**Growth of Information Sector in Indian Economy During the Reform Period**

By

**Shikhanwita Roy**

**Roy Ghosh & Associates**

**Chartered Accountants**

**Howrah-711101**

**West Bengal**

**India**

**Fax : 91 (33) 2638-6682**

**E-mail : shikharay@hotmail.com**

**&**

**Debesh Chakraborty**

**Former Professor**

**Department of Economics**

**Jadavpur University**

**Kolkata**

**India**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Paper submitted for the 20th International Input-Output Conference (June 25-29, 2012) in Bratislava, Slovakia

**Growth of Information Sector in Indian Economy During the Reform Period**

**Shikhanwita Roy and Debesh Chakraborty**

**Roy Ghosh & Associates**

**Chartered Accountants**

**Howrah-711101**

**West Bengal**

**India**

**Fax : 91 (33) 2638-6682**

**E-mail : shikharay@hotmail.com**

**1. Introduction**

The direction and pace of development in Information and Communication Technology (ICT) have been at the heart of economic changes of all world economies for more than a decade. Across the globe, countries have recognized ICT as an effective tool in catalyzing the economic activity in efficient governance and in developing human resources.

Since 1991, Indian economic policy has become more liberal, with the easing of numerous regulatory constraints on industry. One feature of economic liberalization in India is the active promotion of ICT based industrialization by policy makers. For instance, subsequent to the formation of the WTO in 1995, the Indian government became a signatory to the Global Telecom Agreement and the Information Technology Agreement. These international commitments provided external pressure on India to revamp its tariff regime and established a legal framework for rapid adoption of information and communication technology. Furthermore, in 1999, the Central Government introduced the momentous Information Technology Bill in the Parliament. These and other policy initiatives symbolized India’s resolve to move towards greater informatization.

It is not an exaggeration to suggest that Information Technology-Business Process Outsourcing (IT-BPO) industry has put India on the world map in less than two decades. If the country is respected today as an emerging global powerhouse and a vibrant, high-growth economy; a fair share of the credit is due to the contribution made by the ICT industry over the years. With a CAGR of over 24% in the last decade, the Indian ICT industry has emerged as a key growth engine for the economy contributing around 5.6% to the country’s GDP during 2009-2010. The industry generated revenue of $73.1 billion in 2009-10 from $69.4 billion in 2008-09, a growth of 5.3%. The export revenue touched $50.1 billion in 2009-10 accounting for over 68% of the total ICT industry revenue. The rapid emergence of the ICT sector has placed India on global stage during the last one and a half decades.

There has been considerable research on the contribution of ICTs on the economy. Some of the important contributions are by Oliner & Sichel (2000), Jorgenson & Stiroh (2000), Baily & Lawrence (2001), Brynjolfsson & Hitt (2003), Pohojola (2001), Kraemer & Dedrick (2001) who emphasized the use of ICT in enhancing productivity and competitiveness of different sectors of the economy. Another line of work has examined how adoption of ICT improves business processes. To name a few are contributions by Srinivasan, Kekre, & Mukhopadhyay (1994), Mukhopadhyay, Kekre, & Kalathur (1995), Barua & Mukhopadhyay (2000), Mukhopadhyay & Kekre (2002), Hubbard (2003), Athey & Stern (2002). Other impacts of ICT use for example, increased labour bargaining power, augmenting agricultural productivity, promoting education, and above all in building network societies has been dealt in the works by International Institute for Communication and Development (2005), Bayes et al. (1999), Richardson et al. (2000), Sobhan et al. (2002), UNCTAD (2003), Marshall & Taylor (2006), and Castells (2004).

The relevance of the study in Indian context emanates from more than one reason. India’s success in ICT production and export has already attracted world attention and has been well documented in the literature by Joseph & Harilal (2001), Roy *et al*. (2000, 2002), Singh (2003), Siddharthan & Nollen (2004), Parayil (2006), and Chandrasekhar (2006). Therefore, it is pertinent to examine the sources of growth of the information sector of the Indian economy. Further, not many studies have been undertaken at a disaggregated level.

Realizing the huge potential of the Indian ICT industry, this paper makes a modest attempt to study the factors underlying the sources of growth of Indian ICT industry during the period 1993-94 to 2003-04 (for which the input-output tables are available) with the help of a input-output structural decomposition analysis (SDA). This technique is regarded as one of the useful tools to identify sources of growth.

The paper is arranged in the following manner: We begin with the description of the theoretical model developed in an input-output framework adopted for the present study. This is followed by coverage and analysis of data. The results of the decomposition analysis has been presented and analyzed next. The paper concludes with a synopsis of the findings and their implications and also suggests several policy options for further development of the ICT sector of the Indian economy.

**2. Model**

For the purpose of identifying the sources of growth in the various information sectors, a Model based on Structural Decomposition Analysis (SDA) has been developed. SDA are nowadays a common descriptive tool in studying changes over time. The central idea is that the change in some variable is decomposed, usually in an additive way, into the changes in its determinants. It thus becomes possible to quantify the underlying source of the changes. A good volume of literature with respect to SDA methodology and its application has developed in recent years. To name a few are Rose & Carter (1996), Albala-Bertrand (1999), Alcala et al. (1999), Mukhopadhyay & Chakraborty (1999), Dietzenbacher & Los (2000), Drejer (2000), During & Schnabl (2000), Shishido et al. (2000), Jacobsen (2000) and de Hann (2001).

The model is based on Structural Decomposition Analysis (SDA) which is presented below.

1. **Model**

The Model starts from an accounting identity of demand and supply. In an open Leontief system, the basic material balance between demand and supply can be written as

Xi = ui (Di + Wi) + Ei …………………..(1)

where

Xi = domestic production of commodity i

Di = domestic final demand for commodity i

Wi = intermediate demand for commodity i

Ei = exports of commodity i

ui = domestic supply ratio defined by (Xi - Ei)/(Di + Wi)

i.e. the proportion of intermediate and final demand produced domestically in sector i

Noting that the intermediate demand is determined by production levels and input-output coefficient matrix, W = AX, equation (1) in matrix notation can be expressed as

X = uD + uAX + E

o r X = (I - uA)-1(uD + E)

= R(uD + E) …………………..(2)

where

R = (I-uA)-1

u = diagonal matrix of sector domestic supply ratio

A = the matrix of input-output coefficient (aij)

and X, D and E are vectors

Using equation (2) we can transform the basic material balance equation into information balance equation as

eX = e[R(uD + E)] ……………………(3)

where e is a diagonal matrix composed of ones and zeros. The ones appear in the column locations that correspond to information sectors and all the other elements of the matrix are zeros. The matrix selects the information rows from input-output table.

The change in output of information sectors between the base year (0) and the comparison year (1) can be written as

ΔeX = e (X1 - X0)

= e [R1(u1D1 + E1) - R0(u0D0 + E0)] ………………….(4)

Adding and subtracting eR1u1D0 , eR1E0 and eR1u0D0 in equation (4), we have

ΔeX = e [R1u1D1 + R1E1 - R0u0D0 - R0E0 + R1u1D0 - R1u1D0

+ R1E0 - R1E0 + R1u0D0 - R1u0D0]

= e [R1u1(D1 - D0) + R 1(E1 - E0) + R1(u1 - u0)D0

+ (R1 - R0)u0 D0 + (R1 - R0)E0]

= e [R1u1ΔD + R1ΔE + R1ΔuD0 + ΔR(u0 D0 + E0)] ……………….(5)

Now ΔR = R1 - R0

= -R1[(R1)-1 - (R0) -1]R0

= -R1[I - u1A1 - I + u0A0]R0

= R1[u1A1 - u0A0]R0 …………………..(6)

Adding and subtracting u1A0 in equation (6), we have,

ΔR = R1 [u1A1 - u1A0 + u1A0 - u0A0] R0

= R1 [u1(A1 - A0) + (u1 - u0)A0] R0

= R1u1ΔAR0 + R1ΔuA0R0 …………………….(7)

Substituting (7) in (5)

ΔeX = e[R1u1ΔD + R1ΔE + R1ΔuD0 + R1u1ΔAR0(u0D0 + E0)

+ R1ΔuA0R0(u0D0 + E0)]

= e[R1u1ΔD + R1ΔE + R1ΔuD0 + R1ΔuA0X0 + R1u1ΔAX 0]

= e[R1u1ΔD + R1ΔE + R1Δu(D0 + A0X0 ) + R1u1ΔAX 0]

Thus the total output of information sectors can be decomposed into its sources by category of demand as

ΔeX = e[R1u1ΔD + R1ΔE + R1Δu(D0 + W0) + R1u1ΔAX0] ………………….(8)

The first term on the right hand side denotes the impact of the change in domestic final demand; the second one the impact of change in exports and the third term measures the import substitution effect on production of information goods and services as expressed by changes in domestic supply ratio. The fourth term denotes the impact of changes in input coefficients. This effect represents widening and deepening of inter industry relationship over time brought about by the changes in production technology as well as by substitution among various inputs, although one cannot separate these two causes.

Each term in the decomposition is multiplied by elements of the Leontief domestic inverse. The terms therefore capture both the direct and indirect impact of each causal expression on gross output of information sectors, taking account the linkages through induced intermediate demand.

In the decomposition equation, import substitution is defined as arising from changes in the ratio of imports to total demand. This implicitly assumes that the imports are perfect substitute for domestic goods, since, the source of supply constitute an integral part of the economic structure.

The aggregate contribution of import substitution to growth, as defined here, is sensitive to the level of industry disaggregation. For example, it is possible to have positive import substitution in every industry but have the ratio of total imports to total demand increase because of changes in the industry composition of demand.

The effect of changes in input coefficient includes changes in the total coefficient and does not separately distinguish between imported and domestically produced goods. Thus, the input coefficients may remain constant (Δaij = 0) and hence the last term in (8) will be zero even though there are changes in domestic supply ratio. Changes in technology are defined as changes in the total coefficients while any changes in the intermediate domestic supply ratios are included in the import substitution term.

Assuming that changes in information use technologies and changes in non-information technologies within each sector are separable, the effect of change in input coefficients or often termed as technological change can be further decomposed into the effect of technological changes in information use and the effect of technological changes in non-information use . We can do so by partitioning and writing the changes in technical coefficients as

(A1 - A0) = (A1,I - A0,I) + (A1,N - A0,N) …………………..(9)

where AI represents the information rows of technical coefficient matrix and AN represents the non-information rows.Thus,

eR1u1ΔAX0

= eR1u1(A1 - A0)X0

= eR1u1[(A1,I - A0,I) + (A1,N - A0,N)]X0

= eR1u1(A1,I - A0,I)X0 + eR1u1(A1,N - A0,N)X0 ………………(10)

While the first term of equation (10) captures the effect of changes in information inputs, the second term shows the effect of changes in non-information inputs. This tells us that the change in intermediate information demand can be caused not only by changes in direct information inputs (AI) but also by changes in direct non-information inputs (AN). Furthermore, the changes in direct input requirements will be multiplied across the economy, through inter-industry input-output linkages, which are quantified by the total requirement matrix, R.

Domestic final demand can be further decomposed into growth effect and mix effect. If we define λD as the ratio of domestic final demand between any two periods, which is used to indicate the factor of proportional growth during the period i.e.

λD = μD1/ μ D0

where D represents domestic final demand vector and

μ is a unit row vector

Gd is a diagonal matrix whose diagonal elements are λD

then the effect of domestic final demand change can be further decomposed into:

eR1u1ΔD

= eR1u1[D1-D0]

Adding and subtracting eR1u1Gd D0

= eR1u1[D1 + GdD0 - GdD0 - D0]

Rearranging terms then yields

eR1u1ΔD = eR1u1 [Gd- I] D0 + eR1u1[D1 - GdD0] ………………..(11)

The first term of equation (11) shows the effect of growth in domestic final demand and the second term depicts the effect of mix in domestic final demand.

In addition, we can also calculate the information output changes that originate in individual domestic demand categories, such as, private final consumption expenditure (PFCE), government final consumption expenditure (GFCE), gross fixed capital formation (GFCF) and change in stock (CIS). Mathematically this is very simple, because final demand in the input-output system is additive. Thus

eR1u1ΔD = eR1u1∑ h ΔDh

= eR1u1∑ h [(Gd - I) D0h + (D1h- GdD0h)] …………………(12)

where ΔDh  is the change in information output resulting from changes in domestic demand category h.

We summarize the hierarchial structure of the estimation equations in Table 1.

###### TABLE 1

#### **Structural Decomposition of Change in Information Output Based on SDA**

|  |  |
| --- | --- |
| **Factors** | Equation |
| Change in information output | e (X1 - X0) = e [R1(u1D1+E1) - R0(u0D0+E0)] |
| Domestic final demand effect. | eR1u1[D1-D0] |
| Effect of mix | eR1u1[D1 - GdD0] |
| Effect of growth | eR1u1 [Gd- I] D0 |
| For demand source h | eR1u1 [(Gd - I) D0h + (D1h- GdD0h)] |
| Export effect | eR1(E1 - E0) |
| Import substitution effect | eR1(u1 - u0)(D0 + W0) |
| Technical coefficient effect | eR1u1(A1 - A0)X0 |
| Information input coefficient | eR1u1(A1,I – A0,I)X0 |
| Non inf. input coefficient | eR1u1(A1,N - A0,N)X0 |

**3. Coverage and Analysis of Data**

The basic data are the two input-output tables of the Indian economy for the years 1993-94 and 2003-04, prepared by the Central Statistical Organization of India (2001,2010). They are made comparable by suitable aggregation to 35 order. These 35 sectors are grouped into two broad categories: information and non-information. Information activities are those which intrinsically convey information process, produce or distribute information. The sectors that are clubbed under the information sector are computer and related activities, communication equipment, electronic equipment and communication. Those activities which do not satisfy the above criteria are termed non-information. The two tables are adjusted to 1993-94 price levels by using deflators. A detailed list of aggregation of sectors is provided in the Appendix.

**4. Results**

Before discussing the results, it is important to present a very brief account of the macro economy of India and its relation to the information sector during the period under study. The Gross Domestic Product (GDP) growth of the Indian economy in the post-reform period has improved from an average of about 5.7% in the 1980s to an average of about 6.1% in the post-liberalization period initiated in mid-1991, making India one of the ten fastest growing countries in the world. The Tenth Five Year Plan proposed that it should aim at an indicative target of 8% GDP growth for the period 2002-2007.

This acceleration in the growth rate is not possible without tapping the opportunities offered by the international economy in terms of markets, investment and technologies. Therefore, a sustained high rate of growth of exports is essential. The Government of India has singled out Information Technology (particularly software) as a high-priority thrust area for expansion. Table 2 gives the first substantive results of the analysis.

### Table 2. Sources of Output Growth for the Information Sector of India During 1993-94 to 2003-04

**Rs. Millions**

|  |  |  |
| --- | --- | --- |
|  | Rs. Millions | Percentage |
| Change in Output | 2319169.72 | 100.00 |
| 1. Dom. Final dd. Eff. | 998824.64 | 43.07 |
| a. effect of mix | 694761.52 | 29.96 |
| b. effect of growth | 304063.12 | 13.11 |
| 2. Export Effect | 1167481.63 | 50.34 |
| 3. Imp. Subs. Eff. | -23399.75 | -1.01 |
| 4. Technical Coeff. Eff. | 176263.20 | 7.60 |
| a. inf. Input coeff. | 160201.78 | 6.91 |
| b. noninf. Input coeff. | 16061.42 | 0.69 |

Between 1993-94 to 2003-04, India’s total information output has increased by Rs.2319169.72 million. There are various reasons for the growth of IT industry in India. Some are more visible and spontaneous and others are much subtle and in a very slow but steady manner has paved way for the development of IT which is now experienced. Many considered this as a ‘demographic dividend’ for India. Availability of manpower at a comparative cheap price is the main factor according to the researchers. India’s most prized resource is its readily available technical work force. India has the second largest English-speaking scientific professionals in the world, second only to the U.S. It is estimated that India has over 4 million technical workers, over 1,832 educational institutions and polytechnics, which train more than 67,785 computer software professionals every year. The enormous base of skilled manpower is a major draw for global customers. India provides IT services at one-tenth the price. No wonder more and more companies are basing their operations in India. Some quote ‘Indian Education System’ which places strong emphasis on mathematics and science, resulting in a large number of science and engineering graduates. Mastery over quantitative concepts coupled with English proficiency has resulted in a skill set that has enabled India to reap the benefits of the current international demand for IT.

Kumar and Joseph (2005) mention the governmental institutional measures like STPI policy and other liberalization policies behind the flourishing information sector. As Union Minister Jairam Ramesh explained, the role of Indian government’s policies cannot be neglected. It may be the highly subsidized education in India because of which many IIT and Engineering professionals were generated. As Indian economy couldn’t absorb the excess ‘educated’, ‘technical’, and ‘professional’ manpower created by our education system, the brain drain that was allowed especially to U.S. made Indians to dominate the Silicon Valley. Then the return of those NRI’s powered with money, networking ability, prestige and technology started their units here. Further the liberalization process, establishment of STPI and the IT policy made them to excel along with the MNCs. Thus, the policy changes in the post liberalization period had a positive impact on the growth and structure of the Indian IT industry. Along with other Asian countries such as the Philippines, Malaysia and Hong Kong, India witnessed an impressive growth in the information sector during this period.

The growth of the information sector was induced mainly by exports. All things being equal, this shift has increased the information output by Rs.1167481.63 million or 50%. After the economic reforms of 1991-92, liberalization of external trade, elimination of duties on imports of information technology products, relaxation of controls on both inward and outward investments and foreign exchange and the fiscal measures taken by the Government of India and the individual State Governments specifically for IT and ITES have been major contributory factors for the sector to flourish in India and for the country to be able to acquire a dominant position in offshore services in the world. The major fiscal incentives provided by the Government of India have been for the Export Oriented Units (EOU), Software Technology Parks (STP), and Special Economic Zones (SEZ). THE STPI Scheme is lauded as one of the most effective schemes for the promotion of exports of IT and ITES. The [51 STPI centres](http://www.mit.gov.in/sites/upload_files/dit/files/STPIcenters(2).jpg) that have been set up since inception of the programme have given a major boost to IT and ITES exports. Apart from exemption from customs duty available for capital goods (with a few exemptions) there are also exemptions from service tax, excise duty, and rebate for payment of Central Sales Tax. But the most important incentive available is 100 percent exemption from Income Tax of export profits.

Compared to the export, the contribution of domestic final demand has been relatively low (43%). This situation emerged from the fact that buyers were increasingly recognizing and choosing strong multinational vendors brands in the domestic market that they would prefer to outsource high-end work to. If Indian vendors had no standing in the local market and did not compete for these higher-end (transformation oriented) deals domestically, it would hamper their prospects in pursuing similar deals in the international markets. Mr. Partha Iyengar, Gartner Research Vice President, highlighted that Indian companies tended to buy from global IT providers due to the perceived quality and technological capability of their solutions. Locally developed products, for the most part, were used in tactical low risk projects. Some exceptions did exist, for example, in core banking solutions and telecom, where Indian vendors had been able to hold their own against foreign competition. However, these deals were few and far between. On the current state of the Indian ICT market, Mr. Iyengar said, "the domestic ICT industry has limited choices when it comes to local vendors. This is because 60 per cent of Indian services vendors focus on the export market due to the lucrative margin, except for strategic engagements with government and MNCs”(The Hindu, 2005). Moreover, the explosive growth of software and services in the ICT industry in India as an export industry, with the USA the dominant market, has led both to a substantial ‘brain drain’ of high-level ICT personnel and neglect of the many ICT applications in the domestic market.

As far as changes in the domestic supply ratio were concerned the period encountered greater dependence on imports, although at a very marginal level, instead of substituting imports by domestic production. The change in domestic supply ratio had decreased information output by nearly 1%. If computer industry in India is taken as a representative of the IT sector, it is found that the liberalized trade regime during this period, along with its domestic market orientation, resulted in the emergence of a predominantly kit-assembling industry, heavily dependent upon import of high-tech products and components. According to Bureau of Industrial Costs and Prices (BICP) analysis, even those components that are domestically produced has an in-built import bias in the form of raw materials such as silicon, germanium, electronic grade chemicals etc. to the extent of 35% of their prices. Three major reasons behind the increased dependence on imports can be noted. First, the cost of information goods and services that were domestically produced was very high compared with those imported. Hence, demand for import of information goods increased. Second, the requirement of information output for various sectors of the economy was largely guided by the advice of their technical collaborators or joint venture partners. As a result, domestic output of information goods and services remained low, but at the same time, substantial imports took place. Third, the government was of the optimistic view that liberalization of imports and reduction in tariffs would enhance access to advanced technological platform and to the productive tools needed for an internationally competitive IT industry and for diffusing IT throughout the economy.

Production technology changes have acted as a boosting factor for the increase in the information output associated with final demand shifts. Compared with the information output requirements of using 1993-94 production technology to satisfy 2003-04 final demand, the adoption of 2003-04 production technology has increased the output of information sector by Rs.176263.20 millions which is nearly 8% of the total change in information output. Almost all the change in information output brought about by change in production technology has come from increased use of information as input. This has been reflected by the fact that direct information input coefficient has increased the information output by Rs.160201.78 millions or nearly 7%. The contribution of non-information portion has been very small (1%). In spite of a generally good uptake of technology since the 1960s, ICT adoption in Indian manufacturing has significantly lagged behind its global peers. India’s spending on ICT is only USD 50 per capita while China spent double that amount during 2006. This has been mainly because adoption of information technology involves huge investment and also alterations in production routines. Also, the policy environment during this period, however, does not have specific focus on ICT and does not provide for an incentivizing framework to the MSME firms to increase their ICT usage levels. The MSME firms had to confront number of challenges, like internet connectivity, power supply, ICT financing to improve the ICT usage. While there has been progress, India has been falling short of the broadband connectivity targets, both qualitatively and quantitatively. Some of the low-cost solutions enabled by technologies such as remote hosting and software as a service, which can scale up ICT penetration amongst the MSME segment, require higher bandwidth and reliable connectivity to the internet. Lack of broadband connectivity reduces the technology choices available to the user firms and also inhibits technology providers to scale up their offerings. So far power supply is concerned, States which are power deficient tend to have a lower ICT adoption amongst the firms located there, as it increases the investment in infrastructure such as power backup and storage that is required to deploy IT solutions reliably. In case of ICT financing too, the current credit linked capital subsidy (CLCS) monitored and implemented by SIDO covers only capital investments and does not specify investments for ICT solutions.

The domestic final demand effect can be viewed from two different dimensions:

1. the effect of growth of domestic final demand for information output and the effect of mix (i.e. spending pattern of final users)
2. the sources of domestic final demand such as private final consumption expenditure (PFCE), government final consumption expenditure (GFCE), gross fixed capital formation (GFCF) and change in stock (CIS).

The two dimensions intercepted one another and were different aspects of the same domestic final demand shifts. However, each provided a unique insight into the relationship between domestic final demand and information output in the Indian economy.

Almost all the increase in information output resulting from domestic final demand shift has come from the changes in spending mix of the individual demand sectors, which has caused India’s information output to increase by Rs.730246.43 millions or 31%. The growth in domestic final demand for information output has led to an additional Rs.268578.22 millions or 12% growth in information output.

**Table 3. Sources of Growth of Domestic Final Demand for Information Sectors of India During 1993-94 to 2003-04**

Rs. Millions

|  |  |  |  |
| --- | --- | --- | --- |
|  | Mix Effect | Growth Effect | Total |
| Domestic Final Demand | 694761.52  (29.96) | 304063.12  (13.11) | 998824.64  (43.07) |
| PFCE Effect | 226484.07  (9.77) | 127801.37  (5.51) | 369538.27  (15.28) |
| GFCE Effect | 45716.00  (1.97) | 70969.82  (3.06) | 116685.81  (5.03) |
| GFCF Effect | 353860.62  (15.26) | 113130.39  (4.88) | 466991.01  (20.14) |
| CIS Effect | 68700.84  (2.96) | -7838.45  (-0.34) | 60862.39  (2.62) |

\* Figures in the bracket show percentage contribution to the total change in output

Table 3 shows the relative contribution of various sources of domestic final demand. The joint expansion of the PFCE, GFCE and GFCF has been the main force behind the increase in information output associated with domestic final demand shift. While PFCE and GFCE have contributed 15% and 5% respectively, GFCF alone has contributed 20%. Thus, both consumption expenditure and investment expenditure have been the driving forces for domestic final demand expansion of information output. Contribution of the investment expenditure towards increased information output is mainly due to the Government of India’s liberalization and economic reforms programme. The new policies have made governmental procedures transparent, eliminated licensing in almost all sectors, provide encouragement to entrepreneurship through market friendly systems and facilitate easy access to foreign technology and foreign direct investment. In line with its mission of formulating a transparent investor friendly environment, the Government has done away with the complex pre-entry approvals. Approvals for all foreign direct investment proposals relating to the electronics and information technology hardware manufacturing, software development and ITeS Sector, with the exception of Business-to-consumer (B2C) e-commerce are under the automatic route.

The IT sector growth has been driven largely by the private sector on both the supply and demand sides, though government support in terms of IT infrastructure investments, duty free access to hardware for software exporters and zero taxation of export profits played a role. The private sector has accounted for a dominant and rising share of domestic IT spending since 1995-96 and contributed as much as 73 per cent of the total in 2001-02 as compared to 15 per cent and 12 per cent by the government and public sectors respectively.

So far as government expenditure is concerned, the Indian experience in e-governance can broadly be divided into two-main phases: the first phase from the late 1960s/ early 70s to the late 1990s, and the second from the late 1990s onwards. In the first phase, efforts to develop e-government were concentrated on the use of IT for in-house government applications with a principal focus on central government requirements such as defence, research, economic monitoring and planning, and certain data intensive functions related to elections, conducting of national census and tax administration. During this first phase, the introduction of IT in the public sector did not result in the automation of many key departmental activities. In the second phase, the implementation of the national IT Task Force and State Government IT policies symbolized a paradigm shift in e-governance policies towards using IT for a wider range of sectoral applications reaching out to a larger number of people in rural as well as urban areas. Moreover, there has been a movement towards a greater input of NGOs and private sector organizations in providing services to the public. The combined impact of the two phases resulted in a moderate contribution of government expenditure towards increase in information output.

For three of the four sources, the mix effect has been stronger than the growth effect. It has maximum impact on GFCF (15%) followed by PFCE (10%). But for GFCE, the growth effect has been marginally stronger than mix effect. While the contribution of the former was 3%, that of the latter was only 2%.

Our next step is to find out which of the information sectors has contributed most in the growth of total information output. For that purpose we have kept the information sector in the disaggregated form. The four information sectors are computer and related activities (31), communication equipment (32), electronics equipment (33), and communication (34).

**Table 4. Sources of Output Growth for Individual Information Sectors of India During 1993-94 to 2003-04**

Rs. Millions

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Computer & Allied Activities | Comm. Equipment. | Electronics Equipment | Communication | Total |
| Dom.Final Dd. Eff. | 306479.16 (13.22) | 290386.36 (12.52) | 202395.45 (8.73) | 199563.66  (8.60) | 998824.64  (43.07) |
| Mix Eff. | 247653.86 (10.68) | 234509.94 (10.11) | 57089.02 (2.46) | 155508.71  (6.71) | 694761.52 (29.96) |
| Growth Effect | 58825.31 (2.54) | 55876.43 (2.41) | 145306.43 (6.27) | 44054.96  (1.90) | 304063.12 (13.11) |
| Export Effect | 1057930.30  (45.62) | 55641.90 (2.40) | 49987.62 (2.16) | 3921.81  (0.17) | 1167481.63  (50.34) |
| Import Subs. Effect | -3769.56  (-0.16) | -343.19  (-0.01) | -19433.32  (-0.84) | 146.32  (0.01) | -23399.75 (-1.01) |
| Tech. Coeff. Effect | 47542.98 (2.05) | 33059.85 (1.43) | 70149.51 (3.02) | 25510.87  (1.10) | 176263.20 (7.60) |
| Inf.Input Coeff. | 45398.66 (1.96) | 28800.23 (1.24) | 60516.12 (2.61) | 25486.76  (1.10) | 160201.78 (6.91) |
| Non Inf. Input Coeff. | 2144.32 (0.09) | 4259.62 (0.18) | 9633.38 (0.42) | 24.10  (0.00) | 16061.42 (0.69) |
| Total | 1435992.10 (61.92) | 378744.92 (16.33) | 3741149.88  (16.13) | 130282.83  (5.62) | 2319169.72 (100) |

\* Figures in the bracket show percentage contribution to the total change in output

Table 4 divides the information output changes into changes in output of four information sectors. Domestic final demand expansion has been most effective in computer and related activities (13%) and communication equipment (13%), followed by electronics equipment (9%) and communication (9%). For the three information sector, computer and related activities, communication equipment, and electronics equipment, the domestic final demand mix effect has been more powerful than the growth effect. The growth effect has been dominant only for the communication sector.

Export effect, as evident from Table 4, has its maximum impact on computer and related activities. Nearly 91% of the total export effect has been generated from this sector. The reason behind this is quite simple. This sector includes computer hardware as well as software. The rise of the IT software and services industry (the software industry) in the 1990s represents one of the most spectacular achievements for the Indian economy. This sector is highly export oriented and has established India as an exporter of knowledge intensive services in the world. India’s success in the software sector can largely be attributed to the industry’s knowledge and expertise of cutting edge technologies. The main resource that has attracted the industry to the country is the pool of trained manpower generated through investments in human resource development over decades. During 1990s and early 2000 exports were boosted mainly by solutions for Y2K. Till mid-1999, Indian companies had provided Y2K solution to many leading multi-nationals, resulting in cumulative export revenues of $2 billion from 1996 to 1999. However, the loss of Y2K problems is not expected to affect exports in future as the country's expertise in the area has helped win new accounts.

So far changes in domestic supply ratio is concerned it has a mixed impact on various information sectors. While import substitution, though in small degree, has been possible only in communication sector, greater dependence on imports has been reflected in computer and related activities, electronics equipment, and communication equipment. It is quite interesting that although the magnitude of exports of software from India has grown rapidly over the period, computer and related activities still depends on import. The general perception is that these exports comprise low value services. In the early years, the bulk of the software export activity of Indian enterprises consisted in lending their software professionals to their clients to deliver their services ‘on-site’. It was considered to be a rather low level of skill intensity compared to software product designing and development. Therefore, the Indian firms, instead of using domestic software, depended on MNCs for import of high-end consulting and expertise and import of packaged software.

The technological coefficient change though did not have impressive effect still had its presence felt in sectors like communication equipment (3%) and in computer and related activities (2%).

**Table 5. Sources of Growth of Domestic Final Demand for Individual Information Sectors of India During 1993-94 to 2003-04**

Rs. Millions

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Computer & Allied Activities | Communi-cation Equip. | Electronic Equip. | Communi-cation | Total |
| Domestic Final Demand Effect | 306479.16 (13.22) | 290386.36 (12.52) | 202395.45 (08.73) | 199563.66 (08.60) | 998824.64 (43.07) |
| PFCE Effect | 50553.37 (2.18) | 34770.91 (1.50) | 106962.19 (4.61) | 161998.97 (6.99) | 369538.27 (15.28) |
| GFCE Effect | 36434.44  (1.57) | 26143.35 (1.13) | 17222.62 (0.74) | 36885.41 (1.59) | 116685.81 (5.03) |
| GFCF Effect | 209665.97 (9.04) | 209678.86 (9.04) | 46998.21 (2.03) | 647.98 (0.03) | 466991.01 (20.14) |
| CIS Effect | 9825.39 (0.42) | 19793.25 (0.85) | 31212.44 (1.35) | 31.31 (0.00) | 60862.39  (2.62) |

\* Figures in the bracket show percentage contribution to the total change in output

Table 5 shows the contribution of different categories of domestic final demand for four individual information sectors. PFCE has contributed more towards the growth of output of sectors viz. electronics equipment and communication service and GFCF has its maximum contribution in the computer and related activities (9%) and communication equipment (9%).

**5. Conclusion**

The growing importance of the IT industry both in India and abroad has aroused interest in IT in almost all spheres of the economy. Though a good volume of literature has developed in recent years which has dealt with IT, not many studies in India can be traced till date that addresses the sources of growth of information sectors at a disaggregated level. The present study is directed towards this end.

Since the mid-1980s, and especially since 1991, Indian economic policy has become more liberal, with the easing of numerous regulatory constraints on industry. One feature of economic liberalization in India is the active promotion of ICT based industrialization by policy makers. During the period 1993-94 to 2003-04, we have seen that the information sector has emerged as an important sector in the Indian economy.

This growth of the information sector has been mainly induced by export expansion. The increase in exports has come mainly through the computer and related activities sector which includes computer software also. Domestic final demand has also aggravated the growth of information sector during this period. Its size has been, however, smaller than export effect because of the fact that most of the government policies have been directed towards software exports. Though technological coefficient changes have a positive effect on the growth of information sector, its size have been much less than the above two effects. Liberalized policies adopted by the government during this period have led to increased dependence on imports.

In this regard, Gartner, a leading provider of research and analysis on the global IT industry, warned that if Indian service providers continued to pursue the export market at the expense of the local market opportunity, it would have a detrimental long-term impact on the growth of the overall ICT exports business Also revealed from our earlier study (Roy and Chakraborty, 2012) the pace of informatization in the non-information sector of the Indian economy has been slow. Issues like limited exposure to ICT, less IT spending, high cost of domestic ICT solutions, lack of reliable infrastructure, lack of qualified ICT service providers and poor internal IT expertise, have contributed towards a low diffusion rate which is much below the global figure.

Therefore, to make the Indian information sector better placed in the globe much remains to be done. Not only the export market but the domestic market too has to be taken care of. To achieve this, both supply and demand side interventions are to be executed through collaboration between the ecosystem stakeholders – IT firms, manufacturing firms, government, financial institutions and academia. Ranging from internal skills, process maturity, organizational structures, manufacturing ﬁrms have to undertake systematic efforts to improve their readiness to absorb ICT applications. Given the high initial cost of ICT solutions and the MSME management’s uncertainty about Return of Investment (ROI) of ICT investments, there is a need to provide access to ﬁnance for incentivizing ICT adoption and for technology ﬁrms to identify innovative approaches to increase affordability of IT solutions. Easy availability coupled with improved access to ICT solutions will help MSME ﬁrms arrive at a ‘best-ﬁt solution for their business needs. Firms will ﬁnd it difficult to derive value from ICT investments unless their core business processes are optimally ICT enabled. A signiﬁcant majority of ﬁrms only possess a rudimentary knowledge of basic ICT application and hence, do not appreciate the transformational potential of ICT. Awareness among the users has to be aroused since a strong correlation exists between increased awareness of ICT solutions & beneﬁts and high ICT adoption levels. Nasscom [2010] has rightly noted that improving IT adoption in the Indian economy will require a systematic and collaborative approach across five dimensions: Readiness, Affordability, Availability, Usage and Awareness.

**References**

|  |
| --- |
| **Albala-Bertrand, J. M.** [1999] Structural change in Chile: 1960-90, *Economic Systems Research*, Vol. 11, No. 3, pp.301-319. |
| **Alcala, R., Antille, G. & Fontela, E**. [1999] Technical change in the private consumption converter, *Economic Systems Research*, Vol. 11, No. 4, pp.389-400. |

**Athey, S. and Stern, S. (2002),** ‘The Impact Of Information Technology On Emergency Health Care Outcomes’, *RAND Journal of Economics* 33, 399-432.

**Baily, M.H. and Lawrence, R.Z. (2001)** ‘Do We Have A New E-Conomy?’, *American Economic Review* 91, 308-312.

**Barua, A. and Mukhopadhyay, T. (2000),** ‘Information Technology And Business Performance: Past, Present, And Future’, in R.W. Zmud (ed.), *Framing the Domains of IT Management*, Pinnaflex, Cincinatti, 65-84.

**Bayes, A., Braun, J.V. and Akhter, R. (1999),** ‘Village Pay Phones And Poverty Reduction: Insights From A Grameen Bank Initiatives In Bangladesh’, in *Discussion Paper on Development Policy* 8, ZEF, Univesitat Bonn.

**Brynjolfsson, E.and Hitt, L.M. (2003),** ‘Computing Productivity: Firm-Level Evidence’, *Review of Economics and Statistics* 85, 793-808.

**Castells, M. (2004)**, ‘Informationlism, Networks And The Network Society: A Theoretical Blueprint’, *The Network Society: A Cross-Cultural Perspective*, Edward Elgar, Cheltenham, UK; Northampton, MA, USA.

**Central Statistical Organization (CSO),** Government of India (2001) *Input-Output Transaction tables 1993-94*.

**Central Statistical Organization (CSO),** Government of India (2010) *Input-Output Transaction tables 2003-04.*

**Chandrasekhar, C.P. (2006)**, ‘The Political Economy of IT-Driven Outsourcing’, in G. Parayil (ed.), *Political Economy and Information Capitalism in India: Digital Divide, Development and Equity*, Palgrave Macmillan, New York.

**De Haan, M.** [2001] A structural decomposition analysis of pollution, in the Netherlands, *Economic Systems Research*, Vol. 13, No. 2, pp.181-196.

**Department of Electronics, Government of India** (Various issues) *Electronics Information & Planning*.

|  |
| --- |
| **Dietzenbacher, E. & Los, B.** [2000] Structural decomposition analyses with dependent determinants, *Economic Systems Research*, Vol. 12, No. 4, pp.497-511. |
| **Drejer, I.** [2000] Comparing patterns of industrial interdependence in national systems of innovation – A study of Germany, the UK, Japan and the United States, *Economic Systems Research,* Vol. 12, No. 3, pp.377-400.  **During, A. & Schnabl, H.** [2000] Imputed interindustry technology flows – A comparative SMFA analysis, *Economic Systems Research*, 12, pp.363-376.  **Jacobsen, H.K.** (2000), ‘Energy Demand, structural Change and Trade: A Decomposition Analysis of the Danish Manufacturing Industry, *Economic Systems Research*, Vol. 12, pp.259-270. |

**Jorgenson, D. and Stiroh, K. (2000),** ‘Raising The Speed Limit: U.S. Economic Growth In The Information Age’, *Brookings Papers on Economic Activity*, 125-211.

**Joseph, K.J. and Harilal, K.N. (2001)**, ‘Structure And Growth Of India’s IT Exports: Implication Of An Export–Oriented Growth Strategy’, *Economic and Political Weekly*, Vol. 36, No. 34, pp. 3263 – 3270.

**Khosla, B. (2008), ‘**ICT and the Indian SME’, Issue: *India 2008*, Art. No. 3, *http://www.connect\_world.com/index.php/magazine/india/item/765-ict-and-the-indian-sme*

**Kraemer, K.L. and Dedrick, J. (2001)**, ‘Information Technology And Economic Development: Results And Policy Implications Of Cross – Country Studies’, in M. Pohojola (ed.), *Information Technology, Productivity, and Economic Growt*h, Oxford Publications.

**Kumar, N and Joseph K.J. (2005)**, “Export of Software and Business Process Outsourcing from Developing Countries from the Indian Experience”, *Asia Pacific Trade and Investment Review,* 1(1).

**Leontief, W. [1951]**, *The Structure of American Economy 1919-1939,* (New York, Oxford University Press, second edition).

**Marshall, S. and Taylor, W. (2006)**, ‘ICT For Education And Training’, in *International Journal of Education and Development Using Information and Communication Technology*, Vol. 2, Issue 4, Nov-Dec.

**Mukherjee, R. (2006)**, ‘Regulatory evolution in Indian telecommunication’, in *ISAS Working Paper*, No.6, Institute of South Asia Studies, Singapore.

**Mukhopadhyay, K. and Chakraborty, D.** [1999] India’s energy consumption changes during 1973-74 to 1991-92, *Economic Systems Research*, Vol. 11, No. 4, pp.423-438.

**Mukhopadhyay, T. and Kekre, S. (2002),** ‘Strategic And Operational Benefits Of Electronic Integration In B2B Procurement Processes’, *Management Science* 48, 1301-1313.

**Mukhopadhyay, T., Kekre, S. and Kalathur, S. (1995)**, ‘Business Value Of Information Techology: A Study Of Electronic Data Interchange’, *MIS Quarterly* 19, 137-156.

**NASSCOM (2010),** ‘A Roadmap To Enhance ICT Adoption In The Indian Manufacturing Sector’, in *www.nasscom.in/upload/66721/Executive\_Summary.pdf*

**Oliner, S. D. and. Sichel, D.E (2000)**, ‘The Resurgence Of Growth In The Late 1990s: Is Information Technology The Story?’ *Journal of Economic Perspectives* 14, 3-22.

**Parayil, G. (2006)**, ‘Introduction: Information Capitalism’, in G. Parayil (ed.), *Political Economy and Information Capitalism in India: Digital Divide, Development and Equity*, Palgrave Macmillan, New York.

**Pohojola, M. (2001)**, ‘Information Technology And Economic Growth: A Cross-Country Analysis’, in M. Pohojola (ed.), *Information Technology, Productivity and Economic Growth: International Evidence and Implications for Economic Development*, OUP.

**Rose, A and Casler, S. (1996),** ‘Input-output Structural Decomposition Analysis: A Critical Appraisal, *Economic Systems Research*, Vol. 8, pp.33-62.

**Roy, S. (2002),** ‘A Study On Information Economy Of India’, *Ph.D dissertation, Jadavpur University, Calcutta*.

**Roy, S. and Chakraborty, D. (2012) ‘**A Causative Matrix Analysis of the Information Sector of the Indian Economy’- Paper presented in the 16th International Conference of IORA India, held at Gokhale Institute of Politics and Economics, Pune -411 004, 6-8 March, 2012.

**Roy, S., Das, T. and Chakraborty, D. (2000)**, ‘Informatization Strategy For The Indian Economy: Linkage Analysis’, *Artha Vijnana*, Vol. XLII, No. 3, September, pp. 216-227.

**Roy, S., Das, T. and Chakraborty, D. (2002)**, ‘A Study On The Indian Information Sector: An Experiment With Input-Output Techniques’, *Economic Systems Research*, Vol. 14, No. 2, pp. 107-129.

**Shishido, S., Nobukuni, M., Kawamura, K., Akita, T. and Furukawa, S.** [2000] An international comparison of Leontief input-output coefficients and its application to structural growth patterns, *Economic Systems Research*, Vol. 12, No. 1, pp.45-64.

**Singh, N. (2003)**, ‘Information Technology As An Engine Of Broad – Based Growth In India’, in F.J. Richter and P. Banerjee (ed.), *The Knowledge Economy in India*.

**Sobhan, F., Khaleque, M.M, Rahman, S. (2002)**, (Case study) ‘Factors Shaping Successful Public Private Partnerships In The ICT Sector In Bangladesh, Bangladesh Enterprise Institute (BEI), *A joint project of: The Commonwealth Policy Studies Unit (CPSU) –University of London, The Commonwealth Telecommunications Organization (CTO), Information, and Society Development*.

**Srinivasan, K., Kekre, S. and Mukhopadhyay, T. (1994)**, ‘Impact Of Electronic Data Interchange Technology On JIT Shipments’, *Management Science* 40, 1291-1304.

**The Hindu (2005)**, ‘Opportunity lies in ICT domestic market', [*http://www.hindu.com/2005/08/30/stories/2005083006221700.htm*](http://www.hindu.com/2005/08/30/stories/2005083006221700.htm).

**UNCTAD (2003),** ‘E-Commerce and Development Report 2003’, in *http://www.unctad.org/en/docs/ecdr2003\_en.pdf*

\*\*\*\*\*

**Appendix A**

|  |  |  |
| --- | --- | --- |
| Sectors | Industry No. | Industry |
| Non-Information | 1 | Agriculture |
|  | 2 | Animal Husbandry |
|  | 3 | Forestry & Fishing |
|  | 4 | Coal & Lignite |
|  | 5 | Crude Petroleum & N. Gas |
|  | 6 | Minerals |
|  | 7 | Processed Food |
|  | 8 | Beverages & Tobacco |
|  | 9 | Textiles |
|  | 10 | Wood & Wood Products |
|  | 11 | Leather & Leather Products |
|  | 12 | Rubber & Plastic Products |
|  | 13 | Petroleum Products |
|  | 14 | Coal Tar Products |
|  | 15 | Chemicals |
|  | 16 | Non Metallic Products |
|  | 17 | Metals & Metal Products |
|  | 18 | Non Electrical Machines |
|  | 19 | Electrical Machines |
|  | 20 | Transport Equipment |
|  | 21 | Miscellaneous Manufacturing |
|  | 22 | Construction |
|  | 23 | Electricity |
|  | 24 | Gas & Water Supply |
|  | 25 | Transport Services |
|  | 26 | Banking & Insurance |
|  | 27 | Medical & Health |
|  | 28 | Other Services |
|  | 29 | Paper & Paper Products |
|  | 30 | Printing & Publishing |
|  | 35 | Education & Research |
| Information | 31 | Computer & Allied Activities |
|  | 32 | Communication Equipment |
|  | 33 | Electronics Equipment |
|  | 34 | Communication |