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# Effect of Information and Communication Technology on Firms Performance in Iran

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**Abstract:** During the last decades, the technological revolution forces industries and enterprises to use technology-based processes and equipment to overgrow. Production chain management with the use of information and communication technology equips production tools with new technologies. The usage of information and communication technology in industries and manufacturing enterprises in developed countries and countries whose industries have grown significantly, since, the 1990s have caused significant changes in improving product quality, increasing productivity and reducing time in the manufacturing sector. At the same tie, they could overcome their weaknesses with the benefits of ICT and stand in the right place in the economy. This study tries to study the impact of Information and Communication Technology (ICT) on the Iranian manufacturing sector. In this research, the effect of ICT on firm performance (manufacturing units with ten employees and more) has been investigated. By considering data of 22 sectors during 2008-2016 and employing the GMM method, the impact of ICT application's usage on the income growth has been assessed. The results showed that hardware and software usage, communication technology has a positive and significant effect on income growth. While fixed capital formation, employment, exchange rate and R&D have a positive and significant impact, the producer price index has a negative and significant effect on income growth.

## INTRODUCTION

The steam engine's advent in the eighteenth century and the outbreak of the Industrial Revolution in England encouraged other countries to move toward industrialization. This revolution was called the most significant change in the world. The third revolution (information revolution) caused both industry and agriculture can no longer continue without information technology.

Information and Communication Technology (ICT) has significant effects in all areas of business activity in today's world. In the production chain, ICT accelerates the production cycle, improves product quality, improves

labor productivity, reduces the production cost, monitors and controls the production process efficiently and reduces production and distribution time. In the supply chain, ICT eliminates intermediaries in marketing, delivers goods and products to consumers rapidly, helps consumer choice, creates a platform for product comparison and improves customer services with higher quality and speed. At the same time, it provides the opportunity and platform for managers to analyze the production, supply, demand and market conditions. Any manager who is unaware of this critical issue, his company will be seriously harmed in competition with other firms equipped with ICT tools.

In other words, industries are integrated with ICT and it has been able to solve the industry's problems. Naturally, the need for technology will increase to succeed in competitive markets. The importance of ICT in industries and manufacturing enterprises in developed and emerging countries led us to examine whether the use of these technologies in Iran has also led to improved performance or not. Therefore, ICT usage in industrial enterprise's performance with more than ten employees in Iran has been investigated in this study.

**Literature review:** Diversity and evolution of the economic growth model, although, promising to increase human resources to achieve economic growth, it may be different for developing countries whose demand for development differs from the structure of the countries in which these theories have evolved. Therefore, choosing a growth theory from various theories cannot be done easily and it requires a lot of research and studies to select the most appropriate model.

The theories about economic growth from Young, etc., until 2001 brought many changes in terms of influential inputs to growth. These changes include adding endogenous or exogenous variables such as human capital in the model, type of production function, increase or decrease in the scale of production of inputs, the definition of capital and separation into physical and human capital and policy variables. In other words, there have been three different waves of growth theory in the last six decades. The first wave is related to the study of Harrod-Domar. The second wave was the development of neoclassical theory and the most important is the long-term growth model of Solow which is based on the substitution between labor and capital. The third wave of revolution in economic growth models is endogenous growth models that emerged as a reaction to the neoclassical model's shortcomings. This strand of theories, emphasizes investing in human capital, innovation and knowledge as the endogenous factors affecting economic growth.

An enterprise is a set of resources including financial resources, human resources, production tools and technical knowledge that produce and supply specific goods and services and sell them for economic profit. Earning a profit is one of the most important characteristics of economic enterprises; therefore, it is essential to examine the enterprise's performance to determine whether they have been able to achieve their predetermined goal of increasing revenue or profit. In this research, the growth of income has been used to evaluate the firm's performance.

According to Porter's competitiveness strategy, firms that pursue revenue growth strategies are different from firms that seek cost-cutting strategies. The growth of profit from increasing revenue is more sustainable than the growth of a firm from cost reduction; however, managing the revenue is usually more complicated than cost management.

In summary, various factors affect revenue growth as the firm's performance indicators which the most important ones will be discussed.

**Capital formation:** Any society's growth and development depend on fixed capital formation to produce goods and services and distribution between people and enterprises. Therefore, the strength of the national economy depends on the ability and inventory of its infrastructure. This infrastructure's quality and efficiency are adequate for the continuity of society's commercial and economic activities and quality of life and social health. Auken[1] argues that decisions about a firm's fixed capital structure have two aspects: first, the required capital and second, the combination of sources of funding. It assumes that the enterprise is aware of the amount of capital it needs. In such a case, the question arises as to which resources it should use to raise capital.

**R&D:** The development and expansion of intellectual capital in enterprises will be among the next decade's most critical issues. Individual intellectual capital will replace mechanical labor and enterprises will become knowledge-based. Therefore, firms must prepare for this transformation. The continuous growth, the changes of the market structure, the shortening of the product life cycle and the organization's need for adaptability have added to the challenge. Science and technology and establishing a systematic relationship between these two are the primary research and development results. Establishing such a relationship at the right time can be one of the critical factors in companie's growth and development. Today, in most countries, scientific planning and policy-making have become part of their plans. The effect of R7D on firm performance has been assessed and confirmed by

many researchers[2-4]. Unfortunately, this category has not received much attention in Iran which has led to minor innovation in its industry and products.

**Employment:** One of the essential tools for creating changes, the organization's survival and achieving the desired goals and missions is the human resource. Human resources in the organization and how a company looking at them will play a significant role in the organization's success. With the beginning of the third millennium, human resource's role has become more prominent every day. It has considered the only factor in achieving success and sustainable competitive advantage[5].

Farhadi believes that human resources strategies are known as the fundamental pillars of improving the organization's performance. He asserts addressing it is essential for increasing the effectiveness and efficiency of human resource management and development activities of organizations that have reached a level of maturity in this area. In the economic growth literature, investing in human capital and technology moves from low to high growth levels with higher productivity and higher returns. Theoretically, technology affects employment in two ways: first, production process innovation which reduces the demand for non-skilled labor or increases the demand for skilled labor and second, productive innovation which involves changes in the method of production, production of new products and through compensatory effects by creating new job opportunities and increases the demand for skilled labor.

**Exchange rate:** Monetary and financial factors are among the factors affecting the performance of companies. Exchange rates are one of the factors that affect the business relations of enterprises with the outside world. All firms are at risk of exchange rate fluctuations. In addition to affecting foreign loan's repayment, exchange rate fluctuations can affect the company's obligations in foreign markets (such as pre-purchase of goods). Exchange rate fluctuations have affected both the commodity market and the capital market and can have catastrophic effects[6].

**Producer Price Index (PPI):** The PPI represents the inflation rate, with the difference that the basket of this index is only related to production costs by firms. Any change in the manufacturer's price indicates whether the consumers pay more for that product or not. Higher producer prices usually mean that consumers pay more in the retail stage and vice versa. Because a rise in the producer price index implies an increase in production costs and if producers do not pass this increase on to consumers, they will lose. Therefore, with the rise of the producer price index, the producer's income also increases.

**Information and communications technology:** According to Lucas, information and communication technology refers to all technologies for processing and storing information electronically. For this purpose, equipment such as computers, communication equipment, networks, fax machines and any controllable electronic package are used[7].

Rasoulinezhad and Nouri[8] states that ICT is a set of technologies for manufacturing, storing, exchanging and using information in various business forms. This includes business information, voice conversations, still and motion pictures, multimedia and other forms that have not yet been created. As this technology develops and expands in society, it affects micro and macroeconomic variables.

The use of ICT and its applications has accelerated company processes and has led to increased growth through fundamental business changes, including the emergence of E-commerce and ICT-related activities. ICT reduces firm's production costs, increases business efficiency, conduces exchanges electronically and provides intelligent customer service and these changes increase enterprise's value-added and profit. Simultaneously, by creating manufacturing and service industries in the economy and producing new products, ICT has created new job opportunities[9]. The rapid growth of ICT has dramatically affected human life today and seems to have the most significant impact on economic growth and development. Today, a large share of economic activities related to the production, transmission, storage and distribution of data and information among economic actors and therefore, the development of information technology significantly impacts their economic activities. This effect is such that most countries have replaced the knowledge-based economy approach to economic development based on resource-based economic development.

**How ICT play roles?** Jamali *et al*.[7] argue that there are significant relationships between firm's growth and ICT. On one side, information technology increases firm's profit, expected value and organizational learning. On the other side, by decreasing the minimum efficient scale, uncertainty and transaction costs can affect firm's growth. Therefore, ICT has a positive impact on firm's growth and those firms with higher information technology expenditure can have a higher growth rate.

Moreover, Weill *et al*.[10] analyzed the IT infrastructure services and identified 70 different services in 10 IT infrastructure services clusters. The first six clusters that comprise the physical layer of IT infrastructure capability include channel-management services, security and risk management, communication services, data management services, application-

infrastructure services and IT-facilities-management services. In addition to the six service clusters, four clusters represent management-oriented IT capabilities. IT-management services, IT-architecture-and-standards services, IT-education services and IT R&D services are these four clusters. These capabilities are classified into three areas: technology, management and knowledge.

**Technology capabilities:** Investment in ICT has been shown to positively and significantly affect firm performance. ICT is an embedded technology and constitutes a component of products and services. Its usage helps to strengthen the survival of firms in several ways such as reducing firm's cost, improving information access, improving administrative and product management and enhancing productivity by improving management[7].

**Management capability:** Mata, etc., suggest that ICT management skills can be expressed in four essential aspects of management skills including the ability of ICT managers to understand the company (business), the ability to work with other executive managers to develop operational plans, the ability to establish ICT support activities for firm performance and the ability to predict the future.

**Knowledge capabilities:** Tippins and Sohi[11] have focused knowledge specifically on technology systems. This is the part of knowledge that is usually classified as human assets. An organization or company is more than an information processing unit; it is a unit of information and knowledge creation. In general, the capacity of information from the mechanism of information and communication technology is not just information processing but also knowledge processing and transfer[12].

**ICT and enterprise performance:** Today, ICT is one of the crucial factors in the performances of firms. Virtual networks, E-commerce, internet marketing and E-services show the extent of entrepreneurship in the information age. The effects of this change are evident in business, transportation, education, the workplace, home and in general, all aspects of life.

The relationship between ICT and company performance can be examined at two levels: the first level includes the company's internal processes and the second level comprises external processes. At the first level, ICT has a significant impact on the company's internal factors, including quality and diversity, innovation, relative price, optimal capacity, inventory turnover, production growth and commercial profitability. At this stage, it also leads to positive changes in profitability metrics such as net sales, final gross profit, final operating profit, final net profit, fixed resource turnover, total resource turnover and inventory turnover. Furthermore, in intangible outputs such as introducing a new business process, the emergence of highly skilled employees and the emergence of an organizational transition, the cost of software development and database production is very influential. Concerning these effects, it can be said that ICT has a significant impact on the company's overall productivity, leading to quality growth of products, reducing the final cost and increasing the company's competitiveness with competitors.

The second level which includes external processes, provides interaction with investors and shareholders, suppliers, customers and after-sales service. ICT performance at this stage can be seen through the general usage of IT such as Email, E-commerce, Enterprise Resource Planning (ERP), Supply Chain Management (SCM) and Customer Relationship Management (CRM); there are other special applications of IT in the manufacturing which are useful for firms. Computer Integrated Manufacturing (CIM), Manufacturing Automation Protocol (MAP), Material Requirements Planning (MRP), Manufacturing Resource Planning (MRP II), Computer-Aided Design (CAD), Computer-Aided Manufacturing (CAM) and Flexible Manufacturing are some of the applications that are useful to firms.

The effect of ICT on firm performance has been studied in many kinds of research, including Samimi and Kiani[13], Rasoulinezhad and Nouri[8] and O'Mahony *et al*.[14]. Brynjolfsson and Hitt[15], Harrison and McMillan[9] (2006) and Jamali *et al*.[16] that by employing different econometric methods have examined the effect of ICT on the firm performance. The results of these studies indicate a positive and significant impact of ICT on firm's performance.

## MATERIALS AND METHODS

In each study proper methodology should be consider to assess the goal of the research. In this research, the main hypothesis is:

The application of information and communication technology has a positive and significant effect on Iran's industrial unit's performance. In this regard, two sub-hypothesis are: the usage of software and hardware has a positive and significant effect on Iran's industrial unit's performance.

The use of telecommunication technology has a substantial impact on Iran's industrial unit's performance

In this study, revenue growth has been used as the dependent on determining companie's performance. Given that the growth of a company's revenue each year is not unaffected by the previous year's revenue growth, the lag of this variable is used as an independent variable. So, it is a dynamic panel model and for its estimation, the Generalized Moments Method (GMM) is used. The GMM estimator, by taking rst difference from the model, wipes out the time-invariant or firm speci c effects from the model. At the same time, it gets rid of any endogeneity that may be due to the correlation of these firm specific effects and the right-hand side regressors[17]. To test the GMM estimator's consistency, two tests proposed by Arellano and Bond are used. The rst is a Sargan test of over-identifying restrictions which tests the instrument's overall validity by analyzing the sample analog of the moment conditions used in the estimation procedure. The second test examines the assumption of no second-order serial correlation. Failure to reject the null hypothesis of both tests gives support to our estimation procedure[18].

This study aims to investigate the effect of ICT application on firm performance and the following model will be used to test the hypothesis:

$$\begin{aligned}INCOMGit = \alpha+\beta0INCOMGit-1+\beta1SHit+\\ \beta2CTit+\beta3EMPLOYit+\beta4CFit+\beta5EXCHit+\\ \beta6PPIit+\beta7RDit+\varepsilon it)\end{aligned}$$

Where the dependent variable is INCOMG and the independent variables are; SH accounts for payment for software and hardware. CT is payment for telecommunications, EMPLOY for skilled employees, CF for fixed capital formation, EXCH for the exchange rate, PPI for producer price index and RD for research and development costs.

**Data and variables:** The data from enterprises with ten and more employees gathered from the Iran Statistics Center and included 22 sectors (2-digit ISIC Codes) during nine years from 2008-2016. The data of other variables that affect the industry's performance have been collected from the Central Bank of Iran.

**INCOMG:** INCOMG as the dependent variable represents income growth and is calculated using the following formula:

$$INCOMG = \frac{Output\ Value_t - Output\ Value_{t-1}}{Output\ Value_{t-1}}$$

Output value represents the total value of goods produced, revenue received for manufacturing services, changes in the value of the inventory of goods under construction, the difference between the sale value and the purchase value of goods sold without deformation, the value of assets made by the workshop and the value of electricity and water produced and sold by the enterprises.

**SH:** SH indicates the payment for computer software and hardware by industrial units and shows enterprise's total investment in purchasing (domestic and foreign) software and hardware. Most manufacturing units have invested in software and hardware. This investment has been significant in some industries including food industries, chemical and chemical industries and mineral products production.

**CT:** This variable represents payments for communication and telecommunications and is classified as payments for non-industrial services. Industrial workshops are forced to have such costs for non-industrial services to improve their production and their competitiveness in the market. Most of the workshops had payments for communications and telecommunications. The amount of which in the groups of food industries, chemical production and mineral products production was more than other industries. These payments were accompanied by a high jump in 2013 but other industrial workshops do not show significant fluctuations (The list of 2-digit ISIC codes is mentioned in Appendix 1; The data of 2016 is the latest data published by this center).

**Employ:** In the Iran Statistic Center, employees are divided into two categories: production workers and office workers. Production workers are involved in manufacturing operations and are directly involved in the manufacturing and production process and divided into simple workers, skilled workers, technicians and engineers. Office workers include office, administrative, service and transportation staff who are not directly involved in production and manufacturing. In this study, employment is the sum of all production workers, including skilled workers, technicians, engineers and office workers including, office and administrative workers. Such employees seem to be associated with ICT-related tools and affect the firm performance. In some industries, ICT-based employment is lower than in other sectors including the production of tobacco products, tobacco and cigarettes, the production of wood and wood products and cork, the production of office machinery and calculators and the production of bags and shoes and making leather and tanning.

**CF:** Capital formation in industrial units with ten or more employees includes inventory and fixed capital formation changes. The change in inventory is equivalent to increasing/decreasing the value of the goods at the end of

the year compared to inventory value at the beginning of the year. Fixed capital formation is the cost of purchasing capital goods by manufacturing and industrial units minus the net sales of second-hand capital goods and scrap during a financial year that is usually one year. It should be noted that capital goods are final and durable goods that are used in the production of goods and services and their expected economic life is >1 year.

During the years under review in 2016, the formation of fixed capital in the production of chemical materials sector and the production of basic metals has increased significantly. During this period, the industries producing products from tobacco, tobacco and cigarettes and office machines, calculators and accounting have had the lowest capital formation.

**Exch:** The exchange rate is the value of a foreign currency equal to the domestic currency or the national currency amount that must be paid to obtain another country's currency. In Iran, there are two exchange rates; the official exchange rate which sets by the government in competition with the free market and uses to buy some essential goods and items and the market exchange rate, the value of which is equal to the supply and demand of the market. The market exchange rate is used to purchase and sell all goods and services except those in the official exchange rate. Over the years, most of these two rates have come a long way. Considering that the industrial units in this research have mainly used the market exchange rate for their purchases, the market exchange rate has been used in this research. The market exchange rate has not fluctuated and increased significantly from 2008 to mid-2010 but has fluctuated widely from mid-2010-2016. The highest exchange rate was in 2016 and the lowest in 2008.

**RD:** One of the essential non-industrial service payments by industrial units is research and development payments. Research and development are two intertwined processes that lead to new products or changes in old products using technological innovations. All industrial units consider a considerable percentage of their income or profit for research and development to compete in the market and keep their share in the market or increase them.

The industrial units in this research have more or fewer payments in R&D. However, the positive growth of research and development for 2009 and 2010 is evident in most industrial companies while research and development in 2014 and 2015 in some Industrial units have grown negatively. The research and development in the production of motor vehicles, trailers and semi-trailers and production of materials and chemical products had a significant jump in 2014 compared to previous years. In the industries of tobacco, tobacco and cigarette products were the lowest.

**PPI:** The producer price index is the average price of goods and services that firms receive to produce goods and services. The prices included in the PPI are from the first commercial transaction for many products and some services. This index is predictive and its changes are also expressed as a forecast for inflation.

The PPI index has been increasing during these years and its increase has been very noticeable, since, mid-2010. It has increased since then and reached its maximum in 2016.

**Model estimation**

**Descriptive statistics:** Descriptive statistics of this research's variables, including dependent variable and independent variables, are presented in Table 1.

As Table 1 shows, the industrial unit's income had an average growth of 26.89%. The maximum revenue growth of 341.9% in 2009 is related to coke coal production industries, oil refineries and nuclear fuels and the minimum revenue growth of -0.39% in 1394 is still related to the same industry. The median is 18.9%,which means that half of the industrial units had revenue growth of >18.9% and half less than this amount.

The results show that, on average, industrial units paid IRR 49.42 billion ($2.16 Million) annually for telecommunications. The maximum payment of industrial workshops was about IIR 337.45 billion ($10.29 Million) in the production of other non-metallic mineral products in 2014 and the minimum payment of IIR 2.13 billion ($0.2 million) was related to the industry of production of tobacco products in 2008. Half of the companies paid less than IRR26.3 billion ($1.16 Million) and a half more than this amount for telecommunications.

In these industrial units, investment in software and hardware has been an average of IRR28.227 billion ($1.236 Million). The maximum investment in this field was IRR234.07 billion ($7.35 Million) related to the food and beverage industry in 2013 and the lowest investment was zero Rials which is mainly related to the industries producing products from tobacco and tobacco.

Table 1: Descriptive statistic

| | Dependent variable | Independent variables | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Parameters | INCOMG | CT (IRR Billion) | SH (IRR Billion) | Employ (person) | CF (IRR Billion) | EXCH (IRR) | PPI | RD (IRR Billion) |
| Mean | 0.2689 | 49.42 | 28.227 | 22134.18 | 5211.68 | 22828.33 | 61.8 | 95.56 |
| Maximum | 3.419 | 337.45 | 234.07 | 105504 | 57506.72 | 36440 | 100 | 1166.67 |
| Minimum | 0.39 | 2.13 | 0 | 1394 | 18.38 | 9667 | 26.4 | 0.004 |
| Median | 0.189 | 26.3 | 7.45 | 13062 | 1563.35 | 26059 | 58.8 | 24.15 |

In order not to estimate a spurious regression, the stationarity of the variables has been tested using the Levin-Lim-Chow test, the results of which are presented in Appendix 2. These test results show that at a significance level of 99% for income growth and PPI, the $H_0$ hypothesis that there is a unit root is rejected and these two variables are stationary at level. However, SH, CT, Employ, CF, Exch and RD are not stationary at level. Instead, they become stationary at first difference.

## RESULTS AND DISCUSSION

Model 1 and the logarithmic form of the variables have been used to test the research hypothesis. The result has shown in Table 2.

As the result shows, the specifications tests in the model are satisfactory. The Sargan test rejects the null hypothesis and this proves that the instrumental variables are uncorrelated to a set of residuals and are therefore, acceptable instruments. Furthermore, the second-order autocorrelation test (AR (2)) which is used to detect AR (1), is greater than the critical level of 0.1 which shows there is no autocorrelation in the model.

The results show that the lag of income growth has a positive and significant effect on industrial unit's income growth, meaning that firm's performance in the last year has a positive and meaningful impact on the firm's performance this year. If last year's performance improved by 1%, we can expect it to improve by 4.9% this year.

Table 2 also shows payment for telecommunications has a positive and significant effect on revenue growth. If payment for telecommunications increases by 1%, revenue can be expected to increase by 16%.

Employees who use ICT-based tools have a positive and significant effect on income growth. If the number of these human forces increases by 1%, revenue growth will increase by 102%. According to the results, fixed capital formation has a positive and significant effect on income growth. If fixed capital formation rises by 1%, it can be expected that income growth will increase by 7.6%.

The results also confirm that the exchange rate has a positive and significant effect on income growth. According to the results, if the exchange rate increases by 1%, income will increase by 31.6%. According to the results obtained in estimating the model, research and development costs have a positive and significant effect on revenue growth and if research and development costs increase by 1%, revenue growth will increase by 3%.

The lagged income growth, ICT employment, telecommunications payments, fixed capital formation, exchange rates and R&D costs have a positive and significant effect with a 99% confidence interval. Payment for software and hardware has a positive and significant effect on revenue growth with a 90% confidence interval. This means that if you pay for software and hardware, revenue growth will also increase. The ratio is 0.0006 which means that if software and hardware payments increase by 1%, revenue growth can be expected to increase by 0.06%. The result also confirms that the producer price index has a negative and significant effect on revenue growth. If the producer price index increases by 1%, revenue growth will decrease by 17.9%.

Table 2: GMM estimation

| Variables | Coefficient | SD | t-statistic | p-values |
|---|---|---|---|---|
| Income growth (_1) | 0.049 | 0.0117 | 4.227 | 0 |
| DSH | 0.0006 | 0.00035 | 1.719 | 0.0881 |
| DCT | 0.16 | 0.0158 | 10.148 | 0 |
| Demploy | 1.02 | 0.0707 | 14.421 | 0 |
| DCF | 0.076 | 0.0049 | 15.65 | 0 |
| DRD | 0.03 | 0.0044 | 6.896 | 0 |
| PPI | 0.179- | 0.0253 | 7.0889- | 0 |
| Dexch | 0.316 | 0.0279 | 11.306 | 0 |
| Sargan test | 10.24735 | p-value | 0.743885 | |
| Autocorrelation of order 1 | -1.767972 | p-value | 0.0771 | |
| Autocorrelation of order 2 | -1.216835 | p-value | 0.2237 | |

Research finding

## CONCLUSION

Based on the results obtained from estimating the model, two sub-hypothesis of this research will not reject that paying for software and hardware and paying for telecommunication can positively affect income growth. As Jamali *et al*.[7] emphasized, information technology can decrease coordinating costs, fixed costs, increase output (neoclassical theory) and create competitive advantages for firms enabling them to obtain higher profits. Moreover, by increasing profit, information technology can improve the expected Present Value (PV) of firms. The results of this research can confirm these effects.

Telecommunications in today's world have become an integral part of life that all people worldwide consider it a necessity. The nature of telecommunications in the industry has become a requirement. With accessible communication and access to their needs, companies today promote and sell goods and services more easily than before.

According to theories related to the company's performance, naturally, the firm's performance in the past year can significantly impact the firm's performance this year which confirms by this research. By analyzing the company's performance in the past year, it is possible to make the proper strategy for its future plan, evaluate its strengths and weaknesses and strengthen and eliminate them.

The model results also show that the workforce that uses ICT-based tools positively affects income growth.

The results confirm the theories related to employment in this field. These theories suggest that skilled human resources which is considered a fundamental asset for industrial units:

- Can increase production productivity in goods and services
- Improve the quantity and quality of goods
- Eliminating administrative bureaucracies in production and non-production sectors
- Ultimately lead to revenue growth

Like the results of the survey of Curtis *et al*.[19], the results of this study confirm the positive effect of fixed capital formation on income growth. Contrary to the results of a research by Grozdik *et al*.[20], who argue that capital formation in the first year has a negative effect and in the following year has a positive impact on income growth. (However, in the present study, the impact of fixed capital formation on revenue growth in the next year has not been studied).

The increase in the exchange rate during the studied period led to the rise in imported goods prices. This price increase led to more attention to domestic production. Simultaneously, the government's contractionary policies during this period led to a significant increase in domestic product's market share. In other words, it improved the performance of domestic industries and revenue growth. Based on the results of estimating the exchange rate model, it is effective and positive on income growth in this period.

The results of this research confirmed the positive and significant impact of information and communication technology in two forms: expenditures for software and hardware and expenditures for telecommunications on the revenue growth of firms with more than ten employees during 9 years. Therefore, policymakers and planners at the national level are advised to invest in the information and communication technology infrastructure that industrial enterprises require to facilitate their income increase and consequently provide economic growth. Furthermore, the owners and managers of industrial enterprises are advised to equip their enterprises with suitable software and hardware, invest in their telecommunications infrastructure and more importantly, train human resources for using ICT applications.

Understanding the role of information and communication technology in today's competitive world and the visions for the future of this type of technology and its applications in all economic affairs is essential.

Equipping industrial units with this technology and using its applications can be the key to industrial units' success that invested in this technology on time and equipped their units with related ICT.

Appendix 1: The list of 2-digit ISIC codes

| Two-digit ISIC Code | Variables |
|---|---|
| 15 | Food and Beverage Industry |
| 16 | Production of tobacco products |
| 17 | Production of textiles |
| 18 | Production of clothes, applying and dyeing furry skin |
| 19 | Tanning and making leather and making bags, suitcases, saddles, and fittings and producing shoes |
| 20 | Production of wood and wood products and cork other than furniture made of straw and wicker materials |
| 21 | Production of paper and paper products |
| 22 | Printing and reproduction of recorded media |
| 23 | Coke and coal production industries, oil refineries, and nuclear fuel |
| 24 | Industries for production of materials and chemical products |
| 25 | Production of rubber and plastic products |
| 26 | Production of other non-metallic mineral products |
| 27 | Production of basic metals |
| 28 | Production of factory metal products except machinery and equipment |
| 29 | Production of machines and equipment of unoccupied floor elsewhere |
| 30 | Production of office machines and calculators (Crossid16) |
| 31 | Production of generating and transmission machines and electrical devices not classified elsewhere |
| 32 | Production of radio, television, communication devices, and devices |
| 33 | Production of medical instruments, optical instruments, precision instruments, watches and other types of watches |
| 34 | Production of motor vehicles, trailers, and semi-trailers |
| 35 | Manufacture of other transport equipment |
| 36 | Production of furniture and artifacts not classified elsewhere |

Appendix 2: The stationarity of the variables

| Variables | Statistic | Probability | Results |
|---|---|---|---|
| Income growth | -9.82 | 0 | I(0) |
| SH | -0.95 | 0.169 | I(1) |
| DSH | -13.68 | 0 | I(0) |
| CT | -2.76 | 0.0621 | I(1) |
| DCT | -11.09 | 0 | I(0) |

Appendix 2: Continue

| Variables | Statistic | Probability | Results |
|---|---|---|---|
| Employ | 3.77 | 0.999 | I(1) |
| Demploy | -2.76 | 0.0029 | I(0) |
| CF | 0.058 | 0.52 | I(1) |
| DCF | -13.64 | 0 | I(0) |
| RD | -2.043 | 0.0605 | I(1) |
| DRD | -10.61 | 0 | I(0) |
| PPI | -17.53 | 0 | I(0) |
| Exch | -1.088 | 0.138 | I(1) |
| Dexch | -8.26 | 0 | I(0) |

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