The Effects of Information and Communication Technology (ICT) on the Employment of the Factory Industry in Esfahan Province

Mohammad Heydari [a*] and Kambiz Hozhbar Kiani [b]

[a*]PhD of Econometric And Member's Of Scientific Boards of Department of Management and Accounting, Neyshabur Branch, Islamic Azad University, Neyshabur , Iran
Mohammad Heydari* (Corresponding author)

[b] Department of Economics, College of Management and Economics, Tehran Science and Research Branch, Islamic Azad University, Tehran, Iran

Received: Dec. 2014 & Published: Feb. 2015

Abstract: In this paper, the impact of information and communication technology (ICT) on the employment of different specialized categories including the total labor, unskilled workers, skilled workers, technicians, and engineers has been investigated. Independent variables include information presentation index, information acquisition index, number of the internet and computers users, value added, capital price, wage, and the dependent variable is employed labor. The study period was 2006-2010 and the applied method for assessment and analysis of results was pooling data method. The results are: Most of the technology indicators have a significant positive effect on the employment of labor, which indicates the predominance of producing effect on process effect. The negative effects of technology and employment indicators are approved in unskilled and skilled labor that indicates the inability to use these different specialized categories from technology indicators. Technology indicators have a significant positive effect on the employment of technicians and engineers in this province and the positive effect hypothesis of these indicators on employment has been confirmed.

Keywords: Information and Communication Technology (ICT), Employment, Production Function with Constant Elasticity of Substitution (CES), Pooling Data Approach

1. Introduction

Different periods of human life suggest a close connection in technologies, social institutions, and economic activities. This means that new horizons of activities and new areas of cooperation have been obtained for different segments of society with the advent of new technologies that the imagination of some of them was impossible up to this time. Revolution in communications and information has opened new horizons in the field of economics, politics and culture and it is also raised in many countries as a solution in order to cope with the economic crisis such as unemployment. So, the nature of business has been changed from traditional to modern state with the development of these technologies. New jobs are created in addition to the change in the business to meet the need of today's technologies. Accordingly, it can be said that the department of information and communication technology (ICT) should be studied and analyzed as a potential employment in the country. Revolution of ICT (information and communication technology) can be considered as anti-employment matter because the diffusion of ICT in organizations and various companies make organizations downsizing. Organizations will decrease human resources especially at intermediate levels in order to use this technology. Using this technology saves human resources. For example, data integration has removed many jobs that transfer or control data. On the other hand, today new information and communication technologies have opened the ways in an enormous scale. For example, hardware and software services, electronic commerce, and create chain companies through the smooth flow of information provide new employment opportunities.

In summary, it can be said that two types of process innovation and product innovation effects on employment. The innovation process that is change in the production process decreases labor demand or increases unemployment through displacement and innovation product that includes changes in the mode of production and new products and increases labor demand through remedial works by

(DOI: dx.doi.org/14.9831/1444-8939.2015/3-2/MAGNT.7)

creating new job opportunities. Thus, it can be argued that (ICT) effects can be positive or negative on employment depending on which of these effects is stronger. The organization of this paper is providing a theoretical basis for ICT and employment, literature, population and statistical data, specifying model, estimating pattern, analyzing the results, summary and conclusions and recommendations.

2. Literature Review

2-1. Theoretical foundations of ICT and employment

Information and communication technology (ICT) has a various definitions in various books and works. Some of them are referred to the following. ICT is derived from three words, information, communication, and technology. Information is suitable processed data for decision-making. Technology is a set of hardware, software, and brain wares that improve the operation efficiency. Communication also includes "the process of arraignment, understanding and sharing of meaning" (Farhangi, AA. 2001). Information and communication technologies: A set of collection processes, storage, and information retrieval that mainly is formed based on computer and telecommunications infrastructure-based communicative platforms (Navabzadeh, 2001). ICT is a set of hardware, software and think wares that make possible the circulation and use of information (Pahjola, 2002). Scaramuzzi (2002) introduces ICT as a set of technology, storage, exchange, and use of information in various forms of business data, voice, images, animations, multimedia presentations and other forms that have not yet defined. OECD definition from information and communication technologies (ICT): information and communication technology (ICT) is the whole position of production and services industry that are used for storage, transmission and display data and information electronically. Production industry is the industry that is in direction of information and communications process including transmission and displays them and it is used in electronic processes to detect, measure, or maintenance of physical phenomena or control a physical process. Service industries, including those that in order to enable the process of communication and information through electronic means. Technology can reduce the labor demand through changes in the production process and influence on employment and can make changes in the wage, creating new job opportunities and changes in the composition as a means of producing. Surveying the effects of innovation and technological change on employment and unemployment theoretically is very complex.

Two types of process innovation and product innovation influence on employment from two ways. On one hand, process innovation reduces the demand for labor through displacement and, on the other hand, product innovation increases the demand for labor through compensation effects by creating new job opportunities. From macroeconomic perspective, these two effects should be compared and economic enterprises' behavior should be analyzed in the application of ICT and labor to clarify this issue. The tested hypotheses in this paper are as follows: 1. The impact of information and communication technologies (ICT) on the employment of skilled labors in factory industry of Tehran province is positive. 2. The impact of Information and communication technologies (ICT) on the employment of technician labors in factory industry of Tehran province is positive. 3. The impact of information and communication technologies (ICT) on the employment of engineer labors in factory industry of Tehran province is positive. 4. The impact of information and communication technologies (ICT) on the employment of unskilled labors in factory industry of Esfahan province is negative. 5. The consequence of process innovation and product innovation effects on the total employment in factory industries in Esfahan province are positive.

2-2. Research Background

Investigations in line with this paper are divided into two groups, national and international studies that now we discuss each of them. Greenan and Guellec (1997), have estimated employment growth equation for French firms in the period 1985-1991 using three simultaneous equation systems in the form of value added, labor, and capital assets as an endogenous variable. The mentioned study shows more new jobs will be created in firms with advanced technology process and production of new products create more jobs in this sector. Kleinkneeht and Pfeiffer (1998), have estimated the effects of technology on employment using ordinary least squares and demand equations separately in different countries. This study has been conducted in different European countries based on industrial

(DOI: dx.doi.org/14.9831/1444-8939.2015/3-2/MAGNT.7)

enterprises data in 1992 in Germany with 1921 firms, Denmark with 528 firms, France with 3,600 firms, Norway with 743 firms, Spanish firm in 1998, Luxembourg with 241 firms, Belgium with 557 firms, and Italy with 16,374 firms. Using the cost of research and development (R & D) in the production process and control variables such as sales sell square, labor cost (in the level of activity field) and innovation quality indicators showed that innovation indicators on firms' employment in all countries except Italy were meaningless (but mostly in small firms) and there is positive correlation between the cost of research and development to increase employment that is due to the effects of technology on employment.

Evangelista and Savona (2003), surveyed the impact of the employment of innovation for the economy of Italy during the period of 1993-1995. The results show that the direct effect of innovation on employment is largely different. According to the variety of followed innovative strategies by firms for industries and based on the quality of the labor, high quality and job skills replace low-skilled jobs. The net effect is positive in all small firms and less than half of service sectors. The impact of innovation on employment is negative about the service sector in Italy. Diaz and Tomas (2002) investigated the relationship between innovation and employment for the economy of Spain. The focus is specifically on IT. Technology and its effects on job have been studied both quantitatively and qualitatively. The results indicate a lack of skilled workers for Spain firms, which should resolve this deficiency by increasing employment training programs. Mattucci and Sterlacchini (2003), have gained information evaluate the impact of ICT on employment in Italy, among 173 three-digit ISIC code industry in the period of 1997-2000 and obtained the labor demand equation by minimizing the total cost:

$$C = C(W, R, Y, T)$$

In which, C is cost, W is Wage rate, R is rental rate of capital, Y is yield, T is technology. By using the derivative of the cost of production compared to the price of inputs (shepherd's lemma) labor demand obtained:

$$L^d = \frac{\partial C}{\partial W} = L^d(W, R, Y, T)$$

Since, there is not industrial information in the analysis between the industries for rental rate of capital in Italy, the above equation is assigned to the following equation regardless of possible errors:

$$LnL = \alpha_0 + \alpha_1 LnY + \alpha_2 LnW + \alpha_3 LnT$$

Using this equation is possible when the assumption is that R does not change in different industries. Total differential would be taken to calculate the change in employment:

$$\Delta Ln(L) = \alpha_0 + \alpha_1 \Delta Ln(Y) + \alpha_2 \Delta Ln(W) + \alpha_3 (\frac{I_{ICT}}{L})$$

In the above equation, alternative variable for technological change is the ratio ICT investment per unit of labor and alternative variable of Y is value added in constant prices of 1995 and the variable used to measure the real wage is the cost per hour of work per employee. Researchers have divided industries into two groups: secondary industry and service industries. After estimating the model, they concluded that there is an inverse relationship in ICT investment and employment in secondary industries and there is a direct relationship in service industries. Ucdogruk (2004), has studied the effect of process innovations and product innovations in industry employment of Turkey. The studied period was 1995-1997 and 1998-2000.

The results of this study indicate that process innovations and product innovations have a positive impact on employment in high-tech industries and have a negative impact on employment in industries with low technology. Kaushalesh (2004), in his paper, employment growth and electronic work during the period 1995-2003 were investigated. The purpose of this paper was to study the impact of entering electronic work on displacement of labor. Accordingly, both direct and indirect employments were investigated by the arrival of new technologies and production. This study contains a wide set of Large Indian companies such as skilled firms, manufacturers of electronic goods, work industry on apparel manufacturers. The results show that the arrival of new technologies does not necessarily cause the loss of jobs. Employment due to entering the information and communication technology has a significant growth in the studied countries. However, the main

(DOI: dx.doi.org/14.9831/1444-8939.2015/3-2/MAGNT.7)

growth in employment is about skilled workers. Also application of information and communication technology in these companies has created indirect jobs, which varies depending on company size and industry type. Piva and Vivarella (2005), surveyed the relationship between innovation and employment at 575 industrial firms in Italy during 1992-1997. The applied method for data analysis was compiled data method. The results reflect a positive relationship between innovation and employment in the firm. Masterosefsno and piñata (2005), studied the dynamics of innovation and employment during the periods 1994-1996 and 1998- 2000 for ten European countries and eleven industry. The results show that information and communication technology (ICT) has a negative effect on wages and positive effect on total demand, production and therefore employment. Benavente and Lauterbach (2005), studied the impact of innovation on employment using micro data in the Chilean firms. The research period was 1998-2001 and the results showed that the productive innovation has a significant positive effect on employment at the various levels of skills. But no evidence has been found on the effectiveness of the innovation process on employment. Sapprasert (2006), studied the relationship between information and communication technology and services using firm-level data for the Norwegian economy. It was examined that how information and communication technology factors combines with non-technological factors as a technological innovation and affect the economic performance of the firm. The study shows that (ICT) is a key factor of success for the firm.

Especially the use of (ICT) has higher growth in productivity and utility of services firms. These effects are more when non-technological innovation combined with technological innovation. Koellinger (2006), believes that ICT impact on employment in each country can be studied and analyzed in two different ways, which include: 1. Using ICT causes that works be done by less labor and thereby employment be reduced. 2. The use of ICT will lead to new innovations that increase the growth and employment. Increasing the power and speed of information processing, cheapening hardware and software prices and promoting the use of mechanized systems created optimal information systems and quick and easy access to information, possibility of the calculation of the exchange of data with very high speed, fundamental changes in the business way, rise of e-commerce and ICT-related businesses; this condition not only increases the production costs of firms, but also increases the efficiency of business transactions to electronic means and increasing the added value of the firm's profits. For the good or service producer profit maximization is very important. As a result, production, market scale, and product price will be very important for him. Because ICT can reduce the total cost of producer and increases the total revenue that increases the producer profits. Additional incentives to reduce costs, increasing revenues and improve productivity, cause that firms convert their profit to investments. With the creation of new production and service industries and production of new products, new job opportunities will occur. Lachenmaier (2007) has used consolidated data for years 1982-2000 and dynamic estimation system. The results show that innovation processes and innovation production have a positive effect on employment, but the impact of innovation in the process of innovation is higher in production. Innovation in production creates new products in the market that create new demand. This increased demand also increases employment. But innovation processes mean promoting the level of production processes. Therefore, firm performs its work with fewer workers, which would have a negative effect on employment. In other words, this study shows that the use of ICT in various business sectors such as the process or production sector can have various effects on the employment.

Koellinger (2006), analyzed the relationship between the use of internet-based technologies, different types of innovation and their performance at the firm level. The data source for the study was 7302 European employers. The results show that Internet-based technologies are an important factor for innovation in 2003. In all types of innovation, innovation process, innovation product and Internet and non-Internet-based production have a positive impact on employment. OMahony and Robinsson (2008) studied the effect of ICT on skilled labor demand based on cross-country review. A compilation set of job information for four countries United States of America, England, France, Germany were used in this paper. These data for each country contain more than five occupational groups. The results show that employment and wages of skilled labor have increased significantly due to using ICT. Merikull (2008), surveyed the impact of innovation on employment in Estonia on

(DOI: dx.doi.org/14.9831/1444-8939.2015/3-2/MAGNT.7)

industry and firm level. He used Van reenen labor demand equation in his study. The used statistics in the firm and industry level was during the period 1994-2005. The results show that ICT has a positive effect on employment in the level of industry and firm. Innovation process has the strongest effect on the firm level and innovation production has the strongest effect on the industry level.

Harisson et al. (2008), assessed the impact of ICT in four European countries France, Germany, Spain, and England in the firm level during the period 1998- 2000. The results showed that innovation production has a positive effect on employment and innovation process has a negative impact on employment, but compensatory effect by decreasing prices cause the impact of information and communication technology (ICT) in total employment be positive. Bogliacino and Pianta (2010), surveyed the relationship between innovation and employment at the industry level for eight European countries during the period 1994-2004 by Taxonomy method to determine the effect of technological change on educe or create jobs. The results show that technology has a positive effect on labor demand and has a negative effect on wages. Dimelis et al. (2010), studied the effects of information and communications technology (ICT) in the level of industry in America and Europe during the period 1980-2000. The estimation method was GMM that shows a significant effect of information and communication technology (ICT) on growth in Europe and America during the 90s. This effect is stronger for European countries in the early 90s and it is weaker after that. This effect in America in the early 90s was weaker and then got stronger.

Kiani and Akhavan (2003), in a paper entitled "surveying the effects of information and communication technology (ICT) on involvement in industry in Tehran province" investigated the impact of information and communication technology on employment. The population of the study consisted of 2002 cross-industry data in Tehran (56 ISIC three-digit industry code) and industrial sites units with 10 employees or more. Then results collected through random sampling and distributing questionnaires. In this study, CES cost function derived from the production function first and then labor demand function was extracted using the shepherd's lemma. In this study, several factors are considered instead of information and communication technology (ICT) as follows. Pc: the number of users of computers in every industry (ISIC three-digit code), Pcr: proportion of workshops using computer to workplace in each industry (ISIC three-digit code), Pclr: proportion of computer users to labor in each industry (ISIC three-digit code), Int: the number of Internet users in each industry (ISIC three-digit code), Intr: proportion of internet user to the whole workshop in each industry (ISIC three-digit code), Intlr: : proportion of internet user to the whole labor in each industry (ISIC three-digit code), Ecr: proportion of the total e-commerce user to the whole workshop in each industry that in all these indicators only Pcr index replied in significant level of 5%. After estimating this model, results indicate that the impact of information and communication technology (ICT) on the employment of skill levels of skilled, technicians and engineers are meaningless and in the case of unskilled workers, impact of computers is negative on the employment of this skill levels. And finally, the impact of ICT in total employment is negative and it is concluded that the most affected employment in the industrial sector employment is simple. Zakeri Nia (2003), studied the impact of information technology on employment in Iran (1666-1996) based on the experience of elected countries with regard to the particular circumstances in Iran, Information and Communication Technology (ICT) in the short term and long term has a positive effect on employment.

Ghobadi (2005) focused on the effect of information and communication technology (ICT) on gender inequality using fusion data. In most cases, the results show a positive correlation between ICT indicators and the gender inequality. This inequality is higher in developing countries that raise the issue of poverty in these countries. Hozhabr Kiani (2005), examined the impact of electronic commerce on macroeconomic variables. In most cases, a positive relationship (negative) was observed between employment (unemployment) and substitutes for measuring product innovations. Dasht Bozorg (2006), in his thesis entitled "The impact of technology on employment in the industrial sector" has calculated the effects of technology on employment in the period 1668-2003 for large industrial plants using a regression model with interval delay (ARDL). The purpose of this study was to understand the effects of technological change on employment and the structure of employment in the industrial sector. This study estimated the labor demand model with an emphasis on technology and seeks to identify the root of the problem that do the import of capital goods and the cost of

(DOI: dx.doi.org/14.9831/1444-8939.2015/3-2/MAGNT.7)

research and development has an impact on labor demand or not how is its impact. In this study, technology has been determined in research and development expenses and capital goods imports. Model parameters have been estimated using the self-regression estimation method with interval delay. The results in the total factory industry of Iran show that elasticity of demand for skilled labor in the long term to value added in the industrial sector 69% and the elasticity of employment with respect to the stock of physical capital is 37%. Employment elasticity of skilled labor to the cost of research and technology development as a surrogate variable in long-term is positive and 15%. He concluded that the costs of research and development have a positive effect on employment in the manufacturing sector and imports of capital goods in the manufacturing sector have a negative effect on labor demand. Emadzadeh et al. (2006), in an article entitled "Effect of information and communication technologies on employment" using a microeconomic model with a logarithmic model effects (ICT), the employment rate was investigated. Review model is estimated with the approach of the combined data and for 47 countries (including the 22 OECD member-countries and 25 developing countries) during the years 2000-2003.

The result represents a significant positive effect of ICT on employment. The elasticity of employment with respect to the cost of ICT was 0.11 that shows one percent increase in the cost of ICT, to 0.11 percent employment rate increases. Mirzaei, Arbabian and Hafezi (2007), using input-output model surveyed the effects of the ICT sector employment compared with sectors of the economy. For this purpose, various indicators such as the late and former ties outputs and also direct and indirect employment coefficients are applied. The results show that ICT sector in terms of direct employment coefficient has the tenth grade among the various sectors of the economy. So, with each milliard Rials increase in the value added of ICT directly about 48 new jobs will be created in this sector. Indirectly ICT will provide around 32 new jobs in different economic sectors. Rasoulinezhad and Nouri (2009) studied the effect of ICT on employment in Iran using a microeconomic model. The model was a vector error correction for Iran during 1959-2006. The results show that ICT in the short term has negative effects on employment, but in the long term this effect will be positive. The impact of ICT on skilled labor in the long term is positive and on unskilled labor is negative. Afshari and Ramazani (2006), studied the impact of ICT on women's employment in cross-country. The results showed that ICT had no significant effect on the rate of female economic activity but its impact on income and increase their capabilities have been significant. Except that the positive impact of ICT in the short term increases and then decreases with time.

3. Population and statistical data

The population of the research was factory industry of Tehran province in the four-digit level of ISIC code that is obtained from the census and the total population of the ten staff or high in Tehran province in the four-digit level of ISIC codes was during 2006-2010. So the difference between the sample and population included in this study is only to remove some of the information or observations to balance the combined data. In this study, data relating to employment, wages, ICT indicators, value and price of capital were collected from the Statistical Center of Iran and for the years 2006-2010 by the price index of 2004, which are provided by the Central Bank and the separation of ISIC code converted to constant prices and the data on capital stock (K) and the price of capital (R) are calculated in the following with the explained method. Analysis method was based on econometric methods and using a panel data model and software industry of Eviews7. Capital inventory or "tangible fixed produced assets" is a set of physical capital goods in the country that are measurable and involved in the production process of goods and services and generate revenue. According to the definition of national accounts, capital inventory is net capital formation with regarding the cumulative figures in their lifetime (central banks, financial accounts department). Thus, capital inventory can be a total capital value "of buildings and facilities" and "machinery and equipment", which is used in the production process or usable. In this paper, ratio of capital to production and the acceleration is used to calculate the capital inventory. Thus, the ratio of capital to production at the beginning and end of the year is equal, therefore we will have:

$$\frac{K_t}{Qt} = \alpha$$

(DOI: dx.doi.org/14.9831/1444-8939.2015/3-2/MAGNT.7)

In which, K_t capital inventory at time t, Q_t production at time t and α the ratio of capital to production. On the other hand, gross investment based on the acceleration is equal to:

$I_t = K_t - (1-\lambda)K_{t-1}$

λ is the rate of depreciation and I_t is the gross investment.

So, for year t we have:

$I_t = \alpha\ Q_t - (1-\lambda)\alpha\ Q_{t-1}$

The result α is obtained as follows:

$$\alpha = \frac{I_t}{Q_t - (1-\lambda)Q_{t-1}}$$

And using equation (4), K_t is obtained:

$K_t = \alpha\ Q_t$

(λ) the amount of depreciation in the industry is considered as 6 percent based on the work of Hozhabr Kiani and Boghozian (1997) and Karamini, Nahavandi and Saffaripour (1998) in Management and Planning Organization.

Then regression equation is obtained for equation (3) for the last years of statistical data, in which net investment had low volatility using a nonlinear least squares (NLS) (the parameter is non-linear and is not convertible to linear) α and then K_t for ISIC code. Data on the cost of capital is calculated as follows:

WL= Compensation of employees

$\frac{WL}{Q} = \alpha =$ Labor share of production

$1-\alpha = \frac{R.K}{Q} =$ Capital share of production

$R = \frac{(1-\alpha).Q}{K} =$ Capital price

In the above equation, after obtaining α from the first equation and estimating capital inventory (K_t) with the mentioned method and knowing Q the capital cost for each ISIC code is obtained.

4. Model stipulation

The applied model in this study is based on Matteucci and Sterlacchini (2003) using the production function with constant elasticity of substitution (CES) to investigate the effects of ICT on employment in the industries of Tehran province in the four-digit ISIC codes. Production function with constant elasticity of substitution (CES) and with three factor, labor (L), capital (K), and technology (A) is as follows:

$$Q = A\left[\alpha L^{-\rho} + (1-\alpha)K^{-\rho}\right]^{-\frac{1}{\rho}}$$

And the cost function is:

$$C = QA^{-1}WR\left[(1-\alpha)^{\sigma}W^{-\sigma\rho} + \alpha^{\sigma}R^{-\sigma\rho}\right]^{\frac{1}{\sigma\rho}}$$

(DOI: dx.doi.org/14.9831/1444-8939.2015/3-2/MAGNT.7)

In which, W is wage, R is capital price, Q is value added, and A is measure of technology. Since one of the main goals of producing units is minimizing cost, the cost becomes minimal compared to a production function, so that the result of final demand is a function of output and input prices. So, labor demand function using the least-cost method (shepherd's lemma) is obtained:

$$\frac{\partial C}{\partial W} = L^d = QA^{-1}\alpha^{\frac{1}{\rho}}\left[(\frac{1-\alpha}{\alpha})^{\sigma}(\frac{R}{W})^{\sigma\rho}+1\right]^{\frac{1}{\rho}}$$

After the logarithm of labor demand function derived above, we have:

$$LnL = C + \alpha_1 LnW + \alpha_2 LnR + \alpha_3 LnQ + \alpha_4 LnA$$

In this paper, the dependent variable is labor employment at different levels of skilled, simple, technicians and engineers. Independent variables including capital price, labor cost, value added and information and communication technology indicators such as the provision of information (OIP) (percentage of employers who use the internet to provide information on the total number of workplace that have computer), number of using computer index (UCR) (number of employees in each industry using the computer) and internet (UIR) (number of employees in each industry using the internet in general).

5. Estimating patterns and analyzing results

The results of F limer test and χ^2 Hassman is summarized to detect data pooling method and estimating pattern for each variable in the Table (1).

Table 1.

Model		Limer Test		Hausman test	
Work force	Index	df	Cross-section/period F	df	Chi-Sq.Statistic
Total work force	OPI	(85, 320)	21/05	4	245/98
	EIP	(85, 320)	21/05	4	245/98
	UCR	(85, 320)	17/66	4	232/19
	UIR	(85, 320)	14/83	4	109/37
Unskilled Labors	OPI	(85, 320)	10/99	4	57/60
	EIP	(85, 320)	10/99	4	57/60
	UCR	(85, 320)	7/42	4	47/29
	UIR	(85, 320)	9/92	4	51/54
Skilled Labors	OPI	(85, 320)	6/91	4	69/55
	EIP	(85, 320)	6/91	4	69/55
	UCR	(85, 320)	5/40	4	70/88
	UIR	(85, 320)	5/56	4	32/46
Technicians	OPI	(85, 320)	5/49	4	33/18
	EIP	(85, 320)	5/49	4	33/18
	UCR	(85, 320)	6/57	4	40/84
	UIR	(85, 320)	7/41	4	55/42
Engineers	OPI	(85, 320)	10/94	4	35/62
	EIP	(85, 320)	10/94	4	35/62
	UCR	(85, 320)	12/32	4	60/45
	UIR	(85, 320)	13/68	4	55/13

(DOI: dx.doi.org/14.9831/1444-8939.2015/3-2/MAGNT.7)

After selecting the appropriate model based on the results of Table 1, experimental results were obtained as follows with rejecting F limer test and χ^2 Hassman and finally the fixed effects model (FEM).

5-1. Estimation for the total labor

Information of Table (2) shows the estimation results for the total labor of Esfahan province for information and communication technology indicators, wage, capital price, and value added. Since, the variables are logarithmic, parameters are elasticity estimation.

Table 2. Results for the total labor

Variables	Earning Information (EIP)	Providing Information (OIP)	Number of Internet Users to all labors (UIR)	Number of Computer Users to all labors (UCR)
Constant	-14/21 (-56/61)	-14/21 (-56/94)	-15/26 (-89/09)	-14/97 (-87/18)
Log(value)	0/07 (2/65)	0/07 (2/65)	0/06 (3/28)	0/12 (4/85)
Log(w)	-0/77 (-26/86)	-0/77 (-26/86)	-0/81 (-44/56)	-0/73 (-26/12)
Log(r)	-0/09 (-4/95)	-0/09 (-4/95)	-0/06 (-5/51)	-0/06 (-4/10)
Log(A)	-0/03 (-1/85)	-0/03 (-1/85)	-0/15 (-20/99)	-0/29 (-18/19)

* Numbers in parentheses are t statistics

According to Table (2), it can be said that information educe index (EIP), and information presentation (OIP) have no significant effect on total employment. Thus, producing effect is equal to process effect. In other words, the employment rates of these indicators is equal to the unemployment rate. In the case of the internet user number (UIR) and computer user number (UCR), it can be said that both variables have negative and significant effects on total employment that represents the prominent of process effect on producing effect. Estimated parameters were for labor price, capital price, and value added and they are corresponded with economic theory. F statistics also confirmed the significance of the regression.

5.2. Estimation for the unskilled labor

Table (3) shows the results for the unskilled labor in Esfahan province for information and communication technology indicators, value added, capital price and wage.

Table 3. Results for the unskilled labor

Variables	Earning Information (EIP)	Providing Information (OIP)	Number of Internet Users to all labors (UIR)	Number of Computer Users to all labors (UCR)
Constant	-15/37 (-31/58)	-15/47 (-32/06)	-16/91 (-38/71)	-17/35 (-61/48)
Log(value)	0/03 (0/39)	0/03 (0/39)	0/003 (0/99)	0/2 (3/57)
Log(w)	-0/81 (-12/30)	-0/81 (-12/30)	-0/88 (-16/30)	-0/66 (-11/64)
Log(r)	-0/11	-0/11	-0/12	-0/09

(DOI: dx.doi.org/14.9831/1444-8939.2015/3-2/MAGNT.7)

	(-2/83)	(-2/83)	(-4/02)	(-3/18)
Log(A)	-0/25 (-7/56)	-0/25 (-7/56)	-0/23 (-12/83)	-0/8 (-21/40)

* Numbers in parentheses are t statistics

According to Table (3), all parameters for information and communication technology indicators have a significant and negative effect on the unskilled labor's employment. Thus, it can be argued that unskilled labor in factory industry sector doesn't have the ability to use information and communication technology. Thus, the negative effect hypothesis of these indicators on the unskilled labor's employment is approved. Other estimated parameters for the remaining variables are significant and are consistent with economic theory. F statistics also confirmed the significance of the regression.

5-3. Estimation for the skilled labor

Table (4) shows the results for the skilled labor in Esfahan province for information and communication technology indicators, value added, capital price and wage.

Table 4. Results for the skilled labor

Variables	Earning Information (EIP)	Providing Information (OIP)	Number of Internet Users to all labors (UIR)	Number of Computer Users to all labors (UCR)
Constant	-17/86 (-46/02)	-17/88 (-46/60)	-18/07 (-59/14)	-18/04 (-52/05)
Log(value)	0/12 (2/50)	0/12 (2/39)	0/10 (2/16)	0/16 (3/21)
Log(w)	-0/81 (-15/25)	-0/81 (-15/25)	-0/82 (-15/70)	-0/76 (-13/90)
Log(r)	-0/17 (-4/93)	-0/17 (-4/93)	-0/14 (-4/92)	-0/11 (-3/65)
Log(A)	-0/03 (-1/04)	-0/03 (-1/04)	-0/16 (-10/96)	-0/34 (-10/81)

* Numbers in parentheses are t statistics

According to Table (4), it can be said that information educe index and information presentation have no significant effect on skilled employment. Thus, it can be argued that skilled labor in factory industry sector don't have the ability to use information and communication technology. Two indices of computer and internet user number have a negative effect on employment, which indicates the inability of skilled labor in using these two indices. Other estimated parameters for the remaining variables are significant and are consistent with economic theory. F statistics also confirmed the significance of the regression.

5.4. Estimation for the technician labor

Table (5) shows the results for the technician labor in Esfahan province for information and communication technology indicators, value added, capital price and wage.

Table 5. Results for the technicians

Variables	Earning Information (EIP)	Providing Information (OIP)	Number of Internet Users to all labors (UIR)	Number of Computer Users to all labors (UCR)
Constant	-17/71 (-48/35)	-17/55 (-48/02)	-17/26 (-41/42)	-16/65 (-37/09)
Log(value)	0/07 (1/80)	0/07 (1/80)	0/06 (3/16)	0/17 (3/16)

(DOI: dx.doi.org/14.9831/1444-8939.2015/3-2/MAGNT.7)

Log(w)	-0/97 (-18/64)	-0/97 (-18/64)	-0/92 (-16/43)	-1/03 (-16/90)
Log(r)	-0/02 (-0/48)	-0/02 (-0/48)	0/05 (1/42)	0/03 (0/77)
Log(A)	0/39 (10/85)	0/39 (10/85)	0/01 (2/96)	0/26 (3/26)

* Numbers in parentheses are t statistics

According to Table (5), all parameters for information and communication technology (ICT) indicators have a significant and positive effect on the technician labor's employment and the positive effect hypothesis of these indicators on the technician labor's employment is approved. Other estimated parameters for the remaining variables are significant and are consistent with economic theory. F statistics also confirmed the significance of the regression.

5.5. Estimation for the engineer labor

Table (6) shows the results for the engineer labor in Esfahan province for information and communication technology indicators, value added, capital price and wage.

Table 6. Results for the engineers

Variables	Earning Information (EIP)	Providing Information (OIP)	Number of Internet Users to all labors (UIR)	Number of Computer Users to all labors (UCR)
Constant	-16/68 (-48/87)	-16/55 (-48/62)	-16/05 (-53/73)	-15/35 (-39/48)
Log(value)	0/04 (0/98)	0/04 (0/98)	0/02 (0/49)	0/02 (0/49)
Log(w)	-0/80 (-18/42)	-0/80 (-18/42)	-0/73 (-16/33)	-0/83 (-17/04)
Log(r)	-0/02 (-0/68)	-0/02 (-0/68)	-0/03 (0/95)	0/007 (0/23)
Log(A)	0/33 (9/40)	0/33 (9/40)	0/03 (2/30)	0/34 (9/05)

* Numbers in parentheses are t statistics

According to Table (6), all parameters for information and communication technology indicators have a significant and positive effect on the engineer labor's employment and the positive effect hypothesis of these indicators on the engineer labor's employment is approved. Other estimated parameters for the remaining variables are significant and are consistent with economic theory. F statistics also confirmed the significance of the regression.

6. Conclusions and recommendations

According to the research findings, the two indices of the internet user number and computer user number have positive and significant effects on the total employment that represents the prominent of producing effect on process effect in Esfahan province. In the case of unskilled labor, all indices have a negative effects on the unskilled labor employment, which is consistent with economic theory and the negative effect hypothesis of these indicators on the unskilled labor's employment is approved. In the case of skilled labor, some of the indices have a negative effect and some other have no significant effect that indicates the inability of skilled labor in using information and communication technology in this province. In the case of engineer labor, all indices have positive effects on the engineer labor employment and the positive effect hypothesis of these indicators on the engineer labor's employment is approved. According to the results, the following policy recommendations are suggested: A. Due to the positive effects of ICT on the employment of Tehran province's industry, using this factor has increased the employment in engineer levels.

(DOI: dx.doi.org/14.9831/1444-8939.2015/3-2/MAGNT.7)

Thus, this effect can be strengthened by creating correspondence between their job, education and skills, and providing appropriate platforms to use ICT and prevent the rate of unemployment among university graduates. Due to negative effect of ICT on unskilled and skilled employment levels, therefore, the rate of unemployment among them can be prevented by necessary training to these workers. C. Due to the positive effects of ICT on the employment of the whole industry sector of great Esfahan province, the existing production capacities can be expanded by supporting and providing appropriate platforms to use this technology in parallel with complementary economic policies and this can be very effective on increasing the total employment in the industrial sector in Tehran province. D. Due to the high positive sensitivity of labor demand to value added of industry sector and considering the existence of sufficient demand, the approach of the creation and use of new technologies (indigenous technology) can create long term employment capacity especially in expert labor in manufacturing industry while promotion of products' quality. This can enhance the value added significantly. In total, ICT as a comprehensive technology can enable other economic factors and improve the quality of production factors and in this way, it helps the process of economic development and achieves sustainable growth. Considering that ICT is not very capital intensive compared with other industries and rely more on the technical skills of human resources, thus, it has much potential to create employment.

References

Afshari, Z. and Ramazani, F. (2006) "The impact of information technology on employment of women cross-country study," Women Researches, Vol.4, No.1, pp. 23-36.

Bogliacino, F. and Pianta, M. (2010).”Innovation and Employment “: A Reinvestigation using Revised Pavitt classes, Research Policy 39, P: 799-809

Dasht Bozorg, A.A. (2006), "The impact of technology on employment in the industry." Master thesis in economic sciences, School of Economics Accounting, Islamic Azad University, Central Tehran Branch.

Emadzadeh M. (2006), "The effect of ICT on employment", Journal of economic research, No.75, pp. 218-197.

Ghobadi, N. (2005). Information and communication technology impact on gender inequality, modern business economy Quarterly, No. 2, pp: 77- 67

Greenan, N. and Guellec, D. (1997). Technological Innovation and Employment Reallocation, INSEE mimeo

Hozhabr Kiani K. and Baghzian A. (1997), "A method for estimating the capital's major economic sectors", Journal of economic researches of Beheshti University, No. 6.

Hozhabr Kiani, K. and Akhavan Sh. (2007), "Studying the role of information on Employment and communication industries in Tehran" .peyke Noor Vol.5, No.4, pp.41-27.

Kaushalesh Lal,(2004),Growth of Employment and the adoption of E-Business, Discussion Paper Series, United Nation University.

Kleinkneeht, A., Licht G., Pfeiffer F., (1998), the Impact of Innovation on Employment in Erupe – An Analysis using CIS Data, ZEW-Dokumentation,98-02

Koellinger, P.,(2006),Impact of ICT on Corporate Performance, Productivity and Employment Dynamics, European Commission, P:3-22

Matteucci, N., Sterlachini,A.(2003), ICT and Employment Growth in Italian Industries, Available at :http//www.niesr.ac.uk/research/epke/WP-17.pdf

Merikull, Jaanika.(2008), The Impact of Innovation on Employment: Firm and Industry Level Evidence from Estonia.

(DOI: dx.doi.org/14.9831/1444-8939.2015/3-2/MAGNT.7)

Mirzaei, Arbabian and Hafezi (2007), "Effects of information and communications technology sector employment in the economy", Journal of Scientific Research and Development, No. 20, pp: 211- 185.

OECD, 2002: Measuring the Information Economy, (Available at www.OECD.org/sti/measuring-inforeconomy)

Pahjola, M., (2002), New Economy in Growth and Development United Nation University, WIDER. Discussion Paper No2002/67. Available at: www.wider.unu.edu

Rasoulinezhad E. and Nouri M. (2009), "The impact of information technology on employment." Journal of economic research, No.89, pp.107-87.

Scaramuzzi, E. (2002), E-government Lesson and Approaches, Available at: www.newecentury.com/info/lesson

Ucdogruk, Y. (2006), Employment Impact of Product and process Innovation in turkey, University of Istanbul, Turkey.

Van Reenen, J., (1997), Employment and Technological Innovation: Evidence from UK manufacturing firms, Journal of labour Economics, Vol:15,pp:255-284.

(DOI: dx.doi.org/14.9831/1444-8939.2015/3-2/MAGNT.7)