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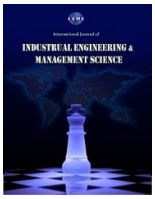

Investigation the Trend of Economic Growth in Line with the Resistance Economy Affected by Information and Communication Technology

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ABSTRACT

More recently, many countries have embraced the idea of "the mainstream" of Information and Communication Technology in sustainable economic growth and development. For any country, sustainable economic growth is essential for the sustainable and balanced development of the whole country. One of the important factors supporting the economic growth is investment in ICT due to their role and function as an essential infrastructure that provides an opportunity for consistent economic development. Therefore, this study examines whether ICT has assisted economic growth in improving in line with the resistance economy or not. Economists predict that economic growth is driven by investment in ICT. However, experimental studies on this subject have yielded different results due to different research methodologies and geographic configuration of the study. The study shows that the productivity gained from ICT is higher than would be expected from a standard neoclassical growth accounting approach.

1. Introduction

The remarkable development of ICT in the previous two decades has encouraged many researchers to examine its economic implications, particularly the contribution of ICT in increasing productivity, promoting economic growth and reducing poverty. Most studies in this field indicate that ICT is a key factor in economic and social development of countries, as it has positive impacts on economic growth, productivity and employment. Also, international organizations such as the United Nations, the International Telecommunication Union, the Organization for Economic Co-operation and Development and the World Bank argue that the ICT sector is a key driver for sustainable development. A study conducted by the World Economic Forum (2013) shows that a 10 percent increase in a country's digitization leads to a 0.75 percent increase in GDP per capita and a 1.02 percent decline in the unemployment rate. According to the Organization for Economic Co-operation and Development (2010), ICT plays an important role in reducing poverty by creating new sources of income and new jobs, as well as by reducing the cost of poor people's access to health and education services.

ICT includes "hardware, software, networks and media collection, storage, processing, transmission and presentation of information (audio, data, text, images)" (Pradhan, et al, 2018). According to the definition of Pradhan, et al (2018), ICT infrastructure refers to "digital telephone network, mobile phone, internet capabilities, web servers and fixed bandwidth and other technologies". The rapid expansion of ICT is critical to economic growth for many reasons: The use of this technology enables various participants in economic and social life to have quick and easy access to information and knowledge (Sepehrdoust, 2018).

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ICT enables companies to communicate faster and better to reduce production costs and improve productivity (Meijers, 2014). Also, ICT provides access to new markets, reduces the capital costs as a result of increasing the efficiency of financial markets, reduces regional differences in income and productivity, provides access to human capital through remote network (Pradhan, et al, 2018). Using ICT, especially access to the Internet, can promote the sustainable development of entrepreneurship, small businesses and micro-enterprises, as it reduces the problem of financing them by reducing information asymmetry and reducing agency costs. According to some authors, such as Roller, L.H.; Waverman, L. T (2001) and Ahmed, E.M.; Ridzuan, R. (2013), ICT can influence economic growth through several important channels, for example: the production of goods and services in the ICT sector directly contributes to the creation of value-added goods and services in the economy. Using ICT goods and services as inputs in the production of other goods and services; Increasing productivity in the ICT sector contributes to the overall productivity of the economy. Using ICT in other sectors of the economy helps to improve its efficiency and productivity. ICT facilitates the exchange of information and influences modern society. Due to the impacts of the ICT revolution, a paradigm shift in human development is taking place, which refers to the process of expanding the range of society's choices, such as education, healthy living and living standards (Yakunina & Bychkov, 2015). The impact of innovation and technological expansion on economic development has long been recognized. ICT increases the availability of information, shapes new communication methods, improves manufacturing processes and improves the efficiency of many different economic activities. With the rapid development of ICT and telecommunications, Internet users continue to grow around the world. Therefore, in less than two decades, societies have achieved a wider connection than ever before (Lee, et al, 2017). There is also a significant difference between high-income countries and middle-income countries where high-income countries produce digital technologies while middle-income countries are just users. High-income countries have previously been a mature stockpile of physical infrastructure, human capital and related government institutions, and have developed policies that amplify the impacts of ICT investments (Dewan and Kraemer ,2000). Also, the economy of resistance, which is one of the superior policies announced by the Supreme Leader of Iran to strengthen the domestic economy against international threats and invasions, should be realized in various ways, such as reducing the government's dependence on promoting productivity. In general, the resistance economy means reaching economic conditions in which the growing economic trend in the country is protected and its vulnerability is reduced; In other words, in this situation, the economic situation of the country and the economic system is such that it will be less damaged and less disrupted against the tricks of the enemies, which will be permanent and in different forms.

The question that arises is that since the role and importance of the realization of the resistance economy and its important impacts in the system and on the other hand, the potential of the field of information technology in order to achieve economic independence is not hidden to anyone, why have we not been able to use the field of ICT and the ICT industry to realize the resistance economy? Therefore, the purpose of this paper is to investigate the impact of using ICT infrastructure on the economic growth in line with the resistance economy. Using the generalized method of moments (GMM), we experimentally examine how different indicators of measurement of ICT infrastructure affect economic growth, which is determined in our study based on GDP per capita. As part of our estimates, we have also included some macroeconomic control variables aimed at highlighting their impact on GDP per capita.

This study contributes to professional literature in at least two ways.

Firstly, we examine the impact of ICT infrastructure on economic growth using four different ICT infrastructure benchmarks, while other previous experimental studies have used only one or two indicators of ICT infrastructure.

Secondly, our research focuses on the axes of the resistance economy, while after our knowledge, there are only few studies.

The rest of this paper is organized as follows:

- Section 2 examines previous experimental studies that have analyzed the effects of ICT on the economic and social development of countries, particularly on economic growth.
- Section 3 presents the analyzed data and variables and explains the experimental methodology.
- Section 4 highlights and discusses the results of our experimental study, and the last section contains concluding remarks and conclusions.

2. Theoretical Foundations and History

2.1. Resistance Economy

Economy literally means moderation and in fact resistance economy is the recognition and struggle to control and neutralize the effects and pressures that cause opportunities to be missed. Reducing foreign dependencies, increasing domestic and national production of the country, trying to be self-reliant, overcoming difficulties and reaching national positive points are examples of resistance economy. This term was mentioned for the first time in the meeting of entrepreneurs with the Supreme Leader of Iran in September 2010 (Rostami and Bahramipour, 2018). So far, there have been several definitions for resistance economy, but based on what is inferred from all of these definitions, resistance economy means identifying the grounds for creating pressure in special circumstances, such as wars and sanctions. In fact, by identifying these pressures, the ways of damaging the economic structure can be blocked, and by managing correctly in order to control and neutralize and even increase economic power by using potential forces, also, steps can be taken by correcting and changing inappropriate and unbalanced policies. Resistance economy is a literature that has been proposed to deal with international sanctions. Resistance economy is a model that has a series of basic goals and principles and a set of policies have been considered to achieve it. Resistance economy means recognizing the areas of pressure or in the current situation of sanctions, trying to control and neutralize them, and in ideal conditions, turning such pressures into opportunities, which is definitely the belief and participation of everyone and the application of rational and prudent management is a prerequisite and requirement for such an issue. Resistance economy is reducing dependencies and

emphasizing the advantages of domestic production and striving for self-reliance (Sotoudeh Nia, S., et al, 2019). In other words, a resistance economy is an economy whose main economic activities in the field of production and trade rely on its own skills, it acts intelligently in interaction with the outside, and the possibility of rapid and automatic change without serious disruption in the market in the face of pressures and shocks It has an external imposition from hostile and non-aligned countries and it continues its progress and prosperity. Resistance economy is a discourse and an economic model that, in addition to making the national economy resistant and strengthening against threats, has the ability to break sanctions with the approach of pushing back the domination system and at the same time, it is progressive, opportunistic, productive, endogenous and extroverted. (Ghavami, 2012). However, the components of the resistance economy are:

1. Popularization of the economy: Popularization of the economy does not mean the participation of the people in the economy, but it means relying on the people in the economic activities and it means that the people have the main role in the economic activities (Mir Moezi, 2012).

2. Empowering the private sector: The experience of countries that have succeeded in downsizing the organizational sector of their governments shows that these countries have achieved very valuable results in terms of quality implementation of their macro projects (Feshari & Pourghaffar, 2014).

3. Reducing dependence on oil: The dependence of the country's economy on one product, including oil, causes severe shocks in the peaks and troughs of the market to the economy of that country. Reducing dependence on oil is possible in two ways: reducing oil production and oil conversion (Karimi, 2012).

4. Development of knowledge enterprises: This component is one of the necessities of the society in realizing the resistance economy policy. Knowledge-based companies and institutions are private companies or institutions formed for the purpose of synergy of science and wealth, knowledge-based economic development, realization of scientific and economic goals, including expansion and application of invention and innovation, and commercialization of research and development results. (Jefroodi & Majid, 2015).

5. Supporting national production: In the conditions of the resistance economy, the most important duty of consumers is to support production units by buying domestic goods (Rostami and Bahramipour, 2018).

6. Fighting against speculation and economic corruption: One of the important components of the resistance economy is dealing with speculation and corruption. Speculation means non-productive activities that take advantage of the turbulences and fluctuations of the market and bring benefits to some people. (Narimani & Asgari, 2012).

7. Consumption management: The fact is that the low quality of domestic products and goods is one of the main causes of extravagance and excessive consumption, as well as people's desire to consume foreign goods and this issue over the long run has caused people to lose confidence in the quality of most domestic goods. (Ghaffarpour & Pourhatami, 2015).

8. Productivity: Productivity is defined as the rate of production of goods and it is a tool to measure the understanding of how a country transforms the resources it has into the goods and services it needs. (Fathollahi & Faryadi, 2015).

9. Management of foreign exchange resources: One of the issues that weaken economic independence and intensify economic dependence is the need for foreign currency (Mir Moezi, 2012).

10. The diversity of the country's export earnings: Countries with a strong dependence on the export of one or more products are caught in a vicious cycle of backwardness. This paper is particularly important for countries that export mineral resources, especially crude oil (Khanzadi & Heidari, 2015).

11. Activating economic diplomacy: one of the most essential tasks in the resistance economy in the global and regional dimension is to provide structures and mechanisms that protect the country from the bullying of the world ruling system and the institutions that serve them (Rostami and Bahramipour, 2018).

12. Maintaining national unity and cohesion: National unity and cohesion is the greatest social asset that accelerates the movement towards the realization of the resistance economy (Mir Moezi, 2012).

13. Endogeneity and Exogeneity: The characteristic of endogeneity and exogeneity, relying on the country's internal power and capacities, is one of the basic axes of the policies of the resistance economy (Sotoudehnia, et al, 2019). The resistance economy is endogenous and it means that it exists in the capacities of a country and its people. The resistance economy is not introverted; this does not mean that external capacities should not be considered. The resistance economy is extroverted and pays attention to other parts of the world and interacts with them and confronts other economic powers with force (Rostami and Bahramipour, 2018).

3. A Selection of the Studies on the Impacts of ICT on the Economic Growth

Yousefi and Mousavinezhad (2019) investigated the role and place of the economic growth in the resistance economy model of the Islamic Republic of Iran. The findings of this research show that the damages related to economic growth include unfavorable business conditions, technical and technological backwardness of production, immobility and competitiveness of production, lack of structure of knowledge-based economy, lack of productivity of production factors, unfavorable conditions of the market institution and private sector and government institution and public sector and chaotic conditions of monetary and financial markets. And finally, the dimensions, components and growth indicators of resistance economy were extracted. Amiri, et al (2018) investigated the impacts of the economic freedom on the economic growth with the approach of the resistance economy in Iran during the period of 2001-2017. The panel method is used in this study. The experimental results obtained show that the level of the economic freedom, inflation and the resistance economy index have a positive and significant effect on the economic

growth, but the employment rate has a negative impact on the economic freedom and the reason for this inverse relationship is the existence of fake jobs and services that have grown in Iran's economy over the past few years. Not only have these jobs not added anything to the GDP, but in some areas they have also caused a decrease in the GDP. Mohseni and Sadeghvand (2017) investigated the impact of the selected indicators of the resistance economy on the economic growth. The model of this research is based on the Cobb-Douglas production function; The results show that the indicators of the resistance economy have a significant and positive impact on the economic growth in the long term, and in the short term, the indicators used have a positive impact and, by chance, have a significant impact on the economic growth; Therefore, considering the importance of the resistance economy for the economic growth of the country, it is appropriate that special attention should be paid to the issue of the resistance economy by everyone. The results of Kohansal Kalkenari and Kafshgari's research showed that the use of some research components such as web browsers, SMS, social networks, weblogs have a significant impact in promoting the culture of the resistance economy, and the use of some other research components such as online chat and e-mail have less impact in promoting the culture of the resistance economy. The research of Ashtari and Khodamoradi (2017) concluded the importance and role of ICT management and the use of these technology tools in achieving the general goals and policies of the resistance economy in relation to the duties of the government agencies. Examining the results obtained from Emadi, et al's research (2016) shows that the impact of ICT on the countries with high income inequality and low social justice is less. In fact, the digital divide caused by the lack of distribution of capital and infrastructure of this technology in society prevents its positive impact on the economic growth. In other words, increasing the access of people to this technology along with its development at the country level will provide a greater contribution to this phenomenon in the economic growth. The results of Rahmani, et al's research (2016) indicated that through ICT and establishing solutions for the realization of a resistance economy, which includes solutions from the government and the nation, we can implement a strong resistance economy in the country, and in this way, we can reduce the country's dependence on foreigners. In a paper titled "Oil, The Sixth Development Plan and the Resistance Economy" Danesh Jafari and Karimi (2014) state that the general policy of the resistance economy is to create a suitable platform for Iran's economy to move in a sustainable growth path. In a paper entitled "An Introduction to the Roadmap for the Implementation of the General Policies of the Resistance Economy of the Islamic Republic of Iran", Seif (2013) concludes that there are three major levels in the implementation of the resistance economy, including the lower level or internal empowerment, the middle level or intrinsic stabilization, and the lower level. or global inspiration, respectively, are emphasized in this written communication, and among thematic goals, the most emphasis is on economic flexibility. Dehesh et al's research (2014) showed that ICT had positive impacts on Iran's economic growth in the context of the resistance economy policy. The results of the research of Komijani and Mahmoudzadeh (2007) show that non-ICT capital plays a dominant role in the economy and explains about 50% of Iran's economic growth. The share of employment in the economic growth is 30-38% and the share of total productivity is 7-10%. The production elasticity of ICT is 0.07 and it is significant, and its contribution to Iran's economic growth is about 7%.

A large body of well-established evidence can be found in studies of the impact of ICT on the economy, at the macro, micro, and industry levels, in line with the resistance economy. For example, the International Monetary Fund (2001) confirmed the positive impact of ICT on the economic growth in some southeast asian countries in the late 1990s. In addition, Piatkowski (2003, 2004) studied the impact of ICT capital on the economic growth and the labor productivity in Bulgaria, the Czech Republic, Hungary, Poland, Slovakia, Slovenia, Romania, and Russia (Mozayani & Moradhassel, 2020).

During the past decades, a number of studies have attempted to discuss the economic impacts of ICT. These studies can be divided into three categories:

The first category - studies on the macroeconomic impact of ICT (for example, Dimelis & Papaioannou, 2010; Dedrick, et al, 2013; Chung, 2018; Liao, et al, 2016; Oyerinde & Bankole, 2019). The second category - studies related to the impact of ICT at the industry level (for example, Stiroh, 2004; Van Ark and Inklaar, 2005; Pieri, et al, 2018; Gupta and Kumar, 2018; Castelnovo, et al, 2018). And finally, the third category – the studies that discuss the impact of ICT at the firm level (for example, Forth and Mason, 2003; Atrostic and Nguyen, 2005; Asongu and Biekpe, 2018). The current study was placed in the first category, which was conducted with the aim of evaluating the impact of ICT on macroeconomic variables such as consumption, growth, productivity and efficiency at the national level. In this category, there are various studies (for example, Gordon, 2000, 2003; Wolff, 2002; Oliner and Sichel, 1994, 2000, 2002; Strobel, 2018; Van Roy, et al, 2018; Stanley, et al, 2018). According to the main topic of the research, the economic growth was used considering ICT and with the resistance economy approach.

4. ICT and Economic Growth

Since the 1990s, ICT has largely contributed to stimulating Gross domestic product (GDP), Total factor productivity (TFP) and labor productivity growth in both developed and developing countries. However, the economic impacts of ICT in developing and less developed countries are different from those in developed countries. This contribution is made directly and indirectly by influencing reality or TFP, embodied technological progress, and labor productivity as the main mechanisms of transmission of the impact of ICT. According to Piatkowski (2003) and Pohjola (2002), ICT can stimulate the economic growth through four main channels as follows:

- Production of ICT goods and services
- Increased GDP in the ICT sector, which helps aggregate GDP growth in the economy.
- Using ICT capital as an input in the production of other goods and services.
- Contributing to Gross domestic product (GDP) at the level of the economy through increasing productivity in the non-producing sectors of ICT, due to the production and use of ICT (Spillover Effects).

ICT plays two essential roles in the process of the economic growth:

Firstly, through capital deepening, which is the result of increasing overall investment

Secondly, by contributing to the growth of TFP, many experimental studies confirm the impact of ICT investment on growth performance (for example, Colecchia & Schreyer, 2001; Jorgenson, 2001; Van Ark, et al, 2002).

ICT investment is usually associated with rapid technological advances in the production of ICT goods and services, which helps to drastically reduce the price of ICT and encourages ICT investment. The contribution of ICT to total productivity growth is more controversial. Some studies for the United States have argued that the increase in total productivity growth in the second half of the 1990s was mainly due to technological advances in the production of ICT goods and services (Gordon, 2000). In addition, in the studies of (Daveri, 2002) researchers; Oliner and Sichel (2000); and, Jalava and Pohjola (2002) the significant positive impact of ICT investment on the economic growth has been proven in developed countries (Jalava and Pohjola 2002). Also, some studies have shown that in the past few years, there is no single factor that affects the performance of the economic growth. Iran, as an emerging economy, has tried to benefit from the use of ICT in recent years. Now, Iran has liberalized its ICT sector to a certain extent with several private sector operators competing in the mobile phone, data services and internet sectors. However, the landline market remains a government monopoly. It should be noted that Iran's privatization program began in the late 90s. In line with Iran's Vision 2025, Iranian authorities are looking to invest in ICT industry along with other technologies such as biology, nanotechnology, aviation, oil and gas. Despite the significant growth of ICT figures (for example, international broadband and Internet penetration) in recent years, the current state of ICT in Iran is undoubtedly much lower compared to global norms. For example, the share of the added value of ICT in Iran's economy is about 1.8 percent (2021), which is not significant at all (Mozayani & Moradhassel, 2020).

On the other hand, there is an optimistic view that developing countries may be superior to developed countries in the diffusion of ICT. Antonelli (1991) points out that the shift from the dominant technological paradigm to a new ICT-based paradigm imposed significant costs on developed countries. It can effectively lock these countries into those paradigms while simultaneously opening up important opportunities for less industrialized countries to catch up and even "boom" beyond industrialized countries because they have relatively lower switching costs. (Seo & Lee, 2006). Accordingly, using growth accounting analysis in this literature, one of the basic assumptions is that price is an indicator factor for its final product. In the case of capital goods, it means that the rental rate per unit of capital, or consumer expenditure on capital, is equal to the final product. Furthermore, the basic neoclassical model assumes that we can measure the current and future marginal productivity of all relevant factors and also, the sum of private and individual efficiency is equal to social efficiency. This implicitly assumes that there are no externalities in ICT investment and use, and this assumption is questionable for several reasons.

One argument is that ICT, as a General Purpose Technology (GPT), induces various innovations, is widely spread across industries, and is embedded in a wide range of applications. Bresnahan and Trajtenberg (1995) define GPT as "technologies characterized by pervasiveness, inherent potential for technical advances, and complementary innovation, leading to increasing returns to scale." The benefits of these technologies and applications are not clear from the beginning and can lead to externalities such as knowledge spillovers. Lipsey, et al (2005) consider ICT as a GPT and show that its impact on productivity goes beyond the capital deepening effect. Another main debate points to the network impacts of ICT, which lead to externalities. Network effects exist when the usefulness of a product or technology to a user depends on the total number of users of that particular product or technology. In other words, ICT as a network capital has a feature that shows that by using it by more companies, more profit will be given to companies that are currently using ICT, without incurring additional costs for the latter companies. Bartel, et al (2007) using company-level data in different countries show that there is a positive and significant impact of ICT spillover on the productivity of companies. Stiroh (2002) uses data from the US manufacturing industry in his econometric analysis based on the reduced form of the production function and relates ICT investments to the productivity growth. He finds little evidence for production spillovers or network effects. In another study, Brynjolfsson and Hitt (2003) showed a positive and significant contribution of computer capital beyond the standard impact of capital on TFP. They also show that there is a lag between the time of investment in ICT capital and its return even up to seven years. O'Mahony and Vecchi (2005) estimate the productivity effect of ICT in a production function approach on sectoral data for the United States and the United Kingdom. Using the Pooled Mean Group (PMG) estimator, they show that the standard method of growth accounting may underestimate the contribution of ICT to output growth and TFP. Meijers (2007) shows that the impact of ICT capital stock on TFP growth is larger than expected from standard neoclassical theory. He also claims that there is a significant lag before such impacts become apparent. This could be the reason why Stiroh (2002), who did not include the lag structure in his analysis, could not find such a positive relationship.

5. Methodology and Data

Conceptual Form: Below, the general framework of growth models with ICT as an explanatory variable is shown. Equation (1):

$$Y_t = A_t F\,(C_t, K_t, H_t, L_t)$$

In equation (1) where t is time in all cases, Y is GDP and output is through ICT inputs (C) and non-IT inputs are possible:

Physical Capital (K), Human Capital (H) and Labor (L)

According to the following model, ICT affects economic growth in two basic ways. Firstly, ICT or C capital, which is used as an input in the production of all goods and services, leads to economic growth. Secondly, ICT can contribute to technological changes and lead to economic growth (Pahjola, 2002). In order to estimate the impact of ICT investment on economic growth, there are two different approaches:

"Production Function approach" and "Growth Accounting approach".

In this paper, we use the production function approach with the generalized form of the Cobb-Douglas production as follows (Equation 2):

$$Y_t = A_t C_t^{\alpha_c} K_t^{\alpha_k} H_t^{\alpha_h} L_t^{\alpha_l}$$

Converting equation (2) into logarithmic form, Equation (3):

$$\ln Y_t = \ln A_t + \alpha_c \ln C_t + \alpha_k \ln K_t + \alpha_h \ln H_t + \alpha_l \ln L_t$$

Based on the network impacts and organizational adjustment of ICT capital discussed in the literature, it may take a long time to reap the benefits of ICT investment. In order to show such lagged impacts of ICT investments on economic growth, equation (3) is extended by including a lag for ICT capital. This specification indicates that the change in the stock of ICT has an impact on the real economic growth rate after n years. The expanded equation (4) is as follows:

$$\ln Y_t = \ln A_t + \sum_{j=0}^{n} \alpha_{cj} \ln C_{t-j} + \alpha_k \ln K_t + \alpha_h \ln H_t + \alpha_l \ln L_t$$

The last step of the growth accounting approach is the differentiation of equation (4) with respect to time. Equation (5):

$$\dot{Y} = \dot{A} + \sum_{j=0}^{n} \alpha_{cj} \dot{C}_{t-j} + \alpha_k \dot{K} + \alpha_h \dot{H} + \alpha_l \dot{L}$$

In equation (5) where the dot on the variables shows the amount of change. Assuming constant returns to scale and each factor receiving its final product, the parameters ci α, k α, h α and l α respectively, measure the share in the total income of ICT input, physical capital, human capital and labor.

6. Experimental Form (Data)

In this paper, we choose to work with the production function approach because it is more commonly used in economics and has more limited assumptions. Specifically, our Regression Model and the Cobb-Douglas double-log are as follows: Equation (6):

$$LnGDP_{it} = \beta_0 + \sum_{j=0}^{n} \beta_{1j} LnICT_{i,t-j} + \beta_2 LnK_{it} + \beta_3 LnL_{it} + \beta_4 LnFDI_{it} + \beta_5 LnOPEN_{it} + U_{it}$$

In equation (6), Ln is the natural logarithm of the variables, 0β is a constant coefficient, GDP per capita is real GDP at constant prices. i , t j ICT − is the ICT capital stock in period t and, previous years as lagged variables, K is the total capital stock and L is the labor input. i t FDI is foreign direct investment as an indicator of technological improvement and according to Papaioannou (2004), we have used FDI to control for spillover effects. Since the main characteristic of our country is trade openness and export orientation, Ln OPEN is used as a proxy for trade openness and is measured as the sum of exports and imports of goods and services as a share of GDP, (X + M / GDP). U is the random error component of the model. Indexes t and i respectively, refer to country and time. In the endogenous growth framework mentioned above, we have human capital as an independent variable, but in the experimental model, due to the unavailability of appropriate data, we remove it.

Gross Domestic Product (GDP) per capita at constant 2000 prices, is obtained directly from development indicators. The labor force data is extracted from the International Labor Organization (ILO). For capital stock, we have referenced WDI, but the problem is that WDI only provides values for gross fixed capital formation (GFCF), which is not really capital stock, which we need to replace in the model. We can construct the capital stock from the GFCF through the following method used by Lee and Guo (2004) called the perpetual stock method. Equation (7):

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

Since capitalization data are not available for the initial year, we calculate the benchmark stock from the investment series. Assuming a constant growth rate in investment, benchmark stock K t-1 is expressed as follows; Equation (8):

$$K_{t-1} = \frac{I_t}{g + \delta}$$

(It) is the investment in period t, g is the average growth rate of investment, and δ is the depreciation rate, usually assumed to be 10% for non-high-tech capital stocks.

7. Findings

The results show that ICT has a positive and significant impact on the growth of GDP. In addition, this impact is significantly positive in each subsector of GDP. Accordingly, we find that every 1% increase in ICT investment leads to a 5% increase in GDP growth. Similarly, investment in capital stock (K) and trade openness (OPEN) have a positive and significant impact on real GDP growth. On the other hand, labor force (L) and foreign direct investment (FDI) have had a positive but insignificant impact on GDP growth. The results for the lagged ICT variables show that although the first lag is negative and significant in all groups, we can find the positive impact of these lagged variables, such as ICT(-5), ICT(-2) and ICT(- 4) that it is very significant on the economic growth. The signs of the parameters in the lagged variables change from negative to positive, which indicates that investment in ICT has a negative impact on the economic growth in the short term, but it is compensated after that. The estimation results, using the fixed effects method, are given in the following table:

Table 1. Estimation results using the fixed effects method

T-score	Test Score	Variable
-2.31 *	-2.83	Constant
2.73**	0.05	Information and Communications Technology (ICT)
-3.41**	-0.01	ICT (-1)
1.57	0.02	ICT (-2)
0.84	0.01	ICT (-3)
-2.68**	-0.02	ICT (-4)
2.71**	0.03	ICT (-5)
2.67**	0.24	Investment in Capital Stock (K)
0.87	0.14	(L) Labor
1.43	0.006	Foreign Direct Investment (FDI)
2.65**	0.18	Business Openness (OPEN)
0.98		R-Squared

Note: * and **, respectively are 1%, 5% and statistically significant. ICT (-1), ICT (-2), ... are the lagged variables of ICT.

The results based on fixed effects models, in which we simultaneously account for heterogeneity and temporal fluctuations in economic performance, confirm the paper's hypothesis. However, it should be noted that some of the explanatory variables in our Regression are either predetermined (trade openness) or endogenous (FDI), thus misleading the results. For example, while FDI is often appreciated for its role in a country's economic growth, some studies such as Hansen & Rand (2006) and Mello (1999) support that the amount of FDI a country receives is influenced by the level of GDP and its growth rate. Accordingly, we investigate the impact of ICT investment on economic growth using the first estimator developed by Arellano and Bon (1991), which addresses these problems more effectively and yields robust estimates. In this method, the lagged values of the explanatory variables are used as tools, and to ensure that there is no bias due to correlation with the error term, the over-identification test is used. Also, we face the problem of country-specific unobservable effects and lagged dependent variables among the explanatory variables. The generalized method of moments estimator can also overcome these problems. We are also facing the problem of country-specific unobservable effects and lagged dependent variables among the explanatory variables. The GMM can also overcome these problems. The J statistic, in the form of $\chi 2$, is distributed with degrees of freedom equal to the number of over identification limits (L–K). L is the number of instrumental variables and K is the number of explanatory variables. J is the most common diagnostic test in estimating the GMM to analyze model fit. Rejecting the null hypothesis indicates that the instruments are not properly selected. This may be because they are not truly exogenous, or because they are erroneously omitted from the regression (Baum, et al., 2003). In this paper, the J statistic rejects the null hypothesis of correlation between residuals and instrumental variables. Therefore, the validity of the results is confirmed for interpretation and the results can be interpreted with high confidence. Our estimation results, based on the GMM and dynamic panel method data - are summarized in the table below. Overall, the results confirm the expected relationship between GDP growth and ICT investment.

Table 2. Estimation results using the dynamic panel method and GMM estimator

T-score	Test Score	Variable
12.2 **	0.81	Constant
4.67**	0.03	Information and Communications Technology (ICT)
-7.58**	-0.04	ICT (-1)
2.13*	0.017	ICT (-2)
1.19	0.008	ICT (-3)
-4.46**	-0.02	ICT (-4)
4.91**	0.03	ICT (-5)
4.28**	0.06	Investment in Capital Stock (K)
1.25	0.08	(L) Labor
0.07	-0.0003	Foreign Direct Investment (FDI)
4.77**	0.21	Business Openness (OPEN)

As Table 2 shows, the coefficients of some lagged variables of ICT are significantly positive and confirm the existence of externality of ICT. These coefficients include ICT(-2) and ICT(-5). Also, the ICT capital coefficient is positive and is statistically significant at the 1% level. Since all variables are in logarithms, the value of the coefficients indicates their elasticity. For example, a coefficient of 0.02 for ICT indicates that a 1% increase in investment in ICT leads to 2% economic growth. The statistics presented by the government organizations and institutions of the country indicate the increasing trend of using ICT, which means that our country has realized the important impact of ICT investment on the economic growth. In summary, these results confirm the significant and sustainable growth-stimulating impact of ICT investment. Also, the hypothesis of this paper is confirmed that external factors of ICT investment have a significant growth impact due to positive lag variable parameters. In addition, the differential impact of ICT investment on the economic growth in the country is shown in Table 4, which are related to ICT access, use and skills, such as households with computers, number of Internet users, and education level. The results of this paper support the studies of Kraemer and Dedrick (2001), Lee, et al (2003) and Pahjola (2001). On the other hand, based on the estimated results, the coefficient of capital stock is 0.05 and it is statistically significant at the significance level of 1%, which shows that non-ICT investments also have a positive and significant impact on the economic growth in these units. The FDI coefficient is negative. Capital deepening and technical growth are among the main factors of economic growth in any society, but the relatively low value of the estimated coefficients for the FDI variable does not reflect this prediction. We also include GDP (-1), which is the first lagged dependent variable in the estimated model, because an increase in previous output expands the market and encourages the introduction of new technologies and the division of labor, which alternately, creates dynamic increasing returns to scale. The results of Table 2 show the positivity and significance of GDP (-1). The sign of labor input coefficient is positive, but not significant. The coefficient of trade openness is 0.19 and is statistically significant at a high level, which indicates the positive impact of this variable on the economic growth. This result is important, because our country stands out from other developing countries due to its high rate of trade openness.

8. Conclusion and Implications

This study is focused on exploring the supply of ICT in Iran with the resistance economy approach. The results of estimating the growth model, using ICT as an explanatory variable, using the panel data method in a ten-year period (2011-2021) show that ICT has a significant impact on the economic growth. This result was obtained after creating significant time lags in the econometric analysis. The coefficients measuring the effect of ICT investment, and its lagged variables, are mainly positive on the economic growth, which indicates that ICT investment affects the economic growth positively. In addition, positive lags indicate the external impact of ICT on the economic growth, which is the main hypothesis of this research. Also, it points to significant lags between the time of investment in these technologies, and the time when externalities in output growth are measurable. We can also conclude that ICT induces outcomes that go beyond the impact derived from a standard accounting analysis of unstructured lagged ICT growth. The existence of a significant time gap between the investment in ICT and the final return may cause the social return of the investment in ICT to be greater than its private return. In such a situation, policy makers should encourage investment in ICT. The coefficient of FDI, which is the technical and technological index of the model, is negative but not significant. This shows that the growth of FDI does not have a strong impact on the economic growth. As a result, ICT plays a vital role as a tool for the

economic growth. Therefore, it seems that it is necessary for our country to encourage its investment in ICT in order to strengthen the economic growth. The last point is that our country cannot enjoy the full benefits of ICT unless it has the proper infrastructure and skills needed to use the capabilities of ICT. It is essential for governments to provide society with information, up-to-date structures and educated people for efficient use of ICT. Along with the external effects caused by ICT, this study shows a large and significant positive coefficient for trade openness in the model, which leads to a strong impact of this variable on the economic growth. Therefore, it is very important for our country to be more active in attracting international markets to its products and benefiting more from the capital goods and services of ICT in the import sector. In other words, policymakers should encourage free trade by reducing tariffs and removing non-tariff barriers to the import of ICT, thereby facilitating the economic growth by increasing the index of trade openness.

9. Moral Considerations

Conflicts of Interests: According to the authors, there is no conflict of interest in this paper.

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