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ICT: the Solution of Employment Problem in India

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Introduction:

The relationship between technology and employment is very old and controversial.Inthelasttwo decades, technology in the form of ICT (Information and Communications Technologies) has gone up remarkable the world over including India. In the absence of official estimates, what emanates from unofficial sources that unemployment rate is at all times high. It has thus become a leading subject of academicdiscussion besides the general discussion. ILO Reports on the other hand claims all times high average employment or economic growth based significantly on increased ICT productivity levels. ICT, the main carrier of the 4th industrial revolution; after the *steam engine* in 19th century and the *electricity* in 20th century, resulted in the new *techno-economic paradigm*, wherein it is impossible to identify an economic activity with no use of ICT, directly or indirectly.In terms the use of ICT, it is now difficult to imagine life without cellphone, computer, Google, Facebook, Twitter, Whattsapp, etc. Within industries, use of ICT in the form of cloud computing, automation, block chain, etc. is on the rise.ICT, with annual growth of over 25 percent during 2005-15,provided direct employment to nearly 4 million people and significantly to millions indirect in sectors using it like banking, insurance, automobiles, etc. The question is what led this to happen; and to know whether new technology in the form of ICT can provide a solution to this galloping problem of unemployment. The paper is structured as follows. It starts with an analysis of output and employment growth in the country is made, with a reference to the global trend of employment growth and output growth, along with its sources including technology in the form of ICT. It follows with the trend and pattern of different components of ICT growth. And, finally the theoretical and empirical discussion on the relationship between technology and employment is provided.

1.1. Employment Situation and the Current Debate on the Issue of Unemployment Rate in India:

Employment is important for growth and development in any country.In the past couple of years, lack of the official estimates of employment and unemployment has bred deep uncertaintiesabout the performance of economy the employment front. This becomes all the way important when Lok Sabha elections were round the corner. This led to intense debate that how the country doing on the employment front, in both quantitativeand qualitative aspects. The views on the topic are classified between pessimistic

and optimistic. In the absence of any official estimates on employment and unemployment situation in the country, the former views are based on anecdotal studies that claim UR being unprecedentedly high in the range 7 to 8 percent. CMIE (Centre for Monitoring Indian Economy) estimates are the most prominent one. The latter views completely refute this on two grounds. First, economy is performing well, with an average growth around 7 percent; more growth means more employment and lower unemployment rate. Two, information of the new EPFO (Employees Provident Fund Office) accounts was used that the employment situation ultimately rosy. Theoretically using this number as new employment generation, was a theoretical fallacy; and was squarely criticized. The government has also gone for a change in the methodology used to collectdata towards estimating employment situation in the country. The conventional method used by NSSO so far is revamped with Periodic Labour Force Survey (PLFS) since 2016. PLFS is more frequent and regular in nature conduced quarterly since 2016. However, the official position of employment estimates became controversial, when unofficial leakages of official also hinted unemployment rate being all-times high in the last 45 years.

According to ILOestimation, global employment growth rate has risen since 2016, and so the unemployment rate declined to 5.6 percent in 2017 and expected to decline to 5.5 percent in 2018. The developed countries are expected to experience the major decline (by 0.2 percentage point in 2018 over 2017).

While justifying its claim of high employment growth, government directly or indirectly refers to new technology (ICTs) towards its dream of making India the Digital Superpower. It thus becomes pertinent to argue whether ICT hold the key of employment problem, if the data is to be believed.

1.2. Employment Growth Rate: The Global Trend

The UN Sustainable Development Goal (SDG-8)states: *'to promote sustained, inclusive and sustained economic growth it is required to provide productive (decent) employment to all'*. According to ILO Employment Report (2018), after a rise in 2016 global unemployment rate has declined to 5.6 percent in 2017; and is predicted to decline further by 0.1 percent in 2018. There are four points worth mentioning**. First**, after a hiatus of ten years most developed countrieshave recorded unemployment rate all times low.For instance, it took only one year (2008 to 2009) for global unemployment rate to increase from 5% to 5.6%, but more than nine years to bring it back to 5%. In 2018, global unemployment rate is expected to decline further by 0.1 percent thus keeping the number of unemployed persons stabilized despite increased labour force. **Two**, decline in UR is largely due to increased economic growth. The average growth has increased form 3 percent during 2010 to 4 percent since 2016. **Third**, source of growth indicates that increase in technology (mainly the ICT). Role of ICT in total productivity has increased significantly over the years in the past of couple in case of developed countries, which have recorded the highest declined in unemployment rate (by 0.2 percent) in 2018. Upper middle countries, in contrast, seemed trapped in down turn economic growth (less than 5 percent average in last five years), henceleading a large chunk of labour force unemployed. Of the total 172 million people unemployed in the world, nearly 32 million (18 percent) lives in India. **Fourth,** if the data is to be believed, for the first time, UR in India has exceeded global UR in 2018. Fifth, the most worrisome factor, among many, is that more than one in every five young people (15 to 24 years age) is in NEET (not in employment, education and training).

Thus world over, development and use of ICT has played significant role not only in direct employment generation but also indirectlythrough different *compensation mechanisms*. In the following section an analysis is made to how ICT has grown over the years.

1.3 Growth and Development of ICT

When it comes to the relationship between ICT and employment, it is pertinent to know the growth and pattern of ICT place the world over, and in India. Given the nature and diffusion of ICT, it led to a new 'techno-economic paradigm'like the technologies of railways and electricity in the past. To begin with, the average ICT intensity (ICT as percentage of non ICT capital investment) is found to have increased not only across countries but alsoacross industries or firms, albeit different rates.It has been recorded more in developed countries and in ICT producing industries compared to ICT using sectors or non ICT using sectors. Besides this, the other factors used to gauge the growth of ICT are tele-density and internet density. High growth in ICT producing sector thus goes in tandem with increased employment growth. Here are some important statistics. The percentage of people, of all ages, using internet daily has grown up exponentially to 106 percent in 2018 in OECD countries up from 35 percent in 2009. The tele-density (cellular phones per 100 people), increased from 2.5 percent in 1996 to 97 percent in 2015 through 76.2 percent in 2010; for OECD countries the corresponding figures are 10.7 percent, 120percent and 98percent. The reason, among many, behind impressive growth of ICT is the increased R&D related to ICT, which has been around 0.4 percent of the GDP in 2015. Over the years, nearly 40 million people are directly employed in ICT, a rise of another millions of people have been in sectors using ICT.

Another remarkable point about employment related to ICT is changed nature of employment. In case of UBER, for instance, three points are worth mentioning. One, it provides flexibilities to work to both males and females workers. On the latter, a study concluded in USA says the proportion of female drivers is more (14%) in UBER than in traditional taxis (8%). Nearly 42 percent women respondent said they prefer UBER because it provides more flexibility in working condition, i.e. they can work part time or with 'flexible work schedule' (OECD, 2018). Two, ICT provides a level playing field cutting across gender, race, religion; region etc. According to a survey conducted by Facebook, World Bank and OECD, the percent of online entrepreneurs operating on Facebook is more among women than among men because it (ICT) provides a level playing field to both men and women cutting across region or culture barriers. Reports, by Shine.com (an online jobs portal)concluded that IT sector will continue to create the maximum number of jobs in India in 2019. Across different sectors BFSI (banking, financial services and insurance) and education is on the top in providing jobs, followed by BPO and call center.

Another unique feature of employment in ICTproducing and ICT using sector is that skill up-gradation is pre-requisite; if not, then high probability job loss. Media is full of reports when large a number of firms have sacked significant number of worker. For example, IBMS has decided to sack some 300 employees, may be more if they fail to up-skill. Among all, 'software industry' (an ICT producing industry) is on the top in lay-off. Java and DotNet is no longer the only qualification, besides this learning of new technologies such as Python, big data, machine learning, robotic process, Artificial Intelligence, internet of thins and block chain is pre-requisite. Over 70 to 80 percent of IT professional are geared towards new technology.

Further, an analysis is made on the relationship between technology and employment, both theoretically and empirically. And then the discussion is extended to ICT, the new technology, towards the conclusion that ICT can be one of the solution of employment problem in India.

1.4. The Relationship between ICT and Employment: Theoretical and Empirical Findings:

The relationship between technology and employment is very old and complex. One of the pioneering hypothesesby Freeman, Clark and Soete (1982), *concluded that ICT is not only good for productivity but even also for employment.*Depending on the end use, any technological change (or innovation) is characterized either product or process (introduced by Joseph Schumpeter in 1961). For instance, the introduction of new products like mobile phone, laptop, computer or other electronic gadgets constitutes product innovation, which if lead to displacement of old products will in total employment loss provided the relative increase in employment due to new products is less than decline in employment due to the old products becoming obsolete. Product innovations are the part of final demand. Process innovations; on the other hand,is nothing but a 'new way of production', which generally involves lesser demand of labourper unit of output produced (or increased labour productivity. How employment responds the change depends on two factors. Oneon the market competition, i.e. perfect or imperfect; wherein the 'former'technology led productivity gained is partly transferred to consumer in terms of declined prices. Second is the 'price elasticity of demand', higher elasticity means higher demand per unit of price decline, so more profit and hence more employment. In the case of imperfect competition, productivity benefits are not fully transferred to consumers, so increased production will not result in employment gain. As for as the indirect employment impact of technological change is concerned, six *compensation mechanisms* are identified. These are briefly discussed below.

a) **Compensation via New Machines:** New technology (or process innovation)may resultinnew machines, the production of which may lead to higher demand for labour in the firms producing new machines. This will lead to employment loss if old machines are substituted with new machine, otherwise new employment generation. b) **Compensation via New Products:** This is product innovation, which means new consumer goods and hence more employment, known as the *direct employment effect* of product innovation. Further, as marked by Schumpeter, product innovation is also associated with decreased prices of these new products and hence more labour demand (Freeman and Soete, 1987). b) **Compensation via Decrease in Prices:** In a competitive economy, process innovation is always associated with increased labour productivity (or decreased unit cost of production, i.e. marginal cost). This means lower prices of these goods and hence more employment. c) **Compensation via New Investment:** In situation of 'market imperfection', say monopoly, if firms do not transfer fully the benefit of technology-led productivity into wage increase, then if the profit is re-invested means scaling up and hence more demand for labour. d) **Compensation via Decrease in Wages: '**Process innovation' leads increased labour productivity which mean lesser demand for labour per unit of output produced and hence lower wages. This may result in more demand for labour in labour intensive production activities. e) **Compensation via Increase in Incomes:** In sharp contrast to the above mechanism, if technology-induced higher productivity results in higher wages, it will stimulate consumption and hence employment.

Thus, the negative employment impact of 'process innovation'will be counter balanced by c*ompensation mechanisms*. In any country, say India, where market imperfection is widely prevalent, these mechanisms will be partially true. Despite substantial investment in ICTs its impact on productivity and employment vary significantly across countries, industries and firms (Jorgenson, 2001).

1.5.Empirical Studies:

As for as the employment impact of ICT is concerned, most important and pioneering hypothesis was put forwarded by Freeman, Clark and Soete (1982) which states a positive relationship between ICT and employment. Unlike the previous waves of technologies, the current *techno-economic paradigm* led by ICTs present a more complex technological trajectory, which is likely to introduce new *compensation mechanism*s apart from those mentioned above in the previous section. It has led to the tertiarisation of the economy led by ICTs wherein the compositional change of output and employment has moved from manufacturing to services (Vivarelli, 2011).

Countries unable to exploit the ICT led productivity and employment potential of tertiary sector, are more likely to confront the employment loss in manufacturing sector. Something found happened in many E.U. countries. In a study by Simonetti et al. (2000), it is found that many countries like U.S., Italy, France, and Japan witnessed negative employment of ICT when used as process innovation; and positive impact on employment when used product innovations. About the employment impact of ICT across different sectors, Pianta(2000)andAntonucciandPianta(2002)foundnegativeimpactinmanufacturingindustriesacrossfiveEuropeancountries. Whileothersfoundapositiveemploymentimpactinknowledgeintensiveservicesectorsandanegativeintraditionalservicesliketradeandtransports.PadalinoandVivarelli(1997)putforwardedanempiricalstudyoftheG-7countries overtheperiod 1960-1994.They pointed out that inthelongrun,against a marked increase in jobcreationin the U.S., there was a moderateemploymentcreation in Europe, and the diffusionofICTstechnologies resulted in joblessgrowthandnegativeemploymentelasticitiesin manufacturing sector among allcountriesbutJapan; even though, nosimilar clear cutevidence was detected for the economy as a whole.

In this regard, some path breaking results is found in studies by Jorgenson (2001), Ark (2004), Gordon (2004) and Vivarelli (2010). *They concluded that ICT producing sectors in general and ICT producing services sectors (particularly banking, insurance and finance) recorded the steepest rise in productivity and employment growth which contributed significantly at aggregated level in many OECD countries, particularly the U.S.* Conversely, some countries in the E.U. have failed to reap the productivity and employment potentials of the ICTs. .

In some of the recent studies on the OECD member countries, during 1995-2007, the contribution of ICT has varied from 1% per year in Australia to 0.4% in Japan; and thus has been a major source of employment. According the latest OECD reports, ICT may be having a *temporary negative impact on employment in terms of skill in some periods but positive and permanent in terms of industry*. ICT affects employment in manufacturing, and some services sectors like business services, trade, transport and communication. The long term neutrality of the employment impact ICT is due to the fact that some sectors,

which experience employment loss due to change in technology, is compensated by increased labour demand in other industries and hence in long no employment loss.

1.6.Development of ICT: Automation, Machine Learning and Internet of Things

World economy is increasingly becoming competitive; firms to gain edge in productivity are striving hard leading to 'automated' production process. For instance a robot (Baxter or Sawyer) can work 24/7,involving little or no variable cost. It is faster than human with little or no error capable to do jobs repetitive, monotonous or dangerous in nature. Baxter and Sawyer are the examples used in assembly line and factory. The industry is growing by leaps and bounds. Worker working in assembly line, bus or taxi driver, autonomous mining and construction companies like Cat are working towards it, phone operator, tele-marketer and receptionists, cashiers, bank teller and clerk, packing, storeroom and warehousing moving, prescriptions, information gathering, analyst and researchers, journalists and reports, pilot, bartender, stock traders, postal workers, soldiers and guards (for instance robots from Knightscope can hear, see and smell danger if any), travel agent chefs and cooks, bomb squad, typists, telephone operator, bowling ball pinsetter and so on.

According to an OECD Report (2018), fewer than 5 percent of workers with tertiary education are on the risk of losing jobs because of automation, which is more than 40 percent among workers with education lower secondary degree. It further said that around 14 percent of the jobs are on the high risk of being automated by 2025; and another 30 percent will face major changes.

1.7. Reasons for Low Employment Growth in India:

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).

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 other words, the employment impact whether positive or negative depends how effective are the compensations mechanisms defined in Chapter 02, Section 2.3 and 2.4. 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 services sectors. This is the direct employment impact of ICT. It could be ascribed to the following reasons.**First**, as evident in the *compensation mechanism through new products* 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 percentin 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.

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 services 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 services 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).

Finally, in the NICTUS group, in secondary and 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 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 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 services 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 product* 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 in total output and employment comes from the ICT using services sector. At the sub-group level, for secondary and services, 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 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.

Appendix A: 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 B: Which Jobs are most at Risk?

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 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 5.C.1) and the occupation affected

during the long term (shown in Table5.C.2). However, it should be understood that the list by no means is exhaustive, it simply provide an overview of the complex picture.

AppendixC: 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

AppendixD: 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 9

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