International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

The Impact of New Technology (ICT) on Employment: A Model on Organized Sector in India

(Dr. Pawan Kumar)

Assistant Professor, Ramjas College
University of Delhi, Delhi-110007
Email: pawaneco1604@gmail.com

(Abstract)

The relationship between technology and employment is long been debated. The recent debate revolves in context of the Information and Communication Technology (ICT), which in turn is perceived as GPT (general-purpose technology) like steam engines or electricity in the past ushered the world into a new techno-economic paradigm. Overtime, ICT investment as a percentage of non-ICT investment (known as ICT intensity) increased significantly across sectors. How increase in ICT intensity has affected employment is the larger question taken up in the paper. Towards answer, on the basis of ICT intensity, industries belonging to the organized sector are categorized into ICT-producing (ICTPS), ICT-using (ICTUS) and non-ICT-using (NICTUS) sectors, with their further division into the manufacturing and the services sector. Empirically, it is found that only the ICTPS witnessed high employment elasticity (EE) with increased ICT intensity since 2000, something found true in both of its segments manufacturing and services sectors, and in both periods Period I (2000–2005) and Period II (2005–2010). In contrast, in ICTUS, EE declined with increased ICT intensity. The trend was found true in both of its constituents. Finally, within NICTUS, in both periods, in both sectors, employment elasticity increased with ICT intensity. In conclusion, for the country as a whole, EE has increased, driven by the services sector, with increased ICT intensity. In sum, ICT has resulted in a positive employment impact in the services sector, but not in secondary sectors.

International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

Introduction

The relationship between new technology and employment is complex and controversial. In the past two decades, ICT (Information and Communications Technology) as new technology has leaped a long way in India. With a growth rate of over 25 percent since 2006, ICT sector has grown in scale and is increasingly becoming a major source of employment. After the technological waves of *steam engine* in the 19th century and *electricity* in the 20th century, ICT is the only technology being regarded as general purpose technology (GPT).

Till late 1970s, countries, particularly OECD members, were apprehensive in using ICTs, because a relatively higher investment made in ICT did not lead to a commensurate rise in employment and productivity growth rates, a notion later known as *productivity paradox*-that computers are seen everywhere except in productivity statistics-a concept introduced and popularized by Solow (Soete, 1987). The perception changed over time. In the 1990s empirical studies by referring to case studies of the U.S. and some EU countries established the positive and significant linkages between ICT, productivity and employment. This in turn gave rise to yet another debate; why productivity (TFP) and employment growth rates in the U.S. increased faster than in the EU. The debate got somewhat resolved towards the mid 2000s, a general consensus emerged that it is the *ICT producing industries* (particularly the services sector) that triggered productivity and employment growth in the U.S. post-1995; something found missing in the EU (Vivarelli, 2011). In other words, the EU countries did not seem to have exploited the productivity enhancing potential of the ICT-producing industries to the extent possible. These results marked a major departure with the earlier studies that doubted the productivity growth potential of the services sectors (Gordon, 2000).

Three channels are identified through which ICT influences growth; surge in ICT investment, strong productivity effects from ICT-producing industries and spillover impacts in the ICT using sectors of the economy (Vivarelli and Pianta, 2000). Though the ICT spillovers are typically difficult to measure at industry level but at firm-level they are found to be present.

International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

In India, the success story of ICT growth began gradually since the early 2000s, it accelerated after 2005. It has become a major source of foreign exchange earning through foreign investment (FDI and FIIs) and export of ITES (IT enabled services). According to NASSCOM (2012), in 2008-09, the sector grew by 14 percent to reach $ 71.7 billion in aggregate revenue (including hardware). Of this, the software and services segment accounted for a major chunk ($ 59.6 billion). In the same year, the total ICT revenue reached 5.8 percent of GDP compared to 1.2 percent in 1997-98. Despite some slowdown, the Indian IT sector has successfully weathered the global financial crisis which started in 2007.

As far as the developing countries (including, India) are concerned, not much research has been done on association between ICT, productivity and employment (Freeman and Soete, 1987 and Vivarelli, 2011). Success stories of the newly industrialized countries (NICs) like, South Korea, Philippines, Indonesia, Malaysia, etc. are often cited as examples of the vital contribution of ICT in growth and development (OECD, 2010). In India, some reports by NASSCOM and Planning Commission and some other anecdotal studies exist but they often deal with the general socio-economic implications of ICT, like its impact on environment, women empowerment, rural development, skill, etc. In this Chapter, an attempt is made to quantify the link between ICT intensity and employment growth in India.

As defined in Chapter 05, ICT and its classification, industries in India also divided into three groups, ICT producing (ICTPS), ICT using (ICTUS) and non-ICT using industries (NICTUS), with the additional sub-division into secondary and tertiary sectors.

The chapter is structured as follows. It starts with the review of literature and the issues emerging out of it. Thereafter, the objective of the study; the trends in output and employment rates, employment elasticity and the ICT intensity are discussed. It is followed by a model, which attempts to establish a link between employment, output, wage rate and technological change with regard to ICT in India. And, finally in the last section, sources of the results and their plausible explanations are discussed.

International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

1. ICT and Employment: a Review of Literature

Theoretically, there is no direct or well defined link between technology and employment. The contradictory nature of the employment impact of new technology also arises due to different assumptions made about the output growth rate, demand, different level of aggregation (sector or industry) and the inclusion and exclusion of indirect or the multiplier effects (Bhalla, 1997 and Kumar, 2005). It also depends how technology is treated, i.e. whether disembodied or embodied. The former is proxied by MFP and the latter is vested in the factors of production. In neo classical economics, technical change is captured by MFP.

Empirically, the views on the relationship between the two are broadly categorized as optimistic and pessimistic. The former, based on the *compensation theory*, believe that technical change through various *compensation mechanisms* always results in positive employment impact, at least, in the long run (Vivarelli, 2011). For instance, during the 1960-2000 many OECD countries, particularly the U.S. experienced increased employment growth with enhanced MFP (Multi-factor productivity) growth or technical change (Stiroh, 2002 and Vivarelli, 2011). The pessimistic view, on the other hand, though in principle believe in the *compensation theory* but rule out the complete counter balance of the labour saving impact of technical change. There is an apprehension that the present forms of technological changes have weakened or eliminated the positive correlation between growth, productivity and employment which has been one of the main characteristics of the post World War II period known as 'golden age' (Rifkin, 1995). Many countries, developed or developing, have been experiencing structural unemployment or this weakening relationship (Vivarelli and Pianta, 2000)[1].

In last two decades, ICT has emerged in a big way the world over including in India. It, accepted as general purpose technology (GPT), has resulted into a new *techno-economic paradigm*. However, its influence on productivity or employment varies across firms, industries and countries. In this regard, the pioneering hypothesis was put forward by that Freeman, Clark and Soete (1982), it concluded that ICT is not only good for productivity but

[1].

International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

even also for employment, and structural unemployment in E.U. during the 1970s was largely due to socio-institutional mismatch and not because of new technology.

Many empirical evidences in context of the ICT also found it impact on employment to be positive. The former, based on the *'compensation mechanisms* via increase in investment, decline in prices, decline in wage rate, etc., believes that technological change is positively associated with employment, and it results in full employment at least in the long run (Freeman and Soete, 1987; Nickell and Bell, 1994; Vivarelli and Pianta, 2000; Edquist et. al., 2001 and Vivarelli, 2011). Tomas and Diaz (2002) studied the effect of technological innovation on the quality and quantity of employment in Spain for the period of 1980-1990. It is found that technological change led to an increase in the number of technicians in 1990 compared to the 1980. Matteucci and Sterlachini (2003), in their experimental study showed the positive relation between rate of investment on ICT and increasing rate of employing at the end of 1990s. Using comprehensive equation of 173 industries, they further concluded that the recent development in US with respect to employment and productivity level of labor force got a close relationship with ICT investment rate. OECD (2010) defined many ways through which ICT affects employment growth, classified as direct and indirect. Harrison, et. al. (2006) investigated the effect of ICT on employment growth in a number of OECD counties; they concluded that during 1998-00, ICT results in direct and positive employment impact, and it also resulted in positive indirect employment impact following *compensation mechanism*.

Most micro level empirical studies found the employment impact of ICT to be positive in firms producing ICT goods or services (O' Mahony, M. and Bart Van Ark. 2003 and Vivarelli, 2011). There is, however, a problem that these results can not be generalized at industry or macro level (Oliner and Sichel, 2000 and Vivarelli, 2011). In other words, study at industry or country level shows mixed results (Jorgensons, 2001 and Bart Van Arc, 2006).

Further, empirical studies also made distinction between product and process innovations, i.e. the way technology is used. For instance, technology is seen as a job killer when applied as process innovation, and a job creator when used as product innovation

International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

(Schmidt, 1983; Pissarides and Vallanti, 2003). When measuring the employment impact of ICT, it is used as product innovation in the ICT producing sectors and as process innovation in ICT using sectors (OECD, 2010). In the former, its employment impact is direct and immediate, i.e., more is the output growth more is the employment; and in the latter it is indirect and often emerge in the long run. The net employment impact is, therefore, positive or negative depends on the relative sizes of these two effects. Empirical studies conducted on many OECD countries, particularly the U.S. and the E.U. concluded that in the former the ICT producing sector is stronger both in terms of MFP and employment growth.

In India, contribution of ICT in GDP and employment is well documented (NASSCOM, 2012). Nevertheless, there are apprehensions it has resulted in negative employment in sectors using it. In other words, unemployment, which is one of the most daunting problems India is facing, got further accentuated with ICT use.

2. The Issues Emerging Out of the Review of Literature

i. Most studies on the relationship between ICT and employment at the aggregated level deal with the developed countries only; studies regarding the developing countries, including India have not been done. Hence, this needs to be done for India.

ii. Empirical studies of the advanced countries available give mixed results not only at firm level, but also at industry or country levels. It is, therefore, difficult to reach a consensus that can be used or replicated for countries, like, India.

iii. Indian economy in the past two decades, particularly, since the beginning of early 2000s, has experienced two unusual situations; one, employment elasticity (EE) has declined in most of the sectors including agriculture since 1994, and two, it is accompanied by widespread development and diffusion of new technology in the form of ICT since early 2000s. It is, therefore, pertinent to empirically test the relationship between ICT and employment in India.

iv. In India, some reports such as from NASSCOM or Planning Commission though exist but they often deal with the direct employment impact or general socio-economic implications of ICT, like, its impact on rural development, women empowerment,

International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

environment, skill, etc. No attempt yet been made to quantify the employment impacts of ICT in the firms or industries using ICT products.

3. Output Growth, Employment Growth, Employment Elasticity (EE) and ICT Intensity in India: a Group Level Analysis

In this section an attempt is made to analyze the behavior of output growth rate, employment growth rate, employment elasticity (EE) and ICT intensity of the groups identified as ICTPS, ICTUS and NICTUS. The total period (2000-10) is divided into two sub-periods Period I (2000-2005) and Period II (2005-10). The analysis is made first at the aggregated and then at the disaggregated level i.e. at group level. *Employment and output growth rates are taken to be compound annual growth rates (CAGR).*

As shown in Table 1, the Indian economy at the aggregated level registered an impressive output growth rate of 12 percent since 2000, and 10 percent and 13 percent in Period I and Period II respectively. Similarly, employment growth rate has accelerated from 3 percent in Period I to around 4 percent in Period II. As a result, EE increased from 0.25 to 0.29. What led this to happen, and to what extent is the increase attributed to new technology proxied by ICT intensity, which has gone up remarkably from 2 percent in Period I to 8 percent in Period II?. Further, the results at aggregated level may at times be misleading; it is, therefore, imperative to extend the discussion to the disaggregated level, i.e group level.

3.1. ICT Producing Group (ICTPS): Among all, the ICTPS group posted the highest growth rates of employment and output in both periods. For instance, as shown in Table 1, the former, accelerated from 9.5 percent in Period I to13.4 percent in Period II, and the latter, remained at double digit level, i.e., 30 percent and 17 percent respectively in Period I and Period II. It led the EE increased from 0.31 in Period I to 0.75 in Period II. Further, among all groups, the ICTPS recorded the maximum increase in ICT intensity, from 2.2 percent in Period I to 11.6 percent in Period II.

International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

In India, in both sub-groups of ICTPS, i.e., in secondary and tertiary sectors, rising ICT intensity is followed by increased employment growth. For instance, the former recorded output growth rate 16 percent in Period II up from 9 percent in Period I; and employment growth rate 5 percent from 2 percent. Consequently, EE rose from 0.2 to 0.31. This sub-group recorded increased ICT intensity from 3 percent in Period I to 6 percent in Period II. Further, as shown in Table 3, all six industries except industry group 323 (Manufacture of TV and radio receivers and recording or reproducing apparatus) posted accelerated growth rates of output and employment in Period II. The EE within the secondary sub-group, however, shows a mixed trend.

The tertiary ***sub-group*** of ICTPS has witnessed the highest growth rates in output and employment and ICT intensity. For instance, as shown in Table 1, output and employment growth rate are estimated to be 40 percent and 35 percent respectively in Period I though they declined to 19 percent and 22 percent in Period II, but these are still highest among all groups and sub-groups. Though EE declined marginally in Period II but it remained around one. As evident in Table 3, the trend of impressive growth rate is recorded by all its constituent industries, 642 (Telecommunications), 722 and 723 (Software Consultancy and Data Processing).

The results outlined above in the ICTPS supports empirical studies that conclude about the positive employment impact of ICT in the ICT producing sectors in which it is used as product innovation (for detail, see Chapter 02). Further, it also is satisfy the ***compensation mechanism through new products*** *that new technology always brings new employment opportunities if there is no demand deficiency (Vivarelli, 2011).*

3.2. ICT Using Sectors (ICUS): The ICTUS group consists of 39 industries in total, 19 from secondary sector and the rest 20 from services sector. This group has ICT intensity more than that of non ICT group but less than that of the ICT producing group is termed as an *intermediate group*. In the group, growth rates of employment and output are found to be

International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

more than in the NICTUS but less than in the ICTPS. Further, EE is recorded to have declined in Period II. What led this to happen?

In India, the secondary sub-group of ICTUS witnessed more or less the same trend as the group at the aggregated level in output and employment growth rates, and so in EE. As evident in Table 1, EE declined sharply from 0.36 to 0.23. ICT intensity is found to have increased from nearly 2 percent in Period I to 3.3 percent in Period II. Further, most industries in the sub-group secondary sector recoded the same pattern of results as at the sub-group level. In other words, be it publishing (221), re-production of recorded media (223), transport equipment (359), all have recorded lower EE with increased ICT intensity. Reasons for this are the same as mentioned above.

Similarly, the tertiary sub-group of the ICTUS group displayed the same trend as in secondary sub-group, i.e., accelerated output growth rate but lower employment growth rate, and hence resulted into lower EE (from 0.36 in Period I to .26 in Period II). Further, as evident from Table 5, results at the industrial level show a mixed trend in EE, whereas ICT has gone up across all industries.

As discussed above in Section 1, *the ICTUS use ICT as* ***process innovation*** *in the from of CAD/CAM; and most empirical results show that it is negatively associated with employment, at all level of aggregation in many OECD countries (Pianta, 2005 and Brynjolfson, 2004).*

3.3. Non ICT Using Sector (NICTUS): The NICTUS group, which by definition has the least ICT intensity, includes 40 industries in total (30 from secondary and 10 from tertiary). As shown in Table 6.1, both employment and output rates accelerated but EE declined marginally from 0.5 in Period I to 0.4 in Period II. ICT intensity has increased, though from a lower base, and that is why no strong relationship is expected between employment and ICT intensity.

Further, as evident in Table 1, the secondary sub-group of NICTUS witnessed employment and output growth rates changing from 4.14 percent and 7 percent respectively in

International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

Period I to 4.8 percent and 8 percent respectively in Period II. Given this, EE declined from 0.60 to 0.56. ICT intensity is recorded to have gone up. But, as evident in Table 5.6, industries in the secondary sector show a mixed trend of EE.

Similarly, the tertiary sub-group has also recorded a marginal decline in EE in Period II. Contrary to this, industries in the sub-group have portrayed a mixed trend of increase in EE. Interestingly, all industries have experienced increased ICT intensity in Period II.

From the above description, it is clear that ICT intensity has some relationship with employment, but at this stage it is difficult to comment on the nature of this relationship, i.e., what is the net employment impact of ICT intensity at the sectoral level, group level and at the aggregated level. In the next section, an attempt is made to asses this.

4. Impact of New Technology on Employment in India: The Model

In an economy, apart from technology there are a host of factors, like, output growth, wage rate, rent, etc., that directly or indirectly affect employment. In the past two decades, ICT has emerged in a big way the world over including in India and is regarded as GPT (General Purpose technology), like steam or electricity in the past. ICT has entered almost all economic activities be it production, distribution or consumption. In this section, an attempt is made to formulate and quantify the net employment impact of ICT intensity in India.

A regression model is formulated to assess the statistical strength of the relationship between employment and ICT intensity. The study is carried out for industries at 3-digit level. The total time period considered, 2000-10, is divided into two sub-periods, 2000-05 (called as Period I) and 2005-10 (called as Period II). The analysis is first made at group level (i.e. for ICTPS, ICTUS and NICTUS) then at sectoral level (secondary and tertiary sectors, also called as sub-groups) and finally at the aggregated level, i.e., taking all three groups together.

As we know, labour demand equation for any generic industry can be derived from the cost minimization function. Reenen (1997) at firm level and Greenen and Guellec (2001) at industry level applied the same labour demand function to estimate the employment impact of technical change, which in our case is proxied by ICT intensity. In this model, an attempt is

International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

made to estimate the employment impact of ICT intensity at group level, i.e., for ICTPS, ICTUS and NICTUS, in India.

$$C= C(w,r,Y,A), \quad (1)$$

where w, r, Y and A are wage rate, rental price of capital, given output and technology respectively. All the variables are expressed in real terms, with 1993-94 as the base year. It is assumed the underlying production function is Cobb-Douglas. Equation (1) gives the cost of producing a given level of output (Y) can be produced with the minimum cost (C) possible. By applying Shepard Lemma, labour demand function is obtained from equation (1), written as

$$dC/dw,=L= L^d(w,r,Y,A)^2 \quad (2)$$

The function assumes a multiplicative form and can, therefore, be expressed in log linear form (Hamermesh, 1993; Matteucci and Sterlachhini, 2003; Bohachova, et. al., 2011). After assuming 'r' constant across industries and omitting the random error term, the labour demand equation (2) reduces to

$$\Delta lnL=b_0+ b_1\Delta lnY+ b_2\Delta lnw+ b_3\Delta lnA \quad (3)$$

$$\Delta lnL=b_0+ b_1\Delta lnY+ b_2\Delta lnw+b_3\Delta ln (ICT/NICT) \quad (4)$$

In equation (4), technological change (ΔA) is proxied by change in ICT intensity, defined as the ratio of ICT to the non ICT capital formation. Since, ICT is accepted as GTP, therefore, it is reasonable to proxy ΔA by ICT. Moreover, empirical studies show that in advanced countries, an increasing percentage of output growth is attributed to MFP or disembodied technical change (OECD, 2010). Though, the whole change in MFP may not be captured by ICT intensity, but since in the past two decades ICT has been increasingly used among industries as indicated by trend of ICT intensity shown in Table 1. Industries (at 3 digit level) are assumed to experience no labour supply constraint, i.e., whatever labour is demanded is supplied.

Labour input is measured in terms of the number of employees. Since, it covers not only the numbers of workers but also those not directly engaged in production process such as

[2] How the labour demand function is derived, is given in Appendix 6.A

International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

managers or supervisors. Changes in variables are computed by long (five year) rather than annual difference of natural logs, these are 2000-05 and 2005-10. The choice of long rather than annual (or first) difference is justified for the reason that single year observation could be too volatile for providing an appropriate measure of ICT intensity. In fact, firms that make heavy investment in a given year may not necessarily do the same in the next year; this is important particularly in countries, like, India having low ICT intensity base.

5. Results of the Model:

In the model outlined above, a regression is run to know the statistical strength of the relationship between employment as dependent variable and output growth, wage rate and technology as dependent variables. R square measures the goodness of fit. The results are shown in Table A.

Starting with the ICTPS group, the sign and size of output co-efficient, a measure of employment elasticity (EE), shows that in both periods employment growth is positively affected by output growth, after controlling for the other variables. In other words, EE recorded to be 0.41 in Period I increased to 0.79 in Period II. It means, a 100 percent increase in output growth led to a 41 percent increase in employment growth in Period I and 79 percent in Period II. In sharp contrast to this, a negative and significant wage rate co-efficient shows an adverse employment impact of an increase in wage rate, something found true in both periods.

The most important result from our perspective, how technological change has affected employment in India and is captured by ICT intensity variable. It shows, in both periods, growth in ICT intensity has resulted in positive employment impact. In other words, after controlling the other variables, a 100 percent increase in ICT intensity that resulted in 2.1 percent increase in employment growth in Period I increased to 4.0 percent in Period II. The t-values show that the results are statistically significant. To put the results in broader context, it is imperative to extend the discussion at sub-group level within the group.

International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

Results for both secondary and tertiary sub-groups portray the same pattern as at the group level. In the former, the output co-efficient is 0.23 in Period I which increased to 0.3 in Period II. In the latter, it has declined marginally from 1.2 in Period I to 0.9 in Period II. Contrary to this, negative and significant wage rate co-efficient shows negative employment impact of wage rate increase, something found true in both sub-groups and in both periods. As far as the impact of new technology on employment is concerned, again the results are found to be positive and significant in both sub-groups. For instance, in secondary sector, a 100 percent increase in ICT intensity led to 1.1 percent increase in employment growth in Period I and 1.5 percent in Period II; and in services sector 2.1 percent and 5.1 percent respectively. The t-values show that the results are statistically significant.

In the ICTUS group as a whole, the regression co-efficients of output, wage rate and ICT intensity estimated to be 0.26, -0.47 and 0.019 respectively in Period I changed to 0.32, -0.44 and 0.009 respectively Period II. All results have broadly assumed the same behavior as in the ICTPS except the sign and size of ICT intensity co-efficient, which needs special mention. The positive ICT intensity co-efficient means, in Period I, a 100 percent increase in ICT intensity led to nearly 2 percent increase in employment growth, which in Period II declined to nearly 1 percent. However in Period I, the result is not found to be statistically significant.

At the sub-group level (i.e. at secondary and tertiary sector), the ICT intensity co-efficient measured at -0.04 and 0.03 respectively is found to be statistically significant only in Period II. In other words, if ICT intensity is doubled it will result in 4.5 percent decline in employment growth in secondary sector and a 3.1 percent increase in the services sector in Period II.

In the last group, non ICT using sectors (NICTUS), which by definitions includes industries with least ICT intensity, all regression co-efficients are found to have assumed same behavior as in the ICTUS group, except ICT intensity co-efficient, which is not found to be significant at both aggregated and at disaggregated levels.

International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

Table A.: Impact of Output, wage rate and Technology (ICT) on Employment in India during 2000-10

			2000-05		2005-10	
		Variable	Coefficient	t-Statistic	Coefficient	t-Statistic
Total	Aggregated	C	0.02	2.44*	0.03	4.35*
		lny	0.23	13.36*	0.27	4.51*
		lnw	-0.31	2.78*	-0.59	4.08*
		icti	0.0266	1.53	0.0352	1.93**
		R-squared	0.59		0.61	
	Secondary	C	0.04	2.23*	0.02	3.92*
		Lny	0.47	3.98*	0.43	5.26*
		Lnw	-0.22	6.62*	-0.34	3.06*
		Icti	-0.0113	0.69	-0.0207	2.43*
		R-squared	0.72		0.77	
	Services	C	0.01	0.23	0.02	5.92*
		Lny	0.31	13.23*	0.36	9.88*
		Lnw	-0.34	5.39*	-0.26	2.86*
		Icti	0.03947	1.59	0.05236	2.24*
		R-squared	0.62		0.67	
ICTPS	Aggregated	C	0.02	3.44*	0.01	2.35*
		Lny	0.41	33.36*	0.79	24.51*
		Lnw	-0.21	1.78**	-0.19	2.08*
		Icti	0.021	2.67*	0.0398	2.1*
		R-squared	0.64		0.61	
	Secondary	C	0.04	2.23*	0.02	6.92*
		Lny	0.23	1.88**	0.3	3.46*
		Lnw	-0.24	5.62*	-0.14	2.06*
		Icti	0.011	2.69*	0.0149	2.71*
		R-squared	0.72		0.67	
	Services	C	0.01	6.23	0	2.92*
		Lny	1.18	13.23*	0.9	9.88*
		Lnw	-0.34	5.39*	-0.46	2.86*
		Icti	0.0216	2.69*	0.0514	3.24*
		R-squared	0.69		0.67	
ICTUS	Aggregated	C	0.01	5.63*	0.04	5.03*
		Lny	0.26	12*	0.32	9.94*
		Lnw	-0.47	4.02*	-0.44	3.39*
		Icti	0.0193	1.23	0.0094	2.08*
		R-squared	0.62		0.55	
	Secondary	C	0.01	5.36*	0.02	5.39*
		Lny	0.36	9.16*	0.23	9.83*
		Lnw	-0.5	3.78*	-0.34	2.78*
		Icti	-0.0325	0.43	-0.0448	1.9**
		R-squared	0.65		0.67	
	Services	C	0	1.88**	0.02	1.8**
		Lny	0.36	11.35*	0.27	7.64*
		Lnw	-0.16	3.63*	-0.23	2.73*
		Icti	0.0611	2.01*	0.0314	2.65*
		R-squared	0.59		0.61	
NICTUS	Aggregated	C	0.02	3.75*	0.03	4.17*
		Lny	0.47	13.64*	0.36	12.33*
		Lnw	-0.46	2.36*	-0.63	2.87*
		Icti	0.0497	0.71	0.0945	1.21
		R-squared	0.55		0.62	
	Secondary	C	0.03	3.01*	0.02	2.89*
		Lny	0.61	10.41*	0.57	10.68*
		Lnw	-0.55	2.09*	-0.63	2.07*
		Icti	-0.0655	0.53	-0.8913	0.26
		R-squared	0.61		0.62	
	Services	C	0.04	6.06*	0.02	9.91*

International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

		Lny	0.29	6*	0.26	4.33*
		Lnw	-0.43	5.36*	-0.55	2.74*
		Icti	0.056	0.7	0.0903	1.03
		R-squared	0.63		0.59	

Source: Own Computation using the Prowess, CMIE database.

Note: 1.* indicates 5% level of significance and ** 10% level of significance.

2. The Secondary sector is largely constituted by the manufacturing sector.

6. Explanation of the Results

In any economy, technology is not evenly distributed across sectors; some sectors use it more intensively than others (Freeman, 1987 and Kumar, 2005). ICT accepted as GPT has led to a *new techno-economic paradigm*, i.e., no economic activity is going on without its use, be it input cost structure, production or distribution. In the process, it entails many structural adjustments; and it is often believed if the problem of institutional change is overcome, it results into productivity enhancement with increased employment in any growing economy (Gordon, 2000). Further, like any other technology in the past, introduction and development of ICT has led to entirely new range of products (including services) and hence new employment opportunities (O' Mahony, M and Bart Van Ark, 2003).

As mentioned above, the employment impact of ICT depends on the fact how new technology is defined, i.e., product or process innovations. Generally the former, which has direct employment effect, is immediate and generally positive and the latter, which has indirect effect surface only in the long run, whether it is positive or negative is not only sector specific but also country specific (Freeman and Soete, 1987; Oliner and Siechel, 2000).

In the present section, an attempt is made to provide plausible explanations of the factors that led to these results from both theoretical and empirical points of view.

As per the NASSCOM-Crisil Report, 2007, for the Indian economy, one rupee spent by the ITES (IT Enabled Sectors) translates into a total output of Rs.2 in the economy. Also every job created in this sector leads to four new jobs in the rest of the economy. This is the indirect employment effects of ICT in India.

Starting with the ICTPS group, employment growth is found to be positively influenced by ICT intensity since 2000, something found true for both secondary and tertiary sectors. This is the direct employment impact of ICT. It could be ascribed to the following

International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

reasons. **First**, as evident in the *compensation mechanism through new product* that industries producing the high-tech goods (including services) experience high employment growth (Freeman and Soete, 1987, Vivarelli, 2011). Empirically, it is found in the U.S. that origin of productivity and employment gains is largely due to industries producing the ICT equipment such as semi-conductor, computer hardware and telecommunication devices (Stiroh, 2002). The ICTPS secondary sub-group recorded output growth rate, which increased from 9 percent in Period I to 13 percent in Period II, and so the employment growth rate. **Second,** as concluded by many empirical studies such as by Vivarelli, Evangilist and Pianta (1996) and Antonnuci and Pianta (2002) that *product innovation* is positively linked to employment. **Third,** *compensation via decline in prices* of ICT product is strong. As per Moore's Law, the power of semi-conductor gets doubled every 20 months while its price halves, led impressive rise in the demand of ICT product and, therefore, more output growth and employment. **Fourth,** *compensation via increase in income*, led to increased demand of ICT products and therefore more employment. **Fifth,** *compensation via increase in investment* also can also be found operational in ICT. It can be substantiated by the fact the compared to other sectors of the economy; ICT has recorded comparatively high investment growth, given FDI growth in the sector. For instance, over 600 Multinational companies (MNCs) are known to be sourcing their product development and engineering services from their centers in India (GOI, 2007-08). **Sixth,** *compensation via increase in machines*, not only in ICT using industries but also in ICT producing ICT intensity has increased significantly, and since most of the products including software, etc. are produced in the country, it therefore result in high employment growth. **Seventh**, government policies such as by setting up of National Manufacturing Competitiveness Council (NMCC) have greatly helped to sustain IT hardware growth in India. Further, Information Technology (IT) Act, 2000, provided a legal framework to carry out all transactions electronically. It, in turn, helped in to facilitate e-Commerce, e-Governance and to take care of all computer related offences. It directly helped in higher investment including FDI and so employment.

International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

Like ICTPS, employment growth in the ICTUS group in India has gained positively from new technology, but the impact is found significant only in Period II. A significant share in total output and employment comes from the ICT using tertiary sector. It is imperative to study the nature of relationship separately in secondary and services sub-groups. For instance, the impact is negative in case of the former, and positive in the latter. Many reasons are adduced for this. **One,** in the ICT using sectors, ICT, introduced as disembodied technology, is used as *process innovations*, which is negatively associated with employment (Vivarelli, Evangilist and Pianta, 1996 and Antonnuci and Pianta, 2002). In other words, ICT application as process innovation involves replacement of highly labour intensive electromechanical work with increasingly integrated component produced by automation produced in other manufacturing component (Freeman and Soete, 1987; Pissaride and Vallanti, 2003). No doubt, process innovation results in improved quality of product, process or services through on-line monitoring in almost all organized sectors industries, ranging from colour television to passenger cars, but it increases demand for only skilled labour. **Two,** since ICT using secondary sector is highly heterogeneous sub-group, it may be possible that in majority of the industries the other *compensations mechanisms* may not have turned out to be strong hence resulting negative employment impact.

Conversely, the tertiary sub-sector of ICTUS offers a mixed bag of labour saving and labour absorbing activities (Freeman and Soete, 1987) as found in many empirical studies in E.U and U.S. In India, interestingly the sub-group has witnessed positive employment of ICT intensity. As mentioned above, ICT can be used as product and process innovations. It is possible, that in majority of industries in the ICT using services sub-group it is used as product innovation; and therefore, it resulted in a positive employment impact. Also, the other *compensations mechanisms* may have turned favorable in India. In sum, ICT use undoubtedly displaces some clerical labour, middle management and other employees, but at the same time it also generates demand for the new skilled workers (OECD, 2010; Vivarelli, 2011; Matrostefano and Pianta, 2005).

International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

Finally, in the NICTUS group, in secondary and tertiary sectors, in India, impact of ICT on employment is not found to be statically significant. It is because of low ICT intensity base. It, however, does not mean that these sub-groups do not make use of new technology, rather they do but it is so low that it is not captured in the regression analysis.

Given the data constraints, the study could not be carried out at three-digit industrial level. Therefore, it is not possible to comment on whether the results recorded at the group and sub-group levels are also possible at the industrial level. In other words, whether the results are widely scattered across all industries or are just confined to a few industries only.

Also, the results mentioned above are not the net but the gross, since it does not take into account the displacement impact of ICT in the economy, particularly in the ICT using sectors. Further, given the data constraints, only the organized sector is covered, and not the unorganized sector, which consist as high as 93 percent of labour force.

Conclusion

Since 2000, development and diffusion of ICT is on the rise the world over including in India. ICT, accepted as GPT (General Purpose Technology), has led the Indian economy to a *new techno-economic paradigm*.

As evident in the *compensation mechanism*, technological change leads to full employment at least in the long run. In many studies, these mechanisms are empirically tested, it is fund that the mechanisms though, in principal, are operative, but ruled out a complete counterbalance of the labour saving impact of new technology (Freeman and Soete, 1987, Vivarelli, 2011). Further, technological change through *compensation mechanism via new products* always has positive employment, is empirically tested and found significant in many OECD countries Vivarelli, Evangilista and Pianta (1996) and Antonnuci and Pianta (2002).

Further, direction of the relationship between technology and employment also depends on how 'technology' is defined, i.e., as product or process innovations. The former has direct employment effect, whereas and the latter indirect effect. The indirect impact that

International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

surface in the long run, is positive or negative, is sector as well as country specific (Freeman and Soete, 1987 and Oliner and Siechel, 2000).

The study conducted empirically in India give many important results. Starting with the ICTPS group, ICT intensity has positively affected employment since 2000; found true for both secondary and tertiary sub-groups also. This direct positive employment impact of ICT is ascribed to the following reasons. **First**, as mentioned above, the *compensation mechanism through new products* such as semi-conductor, computer hardware and telecommunication devices always result in positive employment impact. **Second,** in India, if ICT is used as *product innovation*, it leads to positive employment impact. **Third,** *compensation via decline in prices* of ICT product is also found strong in India. In other words, as per Moore's Law, the power of semi-conductor gets doubled every 20 months while its price halves, give a major boost in the demand ICT and related product and, therefore, more employment. **Fourth,** *compensation via increase in income*, also led to increased demand of ICT products and, therefore, more output growth and hence more employment. **Fifth,** *compensation via increase in investment* also helped in increased employment growth. For instance, ICT sector has recorded comparatively high investment growth, contributed significantly by FDI inflow. For instance, over 600 Multinational companies (MNCs) are known to be sourcing their product development and engineering services from their centers in India (GOI, 2007-08). **Sixth,** *compensation via increase in machines* also has remained strong in the ICT producing. ICT intensity has increased many fold in the sector, and since most of the ICT products are indigenous, i.e., produced domestically, it therefore resulted in employment generation. **Seventh**, the government, by introducing many supporting policies enactment of Information Technology (IT) Act, 2000, provided a legal framework to carry out all transactions electronically. It, in turn, helped in to facilitate e-Commerce, e-Governance and to take care of all computer related offences. It directly helped in higher investment including FDI and so employment.

Like ICTPS, employment growth in the ICTUS group in India has gained positively from new technology, but the impact is found significant only in Period II. A significant share

International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

in total output and employment comes from the ICT using tertiary sector. At the sub-group level, for secondary and tertiary, in the ICTUS give contrasting results. The impact is found negative in former, and positive in latter. Following reasons are adduced for this. **One,** in the ICT using sectors, ICT is used as *process innovations*, which has negative employment impact. In other words, use of ICT as process innovation involves replacement of highly labour intensive electromechanical work with increasingly integrated components produced by automation produced in other manufacturing component. **Two,** since ICT using secondary sector is highly heterogeneous sub-group, and compensations *mechanisms* may not have turned out to be strong in most of the industries hence resulting in negative employment impact of ICT use.

Conversely, in India, the services sub-group has witnessed a positive employment of ICT intensity. It may be due to all the other *compensations mechanisms* of ICT have been strongly operative

Finally, in the NICTUS group, in secondary and tertiary services sectors, in India, impact of ICT on employment is not found to be statically significant. It is because of low ICT intensity base. It, however, does not mean that these sub-groups do not use new technology; rather they do but it impact is so low that it is not captured in the regression analysis.

Given the data constraints, the study could not be carried out at three-digit industrial level. Therefore, it is not possible to comment on whether the results recorded at the group and sub-group levels are also possible at the industrial level. In other words, whether the results are widely scattered across all industries or are just confined to a few industries only.

Also, the results mentioned above are not net but gross in nature, since they do not take into account the displacement impact associated with ICT diffusion, found largely in unorganized sector. In sum, since the study covers only the organized sector, and not the unorganized sector, therefore it must be kept in mind while making any broader implications of the results.

International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

Table 1: Employment Growth, Output Growth, Employment Elasticity and the ICT Intensity (%) in the Secondary Sector in India during 2000-10

Industries	Years	E	Y	EE	ICT/L (Rs.)	ICTI (%)
All Industries	2000-10	**2.98**	**11.65**	**0.26**	26100	4.73
	2000-05	2.56	10.22	0.25	7916	1.99
	2005-10	3.76	12.94	0.29	48828	8.14
ICT Producing Sectors (ICTPS)	2000-10	11.15	24.48	0.46	366107	6.38
	2000-05	9.4	30.65	0.31	133689	2.22
	2005-10	13.33	17.76	0.75	656629	11.58
ICT Producing Secondary Sectors (ICTPMS)	2000-10	2.67	9.46	0.28	97164	3.73
	2000-05	1.88	9.34	0.20	49749	2.59
	2005-10	4.90	15.61	0.31	161101	5.53
ICT Producing Tertiary Sectors (ICTPTS)	2000-10	27.86	28.83	0.97	183004	6.55
	2000-05	40.56	34.66	1.17	68820	1.97
	2005-10	18.98	21.54	0.88	325733	12.29
ICT Using Sectors (ICTUS)	2000-10	3.55	11.91	0.30	10425	4.05
	2000-05	3.34	12.01	0.28	5723	3.28
	2005-10	3.05	13.79	0.22	16302	5.01
ICT Using Secondary Sectors (ICTUMS)	2000-10	3.04	10.88	0.28	10732.71	2.49
	2000-05	3.01	8.36	0.36	4537.72	1.87

International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

	2005-10	3.27	14.02	0.23	18476.46	3.27
ICT Using Tertiary Sectors (ICTUTS)	2000-10	3.58	12.85	0.28	61810	5.15
	2000-05	3.73	10.37	0.36	36661	3.9
	2005-10	3.29	12.69	0.26	93247	6.72
Non ICT Using Sectors (NICTUS)	2000-10	4.02	9.5	0.42	772	0.35
	2000-05	3.91	8.38	0.47	282	0.20
	2005-10	4.22	10.89	0.38	1385	0.66
Non ICT Using Secondary Sectors (NICTMS)	2000-10	4.29	7.55	0.62	5544	0.39
	2000-05	4.14	6.88	0.60	1894	0.18
	2005-10	4.77	8.39	0.56	10107	0.65
Non ICT Using Tertiary Sectors (NICTUTS)	2000-10	4.5	15.75	0.28	6874	0.45
	2000-05	4.43	15.08	0.29	3022	0.24
	2005-10	4.6	16.49	0.27	11689	0.70
Total Secondary Sectors	2000-10	**4.31**	**9.96**	**0.43**	**9493**	2.9
	2000-05	4.01	8.19	0.49	3705	1.87
	2005-10	4.98	12.09	0.41	16852	4.35
Total Tertiary Sectors	2000-10	**6.36**	**20.89**	**0.30**	**149891**	4.71
	2000-05	6.09	20.02	0.30	49996	1.8
	2005-10	5.94	16.90	0.35	266295	8.19

Source: Own Computation using the Prowess data base compiled by CMIE

International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

Note: E: Employment growth; Y: Output growth; EE: Employment elasticity with respect to output; ICTI: ICT Intensity; and L: Employment.

NIC 2004		Year	E	Y	EE	ICT/L (Rs.)	ICTI (%)
300	Office Accounting and Machinery of Computers	2000-10	7.19	9.36	0.77	120900	8.60
		2000-05	6.38	9.04	0.71	60948	5.05
		2005-10	8.22	9.77	0.84	195839	13.05
313	Insulated Wires, Cables and Computers	2000-10	7.29	11.05	0.65	33050	1.37
		2000-05	6.28	10.66	0.58	11176	0.63
		2005-10	9.53	12.77	0.75	60393	2.29
321	Electronic Valves, Tubes and Other Electronic Components	2000-10	5.85	7.91	0.74	107370	4.72
		2000-05	5.85	5.83	1.00	45496	2.37
		2005-10	5.86	10.75	0.54	184712	7.66
322	TV and Radio Transmitters and other Communications Apparatuses	2000-10	2.82	8.21	0.34	97630	5.57
		2000-05	2.17	3.97	0.54	37464	3.50
		2005-10	4.31	13.50	0.32	172837	8.17
323	TV and radio receivers and recording or reproducing	2000-10	0.48	15.13	0.03	121241	3.64

International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

	apparatus						
		2000-05	1.58	17.29	0.09	74645	3.42
		2005-10	0.88	12.42	0.07	179486	3.92
331	Medical and Surgical Instruments and Orthopedics Appliances	2000-10	6.81	12.37	0.55	166336	2.63
		2000-05	5.04	10.48	0.48	157491	3.18
		2005-10	8.52	15.74	0.54	177392	1.94
Aggregate		2000-10	2.67	9.46	0.28	97164	3.73
		2000-05	1.88	9.34	0.20	49749	2.59
		2005-10	4.90	15.61	0.31	161101	5.53

Table 2: Employment Growth, Output Growth, Employment Elasticity and the ICT Intensity (%) in the ICT Producing Secondary Sector

Source: Same as in Table 1.

International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

Table 3: Employment Growth, Output Growth, Employment Elasticity and the ICT Intensity (%) in the ICT Using Tertiary Sectors

NIC 2004	Industries	Years	E	Y	EE	ICT/L (Rs.)	ICTI (%)
181	Other Wearing apparel and accessories expect fur apparel	2000-10	11.71	16.81	0.70	23713	5.05
		2000-05	10.38	12.49	0.83	10872	2.33
		2005-10	13.37	22.21	0.60	39765.76	8.45
221	Publishing	2000-10	5.93	12.18	0.49	25696.13	3.01
		2000-05	9.83	12.97	0.76	4758.40	0.83
		2005-10	1.05	11.19	0.09	51868.29	5.73
223	Reproduction of recorded Media	2000-10	8.59	11.62	0.74	17443.49	2.41
		2000-05	6.26	6.62	0.95	6024.60	0.90
		2005-10	11.50	17.88	0.64	31717.11	4.29
291	Machinery for the production and use of mechanical power, except aircraft vehicle and cycle engine	2000-10	1.21	13.29	0.09	35761.14	5.16
		2000-05	1.21	10.44	0.12	11067.02	2.03
		2005-10	4.23	16.85	0.25	66628.79	9.07
292	Other general purpose machinery	2000-10	1.11	5.18	0.21	17175.34	2.17
		2000-05	1.71	2.27	0.75	5580.74	0.87
		2005-10	0.37	8.82	0.04	31668.58	3.80
293	Domestic appliance	2000-10	1.06	4.46	0.24	26138.87	2.40
		2000-05	0.83	4.12	0.20	6938.02	0.81
		2005-10	3.41	4.88	0.70	50139.92	4.39
311	Electric motors, generators and transformers	2000-10	3.08	11.71	0.26	11195.02	1.50
		2000-05	2.30	6.57	0.35	6422.58	0.95
		2005-10	4.05	18.14	0.22	17160.56	2.19
312	Electricity distribution and control apparatus	2000-10	4.63	20.62	0.22	26701.98	2.46

International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

		2000-05	4.73	18.05	0.26	14361.67	1.59
		2005-10	5.02	23.82	0.21	42127.37	3.54
314	Accumulators, primary cells and primary batteries	2000-10	3.02	11.93	0.25	14846.81	2.00
		2000-05	1.59	4.70	0.34	5285.31	0.98
		2005-10	4.80	20.97	0.23	26798.69	3.27
315	Lighting equipment and electric lamp	2000-10	4.46	10.02	0.45	12701.97	1.73
		2000-05	1.57	2.70	0.58	6176.80	1.19
		2005-10	8.08	19.16	0.42	20858.42	2.41
319	Other electric equipment	2000-10	0.95	4.86	0.19	18621.86	1.46
		2000-05	0.56	1.62	0.34	5245.23	0.62
		2005-10	2.83	8.91	0.32	35342.66	2.52
321	Electronic valve, tubes and other electronic component	2000-10	2.08	6.14	0.34	12979.15	1.26
		2000-05	0.75	4.48	0.17	4893.83	0.51
		2005-10	3.75	8.23	0.46	23085.80	2.20
351	Building and repairing of ships and boats	2000-10	3.31	14.62	0.23	3073.49	0.35
		2000-05	1.35	3.15	0.43	371.10	0.10
		2005-10	9.14	28.96	0.32	6451.48	0.66
359	Transport equipments	2000-10	2.84	10.34	0.27	10468.71	1.90
		2000-05	4.49	11.88	0.38	5249.44	1.27
		2005-10	0.79	8.42	0.09	16992.80	2.68
361	Furniture	2000-10	16.37	17.40	0.94	6532.97	2.10
		2000-05	27.04	24.68	1.10	2260.14	1.65
		2005-10	3.04	8.29	0.37	11874.01	2.67
369	Manufacturing n.e.c.	2000-10	5.73	22.86	0.25	2522.30	3.95
		2000-05	6.60	24.30	0.27	957.53	1.85
		2005-10	4.66	19.81	0.23	4478.26	6.57
401	Production, transmission and distribution of electricity	2000-10	8.06	4.00	2.01	822.09	0.06

International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

		2000-05	11.09	4.99	2.22	721.24	0.05
		2005-10	4.26	2.76	1.54	948.15	0.08
452	Building of complete constructions, civil engineering	2000-10	23.27	25.40	0.91	13024.50	2.49
		2000-05	22.85	19.82	1.15	8962.98	2.02
		2005-10	24.05	32.39	0.74	18101.40	3.09
453	Building installation	2000-10	9.06	16.11	0.56	13189.78	1.33
		2000-05	7.97	19.11	0.47	8056.10	0.40
		2005-10	10.42	24.86	0.41	19606.89	2.49
	Total	2000-10	3.04	10.88	0.28	10732.71	2.49
		2000-05	3.01	8.36	0.36	4537.72	1.87
		2005-10	3.27	14.02	0.23	18476.46	3.27

Source: Same as in Table 1.

.

International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

Table 4: Employment Growth, Output Growth, Employment Elasticity and the ICT Intensity (%) in the Non ICT Using Tertiary Sector during 2000-10

NIC 2004	Industry		E	Y	EE	ICT/L (Rs.)	ICTI (%)
551	Hotels; camping sites and other provision of short-stay accommodation	2000-10	3.63	14.69	0.25	15047	1.06
		2000-05	3.17	14.36	0.22	5392	0.41
		2005-10	4.21	15.1	0.28	27116	1.88
552	Restaurants, bars and canteens	2000-10	11.84	15.72	0.75	12427	3.2
		2000-05	15.68	21.97	0.71	8852	1.62
		2005-10	7.03	7.9	0.89	16896	5.18
601	Transport via railways	2000-10	10.3	40.27	0.26	12744	0.15
		2000-05	4.41	22.32	0.20	6332	0.08
		2005-10	17.65	62.71	0.28	20758	0.24
602	Other land transport	2000-10	9.08	18.74	0.48	4002	3.68
		2000-05	14.21	30.99	0.46	1515	1.87
		2005-10	2.68	3.43	0.78	7110	5.95
611	Sea and coastal water transport	2000-10	2.1	23.42	0.09	15170	0.72
		2000-05	2.98	30.14	0.10	9816	0.74
		2005-10	1	15.03	0.07	21864	0.71
612	Inland water transport	2000-10	3.05	11.63	0.26	2206	0.12
		2000-05	-1.6	12.63	-0.13	1452	0.09
		2005-10	2.87	10.38	0.28	3148	0.15

International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

641	Post and courier activities	2000-10	3.4	4.45	0.76	10012	1
		2000-05	1.62	19.24	0.08	6828	1.13
		2005-10	5.62	-14.03	-0.40	13992	0.84
701	Real estate activities with own or leased property	2000-10	16.05	43.28	0.37	3109	0.06
		2000-05	-2.78	29.46	-0.09	2432	0.05
		2005-10	39.59	60.57	0.65	3955	0.08
711	Renting of transport equipment	2000-10	0.5	21.6	0.02	24000	0.55
		2000-05	-13.54	-6.23	2.17	12369	0.55
		2005-10	18.05	56.39	0.32	38537	0.54
801	Primary education	2000-10	7.73	17.85	0.43	6813	3.4
		2000-05	6.58	17.74	0.37	1690	0.62
		2005-10	7.92	18.59	0.43	13216	6.88

Source: Same as in Table 1.

Appendix A

Let us assume a firm minimizes its cost to achieve a given level of output. In other words, Minimize $C(w,r)=wL+rK$ subject to the given output level $Y(L,K)=A\ L^a\ K^{1-a}$ given that $A>0$ and $0\leq a\leq 1$. After applying Lagrangian we get,

$£= wL+rK +\mu(Y- A\ L^a\ K^{1-a})$

$£_L=w+ \mu\ (- MP_L)=0$ (1)

$£_K =r+ \mu\ (- MP_K)=0$ (2)

$£\mu = A\ L^a\ K^{1-a} =0$ (3)

$MP_L=aA\ L^{a-1}\ K^{1-a}$ (4)

$MP_K= (1-a)\ A\ L^a\ K^{-a}$ (5)

From eqns (1) to (3) we get,

$\mu =w/r=MP_L/\ MP_K$ (6)

International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

$MP_{L/}\ MP_K = (a\ A\ L^{a-1}\ K^{1-a}) / \{(1-a)\ A\ L^a\ K^{-a}\}$

$MP_{L/}\ MP_K = (a/(1-a))\ K/L = w/r$ (7)

$L = \{a/(1-a)\ (r/w)\}\ K$ (8)

$Y = A\ \{(a/(1-a)\ (r/w)\ K\}^{\ a}\ K^{1-a}$

$Y = A\ \{(a/(1-a)\ (r/w)\}^a\ K^a\ K^{1-a}$

$Y = A\ \{(a/(1-a)\ (r/w)\}^a\ K$

$K = Y/A\ \{(1-a)/a\ (w/r)\}^a$ (9)

Or, $K = F_1(Y, w, r, A)$

Now putting the value of K in (8), we get

$L = a/(1-a)\ (r/w)\ Y/A\ \{(1-a)/a\ (w/r)\}^a$

$L = Y/A\ \{(a/(1-a)\ (r/w)\}^{1-a}$ (10)

Or, $L = F_2(Y, w, r, A)$

Putting the values of K and L in the cost function, we get

$C = w\ \{Y/A\ \{(a/(1-a)\ (r/w)\}^{1-a}\} + r\ \{Y/A\ \{(1-a)/a\ (w/r)\}^{\ a}\}$ (11)

$C = \{Y/A\ \{(a/(1-a)\ (r/w)\}^{1-a}\}\{w + r\ \{(1-a)/a\ (w/r)\}^a / \{(a/(1-a)\ (r/w)\}^{1-a}\}$

$C = \{Y/A\ \{(a/(1-a)\ (r/w)\}^{1-a}\}\{w + r\ (1-a)/a)\ (w/r)\}$

$C = \{Y/A\ \{(a/(1-a)\ (r/w)\}^{1-a}\}\{w + r\ \{(1-a)/a)\ (w/r)\}$

$C = \{Y/A\ \{(a/(1-a)\ (r/w)\}^{1-a}\}\{w\{1 + (1-a)/a)\}$

$C = \{Y/A\ \{(a/(1-a)\ (r/w)\}^{1-a}\}\ (w)\ (1/a\ )$

$C = Y/A\{\{(a/(1-a)\}^{1-a}\}(r)^{1-a}\ (w)^a\ (1/a\ )$ (12)

Applying Shepherd Lemma, we get factors demand function.

$dC/dw = L = Y/A\{\{(a/(1-a)\}^{1-a}\}(r)^{1-a}\ (w)^{a-1}\ (a)\ (1/a\ )$ (13)

$L = Y/A\ \{\{(a/(1-a)\}^{1-a}\}(r)^{1-a}\ (w)^{a-1}$ (14)

Equation (14) is a multiplicative function, if we take natural log on both sides it assumes a log-linear form.

The derived labour demand is function of factors prices (w, r) output(Y) and A (Technology). The cost function must fulfill the following properties:

i. It is homogenous of degree one in factor prices
ii. Concave in factors prices
iii. Strictly increasing in Y.
iv. Continuous in w, r and Y

International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

Appendix B: Prediction of the Employment Impact of New Technology

Serial No	**Report**	**Types of the jobs affected**	**No. of jobs affected**
1	Siemens, 1978	40 percent of jobs computerized by 1990 (Germany)	2 million typing and secretarial jobs
2	Nora & Minc, 1978	Banking & insurance jobs (France)	30 % jobs reduction over next decade
3	APEX, 1979	Typing, secretarial, clerical & authors of letter and documents	2,50,000 jobs by 1983
4	Barron & Curnow, 1979	Secretaries, typists, clerks and managers	10-20 % unemployment level in next 15 years
5	Jenkin & Sermen, 1979	Clerical in administrative insurance, banking, buildings etc.	30 % displacement by 1990
6	Virgo, Philip, 1979	Clerical administrative in insurance, banking, buildings etc.	40 % jobs at risk in 1980s
7	Virgo, 1979	Public sector services	Up to 2/3 of all clerical and administrative jobs at risk
8	Sleigh, 1979	Clerical administrative (insurance, Banking etc.)	Modest change in employment pattern
9	Bird, Emma,1980	Secretarial and typing	1,70,000 jobs lost by 1990
10	Hyman, Antony, 1980	Secretarial and typing,	60-70 % Secretarial & typing will lose jobs
11	Metra International, 1980	Clerical	60-70 % of clerical jobs at Risk in the long run

Source: Micro- electronics and Women' Employment in Britain, SPRU Women and Technology Studies, SPRU Occasional paper No. 17 Social Policy Research Unit, University of Sussex, 1982.

Appendix C: Which Jobs are at Risk with the Introduction of new Technology (ICT) ?

There have been few studies, which sought to identify the jobs likely to be most affected with the introduction of new technology. These studies, however, have to be taken with some amount of caution because of the simple reason that all of the jobs affected by the introduction of new technology might not disappear permanently rather would have changed their form either by way of deskilling or by being subsumed into other tasks which earlier

International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

were carried out by other occupation. At the same time, it is also important to differentiate between the short term and the long term changes involved.

The two tables given below list a number of occupational categories based on the ILO specifications which have changed considerably during the short term (shown in Table C.1) and the occupation affected during the long term (shown in Table C.2). However, it should be understood that the list by no means is exhaustive, it simply provide an overview of the complex picture.

Table C.1: Types of the Occupations Affected by the ICT Use in the Manufacturing Sector or in Short Term

Sr. No.	Occupation	Causes of the Change
1.	Printer and Typesetters	Integrated text processing, control of press
2.	Welders	Robot and handling equipments
3.	Electrical Fitter, etc	Automated assembly unit, more company Integration
4.	Technical Draught men	CAD/ CAM
5.	Laboratory Technician	Automated analyzers
6.	Data processing workers	Software technology development
7.	Technician	CAD/CAM
8.	Engineers	CAD/ CAM
9	Metal workers	Robot and handling equipments
10	Toolmakers	Programmed machines tools
11	Electrical machines	Greater integration of components

Source: Gill, C,.page 90.

International Journal of Research in Economics and Social Sciences(IJRESS)
Available online at: http://euroasiapub.org
Vol. 8 Issue 8, August- 2018
ISSN(o): 2249-7382 | Impact Factor: 6.939 |

Table C.2: Types of the Occupations Affected by the ICT Use in the Services Sector or in Long Term

Sr No.	**Occupations**	**Causes of the Change**
1.	Office managers and assistants Sales staff, administration employees	Automated administration with linked decentralized system
2.	Sales staff, wholesale and retail	Computerized cash registers, product Code, integrated storage & stock control
3.	Telephone & telex staff	Automated exchanges
4.	Textile occupations	Automated machinery
5.	Warehouse workers	Automated warehouse
6.	Bank & Insurance expert	ATM/ Electronic fund transfer
7.	Dispatch workers, checkers	Automated packaging & checking
8.	Postal staff	Electronic mails (SMS or E-mails), etc.
10.	Supervisors & foreman	CAM/ CNC machines

Source: Gill, C, page 91.