwanath Goldar, "Investment Climate and Total Factor Productivity in Manufacturing: Analysis of Indian States", Working Paper No. 127, Indian Council for Research on International Economic Relations, New Delhi April 2004.

Wong, Poh Kam (2001) , "The Contribution of Information Technology to the Rapid Economic Growth in Singapore", in *Information Technology, Productivity, and Economic Growth*, Edited by Matti Pohjola, UNU / WIDER Studies in Development Economics, Oxford University Press, New York 21.

Websites : <http://www.itu.int/ITU-D/ITeye/Indicators/Indicators.aspx#>

**CENTRE FOR DEVELOPMENT STUDIES**  
**LIST OF WORKING PAPERS**  
*[New Series]*

The Working Paper Series was initiated in 1971. A new series was started in 1996 from WP. 270 onwards. Working papers beginning from 279 can be downloaded from the Centre's website ([www.cds.edu](http://www.cds.edu))

- W.P. 388 HRUSHIKESH MALLICK**, *Does Energy Consumption Fuel Economic Growth In India?* September 2007
- W.P. 387 D. SHYJAN**, *Public Investment and Agricultural Productivity: A State-wise Analysis of Foodgrains in India.* July 2007
- W.P. 386 J. DEVIKA**, *'A People United in Development': Developmentalism in Modern Malayalee Identity.* June 2007.
- W.P. 385 M. PARAMESWARAN**, *International Trade, R&D Spillovers and Productivity: Evidence from Indian Manufacturing Industry.* June 2007.
- W.P. 384 K. C. ZACHARIAH, S. IRUDAYA RAJAN** *Economic and Social Dynamics of Migration in Kerala, 1999-2004 Analysis of Panel Data.* May 2007.
- W.P. 383 SAIKAT SINHA ROY** *Demand and Supply Factors in the Determination of India's Disaggregated Manufactured Exports : A Simultaneous Error-Correction Approach.* May 2007
- W.P. 382 SUNIL MANI** *The Sectoral System of Innovation of Indian pharmaceutical industry.* September 2006
- W.P. 381 K. J. JOSEPH, GOVINDAN PARAYIL** *Trade Liberalization and Digital Divide: An Analysis of the Information Technology Agreement of WTO.* July 2006.
- W.P. 380 RUDRA NARAYAN MISHRA** *Dynamics of Caste-based Deprivation in Child Under-nutrition in India.* July 2006.
- W.P. 379 P.L.BEENA**, *Limits to Universal Trade Liberalisation: The Contemporary Scenario for Textiles & Clothing Sector in South Asia.* March 2006.
- W.P. 378 K.N. NAIR, VINEETHA MENON**, *Lease Farming in Kerala: Findings from Micro Level Studies.* November 2005.

- W.P. 377 NANDANA BARUAH**, *Anti Dumping Duty as a Measure of Contingent Protection: An Analysis of Indian Experience.* October 2005.
- W.P. 376 P. MOHANAN PILLAI, N. SHANTA** *Long Term Trends in the Growth and Structure of the Net State Domestic Product in Kerala.* October 2005.
- W.P. 375 R. MOHAN, D. SHYJAN** *Taxing Powers and Developmental Role of the Indian States: A Study with reference to Kerala.* August 2005.
- W.P. 374 K. C. ZACHARIAH, S. IRUDAYA RAJAN.** *Unemployment in Kerala at the Turn of the Century: Insights from CDS Gulf Migration Studies.* August 2005.
- W.P. 373 SUNIL MANI**, *The Dragon vs. The Elephant Comparative Analysis of Innovation Capability in the Telecommunications Equipment Industry in China and India.* July 2005
- W.P. 372 MOTKURI VENKATANARAYANA** *On The Non-Random Distribution of Educational Deprivation of Children in India.* July 2005
- W.P. 371 DIBYENDU S. MAITI** *Organisational Morphology of Rural Industries in Liberalised India: A Study of West Bengal.* June 2005
- W.P. 370 SUNIL MANI**, *Keeping Pace with Globalisation Innovation Capability in Korea's Telecommunications Equipment Industry.* March 2005.
- W.P. 369 V.R. PRABHAKARAN NAIR**, *Determinants of Fixed Investment: A Study of Indian Private Corporate Manufacturing Sector.* March 2005.
- W.P. 368 J. DEVIKA**, *Modernity with Democracy? : Gender and Governance in the People's Planning Campaign, Kerala.* February 2005
- W.P. 367 VINEETHA MENON, ANTONYTO PAUL, K N NAIR** *Dynamics of Irrigation Institutions: Case study of a Village Panchayat in Kerala.* February 2005
- W.P. 366 VIJAYAMOHANAN PILLAI N.** *Causality and Error Correction in Markov Chain: Inflation in India Revisited.* December 2004.
- W.P. 365 R. MOHAN.** *Central Finances in India - Alternative to Procrustean Fiscal Correction.* November 2004.

- W.P. 364** **SUNIL MANI.** *Coping with Globalisation Public R&D Projects in Telecommunications Technologies in Developing Countries.* November 2004.
- W.P. 363** **K C ZACHARIAH, S IRUDAYA RAJAN.** *Gulf Revisited Economic Consequences of Emigration From Kerala, Emigration and Unemployment.* September 2004.
- W.P. 362** **M. VENKATANARAYANA.** *Educational Deprivation of Children in Andhra Pradesh, Levels and Trends, Disparities and Associative Factors.* August 2004.
- W.P. 361** **K. P. KANNAN, VIJAYAMOHANAN PILLAIN.** *Development as a Right to Freedom: An Interpretation of the Kerala Model.* August 2004.
- W.P. 360** **VIJAYAMOHANAN PILLAIN.** *CES Function, Generalised Mean and Human Poverty Index: Exploring Some Links.* July 2004.
- W.P. 359** **PRAVEENA KODOTH,** *Shifting the Ground of Fatherhood: Matriliney, Men and Marriage in Early Twentieth Century Malabar.* May 2004.
- W.P. 358** **MRIDUL EAPEN.** *Women and Work Mobility: Some Disquieting Evidences from the Indian Data.* May 2004.
- W.P. 357** **K. RAVI RAMAN.** *The Asian Development Bank Loan for Kerala (India): The Adverse Implications and Search for Alternatives,* March 2004.
- W.P. 356** **VIJAYAMOHANAN PILLAI N.** *Liberalisation of Rural Poverty: The Indian Experience,* March 2004.
- W.P. 355** **P.L.BEENA** *Towards Understanding the Merger-Wave in the Indian Corporate Sector: A Comparative Perspective,* January 2004.
- W.P. 354** **K.P. KANNAN AND R. MOHAN** *India's Twelfth Finance Commission A View from Kerala,* December 2003.
- W.P. 353** **K.N. HARILAL AND P.L. BEENA** *The WTO Agreement on Rules of Origin Implications for South Asia,* December 2003.
- W.P. 352** **K. PUSHANGADAN** *Drinking Water and Well-being In India: Data Envelopment Analysis,* October 2003.
- W.P. 351** **INDRANI CHAKRABORTY** *Liberalization of Capital Inflows and the Real Exchange Rate in India : A VAR Analysis,* September 2003.



- W.P. 350 M.KABIR** *Beyond Philanthropy: The Rockefeller Foundation's Public Health Intervention in Thiruvithamkoor, 1929-1939*, September 2003.
- W.P. 349 JOHN KURIEN** *The Blessing of the Commons : Small-Scale Fisheries, Community Property Rights, and Coastal Natural Assets*, August 2003.
- W.P. 348 MRIDUL EAPEN**, *Rural Industrialisation in Kerala: Re-Examining the Issue of Rural Growth Linkages*, July 2003.
- W.P. 347 RAKHE PB**, *Estimation of Tax Leakage and its Impact on Fiscal Health in Kerala*, July 2003.
- W.P. 346 VIJAYAMOHANAN PILLAI N**, *A contribution to Peak load pricing theory and Application*. April 2003.
- W.P. 345 V.K. RAMACHANDRAN, MADHURA SWAMINATHAN, VIKAS RAWAL** *Barriers to Expansion of Mass Literacy and Primary Schooling in West Bengal: Study Based on Primary Data from Selected Villages*. April 2003.
- W.P. 344 PRADEEP KUMAR PANDA** *Rights-Based Strategies in the Prevention of Domestic Violence*, March 2003.
- W.P. 343 K. PUSHPANGADAN** *Remittances, Consumption and Economic growth in Kerala: 1980-2000*, March 2003.
- W.P. 342 DNARAYANA** *Why is the Credit-deposit Ratio Low in Kerala?* January 2003.
- W.P. 341 MRIDUL EAPEN, PRAVEENA KODOTH** *Family Structure, Women's Education and Work: Re-examining the High Status of Women in Kerala*. November 2002.
- W.P. 340 J. DEVIKA**, *Domesticating Malayalees: Family Planning, the Nation and Home-Centered Anxieties in Mid- 20<sup>th</sup> Century Keralam*. October, 2002.
- W.P. 339 M PARAMESWARAN**, *Economic Reforms and Technical Efficiency: Firm Level Evidence from Selected Industries in India*. October, 2002.
- W.P. 338 PRAVEENA KODOTH**, *Framing Custom, Directing Practices: Authority, Property and Matriliney under Colonial Law in Nineteenth Century Malabar*, October 2002.
- W.P. 337 K.NAVANEETHAM**, *Age Structural Transition and Economic Growth: Evidence From South and Southeast Asia*, August 2002.
- W.P. 336 PULAPRE BALAKRISHNAN, K. PUSHPANGADAN, M. SURESH BABU**, *Trade Liberalisation, Market Power and Scale Efficiency in Indian Industry*, August 2002.

- W.P. 335 J. DEVIKA**, *Family Planning as 'Liberation': The Ambiguities of 'Emancipation from Biology' in Keralam* July 2002.
- W.P. 334 E. ABDUL AZEEZ**, *Economic Reforms and Industrial Performance an Analysis of Capacity Utilisation in Indian Manufacturing*, June 2002.
- W.P. 333 K. PUSHANGADAN** *Social Returns from Drinking Water, Sanitation and Hygiene Education: A Case Study of Two Coastal Villages in Kerala*, May 2002.
- W.P. 332 K. P. KANNAN**, *The Welfare Fund Model of Social Security for Informal Sector Workers: The Kerala Experience*. April 2002.
- W.P. 331 SURESH BABU**, *Economic Reforms and Entry Barriers in Indian Manufacturing*. April 2002.
- W.P. 330 ACHIN CHAKRABORTY**, *The Rhetoric of Disagreement in Reform Debates* April 2002.
- W.P. 329 J. DEVIKA**, *Imagining Women's Social Space in Early Modern Keralam*. April 2002.
- W.P. 328 K. P. KANNAN, K. S. HARI**, *Kerala's Gulf Connection Emigration, Remittances and their Macroeconomic Impact 1972-2000*. March 2002.
- W.P. 327 K. RAVIRAMAN**, *Bondage in Freedom, Colonial Plantations in Southern India c. 1797-1947*. March 2002.
- W.P. 326 K.C. ZACHARIAH, B.A. PRAKASH, S. IRUDAYA RAJAN**, *Gulf Migration Study : Employment, Wages and Working Conditions of Kerala Emigrants in the United Arab Emirates*. March 2002.
- W.P. 325 N. VIJAYAMOHANAN PILLAI**, *Reliability and Rationing cost in a Power System*. March 2002.
- W.P. 324 K. P. KANNAN, N. VIJAYAMOHANAN PILLAI**, *The Aetiology of the Inefficiency Syndrome in the Indian Power Sector Main Issues and Conclusions of a Study*. March 2002.
- W.P. 323 V. K. RAMACHANDRAN, MADHURA SWAMINATHAN, VIKAS RAWAL**, *How have Hired Workers Fared? A Case Study of Women Workers from an Indian Village, 1977 to 1999*. December 2001.
- W.P. 322 K. C. ZACHARIAH**, *The Syrian Christians of Kerala: Demographic and Socioeconomic Transition in the Twentieth Century*, November 2001.

- W.P. 321 VEERAMANI C.** *Analysing Trade Flows and Industrial Structure of India: The Question of Data Harmonisation*, November 2001.
- W.P. 320 N. VIJAYAMOHANAN PILLAI, K. P. KANNAN,** *Time and Cost Over-runs of the Power Projects in Kerala*, November 2001.
- W.P. 319 K. C. ZACHARIAH, P. R. GOPINATHAN NAIR, S. IRUDAYARAJAN** *Return Emigrants in Kerala: Rehabilitation Problems and Development Potential*. October 2001
- W.P. 318 JOHN KURIEN, ANTONYTO PAUL** *Social Security Nets for Marine Fisheries-The growth and Changing Composition of Social Security Programmes in the Fisheries Sector of Kerala State, India*. September 2001.
- W.P. 317 K. J. JOSEPH, K. N. HARILAL** *India's IT Export Boom: Challenges Ahead*. July 2001.
- W.P. 316 K. P. KANNAN, N. VIJAYAMOHANAN PILLAI** *The Political Economy of Public Utilities: A Study of the Indian Power Sector*, June 2001.
- W.P. 315 ACHIN CHAKRABORTY** *The Concept and Measurement of Group Inequality*, May 2001.
- W.P. 314 U.S.MISHRA, MALA RAMANATHAN** *Delivery Complications and Determinants of Caesarean Section Rates in India - An Analysis of National Family Health Surveys, 1992-93*, March 2001.
- W.P. 313 VEERAMANI. C** *India's Intra-Industry Trade Under Economic Liberalization: Trends and Country Specific Factors*, March 2001
- W.P. 312 N. VIJAYAMOHANAN PILLAI** *Electricity Demand Analysis and Forecasting –The Tradition is Questioned*, February 2001
- W.P. 311 INDRANI CHAKRABORTY** *Economic Reforms, Capital Inflows and Macro Economic Impact in India*, January 2001
- W.P. 310 K. K. SUBRAHMANYAN. E. ABDUL AZEEZ,** *Industrial Growth In Kerala: Trends And Explanations* November 2000
- W.P. 309 V. SANTHAKUMAR, ACHIN CHAKRABORTY,** *Environmental Valuation and its Implications on the Costs and Benefits of a Hydroelectric Project in Kerala, India*, November 2000.
- W.P. 308 K. P. KANNAN, N . VIJAYAMOHANAN PILLAI,** *Plight of the Power Sector in India : SEBs and their Saga of Inefficiency* November 2000.
- W.P. 307 K. NAVANEETHAM, A. DHARMALINGAM,** *Utilization of Maternal Health Care Services in South India*, October 2000.

- W.P. 306 S. IRUDAYA RAJAN**, *Home Away From Home: A Survey of Oldage Homes and inmates in Kerala*, August 2000.
- W.P. 305 K. N. HARILAL, K.J. JOSEPH**, *Stagnation and Revival of Kerala Economy: An Open Economy Perspective*, August 2000.
- W.P. 304 K. P. KANNAN**, *Food Security in a Regional Perspective; A View from 'Food Deficit' Kerala*, July 2000.
- W.P. 303 K. C. ZACHARIAH, E. T. MATHEW, S. IRUDAYA RAJAN**, *Socio-Economic and Demographic Consequences of Migration in Kerala*, May 2000.
- W.P. 302 K. PUSHANGADAN, G. MURUGAN**, *Gender Bias in a Marginalised Community: A Study of Fisherfolk in Coastal Kerala*, May 2000.
- W.P. 301 P. L. BEENA** *An Analysis of Mergers in the Private Corporate Sector in India*, March, 2000.
- W.P. 300 D. NARAYANA** *Banking Sector Reforms and the Emerging Inequalities in Commercial Credit Deployment in India*, March, 2000.
- W.P. 299 JOHN KURIEN** *Factoring Social and Cultural Dimensions into Food and Livelihood Security Issues of Marine Fisheries; A Case Study of Kerala State, India*, February, 2000.
- W.P. 298 D. NARAYANA, K. K. HARI KURUP**, *Decentralisation of the Health Care Sector in Kerala : Some Issues*, January, 2000.
- W.P. 297 K.C. ZACHARIAH, E. T. MATHEW, S. IRUDAYA RAJAN** *Impact of Migration on Kerala's Economy and Society*, July, 1999.
- W.P. 296 P.K. MICHAEL THARAKAN, K. NAVANEETHAM** *Population Projection and Policy Implications for Education: A Discussion with Reference to Kerala*, July, 1999.
- W.P. 295 N. SHANTA, J. DENNIS RAJA KUMAR** *Corporate Statistics: The Missing Numbers*, May, 1999.
- W.P. 294 K. P. KANNAN** *Poverty Alleviation as Advancing Basic Human Capabilities: Kerala's Achievements Compared*, May, 1999.
- W.P. 293 MRIDUL EAPEN** *Economic Diversification In Kerala : A Spatial Analysis*, April, 1999.
- W.P. 292 PRADEEP KUMAR PANDA** *Poverty and young Women's Employment: Linkages in Kerala*, February, 1999.
- W.P. 291 P. K. MICHAEL THARAKAN** *Coffee, Tea or Pepper? Factors Affecting Choice of Crops by Agro-Entrepreneurs in Nineteenth Century South-West India*, November 1998

- W.P. 290 CHRISTOPHE Z. GUILMOTO, S. IRUDAYA RAJAN** *Regional Heterogeneity and Fertility Behaviour in India*, November 1998.
- W.P. 289 JOHN KURIEN** *Small Scale Fisheries in the Context of Globalisation*, October 1998.
- W.P. 288 S. SUDHA, S. IRUDAYA RAJAN** *Intensifying Masculinity of Sex Ratios in India : New Evidence 1981-1991*, May 1998.
- W.P. 287 K. PUSHPANGADAN, G. MURUGAN** *Pricing with Changing Welfare Criterion: An Application of Ramsey- Wilson Model to Urban Water Supply*, March 1998.
- W.P. 286 ACHIN CHAKRABORTY** *The Irrelevance of Methodology and the Art of the Possible : Reading Sen and Hirschman*, February 1998.
- W.P. 285 V. SANTHAKUMAR** *Inefficiency and Institutional Issues in the Provision of Merit Goods*, February 1998.
- W.P. 284 K. P. KANNAN** *Political Economy of Labour and Development in Kerala*, January 1998.
- W.P. 283 INDRANI CHAKRABORTY** *Living Standard and Economic Growth: A fresh Look at the Relationship Through the Non- Parametric Approach*, October 1997.
- W.P. 282 S. IRUDAYA RAJAN, K. C. ZACHARIAH** *Long Term Implications of Low Fertility in Kerala*, October 1997.
- W.P. 281 SUNIL MANI** *Government Intervention in Industrial R & D, Some Lessons from the International Experience for India*, August 1997.
- W.P. 280 PRADEEP KUMAR PANDA** *Female Headship, Poverty and Child Welfare : A Study of Rural Orissa, India*, August 1997.
- W.P. 279 U.S. MISRA, MALA RAMANATHAN, S. IRUDAYA RAJAN** *Induced Abortion Potential Among Indian Women*, August 1997.
- W. P. 278 PRADEEP KUMAR PANDA** *The Effects of Safe Drinking Water and Sanitation on Diarrhoeal Diseases Among Children in Rural Orissa*, May 1997.
- W. P. 277 PRADEEP KUMAR PANDA** *Living Arrangements of the Elderly in Rural Orissa*, May 1997.
- W. P. 276 V. SANTHAKUMAR** *Institutional Lock-in in Natural Resource Management: The Case of Water Resources in Kerala*, April 1997.
- W.P. 275 G. OMKARNATH** *Capabilities and the process of Development* March 1997.

- W.P. 274 K. PUSHANGADAN, G. MURUGAN** *User Financing & Collective action: Relevance sustainable Rural water supply in India.* March 1997.
- W.P. 273 ROBERT E. EVENSON, K.J. JOSEPH** *Foreign Technology Licensing in Indian Industry : An econometric analysis of the choice of partners, terms of contract and the effect on licensees' performance* March 1997.
- W.P. 272 SUNIL MANI** *Divestment and Public Sector Enterprise Reforms, Indian Experience Since 1991* February 1997.
- W.P. 271 SRIJIT MISHRA** *Production and Grain Drain in two inland Regions of Orissa* December 1996.
- W.P. 270 ACHIN CHAKRABORTY** *On the Possibility of a Weighting System for Functionings* December 1996.

## **BOOKS PUBLISHED BY THE CDS**

### **Biodiversity, Sustainable Development and Economic Analysis**

J. Hans B. Opschoor

CDS, 2004, Rs. 100/\$11

### **Plight of the Power Sector in India: Inefficiency, Reform and Political Economy**

K.P. Kannan and N. Vijayamohanan Pillai

CDS, 2002, Rs. 400/\$40

### **Kerala's Gulf Connection: CDS Studies on International Labour Migration from Kerala State in India**

K.C. Zachariah, K. P. Kannan, S. Irudaya Rajan (eds)

CDS, 2002, pp 232, Hardcover, Rs. 250/\$25

### **Performance of Industrial Clusters: A Comparative Study of Pump Manufacturing Cluster in Coimbatore (Tamil Nadu) & Rubber Footwear Cluster in Kottayam (Kerala)**

P. Mohanan Pillai

CDS, 2001, pp 158, Paperback, Rs. 175/\$18

### **Poverty, Unemployment and Development Policy : A Case Study of Selected Issues With Reference to Kerala**

United Nations, 2000 (reprint), pp 235

(available for sale in India only), Rs. 275

### **Land Relations and Agrarian Development in India: A Comparative Historical Study of Regional Variations**

Sakti Padhi

CDS, 1999. pp 335, Hardcover, Rs. 425/\$48

### **Agrarian Transition Under Colonialism: Study of A Semi Arid Region of Andhra, C.1860-1900**

GN Rao

CDS, 1999. pp 133, Paperback, Rs. 170/ \$19

### **Property Rights, Resource Management & Governance: Crafting An Institutional Framework for Global Marine Fisheries**

John Kurien

CDS & SIFFS, 1998. pp 56, Paperback, Rs. 50/ \$10

**Health, Inequality and Welfare Economics**

Amartya Sen

CDS. 1996. pp 26, Paperback, Rs. 70/ \$ 10

**Industrialisation in Kerala: Status of Current Research and Future Issues**

P Mohanan Pillai &amp; N Shanta

CDS. 1997. pp 74, Paperback, Rs. 110/ \$ 12

**CDS M.Phil Theses (1990/91-1993/94): A Review Vol.II**

T T Sreekumar

CDS. 1996. pp 99, Paperback, Rs. 120/\$ 14

**Trends In Agricultural Wages in Kerala 1960-1990**

A A Baby

CDS. 1996. pp 83, Paperback, Rs. 105/ \$ 12

**CDS M.Phil Theses (1975/76-1989/90): A Review Vol.1**

G N Rao

CDS. 1996. pp 162, Paperback, Rs. 155/ \$ 18

**Growth of Education in Andhra - A Long Run View**

C Upendranath

CDS. 1994. pp 158, Paperback, Rs. 135/ \$ 15

**Growth of Market Towns in Andhra: A Study of the Rayalseema Region C 1900-C.1945**

Namerta

CDS. 1994. pp 186, Paperback, Rs.125/ \$ 14

**Floods and Flood Control Policies: an Analysis With Reference to the Mahanadi Delta in Orissa**

Sadhana Satapathy

CDS. 1993 pp 98, Paperback, Rs. 110/\$ 12

**Growth of Firms in Indian Manufacturing Industry**

N Shanta

CDS. 1994. pp 228, Hardcover, Rs. 250/ \$ 28

**Demographic Transition in Kerala in the 1980s**K C Zachariah, S Irudaya Rajan, P S Sarma, K Navaneetham,  
P S Gopinathan Nair & U S Mishra,CDS. 1999 (2<sup>nd</sup> Edition) pp 305, Paperback, Rs.250/ \$ 28



**Impact of External Transfers on the Regional Economy of Kerala**

P R Gopinathan Nair &amp; P Mohanan Pillai

CDS 1994. pp 36, Paperback, Rs.30/ \$ 10

**Urban Process in Kerala 1900-1981**

T T Sreekumar

CDS. 1993. pp 86, Paperback, Rs.100/ \$ 11

**Peasant Economy and The Sugar Cooperative: A Study Of The Aska Region in Orissa**

Keshabananda Das

CDS. 1993. pp 146, Paperback, Rs.140/ \$ 16

**Industrial Concentration and Economic Behaviour: Case Study of Indian Tyre Industry**

Sunil Mani

CDS. 1993. pp 311, Hardcover, Rs. 300/ \$ 34

**Limits To Kerala Model of Development: An Analysis of Fiscal Crisis and Its Implications.**

K K George

CDS. 1999 (2<sup>nd</sup> edition) pp 128, Paperback, Rs. 160/ \$ 18**Indian Industrialization: Structure and Policy Issues. (No Stock)**

Arun Ghosh, K K Subrahmanian, Mridul Eapen &amp; Haseeb A Drabu (EDs).

OUP. 1992. pp 364, Hardcover, Rs.350/ \$ 40

**Rural Household Savings and Investment: A Study of Some Selected Villages**

P G K Panikar, P Mohanan Pillai &amp; T K Sundari

CDS. 1992. pp 144, Paperback, Rs. 50/ \$ 10

**International Environment, Multinational Corporations and Drug Policy**

P G K Panikar, P Mohanan Pillai &amp; T K Sundari

CDS. 1992. pp 77, Paperback, Rs.40/ \$ 10

**Trends in Private Corporate Savings**

N Shanta

CDS. 1991. pp 90, Paperback, Rs. 25/ \$ 10

**Coconut Development in Kerala: Ex-post Evaluation**

D Narayana, K N Nair, P Sivanandan, N Shanta and  
G N Rao

CDS. 1991. pp 139, Paperback, Rs.40/ \$ 10

**Caste and The Agrarian Structure**

T K Sundari

Oxford & IBH. 1991. pp 175, Paperback, Rs.125/ \$ 14

**Livestock Economy of Kerala**

P S George and K N Nair

CDS. 1990. pp 189, Hardcover, Rs. 95/ \$ 10

**The Pepper Economy of India (No Stock)**

P S George, K N Nair and K Pushpangadan

Oxford & IBH. 1989. pp 88, Paperback, Rs. 65/ \$ 10

**The Motor Vehicle Industry in India  
(Growth within a Regulatory Environment)**

D Narayana

Oxford & IBH. 1989. pp 99, Paperback, Rs. 75/ \$ 10

**Ecology or Economics in Cardamom Development  
(No Stock)**

K N Nair, D Narayana and P Sivanandan

Oxford & IBH. 1989. pp 99, Paperback, Rs. 75/ \$ 10

**Land Transfers and Family Partitioning**

D Rajasekhar

Oxford and IBH. 1988. pp 90, Hardcover, Rs. 66/ \$ 10

**Essays in Federal Financial Relations**

I S Gulati and K K George

Oxford and IBH. 1988. pp 172, Hardcover, Rs. 82/ \$ 10

**Bovine Economy in India**

A Vaidyanathan

Oxford & IBH. 1988. pp 209, Hardcover, Rs. 96/ \$ 11

**Health Status of Kerala**

P G K Panikar and C R Soman

CDS. 1984. pp 159, Hardcover, Rs.100/ \$ 11 & Paperback, Rs. 75/ \$ 10

