

Impact of Information and Communication Technology on Transport among the Selected Middle East Countries

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The modern transport systems manage traffic, travel scheduling and passenger reservation efficiently. These use information and communication technology (ICT) in order to increase demand for convenience, safety and speed. Therefore, investing in ICT has essential effect on transport sector. This article aims to examine the effects of ICT on growth of transport value added among the selected Middle- East countries. It applies a panel data model over the period 2000-2014 and uses ICT penetration ratio as proxy variable for ICT. The findings show that labor active in transport sector; machinery and transport equipment and ICT penetration ratio have significant positive effects on value added of transport sector. Thus, improving the ICT infrastructure and training the transport agents, besides physical investment in machinery and transport equipment cause higher growth in transport and related services.

Keywords: ICT, Value added, Transport, Panel data

JEL Classification: C23, R41

1. Introduction

As one of the most effective economic activities, transport links the supply to demand in different markets. In the previous economic researches, transport was considered as an intermediate sector to fulfill the primary needs such as trade, tourism, employment, etc. Currently, due to development of the global economy, all countries try to optimize the available capabilities and opportunities in a highly competitive environment. As a result, transport plays direct role in reducing production costs, making access to markets, and increasing competitiveness in the international trade. Therefore, this sector attracts attentions in management, planning, investment and research.

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Transport as an infrastructural sector stimulate economic development. It links together different factors influencing economic growth and development through handling cargo and passenger. In proportion to the development of communities, the need for fast, safe and cheap conveyance has become more widespread. The current transportation industry is resultant of the evolutionary process of human life and basic developments in production, distribution, consumption and technical progress. Transport makes linkages among economic, social and cultural subsectors faster and more extensive.

To demonstrate the economic importance of transport, we should pay attention to three effects of transport in the economic life of people including spatial specialization in production, mass production and expansion of habitats. In other words, development of transport result in mass production and productivity in exploiting natural resources through spatial specialization in terms of comparative advantage. Consequently, humans can improve quality of life by selecting habitats in terms of climatic and safety conditions.

Information and communication technology (ICT) potentially affects movements of people and goods. In other words, ICT can change social and organizational activities. Applying systems for managing transport and traffic, travel information and passenger reservation, this technology increases demand for convenience, safety and speed. Hence, investing in ICT has significant positive impact on transport sector.

Transport is an ICT-intensive sector. Selling e-ticket, networking, tracking shipments, managing passengers and informing people are of main functions of ICT in transportation (Mahmoodzadeh and Fathabadi, 2011). An ICT-based transport sector improves efficiency of transportation and reduces energy use.

As European Commission (2010) argues, the roads' safety has been a main issue in transport. ICT can help to safety of roads through expanding safety systems, and may reduce road accidents. In this regard, Black and van Geenhuizen (2006) claim that ICT innovations seem to be most effective in fatality reduction. They mention reductions on a level of 50 to 60% and on level of 30 to 40% for particular types of advanced divers' assistance in particular road network sections.

In addition, ICT may improve traffic management through introducing new systems. In general, five factors are considered as principal motives of adoption ICT in transportation: adoption of ICT in controlling transportation fleet, energy consumption, environment conservation, and optimization of traffic system and safety of transportation (Mahmoudzadeh and Fathabadi, 2011).

The effects of ICT on transportation can be examined in both micro- and macroeconomic levels. The firm-level empirical studies show that some firms pursue common goals such as improvement of customer services, integration of internal processes in organizations, supply chains, and reduction of costs. To achieve these goals, these firms make use of various ICT systems including radio frequency identification (RFID), e-ticket and electronic reservation, software systems, telematics, integrated selling system, open source programming system, smart transport system, inventory management system and so forth. According to industry-level studies, innovations and ICT systems used in transportation affect desirably performance of transport sector.

In examining the ICT role in transport sector, Black and van Geenhuizen (2009) argue that the extensibility impact of ICT use allows an acceleration of activities over both larger and smaller spatial scales, while serving an array of different purposes of households and business. In addition, trackability² is another attribute provided by ICT to persons, vehicles and goods, which refers to real-time dynamic mapping of activity paths and routes. Finally, intelligence is the most powerful attribute that ICT provides to persons and organizations. It refers to the capability to collect, process, distribute, steer and monitor value chain processes in distributed places.

Banister and Stead (2004) believe that the growth in the service and knowledge-based economy, the breakdown of trade barriers, and the development of new patterns of travel requires using ICT in transport, since ICT use increases transport efficiency.

Giannopoulos (2004) examined the various applications information and communication technologies in the fields of operation and management of networks (all modes), information and guidance to the users (of the transport systems), operation and management of freight transport systems. In this regard, he listed these applications: traffic data information collection and dissemination systems, network control and

² In some texts, "traceability"

traffic management strategies, vehicle control and driver assistance, systems for (Electronic or other) fee collection, freight resource management; terminal and port information and communication systems, freight and vehicle tracking and tracing, and “front” or “back-office” logistics systems.

The remainder of this article is organized in 4 sections. Section 2 reviews the literature. Section 3 devotes to theoretical basics. Section 4 refers to model specification, data, variables and estimation issues. Finally, section 5 concludes.

2. Review of literature

The literature is reviewed in three parts:

Part 1 devotes to examination of the effects of ICT on economic variables such as growth, productivity, and inequality.

Using panel data specification and generalized method of moments (GMM), Belorgey *et al* (2006) examined factors influencing economic growth with an emphasis on ICT across 25 countries. They found that both ICT supply and expenditure have positive effects on economic growth, while labor growth affects economic growth negatively.

Al-Khateeb *et al* (2007) studied the effect of human capital and ICT on economic growth of United Arab Emirates by using co-integration and error correction model. Their findings indicate appropriate training as a prerequisite for using new technologies.

Komijani and Mahmoodzadeh (2009) examined the effects of ICT on economic growth using two kinds of proxies for ICT. The first kinds of variables are fixed line phone penetration ratio as a proxy for ICT infrastructure, and internet penetration ratio for ICT users. The second kinds of variables are ORBICAM indicators, which present network indicator for ICT infrastructure, information user indicator for ICT users, and human capital indicator. The effect of ICT on economic growth was estimated in a steady-state situation using panel data of 51 countries over the period 1995-2003. The findings show that physical capital, fixed line phone penetration ratio, network indicator, information use, internet and trade openness have positive effects on

economic growth, while population growth and inflation rate have negative impacts on economic growth.

In Quah (2001) viewpoint, ICT has the same features—increasing returns, knowledge spillovers—that drive both growth and agglomeration of firms. However, European States show no special advantage in using ICT as a driver for economic growth; ICT clusters seamlessly transcend national borders.

Using a production function, Dimelis and Papaioannou (2010) studied the effects of FDI and ICT on productivity growth in both developing and developed countries during 1993-2001. They found that FDI affects significantly productivity growth in both groups.

The part-one studies entail significant positive relationship between ICT and productivity or growth.

Part 2 emphasizes on the impact of transport infrastructure on economic growth.

Boopen (2006) investigated the relationship between total investment (private and public investment) in transport sector and economic growth based on panel data and cross-sectional models for the selected Sub-Saharan Africa, including South and Central Africa, and some small developing islands such as Fiji, Haiti, Jamaica, during 1985-2000. He found that investment in transport contributed to economic growth.

Daeikarimzadeh et al (2009) examined the effect of public investment in transport on economic growth in Iran over the period 1973-2008. Using an Auto-Regressive Distributed Lags model, they found that public investment in transport has significant positive effect on gross domestic product (GDP). In addition, relationship between economic growth and other variables, such as public investment in non-transport sectors, private investment, and labor employed in whole economy, and exports were significantly positive.

Part 3 focuses on the effects of ICT on sector- level value added.

Yoshimoto and Nemoto (2005) examined the global trend toward e-commerce and computerization in the trucking industry and analyzed the

impact of information and communication technology on road freight transportation in terms of commerce, logistics and fleet management, and proposes hypothetical mechanisms of influence. They suggest that more sophisticated government management of transportation demand as well as freight fleet management systems could cancel out the negative impact of e-commerce on road transportation.

Wang et al (2015) investigated how information and communication technologies (ICT) can contribute to reduction of CO₂ emissions in road freight transport. They adopted a multiple case study approach with three leading UK grocery retailers and used multiple data collection techniques including interviews, system demonstrations, onsite observations and the use of archive information. They found that ICT has a direct positive impact on CO₂ emissions reduction.

3. Theoretical basics

ICT affects a given economy in both supply and demand sides. In the demand side, ICT influences consumer behavior through changes in his/her preferences. It also affects producer behavior in supply side by facilitating the communications.

This study focuses on supply side and examines ICT effect on transportation value-added growth. Besides complementary factors such as managerial and legislative experience, economic structure, public policies and human capital, ICT is included in production function as a capital input, and improves production cycle through deepening capital, stimulating technology progress, and increasing quality of labor. The result is to increase value-added in firm, sector and country levels. Finally, it makes growth in number and quality of labor, total productivity and economic growth. The technology revolution is known with indicators of fast improvement of quality of equipment and software along with reduction of prices. Looking at inputs' relative prices, a profit-maximizing firm responds by replacing equipment, software and ICT services (Forester, 1987; Pohjola, 2002).

Jalava and Pohjola (2002) examined the ICT role in economic growth. In order to study the effect of technology on productivity, they used an implicit production function with Hicks-neutral technology. Pohjola (2001) divided the effects of technology on economic growth into three

categories. In a classical context, technology is the sum of knowledge embodied in production tool and methods. In addition, the effect of technology is embodied in capital goods, which results in increasing capital productivity. In the second case, technology increases labor productivity. In the third case, technology increases total factor productivity, which is interpreted as Hicks-neutral technology.

The effects of investment in ICT are estimated using production function and growth accounting. We assume that production function takes the form of generalized Cobb-Douglas function:

$$Y = AC^{\alpha}K^{\beta}H^{\gamma}L^{\theta} \quad (1)$$

Where Y , K , H , C , and L denote total output, physical capital, human capital, ICT capital, and labor, respectively. Parameter A measures technical progress, and α , β , γ and θ denote input shares. By taking natural logarithm from equation (1), we reach the following equation:

$$\ln Y = \ln A + \alpha \ln C + \beta \ln K + \gamma \ln H + \theta \ln L \quad (2)$$

For available data on variables under consideration, parameters of equation (2) can be estimated within time series for a single-country case or panel data for a group of countries over time. Since the level of time series have unit root, i.e. they are often I(1), we rewrite equation (2) in the form of growth of variables, by taking derivatives of variables with respect to time.

$$\dot{Y} = \dot{A} + \alpha \dot{C} + \beta \dot{K} + \gamma \dot{H} + \theta \dot{L} \quad (3)$$

The dots over variables denote the rate of changes over time. If a constant return to scale is accepted for the production function, and value of marginal product is paid for any input, the coefficients of variables give input shares in total output. This method indicates a standard growth accounting in determining input shares in output growth. From equation (3), changes in technology ($\frac{\dot{A}}{A}$), or Solow (1956) residual, is derived and called multi-factor productivity. The generalized neoclassical growth models consist of many kinds of capital (Mankiw et al, 1992).

4. Model and Estimation

4.1. Model specification

In this article, the effects of *ICT* on value added in transport sector among the selected Middle East countries using generalized neoclassical growth models, which consist of various kinds of capital (Mankiw et al, 1992). By assuming Jorgenson (2001) approach, first we write the following Cobb-Douglas production function.

$$Y_{it} = AK_{Non\,ICT,it}^{\alpha_1} K_{ICT,it}^{\alpha_2} L_{it}^{\alpha_3} \quad (4)$$

Where, value added, Y is a function of non-ICT capital ($K_{Non\,ICT}$), *ICT* capital (K_{ICT}) and labor, L . The subscripts i and t denote cross-section and time, respectively. By taking logarithms of equation (4), and writing the obtained equation in an econometric model, equation (5) is derived:

$$\begin{aligned} \ln Y_{it} &= \alpha_0 + \alpha_1 \ln K_{Non\,ICT,it} + \alpha_2 \ln K_{ICT,it} + \alpha_3 \ln L_{it} + u_{it}, \quad u_{it} \\ &= \alpha_i + v_t \end{aligned} \quad (5)$$

Where α_i represents country-specific effects, known as fixed effects, i.e., they indicate country-specific effects. v_t is disturbance term, which measures unobservable effects of each variable over time.

4.2. Statistical sample

According to the Iran Vision 2025, the statistical sample includes Iran's rivals in the selected Eurasia and MENA regions, including Armenia, Azerbaijan, Bahrain, United Arab Emirates, Oman, Saudi Arabia, Qatar, Afghanistan, Georgia, Iraq, Kuwait, Egypt, Israel, Jordan, Kazakhstan, Kirgizstan, Lebanon, Pakistan, Tajikistan, Syria, Yemen, Turkey, Turkmenistan, Uzbekistan, and Palestine. Of these, Armenia, Israel and Palestine were excluded of our study due to lack of reliable data. Thus, the statistical sample was confined to 24 countries, including Iran.

Since transportation value-added is usually not reported separately in the national accounts, the dependent variable refers to value-added of transportation, storage and telecommunications sector. In addition, explanatory variables are labor active in *ICT*, machinery and transport

equipment, length of road networks, expenditure on investment in *ICT*, *ICT* penetration ratios and *ICT* user indicators. The period of study covers 2000-2014.

4.3. Variables and data

Dependent variable

Value added of transport, storage and communication (TSC): For gathering data on this variable, the shares of TSP in GDPs were derived from the Statistical, Economic and Social Research and Training Centre for Islamic Countries (SESRIC)³, and were multiplied by corresponding GDPs. For non-Islamic countries such as Georgia, the share of *TSC* in *GDP* was extracted from Georgia Statistical office⁴, while its *GDP* was obtained from World Bank.

Explanatory variables:

Labor force active in TSC: labor force is an influential production input, which creates considerable value added proportional to its productivity. The number of workers employed in *TSC* sector was extracted from International Labor Organization (ILO), and national statistical yearbooks.

Non-ICT investment in TSC: physical capital in the form of road, motor vehicle, shipping fleet, aircrafts, ports, and so forth is an essential input in *TSC* sector. Since data on investment in *TSC* is not explicitly available, we focused on the length of paved roads and value added on machinery and transport equipment, but finally we included value added on transport equipment and machinery as share of total manufacturing value added in the model. This variable was extracted from World Bank.

ICT investment in TSC: there are various indicators to measure the investment in *ICT*. For instance, expenditure on *ICT*, internet penetration ratio, internet bandwidth, mobile and fixed telephone subscribers have been used in related studies (Pohjola, 2001, Moshiri and Jahangard, 2004; Komijani and Mahmoodzadeh, 2009). In this study, we use a composite *ICT* indicator, which aggregates cellular mobile telephone subscribers, internet subscribers, and telephone lines

³ www.sesric.org

⁴ www.geostat.ge

in operation per 100 persons. The other ICT indicators were also considered, however they were not included into model due to gap in data. Table 1 defines variables in brief.

All variables are in logarithms because of derivation and interpretation of elasticities.

Table 1: Variables under study

Variable	Definition
$Ln(Y)$	Logarithm of TSC value added
$Ln(LF)$	Logarithm of labor force in TSC sector
$Ln(EQP)$	Logarithm of expenditure on machinery and transport equipment
$Ln(ICT)$	Logarithm of ICT penetration ratio

Since data is not fully reported for all variables, we continue our analysis in two subsamples: subsample 1 in which we have data of 4 variables, and subsample 2 where data is available only for $Ln(Y)$, $Ln(LF)$ and $Ln(ICT)$. As a result, subsample 1 consists of a smaller sample: Azerbaijan, Egypt, Georgia, Iran, Jordan, Kyrgyz republic, Kuwait, Oman, Qatar, Turkey, Yemen, while subsample 2 includes larger sample with 9 other countries: Bahrain, Iraq, Kazakhstan, Lebanon, Pakistan, Saudi Arabia, Syrian Arab Republic, Tajikistan, and United Arab Emirates.

4.4. Econometric strategy

The first step for estimating model (5) is to test all variables against unit root in order to discard spurious regression. Due to nature of data, we exercise unit root test for our panel data. Table 2 reports the results of unit root test, which reject the common/individual unit root in the series.

Table 2: Pool unit root test

Subsample	Variable	Method	Statistic	Prob.**	Decision
1	Ln(Y)	LLC t-stat	-3.091	0.001	I(0)
		IPS W-stat	-3.521	0.000	I(0)
1	Ln(Labor)	LLC t-stat	-7.659	0.000	I(0)
		IPS W-stat	-3.254	0.0006	I(0)
1	Ln(ICT)	LLC t-stat	-9.198	0.000	I(0)
		IPS W-stat	-3.903	0.000	I(0)
1	Ln(EQP)	LLC t-stat	-9.464	0.000	I(0)
		IPS W-stat	-6.714	0.000	I(0)
2	Ln(Y)	LLC t-stat	-4.764	0.000	I(0)
		IPS W-stat	-2.199	0.014	I(0)
2	Ln(Labor)	LLC t-stat	-8.152	0.000	I(0)
		IPS W-stat	-3.977	0.000	I(0)
2	Ln(ICT)	LLC t-stat	-10.456	0.000	I(0)
		IPS W-stat	-3.646	0.000	I(0)

Note: Regarding unit root tests, LLC t-stat refers to t-statistic in Levin, Lin & Chu method, and IPS W-stat indicates Wald statistic based on Im, Pesaran and Shin method. LLC method assumes common unit root process, while IPS method assumes individual unit root process. d.f. means degree of freedom.

Source: Authors' calculations

The second step is to choose between pooled or panel specification. This selection is made by F-test. The null hypothesis assumes common effects in the form of pooled regression. In other words, intercepts of cross-sections and periods are assumed to be identical. If this hypothesis is rejected, then the decision is made in favor of its alternative. i.e., panel regression. For both cases, the F-tests confirm the panel specifications.

Table 3: Test for pool or panel specification

Subsample	Effects Test	Statistic	d.f.	Prob.
1	Cross-section F	518.922	(10,151)	0.000
	Cross-section Chi-square	588.347	10	0.000
2	Cross-section F	302.226	(19,274)	0.000
	Cross-section Chi-square	914.373	19	0.000

Source: Authors' calculations

The third step is to decide for using fixed effects (FE) or random effects (RE). This decision is made according to Hausman test, which assumes RE specification in estimating panel data model. Table 4 indicates the acceptance of alternative hypothesis. i.e. fixed effects.

Table 4: Hausman test for choosing Fixed or Random Effects

Subsample	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
1	13.531	3	0.0036
2	25.488	2	0.0000

Note: This test assumes Cross-section random effects.

Source: Authors' calculations

The final step is to estimate model (5) in fixed effects' format. Table 5 reports the estimation output. According to the results for subsample 1, the logarithms of labor force, ICT penetration ratio, and expenditure on machinery and transport equipment explain the changes in logarithm of TSC value added. All variables are statistically significant at 1% or 5% level of significance. In addition, adjusted R-squared (\bar{R}^2) and F-statistic are noticeably high. As a result, regression results are plausible.

For subsample 2, this table represents the similar results with slightly lower \bar{R}^2 and F-statistic than those of subsample 1. This is not

surprising since regression model in subsample 2 accounts for only two variables.

Table 5: Estimation Results

Variables	Subsample 1	Subsample 2
<i>Intercept</i>	14.633 (13.333)*	14.993 (20.456)*
<i>Ln(Labor)</i>	0.584 (6.397)*	0.563 (9.529)*
<i>Ln(ICT)</i>	0.201 (8.109)*	0.194 (11.640)*
<i>Ln(EQP)</i>	0.089 (2.409)**	-
\bar{R}^2	0.987	0.982
<i>F stat.</i>	921.717	726.445

Note: figures in parentheses indicate t statistics. * and ** denote statistical significance at 1% and 5% level of significance, respectively.

Magnitudes of coefficients in both regressions seem reasonable. The coefficients of *Ln(labor)* show that one percent increase in labor force, in terms of number of workers, results in about 0.5 percent increase in *TSC* value added on average. Similarly, one percent increase in *Ln(ICT)* boosts the *TSC* value added by nearly 0.2 percent, other thing being equal. The comparison of elasticities of *TSC* value-added with respect to labor force and ICT reveals the higher responsiveness of value-added to changes in labor force than ICT. This finding is compatible with results of Dewan and Kraemer (2000) and Pohjola (2001). In explaining the less effectiveness of ICT in developing countries, these studies refer to lack of complementary infrastructures for supporting ICT uses. In any way, increasing investment in *ICT* infrastructure may increase value-added of *TSC* sector. For subsample 1, sum of all elasticities denote decreasing returns to scale in supply of transportation and related services. This finding may be misleading. But, we should bear in mind that investments in different sectors across developing countries are of low efficiency due to managerial problems and financial barriers.

The coefficient of *Ln(EQP)* indicates inelastic supply of *TSC* services with respect to changes in share of machinery and transport equipment in *TSC* sector within subsample 1. In other words, if relative importance of such equipment increases by one percent, then the *TSC* value added will increase by nearly 0.1 percent. In subsample 1, the effectiveness of ICT on *TSC* value-added is greater than that of transport equipment, which reaffirms the conclusions made by Moshiri and Jahangard (2004),

who divided industries into 3 categories: ICT-producing firms, high ICT-intensive firms and low ICT-intensive firms. TSC sector belongs to high ICT-intensive category.

5. Conclusion

This study used ICT penetration ratio as a key ICT composite indicator to explain the TSC value-added. The estimation of panel data model in fixed effects framework indicates the positive effects of ICT use on TSC value-added for two groups as rival countries in Iran Vision 2020. Since ICT encourages TSC services, so the increase in ICT investment is a necessity for Iran, and its rivals. The final effect will be trade promotion within Middle East region through increasing TSC supply.

According to the findings, policy recommendations are presented as follows:

- Because of positive impact of ICT on TSC sector, investing in ICT may increase the supply of TSC services.
- Since TSC services are provided with employing skilled labor force, thus labor force should be trained in order to use ICT effectively.
- Investing in road and ICT infrastructure should be encouraged in both public and private sectors.
- In order to mitigate external effects of transportation, ICT-intensive activities such as E-training, E-tickets, E-customs, and webinars should be supplied as substitutes for face-to-face TSC services.

References

Al-Khateeb, F. B., Darrat, A. F. and Elkhal, K. (2007), "The UAE Growth Surge: Have Information Technology and Human Capital Contributed?," *Studies in Economics and Finance*, 24(4), 297-306

Banister, D. and Stead, D. (2004), "Impact of Information and Communications Technology on Transport," *Transport Reviews*, 24(5), 611-632.

Belorgey, N., Lecat, R. and Maury, T. P. (2006), "Determinants of Productivity Per Employee: An Empirical Estimation Using Panel Data," *Economics Letters*, 91(2), 153-157.

Black, W. R. and van Geenhuizen, M. (2006), "ICT Innovation and Sustainability of the Transport Sector," *European Journal of Transport and Infrastructure Research*, 6(1), 39-60.

Boopen, S. (2006), "Transport Infrastructure and Economic Growth: Evidence from Africa Using Dynamic Panel Estimates," *The Empirical Economics Letters*, 5, 141-164.

Daeikarimzadeh, S., Emadzadeh, M. and Kamkar, H. (2009), "Public Investment in the Transportation Sector and Economic Growth in Iran (1970-2008)," *Quarterly Journal of Economic Modeling*, 3(10), Page 63-82.

Dewan, S. and Kraemer, K. L. (2000), "Information Technology and Productivity: Evidence from Country-Level Data," *Management Science*, 46(4), 548-562.

Dimelis, S. P. and Papaioannou, S. K. (2010), "FDI and ICT Effects on Productivity Growth: A Comparative Analysis of Developing and Developed Countries," *The European Journal of Development Research*, 22(1), 79-96.

European Commission (2010). *Intelligent Transport Systems: EU-funded Research for Efficient, Clean and Safe Road Transport*. Publications Office of the European Union, Luxembourg.

Forester, T. (1987), *“High-Tech Society: The Story of the Information Technology Revolution,”* MIT Press.

Giannopoulos, G. A. (2004), “The Application of Information and Communication Technologies in Transport,” *European Journal of Operational Research*, 152(2), 302-320.

Jalava, J. and Pohjola, M. (2002), “Economic Growth in the New Economy: Evidence from Advanced Economies,” *Information Economics and Policy*, 14(2), 189-210.

Jorgenson, D. W. (2001), “Information Technology in the US Economy,” *American Economic Review*, 91,1-32.

Komijani, A. and Mahmoodzadeh, M. (2009), “The Infrastructure, Usage and Spillover Impacts of Information and Communication Technology (ICT) on Economic Growth (EG) in Developing Countries,” *Iranian Journal of Trade Studies*, 13(49), 31-74.

Mahmoodzadeh, M. and Fathabadi, M. (2011), “The Impact of Information and Communication Technology (ICT) on the Value Added at the Road Transport Sector in Provinces of Iran: A Case Study in the Passenger Transport Subsector,” *The Journal of Economic Policy*, 3(5), 195-216.

Mankiw, G., Romer, D. and Weil, D. (1992), “A Contribution to the Empirics of Economics,” *Quarterly Journal of Economics*, 107, 407-437.

Moshiri, S. and Jahangard, E. (2004), “Information and Communication Technology and Iranian Economic Growth,” *Iranian Journal of Economic Research*, 6(19), 55-78.

Pohjola, M. (2001), “Information Technology and Economic Growth: A Cross-Country Analysis,” *Journal of Transforming Economies and Societies*, 8(2), 20-33.

Pohjola, M. (2002), “The New Economy: Facts, Impacts and Policies,” *Information Economics and Policy*, 14(2), 133-144.

Quah, D. (2001), "ICT Clusters in Development: Theory and Evidence," *EIB papers*, 6(1), 85-100.

Solow, R. (1956), "A Contribution to the Theory of Economic Growth," *The Quarterly Journal of Economics*, 70, 56-94.

Wang, Y., Sanchez Rodrigues, V. and Evans, L. (2015), "The Use of ICT in Road Freight Transport for CO2 Reduction – an Exploratory Study of UK's Grocery Retail Industry," *The International Journal of Logistics Management*, 26(1), 2–29.

Yoshimoto, R. and Nemoto, T. (2005), "The Impact of Information and Communication Technology on Road Freight Transportation," *IATSS Research*, 29(1), 16-21.

Websites:

www.geostat.ge

www.ilo.org

www.itu.int

www.sesric.org

www.worldbank.org